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Annaël Barnes

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# Supporting ecological compensation for mining projects in the arid zones of Central Asia: an approach in terms of ecosystem services

Presenter: Annaël BARNES  
Email: [annael.barnes@cirad.fr](mailto:annael.barnes@cirad.fr)  
Scientific: Paulo SALGADO, CIRAD, UMR Selmet Montpellier,  
Supervisors: France – Alexia STOKES, INRAE, UMR AMAP,  
Montpellier, France

The arid ecosystems of Central Asia provide many ecosystem services that benefit the local populations and the multi-species pastoral livestock of these territories. In addition, the subsoils of these areas are rich in minerals, hence significant mining activity. Mining projects require an Environmental Impact Assessment, a study which describes the impacts on the environment and recommends measures against them. Among those measures, there is in the following order (i) Avoiding; (ii) Minimizing; (iii) Restoration; (iv) Compensation: it is the “Mitigation Hierarchy”. All these measures aim to achieve the « No Net Loss », or even the « Net Gain » of biodiversity. In Central Asia, the method recommended for the ecological compensation is the monospecific planting of saxauls (*Haloxylon ammodendron* and *Haloxylon persicum*), which are woody xerophyte occurring in the arid zones of Central Asia. Planting is carried out on the same area as the impacted area, or even double it, at high densities. This method raises questions, particularly with regard to the technical success of the plantation, the impact on ecosystems and their services, and the acceptance by local communities. Thus, this thesis aims to support ecological compensation in Central Asia, more precisely in Mongolia, Kazakhstan and Uzbekistan, via an ecosystem approach.

The first objective is to quantify the ecosystem services provided by grazing land in the arid zones of Central Asia. For this purpose, interviews are conducted with local populations and other stakeholders in order to identify the ecosystem services of interest. Subsequently, ethnobotanical surveys and field measurements are carried out in order to study the link between vegetation and ecosystem services. The second objective is the evaluation of different practices that can improve the provision of those services, such as planting or defensive measures. Each identified option is analysed according to its feasibility conditions. Interviews with local populations are conducted to assess the acceptance of these practices. Finally, as a third objective, this thesis aims to propose a tool for the assessment of ecological compensation scenarios, in order to quantify the level of provision of ecosystem services and to assess the economic cost and the level of acceptance for each scenario.

Keywords: Ecological compensation; Ecosystem services; Central Asia

The image is a composite illustrating the morphology and anatomy of *Ficus religiosa*. At the top left, a globe highlights the species' distribution in Africa. Next to it is a map of the continent with a red dot indicating the study area. To the right is a detailed botanical drawing of the tree's branching structure. Below these are several anatomical drawings: a cross-section of a stem showing vascular bundles, a longitudinal section of a branch, and a drawing of a stem with a large, prominent lenticel.

In the center, a photograph of a tree is accompanied by a diagram of its branching pattern. A text box explains: "Quelques fois l'Épic, les UC sont arrondies : les étages de branches se forment en fil de l'ÉC". Below this is a drawing of a stem with a large lenticel. To the right, another drawing shows a stem with a large, rounded vascular bundle.

The bottom section features a 3D model of a tree with a brown trunk and green canopy. To its left, a vertical stack of stem sections is labeled UC 1 through UC 5. Below this is a drawing of a stem with a large lenticel. To the right, a photograph shows a stem with a large lenticel, labeled "Rameaux horizontaux (libre 4°UC)". Below this are several photographs of stem sections showing different anatomical features, labeled "Arrêts de croissance" and "Mors de bourgeons terminaux".