THE FERTILIZER INDUSTRY SUBMISSION TO THE CONSULTATION ON THE KORONIVIA JOINT WORK ON AGRICULTURE OF THE SBSTA

The International Fertilizer Association welcomes the landmark Decision on Agriculture adopted by the COP23 in November 2017, aka. the Koronivia Joint Work on Agriculture. In our capacity as an observer to the UNFCCC, we appreciate the opportunity to provide our views to the SBSTA and SBI on this critical issue.

IFA is the only global fertilizer association with a membership of more than 450 entities, encompassing all actors in the fertilizer value chain: producers, traders, distributors, service providers, advisors, research organizations and NGOs. IFA Members are present in 67 countries, and 45% in developing economies.

We believe it is critical to always consider plant nutrition topics in relation to food security, as well as to climate change adaptation, mitigation, and carbon sequestration sinks.

Key messages:

- Fertilizers are essential for achieving global food security. When considering GHG emissions from fertilizers it is important to focus on GHG emissions per unit of output of agricultural crops grown with the assistance of fertilizers in order not to jeopardize agricultural productivity and by extension food security;
- Farmers can adapt to climate change by using fertilizers according to Best Management Practices that strengthen their crops' resilience and makes the best use of resources like water;
- Fertilizer Best Management Practices can also reduce GHG emissions from fertilizer application, prevent deforestation and increase soil carbon sequestration, thus playing an essential role in the agriculture sector's climate change mitigation potential;
- Mineral and organic nutrient sources are complementary: mineral fertilizer have a higher nutrient content than organic sources, a well-defined composition and are readily available to crops. Organic nutrient sources are rich in organic matters and contribute to improve soil properties. Integrated Plant Nutrient Management takes advantage of this synergy.

1. Fertilizers are indispensable to global food security

Fertilizers contribute to about 50% of the world's food production, and with the world population expected to reach 9.7 billion people by 2050, the agriculture sector needs to increase its productivity by 60% compared to 2005 levels to meet the increasing global demand in food. This must also be accomplished in the context of the shrinking availability of arable land. Achieving global food security today and in the future cannot be achieved without fertilizers.

It is estimated that fertilizers represent 2.5% of global GHG emissions, 1.5% of which deriving from their application. Though this figure seems negligible, especially considering that the agriculture sector as a whole accounts for 12% of emissions, the fertilizer industry is committed to reducing its carbon footprint[1].

While it is important to reduce the absolute emissions from fertilizer application and production, a sole focus on these emissions (without consideration for agricultural yields) could be shortsighted and present at risk to agricultural productivity, and by extension, global food security. **The focus must be on improving the relative carbon intensity of agricultural crops grown with the assistance of fertilizers.**

This can be accomplished with the efficient and effective use of plant nutrients, through **crop- and site-specific Fertilizer Best Management Practices (consistent with the "4R" principles)**, that are applicable to each country and region worldwide.

4Rs refer to applying the **right source** of nutrients (that includes mineral and organic fertilizers, and special fertilizer products such as urease and nitrification inhibitors), at the **right rate** needed to optimize yields for a specific crop, at the **right place** in the field, and **at the right time** they are or will be needed by the crop.

2. Adapting to climate change through Fertilizer Best Management Practices

a. Improving plant resilience

The agriculture sector is one of the most vulnerable to climate change, and its negative effects (such as extreme weather events, increasing temperatures, declining availability of water and other resources) have started to severely impact agricultural livelihoods in many regions.

Site-specific nutrient management allows for a correct fertilization of plants that helps boost their health, and their resilience to climate stress.

[1] GHG emissions related to fertilizer production represent approximately 1% of total global GHG emissions. Energy efficiency and improved resource management during and after the fertilizer production process are continuously implemented: from 2000 – 2015, IFA benchmarks have indicated an average of 4% improvement in energy efficiency and a 9% reduction of CO_2 on ammonia production sites.

Plant nutrients play specific roles in plant growth: **nitrogen (N)** is an important component of proteins and nucleic acids; **phosphorus (P)** allows plants to develop strong roots and is an important component of molecules involved in energy transfer; **potassium (K)** helps them grow in a healthy way and become resistant to drought and disease.

Micronutrients such as **zinc (Zn)** help to improve better seedling establishment and higher plant tolerance to environmental stress factors[2].

Providing plants with concentrated, consistent and easily available nutrients to plants is the function of mineral fertilizers, and when applied using Fertilizer Best Management Practices (FBMPs) in the 4 areas of nutrient management, can considerably increase crops' resilience to climate change. Healthy soils and plants can better withstand climate stress and also contribute to greater water use efficiency. Moreover, it will be vital for farmers to maximize their yields in good seasons to make up for potentially more severe weather events.

b. Adapting to a water-scarce environment

Often, water and nutrient management are addressed separately, although they are intimately linked. Improvements in nutrient use efficiency should not be viewed only as a fertilizer management issue. The same is true for water. Plant nutrients and water are complementary inputs, and the most limiting input will constrain plant growth response to nutrient and water. The soil water content is the single most important factor controlling the rate of various processes in soils that influence nutrient cycling, flows and availability to plants. Similarly, poor soil fertility limits the availability of plants to efficiently use water.

The fertilizer industry encourages the adoption of "**fertigation**", a practice that entails applying fertilizers to crops with irrigation water. **Fertigation** makes it possible to synchronize the crops' nutrient requirements with fertilizer supply throughout its growth cycle addressing the rate, time and place dimensions of nutrient stewardship.

Fertigation can also be carried out with extremely simplified irrigation systems, like drips from water bottles, a useful resource to prevent water losses in water-scare areas.

Benefits of fertigation include:

- Increased uptake of nutrients by the plant.
- Reduced overall water consumption due to precise placement (with drip irrigation) and timing.
- Application of nutrients can be controlled, and nutrient uptake efficiency is automatically increased.

[2] Seventeen elements are essential for plant growth and can be divided in three groups: primary macronutrients (N, P, K), secondary macronutrients (sulphur (S), magnesium (Mg) and calcium (Ca)) and micronutrients: iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo), chlorine (Cl) and nickel (Ni). Plant growth is limited by the essential element that is the furthest below its optimum. N, P, and K are generally the most widely deficient elements, but mineral fertilizers also supply secondary and micronutrients as well, as they are gradually becoming new limiting factors throughout the world.

Conservation practices

Conservation practices (such as crop rotation, reduced tillage, mulching, cover cropping) can increase soil resilience by reducing soil erosion and water evaporation, while stream buffers and wetlands contribute to filter surface water. Combining them with 4R nutrient stewardship ("4R Plus") is starting to show very good results in conserving humidity in soils, reducing nitrogen losses to the environment while boosting productivity.

3. Reducing emissions from fertilizer application

As mentioned above, when considering GHG emissions from fertilizer use, the focus should be on relative emissions of agricultural crops grown with the assistance of fertilizers. **Zero losses are not an achievable goal given that we are dealing with natural biological processes**.

It is also vital to keep in mind that whereas GHGs are emitted during fertilizer production and application, **much greater GHG savings are made as a result of enhanced crop productivity through the use of fertilizers**:

In Sub-Saharan Africa (the region with the lowest fertilizer consumption in the world), a **20% increase of fertilizer use** could result in more than **2 million hectares of land spared**, and up to **13 million tons of carbon sequestered** compared to **0.4 million tons emitted**, as illustrated below:

Land spared with intensification

Scenario for fertilizer increase by 20% in high potential areas in SSA

Yields		Land spared	C emission	C sequestration
Maize	+ 10%	Land spared 2 Mil. ha	C emission 0.4 Mil. t C	C sequestration 13 Mil. t C
Rice	+ 5%			
Wheat	+ 11%			

Vlek et al, 2017

a. Reducing N_2O emissions with Nutrient Use Efficiency (NUE)

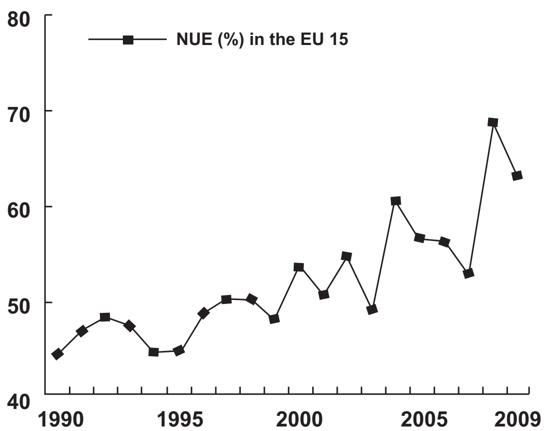
When mineral and organic fertilizers are applied, soil microbial activity causes some loss of the greenhouse gas Nitrous Oxide (N_20).

Practices that improve Nutrient Use Efficiency (NUE) and effectiveness can increase nutrient uptake by the plant and reduce losses to the environment. NUE is defined as the proportion of the mineral and/or organic nutrient source applied, that is taken up by the crop. For monitoring purposes, NUE is calculated as output/input ratio (the proportion of nutrients applied that end up in the harvested product).

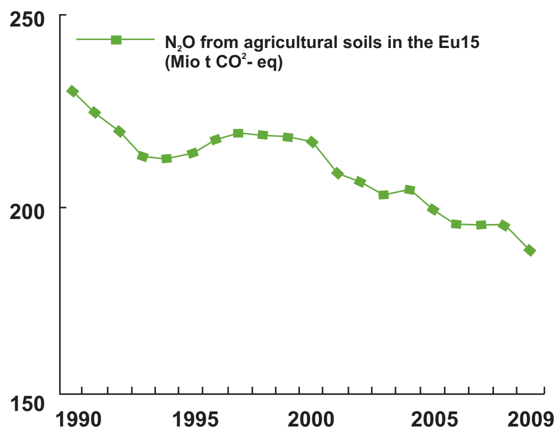
Best Management Practices in the 4 areas of nutrient management, including innovative, tailored products that the fertilizer industry is developing, clearly enhance NUE.

In Europe, NUE has increased significantly compared to 1990 levels while N_2O emissions from agricultural soils have dropped in a significant way (Yara, 2016):

In Europe (EU 15) NUE (Nitrogen Use Efficiency) has increased



... while N_2O emissions from agricultural soils have decreased



In the United States, corn production doubled between 1980 and 2010 using slightly fewer nutrients than were used in 1980: according to the USDA, farmers grew 6.64 billion bushels of corn using 3.2 pounds of nutrients per bushel; in 2010 they grew 12.45 billion bushels using 1.6 pounds of nutrients per bushel. (TFI, 2011).

b. Prevention of deforestation through sustainable intensification

Fertilizers can contribute to forestalling deforestation, as they allow for increased productivity on arable land. They help maintain the integrity of globe's forests, which are important carbon sinks. In the context of climate change, this is crucial, as deforestation and loss of peatlands, wetlands and grasslands combined represent about 10% of global GHG emissions, not to mention considerable damages to the ecosystem.

According to a research study by Burney et al. (2010), about **one billion of hectares of land had been preserved** from conversion to cropping between 1961 and 2005 because of advances in crop productivity, **leading to carbon emission savings of 317 to 590 Gt CO_2 -eq** from not converting that area. The authors also concluded that " although GHG emissions from the production and use of fertilizers have increased with agricultural intensification, those emissions are far outstripped by the emissions that would have been generated in converting additional forest and grassland to farmland."

c. Increased soil carbon sequestration

Soils constitute the largest terrestrial pool of carbon and can store up to 50-300 tons of carbon per hectare, which is equivalent to 180-1100 tons of CO_2 . According to the IPCC, **this represents 89% of agriculture's future mitigation potential**. Since soil carbon sequestration thus holds great promise for helping countries meet the targets set out in the Paris Agreement, IFA encourages the SBSTA and SBI to pursue how this potential can be best exploited, by providing guidance on agricultural best management practices and guidance on monitoring, measuring and verification.

Restoration of degraded soils through soil conservation practices and widespread adoption of fertilizer best management practices that include both organic and mineral nutrient management, **can reverse the historic losses of soil carbon worldwide and increase soil carbon sequestration**. Optimized fertilizer management leads to maximized biomass production, which maximizes carbon uptake by plants and increases soil carbon storage when non-harvested biomass (e.g. roots and stems) returns to the ground. Improved agricultural practices will lead to higher Soil Organic Matter (SOM), which improves not only soil health and productivity but results in more in more CO_2 sequestration.

High SOM levels can be achieved adopting Fertilizer Best Management Practices, which are part of an Integrated Farming system. This includes **Integrated Soil Fertility Management (ISFM)** which encompasses all dimensions of plant nutrient uptake as well as a selection of crop varieties and the biological and physical dimensions of soil health, combined with knowledge on how to adapt practices to local conditions.

Integrated Plant Nutrient Management (IPNM), a key component of IFSM, *entails starting with on-farm organic sources of nutrients and supplementing them with manufactured fertilizers to achieve the farmer's yield goal. The 4R Framework can be applied within IFSM, when selecting the Right Source of plant nutrients for the crop.*

The fertilizer industry recommends IPNM as a key climate change mitigation strategy as:

- ***It is an effective method for increasing soil carbon sequestration,*** which reduces GHGs released to the atmosphere: in Northwest China, a 7-year study comparing nine methods of fertilization on cultivated farmland found that organic manure combined with chemical fertilizer accumulated 2.01 tons of carbon per hectare per year in soils.
- ***It allows for the best use of organic and mineral nutrient sources, in a complementary way:*** organic fertilizers supply soil organic matter that improve soils' health and ability to retain water, and mineral fertilizers complement these with concentrated, consistent and readily-available nutrients to plants.
- The crop yield residues from mineral fertilizer-fed crops ensure that ***carbon-containing organic matter (present in straw, stems and roots) are either added or kept in the soil.***
- In addition to increasing soils' carbon sequestration potential, ***soil organic matter also improves the fertility, structure, water retention and biological activity of soils.***
- ***By making the best use of organic and mineral inputs, it is the best method to sustainably increase yields on available arable land:*** a meta-analysis of research in sub-Saharan Africa comparing the effects of organic fertilizers, mineral fertilizers and IPNM on maize, found that, on average, IPNM produced the highest yield responses at 114% over the control plot (i.e. a plot with no management serving as a baseline)
- By sustainably increasing yields on arable land, ***IPNM has the potential to prevent further deforestation.***

While calls for using only organic fertilizers are strong in certain parts of the world, most agronomists agree that the best approach for optimal plant growth is IPNM: organic fertilizers, though excellent in stimulating microbial activity and improving soil structure and water retention capacity, have low and variable nutrient content that changes over time.

- Using organic fertilizer alone makes it extremely difficult to consistently give plants the exact right amount of nutrients needed for their health and growth, which is why they should be complemented with mineral fertilizers, whose amounts can be precisely adjusted to meet the needs of specific areas within a field.
- Nutrients in organic fertilizers need to be mineralized in the soil before plants can take them up. As the mineralization rate changes according to soil moisture and temperature, nutrient release patterns may not match temporal crop requirements, increasing the chance of losses.
- Organic fertilizers produce GHG emissions: According to a modelling study done by Wageningen University, in some countries like The Netherlands where the efficiency of mineral fertilizers is high, GHG emissions in organic arable and vegetable farming are 0-15% and 35-40% higher than in conventional farming, respectively (Wageningen Journal of Life Science, 2014).

4. Incentives to farmers to implement Fertilizer Best Management Practices

An important challenge is to reach out to the world's 500 million farmers worldwide, especially smallholder farmers, and make them knowledgeable in site- and crop- specific plant nutrition.

Farmers around the world understandably pursue agricultural practices that enhance their yield and improve their livelihoods, and maintain soil health. "Invisible" benefits, such as reduced greenhouse gas emissions, should not come at the expense of yields and should ideally also be compensated, i.e. through government incentives, ecosystem service payment or carbon credits.

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