AGROFORESTRY SYSTEMS AS ALTERNATIVE FOR CONSERVING NATIVE PLANT SPECIES AND IMPROVING AGRO-ECOLOGICAL KNOWLEDGE

Cadena González AL[1]*, Buttschardt T[1]

(1) Institute of Landscape Ecology, Westfälische Wilhems University of Münster, Münster, Germany

*Corresponding author: a_cade01@uni-muenster.de

Abstract

Depletion and displacement of native plant species by exotics is reported worldwide, including tropics and temperate areas. Agroforestry systems (AFS) may help to conserve native plant species. Therefore, the aim of the project is to analyze local factors that determine if farmers cultivate native species in AFS or not in the tropics and temperate regions, and to find out if lack of agro-ecological knowledge is a significant factor. The study comprises literature review, case studies with implementation of questionnaires and interviews of farmers in the tropics and temperate regions. Results from a case study in La Vega municipality, Colombia, include a characterization of plant species reported to be cultivated locally in AFS. We will complete an analysis of local social factors that determine plant cultivation, including the analysis of the role of agro-ecological knowledge at local level.

Keywords: native species; agroforestry systems; plant conservation; conservation and benefits

Introduction

Native plant species have been displaced by exotic plant species in several regions, including tropics and temperate areas (Gómez et al. 2011). One of the reasons is expansion of modern agricultural land use which has led to disruption of natural habitats and loss of biodiversity (Douglas et al. 2014). Productivity of exotic species has been the most frequent reason supporting the introduction of exotic species into agricultural systems. For example, tree species that require low inputs, but offer high potential of adaptation and fast growth, are frequently planted in the central area of the Colombian Andes (Pacheco 2004) and in the south-east of Brazil, in Minas Gerais (Couto et al. 1994), where local markets focused on wood are established and, similarly, small-scale farmers are interested in inexpensive sources of wood. These species include, e.g., *Eucalyptus*, well industrialized in Brazil and Colombia where also Acacias and Pines are popular (Escobedo et al. 2015). However, in spite of the high productivity of these species, they have not brought positive returns to the environment as a whole. Rather they seem to have deteriorated the soil and to have rendered land in agricultural regions unproductive (personal communication). Another example is *Acacia melanoxylon*, an exotic [illegible] in various [illegible] has invaded woodlands and affected natural habitats (Jose 2011). Such ecological impacts also entail social problems because in several cases small-scale farmers, although getting the right to cultivate the land, are not able to restore the degraded soils due to various difficulties. Furthermore, in a number of localities worldwide native species have disappeared or are endangered due to overuse or lack of cultivation and failed restoration of resources (Van Andel and Aronson 2012; Cadena et al. 2013). As an alternative to monocultures of trees or crops, agroforestry systems (AFS) are integrated forms of land use that besides high production also have potential to reduce adverse environmental impacts, such as land degradation, reduced food production, and climate change (Smith et al. 2012; Leakey 2014; Morhart et al. 2014). Further, they may help to recover and maintain native plant species (Barrios et al. 2018). A key element for the conservation of native species in AFS is the recovery and improving of traditional agroecological

knowledge and the attention to the reasons that farmers have for not investing in cultivation and protection of these species.

Project description

The project comprises literature review; case studies in the tropics and temperate regions; statistical analyses of data; identification of local factors that determine cultivation of plant species; characterization of plant species reported to be cultivated among local agroforestry systems, this characterization includes agro-ecological requirements of the plant species.

So far, a case study in the Eastern Andean range in Colombia, municipality of La Vega, department of Cundinamarca, has been completed. This case study aimed at (i) identifying local factors that influence farmers' decisions to cultivate native species or not, at (ii) studying the traditional structure of AFS, and at (iii) assessing gaps in agro-ecological knowledge at local level. The municipality of La Vega comprises a wide elevational range between 1,100–2,700 meters and, consequently, a marked climatic gradient and a diverse geographical structure which allows for cultivation of a high diversity of crops and tree species. In spite of the benign characteristics of the natural environment and high quality of soils, many local farmers, especially subsistence farmers, struggle to gain some income to support their families. This situation is becoming worse due to effects of climate change. Thus, farmers need support to ensure food production, to diversify their income sources, and to improve agro-ecological knowledge. Regarding protection of native plant species, effective programs are needed that motivate locals to conserve local genetic material, e.g., via collection of seeds and seedlings found in the wild. Five representative villages were selected in order to carry out the field work. Data were obtained via qualitative and quantitative methods, namely community meetings, questionnaires, semi-structured and structured interviews with farmers, expert interviews, open talks, and visits to farms. A total of 71 farmers participated in the study.

Based on the plant species cultivated and described by the farmers, further research was done in order to characterize the agro-ecological requirements of these species. The results included in this paper comprise information of the structure that farmers give to their AFS and detailed ecological and botanical characterizations of the crops and trees cultivated in the locality, including information on characteristics such as origin of the species, drought tolerance, life cycle, red list status, and ecological requirements.

To date, we have characterized a total of 152 species including crops and trees. One hundred and three species of this list have been identified as perennials, and 20 species belong to the group of annuals and biennials. Among these species, 50 are exotic and 71 natives; 22 are nitrogen-fixers, 17 species are resistant to drought, some of them with clear limits of resistance as they can only survive droughts of maximum three months. The most popular agroforestry systems in the locality are homegardens and intercropping systems represented by approximately 60 % and 10% respectively.

Until now, the results show that the cultivation of exotic woody species is greatly intensified, and farmers are mainly depending on few crops (*Coffea arabica* and *Thebroma cacao*) (Figure1). Other popular exotic woody species are *Persea Americana, Citrus nobilis* and *Citrus aurantium,* Additionally, another popular and non-timber exotic plant species is *Musa paradisiaca.*

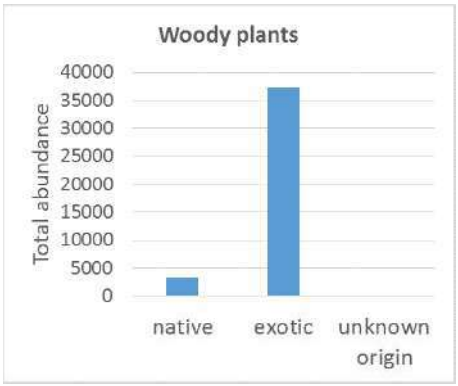

Figure 1: Cumulative number of woody plants species on 26 farms in La Vega, Cundinamarca, Colombia, according to their place of origin.

In the case of herbaceous plants, the inclusion of native species in AFS is more popular than exotics species (Figure 2).

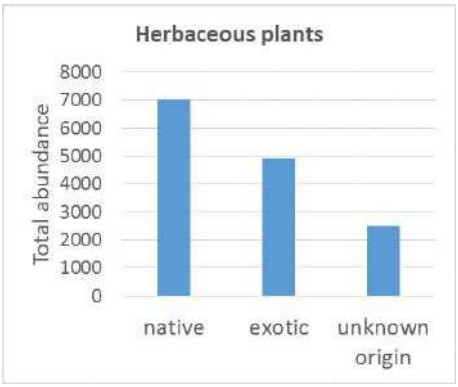

Figure 2: Total cover (m²) of herbaceous plants species on 26 farms in La Vega, Cundinamarca, Colombia, according to their origin.

By the end of the project, approximately end of 2019, we expect to contribute significantly at local level to: (i) the improvement of design and structure of AFS based on the potentials of local plant species and agro-ecological knowledge –the results obtained during the characterization of the species mentioned during interviews, will guide the elaboration of proposals for designing and structuring AFS – (ii) the promotion of diversification, (iii) the conservation of native plant species that will be achieved during the visits, talks and interviews with farmers, and (iv) the process of communication of results and transfer of knowledge which is expected to be achieved by the elaboration of a report and direct communication with farmers.

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