Maintaining Agrobiodiversity in Man and the Biosphere (MaB) reserves in Guantánamo, Cuba - Driving forces influencing on-farm agrobiodiversity

Introduction - The recent shift towards the inclusion of communities in nature conservation signals a broadening perspective among conservationists. Earlier practices of fencing off pieces of nature to "mitigate" human impact proved to be unsustainable in terms of social and conservation impacts (Adams et al. 2004). One of the first and best-known concepts aiming to reconcile biodiversity conservation with its sustainable use is the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Man and Biosphere (MaB) reserve model (UNESCO 1996). However, while environmental protection has always been an essential principle in the management of these MaB reserves, the protection of agricultural landscapes has largely been neglected (Lenné and Wood 2011). In the Cuchillas del Toa MaB reserve, located in Cuba's most eastern Province Guantánamo where about 6000 subsistence farmers live, the interface between natural ecosystems and agricultural landscapes have not been adequately investigated yet (UNEP 2010).

The Man and the Biosphere reserves' conceptual idea is to reconcile environmental protection with sustainable development and to consider human interests in the conservation landscape while still maintaining the ecological values of existing protected areas (UNESCO 2011). Conceptually, the MaB reserve model is attractive, yet the practical reality of implementing dual "conservation" and "sustainable use and development" goals is challenging (Coetzer et al. 2014). When wanting to implement MaB reserves successfully and sustaining agrobiodiversity in protected landscapes in the long run, an innovative and flexible approach to nature conservation is needed in order to bridge the objectives of agrobiodiversity conservation and the enhancement of livelihood of agricultural communities (PAR and Bioversity International 2010).

Material and Methods - The present research, carried out between 2013 and 2014, determined the most important driving forces for maintaining on-farm agrobiodiversity in the Cuchillas del Toa MaB reserve by assessing farming systems, analytically describing the predominant types of agricultural practices and to identify socio-economic factors that influence farmers' livelihood. The main objective was to understand how bio-cultural production landscapes in protected areas can be synergistic with conservation of ecosystems to improve community livelihoods and agrobiodiversity maintenance. A household-level survey was conducted in two different agro-ecological zones (coastal and mountain area), on 37 households, along with transects and mapping of landscape. A participatory farmer workshop was organized to identify opportunities, synergies and trade-offs for considering the use of agrobiodiversity as an option to improve the conservation of protected areas.

Results and Discussion - In the Cuchillas del Toa MaB reserve, interviewed farmers maintain a wide range of agrobiodiversity, both traditional varieties and their wild relatives, manage the diversity through their use, and select it according to the necessities of their families. The traditional species and varieties are grown in different types of traditional mixed farming systems. These different mixed farming systems lead to landscape rich in agrobiodiversity and build a supporting matrix for its conservation, what highlights farmers' important contribution to the maintenance of the unique mosaic landscapes of the Cuchillas del Toa MaB reserve (Perfecto et al. 2009). As many wild species growing in the Cuchillas del Toa MaB reserve are only maintained through initiatives by farmers, farmers also contribute to safeguarding certain natural habitats and to the conservation of a considerable number of wild species. Farming families in both zones interact with elements of the wild flora diversity in many ways by using it for various reasons: as living fences to pasture animals, as shade trees in coffee plantations, to repel insects in home gardens, as timber for house construction or for energy purposes.

However, in spite of the outlined positive signs that farmers in the Cuchillas del Toa MaB reserve contribute to the conservation of a considerable number of traditional species and their wild relatives, the present research data confirms that farmers face a number of challenges, which undermine the ability of the local farming communities to sustain the traditional farming systems that have helped to develop and conserve agrobiodiversity over centuries. The results of the present research reveal several socio-economic factors that have different implications on farmers' livelihood and negatively affect agrobiodiversity. Apart from causing heavy demographic changes, these factors also highly reduce the diversity of cultivated and wild species in small family farms in the Cuchillas del Toa MaB reserve. Especially in the mountain agro-ecological zone, farmers have limited access to health, education and other basic infrastructure (electricity and roads) and migrate to urban areas with

seemingly better living conditions. This leads to unclear intergenerational tenure over farm holding, which enhanced similar to many other areas in the world (Anderson 2003), the loss of plant and animal genetic resources on-farm. Insecure farm succession also encourages families' short-term thinking leading to a concentration on short-cycle crops. Some interviewed farmers have excluded root and tuber crops and/or neglected and underutilized fruit trees needing up to 18 years to enter into full production, from their production systems. The migration of especially younger people attracted by modern lives in urban areas, has led to a lack of labor forces on-farm. The aging rural population concentrate on low labor-intensive crops and on less crops in general, leading to a loss of especially traditionally kept species (e.g. arrowroot (*Maranta arundinacea).* Limited transportation infrastructure and bad roads hampers the commercialization of farm products and fosters farmers' concentration on only a couple of cash crops.

The present research found an intrinsic link between traditional knowledge and agrobiodiversity manifested in the fact that many species, maintained by farmers, are the result of families' traditional knowledge. Due to the abandonment of farmers' traditional ways of life and with rural-to-urban migration, interrupting the handing over of the knowledge from generation to generation, farmers' traditional knowledge was found to be rapidly lost. This is especially alarming for those farms that host varieties that are of global significance, being exclusively cultivated in the Cuchillas del Toa MaB reserve (e.g. landraces of *P. vulgaris*).

Additional negative impacts are created by unsustainable management practices of natural resources and inappropriate land use (e.g. intensive agricultural production on steep slopes causing soil erosion). As a result, according to farmers, one of their most limiting production factors is decreasing soil fertility. Especially farmers in the mountain agro-ecological zone confront this problem by increasing use of mineral fertilizer. Unsustainable management practices also include mistiming and too high dosages of pesticides, killing natural enemies and creating resistances.

In view of these unsustainable management practices, the means and resources to manage the MaB reserve area turned out to be insufficient. At the moment, they allow only for general activities in protection and environmental education, which are mainly concentrated on the Cuchillas del Toa MaB reserve core zone, the Alejandro de Humboldt National Park (coastal agro-ecological zone). Consequently, farmers in the mountain agro-ecological zone have a low understanding of the conceptual framework of the MaB reserve, where almost no environmental education programs and capacity-building about sustainable management practices have taken place so far. The legal concept of Cuchillas del Toa MaB reserve turned out to be poorly defined and responsibilities among the different instances of the Cuban State authorities managing the reserve are not clearly settled.

Conclusions and Outlook - The research data confirms that interviewed farmers face a number of challenges in relation to the conservation of on-farm agrobiodiversity and socio-economic factors are the most important driving forces in negatively affecting on-farm agrobiodiversity in the Cuchillas del Toa MaB reserve. Especially in the most remote located farming communities' limited access to health, education and other basic infrastructure fosters rural-to-urban migration with all its negative consequences for agrobiodiversity conservation. Given the found intrinsic link between agrobiodiversity and farmers' traditional knowledge, the latter is rapidly lost. Additional negative impacts are given by unsustainable management practices fostered through farmers' lack of knowledge about the MaB reserve model, poorly defined legal concepts in buffer and transition zones and unclear responsibilities among the different instances of the Cuban State authorities about the management of the Cuchillas del Toa MaB reserve.

Based on these results, several actions can be recommended. Basic infrastructure in the most remote located MaB reserve areas should be improved to slow down rural-to-urban migration. Given the intrinsic link between traditional knowledge and on-farm agrobiodiversity, it is recommended to promote awareness and ownership for the values of traditional knowledge and ensure its documentation. In the face of farmers unsustainable management practices, environmental educational programs and capacity building processes in sustainable management practices must be developed and embedded in an effective and appropriate MaB reserve management plan that incorporates agrobiodiversity and improved land management among its main components. There is no one-size-fits-all solution for the MaB reserves' challenging dual implementation of conserving agrobiodiversity and at the same time improving the livelihood of rural communities can be achieved. Only with the development of an innovative and flexible approach, which can be adapted to different situations, taking into consideration the local needs and conditions of the rural farming communities in the different parts of the reserve, the MaB reserve concept will have the power to positively influence the sustainable agriculture and biodiversity conservation.