SBI/SBSTA Koronivia Joint Work on Agriculture:

2(d): improved nutrient use and manure management towards sustainable and resilient agricultural systems

Response from Biovision, FiBL and IFOAM - Organics International, IFOAM-EU,

INTRODUCTION

At COP23, Decision –CP/23 invited parties and observers to submit their views on the joint SBSTA-SBI work known as the "Koronivia Joint Work on Agriculture" (KJWA), to inform workshops to be held at UNFCCC COP25 on the topics of: ***2(d): improved nutrient use and manure management towards sustainable and resilient agricultural systems***

Inputs on the content of the workshop

The organizations submitting this contribution, believe that **organic farming practices and agroecological practices**, **must be taken into account as very promising strategies to ensure the establishment of sustainable and climate resilient agricultural systems** by i) sustaining and mimicking the natural functioning of ecosystems, ii) relying on the recycling of nutrients, rather than the exogenous addition of critical nutrients such as nitrogen and iii) designing systems which are built on diversity at field, farm and landscape scale**.**

1. Linking improved nutrient use with ecosystem services

Improved nutrient use cannot be dealt with as a stand-alone issue. We would like to stress the importance of an integrated approach to nutrient management which supports plant productivity while preserving and enhancing soil organic matter stocks, below and above ground biodiversity and reducing nutrient losses to the atmosphere and aquatic systems.
As also highlighted in recently published reports such as IPBES (2019) or IPCC on Land (2019), the climate and biodiversity loss crises are two sides of the same coin, which need to be addressed in synergy. This is especially true when we look at overall nutrient balance and fertility of agricultural soil. With better soil structure and greater organic matter content, soils hold more nutrients which improves those nutrients' bioavailability and soil carbon sequestration. All these properties increase the resilience of the farming system. Organic agriculture has a strong focus on enhancing and maintaining soil-fertility and quality and a number of organic core practices support this, which also has considerable climate change adaptation co-benefits.

Agroecology and organic farming design climate-resilient systems through a vast array of practices that enhance biodiversity and agrobiodiversity (intercropping; polycultures; crop

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rotations; mixed crop-livestock systems; agroforestry systems and hedgerows, shelterbelts, and living fences, improved and locally adapted crop varieties and protection of grassland to cropland) and through soil-enhancing practices (such as composting; mulching; green manures; nitrogen-fixing trees; animal manures, recoupling animals with crop nutrient cycles; cover cropping; low soil disturbance tillage; and practices that enhance below ground diversity, e.g. valuable mycorrhizal fungi and other soil microorganisms important to many ecosystem functions like soil fertility management).

2. Improved Nutrient Use

Despite nitrogen being a key nutrient necessary for the good development of plants, its large-scale production and application worldwide are responsible for high levels of emissions and farmers have become increasingly dependent on chemical fertilizers. This is the result of incremental loss of soil fertility and the adoption of unsuitable farming system practices (i.e. adoption of monoculture rather than crop rotations). Today, Agriculture is the sector contributing the most to nitrous oxide emissions, a potent GHG with 300 times the global warming potential of carbon dioxide.

The majority of nitrogenic GHG agricultural emissions come from application of manure or synthetic nitrogen fertilizers to soils. According to the scientific literature available, on average around 50% of nitrogen applied to soils is not taken up by crops (Bodirsky et al., 2012; Davidson, 2012; Davidson and Kanter, 2014; Erisman et al., 2008). This poses a major threat to the sustainability of the food systems: the excess which is not taken up pollutes waterways and human water supplies, and partially is converted into nitrous oxide. Since there is a non-linear relationship between application rates and uptake of synthetic nitrogen fertilizers, the incremental use of these products results in increased release of nitrogen surplus in the environment (Davidson and Kanter, 2014; Mueller et al., 2014; Shcherbak et al., 2014).

Since there is **a direct correlation between nitrous oxide emissions and the amount of nitrogen fertilizer applied (**Bouwman et al. 1993**), reducing nitrogen application rates is the most effective measure to reduce** emissions. Globally, we are facing massive overabundance of nitrogen in our environment, with pollution threatening water supplies and biodiversity, contaminating the air we breathe, and contributing to atmospheric warming. Given the high nitrogen surplus on certain soils (i.e. in Europe), there is considerable potential for reducing the application of nitrogen.

Organic agriculture and agroecology offer a role model for a highly efficient but low nitrogen input system. By focusing on establishing closed nutrient cycles and thereby minimizing losses through runoff and volatilization and not allowing for the use of synthetic nitrogen fertilizers, these systems result in nitrogen levels tending to be lower per hectare than on conventional farms. Skinner et all. (2019) observed a 40% reduction of N_2O emissions per hectare for organic compared to non-organic systems. In addition to N input, soil quality

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properties such as pH, soil organic carbon and microbial biomass significantly affected N_2O emissions.

Reducing nitrogen applications has additional benefits if it is achieved through the reduction of mineral fertilizers, as this results in a corresponding reduction not only of emissions linked to on field application but also of emissions from fertilizer production.

IPCC estimates that conventional strategies that are proposed to reduce emissions by relying on incremental nitrogen use efficiency through the 4 Rs principle (right source, at the right rate, at the right time, in the right place) are way less efficient than drastically reducing the use of synthetic nitrogen fertilizers. The Fourth Assessment Report of the IPCC arrives at the conclusion that reductions in nitrous oxide emissions could contribute to 2% of the mitigation potential in agriculture (Smith et al., 2007).

It is important to underline that reducing the production and adoption of synthetic fertilizers is one of several measures to reduce nitrous oxide emissions from agriculture. It is necessary to integrate other practices and approaches, such as modifications in livestock feeding, use of cover crops and modifications in dietary behavior and lifestyle changes, strategies that also deliver on targets such as food nutrition security and sovereignty.

Even if yield gaps between conventional and organic are around 20%, in combination with reduced feed production (e.g. much less forage maize, and much less cereals and soy as concentrate feed) and less animals, this can contribute to a sustainable more climate friendly production system that delivers enough food (Muller et al., 2017). Organic agriculture and related approaches also build overall resilience in agricultural systems by enhancing soil health and fertility, increasing soil water-holding potential, and increasing the diversity of soil microflora and fauna, keeping in mind that these soil qualities will be critical in dealing with the varied impacts of drought and flooding due to climate change.

3. Manure Management

The livestock sector is a significant contributor to global human-induced GHG emissions. Livestock supply chains emitted an estimated total of 8.1 gigatonnes CO_2-eq in 2010 (using 298 and 34 as global warming potential for N_2O and CH_4 respectively). Methane (CH_4) accounts for about 50 percent of the total. Nitrous oxide (N_2O) and carbon dioxide (CO_2) represent almost equal shares with 24 and 26 percent, respectively (FAO[1]).

The key factor to reduce these emissions is to reduce animal numbers and in consequence manure quantities, as discussed above. A central lever to achieve this would be to reduce imported feed and to focus on livestock reared on non-food competing feed, such as grass, byproducts, residues and waste, thus reducing concentrate feed use and production, which also contributes to the nitrogen oversupply and corresponding emissions The key factor in reducing the remaining emissions from manure lies in how the manure is handled because the

[1] http://www.fao.org/gleam/results/en/

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amount of methane emitted is highly dependent on the anaerobic conditions and temperature in the manure management systems. Better storage and processing of manure can significantly reduce greenhouse gas emissions of both nitrous oxide and methane by 50% (Amon et al., 2006).

Manure composting is often used in agroecology, organic agriculture, and in biodynamic agriculture in particular. This technique alone can reduce nitrous oxide by 50% and methane emissions by 70%, although it does have the potential to increase ammonia emissions and thus may result in 50-120% higher indirect nitrous oxide emissions (FiBL, IFOAM – EU, 2016). Yet, the indirect emissions from the application of manure compost can be much lower than those from normal manure. Given the trade-offs over the entire life- cycle from production to application, manure compost has the potential to reduce emissions from manure management.

4. Reduction of Water Pollution and Eutrophication

Nitrogen fertilizers and associated nitrate leaching are a major cause of eutrophication and water pollution and subsequent biodiversity loss. Studies show that much higher rates of nitrate leaching occur in conventional farming systems than organic, and that the former are associated with higher levels of pollution. This is in part due to the lower nitrogen application rates in organic farming systems and the correspondingly better plant uptake, which curbs the rate of nitrogen leaching. Another factor is the greater amount of soil organic carbon in organic agricultural systems, which results in a correspondingly higher nitrogen holding capacity in the topsoil of organic farmland and reduces surface runoff, thereby reducing soil erosion and preventing flooding of agricultural fields (Zeiger and Fohrer, 2009, Lorenz and Lal, 2016). This in turn helps increase yields and helps plants adapt to negative climate change impacts, such as water-related extreme weather events (Muller et al., 2011). Finally, organic farming does not allow synthetic pesticides that also run off into water bodies with a polluting effect and toxicity for water animals. The ban on such products therefore prevents these negative impacts.

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