SUSTAINABILITY OF MANAGEMENT PRACTICES OF MOUNTAIN PASTURES IN REUNION ISLAND (Indian Ocean)

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ABSTRACT

The grazing systems are an essential component of these volcanic highlands (1000-2000m). Our investigations consist of building up diagnosis tools and decision rules for a sustainable control of these fragile grazed ecosystems composed of native and sown pastures.

The use of a systemic approach allows us to analyse the inter-relationship between the vegetation dynamic and the agricultural practices through three biological indicators which relate to one hundred paddocks in six cattle farms. Concerning the vegetation dynamics, it seems that some management practices lead to a non-reversable degradation stage. As regards the forage system, the measure of sward-height and estimation of the volume of available herbage show a poor relationship between management practices of pastures and the biological seasonal rhythm. The mineral nutritional composition of vegetation illustrates that fertilizing practices are not adapted to the particular nature of soil (especially Phosphorous availability).

KEYWORDS

Agro-ecology, pasture management, diagnosis, dynamics, systemic approach

INTRODUCTION

For 20 years, in Reunion Island, development plans work towards the stabilisation of the rural population through sustainable agriculture, in a mountain environment with hard ecological conditions. The grazing area are an essential component of them; they constitute the basic forage resource of beef and dairy farming systems. In an insulary context (2500 km^2), intensification is necessary to the development of animal production. However the benefits of livestock systems to social and touristic point of view must be considered as well as the reduction of harmful environment and territory management of these fragile and original highlands.

A well-planned grazing management is one of the keys of the sustainability and the profitability of these mountain rotational grazing systems. The control of grazing resources in quality and quantity through the year is the short term problem for the breeders. The durability of species composition concerns a more long time scale forage and landscape management. A research program was created (4,5) to elaborate agro-ecological diagnosis. The concepts of Systemic Ecology (9) provide the tools to estimate the relative influence of factors. which are associated with management practices and the environment. These factors are responsible for the dynamics of vegetation at different time scales (3).

METHODS

Between 1991 and 1994, a systemic approach, connected to an agronomic analytic research, and the ecologic concepts of organization, disturbance and succession (1,7) were used to study the grassland considered as "a complex ecologic system managed by man" (2).

Because of difficulties in the interpretation of soil analysis, nutritional status of the pastures was estimated from the mineral content of the herbage. Agronomic experiments were conducted to validate in local conditions the dilution process for nitrogen , phosphorus and potassium established in temperate climate (8). Herbage analysis can be used to assess N, P, K status of pastures and to monitor the effect of fertilizer supply (6) in relation with the growth of the sward.

Three biological indicators (sward-height, mineral nutritional status and botanical composition) were implemented on one hundred paddocks of 6 cattle farms included in a technico-economic survey of the "Chambre d'Agriculture de la Réunion" who provide information about management practices. The aim is to analyse the relationship between grazing management practices (defoliation frequency, stocking rate, fertilizer applications...) and the agro-écological functioning processes of meadows at different time scales (a few days or weeks, seasons, years). These correspond at the rate of decision of forage systems. An electro-mechanical sward stick is used for measuring the height of herbage for estimation of the biomass of pastures. Botanical composition was assessed with the quadrat-point method along transect in the paddocks.

Phytosociological methods (Braun Blanquet) are also employed to elaborate (on more than 300 plots) a typology of diversity of grassland and to describe the slow rate factors responsible for the long range evolution.

This combination of approaches allows us to explore gradually the complexity of these ecologic grazing systems at different organizational levels, using in particular multivariate analysis (Correspondence Analysis, Cannonical Correspondence Analysis) and mapping information.

RESULTS AND DISCUSSIONS

The mineral status of the meadows of the survey shows that fertilizing practices are not adapted to the particular nature of this mountain volcanic soil (Andosoils). Especially phosphorous unavailability is a limiting factor for growth of the sward and for nitrogen absorption. Applications of 250 kg ha^{-1} of N and 120 kg ha^{-1} of P were able to reach non limiting curve N (% DM)= 4.8. $DM^{-0.32}$ (temperate species) for the main dominant species (*Dactylis glomerata, Pennisetum clandestinum, Holcus lanatus, Anthoxanthum odoratum*). This corresponds to index IN=1. The non limiting index for P is rarely reached. We show that increasing the N index by 0.1 points permits increasing the dry matter yield of 1 t ha^{-1}. This can contribute reducing the problem of forage availability in Winter (average temperature 12°C and 2 months with rainfall lower 50 mm). A deficient mineral status contributes also to the degradation of species composition of cultivated pastures (*Dactylis glomerata, Pennisetum clandestinum).*

The measure of sward-height and estimation of the quantity of available herbage show a poor relationship between rotational grazing practices and the biological seasonal rythm. In the rain season, rainfall ranges from 2000 to 3000 mm and average temperature from 17 to 21°C. This leads to an herbage accumulation (200 to 1000 m^3 per animal) of bad quality due to the length of the deferment (more than 2 months). On the other hand, in winter, the quality of herbage is better but the available quantity can dangerously decrease down to a

minimum (200 m3 per animal). Cattle stay in the same paddock too long a time and the short residual sward height reduces the dry matter accumulation rate. These differences to the reference states lead also to a non maintenance of botanical stability.

Different states of change in botanical composition are observed in relation to the above fast rate processes. Slow rate processes like pasture improvement and environmental factors have an effect on botanical composition. Figure 1 shows the evolution of pasture from clearing of natural vegetation up to intensive cultivated meadows. Some management practices lead to pasture reversion or to non-reversing degradation stage. *Ulex europeus* (the gorse) is one of the degradation species of pastoral areas, this is also the case in other islands such as Hawaii and Tasmania.

This methods of diagnosis are actually used in a research-development program and constitute decision making aids for the management of grazed forage resources.

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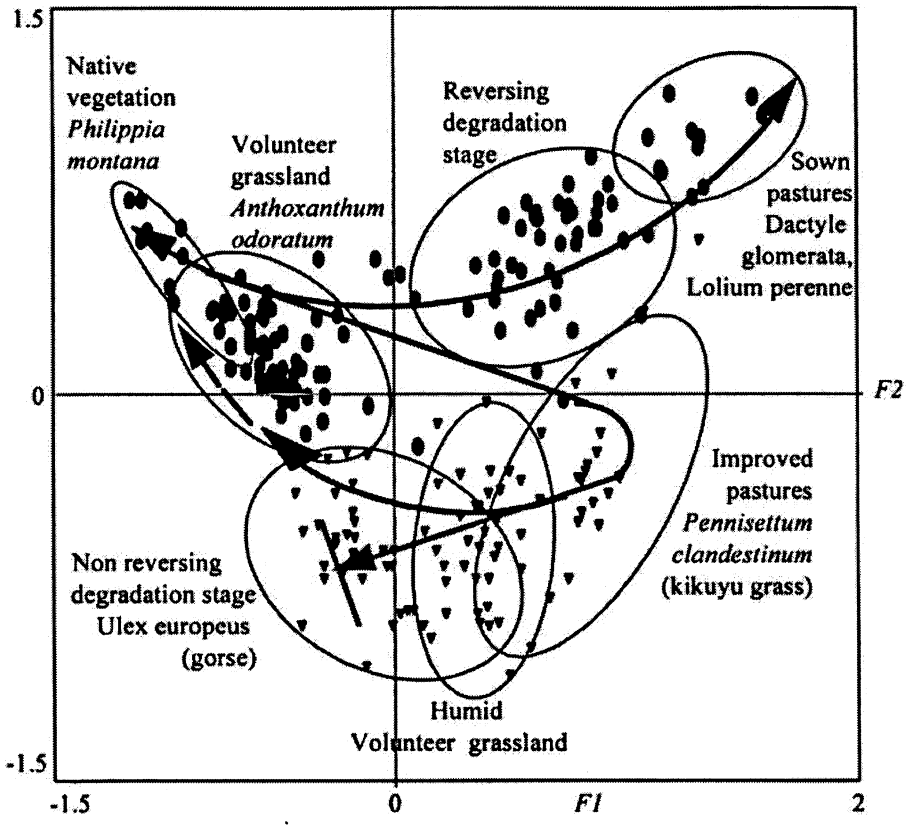

Figure 1
Trajectories of evolution of pastoral area of "Plaine des Cafres" Factorial plan (F1F2) of Correspondence Analysis (212 plots, 69 species).