PhD School on Agriculture, Environment and Bioenergy

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

(XXXIV cycle, 2018-20)

Project draft

1. Field of interest

Agricultural Chemistry (AGR13), Agricultrual Economy (AGR01):

2. Project title

Multicriteria assessment for innovative solutions to nutrient recycling

3.Tutor (membro del Collegio dei Docenti): Fabrizio Adani

- Eventually: co-tutor/s

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

Intensified European agriculture is crucial for the EU food supply and self-sufficiency, but it also generates environmental challenges related to GHG emissions and nutrient related pressure (eutrophication). In addition, European agriculture is under economic pressure due to its high dependency on import of primary nutrients and energy. Nitrogen (N) has been highlighted as one of the three "planetary boundaries" that have been exceeded beyond supportable levels alongside climate change and biodiversity loss (Steffen et al, 2015). For example, one of the most potent greenhouse gases is nitrous oxide (N_2O) whose concentrations have increased in the past 50 years from 270 to 330 ppb (IPCC, 2014). This is significant taking into account that N_2O has a global warming potential which is 300x that of CO_2 and for which agriculture is responsible for 60% of its emission. In addition, ineffective management of manure and other fertilizing products results in eutrophication of water bodies with nitrates as well as elevated volatile ammonia emissions threatening biodiversity adjacent to agricultural activities. Phosphorus (P) has been highlighted and was placed on the "Critical Raw Material" list by the European Commission, considering the European continent is dependent on import (currently EU28 is 92% dependent (P-REX Policy Brief)) to secure its own agricultural production (and hence food security). Carbon has been insufficiently investigated and even overlooked in past nutrient oriented research, yet N-, P- and C-cycles are intertwined and need to be examined within a single methodological framework. Carbon is of primary importance as (effective) carbon in organic matter returned to soils, which plays a vital role in abatement of soil degradation and maintaining soil fertility. In Europe, 45% of soils are thought to have a low or very low organic content matter (0-2 % organic carbon). These soils are located primarily in southern Europe but also in areas of France, the UK and Germany (EC, 2016). In addition, closing the carbon cycle is highly relevant from the perspective of renewable energy potential fromagro residues (e.g. biogas) and reduction of GHG emissions from agricultural practices (e.g. CH_4 losses from animal husbandry).

5. Layout of the project (draft)

The main objectives of this project is to suggest changes in farm systems management and/or the introduction of innovative technologies at farm level able to get "solutions" for C, N, P closing loops, including GHG emission reduction.

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

Pre-selected demo cases and other innovations case studies selected along the project, will be tested at demonstration scale by performing research activities. Data acquired from both theoretic and research activities will be used for successive environmental, micro a macro-economic and human factor evaluation.

This will be done by:

- (Long-)Listing and prioritizing farm system managements and technologies (solutions) for closing
- C-N-P loops reducing environmental impacts.
- Selecting and shortlisting solutions to be further tested by research activities.
- Analyzing process flow and defining products (biobased fertilizers).
- Attesting agro-chemistry and agronomical properties of products derived from solutions selected.
- Assessing the effect of the proposed solutions on soil/plant/air environment system.

Multicriteria assessment analysis will be used as tools to produced result

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

- (Long-)Listing and prioritizing farm system managements and technologies (solutions) for closing (1 year).
- C-N-P loops reducing environmental impacts (1 years).
- Selecting and shortlisting solutions to be further tested by research activities (1 year).
- Analyzing process flow and defining products (biobased fertilizers) (2 year).
- Attesting agro-chemistry and agronomical properties of products derived from solutions selected (2 year).
- Assessing the effect of the proposed solutions on soil/plant/air environment system (3 y).

6. Available funds (source and amount)

Proposal number: 773682-2 Type of action: RIA
(Research and Innovation action) **Topic: SFS-30-2017**
Call: H2020-SFS-2016-2017 (Sustainable Food Security – Resilient and resource-efficient value chains)

6. Literature: max 10 citazioni

Fangueiro D., Surgy S.,Fraga I., Cabral F., Coutinho J., 2015. Band application of treated cattle slurry as an alternative to slurry injection: Implications for gaseous emissions, soil quality, and plant growth. Agriculture, Ecosystems and Environment, 211: 102–111

Braga, R.P., Cardoso, M.J., Coelho, J.P., 2008. Crop model based decision support for maize (Zea maysL.) silage production in Portugal. Eur. J. Agron. 28, 224–233.

Shvaleva A, Siljanen HMP, Correia A, Costa e Silva F, Lamprecht RE, Lobo-do-Vale R, Bicho C, **Fangueiro** D, Anderson M, Pereira JS, Chaves MM, Cruz C and Martikainen PJ 2015. Environmental and microbial factors influencing methane and nitrous oxide fluxes in Mediterranean cork oak woodlands: trees make a difference. Front. Microbiol. 6:1104. doi: 10.3389/fmicb.2015.01104

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Ribeiro H., Fangueiro D., Alves F., Ventura R., Coelho D., Vasconcelos E., Cunha-Queda C., Coutinho J., Cabral F., 2010. Nitrogen mineralization from an organically managed soil and nitrogen accumulation in lettuce. Journal of Plant Nutrition and Soil Science, Journal of Plant Nutrition and Soil Science, 173: 260-267.

Alvarenga, P., Palma, P., Mourinha, C., Farto, M., Dôres, J., Patanita, M., Cunha-Queda, C., Natal-da-Luz, T., Renaud, M., Sousa, J.P. (2017). Recycling organic wastes to agricultural land as a way to improve its quality: A field study to evaluate benefits and risks. Waste Management. 61:582-592.

Alvarenga, P., Mourinha, C., Farto, M., Santos, T., Palma, P., Sengo, J., Morais, M.- C., Cunha-Queda, C. (2015). Sewage sludge, compost and other representative organic wastes as agricultural soil amendments: Benefits versus limiting factors. Waste Management. 40: 44–52.