Submission from the CGIAR System Organization, the World Business Council for Sustainable Development (WBCSD), the French National Institute for Agricultural Research (INRA) and the World Bank, in response to Decision 4/CP.23.

These are views on

Improved nutrient use and manure management towards sustainable and resilient agricultural systems

Key Messages:

- Nutrients, especially nitrogen (N), phosphorus (P), and potassium (K), are essential building blocks of plant growth and livestock production. However, the efficiency of global nutrient-use through the addition of organic (e.g. manure) and synthetic fertilizers to soils is only about 50%, leading to considerable greenhouse gas emissions (mainly nitrous oxide - N_2O) and aquatic pollution, that can result in additional land use pressures due to fisheries and aquaculture production losses.
- Increasing the efficiency of nutrient use in food systems, through better application of fertiliser, improved manure management and recycling of nutrients in residues, by-products and wastes has the potential to balance the global fertilizer application budget and benefit low-input systems in becoming more productive and high-input systems in becoming less emissions intense. It can also provide important co-benefits for soil, air, and water quality, biodiversity, renewable energy generation, and soil carbon sequestration.
- A range of management practices to increase nutrient efficiency have demonstrated success on the ground, including improved efficiency of fertilization application and types, better adapted crops/seeds for nutrient uptake, use of low-emission fertilizers and fertilizer application techniques and increased used of organic fertilizers in place of synthetic. However, more work is needed on several fronts to enable these practices to be implemented at scale and fulfil the potential of nutrient management to contribute to high-yield, low-emission development pathways.
- Key areas in which action is needed: increasing public awareness, technical assistance, policies, and financial mechanisms to incentivize nutrient and manure management planning; redirection of public support to agriculture away from subsidies that incentivize overfertilization and disincentivise recycling; effective soil testing and farmer recommendations; enhancing the quality of data on nutrient and manure use and relevant farm conditions and management practices, especially for smallholders; and standardized Monitoring, Reporting, and Verification (MRV) approaches to measure and disseminate the multiple benefits of improved nutrient and manure management for both mitigation and resilient livelihood strategies.

Priority Actions for the Koronivia Joint Work on Agriculture:

- Provide countries with technical assistance to assess and raise ambition of targets related to nutrient use and manure management in Nationally Determined Contributions (NDCs) under the Paris Agreement.
- Call upon countries to redirect their public support to agriculture (approximately US$570 billion per year in 51 countries[1]) from distortionary subsidies that incentivize overfertilization to public good investments for improving nutrient use efficiency and balancing the global fertilizer application budget.
- Propose global standards for fertilizer production and application focused on closing productivity gaps, reducing emissions, and enhancing co-benefits (water, soil, air, energy, biodiversity). Develop MRV mechanisms (e.g. technologies, protocols, minimum data proxies) that can measure the multiple benefits of applying those standards.

Nutrients are essential for plant growth and livestock production. Sourced from synthetic (e.g. NPK-based) and organic (i.e. animal manure and crop residues) fertilizers, nutrients heavily determine global agricultural yields along with irrigation and climate. Improving crop and soil management practices, including through better nutrient management, is estimated to have the potential to increase production by up to 70% for most crops by closing world yield gaps to 100% of attainable yields.[2]

However, global nutrient-use efficiency is estimated to be only about 50%, resulting in significant greenhouse gas emissions (mainly nitrous oxide - N_2O).[3] It is estimated that improving nutrient use efficiency could mitigate 0.71 GtCO2e annually by 2030, representing 14.5% of the total agriculture and grassland contribution to efforts to hold warming below 2°C.[4] The use of nutrients (organic and synthetic fertilizers) is also linked to soil carbon sequestration, as increased yields and vegetative biomass can result in larger amounts of biomass and higher quality and quantity of annual carbon inputs (crop residues) to the soils.[5] Important practices also include the avoidance of burning residues and optimizing recycling of both residues and manure.

Furthermore, additional emissions can be reduced through improved fertilizer production technology, the replacement of synthetic fertilizers with organic (overall upstream emissions add about 35% to in-field emissions from synthetic fertilizer), and the generation of clean and renewable energy e.g. from anaerobic bio-digesters for livestock manure.[4,6] Improving nutrient use efficiency also provides co-benefits such as soil quality (maintaining soil fertility and enhancing soil carbon), air quality (reducing ammonia and nitric oxide emissions), water quality (reducing nitrification and eutrophication), and improving habitat for biodiversity (increasing fish species richness and abundance).[4]

Enhancing the efficiency of nutrient use can be accomplished through a range of existing approaches and technologies that have demonstrated success on the ground. These include improved fertilization timing, precision agriculture, incorporating leguminous crop and forage rotations, using different types of N-fertilizers (e.g. ammonium nitrate instead of urea), improved crops and forage varieties for more efficient nutrient use, and integrated manure management for nutrient recovery and replacement of synthetic sources.[4,6] The latter is especially important as animal protein consumption in human diets is likely to increase globally. However, several technical, institutional, and political economic factors still pose difficulties in assessing and improving yields while using nutrients efficiently.[1,6,7] This submission proposes a set of priority actions areas for consideration by KJWA to further the nutrient and manure management agenda:

Priority #1: Strengthening the role of nutrient inputs and manure management in NDCs

Given the significant potential for nutrient management improvement to contribute to global agriculture mitigation efforts, the role of enhanced nutrient use efficiency should be given greater priority in support to NDC development and refinement. On the one hand, about 80% of NDCs include actions on mitigation in agriculture and around 90% included the agriculture sector as a priority area for adaptation action. A preliminary analysis of NDCs indicates however that less than 25% of countries focused on mitigation commitments directly related to both fertilizer (43 countries) and manure management (46 countries). A number of additional countries have made commitments that relate more broadly to nutrient and manure management issues e.g. through commitments on livestock, cropland, and grassland management.[8]

Technical assistance is needed to support countries to define and/or raise the ambition of nutrient management targets in their NDCs, as well as to capture and disseminate the (co-)benefits of the improved nutrient use efficiency achieved. Country updates to NDCs will be important opportunities for providing this awareness raising and technical support.

KJWA could focus on:

- Encourage technical agencies to issue guidance on identifying opportunities for including nutrient management aspects into NDCs. This should include highlighting existing best practices examples. A key intervention that should be universally recommended is the prevention of soil erosion on all crop and grazing lands. Loss of soil via wind and water erosion results in the direct removal of nutrients, carbon, and soil microbiota that are essential for soil health and quality.[9]

- Propose the development of technical assistance to be used by NDC Partnership[10] in the support that it provides to members leverage their resources and expertise to help countries with the tools they need to implement their NDCs.

Priority #2: Targeting public and private support to balance the use of fertilizer in agricultural production

Existing technologies and approaches to improve nutrient use efficiency and manure management have demonstrated the opportunities for reducing imbalances in the local and global nutrient budgets, benefiting low-input systems by making them more productive and high-input systems less emission intense. While large gains can still be made through more widespread adoption of these existing technologies, numerous institutional, political, social, and economic factors have been shown to influence significantly the adoption of such new technologies and approaches by farmers.[7] Budget limitations and other political economy considerations have led many countries to introduce subsidies in the forms of price supports and transfers to producers; however, these have typically resulted in lower economic returns relative to public investment in agricultural research and development.[1] Moreover, certain particularly distortionary subsidies often result in significant negative impacts on the environment including excessive fertilizer use.[1] Lack of adequate training on climate change adaptation and mitigation, gender, level of education, access to information, and lack of trust in recommendations by agricultural extension agents constitute further barriers to adoption.[7] New soil testing coupled with rapid advances in Information and Communication Technology (ICT) can reach a larger number of farmers and provide more reliable recommendations for farmers (e.g. handheld soil scanners and targeted recommendations).

More work is needed to identify global hot spots for nutrient management (areas with particularly low productivity due to soil nutrient deficiencies and areas with significant emissions related to inefficient nutrient use) and realign public and private support to deliver public-good outcomes to promote nutrient use efficiency and avoid overfertilization in those areas[1,2,3]. Encouraging market subsidies and the private sector led input markets are important strategies to align polices to sustainable nutrients use.[11] A global and open access soil data repository (e.g. ISRIC[12]) with quality referenced soil data for all countries would also significantly improve soil nutrient and carbon management and conservation for both adaptation and mitigation goals. Research has also shown that tailoring regulations, incentives, and outreach to local conditions, administered and enforced by local entities, and supported by trust established among local stakeholders improves the success of efforts designed to increase fertilizer use efficiency.[7]

KJWA could focus on:

- Propose the development of a policy brief under the Technology Executive Committee (TEC)[13] on designing policy reforms to reduce distortions in subsidy programs including those that influence fertilizer use and to increase public support for agricultural public goods investments related to nutrient management (e.g. agricultural extension, skills development, research and development to promote organic fertilizer products and markets).

- Draft inputs to Green Climate Fund (GCF) strategy development to identify hot spots and leverage public and private investments toward improving nutrient management in hot spot areas.

Priority #3: Addressing bottlenecks in Monitoring, Reporting and Verification (MRV) for nutrient management

Positive correlations between the use of fertilizers and crop productivity make the amount of nutrients applied to soil a strong proxy indicator for evaluating nutrient use efficiency. However, research suggests a general trend of exponentially increasing emissions as fertilizer-N inputs increase and exceed crop needs.[14] Use of this knowledge in Monitoring, Reporting and Verification (MRV) systems should improve assessments of fertilizer-derived emissions and refine the accuracy of mitigation protocols. Challenges also persist for the setting of baselines to evaluate the additionality of targeting reductions in emissions associated with fertilizer application versus overall emission reductions, and without productivity depletion. Capturing data on field conditions, especially for smallholders, to validate global databases is a persistent challenge in the development of scalable nutrient advisory for farmers.[15]

A standardized, accurate approach to MRV for assessing nutrient use efficiency in the context of productivity and emission trade-offs would significantly enhance the ability to assess and improve nutrient management over time and to compare results across cases. Promising innovations in information technology, remote sensing, site-specific measurements, modelling, and blockchain technology could be combined to enable government, investors, farmers, and other stakeholders to invest in nutrient use efficiency improvements with increased certainty regarding the costs, benefits, and trade-offs of such improvements.

KJWA could focus on:

- Mobilize requests from countries for support under the Climate Technology Centre and Network (CTCN)[16] for (i) tools, methodologies, platforms training for MRV on nutrient management and (ii) global standards for fertilizer production and application.

References

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[10] The NDC Partnership works directly with national governments, international institutions, civil society, researchers, and the private sector to fast-track climate and development action.
[11] World Bank. 2016. Greenhouse gas mitigation opportunities in agricultural landscapes: a practitioner's guide to agricultural and land resources management. Agriculture Global Practice.
[12] ISRIC - World Soil Information. ISRIC Data Hub.
[13] The Technology Executive Committee (TEC) is the policy arm of the Technology Mechanism, which was established at COP16 in 2010 to enhance climate technology development and transfer to developing countries. It focuses on identifying policies that can accelerate the development and transfer of low-emission and climate resilient technologies.
[14] Shcherbak, I., Millar, N., Robertson, G.P. 2014. Global metaanalysis of the nonlinear response of soil nitrous oxide (N2O) emissions to fertilizer nitrogen. PNAS, 111, (25) 9199-9204.
[15] European Space Agency. Earth Observation for Sustainable Development (EO4SD) - Agriculture and Rural Development Cluster project.
[16] The Climate Technology Centre and Network (CTCN) provides technical assistance in response to requests submitted by developing countries via their nationally-selected focal points, or National Designated Entities (NDEs). Upon receipt of such requests, the Centre mobilizes its global Network of climate technology experts to design and deliver a customized solution tailored to local needs.