HEI COOPERATION FOR CAPACITY BUILDING IN BIODIVERSITY CONSERVATION, FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

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The University of Torino plays an important role in coordinating higher education programs for development in Africa, Asia and South America. The themes of this panel span over various aspects of cooperation projects focused on biodiversity conservation, food security and sustainable development in developing countries, including educational activities, rural development, and technological transfer. One of the major shared points will be the analysis of the link between knowledge, technological transfer and empowerment within the processes of local and global development. This virtuous cycle plays a crucial role in shaping the processes of economic, social and political development, redefines needs and affects the perspectives and health of individuals and communities.

The discussion highlighted the methods and practices leading to success stories between University consortia, and between Universities and local NGOs or public entities. Furthermore, a key strategy to improve sustainability of cooperation actions was the identification of common goals that will be pursued after the end of the project, thanks to the establishment of a long term consortium agreement. Students' involvement in cooperation projects deeply increases the achievement of results foreseen by Dublin descriptors, such as the capacity to apply acquired knowledge, capability of communication, etc. A direct consequence is to open the door to improved capability to find a job both abroad and in Italy, when students finish their formal training.

We finally discuss how capacity building may help rationalising resource management and ensure innovative changes and how previous experiences may generate useful insights into a revision of our global agenda. Discussion started by the presentation of 3 "best lessons learned" during cooperation projects carried out by the University of Torino in Africa, Asia and South America. Prof. Giancarlo Bounous, together with Prof. Paola Bonfante, Prof. Silvia Perotto and Dr. Gabriele Beccaro summarized the activities run by many agreements of the University of Torino with South America Higher Education Institutions. Many different activities in the academic field, such as exchanging students, have been carried on during these last years in Brazil, Argentina, Bolivia, Uruguay, Chile and in many other South America Countries. The topics of the cooperation regard biodiversity exploitation and its active preservation, dissemination of rural innovation, especially oriented to the vocation to generate new incomes, use and valorisation of local agro-biodiversity, innovative agronomic techniques. Rural development and environmental and social sustainability, by providing staple food as well as promoting economic growth of the local communities, strictly linked with the tourism resources.

Carlo Semita discussed on behalf of Elena Ferrero, Gabriella Trucchi, Angela Calvo, Chantal Yvette Zoungrana Kaboré, Aboubacar Toguyeni, Balla Abdouramane, Alhassane Yenikoye, Yacoub Idriss Halawlaw and Issa Youssouf how CISAO will promote environmental care in a sustainable development perspective, improving life conditions of the population and reducing the gender gaps in employment access and in sharing knowledge by enhancing higher education systems through Master courses to give technical, scientific and methodological bases to the students, allowing them to manage natural resources and improve agriculture and food security.

Cristina Giacoma on behalf of all other co-authors (Marco Gamba, Valeria Torti, Daniela Antonacci, Maria Chiara Paire, Ahmed Ouledi, Kamaliddine Afraitane, Hantanirina Rasamimanana, Julien Randrianodiasana, Nicole Andriaholinirina, Eustache MIASA, Gabriele Beccaro and Giancarlo Bounous, stressed how multidisciplinarity played a fundamental role in the collaborative efforts with HEIs in Madagascar and Comoros Islands to conserve and protect biodiversity in this priority hotspot of the Indian Ocean. The actions involving the University of Torino and its partners aimed to: i) implement academic education curricula devoted to the study of biodiversity and sustainable development; ii) foster cooperative attitudes and cooperation activities of the HEIs; iii) support endogenous sustainable development processes for food security in the projects target countries; iv) build a field station in order to facilitate student and researchers mobility; v) promote community based sustainable development; vi) increase the diversity in the partnership involving international and local ONG, local and national associations, professional organizations. The participation of partners with different profiles was also a key point for making these collaborations a success story.

Marco Gamba on behalf of the other co-authors (Chia L. Tan, Yeqin Yang, Kefeng Niu, Lei Shi, Weiyong Zhang, Isidoro Riondato, Cristina Giacoma, Emilio Balletto and John A. Phillips) how important is to foster positive attitudes and behaviour toward wildlife in rural children. He discussed different modalities to run a creative education program for children and the role that researchers and Universities can play. He features the collaborative effort in China as a model which can be adopted in other geographic regions where species and habitat conservation must become a top priority. Universities can have an important role in critical assessment of previous experiences in order to enhance the effectiveness of cooperation with other development stakeholders (e.g. governmental and local authorities, civil society and NGOs, foundations and private companies, and local associations).

Finally, cooperation within each institution, among institutions and opening to as many stakeholders as possible when implementing educational programs, have been identified as key points to reach sustainable results.

COOPERATION EXPERIENCES WITH HEIS IN THE INDIAN OCEAN

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ABSTRACT

As underscored by the United Nations, which designated 2011-2020 as the UN Decade on Biodiversity, biological diversity is not only a very important heritage to transmit to future generations, but supplies vital ecological services to all local communities. Together with global changes, overexploitation is the main threat to the communities' sustainable development based on locally available natural resources. Acting in a collaborative effort with higher education Institutions in Madagascar and the Comoros Islands, the University of Torino has partnered to conserve and protect local biodiversity in this priority hotspot of the Indian Ocean, by carrying out and promoting research, training and capacity building activities. Actions involving the University of Torino and its partners aimed at: i) implementing academic education curricula devoted to the study of biodiversity and sustainable development; ii) fostering cooperative attitudes and the cooperation activities of both the HEIs North-South and South-South programmes; iii) supporting endogenous sustainable development processes for food security in the projects' target countries; iv) building a field station, in order to facilitate students' training and mobility; v) promoting community based sustainable development; vi) fostering the partnerships' level of representation, by involving international and local NGOs, local and national associations, professional organizations, as well as private companies. During the process of evaluating the effectiveness of UNITO actions we found that the academic curricula implemented are effective in capacity building of specialists in biodiversity and agricultural management, and that the HEI network is successful in attracting partners from various social categories. The newly built research field station and multipurpose centre in the forest proved very useful not only for the academic training of young researchers but also for local capacity building in both biodiversity and agricultural techniques. It also worked as a keystone for improving local governance.

RELEVANCE OF UNITO ACTIONS

Current biodiversity is the result of over 4 billion years of evolution resulting in a bewildering verity of forms, functions and processes. IUCN listed Madagascar and the Comoros among the Earth's major biodiversity hotspots [1]. These areas, however, suffer from extremely high levels of poverty, so that fostering a sustainable co-evolution between society and ecosystems is going to be crucial. In fact, due to the on-going loss of forest cover, biodiversity is dramatically declining in these countries. Since local economies are mainly based on the exploitation of natural resources, preserving forests and biodiversity is essential for a sustainable economic and human development of Madagascar and Comoros. Preserving natural resources is central for preventing soil-erosion and for protecting water supplies, two focal issues having strong positive impact on household food security. Maintaining a high degree of biodiversity is also crucial for ecotourism development and for other income-generating opportunities. Despite that the Malagasy and Comoran governments have implemented numerous environmental protection measures, such efforts have not yet been enough for achieving the goal of conserving biodiversity in these Countries. Low efficacy was mainly due to the limited knowledge of the islands biodiversity and distribution patterns, very limited number of local experts in conservation projects, poor involvement of local workforce, and low levels of awareness of the local communities as concerns conservation issues and inadequate management and governance abilities. The situation requires more research on biodiversity, more training and more effective cooperation actions.

Starting in 2002, the University of Turin (hereinafter UNITO) promoted research projects on biodiversity and capacity building in Madagascar and Comoros, at the individual, institutional and social levels (see http://www.mad.unito.it). UNITO activities of community capacity building at individual level started in Madagascar thanks to private funds of Zoological Parks (*Parco Natura Viva*: *Verona*) which supported cooperation with the most

important Zoological Park in Madagascar, the research centre of *Enseignement Supérieur et de la Recherche Scientifique*, Parc Botanique et Zoologique Tsimbazaza (PBZT).

Community capacity building started shortly afterwards at the institutional level with the Malagasy Universities for developing bidirectional North to South transfer of training abilities in the field of Sustainable Biodiversity Management and Conservation. The activity was supported by MIUR project *"Promozione di attività formative inerenti la "Conservazione della biodiversità" presso l'Università di Mahajanga (Madagascar)"* under *Programmi per l'incentivazione del processo di internazionalizzazione del sistema universitario (d.m. 8 maggio 2001 n. 115 art. 10) - collaborazioni interuniversitarie internazionali del Ministero dell'università e della ricerca*. The implementation of an international joint master (or "*laurea magistrale*") degree also supporting South to South cooperation between Malagasy and Comoran Universities was finalized by the project SCORE (Supporting Cooperation for Research and Education), financed and implemented in the framework of the EDULINK Program (9th European Development Fund, Reference: EuropeAid/126851/D/ACT/Multi).

A second EU project B.I.R.D. "BIODIVERSITY INTEGRATION AND RURAL DEVELOPMENT" (Reference: FED/2009/217077) further enhanced the professional training of the master degree students, but also promoted community capacity building at the societal level, by involving the local authorities of villages and Fokontany authorities near the Maromizaha forest. The project supported the implementation of local action plans and fostered the socioeconomic development of local communities. The key strategy was to start a research field station capable to act as a multipurpose centre, where researchers could be hosted, where training and dissemination events took place and organizational meetings with the local communities were held.

APPROACHES AND INSTRUMENTS STRENGTHENING THE EFFECTIVENESS OF PROGRAMS

Education and training have a significantly positive impact on health, social and political participation, equal opportunities, economic growth rates, income and productivity, as well as benefits distribution. To achieve these results UNITO cooperation activities fostered local capacity building by:

- following a bottom-up approach to formulate development policies, which, starting from individuals have to involve institutional and research bodies, as well as the civil society, i.e. in particular, universities, biodiversity and agricultural research associations, forest management institutions and local farmers' associations;
- establishing long-term cooperation agreements between UNITO and ACP partners. Partnerships is expected to contribute to the improvement of higher education quality levels in fields relevant for the partner countries and consistent with local poverty alleviation policies, thereby contributing to the achievement of the Millennium Development Goal of poverty alleviation and sustainable development;
- promoting higher education and interdisciplinary approached, to make available skilled local human resources in the field of Sustainable Biodiversity Management and Biodiversity Conservation;
- integrating biodiversity valorisation and rural development, in order to develop and disseminate innovative biodiversity conservation policies;
- relying on locally available materials and labour.

SUSTAINABILIY

Environmental sustainability is among the most suitable means to ensure the long term conservation of local biodiversity. The environmental sustainability of UNITO activities was assured in many ways: i) by choosing indigenous species for agricultural practices, ii) by using sustainable agro techniques, iii) by protecting the local fauna and vegetation, iv) by providing renewable energies equipments, v) by showing to local communities the forest and wildlife as a development and income opportunity.

Social sustainability is assured by strongly involving in the projects' activities the local villagers, who are living close to the forest, and by insuring the appropriate attention to gender issues. Concerning environmental education, we successfully involved the teachers of local schools in the permanent training and exchange of newly acquired information. Children were sensitized on appropriate nutrition and environmental benefits. Moreover, the adoption of a bottom up approach through the involvement of local partners facilitated their ownership of the project.

Finally, the long term sustainability of the projects has been assured by capacity building activity carried on with local partners and addressed to local populations and communities. The initial network was made up by HEIs (the lead partner DBIOS - Dept. of Life science and System Biology of University of Turin, DISAFA - Dept. of Colture arboree of University of Turin, GRENE - Gestion des Ressources Naturelles et de l'Environnement de l'Université de Toamasina, ESSA - Ecole Supérieure des Sciences Agronomiques, Dép. d'Agriculture de l'Université d'Antananarivo, and FST - Faculté des Sciences et Techniques de l'Université des Comores.

A key point in order to ensure sustainability of the actions is the enforcement of research and tourism services to promote the Maromizaha Forest and the Comoro islands as a competitive destination for researchers, thus assuring a

financial support. The involvement of as many stakeholders as possible is another crucial aspect. Among the focal objectives of the BIRD project was to foster the generation of a network of protected areas. To achieve this goal we promoted the involvement of local research associations such as GERP (Groupe d'Etude et de Recherche sur les Primates de Madagascar), of NGOs such as Ulanga and Fanamby, as well as private companies such as PNV and the Ambatovy Mining Enterprise. At institutional level we obtained to involve the Malagasy Ministry of Enseignement Supérieur et de la Recherche Scientifique, as well as the Ministry of the Environment.

INSTRUMENTS

The instrument that was determinant in assuring the effectiveness of UNITO projects was the establishment of two multipurpose centres, respectively in Madagascar (the Maromizaha Multipurpose Centre) and in the Comoros (the Karthala Multipurpose Centre). The centres function, among other things, as training centres for research and tourist guides. This proved a key issue for the projects' success consisted in the training of skilled naturalistic research guides, after an intense three-month training in Maromizaha. Specific field examinations were run in Madagascar to select the candidates. One of the aims of the project is to make those professional figures able to come abreast of international researchers, so it was fundamental to make themselves independent in data collecting. In that way research guides will assure continuous monitoring of the biodiversity of the Maromizaha forest, helping GERP in managing the site and promote conservation programs. Guides dedicated their attention to the reproductive biology of several species, including lemurs, on the social life of sympatric species, and on the vegetative cycle of plants living at different altitudes. During the evenings they also started a specific training on the use of computers and on database management, a crucial step to empower these professional in manage and share the data they collect. They were also taking care of the finalization of the information area at the multipurpose centre in Maromizaha. As a result, the number of effective researchers coming to the "Nouvelle Aire Protegé" (NAP) of Maromizaha started with 8 persons in 2009 and reached the highest peak in 2011, with 208 visitors coming to study the animal and botanical biodiversity of Maromizaha.

Centres work also as training centres for promoting local communities' awareness activities and dissemination of innovative and transferable cultivation models, identifying, applying and spreading the potential of both native and new species and varieties suited to generate new incomes, actively conserving the local genetic resources and contributing to the dissemination of the knowledge and sustainable use of the natural resources, to diversify and improve local food production. Around 15,500 m^2 of surface have been cultivated with vegetables and fruits and trusted to local farmers trained and provided with materials, equipment and technical support.

The centre promotes also the introduction and use of renewable energies at the community level, reducing forest exploitation. Implemented activities consisted in:

- training courses for 17 technicians in the building and maintenance of solar energy equipments (solar ovens, solar fruit-driers, solar panels);
- dissemination activities on renewable energies and equipments directed to local communities;
- setting and delivery of 130 solar oven;
- setting and delivery of 7 solar driers, one of which assigned to a cooperative for the processing of the fruit produced in the experimental parcels;
- setting and delivery of 10 higher efficiency stoves;
- we produced a guide for the construction of the ICARO edit and delivered it to ACAMECA enterprise as well as to 20 participants to the course;
- sensitisation of 200 local people on renewable energies use.

Moreover, centres are essential for promoting ecotourism by publicising and valorising natural resources, thereby generating new income for local communities. Both centres were quipped with facilities for teaching, biodiversity survey and biological research (power generators, reflex cameras, microphones, GPS, digital cameras, radio-transmitters, animal sound recorders; meteorological tools, entomological materials, notebooks and PCs); in Madagascar a solar energy system was installed to electrify the centre, thereby allowing autonomous lighting and powering of the scientific equipment (laptops, scientific instruments, field instruments, GPS).

TECHNOLOGY TRANSFER AND CO-CREATION

To come to technological transfer, UNITO cooperated with all the local partners to disseminate competence in scientific training both in the field of biodiversity and of agriculture, by:

- Training local technicians in agricultural models. We successfully applied the mixed-parcels model of vegetables and fruit trees. The mixed parcels already generated income during the first year, thereby supporting economically the project during the 3 years necessary to obtain crop. We now can rely on 30 peasant leaders able to spread the know-how to other villagers.

- Organising and implementing "energy training" and setting of renewable energy equipment. We especially designed ICARO solar dryers. ICAROs delivered last year gave important results and generated favourable impact. They were used to produce dry fruit which was sold on the market in small packages. The Centre also arranged a weekly delivery of dried fruit to local bakeries. Villagers showed a great interest in the ICARO drier and demonstrated to be able to exploit it at its best.
- Introduction of new cultivated species and cultivars by 1) spreading improved cultivars of traditionally cultivated vegetables, 2) introducing new temperate fruit-tree cultivars, 3) promoting the cultivation of under-utilized and indigenous fruit species. The Anevoka site, for its location on the border of a primary forest, was particularly suitable to experiment with endemic species. Since these originate in the forest, they would be in similar conditions to those of their habitat of origin. Among these Styger et al. (1999) have identified various species and determined the foremost ones. In addition to native species, some exotic species were adapted and distributed throughout the island. In most cases these species, such as Spanish tamarind (*Vangueria madagascariensis*, Rubiaceae), the Salehy (*Omphalea biglandulosa*, Euphorbiaceae), the Sefontsohy (*Colea fusca*, Bignoniaceae) were previously underutilized.

KNOWLEDGE SHARING

In a context where natural resources may potentially generate strong economic and rural development, most of the population of Madagascar and the Comoros does not have access to any suitable education, also because of the enormous difficulty of movement within the two countries, which hampers all innovation processes in rural areas. Projects in Madagascar and the Comoros has shown that an appropriate combination of measures in agricultural, forestry and renewable energy domains could contribute, if efficiently spread, to improve the livelihoods of small farmers. This was achieved by disseminating information necessary for planning the sustainable use of land and of natural resources. Focusing actions on a local scale by an interdisciplinary, bottom-up approach, we formulated developmental policies integrating biodiversity valorisation and rural development. By relying on locally available resources, long- term cooperation agreements, as well as by establishing research field stations acting as multipurpose centres, we promoted effective capacity building actions, at the individual, institutional and social levels.

Our next challenge will be in the development of information and communication technologies for development or ITC4D for increasing dissemination of knowledge, methods and instruments of successful cooperation interventions.

Fig. 1 - The Maromizaha Multipurpose Centre in Madagascar.

NOMENCLATURE

BIRD	Biodiversity Integration Rural Development (9th EDF, Reference: FED/2009/217077)
DiSAFA	Department of Scienze Agrarie, Forestali e Alimentari of the University of Turin, Italy
DBIOS	Department of Life science and System Biology of the University of Turin, Italy
ESSA	Ecole Supérieure des Sciences Agronomiques, Université d'Antananarivo, Madagascar
FST	Faculté des Sciences et Techniques de l'Université des Comores
GERP	Groupe d'Etude et de Recherche sur les Primates de Madagascar
HEI	Higher Education Institution
MIUR	Ministero dell'Università e della Ricerca
ITC4D	Information and communication technologies for development
IUCN	International Union for Conservation of Nature
NGO	Non Governmental Organization
PNV	Parco Natura Viva of Verona, Italy
SCORE	Supporting Cooperation for Research and Education (9th EDF; EuropeAid/126851/D/ACT/Multi)
UNITO	University of Turin, Italy

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FOSTERING "LITTLE GREEN GUARDS" THROUGH A COLLABORATIVE PARTNERSHIP TO CREATE AN EFFECTIVE CONSERVATION EDUCATION PROGRAM FOR RURAL CHILDREN IN GUIZHOU, CHINA

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ABSTRACT

San Diego Zoo Global (USA), Fanjingshan National Nature Reserve Administration (China), and the University of Torino (Italy) have partnered in a collaborative effort to promote environmental sustainability and biodiversity conservation in Guizhou, China. The objectives of the partnership are twofold: (i) train researchers and wildlife professionals using a multidisciplinary program that employs the latest methods and tools in order to deepen their understanding of wildlife and the environment, and (ii) foster positive attitudes and behaviour toward wildlife in rural children through a creative education program called the Little Green Guards. A recent development of the education program is the Little Green Guards Club for children whose houses border nature reserves. During club meetings, staff of the three cooperating institutions and volunteers participated in teaching English and natural history lessons. Club activities included animal themed art projects, games, movies, and field trips designed to cultivate empathy for animals and appreciation for nature in these children. Evaluations conducted before and after implementation of the education program showed a significant increase in children's knowledge of and affection for wildlife, and sometimes coincided with positive behavioural changes toward native species. Here we feature our collaborative effort in China as a model which can be adopted in other geographic regions where species and habitat conservation must become a top priority. We will discuss the role of Universities in critical assessment of previous experiences in order to enhance the effectiveness of cooperation with other development stakeholders (e.g. governmental and local authorities, civil society and NGOs, foundations and private companies, and local associations).

INTRODUCTION

China is most notable for being the world's most populous country with over 1.3 billion people [1]. As a result of recent economic expansion, China now leads the world in consumption of natural resources and their pollution by products [2,3]. While the country's thriving economy makes daily international headlines, little attention has been paid to China's rapidly disappearing wildlife species and the natural places where they occur. For much of the western world, wildlife conservation in China does not appear to be a critical issue as the international symbol of all Chinese wildlife, the giant panda (Ailuropoda *melanoleuca),* shows signs that its population number is either stable or, in the case of the captive population, on the rise. On the other hand, to most Chinese, wildlife conservation is a non-issue because wildlife and wild places, unless exploitable, possess no tangible benefits [4]. According to the latest IUCN Red List assessment, China ranks in the top ten countries having the most number of threatened species [5]. These diametric opinions highlight the large disconnect that exists between the lay and the scientific communities. How do we bridge this gap to ameliorate the current wildlife situation in China? This paper focuses on this key question, the question that provided the impetus for creating the *Little Green Guards* program.

THE BASIS FOR THE *LITTLE GREEN GUARDS* PROGRAM

Founded in 2011, the *Little Green Guards* is a conservation education and outreach program for children living in remote communities bordering Fanjingshan and Mayanghe nature reserves in Tongren City Prefecture, Guizhou Province, China. Fanjingshan and Mayanghe nature reserves each hosts a unique assemblage of flora and fauna, and are part of the United Nations Educational Scientific and Culture Organization's (UNESCO's) World Network of Biosphere Reserves of the Man and the Biosphere (MAB) Programme. Specifically, Fanjingshan is home to over 6,000 animal and plant species; many are rare and relict, the most prominent being the Guizhou snub-nosed monkey (Rhinopithecus *brelichi)* that only occurs here as a single global population of about 700 animals [6]. Mayanghe, dominated by

limestone hills, also harbors a rich diversity of over 2,000 animal and plant species. The main target species for protection in Mayanghe is the Francois' langur (Trachypithecus *françoisi),* estimated at about 730 individuals, or roughly 70% of the total global population [7]. Due to small population size and limited range, these two Endangered monkeys [8] are far more vulnerable to extinction than the giant panda (Figure 1).

Fig. 1 - Threatened primate species in Guizhou, China: Guizhou snub-nosed monkey *Rhinopithecus brelichi* (large, right photo), François' langur *Trachypithecus françoisi* (small top, left photo) and Tibetan macaque *Macaca thibetana* (small bottom, left photo). Credits: San Diego Zoo Global/Fanjingshan National Nature Reserve Administration.

RURAL COMMUNITIES AND EDUCATION IN GUIZHOU

The rural communities immediately adjacent to Fanjingshan and Mayanghe nature reserves are densely populated by ethnic minorities such as the Miao, Tujia and Dong groups. These communities are considered to be at or below the poverty level [9]. All families we surveyed here have multiple children, generally 3-4, but some have as many as 9. Moreover, in many households the children are largely under the care of illiterate grandparents or other adult relatives while their better educated, albeit absent parents, labour in large cities (C. Tan et al. unpubl. data). As with past generations, the current youth have extremely limited economic and educational opportunities. Due to financial hardships at home and the state of education system in these rural areas, most young people stop their schooling after the nine-year compulsory education (K. Niu et al. unpubl. data).

The state-run education system in China has a number of shortcomings, most notably those that can be attributed to an unequal distribution of funding and human resources, and a rigid national examination metric for admission to high schools and universities. These inequities create a vicious cycle whereby rural inhabitants continuously remain an underprivileged class because of a lack of social advancement primarily due to poor education. It has been our experience that the quality of education decreases the farther the school is located from an urban center. By virtue of their remoteness, rural schools are extremely under-funded and under-resourced. The poor standard of living in villages coupled with the lack of any financial incentives from the central government pose an insurmountable challenge for rural schools to recruit and retain quality educators.

The nationally set curriculum for the nine-year compulsory education is meant to prepare students for the highly competitive high school and university entrance examinations. At the primary school level, the subject emphasis is on reading, writing and arithmetic. In the case of Tongren rural schools, the curriculum is heavily weighted toward Chinese and Mathematics. For example, a weekly lesson plan for the second-grade at one of the local schools contains 30 class periods, of which 13 are devoted to Chinese and 7 to Mathematics. Subjects such as Physical Education, Moral Principles and Daily Conduct, and Local Course (with topics related to culture, history, and geography of this area) are scheduled during 6 other periods. Even though there may be a class period separately allocated to Music and Drawing, the school usually has no funding for purchasing equipment or supplies for the students, and in general, these class periods are taken up by additional Chinese or Mathematics lessons. As part of China's education reform [10], English is taught in urban primary schools starting at about the third grade. However, rural primary schools do not include a foreign language in their curriculum because they lack educators capable of teaching the subject.

Since biology is not part of the primary school curriculum, the concept of biodiversity conservation is unknown to

the rural children. The *Little Green Guards* program, therefore, is an endeavour aimed at enriching the standard curriculum. Benefits to local residents, especially the education of children, frequently accrue when conservation efforts attain international recognition. As such, the *Little Green Guards* program may help rural children gain upward mobility by offering them extracurricular learning opportunities and allow them to escape from poverty in the future.

THE BASIS FOR INTERNATIONAL PARTNERSHIPS

The growing complexity of global social and economic problems, especially in developing countries in Asia and Africa, has dramatically hindered biodiversity education efforts intending to fundamentally change traditional attitudes and behaviours toward over consumption of natural resources. This situation has created an urgent need for formal cooperation among private institutions, local governmental agencies and universities to work in synergy thus creating conservation programs that generate broader impacts. In the case of the *Little Green Guards* the synergy is dynamic. San Diego Zoo Global and LDVI International spearheaded the creation of educational materials and provided support for school activities, as well as recommending capable professionals and allocating financial aid. The governmental partners, Fanjingshan National Nature Reserve and Mayanghe National Nature Reserve, provided local knowledge and the human resources necessary to transform the program content into locally appropriate messages resulting in effective conveyance to the intended audience. University personnel, who have an expertise in providing capacity building and professional training, have further contributed to the effort by distilling complex biodiversity topics into an easily understood format.

Given the economic and educational deficiencies in rural Guizhou, we face many challenges when conducting our *Little Green Guards* program. The expertise of our international team helps us solve these problems at different levels. Specifically, San Diego Zoo Global and LVDI International work closely to create an overall education framework that includes tailored lessons in combination with thematically related activities aimed at increasing schoolchildren's knowledge of and affection toward local wildlife species. Fanjingshan National Nature Reserve Administration plays a pivotal role in coordinating in-country program activities and providing liaison support among local and international partners. To help build the capacity of reserve personnel, the University of Torino is a key partner for providing scientific input and training to ensure the program's sustainability. All partners actively fundraise to support program objectives and publicize our work through different channels.

IMPLEMENTATION

In 2011 the *Little Green Guards* program founders, Chia Tan and Kefeng Niu, worked with Lei Shi and two volunteers from Guiyang universities, Bing Yang and Tianyou Yang, in developing and implementing the inaugural activities. An emphasis was placed on raising awareness of endangered species at Fanjingshan and Mayanghe nature reserves, particularly the two flagship species: the Guizhou snub-nosed monkey and the François' langur. The program was implemented at two schools. Since the students (and teachers) had not been introduced to conservation education topics, it was important that they gained positive experiences from this first exposure. In the classroom, we used simple narratives and slides to describe the basic biology of charismatic local fauna and flora. We also incorporated animal-themed games, songs, and drawings to cultivate an interest in wildlife in these children. To begin connecting them with wildlife found in their "backyard", the older students (fifth and sixth graders) participated in guided field trips to see the local monkey species (Figure 2). Identical pre- and post-program questionnaires were used to evaluate the impact of this outreach and education effort. Students were asked whether or not they have heard about the local nature reserve. They were also asked whether or not there are any monkeys in the forest, and if so, describe what kind. Additionally, we used this opportunity to evaluate third- and sixth-graders' general knowledge of and attitudes toward a variety of animal species, both domesticated and wild. This information helped us design appropriate and effective conservation education modules for subsequent program activities. We deemed our first school event a success because all of the children were sad to see us leave when the four-day program ended.

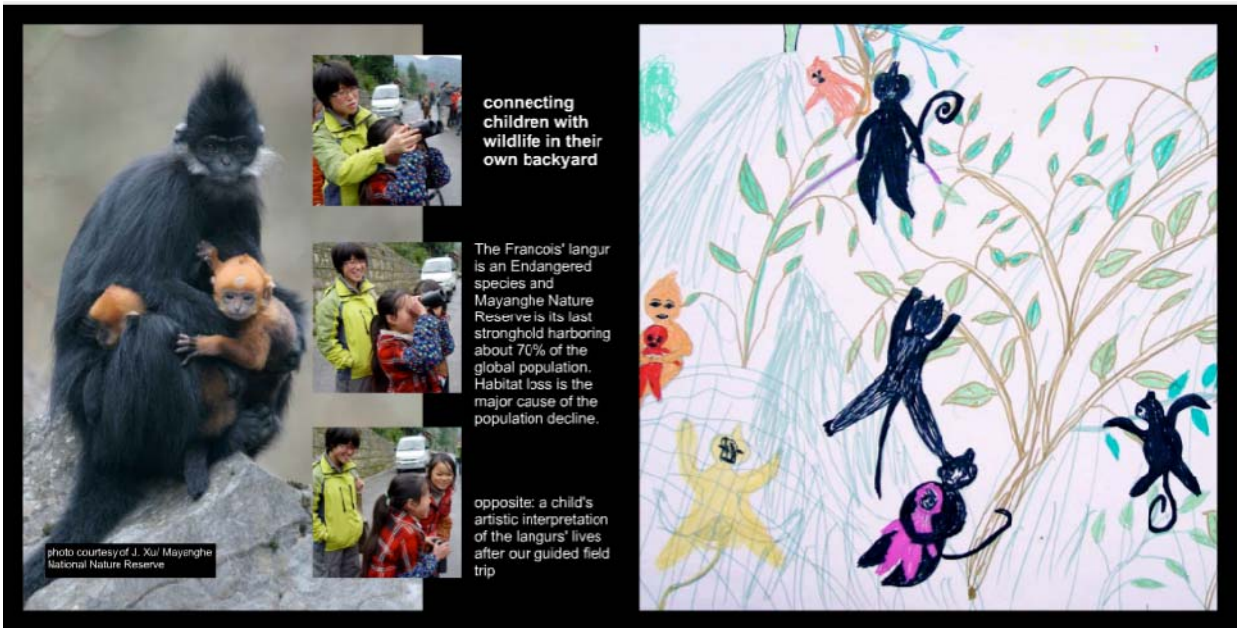

Fig. 2 - Connecting Guizhou rural schoolchildren with monkeys found in their "backyard" through guided field trips. Credits: San Diego Zoo Global/Fanjingshan National Nature Reserve Administration/ Mayanghe National Nature Reserve Administration.

We learned from our pilot program that knowledge of wildlife was lacking in these rural children. We also discovered major deficiencies in China's education system in these rural settings. When we returned to the local schools the following year, we had developed a complete module, called "My Habitat", to teach children the relationship between wildlife species and their required habitats (Figure 3). This module (3 versions based on grade levels) contained the lesson, associated exercises, and thematically related activities such as songs, art projects, and the student evaluation. At one of three local schools where we administered the program, we organized a schoolyard concert for the local community that was attended by over 400 residents and government officials. Students performed ethnic dances choreographed by their teachers, as well as singing a chorus pledging to conserve wildlife. We also showcased students' artwork produced during our program period to inform family members about the local wildlife species (Figure 4). Our efforts attracted the attention of local television stations, television documentary film production companies, and online media companies. Also, our volunteers, partners, and sponsors multiplied at this time, and we were able to enlist support from Chinese corporate sponsors to help defray program costs.

Fig. 3 - Fifth graders of Kaiwen Primary School learned about local wildlife species and their habitat in Fanjingshan. Credits: San Diego Zoo Global/Fanjingshan National Nature Reserve Administration.

Fig. 4 - *Look Grandma, I painted this monkey mask!* – A proud first grader presented her artwork to her grandmother before the schoolyard concert at Kaiwen Primary School. Credit: D. Cui, Beijing Zoo.

Fig. 5 - World-renowned entomologist, Professor Emilio Balletto shared his love for butterflies with Little Green Guards Club members in Niujiaodong Village. Credit: K. Niu, Fanjingshan National Nature Reserve Administration.

FUTURE PLANS

The *Little Green Guards* program has been proven successful in terms of effectiveness in the overall design and execution of its education and outreach components. Aimed to maximize the program's sustainability and lasting impact, we propose to:

1) develop set curriculum (six lesson modules) that concentrates on the biology and protection of native species and their habitats for eight target schools (approximately 1,100 students) near Fanjingshan and Mayanghe nature reserves. We will work with conservation educators to create biologically - sound, age – appropriate modules following the guidelines of Tongren Unified School District for Local Course (or "Di Fang Ke"). The main purposes of Local Course are to increase students' awareness and understanding of native wildlife, and to instill a sense of pride about their natural heritage and a responsibility for its stewardship. Similar to the module developed for "My Habitat", each new module will contain teacher's instructions, the topic lesson, related activities to enhance learning, and student evaluation.
2) conduct workshops to train educators (approximately 75 teachers) from the program target schools on how to implement modules and integrate them into existing Local Course. As conservation biology training for teachers in rural schools is nonexistent, the goal of the workshops is to introduce teachers basic conservation education techniques, discuss the module contents, and assist module implementation in class. Besides providing a "how-to" guide, the workshops will empower teachers to be role models and conservation advocates.
3) establish Biodiversity Conservation Learning Centers to further communicate the purpose and value of protecting local wildlife species to the community. We will select three schools closest to reserves' core protected areas and help each school transform a classroom into a Biodiversity Conservation Learning Center. The room will be furnished with audiovisual equipment, books, visual displays and students' artwork. Also at the school entrance, we will create a biodiversity mural and install an interpretative panel to disseminate information regarding the endangered wildlife species in the area. The mural and interpretive panel will educate not only the students and teachers but also community members and visitors.
4) recruit and train student volunteers from universities in Guizhou to conduct outreach events in rural and urban settings. To reach a wide audience and create locally relevant messages to promote pro-conservation attitudes and behaviours, we will recruit volunteers, especially students from Guizhou teacher's colleges. We will develop a volunteer program coordinated by nature reserve staff. We will speak at recruitment events and provide volunteers with the techniques and tools needed to be affective and effective wildlife conservation ambassadors. Trained volunteers will assist with outreach efforts at target schools and other venues. The experience may inspire some recruits to teach in rural schools where access to quality education is lacking.

The Little Green Guards is the first program in China to recognize that conservation education initiatives, in order to be successful, need to be uniquely tailored to citizenry of different socioeconomic levels, with the most need being in

the indigenous communities that rely heavily on the natural resources of protected areas. Through the proposed activities and continued cooperation among local and international partners, and the Tongren Unified School District educators, we can ensure that rural schools neighbouring nature reserves play a pivotal role in educating a new generation of responsible citizens who can become guardians of their native wildlife treasures. Additionally, through their children we can begin to transform the feelings, motivation and commitment of other family members toward native species and habitat conservation. Thus, we believe the Little Green Guards can be a model which can be adopted in other geographic regions where species and habitat conservation must become a top priority.

ACKOWLDEGMENTS

Our program would not be possible without the support and assistance of the following people and organizations: B. Yang, T. Yang, R. Feng, N. Yang, G. Zhang, D. Cui, D. Sun, Mr. Jin, Y. Qiu, Y. Zeng, X. Dong, X. Zhi, V. Hale, A. Ang, teachers of Dabaoçun, Taohuayuan, Kaiwen, and Banpotai Primary Schools, C. Ishee and Family, Anonymous Donor, Margot Marsh Biodiversity Foundation, the Offield Family Foundation, San Diego Zoo Global, San Diego Zoo Volunteers, the Ocelots, V. and H. Bord, J. Opdycke, B. and T. Durler, Fanjingshan National Nature Reserve Administration, Mayanghe National Nature Reserve Administration, the Forestry Department of Guizhou Province, Guizhou Environmental Protection Bureau, Guizhou Foreign Experts Bureau, the State Administration of Foreign Experts Affairs, International Primatological Society, Wuhan Sante Cableway, Shenzhen Sea Sky Land Technologies, LVDI International, and the University of Turin.

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A PROGRAM IN HIGHER EDUCATION FOR FOOD SECURITY AND ENVIRONMENTAL SUSTAINABILITY

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ABSTRACT

The CISAO, an Interdepartmental Centre of the University of Turin, in partnership with three Sahelian Institutions of the Higher Education, has submitted the project “Réseau des Universités Sahéliennes pour la Sécurité Alimentaire et la Durabilité Environnementale (RUSSADE)” to the EuropeAid-ACP-EU Cooperation Programme in higher education (EDULINK II).
The overall objective of the project is to mobilize knowledge and know-how to fight hunger and poverty and to increase environmental care in a sustainable development perspective, improving life conditions of the population and reducing the gender gaps in employment access and in sharing knowledge. The specific objective is to enhance higher education systems through Master courses to give technical, scientific and methodological bases to the students, allowing them to manage natural resources and to improve agriculture and food security.
Programs are multidisciplinary and treat both challenges and difficulties of the agricultural development in Sahel with the purpose to enhance abilities in different strategic fields: livestock productions, food security and safety, environmental protection, sustainable and fair development. For these reasons the high level Master is planned with innovative multidisciplinary integrations, structured in a common early training followed by specialized education courses chosen among three options (animal and vegetal productions and environmental protection), to give to young people work opportunities in key sectors of their countries.
To ensure mutual exchange and harmonization of expertise, it is necessary to establish an active network between the four involved universities, integrating theoretical, practical and experimental knowledge with special focus on local and regional issues.
The target groups are the students of the Master: graduates in agronomy, biology, veterinary medicine, geography, geology, environmental sciences (or equivalent degree), local teachers, researchers and professionals.

INTRODUCTION

The beneficiary (partner leader) of the project “Sahelian Universities Network for Food Security and Environmental Sustainability (RUSSADE)” is the University of Turin (Italy), supported by the Piedmont Region, International Affairs Section, and the Italian NGO Terre Solidali Onlus.

The involved African partners are CRESA of the University of Niamey (Niger), the Polytechnic University of Bobo Dioulasso (Burkina Faso), the University Institute of Science and Technology of Abéché (Chad).

The choice of these HEIs as project partners comes from a long cooperation in several scientific areas between the University of Turin and African institutions, such as Universities of Niger and Burkina Faso (Abdou Moumouni University of Niamey and Polytechnic University of Bobo Dioulasso). Moreover, the University of Turin recently established new relationships with the University Institute of Science and Technology of Abéché, in Chad.

The project was presented by CISAO, an organization that integrates multidisciplinary skills and knowledge, whose institutional task is to promote and coordinate scientific and educational exchanges with the countries of West Africa and particularly of Sahel [1].

The International Affairs Section of the Piedmont Region participates to the Project as a stakeholder and as a donor. Terre Solidali Onlus (an Italian non-profit organization of social utility) involves its experts in special activities and features (such as orientation activities, support in the field work, demonstrative practices and training sessions).

REASONS OF THE INTERVENTION

The strategy of the European Union has recently included financial support also in the educational field and strengthening the systems of higher education of African countries. Likewise, the guidelines for EDULINK II call for proposals indicate “energy facilities, agriculture and food security” as instruments to eradicate poverty. For these reasons, CISAO and its African HEIs partners are developing a project whose general objective is to use knowledge to fight hunger and poverty and to promote environmental protection in a sustainable development perspective [2].
To achieve this goal the following requirements are considered as crucial factors:

a) a stronger synergy between Sahelian HEIs and with the University of Turin will enhance capacity, excellence and regional integration and will allow the creation of a permanent network;
b) the quality of higher education in the field of agriculture and management of natural resources will improve food security and living conditions of Sahelian people [3].

In general terms, to improve the impact of education on the quality of life of local population means to think about the present situation and to act for a better future so that the target people could receive scientific and methodological instruments to manage natural resources with an eye on environmental sustainability and equity.

A holistic approach to improving agriculture and food security should not neglect the social-economic aspects related to these themes, including the gender gap reduction in terms of access to employment and knowledge sharing (1, 7, 8 Millennium development Goals) [4].

The attention of the project, concerted between all partners, was focused on several inter-related and inter-dependent critical issues such as environmental challenges, social-economic and structural difficulties to be overcome, measures to be consequently adopted, identification of target beneficiary groups, organization of actions implementation, mechanisms for monitoring, evaluation and control of the activities.

The **target groups** are identified among:

- graduates in agronomy, biology, veterinary medicine, geography, geology, environmental sciences or equivalent degree. Sometimes, the knowledge of these students is too theoretical or not properly orientated to the local challenges;
- the academic staff of the HEIs partners, in order to update and improve their teaching skills, thanks to a more integrated methodology. In fact, these teachers often experience cultural isolation, sometimes consequent to a landlocked location, and need to exchange opinions on teaching-learning processes, in order to become conscious of their teachers role and of the effect of their actions on their students (success rate, for example).

The **final beneficiaries** of the project will be:

a) academic institutions of the Sahelian region and their students;
b) public services, such as local or regional institutions, NGOs, agribusiness and agro-food enterprises: these institutions have often difficulties finding qualified employees, sufficiently trained in relation to their tasks;
c) the final medium/long term beneficiaries are the most vulnerable or disadvantaged sections of the population, such as rural populations, children and women. These groups are obviously in major risks of poverty and malnutrition, in addition to health fragility and social exclusion. The requirements of these groups will be obviously taken into account by the trainers as well as by the newly trained students. Moreover, these requirements should become pressing needs in future professional actions and should also receive the attention of civil society with a long-term perspective of equitable sharing of resources.

LOCAL ISSUES AND ENVIRONMENTAL CHALLENGES

Poverty rate in Sahel is very high, especially in the countries involved in the project (56,5% in Burkina Faso, 61,9% in Chad and 43,1% in Niger) [5] [6] [7] [8].

These high poverty rates are strongly linked to malnutrition, which is a challenge in maintaining social peace and stability and prevents the development of human resources.

Food insecurity, that is the result of a widespread and severe scarcity of productive resources, plagues most of these countries and primarily affects the most vulnerable part of the population. It is difficult to realize agricultural improvement because soils are overworked and depleted, as well as animal productions improvement that is hampered by low biological performances of animals, by scarce availability of food resources and by a poor livestock management. Furthermore, aridity, together with overpopulation, generates a process of environmental degradation of local and regional extension and consequently determines people migration to the humid tropics [9] [10] [11].

The fast urbanization in Sahel countries creates many problems: environmental degradation, instable public health, excessive energy consumption, in a context of lack of human resources qualified for solving these problems [12] [13].

To attain a collective and sustainable food security the local governments have adopted, over the last decade, some

Strategies for Poverty Reduction, which assign to the rural sector the role of principal motor of economic growth in these countries until 2015 [14] [15].

Since the droughts of the 70s and 80s, the Sahel is undergoing a continuous process of environment degradation (Fig. 1). The desertification process has a significant impact also on several river flows and river ecosystems, damaging human activities.

Fig. 1 – Intensive erosion effects on soil and rocks in Tillabéri region (Niger). (Photo E. Ferrero)

Environmental damage exacerbates inequality by exerting a negative impact on the already poor people and, in the meantime, the inequalities of human development also amplify the environmental damage [16] [17].

In this regard, the role of universities as engines of development is undeniable. However, African HEIs are facing enormous financial and social problems: a low schooling rate at all levels, outdated infrastructures, inadequate financial, political and logistical support by governments and enterprises [18]. A limited involvement of the private sector is still persistent due to inconsistent and occasional relationships between universities, industry, government, social and productive sectors of the economy.

At the same time, unstable political climate, restriction of freedom expression and culture of corruption are some reasons that contribute to the brain drain, to disrupt academic work and to provide constraints on the production of knowledge, hindering socio-economic development. In the field of information technology and communication (ICT) and in activities related to research and development, the gap between Africa and the industrialized countries continues to widen. The disparities are even greater in the case of the transfer of knowledge to industry and society. The link between science and development is not quite considered as a decisive strategy by policy makers of the Sahelian countries, consequently the research has a low impact on improving people life conditions.

Development strategies in Sahelian countries require the implementation of projects and programs that take into account the close relationship among **research** (emergence of new scientific knowledge), **training** (enhancing professional capacities and infrastructures in the field of science and technology) and **innovation**, (transfer of basic knowledge to the application), through the creation or the involvement of enterprises. This is the concept called **"Triangle of knowledge"**.

AIMS AND GOALS

This project aims to organize a specialized Master to prepare a skilled staff for strategic positions in the technical structures of ministries, training and research institutions, enterprises, NGOs, all working in the field of rural development.

Educational multidisciplinary programs should face challenges and difficulties of agricultural development in Sahel region with the purpose of enhancing capacities in various strategic fields: livestock productions, food security and safety, environmental protection, enhancing knowledge for sustainable and fair development.

A multidisciplinary and interdisciplinary approach should be used in planning curricula for technicians involved in development activities.

Focus of the master is the awareness of links between the different areas involved to cope and develop coordinated and tailored programs.

The courses and training activities will take place in an innovative way, offering an integrated and interdisciplinary handling of themes concerning sustainable rural development in cyclical vision and "supply chain" structure. The

diagram and the list of skills were previously discussed and shared by the partners (Fig. 2).

Thanks to the innovative procedures of this kind of training, the project recommends measures designed to strengthen the capacity and effectiveness of higher education, to promote basic and applied scientific research, to improve educational quality through updated teaching methodologies and to progress administrative management of the universities, which will involve a growing number of students.

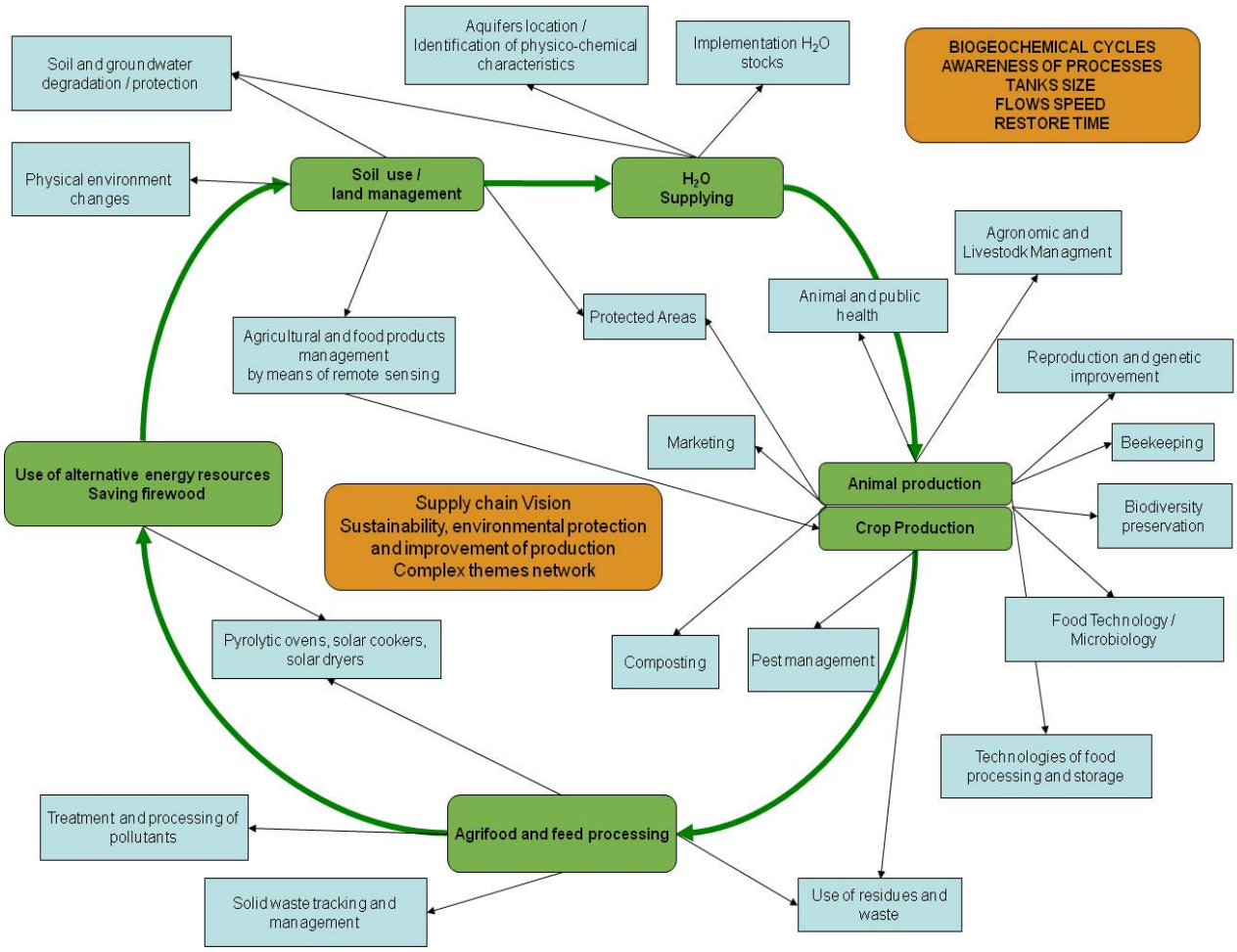

Fig. 2 – Supply chain and cyclical vision map, including and connecting the Master's topics (from [3], mod.).

An important aspect will be the strengthening of links between HEIs and a wider cooperation between them in the areas of training and research: this network, encouraging the exchange of academic staff and students, will create a more favourable environment for debate and innovative research, will promote a greater awareness of the complex connections between human choices and natural processes and will also accelerate the process of democratization.

STRUCTURE OF THE MASTER

The Master's structure includes different topics (land management, environmental restoration, agro-pastoral production chain, farmer organizations and strategies, local development). Disciplinary integrations will be offered by Niger, Burkina Faso, Chad teachers and CISAO members in an institutional framework for shared and collective vision. The integration fits into an innovative higher education vision and, at the same time, offers as opportunities for young people, allowing them to work in key sectors of the region.

The timetable for the three years project includes three main steps.

a) **First period**: consulting actions on the organization of the Master and the strengthening of relations between academic institutions and other stakeholders. Some workshops will be organized to facilitate these cultural exchanges, to discuss and select students' curricula and to facilitate their integration into the working world. Delegations from all the involved HEIs will participate in the planned workshops. These meetings will also provide a special session with the participation of local authorities, enterprises, NGOs, etc. During this period, collaborations will be activated with institutions that could host the Master's students for internships or for their employability.

b) **Second period**: realization of the Master teaching steps, according to the programme of training modules. The teaching material will be available on the project web site for teachers and students.
c) **Third period**: diffusion of results and impact on the region, production of educational materials also designed for primary and secondary school teachers, for a better dissemination of the integrated vision of development problems. This third period will also include the evaluation of the actions carried out during the project and a feed back on the structure of the Master with a consequent effect of improvement.

The Master provides theoretical courses taught by academic staff of different nationalities and seminars held by non-academic professionals (e.g. officials of the Piedmont Region or operators of the associated partner Terre Solidali Onlus) or by local officials of local associations or NGOs, etc., whose involvement has been considered relevant.
These actions will be integrated with practical activities (laboratory activities, field trips, etc) (Fig. 3).

Fig. 3 – The laboratory facilities at the Faculty of Agronomy of the Abdou Moumouni University of Niamey give the possibility to integrate practical work with lectures and field trips. (Photo C. Semita)

Distance education is also recommended to increase the impact of any action capacity building, even if the HEIs partners still need a technological improvement. Therefore, at the moment, only the establishment of a database can be forecasted, with the creation of a website and a newsletter (Fig. 4).

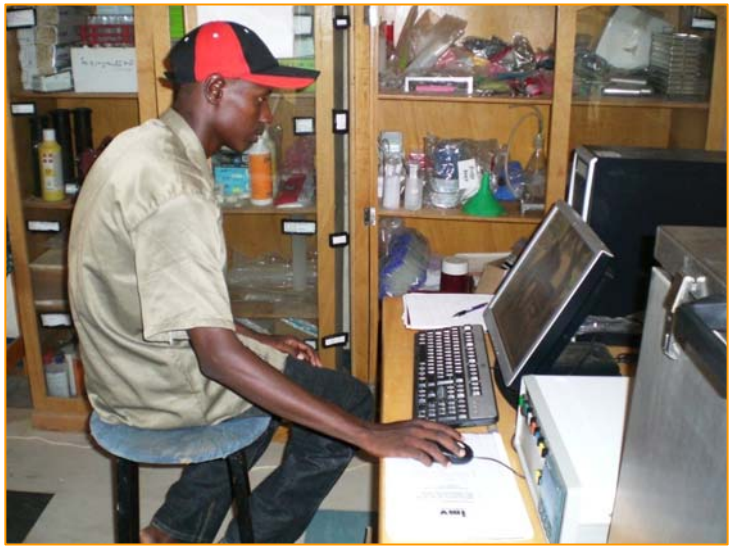

Fig. 4 – Enhancing structures and digital equipment of the Abdou Moumouni University of Niamey will support the integrated distance education and improve relations between the partners. (Photo C. Semita)

METHODOLOGICAL APPROACH

The approach is systemic and will involve multidisciplinary knowledge. The themes of improving livestock production, preservation of local animal and vegetal biodiversity and the use of biotechnology in animal reproduction and genetic improvement will be connected to the modernization of agriculture, the use of technologies for preservation and processing of animal and vegetal food products and the implementation of systems using solar energy (solar cookers and photovoltaic systems). Innovative teaching strategies will be prepared and proposed in order to connect these items to other key themes, like land management (transformation of the physical environment and degradation)

and land use, supply and protection of water resources, management of solid wastes and pollutants.

This list is not exhaustive: all these issues will be thoroughly discussed between the partners during the first phase of the project as well as the network between them and between the teachers' skills.

A main methodological concern will be the spreading of sustainable appropriate technologies, easy to be used by local not qualified staffs, with a low impact to the environment, applicable in the Sahelian context.

The goal is to bring more changes in the educational field to help teachers to be open-minded, prepared for the exchange of ideas, so that students can benefit of a more practical and multidisciplinary approach and acquire a greater awareness and understanding of these complex problems.

The main result of such training is the acquisition not only of technical skills, but also of a deep awareness of local issues, taking into account that a local intervention affects the entire region: what happens in a limited area can affect the entire country.

Teachers and researchers will be stimulated to master the latest scientific and methodological knowledge in their own fields and to the other side to create a positive interdependence with students, developing a sense of personal responsibility, encouraging the acquisition of cognitive and social skills and developing the motivation to learn and solve complex problems by promoting teamwork. Understanding the links between learning, theory, research and professional practice develops the capacity to face problems in a systemic way, in different contexts and to acquire professional skills to work respectfully on different environmental components.

EXPECTED RESULTS

For the success of the project as a whole, it is crucial that innovative actions do not remain only confined to the academic world; the key problem is to find strategies in order to spread them to a larger scale, starting from the trained technicians. To achieve this goal the policymakers of the Sahelian countries should be aware of the role of education in general and universities in particular as engines for development.

It is therefore necessary that universities get out of their circle of elites opening to the outside world, so that knowledge can be a real contribution to national and regional development policies. The qualified and trained professionals should also understand that the acquired skills are not only a personal asset, but also a resource to be spent for development actions.

In this context, the project's educational task is to strengthen individual motivations and to employ knowledge at service of socio-economic development and poverty reduction in the region.

To obtain a wider effect, it is necessary to disseminate and share the principles and results of the project with social and productive sectors of the economy and civil society (Fig. 5).

The three-year length of the project could be a period of time long enough to create a critical mass able to interact with policy-makers dealing with the serious problems of development. This will happen if some crucial topics, like the effects of climate change, the problem of environmental degradation at all levels (including the challenge of waste and recycling), the issue of modernization of the rural sector, are brought to the attention of a wide audience in an effective and compelling way.

An action of this nature may cause a change in mentality: for example, awareness of the links between development, environmental degradation and poverty should lead to changes in individual behaviour for the maintenance and respect of natural resources.

Fig. 5 – The participants in seminar at the University Abdou Moumouni of Niamey, Niger. (Photo G. Trucchi)

ACKNOWLEDGMENT

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The RUSSADE project was submitted and approved by the European Union in to the EuropeAid-ACP-EU Cooperation Programme in higher education (EDULINK II). The completion of the bureaucratic procedures prior to the signature of the grant agreement and the activation of the project are still in progress.

NOMENCLATURE

ACP	African, Caribbean and Pacific Group of States
CISAO	Interdepartmental Centre for Research and Technical-Scientific Cooperation with Sahelian and West African Countries.
CRESA	Regional Centre for Specialized Education in Agriculture
EU	European Union
HEIs	Higher Education Institutions
IUSTA	University Institute of Science and Technology of Abéché
LERNSE	Laboratory of Studies and Researches in Natural Resources and Environmental Sciences
NGO	Non-Governmental Organization
Onlus	Non-profit organization of social utility
RUSSADE	Network of the Sahelian Universities for Food Security and Environmental Sustainability
UPB	Polytechnic University of Bobo Dioulasso

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