# PhD School on Agriculture, Environment and Bioenergy

(http://sites.unimi.it/dottorato_aab/)

***(XXXV cycle, 2019-21)***

## Project draft

**1.Field of interest**

*AGR/02*

**2.Project title**

Climate change and pastures: quantification of impacts and identification of adaptation strategies

**3.Tutor** (membro del Collegio dei Docenti)

Roberto Confalonieri

**- Eventually: co-tutor/s**

None

**4. Relevance of the topic and state of the art:**

Grassland ecosystems are crucial suppliers of food and ecosystem services and their functionality is strongly affected by the effect of environmental conditions on species composition (e.g., Delaby et al., 2010) both within-season and under climate change scenarios. There is a growing demand for tools able to manage cuts and grazing to maximize both productivity and quality of forages, and simulation models are considered as key instruments to face these challenges. Models for the simulation of grassland dynamics can be classified in two main categories: the first is based on the explicit simulation of crop growth of the different species present in the community and of the competition among them (e.g., GEMINI, Soussana et al., 2012). This kind of models, although strictly adherent to the underlying system, is difficult to initialize and parameterize, since represented by three-dimensional, individual-centred models. Moreover, they require relevant hardware resources in case of large-area simulations. For these reasons, such models are not suitable for operational conditions (Röhrig and Stützel, 2001). The second category is based on the simulation of the grassland as a single crop (e.g., STICS-grassland, Brisson et al., 2008). This approach to the simulation of plant mixtures is of course simpler. However, it is not considered as a valuable choice (Soussana et al., 2012), since no dynamics in the relative presence of the different species can be reproduced.

**5.Layout of the project (draft)**

**5.1.Materials & Methods:** da mezza pagina ad una pagina massimo

A new modelling approach (CoSMo; Confalonieri, 2014; Movedi et al., 2019) will be evaluated and improved using dedicated field campaigns. CoSMo (Community Simulation Model) is a solution that can be considered as intermediate between the two described above. It is based on two assumptions allowing the use of a single instance of a generic crop model to simulate phytocoenosis dynamics and productivity. The first is that community parameters can be derived at each time step from the relative presence of the different species and from parameter values determined for the species in monoculture. The second is that inter-specific competition and changes in species

relative presence can be simulated as a function of species-specific responses to hierarchically-arranged drivers (triggered and continuous) representing the suitability of the different species to the conditions explored. Data for CoSMo evaluation will be collected in different types of grassland in different environments. Besides environmental characterization (e.g., soil, weather), data collected (different times within each season for two years) will be aboveground biomass and plant height (for single species and for the community as a whole) and leaf area index (community), phenology (different species) and relative presence of the different species in the community. Data for model parameterization will be collected on the main species in the communities monitored for model evaluation but in monoculture, within dedicated experimental plots. Parameterization data will be used for assigning values to the model parameters describing morphological and physiological traits of the different species. Data collected on grasslands will be used to calibrate parameters dealing with inter-specific competition.

**5.2.Schedule and major steps (3 years):** mezza pagina max

The research will be articulated in the following work packages (WP) and tasks (T).

| | | | | Year | | |
|---|---|---|---|---|---|---|
| **WP** | | **Task** | | **1** | **2** | **3** |
| WP1 | Experiments | T1.1 | Plot experiments on species in monoculture | ● | ● | |
| | | T1.2 | Measurements on different grasslands | ● | ● | |
| WP2 | Model improvement and evaluation | T2.1 | Parameterization for monoculture | | ● | ● |
| | | T2.2 | Calibration of competition parameters | | ● | ● |
| | | T2.3 | Improvement of model algorithms | | ● | ● |
| | | T2.4 | Model evaluation | | ● | ● |
| WP3 | Simulation platform | T3.1 | Model implementation | ● | ● | |
| | | T3.2 | Simulation platform development | | ● | ● |
| WP4 | Scenario analysis | T4.1 | Changes in species composition under climate change | | | ● |
| | | T4.2 | Potential competitiveness of exotic species | | | ● |

**6. Available funds (source and amount)**

Different projects from private companies as well as from regional and international calls, up to 150k euros on this research line if needed.

**6. Literature:** max 10 citazioni


Brisson, N., Launay, M., Mary, B., Beaudoin, N., 2008. Conceptual basis, formalisations and parameterization of the STICS crop model. Éditions Quæ, Versailles, France, pp. 297.

Confalonieri, R., 2014. CoSMo: a simple approach for reproducing plant community dynamics using a single instance of generic crop simulators. Ecol. Model. 286, 1-10.

Delaby, L., Baumont, R., Peccatte, J.R., Aufrère, J., Peyraud, J.L., 2010. Description and prediction of multi-species pasture nutritive value across the grazing season. Proceedings of the 23rd General Meeting of the European Grassland Federation, 29/8-2/9, Kiel, Germany.

Movedi, E., Bellocchi, G., Argenti, G., Paleari, L., Vesely, F.M., Staglianò, N., Dibari, C., Confalonieri, R., 2019. Development of generic crop models for simulation of multi-species plant communities in mown grasslands. Ecol. Model. 401, 111-128.

Röhrig, M., Stützel, H., 2001. A model for light competition between vegetable crops and weeds. Eur. J. Agron. 14, 13-29.

Soussana, J.-F., Maire, V., Gross, N., Bachelet, B., Pagès, L., Martin, R., Hill, D., Wirth, C., 2012. GEMINI: A grassland model simulating the role of plant traits for community dynamics and ecosystem functioning. Parameterization and evaluation. Ecol. Model. 231, 134-145.