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**Online consultation for developing the Code of Conduct for the Management of Fertilizers**

**Collection of contributions received**

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# Topic note

Dear Stakeholders and Members,

We are tasked with a unique opportunity to mould the future of fertilizer use globally and are seeking inputs on the development of a Code of Conduct for the Management of Fertilizers (CoCoFe).
The creation of the CoCoFe is being proposed to promote the responsible and judicious use of fertilizers in the interest of the following objectives:

1. maintaining or increasing global food production;
2. maximizing the efficient use of plant nutrients to enhance sustainable agriculture;
3. minimizing the environmental impacts from the use of fertilizers including pollution by loss of nutrients via runoff, leaching, greenhouse gas emissions and other mechanisms;
4. minimizing environmental and human health impacts from pollutants such as heavy metals in fertilizers;
5. maintaining and increasing food safety.

The aim of the CoCoFe is to assist member countries design policies and regulatory frameworks for the sustainable use of fertilizers. The focus is more on discouraging fertilizer overuse whereas a second document, to be developed later, will address scenarios with low or no fertilizer use under the topic of integrated soil fertility management. The CoCoFe should assist policy makers at the regulatory and extension levels to outline the roles and responsibilities of the multiple stakeholders involved in various aspects of fertilizer management including governments, industry, universities, NGO’s, traders, farmers organizations, etc.

Note: The CoCoFe is not designed to provide specific recommendations on field applications of fertilizers, i.e. rates, placement, timing, etc., but rather broader recommendations on what should be considered when designing strategies to manage fertilizers sustainably.

Your input is necessary to allow the Intergovernmental Technical Panel on Soils (ITPS)1 to better frame the multifaceted needs of all stakeholders who would use the CoCoFe or be impacted by the use of the CoCoFe

This online consultation, through a series of questions, invites you to address the following:

* Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?
* How should be the CoCoFe be structured to have the maximum positive impact?
* Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?
* What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?
* Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?

Thank you very much for engaging in this critical process. We look forward to receiving your valued inputs to make these guidelines a reality.

**Eduardo Mansur**

**Director Land and Water Division, FAO**

**Facilitators**

Gary Pierzynski, Intergovernmental Technical Panel on Soils

Debra Turner, United Nations Food and Agriculture Organization (FAO)

Ronald Vargas, Global Soil Partnership Secretary

**Background and process**

The recently published Status of the World’s Soil Resources (SWSR)2 report identified ten major threats to our soils that need to be addressed if we are to achieve the Sustainable Development Goals. Therefore, urgent efforts are required to enable and engage with sustainable soil management (SSM) at all levels.

The Voluntary Guidelines for Sustainable Soil Management (VGSSM)3 produced by the Global Soil Partnership (GSP)4 is a first step to addressing these threats. Two of these are nutrient imbalances and soil pollution and that involve plant nutrient applications that can be excessive, insufficient, or polluting, none of which are sustainable. Chapter 3.3 - *Foster nutrient balances and cycles* and Chapter 3.5 - *Prevent and minimize soil contamination* of the VGSSM provide initial guidance on promoting sustainable nutrient use in relation to soils, agriculture and the environment, however further support is required to implement these recommendations.

The ITPS was tasked to develop the CoCoFe and this online consultation soliciting input on what should be included in a COCoFe is one of the early steps in the process. This input will be utilized to develop a zero-order draft that will be reviewed by ITPS, followed by further review of a first draft by a panel of experts representing all major partners and stakeholders. The process will then continue with the finalization of the CoCoFe and submission to the Global Soil Partnership Plenary Assembly, the Committee on Agriculture (COAG)5 and, if endorsed, to the FAO Council6.

Achieving SSM will generate large benefits for all, therefore, the availability of comprehensive guidelines on the use and management of fertilizers is of major importance.

**References**

1 ITPS - <http://www.fao.org/global-soil-partnership/intergovernmental-technical-panel-soils/en/>

2 SWSR - <http://www.fao.org/3/a-i5199e.pdf>

3 VGSSM - <http://www.fao.org/3/a-i6874e.pdf>

4 GSP - <http://www.fao.org/global-soil-partnership/en/>

5 COAG - <http://www.fao.org/coag/en/>

6 FAO Council - <http://www.fao.org/unfao/govbodies/gsbhome/council/en/>

# Contributions received

## Mulugeta Taye, Dadimos Development Consultants, Ethiopia

I think this is a timely issue in the world. However, the thinking sounds to follow the usual silo-based approach, which only focuses on agriculture. Fertilizers are affecting not only our agricultural system but also others sectors such as water and energy. At the same time water and energy uses are also affecting agriculture (including fertilizer use), positively and negatively. Therefore, I suggest FAO to consider water-energy-food-climate nexus in this fertilizer related analysis.

Mulugeta

## Amanullah, Department of Agronomy, The University of Agriculture Peshawar, Pakistan

**Amanullah, M. Asif and L.K. Almas. 2012. Agronomic efficiency and profitability of P-fertilizers applied at different planting densities of maize in Northwest Pakistan. Journal of Plant Nutrition. 35: 331-341.**

The use of appropriate source of phosphorus (P) fertilizer at different planting densities has
considerable impact on growth, grain yield as well as profitability of maize (Zea mays L). Field
experiment was conducted in order to investigate the impact of P sources [(S0 = P not applied, S1 =SSP (single super phosphate) S2 = NP (nitrophos), and S3 = DAP (diammonium phosphate)] on
maize growth analysis, yield and economic returns planted at different planting densities (D1 =
40,000, D2 = 60,000, D3 = 80,000, and D4 = 100,000 plants ha−1) at the New Developmental
Agricultural Research Farm of Khyber Pakhtunkhwa Agricultural University, Peshawar, Pakistan,
during summer 2006. This paper reports the profitability data with two objectives: 1) to compare
agronomic efficiency and profitability of P-fertilizers, and 2) to know whether plant densities affect
agronomic efficiency and profitability of P-fertilizers. Application of DAP and SSP resulted in higher
partial factor productivity (PFP) (63.58 and 61.92 kg grains kg−1 P), agronomic efficiency (AE)
(13.01 and 13.71 kg grains kg−1 P) and net returns (NR) (Rs. 16,289 and 16,204 ha−1), respectively,
while NP stood at the bottom in the ranking with lower PFP (57.16 kg grains kg−1 P),
AE (8.94 kg grains kg−1 P) and NR (Rs. 4,472 ha−1). Among the plant densities, D3 stood first
with maximum PFP (69.60 kg grains kg−1 P), AE (18.21 kg grains kg−1 P) and NR (Rs. 21,461
ha−1) as compared to other plant densities. In conclusion, the findings suggest that growing maize
at D3 applied with either SSP or DAP is more profitable in the wheat-maize cropping system in the
study area.

**Nitrogen Rates and Sources Affect Yield and Profitability of Maize in Pakistan**

Nitrogen is one of the most important factors affecting maize yield and profitability. To investigate the impact of N fertilizer sources (urea, calcium ammonium nitrate [CAN] and ammonium sulfate [AS]) applied in various amounts (0, 50, 100, 150, and 200 kg N ha-1) on grain yield and profitability of maize genotypes, local cultivars (Azam and Jalal) versus hybrid (Pioneer-3025) field experiments
were done during summer 2008–09 (Year 1) and 2009–10 (Year 2). The N yielded 41 and 26% more grain than the check in Year 1 and Year 2, respectively. In both years, grain yield increased in response to the increase in N application. Application of CAN and AS resulted in more grain yield than urea in Year 1, while no differences in yield were observed in Year 2. The hybrid (P-3025) yielded 30 and 24% more grain than the average of local cultivars in Years 1 and 2, respectively. In Year 1, the net returns (NR) of PKR16262 ha-1 (one US$ = 95 Pakistani Rupees) was obtained with CAN but value cost ratio (VCR) of 3.7 was noticed with urea; in Year 2, both NR (PKR14271 ha-1) and VCR (3.1) was greatest with urea. In both years, the greatest NR was obtained with 100 and 150 kg N ha-1. Application of urea at 150 and 200 kg N ha-1, CAN at 100 and 150 kg N ha-1, and AS at 50 and 100 kg N ha-1 was economical in terms of NR in both years.

**Influence of Organic and Inorganic Nitrogen on Grain Yield and Yield Components of Hybrid Rice in Northwestern Pakistan**

Field experiments were conducted to assess the impact of various organic sources, inorganic
nitrogen (N) and the different combinations of inorganic N (urea) + organic source on the yield
components (YC) and grain yield (GY) of hybrid rice (Oryza sativa L., Pukhraj) under rice-wheat system. The experiments were conducted at Batkhela (Malakand), Northwestern Pakistan, in 2011 and 2012. Our results revealed that YC and GY ranked first for the hybrid rice when applied with sole inorganic N (urea), followed by the application of N in mixture (urea + organic sources), while the control plots (no N applied) ranked in the bottom. Among the six organic sources (three animal manures: poultry, sheep and cattle; three crop residues: onion, berseem and wheat), application of N in the form of poultry manure was superior in terms of higher YC and GY. When applying 120 kg/hm2 N source, 75% N from urea + 25% N from organic source resulted in higher YC and GY in 2011, while applying 50% N from urea + 50% N from organic sources caused higher YC and GY in 2012. Therefore, the combined application of N sources in the form of urea + organic source can produce good performances in terms of higher YC and GY of rice under rice-wheat cropping system.

Attachments:

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/22-P-Source%20Profitability-JPN-2012.pdf>

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/14-Economics-N%20source_0.pdf>

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/52-Hidayat%20GY%20and%20YC-Rice%20Science-2016_0.pdf>

## Dick Tinsley, Colorado State University, United States of America

As I review the previous 4 comments listed below, I am not sure where this forum is leading. When I think of code of conduct for fertilizer I focus mostly on the administrative side, of quality control and access. In that regard my concern is on what host governments can afford with their highly limited budget and make certain whatever regulations can be financially enforced and minimizing any opportunity for "informal income" opportunities by civil officers. My concern is based on most host governments being financially stalled, with poorly paid civil officers and virtually no operating funds. The result could be testing of fertilizer quality being mostly on the honor/gratuity system and access to limited supply of fertilizer requiring some informal payments to gain access. Please review the following webpages:

<http://smallholderagriculture.agsci.colostate.edu/financially-suppressed-economy-2/>

<http://smallholderagriculture.agsci.colostate.edu/financially-stalled-governments/>

<http://smallholderagriculture.agsci.colostate.edu/impact-of-financially-stalled-government-limited-variety-improvement-seed-certification/>

## Talal Darwish, National Center for Remote Sensing – CNRS, Lebanon

1. Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?

The objectives are appropriate. But I believe beside policy makers and regulations we should also include and address farmers as fertilizer users to provide capacity building.

2. How should be the CoCoFe be structured to have the maximum positive impact?

It should include the food security issues, public health problems; environment related aspects of nutrient buildup, leaching, migration with erosion-sedimentation, ground water pollution, **fertilizer quality and byproducts**. It can also include the integrated soil fertility and productivity assessment and management with the **concept of balanced state of nutrient in relation to soil and water pools, health hazards, environmental and economic aspects of fertilizer application.**

3. Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?

Address also farmers, associations and cooperatives of farmers, **consumers notably gender,** **students** at all levels (with simplified stories for children and more complicated booklets or leaflets for middle and high schools). Even the university disciplines not related to soil and irrigation/plant production must go through curricula related to food security/fertilizer application interaction and interface with special attention to public health and environmental protection.

4. What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?

Yes in the view of **balanced plant nutrition,** all these aspects should be included plus the physical ameliorators of water content in the soil as fertilizers and salts might also concentrate in these "polymers" at the depth of their application and create **salinity**problems.

5. Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?

To promote responsible and judicious use of fertilizers, CoCOFe must be presented in friendly and simple way, accessible to decision makers, farmers, housekeepers with possibility of controling **food quality and tracing back**. I suggest to encourage MS to carry the assessment and mapping of**soil fertility, soil and water quality, landuse planning based on land quality and suitability to promote multifunctional landuse only on soils with low background values of heavy metals and absence of pesticide residues and high concentration of nitrates and nitrites.**

## Amanullah, Department of Agronomy, The University of Agriculture, Peshawar, Pakistan (second contribution)

On phosphatic fertilizers P2O5 is written on bags but the recommendations for growers is in the for of P not P2O5. The fertilizers industries just deceived the uneducated farmers in developing countries. I mean if the fertilizers industries write P on the bags insteadof P2O5 the amount percent on bags will decrease and the growers will know the actual amount of P. Likewise the problem of K2O on bags deceived farmers for K required in the form of MOP and SOP.

MY CONCERN IS ALSO ABOUT AMMONIUM SULPHATE AND CAN HAVING LESS NITROGEN. BUT THE PRICE OF AMMONIUM SULHATE AND CAN IS HIGHER THAN UREA IS NOT JUSTICE WITH THE GROWERS. IN PAKISTAN THE GOVERNMENT FERTILIZERS INDUSTRY PRICE WAS 50% LESS THAN THE PRIVATE INDUSTRY FERTILIZERS. PRIVITAZATION OF FERTILIZERS INDUSTRY FURTHER INCREASED THE COST OF PRODUCTION AND NEGATIELY AFFECTED YIELD DUE TO HIGHER FERTILIZERS COST. ADULTEATION OF FERTIZERS IS ALSO A BIG PROBLEM. THE GOVERNMENT RESPONSIBILITY IS TO CHECK THE FERTILIZERS AND HELP THE GROWERS. SOME OF THE BIG PEOPLE MIX DIFFERENT LOW QUALITY FERTILIZERS AND MAKE THEIR OWN NPK FERTILIZERS OF LOW QUALITY. IN NORTHWEST PAKISTAN THE TOBACCO INDUSTRY GIVE K FERTILIZERS AT HIGHER PRICE TO THE GROWES OTHERWISE THEY WILL NOT BUY THE TOBACCO FROM GROWERS.

THANKS

AMANULLAH AGRONOMIST PHD

## Andrew Isingoma, Rwanda Agriculture Board, Rwanda

Dear Global scientists, I request to present the:

POSSIBLE SOLUTIONS TO THE QUESTIONS RELATING TO THE DEVELOPING THE CODE OF CONDUCT FOR THE MANAGEMENT OF FERTILIZERS, On the attachment below.

Attachment:

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/Andrew_suggested_points_FAO_cocofer_no147.docx>

## Dick Tinsley, Colorado State University, United States of America (second contribution)

After reviewing Andrew's comments I have to put in a note of concern regarding the emphasis on Organic Fertilizer. There are 2 main concerns one is the volume of organic material available to make organic fertilizer relative to the potential demand. I fear you can only meet a very small fraction of total need through organic material. The second concern is the labor required to collect process and redistribute organic fertilizers, the caloric energy this will require, and will that energy be recovered by the higher yields. I seriously doubt it. Please review the following webpages including links to other pages:

<http://smallholderagriculture.agsci.colostate.edu/organic-source-of-nutrients-some-simple-computations-please/>

<http://smallholderagriculture.agsci.colostate.edu/calorie-energy-balance-risk-averse-or-hunger-exhasution/>

Thank you,

Dick

## Hamadoun A. Haidara, AADECOM, Mali

**Original contribution in French**

La gestion des engrais doit être confiée à un comité national et local. Le comité national doit comprendre au moins sept personnes :

* 1 représentant du ministère de l'agriculture,
* 1 représentant du ministère de la santé,
* 1 représentant du ministère du commerce,
* 1 représentant des paysans,
* 1 représentant des ONG nationales,
* 1 représentant des femmes,
* 1 représentant des jeunes.

Le comité local doit comprendre 5 membres :

* 1 représentant des services agricoles,
* 1 représentant des paysans,
* 1 représentant des jeunes,
* 1 représentant des ONG locales,
* 1 représentante des femmes.

Un calendrier de gestion doit être confiée aux comités installés qui ne doivent inscrire leur travail que dans un cadre commun et participatif.

**English translation**

Fertilizer management should be entrusted to a national and local committee. The National Committee must have a minimum of seven members:

* 1 representative of the Ministry of Agriculture,
* 1 representative from the Ministry of Health,
* 1 representative of the Ministry of Commerce,
* 1 representative of peasants,
* 1 representative of national NGOs,
* 1 representative of women,
* 1 youth representative.

The work place committee must have 5 members:

* 1 representing agricultural services,
* 1 representative of peasants,
* 1 youth representative,
* 1 representative of local NGOs,
* 1 women's representative.

A management calendar should be entrusted to the established committees, which should only work within a common and participatory framework.

## Yesuf Mohammed, University of Montana, United States of America

Hello,

I have the following opinion as far as CoCoFe is concerned.

*This online consultation, through a series of questions, invites you to address the following: · Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?*

The objectives are appropriate. These objectives may not relevant for all participating countries. So, country by country prioritization of the objectives is important.

*How should be the CoCoFe be structured to have the maximum positive impact?*

Learning from other countries strength/weakness and incorporate the impacts to convince officials will have sustainable impact by advising the agricultural departments or ministries or national agricultural research system in a country.

*Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?*

There could conflict of interest bringing different stakeholders in this kind of structure. The member should be neutral public organizations funded by the public and responsible for the whole society. Researchers including extension and policy makers might be enough as member of the CoCoFe.

*What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?*

Nutrient sources should be based on country by country case. Nutrient recycling should be encouraged first if available. Energy source is required to use compost and biosolids. The use of inhibitors needs more research since their effectiveness depends on several factors.

*Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?*

I believe it can contribute for judicious use of fertilizers through research and extension. Availing credit and determining minimum price for crop yields particularly in developing countries will help for better use of fertilizer that can contribute to feed the world and enhance carbon sequestration. There is experience when farmers grow same crop and produce more yield per ha but at the end of the day the price of the produce was not able to cover the cost. This can discourage use of inputs and starvation on the next season. There should be something in this line how farmers can get profit and cover their cost to encourage them to use inputs sustainably.

Thank you letting me participate in an effort to feed the people and to protect the environment.

Yesuf

## Pradip Dey, ICAR-AICRIP (STCR), Indian Institute of Soil Science, Bhopal, India

Dear All,

Good day!

Management of Potassium (K) bearing fertilisers requires to consider the following approach:

Balancing external application of potassium (K) fertilizers and utilization of soil reserve K is an important aspect of plant K-nutrition as rapid depletion of soil reserve K has negative consequences on soil quality and crop productivity. The critical limit of exchangeable K varies for soil to soil and crop to crop although K-rating limits are irrespective of crops or soils. Moreover, supply of soil K to plants is a complex phenomenon involving dynamic equilibrium among its various chemical forms. The K response in vertisols is often anomalous. These limits in Vertisols are not only higher but differ considerably from crop to crop and location to location. It was found the range of critical limit as 451-799 kg/ha, the lowest being for oilseed crops and highest for vegetable crops. The critical limits obtained from LTFE experiments is at around 315 kg K/ha for some Vertisols. The higher critical limits from soil test crop response experiments are because of the higher yield targets taken in calculating the critical limits. Such higher yield targets are seldom obtained in LTFE trials. Also, there is a difference in the way the calculations are made. The critical limit for rice is 553 kg/ha (range 250-796 kg/ha). There is ample opportunity to increase rice yield in Vertisols if K fertilization is done based on soil test. Experiments done under AICRP (STCR) have shown that the fertilizer K requirement is 34 kg K2O/ha at a soil test value of 350 kg/ha for achieving the yield target of 50-60 q/ha for rice, and this requirement changes to 26 kg, and 19 kg if the soil test values are 400, and 450 kg/ha, respectively. Wheat requires almost similar K fertilization as rice. The K fertilizer requirement for maize crop is much less though. It is only 16 kg K2O/ha at a soil test value of 400 kg/ha and 11 kg K2O/ha at a soil test value of 350 kg/ha. The recommendations for cotton is 38 kg K2O/ha. The K requirement is very high in Maharashtra, and almost nil in Karnataka. Such results are difficult to interpret only on the basis of exchangeable K. Vertisols have also been categorized on the basis of non-exchangeable K content.

With warm regards,

Pradip Dey

## Andrew Isingoma, Rwanda Agriculture Board, Rwanda (second contribution)

***I have reviewed presentations of the following scientists, while giving my views/ideas to them on some selected points  thanks:***

* **Pradip DeyICAR-AICRP (STCR),** Indian Institute of Soil Science, BhopalIndia ''The critical limit of exchangeable K varies for soil to soil and crop to crop although K-rating limits are irrespective of crops or soils. Moreover, supply of soil K to plants is a complex phenomenon involving dynamic equilibrium among its various chemical forms''.
* **Andrew comment:**This means that for adequate usage of k supply, one must consider variations in soil because different agro-ecological zones have different soils. therefore; CocoFer have to consider country different way of fertilizer handling.

From the attachment of the document presented by:

* **Dick Tinsley** **Colorado State UniversityUnited States of America**, the first paragraph says that:  ''One of the aspects in promoting more sustainable agriculture for smallholders in developing countries is to promote enhanced nutrient cycling by relying on organic sources of plant nutrients''. the papers goes on to explain the inconveniencies and strong disadvantages of using organic fertilizers, and bulky solid plant materials in banana plantation illustrating misuse and heaviness of using organic fertilizer.
* **Andrew comment: i** strongly agree with the consern and inconveniencies presented by **Dick** **T.** USA; in the two attached documents; it caused me to have a look on advantages and disadantages of using organic and chemical fertilizers, and i learned that one must consider both sides (advantage and disadvantage), not just biasing on one fact.  Also there must be extention agronomists advising farmers the plactice of using fertilizers (chemical or organic fertil).
* **Dick Tinsley** ''My concern is based on most host governments being financially stalled, with poorly paid civil officers and virtually no operating funds. The result could be testing of fertilizer quality being mostly on the honor/graduity system and access to limited supply of fertilizer requiring some informal payments to gain access''.
* **Andrew comment:**i gree, with this consern and advise that the cocofer must consider financial aspects of most countries especially developing countries, this means that; before implementing cocofer into action; survies research must be done from selected countries conserning country ideas on how fertilizers (organic and chemical) are being used, aswell  farmers accessibility.
* I request to have a look on the concern presented by **Dr. Amanullah** Department of Agronomy, The University of Agriculture PeshawarPakistan ''On phosphatic fertilizers P2O5 is written on bags but the recommendations for growers is in the for of P not P2O5. The fertilizers industries just deceived the uneducated farmers in developing countries. I mean if the fertilizers industries write P on the bags insteadof P2O5 the amount percent on bags will decrease and the growers will know the actual amount of P. Likewise the problem of K2O on bags deceived farmers for K required in the form of MOP and SOP''.
* **Andrew comment:** This concern is very genuine; and it implies that labeling and the content is different, the needed element is very little being engulfed in un needed materials, which cause farmers to pay alot of money un necessarily, we can say; the cocofer must consider farmers losses and fartilizer manufacturers, giving fertilizer standadizations and genuine content inside ''matiere ajuva".
* **Talal Darwish** **National Center for Remote Sensing-CNRS Lebanon;** To promote responsible and judicious use of fertilizers, CoCOFe must be presented in friendly and simple way, accessible to decision makers, farmers, housekeepers with possibility of controling food quality and tracing back. **I suggest to encourage MS to carry the assessment and mapping of soil fertility, soil and water quality, landuse planning based on land quality and suitability to promote multifunctional landuse only on soils with low background values of heavy metals and absence of pesticide residues and high concentration of nitrates and nitrites.**
* **Andrew comment:**i have realised that most suggestions from different people, have some points in common about fertilizer amendiments, from the above point, i suggest cocofer managers must prepare survey and carry out soil assessment atlist few countries from every continent grobaly.
* **Dr. Amanullah Department of Agronomy, The University of Agriculture PeshawarPakistan** ''When applying 120 kg/hm2 N source, 75% N from urea + 25% N from organic source resulted in higher YC and GY in 2011, while applying 50% N from urea + 50% N from organic sources caused higher YC and GY in 2012. Therefore, the combined application of N sources in the form of urea + organic source can produce good performances in terms of higher YC and GY of rice under rice-wheat cropping system''.
* **Andrew comment:**do you know that i did this experiment in 2012; and i fount that mixing organic and chemical fertilizers (NPK),  do better in maize field than sole chemical fertilizer (NPK), the higher grain yield were obtained in fertilizer mixtures than the sole application.This is simply because the dissociation of sole chemical fertilizer were direct and can be finished from the soil by weeds and crops together, but the dissociation of organic fert. is progressive, this means that though it is on small amount, it is keept present in the soil, the progressiveness of organic fertilizer keeps availability of required nutrients at a prolonged period than chemical fertilizer only.
* **CONSIDER THE FOLLOWING**
* I dont mean that organic fertilizer can replace chemical fertilizer, but i mean that the fore can be the assistant of the latter once the latter is absent or once farmers have no accessiblity.
* In developing countries we dont need a lot of machinery to recycle plant remains to make organic fertilizer, farmers make organic in simple and local way and it help them
* farmers only need local agronomists (abafashamyumvire) and help them to recycle the plant remains, most farmers are not able to buy chemical, and they use organic, here we dont mean that organic fertilizer replace chemical fertilizer.
* Farmers not need lorries and other machines to trasport organic, they trasport by themselves, please the cocofer must not base only on the big farming systems/ modernity/machinery, or big plantations, also consider small subsistance farming systems.

**I request to view this Papers: very important**

**1.THE COMBINED USE OF CHEMICAL AND ORGANIC FERTILIZERS AND/OR BIOFERTILIZER FOR CROP GROWTH AND SOIL FERTILITY**
   Jen-Hshuan Chen Department of Soil and Environmental Sciences, National Chung Hsing University 250 Kuo-Kuang Road, Taichung. Taiwan ROC.

**2. Soil ferility and organic fertilizers in organic farming**
**Ivan Manolov 1**(Agricultural University, Plovdiv),
Ardian Maci 2 (Agricultural University of Tirana)

**3. 52-Hidayat GY and YC-Rice Science-2016.pdf**

Attachment:

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/289_Organic-fertilizers-Eng.HUNGARY%5B1%5D.pdf>

## Porfirio Fuentes, International Fertilizer Development Center (IFDC), United States of America

Please see my contribution to the CoCoFe consultation below, in the forms of response to the quesions posted on the original note above.

Thanks.

**Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?**

In order to make a better judgment on whether the proposed objectives are appropriate, it is necessary to have a clarity on what the ***goal*** of the CoCoFe is. ***A goal can be defined as a broad, general, tangible, and descriptive statement.***

With this definition in mind, I can presume that the CoCoFe goal, is *“to promote the responsible and judicious use of fertilizers”*. If this is the goal of CoCoFe, it seems to be narrowly focused on the use (demand side) of fertilizer, while the stated objectives, specially 3 and 4, related to environmental and health impact, have also mining, production and processing implications; also, 4 is directly related to fertilizer production and beneficiation. The CoCoFe “goal” as stated, with the *“aim of assisting member countries design policies and regulatory frameworks for the sustainable use of fertilizers”*, would place the regulatory burden on the use (demand side) of fertilizer while neglecting the negative externalities resulting from mining, production and other activities along the supply and value chain, reflected on environmental contamination and negative impact on human health.

Consequently, I suggest to make a small change to the CoCoFe goal to be stated as:  “*to promote the responsible and judicious****supply****and use of fertilizers”* where supply embraces the activities of [domestic] production (including mining), processing, blending and all other value added activities along the supply chain; and, demand would include the needs of fertilizer or nutrient sources as feedstock at each stage of the value chain, perhaps emphasizing on the last stage of the supply-demand chains: the agricultural producer/farmer as final user of fertilizer.

**Based on the proposed CoCoFe goal of “promoting the responsible and judicious supply and use of fertilizers”, the underlying objectives could be:**

1. maintaining a sustainable and environmentally friendly [domestic] fertilizer industry to supply increasing needs of global agriculture to produce more and safe food;
2. Increasing the efficient beneficiation of fertilizer nutrient sources (i.e., phosphate rock, potash(?)) and improve production processes to reduce the negative environmental externalities and improve the quality of fertilizer products;
3. maximizing the efficient use of nutrients fertilizer to enhance sustainable agriculture production;
4. minimizing the effect of nutrients losses via volatilization to the atmosphere (greenhouse gas emissions), runoff and leaching into surface water streams and underground waters, with negative human health and environmental consequences;
5. minimizing the human health hazard related to pollutants and heavy metals in fertilizers, to improve food safety;

Alternatively, these objectives could be narrowed down to 3, as follows:

1. Maintaining a sustainable and environmentally friendly [domestic] fertilizer industry to supply the increasing needs of global agriculture to produce more and safe food.
2. maximizing the efficient beneficiation of fertilizer nutrient sources (phosphoric rock and potash(?)) and improve production processes while minimizing the negative externalities related to environmental contamination and eliminating pollutants such as heavy metals to improve fertilizers quality;
3. maximizing the efficient use of nutrients fertilizer to enhance sustainable agriculture production while  minimizing nutrients losses via volatilization to the atmosphere (greenhouse gas emissions), runoff and leaching into surface water streams and underground waters with negative human health and environmental consequences;

**How should be the CoCoFe be structured to have the maximum positive impact?**

CoCoFe should be structure in strata according to the different stages of production, supply and demand of fertilizer. Although this stratification can vary from country to country, it is possible to identify a generic supply-demand chain, from production to consumption, which would be applicable to almost any country. The stratification would resemble a cone, starting with general to specifics codes, where the codes of the top strata in the “cone” are applicable to the stratum below. Depending on how a country supply-demand chain is structured, the CoCoFe could start being applied at any strata below the top on the “cone”.

For example, the first stratum of CoCoFe could focus on the production of fertilizer, applicable to those countries with endowed resources to produce fertilizer (natural gas for producing nitrogen based fertilizer, phosphate rock and potash mines). Another stratum could be elaborated to be applicable to the transformation/processing fertilizer industry including blending. Successive strata can be importers, blenders, wholesalers, retailers and consumer or farmers.

On the same talking, for the current consultation to *“better mold the future of fertilizer use globally”*, must also include the different strata, perhaps in a simultaneous but separate consultation to make the CoCoFe more relevant and effective, otherwise it run the risk of facing resistance at the moment of adoption and implementation at one of more stratum.

**Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

In addition to the players in the different stratum mentioned above, it is important to include government officials, specially technocrats and perhaps academicians and the scientific community, specifically those that are working or have worked and relate directly to the players in the different stratum and along the supply and demand sides of the fertilizer market.

**What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

I believe the scope of the CoCoFe should be inorganic nutrient sources/fertilizer since given their physical and chemical characteristics, facilitate standardization and regulation, as compared to inorganic nutrient sources.

Considering the multi-sources of organic nutrients and the erratic nutrient content, depending on the organic sources, it makes it difficult to standardize organic materials as source of nutrients, and therefore regulate it. Organic material should be seen first and foremost, as soil amendment to improve the soil structure to increase microbial activity, water retention and cationic exchange, which facilitate the absorption of nutrients by the plant root; and secondary, perhaps as a not too important source of nutrients supply to the soil and the plants. Nutrient content of inorganic material can be considered a positive externality; therefore, supplementary to inorganic sources, not as the main source of nutrients. This topic of organic nutrient sources has been widely discussed by others in this forum during the past few days.

Perhaps organic nutrient sources will required other “CoCoOrgFe” in the future as the industry matures.

With respect to the use of bio-stimulants, nitrification inhibitors, urease inhibitors, etc., I believe they should be part of the discussion and the CoCoFe, since they can help improve nutrient use efficient and help achieve the stated environmental and perhaps the human hazards objectives.

**Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?**

Yes, CoCoFe has the potential to promote the responsible and judicious use of fertilizers, but only if the right audience, as discussed before, are brought into the discussion and plenty of time is spent in socializing the CoCoFe among the different stakeholders, which make take different rounds of discussions at different levels and years before the CoCofe comes to fruition and starts being implemented.

**Additional comments:**

1. The noted statement *“The CoCoFe is not designed to provide specific recommendations on field applications of fertilizers, i.e. rates, placement, timing, etc…”* is not congruent with the statement *“The*[CoCoFe] *focus is more on discouraging fertilizer overuse”*and with some of the stated objectives, especially 2, 3 and 4; the ones related to maximizing efficiency of nutrient fertilizer use and minimizing environmental contamination and the negative effeect on human health. All these are directly related to the 4R of nutrient stewardship, with direct implication to the application of fertilizer by farmers. Therefore it is suggested to revise the objectives or the noted statement should be eliminated or modified to make it clearer.
2. Although we can presume the audience of CoCoFe has a good technical knowledge and background on fertilizer, it is important to start a discussion of "terms and definitions” to be included in the CoCoFe. For example what is considered organic fertilizer and inorganic fertilizer? What are bio-stimulants? Etc.
3. It is important to beware that the regulatory burden from the adoption of CoCoFe, has the potential to impact on the cost of supplying and using fertilizer. This has higher implications for developing countries such as in SSA, considering that in these countries fertilizer production is almost non-existent and its use is low to negligible due to its high transaction costs along the international and domestic supply chains. Therefore, hindering or countering the efforts of international organizations and governments programs aimed at reducing the cost of fertilizer at retail.

## Ronald Vargas Rojas, co-facilitator of the consultation

Dear Participants,

I would like to thank each and every one of you for participating and providing your opinion and feedback on the development of a Code of Conduct for the Management of Fertilizers (CoCoFe). We are taking all of your comments into consideration.

In order to have a better idea of what this code of conduct would be like, please take a look at this link where the same concept is applied to pesticide management:http://www.fao.org/fileadmin/templates/agphome/documents/Pests\_Pesticides/Code/Code\_ENG\_2017updated.pdf

While the two documents will evidently be different due to the nature of the products discussed, does this change some of your responses? Mr. Mulugeta also brought up an important point that should be discussed: What terms and definitions should be included in the CoCoFe?

I have also answered some comments below and would love to hear back from you, keep the discussion going!

Dear **Mr. Mulugeta**,
The Code of Conduct for Fertilizer Management will provide a framework aimed to guide government regulators, the private sector, civil society and other stakeholders on best practice in managing fertilizers. We believe that this code of conduct will have a beneficial impact on the agricultural sector, but will also have economic and environmental benefits. We therefore hope that through the effective implementation of this code of conduct, we can achieve significant reduction in risks associated with fertilizer use on the environment (which would tackle the points that you mentioned above). I hope that this helps clarify the situation.

Dear **Mr. Tinsley**,
Thank you for your response, and yes you are right about the code of conduct focusing mostly on the administrative side. The code of conduct will provide a framework that will guide government regulators, the private sector, civil society and other stakeholders on best practice in managing fertilizers.
I would also like to thank you for the links you shared about the income differences between developed and developing countries, and how these differences can have an impact on the business environment and the tax base for supporting public agricultural services. Your concerns are valid and will be taken into consideration.

Dear **Mr. Darwish**,
Thank you for your input. The Code of Conduct for Fertilizer Management will provide a framework aimed to guide government regulators, the private sector, civil society and other stakeholders on best practice in managing fertilizers. While getting input from farmers would be greatly beneficial, they are not the target audience for this document. There will be second planned document that will cover the other concerns.

Dear **Mr. Isingoma**,
Thank you for your input, and for your comment about combining objectives 1 and 5. We will be considering your comment. Just to clarify, objective one refers to increasing crop productivity, which in turn would increase global food production. The fifth objective refers to the availability of safe food of expected quality in the markets.
As mentioned before, the scope of this code of conduct does not permit us to include farmers as the target audience. As Mr. Tinsley mentioned, a code of conduct generally provides us with a framework that would involve the administrative side of fertilizer usage.
Thank you for the rest of your contribution and for pointing out the importance of organic fertilizer in SSA. While utilizing available resources such as organic fertilizers is encouraged and important if proper management practices are used, it is also important to meet the needs of the crops being grown as Mr. Tinsley mentioned.

Dear **Mr. Mohammed**,
Thank you for participating in this forum. You mentioned that the objectives might not be relevant for all participating countries. Is there a specific example that you can think of that might need a different set of objectives?
While this code of conduct might be very general, it is a first step that provides a framework to help in managing and using fertilizers. It would not be country specific. With this information in mind, which nutrient input sources do you think should be included?

Dear **Mr. Fuentes**,
Thank you very much for your very insightful comments. You mention that the supply side of fertilizers should also be included in the code of conduct, and while we agree on the importance of the matter, we believe that splitting the two issues would be more appropriate. If you look at The International Code of Conduct on Pesticide Management linked above, you might get a better idea of what this code of conduct would look like and the kind of information that would be included. With that in mind, do you have any other suggestions?

## Esperanza Cerón Villaquirán, Educar Consumidores, Colombia

Educar Consumidores suggests that you specify the objectives in the following way:
1. Direct all efforts of CoCoFe to guarantee the food health of the population.
2. Maintain or increase world food production; including an effective campaign against waste.
3. Promote and strengthen organic agriculture both at the level of the peasant family, and sustainable urban agriculture.
4. Maximize the efficient use of plant nutrients to improve sustainable agriculture, encouraging organic agriculture
5. Minimize the environmental and human health impacts of contaminants such as heavy metals contained in fertilizers;
6. Increase food safety that fully guarantees food health, which is not reduced to biological contamination but of all kinds of toxic pollutants of agro-industrial origin

The best audience is the consumers in general, the farmers, the women who in general make the decisions of food consumption, the chefs, the health professionals who work in nutrition. Educating final consumers is an essential task for CoCoFe to fulfill its mission.

CoCoFe must include all synthetic fertilizers, biostimulants, pesticides, all inhibitors, attractants, repellents, physiological regulators, defoliants, fungicides, herbicides, genetically modified products, and in general products that have less than 30 years of proven safety study for human and environmental health in the short, medium and long term. All the mentioned products affect the fertilization and environmental health of the soil, which is why they must be taken into account.

CoCoFe should promote the use of fertilizers that guarantee through rigorous studies and controlled by external laboratories and with civil society surveillance, which do not affect human or environmental health in any way. IT MUST BE DECLARED FREE OF CONFLICTS OF INTEREST AND SHOULD NOT BE KEPT INDEPENDENT OF THE INDUSTRY.

## Davide Ciceri, Massachusetts Institute of Technology, United States of America

**Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?**

Overall the goals proposed are quite broad, and should appeal to the diversified set of stakeholders that includes governments, fertilizer producers and farmers from different geographical areas. However, one possible concern is that the global nature of the document may make difficult reconciling regional specificities (e.g., fertilizer overuse vs. underuse). It is already anticipated by CoCoFe leadership that *The focus is more on discouraging fertilizer overuse whereas a second document, to be developed later, will address scenarios with low or no fertilizer use under the topic of integrated soil fertility management*. Perhaps drafting one single document with both global and sub-regional goals may result in a more effective policy.

**How should be the CoCoFe be structured to have the maximum positive impact?**

I agree with comments from colleagues presented earlier in this forum. The policy would need to consider at least regional specificities. The overall document should contain goals, general measures to achieve the goals and region-specific measures to implement them. Colleagues have already mentioned the importance to take into account the supply side.

**Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**The global nature of the project makes difficult to identify one specific audience. Producers, governments, extension services and farmers should all be able to access the information in the policy. Sometime NGOs have the best opportunities to implement policies in the field, but they may be driven by targets other than those specified in the objectives. It is important to broaden the appeal of the document to the fertilizers producers. The best possible CoCoFe will not be successful if the fertilizer producers are not part of the implementation strategy. Most of the background problems related to climate change, green processing, heavy metals contaminations etc. can only be resolved if the fertilizer supplier identifies new market opportunities and successful business models stemming from those challenges. Objectives, definitions, language and overall structure of the document should therefore take into account the fertilizer industry.

**What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**Again, if the policy is to be global addressing all inputs would seem more appropriate. On the other hand, organic “inputs” are always going to be subject of debate, as evident also from this forum. In my opinion organic inputs may be useful only in specific local situations, but including them in scientifically sound CoCoFe document would overcomplicate the necessary phrasing and wording. I am not qualified to comment on the relevance of bio-stimulants, inhibitors etc., which I am not sure are traditionally classified as fertilizers. As mentioned by colleagues in this forum, it becomes critical to give an appropriate definition of “fertilizer”, “inputs”, “organic” etc. For CoCoFe to be effective, my suggestion is to  focus strictly on “fertilizers”, leaving aside any products that does not fall into that category. Such products can be address by other documents later.

**Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?**That will depend on the consensus achieved on the final draft of CoCoFe, as well as the tools envisaged for the implementation of the policy. It would be useful and interesting to include some sort of measurable quantity or evaluation mechanism to track the progress of the distribution and adoption of CoCoFe.

## Dick Tinsley, Colorado State University, United States of America (third contribution)

**Opening Comment**

Before being with my commentary, I would like to express my concern and disappointment on the limited commentary being submitted to this forum. Only 15 comments for a forum that is over half completed. Perhaps it is just poor time around the major Christmas/New Year Holidays.

**Introduction – Economically Suppressed Economy (Revisited**)

for my additional commentary. Having been encouraged by the facilitators comment that the forum was intended to look at the administrative issues surrounding fertilizer usage, allow me to continue where my first comment left off and review the other aspect of a financially suppressed economy, with limited tax base to support public services. That is the need to rely on the private sector for most business activity with an emphasis on the family enterprise system that is in most direct contact with smallholder producers. These are the default service providers that handle the bulk of the agriculture support business, both inputs and marketing, even when there are major development NGOs and public-sector entities trying to assist small farmers, and often boasting how great they are. Given the limited government budgets to provide a regularity service, and the fairly large prospects that when attempting there is greater prospects that the service will be on the honor/gratuity system more providing an informal income opportunity for the civil officers than an effect quality or regulatory control, there really is not much alternative.

http://smallholderagriculture.agsci.colostate.edu/financially-suppressed-economy-2/

http://smallholderagriculture.agsci.colostate.edu/consumer-price-comparisons-usa-vs-host-country/

http://smallholderagriculture.agsci.colostate.edu/informal-income-opportunities-seed-fertilizer-voucher-program-of-afghanistan/

**Private Service Providers – Family Enterprise System**

The question is how necessary is such quality and regulatory control over fertilizer and other agronomic inputs in a financially suppressed economy? That is, with the limited purchasing power of an impoverished society, there is tremendous downward pressure on consumer products. Typically, consumer price of locally produced foods will be only 1/3rd or 1/5th that in more developed countries like the USA. For this to happen, the crop production delivery system must be extremely efficient with razor thin profit margins, particularly if fuel prices are at a primum to at least the USA price more in line with European prices, and inputs such as fertilizer and crop protection chemicals are on the world market prices. There is no room for any cumbersome business model as usually found with Government Parastatals or even Producer Organizations. Under these suppressed economic conditions, it is possible for the nominal price the farmer receives be only 1/3rd the consumer price, with the difference representing easily accounted for in packing, spoilage loses, pilferage, shipping costs, etc. leaving only reasonable profit margins for the middle men preforming the essential services.

It should be noted that the private service providers are often condemned as being exploitive of smallholder farmers. However, this done by decree without any supporting documentation of costs of business accounting, including the nearly transparent tripling of ton/km transport costs for working off the tarmac to serve remote smallholder areas. Without any supporting data, such condemnation could be considered slander and those making such claims subject to the host country liability laws governing slander. It should also be noted that those making the slander condemnations usually have a vested interest in promoting government support services and producer organizations seeking donor support, etc.

http://webdoc.agsci.colostate.edu/smallholderagriculture/ECHO-Private.pdf

http://smallholderagriculture.agsci.colostate.edu/private-service-providers-family-oriented-fragmented-business-environment/

http://webdoc.agsci.colostate.edu/smallholderagriculture/Off-TarmacTransportCosts.pdf

**Parastatal and Producer Organizations**

These alternative of government parastatals and producer organizations and touted as being ideal and in the best interest of the smallholder farmers. However, this is again done by decree without any accounting or other supporting data comparing the costs of business between them and the competing private service providers. Just a rather arrogant assumption that because they represent the government or farmers, they are automatically competitive with no need to keep track of overhead costs. Certainly, parastatals have been fully discredited for their cumbersome non-transparent business model, and we need not return to the ADMARCs that plagued Malawi for many years. However, the producer organizations may not be much of an improvement. While they claim they can bulk up commodities for sale or inputs for purchase to get the farmers a better price, and this is possible but I have never seen what this means in terms of percent of financial benefit. Is it 1%, 2%, does it go as high as the 35% needed to offset the overhead costs mentioned by the Central Growers Association in Kitway, Zambia. Nor have I ever seen the overhead costs to obtain these benefits to make certain the overhead costs are less than the private service providers thin profit margins. Thus, the proclaimed and envisioned financial benefit remains completely unsubstantiated. Instead there appears a large complaint about not honoring commitments and members side selling the bulk of produce to the “much condemned” private service providers for immediate cash and necessary by the overall financial management strategy of retaining goods in-kind as long as possible, selling only to meet immediate cash needs and needing the cash. The net result is that producer organization rarely have a market volume appreciable exceeding the loan repayments with 90% or more being side sold to private service providers. I don’t think you can substantially impact poverty with that limited market volume. This is than covered up with some exceptional promotional reporting, that rambles on but avoid including the basic business parameters that determine the success and sustainability of an enterprise.

http://smallholderagriculture.agsci.colostate.edu/perpetuating-cooperatives-deceptivedishonest-spin-reporting/

http://smallholderagriculture.agsci.colostate.edu/request-for-information-basic-business-parameters/

http://smallholderagriculture.agsci.colostate.edu/financial-management-strategy-retain-assets-in-kind/

http://smallholderagriculture.agsci.colostate.edu/appeasement-reporting-keeping-beneficiaries-at-risk-2/

**Quality control**

While one of the important concerns in fertilizer management is quality control and avoiding someone diluting the nutrient content, the question how can this be best done with financially stalled government that would struggle to maintain a fertilizer testing lab to verify the nutrient content of imported or manufactured materials, and fudge the results as an informal income opportunity. For this I don’t have a real answer nor webpage to reference. However, the starting point would be to import only well bagged fertilizer with the manufactures label clearly visible including a date/batch stamp that could be traced and at least the age and expiration date clearly discernable. I would expect the cost of tampering with such bags would not be worth the added value of diluted material, and any breakage bags would have to be sold at a discount. Again, I would expect the private traders would be more concerned with maintain high quality as they rely on repeat customers. One aspect of private sector business model is the importance of inventory control and not get overstocked that ties up needed capital. It also must be noted that some fertilizer like urea, and NH4SO4 can usually be visible identified just by looking at the granular structure, and if someone attempted to dilute the fertilizer with sand this would also be easily seen with quick bag check.

**Application rates**

Finally, one must look carefully at the recommended application rates and possible need for farmers to adjust them to their specific conditions. In this regard, it must be noted that recommendations are based on small plot analysis aimed at maximum yield, and not the economic optimal yield that provides the farmers the best return on their investment. I would venture that under developed country conditions the optimal fertilizer applications would be 75 to 80% of the maximum yield recommendation, however, under the suppressed economic conditions of most developing counties with the more limited returns they can receive the optimal percent could go as low as 60% of maximum. This might then be further eroded by the operational limits under which smallholder operate particularly if relying mostly on manual labor working with hoes. This operational limit will extend crop establishment up to 8 weeks, with considerable additional compromise in terms of plant populations and quality weeding. All of this progressively costing potential yield and impacting on fertilizer response.

http://webdoc.agsci.colostate.edu/smallholderagriculture/OperationalFeasibility.pdf

http://smallholderagriculture.agsci.colostate.edu/calorie-energy-balance-risk-averse-or-hunger-exhasution/

At this point I have said more than enough and will sign off. I hope you all have a chance to review some of the referenced webpages and additional links within them.

Thank you for putting up with this bit of unrepentant heresy.

Dick Tinsley

## Manuel Castrillo, Proyecto Camino Verde, Costa Rica

**English version**

Best regards. First of all, we would expect a reluctance on the part of producers of artificial fertilizers to adopt restrictive regulations or to eliminate many of the heavy components that they use - which are the majority -, therefore, we would have to see the disposition of these actors, the agencies of international trade and governments. Information and control options remain scarce in many poor and even permissive countries in countries of the second world or in emerging countries. What are the opportunities for small farmers to opt for quality fertilizers or pesticides of low cost? Attitude change consensus - difficult thing - between large industrial fertilizers and pesticides?
Each country or region has its own characteristics to adopt changes in its handling of inputs and eradicate habits leads to adapt particular strategies, taking into account costs, availability and information of new products, this in terms of sustainability and productivity factors for those interested . How binding could be a new Conduct Framework, if in spite of many regulations, the good uses of pesticides are still not being met. The target groups could be from high school onwards and in general enable consumer opinion spaces in In general, large distribution chains, food wholesalers and retailers can demand certifications - giving them a plus to consumers - as well as local structures (of wide participation) to inspect their producers.
The pulse with the large transnationals should be based on the current situation of climate and the state of population growth that needs safe and nutritious food. People have the right to a healthy diet!

**Spanish version**

Saludo cordial. Ante todo, se esperaría una reticencia de los productores de fertilizantes artificiales a adoptar una normativa restrictiva o que elimine muchos de los componentes pesados que usa - que son la mayoría -, por lo cual, habría que ver las disposición de estos actores, las agencias de comercio nternacional y los gobiernos. Las opciones de información y control siguen siendo escazas en muchos países pobres e inclusive permisivas en países de segundo mundo o en emergentes.Cuáles son las oportunidades para los agricultores de pequeñas fincas de optar por fertilizantes o plaguicidas de calidad y de bajo costo? Cabría un cambio de actitud consensuado - cosa difícil - entre los grandes industriales  de fertilizantes y plaguicidas?
Cada país o región poseen características propias para adoptar cambios en su manejo de los insumos y erradicar hábitos lleva a adecuar estrategias particulares, tomando en cuenta costos, disponibilidad e información de nuevos productos, esto en razón de la sostenibilidad y factores de productividad para los interesados. Qué tan vinculante podrían llegar a ser un nuevo Marco de Conducta, si a pesar de muchas normativas, se siguen incumpliendo los buenos usos de plaguicidas.Los grupos meta podrían ser desde la secundaria en adelante y en general habilitar espacios de opinión de los consumidores en general, las grandes cadenas de distribución, mayoristas y minoristas de alimentos, pueden exigir certificaciones - dándoles un plus ante los consumidores -, así como, estructuras locales ( de amplia participación ) de inspección de sus productores.
El pulso con las grandes transnacionales debe darse en base a coyunturas de la actual situación climática y el estado de crecimiento poblacional que necesita alimentos seguros y nutritivos. Las personas tienen derecho a una alimentación saludable!

Attachments:

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/El%20futuro%20de%20la%20de%20la%20alimentaci%C3%B3n%20y%20la%20Agricultura%2C%20FAO%202017.pdf>

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/BUDGET%20WORK%20TO%20ADVANCE%20%20THE%20RIGTH%20TO%20FOOD.pdf>

## Dhananjaya Poudyal, Nepal Nutrition Foundation, Nepal

* Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?

**Objectives are appropriate for me. No changes are necessary in the objectives.**

* How should be the CoCoFe be structured to have the maximum positive impact?

**In general the code of conduct should be rigid which should not be changed in any circumstances. It should be powerful and strict to take action for any guilty person.**

* Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?

**Both the farmers who use the fertilizers and the producers who do supply of fertilizers are the best audience for this purpose. The audience can be broadening towards the community people, consumer societies, and the merchants/shopkeepers dealing with fertilizers. They can be given orientations about the contents and theme of the code of conduct. Besides, there should be provisioned of penalty if somebody discard the clauses of code of conduct**

* What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?

**Code of conduct should be applied for all the fertilizers and manures too. However, synthetic fertilizers are more sensitive than the others from the point of view of health hazards. It is recommended to include the other products too as mentioned above in the scope of code of conduct.**

* Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?

**I think so. The code of conduct will be supportive to make more responsible to the fertilizer producers and to the farmers too for taking care towards legal provisions. It will be happened because they will be bound with some restrictions under the judicious processes. Actually, people from any disciplines or sectors do not follow the code of conduct in the country. They do not care about it since they feel that the code of conduct is applied only for the fragile persons.**

**Therefore, the respective government whether from the country, region, or state should strictly follow the legal actions against every guilty person. In the meantime, it should be oriented, disseminated, and trained about the details of the code of conduct through the process of social mobilization.**

## Susanne Schmidt, The University of Queensland, Australia

Dear all

My comments are

1. Move beyond the ‘4R’ as these represent an ideal framework only but are unrealistic with current fertiliser technology.
2. Make regulating nutrient losses a priority as N2O emissions and water pollution are globally felt and pose strong risks. Develop a risk matrix with view of the risks of losing fertilisers with view of soil, climate, crops.
3. Consider nutrients in a broader crop system context with mineral fertilisers, repurposed nutrient-rich wastes, N-fixing plants for a holistic approach to nutrient supply of crops and soils.
4. Consider the benefits of improving soil with the addition of organic carbon bound to nutrients (soil biological function, improved root growth, building of soil organic matter etc).
5. Consider amelioration of wastes: most are not ideal crop nutrients with to too fast/too slow release patterns, toxicity, unbalanced nutrient stoichiometry etc. mixing several wastes, adding sorbents (geosorbers, biochar) and other manipulations will be needed.
6. Consider nutrients beyond NPK, as micronutrient deficiencies are more becoming more common and often the effects seen with higher NPK addition is in fact a response to micronutrient ‘contaminants’ in NPK fertiliser, such as Zn.
7. Request more comprehensive testing and long-term experimentation, local farmers experimenting and involvement of the community to ensure knowledge generation with stakeholder involvement.
8. Consider the circular nutrient economy to recycle nutrient-containing wastes at local and regional scales.
9. Advance the next-generation fertiliser concept with aim to optimise nutrient source and release patterns driven by crops rather environmental conditions.

Best wishes

Susanne

## Zahangir Hossain, University of Newcastle, Australia

First of all, I agree with the objectives. For sustaining health, it is necessary to recycle plant nutrients from the various types of wastes like agricultural waste, manure, industrial waste etc. Nowadays, biochar can also be an important contribution for sustainable agriculture as well as minimize environmental problems.

Zahangir

## Eyongetta Njiessam, University of Dschang, Cameroon

Greetings to you,my humble opinion stipulates thus,

holding to the fact that artificial fertilizers have huge effect on the life of the soil, causes eutrophication in water and the heavy metals contained in such as lead bio-magnify through the ecosystem and which totally affects human health, I think this totally contradicts the objectives of FAO program which is to eliminate hunger, poverty, malnutrition and food insecurity and off-course to improve agriculture, forestry and fisheries in a sustainable way.

there is therefore the need to first of identify the various stake holders involved, the consumers of artificial fertilizers, the producers and entrepreneurs involved and try to school them on the effects of artificial fertilizer on the ecosystem.

The FAO member states should encourage organic farming as a feasible means to effectively achieve sustainable agriculture and fight food insecurity. This could be through the production of organic fertilizers using farm, poultry and livestock waste and also to encourage environmental education in schools to be able to educate the future generation on the importance of organic farming on the environment. Training could also be given to farmers on the advantages of organic fertilizers over artificial fertilizers.

FAO member states could also place a high tax on the importation of artificial fertilizers and try to give subvention to farmers and train them on how to be able to recycle their farm waste to produce organic fertilizers.

Thank you
E.s Njie-assam

## Naveen Paudyal, UNICEF, Nepal

**Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?**

The objectives of CoCoFe is appropriate, however, like to suggest some more as follows:

Protect and promote the endogenous knowledge of fertilizer production, such as compositing using the available raw material resources, at the local level.

Create linkage between the industrial bio-products that has characteristic to turn into the compost/ bio manure type of fertilizer to contribute in the livelihood of the communities around the industrial areas (example sugar cane factory) and health of the soil.

**How should be the CoCoFe be structured to have the maximum positive impact?**

Though I have not chance to go in detail on the CoCoFe, the maximum impact of the CoCoFe translates through ensuring use of bio-waste (even those releasing from household) to prepare compost/ biomanures. With the increasing urbanization, bio-waste from households are increasing in urban settings whereas, very less effort is made in large scale to turn it into fertilizer. Many country either due to lack of technical knowledge or financial resources are not managing these waste, which finally reaching into river system through sewages. This thing need to consider during structuring CoCoFe. Since I have limited exposure to work in the agriculture sector, I cannot add more on it but having the academic background of Sugar Technology, I can guess, there is ample opportunity to structure CoCoFe thinking it from soil health prospective as well as minimizing the household waste.

**Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

I think, Government (Federal, Provincial and Rural Municipality/ Urban Municipality), National Planning Commission, Ministry of Agriculture, Ministry of Local Development, Ministry of Finance, UN agency like FAO, I/NGO working in the field of agriculture, University with Pre-harvest and Post-Harvest Courses, Federation of Chamber of Commerce and Industry, Social Influencers and Community leaders are potential audience for the CoCoFe. Of course, main benefiary of the CoCoFe should not be left out from demand side.

**What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

The scope of CoCoFe depends on the country specific situation and base on the soil characteristic. The global CoCoFe should be adjustable depending upon the country need. The main point here is, every country should have capacity to check their soil health on regular basis and Government structure should have capacity to take appropriate decision. There is no question our focus should be on bio-solids and compost, however, every country always has limitation to supply bio-solids and compost since these types of fertilize is not produce in large scale. Sometimes, delivering synthetic fertilizers to farmers become essential under the condition where bio-manures are not available in sufficient quantity. So far possible, if endogenous knowledge on preparing compost fertilizer could be promoted, it can be local solution, which is more cost effective and sustainable. In general, Nitrogen, Potassium and Phosphorous are the usual choice of nutrient for farming but depending on the soil and type of crop planned to planted, another nutrient is also requiring. One of such nutrient would be Zinc for tea plant.

**Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?**

I hope, CoCoFe will certainly assist in promoting responsible and judicious use of fertilizers but it need to be taken care, the code will not just focus on the synthetic fertilizer and also, look other expects like livelihood, sustainability and use of endogenous knowledge. I suggest to add gender dimension also if possible since women are given the responsibility to spray fertilizers in farm in most of the under developed country. Some of such dimension is looking on safety issues or use of innovative technology for spraying fertilizer in farm.

## Annah Mutinda, Ministry of Agriculture, Livestock and Fisheries, Kenya

**Given the global scope of the CoCoFe, do you think the objectives are appropriate?  If not, how would you add to them or modify them?**

The objectives are appropriate and also sufficient since they cover practices/expectations from manufacture (ensuring the fertilizers meet the quality standards on heavy metals and nutrient content) to application in the farms (maintaining and increasing food safety)

**How should be the CoCoFe be structured to have the maximum positive impact?**

It should cover code of conduct by fertilizer manufacturers, distributors and farmers. It should also provide for enforcement mechanisms and a recognition system for those abiding by the code. To this end, it should provide for institutional arrangements for implementation at the global, regional and country levels.

**Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

While concurring with other participants that best audience for the CoCoFe would fertilizer manufacturers, Distributors and farmers (actually misuse of fertilizers happens at the farm, resulting to environmental pollution), I would add that the Government ministries responsible for agriculture, industry, trade and standards should be reached with the CoCoFe. Extension service providers (government, NGOs, Private) would also be part of the audience.

**What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.?  Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

Since the CoCoFe is not a prescriptive document, it should cover all functions along the fertilizer supply chain. It should provide for code of conduct for manufacturers, distributors and users of all fertilizers be they inorganic, organic or biofertilizers.

**Will the CoCoFe assist in promoting responsible and judicious use of fertilizers?  Why or why not?  What other suggestions do you have to help the CoCoFe meet our objectives?**

Yes I believe it will promote responsible and judicious use of fertilizers and especially if accompanied by proper implementation and enforcement mechanisms as well as a reward/sanctions system. A lot of sensitization for awareness creation and capacity building the stakeholders will also be required.

## Pitam Chandra, ICAR, India

It is time that we move away from general prescriptions for fertilizers' application. With the power of the ICT and rapid soil tests, we need to be specific in applying the precise soil nutrients. Methodologies and applicators must be developed and the farmers must be skilled to move in this direction.

Regards

Pitam Chandra

## Terry Roberts, International Plant Nutrition Institute, United States of America

Comments from scientists at the International Plant Nutrition Institute (IPNI) are below.

**Online consultation for developing the Code of Conduct for the Management of Fertilizers**
IPNI Scientists
**12 January 2018**

**GENERAL COMMENTS**

The experience of the International Plant Nutrition Institute has shown us that there are several important policies at the national scale that are important to the advancement of responsible management of plant nutrition. These include:

1. Policies on public and private funding for:

a. Research on agronomy, plant nutrition, and soil fertility

b. Extension of information arising from such research to farmers and crop advisers.

c. Educational programs.

d. Nutrient balances and soil test summaries from national to farm scale.

2. Policies supporting the operation of institutions that:

a. Reward farmers and crop advisers for better management of plant nutrition.

b. Conduct relevant soil fertility research.

c. Certify responsible management of agronomy and plant nutrition.

Only in countries where such infrastructure is present, the proposed CoCoFe has good prospects for success.

**SPECIFIC COMMENTS**

**1. Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?**

* We suggest changing Objective #1, “maintaining or increasing global food production” to “increasing global food production” on the grounds that “maintaining” is insufficient for nutritional security of human communities, considering UN projections for human population and food demand, and current levels of human undernourishment. An objective of closing the yield gap in areas with declining soil fertility or inadequate use of fertilizers is missing.
* Objectives #1 and #5 could be combined, such that not just the amount, but also the nutritional quality and safety of foods is improved.
* In Objective #2, “Maximizing efficient use” should be “Maximizing effective and efficient use.” The effectiveness in increasing crop yields is key to agricultural sustainability.
* Objective #3 presumes all environmental impacts of fertilizer use are negative. We suggest this objective be changed to state “preventing misuse of fertilizers, reducing environmental harm (caused by pollution through losses of nutrients) and increasing environmental benefits (caused by improved soil health and land productivity sparing land for nature).”
* Since objective 2 already emphasizes sustainable agriculture then is there a need for Objective 3 as written? Or if it’s necessary to emphasize the pollution aspects then they could be combined as they have a cause and effect relation: “maximizing the efficiency of plant nutrient use to minimize the environmental impacts through loss of plant nutrients via runoff, leaching, greenhouse gas emissions and other mechanisms;
* Objective #4 should be changed to “managing risks from non-nutritive elements in fertilizers to levels acceptable for environmental and human health.” Human health benefits of fertilizer must also be highlighted to the target audience. This could be included in Objective 5 as “Maintaining and increasing food quality and human nutrition through optimum use of plant nutrients.
* “discouraging fertilizer overuse”, seems to be the premise of developing this document. If the document emphasizes on overuse of fertilizer, which is limited to certain geographies, it must also focus on under-use of fertilizer, which is more widespread geographically, and its implications on crop productivity, human health and farm income. The perceived “overuse” of a particular nutrient, for example N, is often due to inadequate application of other limiting nutrients. To clear the negative connotation of fertilizer use, “encouraging optimum fertilizer use” should be the focus rather than “discouraging fertilizer overuse”
* The statement on the focus separating scenarios of over use from those of under use, and therefore the approach to developing this code of conduct, should be changed. IPNI’s experience indicates a wide range of input use levels and soil fertility conditions within each of the countries within which it works. These wide ranges suggest that both under use and over use scenarios need to be addressed within each country, regardless of stage of development. A comprehensive code would be more likely to facilitate the transfer of nutrients from regions in surplus to regions in deficit.
* CoCoFe’s aim and focus should go beyond just overuse and underuse (“right rate”) and also address “right source, right time, right place” to optimize impacts on food security, the quality of soil, water and air resources, and environment in general, for the benefit of human family.
* Consider an additional objective: maintaining and increasing productivity of arable soils

**2. How should be the CoCoFe be structured to have the maximum positive impact?**

* The CoCoFe should be structured to provide guidance at the regulatory level to outline the roles and responsibilities of the multiple stakeholders involved in the fertilizer supply chain; and outline 4R Nutrient Stewardship as the framework of sustainable fertilizer use at the technical level.
* As indicated in the aim and focus statements, we agree the CoCoFe should assist policy makers at the regulatory and extension levels to outline the roles and responsibilities of the multiple stakeholders involved in various aspects of fertilizer management including governments, industry, universities, NGOs, traders, farmers organizations, etc.
* CoCoFe should be structured as a set of principles relating management of applied fertilizer materials to impacts on sustainability (economic, environmental, and social). IPNI’s 4R Plant Nutrition manual provides an example of such a set of principles. These principles of 4R Nutrient Stewardship are summarized in a recent two-page article that was targeted for North American nutrient service providers (TWB CropLife article; attached).
* The process of developing CoCoFe should be structured to include involvement of stakeholders with an international focus, such as the International Fertilizer Association and the International Plant Nutrition Institute.

**3. Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

* The best audience should be government at the regulatory and policy level and government, Fertilizer Industry, NGOs, University, Farmer Schools at the technical level
* This will differ by country; however, 4R Nutrient Stewardship is an example of guiding principles that scale to address different stakeholders. We suggest such scalability is important for the principles of CoCoFe as well. For maximum effectiveness, the CoCoFe principles should be understandable—and implementable—by all those playing roles in the governance, regulation, and implementation of nutrient management strategies, tactics and practices from the national to the farm and field scale.
* The ultimate fertilizer handlers are the farmers, so they are an important target audience. Farmer associations and all involved directly with them as decision supporters, i.e. field researchers, consultants and extensionists, should be engaged in implementing the code. There is a good example of a broad program developed in Brazil to promote the implementation of best management practices regarding all aspects of the farm that involved different players including bankers, but led by a farmers’ association: <http://www.sojaplus.com.br/site/en>.

**4. What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as biostimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

* All nutrient sources listed above should be included, not just mineral fertilizers. Any substance applied to agricultural land for the purpose of increasing nutrient availability to plants, including those improving nutrient use efficiency, should be included. This would contribute to a more holistic approach on managing resources.
* The CoCoFe principles need to address and emphasize the use of scientific evidence to define efficacy of inputs in providing plant available nutrients, and the efficacy of nutrient application practices in terms of the full set of their impacts on economic, environmental and social components of sustainability.

**5. Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?**

* CoCoFe could be successful in promoting responsible and judicious use of fertilizer only when the audience, scope and aims are defined clearly. Sustainable fertilizer use is a global agenda. However, overzealous focus on negative aspects of fertilizer use may alienate stakeholders, including governments who are responsible for feeding large populations from diminishing land areas, making it a futile exercise. The basis of the CoCoFe should be on a rigorous science-based framework like the 4R nutrient Stewardship, and framed through discussion with regional stakeholders with their multiple objectives in mind for the necessary buy-in and implementation.
* IPNI’s experience with the 4R Nutrient Stewardship framework shows a considerable boost in attention to management of fertilizers from those who have been exposed to its principles (primarily agricultural retailers and farmers, and particularly in regions where specific nutrientrelated environmental issues have been dominant; e.g. Lake Erie Watershed).
* We suggest the principles of 4R Nutrient Stewardship, which have been developed based on extensive consultation with stakeholders within the crop nutrition industry, could serve as a starting point for development of CoCoFe, using a process of wider stakeholder engagement, seeking to make the principles accessible to wider audiences.

Attachment:

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/CropLife%20artice%20-%20The%20principles%20of%204R.docx>

## Lal Manavado, University of Oslo affiliate, Norway

**On Guidelines to Embody a Sound Code of Conduct in Policies Pertaining to Sustainable Soil Fertility**

Should suggestions given here are adopted, it must be borne in mind that they are not universal in that some of them may be already included in relevant policies, or they are not relevant due to the type of crop, existing state of the soil, economic constraints, or other factors. Thus, it may be seen as a bag of options from which one may select those best suited to the circumstances involved.

Let us not forget the logical order of our task. Its overall purpose is to enhance sustainable global nutrition by “maintaining or increasing global food production.” Its successful achievement depends in part, on having a sustainable soil fertility. I think there will be a general agreement on the argument thus far.

Now, the use of fertilisers is perhaps the most important means of achieving this objective while its inappropriate application will have the opposite effect as shown by the ruins of the soil in vast tract of land near the now defunct Aral Sea. Thus, our efforts are concerned with a sub-set of  means in use to enhance soil fertility in a sustainable way, and our efforts are concerned with the point 2 to 5 specified in the document on our purpose. I think now I have placed the discussion within a holistic framework, from which to take my point of departure.

Before proceeding, may I point out the last two points, 4 and 5 have a causal link, for certain concentrations of heavy metal and other organic extraneous materials in artificial fertilisers are taken up by food crops and their subsequent consumption is known to have adverse health effects, hence undesirable. I think these two points may be united owing to their causal connection to our health.

The purpose of the code then, has two dimensions. The first would be to identify how the use of fertilisers may enhance soil fertility, i.e., what policy could promote the optimal use of them. Next, it is important to identify what uses of fertilisers would have an adverse effect on soil fertility, environment and health. Together, these will consititute an inclusive code that may be fruitfully embodied in a set of relevant policies.

It would be reasonable to suggest that the possibility of successful agriculture depends on having an adequate and sustainable ecosystem services and the use of crops suitable to an area. Those services include the concentration of carbon dioxide in the air, water supply, air and soil temperatures and indeed soil fertility that depends on its mineral content, general composition and structure. It is established beyond reasonable doubt that the well-being of our environment is essential for an adequate supply of ecosystem services mentioned earlier. Therefore, the use of fertilisers represents a supplementation of a particular ecosystem service to enhance one aspect of soil fertility, viz., its mineral content in a manner that does not adversely affect its other content or structure. Some may argue that as the use of mulch enhances soil porosity, and hence its overall fertility, it may also be included. If this is desired, such fertility enhancements should also be subjected to the same requirements as will be described below.

At this point, let us recall that it is axiomatic that a region’s food culture represents the culture of plants best suited for its soil, climatic and geographic conditions through a long trial and error over a period. Next, well-being of our environment on which ecosystem services depend, have a qualitative and a quantitative dimension. While the former represents its biodiversity, the latter indicates the optimal sustainable population of each individual species in the area. Thus, supplementation of soil fertility should not be undertaken at the risk of diminishing an area’s biodiversity or those optimal populations. Otherwise, one runs into an evil chain of gradually diminishing natural ecosuystem services leading to an increased need for their supplementation that ends in salination and soil ruins as in the areas around the Aral Sea.

So, the proposed code of conduct ought to  ensure that the use of fertilisers pay careful attention to the following considerations:

1. Maintain or enhance the ecosystem services of the area with reference to an optimal as governed by its climate, geography and soil composition so that the crops best suited for the location may thrive. This objective may be achieved in part by ---
2. Using fertilisers to achieve the natural levels for a given soil type the micro-nutrients required for a given crop. Whenever it is possible, one should prefer the use of compost, green manure and similar organic fertilisers.
3. As its counterpart, do not use fertilisers to supplement those micro-nutrients already present in adequate quantities in order to avoid salination and environmental damage
4. Whenever it is possible, undertake soil. Micro-nutrient assays to ascertain the relevant qualitative and quantitative needs of supplementation for the crops involved prior to the use of fertilisers.
5. Ensure that the fertilisers used do not run off out of the cultivated area to avoid their adverse effects on the environment like biodiversity imbalance due to species predomination like algal blooms in water ways andeventually  the sea. Sequential slow-release of fertilisers is often useful in achieving this goal.
6. It would not be sustainable to use fertilisers to increase the soil fertility to cultivate a crop that is unsuitable to be grown in the virgin soil of an area. It is this error that has rendered many areas of once tree-clad Amazons barren and bare today.
7. Whenever possible, it is highly desirable to monitor soil status on a regular basis to ascertain the availability of micro-nutrients required, soil composition and structure (porosity, distribution of larger elements, etc.) as well as soil biology with a view to adjusting supplementation as required.
8. A careful distinction should be made between the use of fertilisers to enhance soil fertility and an ‘increased crop yield’, because the latter will legitimize the use of plant growth accelerators which are known to be endocrine disruptors whose intake poses a very serious threat to human and environmental health.

Here, I will devote a little time to how one may avoid making  the use of fertilisers a possible threat to human and environmental health. While the importance of the former is obvious, the latter may not only directly affect our health (global warming), but could indirectly do so by reducing the availability of ecosystem services, resulting in food shortages. So, in order to “maximise the efficient use of plant nutrients to enhance sustainable agriculture,” the following conditions should obtain:

1. Strict regulation of what each inorganic fertiliser contains with a view to exclude them from containing heavy metals, growth accelerators or any other compound whose effects are known to be injurious to the living, and whose long term effects on the same are not yet known. Such higher standards of purity should be obligatory.
2. In addition to their loss by run-off and causing polution, surface application of dry chemical fertilisers are easily dispersed by the wind especially when they are followed by dry spells. This can pose a health hazzard to people and upset the ecology of the surroundings. Therefore, this practise is to be deprecated. It would be far more effective if inorganic fertilisers in suitably inert depots are ploughed into the soil so that the nutrients they contain are slowly released into the substrate, thus enhancing their effect. As an alternative, the required quantity of inorganic fertilisers may be mixed with organic ones and applied.
3. Inorganic fertilisers are prone to cause leaching, i.e., fertiliser displacing a less reactive metal element from small rock particles in the soilwhile making less nutrientsavailable from the fertiliser and increasing the concentration of some metal whose higher concentration is not desirable. How to deal with this issue is discussed in 1.I to 1.III above. It must not be forgotten that an adequate soil analysis needed here may be undertaken in a fairly simple laboratory for a reasonable cost even though very expensive more sophisticated ones are available.

These are some of the essential actions to be undertaken in the field in real life. The question then is how to motivate the fertilizer users and those who connected with their production and sales as well as  those who control the latter to undertake appropriate actions. Naturally, it is the last group who lays down the norms needed for the purpose and facilitate or hinder their adequate application. So, let us begin with them whose responsibility is to formulate and implement policies that ensures prudent use of fertilisers.

Some useful steps in this direction may involve inclusion of sound use of fertilisers in the curriculum of agriculture education and training, legal instruments to enforce the quality of inorganic fertilisers both with reference to manufacture and sale, trade policy that excludes the import of fertilisers that do not meet those standards, financial and technical support to promote the guidelines given above including more wide spread use of organic fertilisers as much as possible, and particularly practical research into combined farming where maximum amount of ‘crop remainders’ can be re-cycled within a farm. This last is not a suggestion concerned with the ‘cutting edge stuff’, rather it is a request for an enquiry into how the existing good local farm practices may be combined in  some new combinations for a greater food yield with less cost in fertilisers.

As mentioned at the outset, this is only a skeleton to be fleshed out according to what relevant for a given locale. What is applicable to all is the importance of knowing soil structure and chemistry as well as its biology before one decides on crops and fertilisers to be used. Traditional food culture despite its shortcomings often represents this knowledge in its pragmatic manifestation, and should serve as a sound point of departure for further work and gradual improvement.

Hope this would be of some use.

Cheers!

Lal Manavado.

## Porfirio Fuentes, International Fertilizer Development Center, United States of America (second contribution)

Dear Ronald and all,

Thank you for the quick feedback to my original comments. Please review the text below as a matter of response to your question: do you have any other suggestions? In reference to my comment of including the supply side of fertilizer industry in the CoCoFe.

Although I do appreciate the intent of the CoCoFe consultation facilitators to focus only on the use of fertilizer, I want to politely re-emphasize on the need to include the supply and demand side of the fertilizer industry, while supporting the point of view from other panelists who have also seen the need to make CoCoFe holistic by including the supply side of the industry.

To focus only on the use of fertilizer to **minimize**the negative externalities related to the environment and human health, is to ignore the negative externalities on the environment and human health of the supply side of the fertilizer industry and give a “clean bill of health” to the production and manufacturing processes while placing all potential regulatory  burden that would emanate from CoCoFe, on the use of fertilizer. I do understand and can also appreciate the implications with the industry by addressing those issues in CoCoFe and I can also appreciate the ease of addressing such issues from the user perspective only; but the fact is, that there is a lot the industry can still do to help reduce and therefore minimize such externalities through improvements in the production and manufacturing processes. We know that many of the negative environmental and health hazards from the use of fertilizer have their roots in fertilizer production and manufacturing processes. Focusing on the use (demand) of fertilizer will help **reduce**such externalities, but having a holistic approach (which entails considering also the supply side of fertilizer), will definitely **minimize**them.

Therefore if we are to keep as part of the CoCoFe objectives, “to **minimize**environmental and health impacts from pollutants such as heavy metals in fertilizers”, we need to start at and focus also on the supply side of the industry for an effective **minimization**of environmental contamination and human health hazards by improving the production and manufacturing processes to reduce or eliminate contaminants (i.e., heavy metals) in fertilizers and perhaps by investing in developing more efficient fertilizer (a new generation of “smart” fertilizer products congruent with crop genetics technological advances); complemented with a more efficient use of fertilizer.

However, if the facilitators of this consultation insist on the CoCoFe focusing only on the use or demand side of fertilizer, I suggest to eliminate the rhetoric of “**minimizing**environmental contamination and health hazard from the use of fertilizer”, and keep this as an implicit, not explicit objective. Having said that, I suggest to consider the following objectives:

1. Increase food production to supply the increasing needs of more and safer food;

2. Maximize the efficient use of nutrients fertilizer to enhance sustainable agriculture production;

3. Minimize nutrients losses to the environment (GHG, runoff and leaching into surface water streams and underground waters) to **reduce**contamination and human health hazard.

Less and more clear objectives, will help simplify the elaboration the CoCoFe and perhaps facilitate its vulgarization.

I believe the rest of the points raised in my original comment, still applies.

Thanks.

## Ronald Vargas, co-facilitator of the consultation

Dear Participants,

I would like to thank all of you once again for your contributions to this discussion and for your valuable feedback that will enable us to develop a Code of Conduct for the Management of Fertilizers (CoCoFe). In the last week, we have received 14 contributions and the commentary below intents to further fuel the discussion.

For any newcomers, please look at our last contribution for the link of the International Code of Conduct on Pesticide Management in order to have a better idea of the formatting and content of the CoCoFe.

The new comments seem to be related to the comments we have received since the beginning of the discussion and include the change in formulation and phrasing of the objectives, inclusion of regional specificities, changes in the scope and target audience of the CoCoFe, and the inclusion of all relevant inputs and not only synthetic fertilizers. Please know that we are taking all of your comments into consideration.

New and interesting topics have also been received such as:

* The need of having a way to measure or quantify the progress of distribution and adoption of the CoCoFe.
* The Inclusion of various types of wastes (agricultural waste, manure, industrial waste etc.).
* The protection and promotion of endogenous knowledge of fertilizer production at the local level such as composting.
* The acknowledgment of lack of technical knowledge on how to deal with fertilizers and agricultural waste in some areas/ regions.

With these comments in mind, I would like to add that the CoCoFe will attempt to tackle some of the points mentioned above such as bio-waste storage and recycling, and farmer technical assistance.

We would also like to invite you to address the following points:

**What would be a good way to measure or quantify the progress of distribution and adoption of the CoCoFe?**

**Keeping in mind that the CoCoFe will serve as a guiding framework for all Member States, what should be included in order for the code of conduct to help address different stakeholders?**

We are looking forward to further discussions as we jointly explore how we might strengthen the CoCoFe.

## Straton Khanje, United Republic of Tanzania

CocoFe objectives are appropriate.

Introducing micro-dosing technology especially in developing countries is inevitable. The technology can reduce the problem of inadequate use of fertilizers by coming up with a rate that uses smaller amounts of fertilizers which small scale farmers can afford.

Integrated organic and inorganic fertilizers-

Plough under crop residuals, adding animal manure, including micro-dosing of industrial fertilizers. These will protect our environment while increasing food production.

## ****Kátia Fernanda Garcez Monteiro, UVN/ONU, Brazil****

Original contribution in Spanish

¡Hola a todos y todas!

Una sugerencia de medir el progreso de la adopción del CoCoFe sería crear criterios e indicadores, sería interesante también crear una especie de sello visando la certificación al cumplimiento de los criterios establecidos

como por ejemplo, aumento en el porcentaje de consumo de fertilizantes orgánicos, cantidades (Toneladas), tamaño de áreas utilizadas, tipos de cultivos agrícolas, etc.

English translation

Hello everyone!

A suggestion to measure the progress of the adoption of the Code of Conduct for the Management of Fertilizers (CoCoFe) would be to establish criteria and indicators. It would also be interesting to create a kind of seal certifying the fulfillment of the established criteria, as for example, the increase in the percentage of consumption of organic fertilizers, quantities (tons), size of areas used, types of crops, etc.

## Lindsay Campbell, University of Sydney, Australia

The code of conduct should include inter alia:

1.    Ethics of individuals, companies and organisations that are involved in the management of fertilizers.

2.    The code should include criteria for the quality of fertilizers and, in the negative sense, contaminant concentrations in fertilizers.

3.   The code should include criteria for (i) the availability of nutrients and (ii) the time course of availability especially for slow release products.

4.   The code should provide clear mandatory guidelines for labelling as to the elemental composition of fertilisers e.g. P, K etc. (not P2O5, K2O etc.) as well as complexing agents for micronutrients when such complexes are used. The guidelines should include 'country of origin and country of manufacture' in the labelling to minimise the number of trade disputes.

5.    Organic materials e.g. biosolids, biostimulants, N-inhibitors, algal extracts etc. should be included in the code but separate from the traditional inorganic fertilizers and standard fertilizer complexes for micronutrients.

6.    The code should be able to provide guidelines as to the consequences of over fertilization, erosion hazard, pollution of waterways or water bodies or groundwater.

7.     The code ultimately should be adopted to countries participating or belonging to FAO activities. In the first instance, the code will be a 'work in progress' so adoption should not be pushed to avoid adverse or unintended consequences.

## Wolfgang Hofmair, Borealis L.A.T GmbH, Austria

1. Maintaining global food production is not enough. Beside so many millions of starving people, we are facing not only a continuously growing population, but also an increasing demand of renewable raw materials for smart, biodegradable products.
Furthermore, sustainable biodiversity needs to protect a minimum percentage of unproductive areas. We have to support a change in dietary behavior in the well-developed countries, for health reasons. However, we can´t forbid a dietary change in developing countries for welfare reasons. In sum, this can´t solve the challenge.

2. Striving for higher nutrient use efficiency will be and has been the key driver of a more sustainable food production. In the past, step change progress always came with innovation, connected with much better skilled farmers. Social acceptance of modern plant breeding - and protection - technologies is necessary, if they should keep their beneficial role. In addition, digitalization and smart agriculture will help a lot in this context.

3. Preventing misuse of fertilizers (organic and mineral!) to minimize unintended environmental pollution and at the same time gaining the benefits from much higher yields per hectare agricultural land and the given precipitation is possible! Acknowledging and promoting this double target is key for the future of food safety and biodiversity. Satellite tools and smart farming should deliver the necessary transparency and societal confidence in modern agriculture.

4. Minimizing pollutants (organic and inorganic) within the whole food chain (production and logistics and manufacturing) is a basic requirement. Especially in context with nutrient recycling from organic sources like compost, animal manure and sewage sludge the safe and reliable removal of organic pathogens and contaminants is crucial; at the inorganic side a balanced risk management approach needs to be found, between very strict heavy metal limits and not to exclude huge and valuable nutrient source like sewage sludge ashes.

5. Maintaining and increasing food safety: no additional comments beside what I have mentioned in point 4.

## Wolfram Zerulla, BASF SE, Germany

It is common knowledge that food production has to be increased significantly the next decades to feed a still growing global population. The application of all essential nutrients in a sufficient amount, at the right time and the right way is key to produce food in an enough amount and to avoid negative environmental impacts such as leaching, gaseous losses or run-off. The target should be on one hand side the highest nutrient use efficiency possible and the other side safe products regarding organic and inorganic contaminants not only in mineral but also in organic fertilizers.

## Anatoliy Khristenko, “Institute for Soil Science and Agrochemistry Research named after O. N. Sokolovsky”, Ukraine

Correct information about soil fertility makes it possible to use existing resources more efficiently, without significant additional costs, especially in the context of a global increase in prices for energy and fertilizers.

Obtaining a correct assessment of available phosphorus, potassium and microelements in the soil is a world problem. Disadvantages, which are typical for methods based on solutions of pure acids or alkalis, are largely characteristic for all methods that have extragent pH values more than 8,0 (for example, bicarbonate method - ISO 11263, pH -8,5) or have extragent pH values less than 4,5 (Brau-Kurtz 2 (рН-1,0), Mehlich 1 (рН-1,2), Arrhenius (рН-2,0), Mehlich 3 (рН-2,5), Mehlich 2 (рН-2,6), Van Lierop (Kelowna) -рН-2,7, Egner-Riehm (рН-3,6), Brau-Kurtz 1 (рН-3,5), Egner-Riehm-Domingo (рН-4,2) and etc).

The National Scientific Center "Institute for Soil Science and Agrochemistry Research named after O.N. Sokolovsky" conducted work aimed at the improvement of the national standardization system. The Technical Committee for Standardization (which was established on the basis of Scientific Center in 2001) has developed more than 300 normative documents in the area of soil science, agrochemistry and soil conservation. Of these, more than 170 standards have developed in the framework of the program "Harmonization of National Standards with International and European".

In our opinion, the Code of Conduct for the Management of Fertilizers (CoCoFe) must necessarily include a section aimed at solving the problem of correct determination of the mobile forms of macro- and microelements content in the soils.

The relevant legislative bodies: the Global Soil Partnership Plenary Assembly, the Committee on Agriculture (COAG), government regulators and other stakeholders should make efforts to harmonize national and international regulatory documents, create new international standards, and improve soil diagnostic methods.

The National Scientific Center "Institute for Soil Science and Agrochemistry Research named after O.N. Sokolovsky" is ready to take an active part in solving the above problems, both at the regional and global levels.

With respect,

Mykola Miroshnychenko

Anatoly Khristenko

## Alejandro Silva, Sociedad Venezolana de la Ciencia del Suelo, Venezuela

Original contribution in Spanish

**Dado el alcance global del CoCoFe, ¿cree que los objetivos son apropiados? Si no, ¿qué añadiría o modificaría? ¿Cómo se debe estructurar el CoCoFe para lograr el máximo impacto positivo?**

En líneas generales estaríamos de acuerdo con los objetivos  propuestos. Tal vez sería conveniente darle mayor precisión al objetivo 2 reformulándolo de la siguiente manera: “optimizar el uso eficiente de los fertilizantes en la nutrición mineral de los cultivos para promover una agricultura sostenible a nivel global”

**¿Quién sería la mejor audiencia para que el CoCoFe cumpla con nuestros objetivos y cómo podríamos ampliar y diversificar esta audiencia para aumentar su influencia?**

Entendiendo audiencia como los grupos focales hacia los cuales se dirigirían las recomendaciones del CoCoFe, la misma debería incluir entes de los respectivos estados responsables en definir políticas, órganos legislativos, entes de investigación, fabricantes y distribuidores de fertilizantes, gremios de agricultores, entre otros.

Por su parte el CoCoFe debería estar integrado en un principio por un panel de expertos o especialistas que aporte un documento base a ser sometido a consulta a los diferentes actores involucrados.

**¿Cuál debería ser el alcance del CoCoFe? Qué fuentes de entrada de nutrientes deberían incluirse: solo los fertilizantes sintéticos, o también el estiércol, biosólidos, compost, etc.? ¿Deberían contemplarse también otros productos, como los bioestimulantes, los inhibidores de la nitrificación, los inhibidores de la ureasa, etc.?**

Bajo el concepto amplio de la fertilidad de los suelos y del manejo integrado de la nutrición mineral de los cultivos, los fertilizantes sintéticos  constituyen solo una parte de la ecuación, pudiendo tener mayor o menor importancia entre los diferentes sistemas de producción agrícola. Para tener impacto en la promoción de una agricultura sustentable se hace necesario considerar de manera global los aportes de las diferentes fuentes de nutrientes.

De igual forma se hace necesario revisar las tecnologías disponibles o en desarrollo para mejorar la eficiencia y minimizar pérdidas y posibles impactos ambientales, que incluya desarrollo de nuevos productos fertilizantes, mejoradores, acondicionadores, enmiendas, etc., así como sistema de manejo agronómico que incluya métodos de aplicación de la fertilización, aprovechamiento de restos de cosechas y otros residuos orgánicos, rotación de cultivos, manejo del agua, etc., tomando como referencia experiencias previas de países miembros y sobre la base de análisis costo-beneficio. Todo lo anterior debe estar soportado en una red de carácter regional para el diagnóstico de la fertilidad de los suelos y requerimientos de fertilizantes integrado a los cuerpos de extensión y de asistencia técnica de cada país.

**¿Ayudará CoCoFe a promover el uso responsable y juicioso de los fertilizantes? ¿Por qué o por qué no? ¿Qué otras sugerencias se le ocurren para ayudar al CoCoFe a cumplir nuestros objetivos?**

El impacto que pueda tener el CoCoFe  en la promoción del uso responsable y juicioso de los fertilizantes vendrá dado por lo apropiado y viable que resulten las propuestas para las condiciones naturales y sistemas de producción que imperen en cada uno de los países miembros. De igual forma se hará indispensable promover entre los miembros sistemas de monitoreo que permitan cuantificar en el tiempo  los cambios que se alcancen en el uso de fertilizantes que tienda a consolidar una agricultura sustentable.

Agradecidos por considerar nuestras opiniones y atentos a nuevos requerimnientos.

Me suscribo Atentamente

Alejandro Silva

SVCS

Maracay – Venezuela

English translation

**Given the global scope of the CoCoFe, do you think the objectives are appropriate?  If not, how would you add to them or modify them?How should be the CoCoFe be structured to have the maximum positive impact?**

In general terms we agree with the proposed objectives. However, rewording objective 2 as follows might be convenient for enhanced precision: "optimizing the efficient use of fertilizers in the mineral nutrition of crops to promote sustainable agriculture globally"

**Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

Assuming the audience are the focus groups targeted by CoCoFe recommendations, it should include policy-making and legislative bodies, research entities, manufacturers and distributors of fertilizers, and farmers' organizations, among others.

As forthe CoCoFe, a panel of experts or specialists should initially deliver a source document for stakeholder consultation.

**What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.?  Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

The concept of soil fertility and the integrated management of mineral nutrition of crops is broad and synthetic fertilizers are just part of the equation, with variable importance across different agricultural production systems. The contributions of the different nutrient sources must be considered globally to have an impact on the promotion of sustainable agriculture.

Similarly, current or future technologies aimed at improving the efficiency and minimizing losses and potential environmental impact - and including the development of new fertilizer products, improvers, conditioners, amendments, etc., as well as agronomic management systemsfeaturing fertilizer application methods, use of crop residues and other organic waste, crop rotation, water management, etc.- should be reviewed, taking previous experiences of member countries as a reference and using a cost-benefit analysis. All this must be supported by a regional network assessing soil fertility and fertilizer requirements, embedded into the extension and technical assistance bodies of each country.

**Will the CoCoFe assist in promoting responsible and judicious use of fertilizers?  Why or why not?  What other suggestions do you have to help the CoCoFe meet our objectives?**

The impact that the CoCoFe may have on the promotion of the responsible and judicious use of fertilizers will be determined by the suitability and feasibility of the proposals for the natural conditions and production systems in each of the member countries. In the same way, promoting monitoring systems among the members to measure the changes in the use of fertilizers aimed at consolidating sustainable agriculture over time will be essential.

Thanks for considering our opinions, we are open to further discussion.

Yours sincerely.

Alejandro Silva

SVCS

Maracay - Venezuela

## Muraleedhar Prasad, Farm Care Foundation, India

My suggestions are:

- Issue of Soil Health Cards to all farm holdings. Soil Health Card Scheme implemented in India provides status of soil of the farm holding with respect to 12 parameters based on soil test results and provides advice on the dosage of fertiliser and also the needed soil amendments.

- Integrated Nutrient Management (INM)- judicious use and optimisation of benefits of all possible sources of organic, inorganic and biological components is very much needed. The use of inorganic fertilisers can be reduced if INM is followed. The availability of nutrients in the biological wastes available in the locality should be analysed properly and results made known to the extension officers.

- Soil-water-plant relationship- Timing of application and dosage of application must be based on appropriate water-fertiliser regime. Nutrient uptake includes three mechanisms- mass flow, diffusion and root interception.

- To  prevent fertiliser contamination, soil application of fertiliser should be reduced, timing of fertiliser application should coincide with plant need (application based on stages of plant growth) and fertiliser should be mixed with soil to reduce surface run-off of the fertiliser compounds.

- Governance issues related to ensuring availability  distribution and use of fertilisers- a) mobile based fertiliser management system can be employed for monitoring using IT based technical platform, b) Monitoring of ensuring subsidy for fertilisers based on direct transfer system, etc.

Prof.R.M.Prasad
Former Associate Director of Extension, KAU
General Secretary, Farm Care Foundation, Thrissur, Kerala

## Charlotte Hebebrand, International Fertilizer Association, France

**Online Consultation for Developing the FAO Code of Conduct for the Management of Fertilizers**

***Contribution of the International Fertilizer Association***

The International Fertilizer Association (IFA) welcomes this initiative led by FAO and is pleased to share its feedback to the questions raised by the facilitators of the online consultation. More generally, we believe it is important for FAO, as the UN’s lead agency on food and agriculture, to develop guidance on fertilizer use, having already developed guidelines or codes of conduct for a number of other agricultural inputs (i.e. pesticides, animal feed). IFA, an active member of the Global Soil Partnership, supported the Voluntary Guidelines for Sustainable Soil Management, which provides important guidance on plant nutrition, which could usefully be expanded on in a Fertilizer Management Code of Conduct.

IFA has enjoyed a longstanding and good working relationship with FAO. Back in the 1960s, our organizations worked closely together under the Fertilizer Industry Advisory Committee (FIAC) to inform farmers in developing countries about the role fertilizers can play in increasing yields. The key issue before us today is how to promote effective and efficient use of fertilizers to promote food security while minimizing nutrient losses to the environment, and IFA stands ready to engage with FAO on this important task. IFA and its members can provide valuable expertise and input into this important project, and help FAO in the ultimate promotion of the Code of Conduct among key stakeholders. Given our longstanding relationship, cemented in 2016 by a Memorandum of Understanding, which includes pillars on advocacy, communication and knowledge sharing, IFA looks forward to playing a constructive role in this important and timely project.

**About IFA**

The International Fertilizer Association (IFA) is the only global fertilizer association with a membership of almost 500 entities in 67 countries, encompassing all actors in the fertilizer value chain: producers, traders, distributors, service providers, advisors, research organizations and NGOs. IFA promotes the efficient and responsible production, distribution and use of plant nutrients to enable sustainable agricultural systems that contribute to a world free of hunger and malnutrition.

**Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?**

General comment: We believe that the Code of Conduct in general, and its objectives in particular, should address all nutrient sources used for plant nutrition (mineral and organic), which can be defined as “fertilizers” in its broad sense. In order to ensure common understanding, it will require the precise definition of key terms.

Objective 1: The objective should be reworded as “Increasing global food production” to be consistent with long-term projections, which all highlight the need to increase the global agricultural output to meet the requirements of the still fast-growing world population and accommodate dietary changes in emerging and developing economies. Biomass production for bioenergy and biomaterials is likely to create additional demand. Part of this additional demand can be addressed by reducing food losses and wastes but bridging yield gaps will remain an essential objective.

Objective 2: To be sustainable, fertilizer management has to be both efficient (ratio between what goes in and out of the farming system) and effective (meet productivity objectives). If efficiency is achieved to the detriment of crop yield, it cannot be considered a sustainable option. Therefore, we suggest rephrasing objective 2 as follows: “Optimizing the use efficiency and effectiveness of plant nutrients to ensure sustainable agricultural systems”.

Objective 3: The list of loss pathways doesn’t need to be spelt out in the objective. In addition, the positive environmental impacts associated with avoided deforestation should be mentioned. We suggest the following wording as an alternative: “Minimizing environmental impacts associated with nutrient losses to the environment and increasing environmental benefits through avoided land use changes”.

Objectives 4 and 5: Again, it doesn’t seem appropriate to give an example in the objective (objective 4). Heavy metals are indeed unwanted trace elements but other impurities such as organic compounds and pathogens may also have negative impacts on the environment and human health. In addition, objectives 4 and 5 are closely related and quite redundant. We would like to suggest the following wording for objective 4: “Ensuring food safety by assessing and managing risks from non-nutritive trace elements in fertilizers”.

New Objective 5: Adding a reference to food quality would be useful as fertilizer management practices can influence nutritional quality of food products. The proposed objective could read “Improving food quality and nutrition security through optimal use of plant nutrients”.

New objective 6: Surprisingly, no objective refers to maintaining or enhancing the health of agricultural soils, while nutrient management plays a key role in keeping productive soils through replacement of nutrients removed with consecutive harvests and in controlling soil organic matter levels. By preventing soil nutrient mining and soil organic matter depletion, fertilizers (mineral and organic) play a key role in preserving healthy soils and preventing soil degradation. The objective could read: “Managing fertilizers to maintain or increase organic matter levels and the pool of plant-available essential nutrients in cultivated soils”.

**Aim of CoCoFe**

The invitation to the CoCoFe consultation states that “the focus [of the Code of Conduct] is more on discouraging fertilizer overuse whereas a second document, to be developed later, will address scenarios with low or no fertilizer use under the topic of integrated soil fertility management”. We strongly believe that overuse and underuse are equally important challenges. They both reflect unsustainable practices and, as such, should be addressed in the Code of Conduct.

In addition, this statement puts emphasis on the fertilizer application rate. While rate is an important component of efficient and effective fertilizer management, the other 3 areas of fertilizer management (source, time and place) should be paid as much attention. Good fertilizer management performance can only be achieved by implementing fertilizer best management practices (BMPs) in those four areas.

* Right Source – Choose plant‐available nutrient forms (organic and mineral) that provide a balanced supply of all essential nutrients with release matched to crop demand.
* Right Rate – Ensure an adequate amount of all limiting nutrients is applied to meet plant requirements in relation to yield and quality goals.
* Right Time – Time nutrient applications considering the interactions of crop uptake, soil supply, environmental risks, and field operation logistics.
* Right Place – Place nutrients to take advantage of the root‐soil dynamics considering nutrient movement, spatial variability within the field, and potential to minimize nutrient losses from the field.

We suggest rewording CoCoFe’s focus as “Encouraging efficient and effective fertilizer use”. Depending on the country, or the farming system within a country, the focus may be more on overuse or underuse when it will come to translating the Code of Conduct in practical recommendations.

 **How should be the CoCoFe be structured to have the maximum positive impact?**

The Code of Conduct should reinforce and elaborate on the key references to fertilizers in FAO’s Voluntary Guidelines for Sustainable Soil Management (VGSSM).

CoCoFe should provide scientific principles for the good management of fertilizers. These principles should be universal (across geographies and farming systems). At a later stage, the Code of Conduct should be supplemented by regional or national manuals that would provide more practical recommendations (fertilizer BMPs) to farmers and their advisors.

The fertilizer industry has developed its own guidelines for sustainable fertilizer management, called “4R Nutrient Stewardship”, a framework for applying the right nutrient source, at the right rate, at the right time, in the right place, to achieve improved sustainability. Implementation of the 4Rs at the local level requires adoption of site- and crop-specific BMPs in the 4 areas of nutrient management. See the [IFA/WFO/GACSA Nutrient Management Handbook](http://www.fertilizer.org/images/Library_Downloads/2016_Nutrient_Management_Handbook.pdf) for more details.

4R Nutrient Stewardship has been adopted by key stakeholders, including farmers organizations and farmers advisors. For instance, nutrient stewardship is part of the curriculum for the Certified Crop Adviser (CCA) programme of the American Society of Agronomy (ASA). The 4Rs have also been successfully included in public-private partnerships like FertCare in Australia, the 4R Plus Initiative (4R Best Management Practices plus mitigation conservation practices) in Iowa, or in the Lake Erie watershed – to just name a few. The local fertilizer industry has actively participated in helping to set up trainings and certifications for these programmes.

CoCoFe would benefit from building on industry’s 4R Nutrient Stewardship Framework.

**Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

Should the Code of Conduct be composed of universal scientific principles/technical guidelines (as recommended above), the primary audience would be policymakers and regulators, who are responsible for designing national policies, strategies and regulatory frameworks in relation to agriculture and fertilizers.

The secondary audience would be made of scientists and the fertilizer industry, who are involved in developing fertilizer recommendations, fertilizer products and formulations, decision-making support tools, etc.

The tertiary audience would be composed of farmers and their advisors (e.g. extension services, fertilizer retailers, NGOs), whose main interest would be in subsequent practical recommendations/manuals.

**What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

The scope of CoCoFe should consider all sources of nutrients used to feed plants, i.e. mineral fertilizers, organic sources of nutrients (manure, compost, biosolids, etc.) and combinations thereof (organo-minerals). A Code of Conduct restricted to mineral fertilizers only would be counterproductive as sustainable fertilization practices require integrating organic and mineral nutrient sources, using organic sources available on the farm (or nearby) and supplementing them with mineral fertilizers to reach the farmer’s yield goal. This is part of the Integrated Soil Fertility Management (ISFM) strategy, a concept that should be supported by CoCoFe.

The Code of Conduct should also cover all essential nutrients (macro- and micronutrients) as any deficiency in one nutrient can impact the use efficiency and effectiveness of the others.

Additives aimed at improving nutrient use efficiency such as inhibitors, polymer coatings and biostimulants should be included as well, reflecting CoCoFe’s 2nd objective which is about improving nutrient use efficiency.

Note: The term “synthetic” fertilizers is inappropriate to define “mineral” fertilizers as several commercial mineral fertilizers are not the result of a chemical/synthetic process.

 **Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?**

If the Code of Conduct spells out the scientific principles that should apply to fertilizer management, and if stakeholders adopt these principles and translate them in practical site- and crop-specific recommendations, then CoCoFe is likely to contribute to the responsible and judicious use of fertilizers. It should be kept in mind that, today, the main challenge is in developing countries. Therefore, the Code of Conduct should be relevant to them. Considering that two thirds of IFA members are in developing and emerging economies, IFA can play an important role in promoting CoCoFe.

**What would be a good way to measure or quantify the progress of distribution and adoption of the CoCoFe?**

There is definitively a need for monitoring adoption, promotion and implementation of CoCoFe (or CoCoFe-compatible schemes) by relevant stakeholders. A number of indicators could be tracked in this connection: number of countries having translated the Code of Conduct in their national fertilizer strategy; buy-in by the fertilizer industry; review (and revision as needed) of national fertilizer recommendations consistent with CoCoFe’s principles; development of decision-making support tools consistent with CoCoFe’s principles; percentage of farmers receiving advice compatible with CoCoFe’s principles; percentage of the cultivated area fertilized according to CoCoFe’s principles; etc. Out of this list of proposed indicators, outreach to farmers may be the most relevant one if CoCoFe is to make an impact at the field level.

**Keeping in mind that the CoCoFe will serve as a guiding framework for all Member States, what should be included in order for the code of conduct to help address different stakeholders?**

The Code of Conduct should provide universal principles. Member States should then translate these principles into their national fertilizer strategy and in site- and crop-specific fertilizer recommendations. In order to have a meaningful impact, the Code of Conduct should encourage multi-stakeholder dialogue at the national level and partnership towards commonly agreed national or sub-national objectives.

**Next Steps**

We have well noted that the Intergovernmental Technical Panel on Soils (ITPS) has been tasked to develop the CoCoFe. Because ITPS is mostly composed of soil scientists, we would like to suggest that the Panel invites crop nutrition scientists and fertilizer experts to join the steering group in order to ensure that all required fields of expertise are properly represented during the development process. For instance, we believe that the steering group would benefit from the scientific expertise of the International Plant Nutrition Institute (IPNI). IFA is also ready to recommend highly-respected experts as needed.

## Mylene Rodríguez Leyton, Universidad Metropolitana de Barranquilla, Colombia

*[English translation will be available soon]*

**APORTES AL CODIGO DE CONDUCTA PARA EL MANEJO DE LOS FERTILIZANTES EN LA AGRICULTURA DESDE LA PERSPECTIVA DE LA SEGURIDAD ALIMENTARIA Y NUTRICIONAL**

Mylene Rodríguez Leyton,

Docente Investigador, Universidad Metropolitana de Barranquilla.

Colombia

De acuerdo con La Cumbre Mundial sobre la Alimentación (FAO, 1996) la seguridad alimentaria existe cuando todas las personas tienen, en todo momento, acceso físico, social y económico a alimentos suficientes, inocuos y nutritivos que satisfacen sus necesidades energéticas diarias y preferencias alimentarias para llevar una vida activa y sana. La inseguridad alimentaria se genera no solamente cuando existe carencia de alimentos suficientes sino cuando no se cumple con los atributos necesarios para garantizar la salud y nutrición de las personas, como el contenido nutricional y la inocuidad, condiciones que se generan en todos los eslabones de la cadena agroalimentaria, iniciando por la producción de los alimentos.

Durante la etapa de producción de alimentos los agricultores utilizan los fertilizantes, este uso es múltiple y variado, su propósito se orienta a mejorar el suministro de nutrientes a los cultivos y obtener mayor producción tanto en calidad como en cantidad, especialmente teniendo en cuenta que el acelerado crecimiento de la población supone la necesidad de incrementar la producción de alimentos y el reto de garantizar la seguridad alimentaria y nutricional. El uso de fertilizantes y agroquímicos en agricultura, representa cambios sustanciales en la producción agrícola con lo cual se estaría contribuyendo a la seguridad alimentaria de la población; sin embargo, se ha demostrado que el uso de los fertilizantes también puede ocasionar problemas en la salud humana y generar efectos negativos en el medio ambiente debido a la exposición a estos agentes químicos, lo cual significaría que pueden convertirse en factores de riesgo para la inseguridad alimentaria.

El código de conducta para el manejo de los fertilizantes debe ser coherente con el propósito de garantizar la seguridad alimentaria mundial potencializando los efectos positivos sobre la producción de alimentos saludables e inocuos con el menor efecto posible sobre el medio ambiente y la salud humana.

Estudios han demostrado que el uso de insecticidas, herbicidas, fungicidas o fertilizantes no es del todo eficiente con lo que se acentúa el problema de contaminación del agua, del suelo y del aire, y se pueden generar residuos potencialmente dañinos para los alimentos que se consumen; así mismo, la aplicación frecuente de plaguicidas, de forma más o menos regular, puede originar efectos adversos sobre la salud de los trabajadores expuestos; las exposiciones crónicas a estos compuestos pueden originar inicialmente alteraciones bioquímicas que no evidencian síntomas clínicos iniciales, aunque si son respuestas biológicas medibles que se pueden constituir en biomarcadores que permiten pronosticar la aparición de enfermedades antes de su manifestación clínica pero que evidencian los efectos sobre órganos como el riñón, el hígado, el sistema inmunitario y el sistema nervioso (Hernández- Jerez, 2017).

La presencia en los alimentos de agentes nocivos que puedan afectar la salud no solo concierne a la dimensión de disponibilidad, de la seguridad alimentaria sino que tiene que ver con su inocuidad y con la utilización correcta del organismo humano, de los mismos.

Por lo anterior, es de vital importancia considerar que los mecanismos utilizados para mejorar la productividad agrícola deben orientarse hacia la sustentabilidad, no solo desde la mirada del desarrollo económico, sino desde los aspectos ambientales y sociales (Salgado, 2015), lo cual significa tener en mente la integralidad y complejidad del concepto de seguridad alimentaria y nutricional, donde interactúan los sistemas agrícolas con los sistemas alimentarios.

El código de conducta para el manejo de los fertilizantes desde la perspectiva de la sostenibilidad implica tomar decisiones en interacción de los consumidores con los agricultores y sus decisiones de producción, lo cual es favorable para los sistemas de agricultura sustentable. Así los agricultores y los usuarios de los fertilizantes deben concebirse como actores y partes interesadas en la mejoría de la seguridad alimentaria y nutricional y como tal deben interactuar e interrelacionarse con los demás, especialmente con los consumidores (Salgado, 2015); para ello deben tener consciencia de las conexiones de la seguridad alimentaria y nutricional y de su responsabilidad en la generación de sistemas alimentarios sostenibles.

El código de conducta para el manejo de los fertilizantes implica incorporar valores como la ética y la responsabilidad. La ética fundamentada en los valores que promuevan unas relaciones respetuosas entre los sistemas socioculturales y los ecosistemas de la naturaleza. Se requiere fortalecer valores que generen un equilibrio entre la naturaleza y la vida humana; es decir, una ética alimentaria, que permita el ejercicio de la democracia ecológica que dé cabida a todos los seres en un nicho ecológico (Noguera, 2007).

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## Sally Flis, The Fertilizer Institute, United States of America

Online consultation for developing the Code of Conduct for the Management of Fertilizers

The Fertilizer Institute

January 26, 2018

The Fertilizer Institute (TFI) is pleased to provide the Food and Agriculture Organization of the United Nations on the development of the Code of Conduct for the Management of Fertilizers. The members of TFI, and our scientific partners with the International Plant Nutrition Institute (IPNI), are leading the way in development and implementation of new technologies and scientifically-based management for agricultural cropping systems to better meet social, environmental, and economic goals.

Statement of Interest
The Fertilizer Institute represents the United States fertilizer industry including producers, importers, retailers, wholesalers and companies that provide services to the fertilizer industry. TFI members provide nutrients that nourish the nation’s crops, helping to ensure a stable and reliable food, fuel, and fiber supply. Whether from organic or commercial sources, fertilizer nutrients are a key component of sustainable crop production systems. Fertilizer is a key ingredient in feeding a growing global population, which is expected to surpass 9.7 billion people by 2050. Half of all food grown around the world today, for both people and animals, is made possible through the use of fertilizer. As demand continues to grow, farmers around the world will continue to rely on fertilizer to increase production efficiency, producing more food while optimizing inputs.

Background
The 4R framework and supporting practices are integral components for enhancing water and air quality, food supply chain sustainability, crop productivity and soil health. 4R Nutrient Stewardship is a science-based framework to aid implementation of fertilizer best management practices on the farm. Properly managed fertilizers support cropping systems that provide economic, social and environmental benefits. On the other hand, poorly managed nutrient applications can decrease profitability and increase nutrient losses, potentially degrading water and air.

4R nutrient stewardship requires the implementation of best management practices (BMPs) that optimize the efficiency of fertilizer use. The goal of fertilizer BMPs is to match nutrient supply with crop requirements and to minimize nutrient losses from fields. Selection of BMPs varies by location, and those chosen for a given farm are dependent on local soil and climatic conditions, crop, management conditions and other site-specific factors.

General Comments

For clarification is the second document to address situations where fertilizer use is insufficient rather than using low to no fertilizer? Scenarios of crop production with low to no fertilizer use would lead to a decrease in global food production, resulting in an increase in food insecurity, malnutrition, and hunger. The focus of this effort should be placed on sustainable fertilizer use in a whole system approach, rather than split focus on over and under or no fertilizer use.

Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?

Objectives need to focus in on what sustainable agriculture is, such as utilizing existing agricultural lands by intensifying production to maintain and increase crop yields. The first objective should include a statement on land use. To minimize environmental impacts of fertilizer, 4R Nutrient Stewardship needs to be a part of the discussion for any potential solution. The 4R Nutrient Stewardship framework should be front and center in the objectives as it is an internationally recognized framework for sustainable fertilizer use and includes science-based practices that are site specific. Additionally, the last objective needs to include nutrition. Without fertilizers, nutrition of crops would be less. Micronutrients are vital to improving human health around the world.

Suggested revised objectives:
1. increasing global food production on current agricultural land; (need to include land use – increasing production can be done by increasing land area, this is contrary to sustainable ag principles).
2. optimize the efficient use of plant nutrients;
3. minimizing the environmental impacts from the use of fertilizers including pollution by loss of nutrients via runoff, leaching, greenhouse gas emissions and other mechanisms;
4. minimizing environmental and human health impacts from pollutants such as heavy metals in fertilizers;
5. maintaining and improving food nutrition and safety.

How should the CoCoFe be structured to have the maximum positive impact?

Recommendations from a science team/network with top nutrient management specialists representing many geographical cropping regions should be provided to a governing council of policy officials from FAO.

Inclusion of the science based principles of 4R Nutrient Stewardship that are applicable to all systems, regardless of farm size, level of technology, or type of crop produced should be included. Additionally, because of work with IPNI and other fertilizer organizations, the 4R principles are already globally recognized. Considering the right source, at the right rate, at the right time and in the right place is designed to be implemented by taking into account the site-specific conditions of each field or farm. This meets the design plant that the CoCoFe will provide broad recommendations on what should be considered when designing strategies to manage fertilizers sustainably.

Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?

The primary audience for the CoCoFe should be the agencies in individual countries that are responsible for agricultural policy. Increased influence and impact of the CoCoFe could be achieved by also addressing agricultural education, extension, research, retail entities, and crop consultant groups in each country as well as the agencies or groups in each country that are responsible for funding agricultural education, extension, and research.

What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?

All nutrient sources that provide plant nutrition should be included in addition to advanced fertilizer formulations that help to better match nutrient availability to plant uptake. Including these products will help encourage innovation and advancements in the nutrient use efficiency of fertilizers. Inclusion of all nutrient sources and products should be based on the scientific data available on their use and efficiency.

Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?

The success of the CoCoFe in promoting responsible and judicious use of fertilizer is dependent on engaging governments, agricultural scientists, agricultural educators, NGOs involved in sustainability and the global fertilizer industry. The CoCoFe should be based on a rigorous science-based
framework like the 4R nutrient Stewardship, and framed through discussion with regional
stakeholders with their multiple objectives in mind for the necessary buy-in and
implementation.

## Cassandra Cotton, Fertilizer Canada, Canada

Please find attached Fertilizer Canada’s response to the online consultation for the development of the Code of Conduct for the Management of Fertilizers. On behalf of Fertilizer Canada and our members, thank you for the opportunity to provide feedback.

Cassandra Cotton
Director, Sustainability
Fertilizer Canada | Fertilisants Canada

Attachment:
<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/FertilizerCanada_CoCoFe_Submission.pdf>

## Sandro Secco, FCP Cerea, Italy

We think that is fundamental for the human and animal health to manage the fertilizers market in a sustainable and healthy way.

It's important a professional approach, based on crop needs and soil characteristics.

The fertilizer application have to be managed following the environmental and crop needs.

## Debra Turner, Ronald Vargas and Gary Pierzynski, facilitators of the consultation

Dear Participants,

We are six weeks into the forum now, a bit less if you consider the holiday period, and we are still receiving very valuable feedback and inputs to the discussion on a future Code of Conduct on the Management of Fertilizers (CoCoFe). Again, we are extremely grateful to everyone for your contributions.

In the previous 2 weeks, we have received contributions from a broad representation of society, including Academia, Farmers Organizations, and Industry. We have had a few more suggestions on how to better frame the objectives, such as including the issue of nutrient-use in relation to land-use, as well as including food nutrition in addition to food safety.

Once again, there is a broad consensus that all plant nutrient sources should be included in the CoCoFe as they are all part of an Integrated Soil Fertility Management (ISFM) strategy to sustainable food production. It was also suggested that including advanced nutrient formulations will help encourage innovation and advancement in nutrient use efficiency technology.

With the extension of the forum until the 11th of February, we are still anticipating more feedback, both from those of you who have responded already and from those of you who are new.

Next week, in addition to the digest, we will also provide some more information on the next-steps in the process towards producing the CoCoFe document.

Thanks and best regards from the CoCoFe facilitation team,
Debra, Ronald and Gary

## Aklilu Nigussie, Ethiopian Institutes of Agricultural Research, Ethiopia

On the objectives:-

1. As there is always heterogeneous factors that can affect production and productivity it will be advisable to target:-

* Increasing food production and productivity than maintaining

2. For the second objective only maximizing or efficient use of external plant nutrients cannot sustain agricultural production and productivity so:-

* It will be rational to increase fertility of the soils or the farm or alarming increase of soil health with organic composition of nutrients can sustain agriculture visa vis other things are constant (climate variability, pest or insect or virus infestation and others)

3. Objective of minimizing environmental and human health impact can be merged as one objective yet:-

* The objectives can encompass animal health and eradicating toxicities of food plants from inorganic fertilizer application

4. Food safety could be from the post-harvest handling, application of toxic fertilizer, pesticides, fungicides or any environmental and human wastes; so that:-

* Food safety type to address should be indicative like increasing food safety from application of inorganic fertilizer or any.

Here as dynamism is always expected positively or negatively it is good to set objective not with maintaining rather increasing.

## Dr. Amanullah, Department of Agronomy, The University of Agriculture Peshawar, Pakistan

In developing and under developed countries the cost of chemical fertilizers is very high. But the growers / smallholders are very poor.

The growers are not able to buy the chemical fertilizers. As the soil fertility in these countries is also low because of low organic matter in soil.

Therefore, yield is very low which is the main cause of food security issue in these countries. The UN organizations need to think about the high prices of chemical fertilizers. Better if FAO or other organizations try their best to reduce the higher prices of chemical fertilizers.

The governments must give the fertilizers to growers on subsidized rates. Otherwise, decline in soil fertility and food security problem will further increase, thanks.

## David Ojo, NIHORT, Nigeria

Tropical soils are most variable and fragile to soil fertilizer ammendments based on my research and consultancies. There is the need to employ and deploy those atht are most vulnerable and seasoned especially at the local levels in adaptation and implementation plans for fertilizer use efficiencies .........

David,

NIHORT, Nigeria.

## John Conway, Royal Agricultural University, United Kingdom

Given the global scope of the CoCoFe, do you think the objectives are appropriate? **YES**

How should be the CoCoFe be structured to have the maximum positive impact?

Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence? **Extension officers, agronomists and other fertilser advisers. Places where fertiliser is sold**

What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well? **All nutrient materials should be included : through Europe we have regulations especially on manure & biosolids due to nitrate leaching : I am not sure whether they have caught up with the explosion in AD digestate.**

Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives? **It will assist if it is widely disseminated - bout our research in Nigeria suggests there are so few extension workers the message may not reach farmers. Sellers of fertiliser materials should be required to display notices and hand out leaflets with every sale made.**

## Philippe Eveillard, UNIFA Union des Industries de la fertilisation, France

**Contribution de l’UNIFA, Union des Industries de la Fertilisation, France**

**Qui sommes-nous ?**

Un syndicat professionnel de 50 producteurs d’engrais minéraux et organiques, d’amendements minéraux (carbonates de calcium, chaux) et de biostimulants destinés à améliorer la nutrition des plantes et la fertilité des sols. Nous sommes membre fondateur en 1980 de l’association française pour la promotion de la fertilisation raisonnée, le COMIFER (integrated nutrient and soil management) qui comprend tous les acteurs nationaux sur cet enjeu : ministères de l’agriculture et de l’écologie, recherche, enseignement, instituts techniques et agriculteurs.

Nos réponses aux questions posées sur les thèmes figurent ci-après:

* Compte tenu de la portée mondiale du CCGE, pensez-vous que les objectifs sont appropriés?  Dans le cas contraire,  quels éléments supplémentaires ou changements souhaiteriez-vous apporter?

Le code de conduite ne s’adresse pas qu’à la gestion des apports. Il peut être élargi à tous les moyens pris pour améliorer la nutrition et la fertilité des sols. La place des engrais et amendements est irremplaçable mais l’introduction de cultures légumineuses ou de plantes de service (capturant le nitrate ou d’autres éléments nutritifs) avant d’être détruites et réincorporés au sol sont des actions complémentaires. Le code doit couvrir tous les éléments nutritifs indispensables aux plantes et toutes sources organique ou minérale des fertilisants.

Sur les cinq objectifs eux-mêmes :

1-~~maintenir ou~~ accroître la production alimentaire mondiale : un accroissement de la production est nécessaire face à l’essor de la démographie jusqu’à 2050 au minimum. Si des gains sont à attendre d’un moindre gaspillage alimentaire, ils ne suffiront pas et une amélioration de la productivité des cultures sera nécessaire.

1. maximiser l'utilisation efficace des nutriments ~~végétaux~~ indispensables aux plantes pour promouvoir une agriculture durable;

Le sol doit être pris en considération car il constitue le réservoir d’éléments nutritifs que la fertilisation n’a comme objectif que de compléter. Si ce réservoir se réduit parce que l’exportation d’éléments par les récoltes n’est pas compensée alors l’agriculture n’est pas durable.

1. réduire au minimum les incidences de l'utilisation d'engrais sur l'environnement, y compris la pollution due à la perte de nutriments par ruissellement, lixiviation ~~lessivage~~, émissions de gaz ~~à effet de serre~~ et autres mécanismes;

Plus généralement les transferts d’éléments nutritifs en dehors du sol (vers l’eau et l’air) sont à éviter car ils constituent une perte économique et entrainent un coût environnemental

1. réduire au minimum les incidences sur l'environnement et la santé humaine descontaminants présents dans certains fertilisants ~~polluants tels que les métaux lourds contenus dans les engrais;~~

Ces contaminants ne sont généralement pas liés aux processus de production mais plutôt à la composition des matières premières. Le terme contaminant englobe les éléments trace ETM, les produits organiques persistants (ex : HAP) et les pathogènes pour certains fertilisants d’origine organique (excrétions animales ou humaines).

1. maintenir et accroître l’innocuité alimentaire. Redondant avec l’objectif précédent
* Comment le CCGE devrait-il être structuré pour avoir le maximum d'impact positif?

Traiter ensemble les apports organiques et minéraux qui sont complémentaires. Viser un usage raisonné des éléments nutritifs pour éviter à la fois les situations d’apports insuffisants (agriculture minière épuisant la fertilité des sols) et d’apports excessifs (transferts accrus vers l’air et l’eau)

* À qui le CCGE doit-il s’adresser pour atteindre les objectifs escomptés et comment élargir et diversifier ce public cible pour accroître son influence?

Accroitre le niveau de connaissances des pouvoirs publics, des législateurs, des relais scientifiques et techniques. Favoriser la démultiplication dans les langues nationales de principes d’action pour une gestion responsable et intégrée des éléments nutritifs. Une grande importance doit être accordée aux interactions entre les éléments nutritifs, à l’équilibre nutritionnel et à l’entretien d’une fertilité des sols favorables à la croissance des racines des plantes.

* Quelle devrait être la portée du CCGE? Quelles sources d'~~intrants~~ éléments nutritifs conviendrait-il d’inclure : uniquement des engrais ~~synthétiques~~ minéraux, ou aussi les produits d’origine organique ~~le fumier, les biosolides, le compost~~, etc.  D'autres produits tels que les biostimulants, les inhibiteurs de nitrification, les inhibiteurs d’uréase, etc. devraient-ils également être inclus?

Engrais minéraux incluent toutes les formes : phosphates, potassium, magnésium, calcium issues de minéraux naturels. Il n’y a aucune synthèse associée à leur production.

Produits d’origine organique englobent les nombreuses formes d’effluents d’élevage (fumiers, lisiers, fientes…) éventuellement traités (composts, digestats de méthanisation) et aussi d’autres sous-produits d’origine alimentaire ou des déchets urbains.

Le raisonnement associe ces deux sources organique et minérale qui sont complémentaires. Les amendements organiques et minéraux contribuent marginalement à la nutrition mais sont très importants pour la fertilité des sols (humus, correction de l’acidité des sols…). Enfin les biostimulants plus récemment apparus sont susceptibles d’améliorer la nutrition des plantes et peuvent être inclus dans la réflexion.

* Le CCGE contribuera-t-il à promouvoir une utilisation responsable et judicieuse des engrais?    Pourquoi ou pourquoi pas?  Avez-vous d’autres suggestions pour aider le CCGE à atteindre nos objectifs?

Le code doit sensibiliser à l’ampleur des enjeux liés à la fertilisation : sécurité alimentaire future, qualité de l’offre alimentaire et amélioration de la fertilité des sols cultivés base d’une agriculture plus durable.

Il ne doit pas être prescriptif car le raisonnement est du niveau local et tient compte de nombreuses variables (sols, climats, systèmes de culture…°Il doit poser les principes de raisonnement qui peuvent s’appliquer d’une façon générale en se fondant sur les dernières connaissances scientifiques.

Pour faire vivre ce code, des partages d’expérience entre pays seront certainement à encourager sous toutes leurs formes (forum, colloques régionaux…).

**L’UNIFA met à disposition de l’enseignement agricole un espace de ressources pédagogiques.**

<http://www.unifa.fr/librairie/espace-pedagogique.html>

## Suresh Kumar Chaudhari, Indian Council of Agricultural Research, India

In India, the quality of fertilizers both chemical and organic (biofertlizers, Compost, Manure etc.) are regulated as per Fertilizer (Control) Order (FCO), 1985 promulgated under section 3 of Essential Commodities Act. The main objectives are to regulate trade, price, quality control and distribution of fertilizers. As per clause 19 of FCO, no person shall himself or by any other person on his behalf manufacture/import for sale, sell, offer for sale, stock or exhibit for sale or distribute any fertilizer, which is not of standard prescribed in FCO. The Content of Fertilizer (Control) Order (FCO), 1985 can be viewed in <http://www.faidelhi.org/fertiliser-control-order.htm>.

Samples of fertilizers are drawn periodically by fertilizer inspectors of State Governments to check their quality as per the parameters prescribed in the FCO. In case of imported fertilizers, the fertilizer inspectors of Central Government draw samples from ships/containers. State Governments are empowered under the FCO to take appropriate administrative and legal action against those not complying with the provisions prescribed in the Order. The distribution of chemical fertilizers from production to end-users are monitored online through Fertilizer Monitoring System under Department of Fertilizers, Ministry of Chemicals & Fertilizers.

## E.V.S. Prakasa Rao, Independent Researcher, India

Different countries could have R&D policies of evaluatiing indigenously available materials which could be incorporated with fertilizers to enhance their use efficiency as well as reduce adverse effects on environment. For eg. research has been done in India on using indigenous materials such as neem (Azadirachta indica) cake, pyrites and natural essential oils and derivatives for enhancing N-use efficiency in a variety of cropping systems and soil conditions. Government of India has taken a poilicy decision to coat all the manufactured urea with neem oil in the country ( Prakasa Rao et al., 2017). The paper is attached.

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/Indigenous%20materials%20for%20increasing%20the%20efficiency%20of%20fertilizer%20nitrogen.pdf>

## Dhanya Praveen, Environment Protection Training and Research Institute, Hyderabad, India

Suggestions:

1. Incentives for sustainable Farm management especially for maintaining diversified cropping systems will definitely help in the long run to ensure soil health. Apart from that imposing taxes for the use of fossil fuels. extension and other agricultural
2. Additional incentives to even agricultural extension service professionals as a boost to enhance responsibility on reducing methane and nitrous oxide emissions due to overuse of fertilizers.
3. GPS tracking facilities will help in assuring the timely monitoring and management of emissions and other impacts of overuse of fertilizers.
4. Time to time, Stakeholders should be called for comprehensive action to address the issues of efficient fertilizer applications especially to tap traditional knowledge on the use of locally adapted seeds and livestock varieties and for producing on-farm fertilizers like compost, manure etc.
5. Scaling up organic agriculture as part of Climate smart Agriculture initiatives as not only National programmes but even at local level.

## Mireia Llorente, University of Extremadura, Spain

Creo que es esencial entender y trasmitir la noción de que el cuidado de la fertilidad del suelo y su fertilización son dos conceptos diferentes. Sólo a través del cuidado y manejo de la fertilidad del suelo directamente relacionado con el mantenimiento e incremento de la materia orgánica en el mismo podremos hablar de manejo sostenible. La materia orgánica del suelo lo hace resiliente ante los escenarios de futuro. Para lograr una productividad sostenible o mejorada es imprescindible entender que el suelo requiere de la incorporación de materia orgánica. La fertilización mineral sólo ha de entenderse de forma complementaria o añadida a lo anterior.

## J G Ray, School of Biosciences, Mahatma Gandhi University, India

The correct meaning of the word ‘management’ is ‘use with skill’. In the case of fertilizer management this is very important; because the major problem with chemical fertilizer usage is ignorant and irresponsible uses and the associated environmental and health issues.

Illiterate farmers in most of the developing countries consider chemical fertilizers as something ‘magical’ and use the same in enormous quantities without the exact knowledge of the kind of fertilizer required, the quantities need to be applied and the exact time and mode of application.

As a result, the excessive or unwanted chemicals applied leach out to surface water bodies, down to the groundwater resources causing widespread eutrophication and destruction of water resources.

The excess chemicals even remain in the field soil and affect the natural biological process of soil and adversely affect the inherent qualities of soils to support plant growth.

Therefore, the major codes of conduct for management of chemical fertilizers should include:

1. Strict control of unnecessary and untimely application of chemical fertilizers
2. Farmers should be able to consult the agricultural officers/specialists and get the prescription for the right kind/amount of fertilizer to be purchased and the time and mode of application as well
3. For a particular kind of crop of a particular cultivated region (or for a specific soil type), the right kind of fertilizers for the specific requirement of the crop alone should be made available in the region
4. There should be green belt or phytostabilization or Phytoextraction traps around a chemicalized field to prevent leaching out of excess fertilizers into nearby surface water bodies
5. Farmers should get instructions in native language on all kinds of adverse ecological impacts that may arise from chemical fertilizer applications in soils

Farmers should be informed of the kind of heavy metal or other contaminants in a fertilizer and the impact of the continuous usage of such fertilizers

In the case of organic fertilizers as well as biofertilizers also, similar kind of instructions should be provided. In general, majority of illiterate farmers think that the organic fertilizers are totally harmless and they are unaware of the kind of ecological impacts from excessive use of the same.

1. Organic fertilizers also contain inorganic or organic impurities, which the farmers should be informed
2. Farmers are often cheated with regard to the quality of organic fertilizers; therefore, the nutrient (NPK or other nutrient) equivalency of the organic fertilizers should be provided
3. When a biofertilizer is given, exact soil and environmental conditions required for their successful activity in soils as well as the biological health of the microbial seeds should be provided
4. Environment or health hazard from the use of a biofertilizer should be properly informed

Food security is very significant for human survival. Environment security is also equally significant. Therefore, the major theme in the ‘code of conduct for fertilizer management’ should be learned applications of the same and strict control of ignorant and irresponsible uses of fertilizers to ensure sustainable management of food security.

## Lydia Mhoro

Fertilizer use is inevitable in the world of today due to high population growth and most of the arable lands are highly degraded in terms of soil fertility (physical, chemical and biological). However, to minimize the side effects of fertilizer use the following should be included in COCOFe

(i) The COCOFe should emphasize on the quality on the carrier materials used by fertilizer manufacturers (most of them are heavy metals which are detrimental for human health)

(ii) The COCOFe should include the application time and method for a specific fertilizer based on their solubility (most peasants especially in developing countries do not know the best way and time of fertilizer application)

(iii) Soil testing is before fertilizer application should be emphasized to minimize overdosing which consequently cause environmental pollution

(iv) Organic fertilizers such as manure, industrial by-products and crop residuals should be integrated with industrial fertilizers to avoid high use of industrial fertilizers.

## José Antonio Cayuela, CSIC, Spain

Given the global scope of the CoCoFe, do you think the objectives are appropriate? Yes, I think so.

How should be the CoCoFe be structured to have the maximum positive impact? In my opinion, the CoCoFe structure should matches the fertilizers behaviour in soil. Nitrogen fertilizers deserves particular attention, since the stability in soil of mineral N is very few. P, K and other may be grouped in common procedures. I think the CoCoFe structure may be similar to that of 'Good agricultural practices for fertilization', developed in some countries (I know the case of Spain, to which good practices codes I indirectly contributed through my doctoral tesis entitled 'Nitrate leaching under corn monoculture').

Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence? I think the agents involved in the decisions on the dates when the fertilizers must be applied, they are the best audience. It is today well known that N fertilizers must be saved from rainy seasons, which dramatically lixiviate the mineral nitrogen from the upper layer of the cultivated soil.

What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? In my opinion, all fertilizers types should be included. In Europe, the largest points of groundwater contamination by nitrates was produced, some decades ago, by organic residues from big livestock farms.

Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well? Yes, in brief.

Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Yes, it will. Why or why not? It will guides good practices. What other suggestions do you have to help the CoCoFe meet our objectives? I think the 'Good practices for fertilizers management' codes developed in some countries can help.

## Brajendra Parmar, ICAR-Indian Institute of Rice Research, Hyderabad, India

I wish to draw attention towards one such intervention, how Government action can lead to sudden upliftment of the use efficiency of nutrients. In 2015, the government Ogf India ,had made it mandatory to coat domestic/imported urea with neem oil. This was done to boost crop yields, reduce cost of production and curb diversion to non-agriculture sectors. This was also done with the background information that India produces around 2.5 lakh tonnes of neem oil every year, which is sufficient for mandatory 100 per cent coating of domestic and imported urea, Also several reports suggest that It is estimated that over 60 per cent of the world’s neem tree population is found in India. Recent media reports suggest and senior government functionaries stated that the manufacturers have been asked to install CCTV camera at production facilities and ports, and ensure proper testing of neem oil in-house as well as through outside laboratory before using the same for urea coating, he added. Higher government functionaries stating that neem-coated urea is showing positive results, the official said a study conducted by the Agriculture Ministry in four states —— Bihar, Maharashtra, Madhya Pradesh and Punjab —— found that there was increase in farmers’ returns due to rise in crop yields and reduction in cost of production because of lower consumption of urea. The study, conducted through Bengaluru-based Agricultural Development and Rural Transformation Centre (ADRTC), found that use of neem-coated urea improved soil health, reduced costs on plant protection chemicals, reduced pest/disease attack and higher crop yields,

I suggest such measures can in a single stroke lead to immediate increase in use efficiency of this particular nutrient at field level.

## Brajendra Parmar, ICAR-Indian Institute of Rice Research, Hyderabad, India

Dear All,

One major concern of poor nutrient use efficnecy has been how we have addressed hisatorically the nutrient applications. Whether we have sound mechanisms to measure good soil health indicators.  I quote from my recent research paper as

Why concern about soil – health?

          Our soil is continuing to undergo increasing stress from alarming pace of population growth, of vegetation line, soil degradation, increasing concentration of population in soil, climate change and loss of bio-diversity. There is extreme  change in the global climate on one side of the country there is drought and in other part unseasonable and erratic precipitation adversely affect the crop production resulting in serious impact in our existing agricultural growth. Modernization of agriculture has considerably affected the physical and chemical constraints like formation of traffic soil pan, soil crusting, soil structure deterioration due to decline in organic matter, soil nutrient depletion, non-judicious water management. All these constraints will badly reflect soil health and crop production.

Major factors affecting soil quality

          The major causes of poor soil quality are :

1. Wide gap between nutrient demand and supply
2. High nutrient turnover in soil plant system coupled with low and imbalanced fertilizeruse.
3. Emerging deficiency of secondary and micronutrients due to improper use of inputs such as water, fertilizers, pesticides, etc.
4. Insufficient use of organic inputs
5. Acidificaiton and Al3+ toxicity
6. Development of adverse soil conditions such as heavy metal toxicity
7. Disproportionate growth of microbial population responsible for soil sickness and erosion, deforestation due to rapid urbanization and industrialization.

Quantitative assessment of soil quality

          There are mainy approaches that are used for soil quality evaluation per se soil health. In all these cases minimum data set (MDS) can be used. Among them, the following approaches are  important to assess soil health condition.

* Comparative assessment: Here the performance of a system can be evaluated in relation to alternatives at a given time only. For example, after 15-25 years of cultivation, some quality parameters get changed over initial soil quality attributes due to land-use-management practices, particularly in long term soil fertility experiments under different cropping system.
* Dynamic assessment: In this case, a performance of a system can be evaluated in relation to alternative across time. The dynamic assessment approach should includes many steps viz., explicit identification of the desired outputs of management (productivity, erodability, human, animal health etc.). Then assessment of design of the system to determine if it will produce the desire output. Identification of soil quality parameters, establishment of starting point, historical record of the site should be maintained and stabilization of a system process that is out-of-control. A stable system of variation is one of which the variation is solely a result of the system in place, and there are no special causes of variation.
* Common statistical approach – Regression analysis: Here multiple linear regressions can be used to calculate soil quality index of crop productivity using soil attributes as important determining factors.
* Pedotransfer functions: This is a mathematical function that relates soil characteristics and properties with one another using minimum data set for evaluation of soil quality. Many pedotransfer functions occur in the literature and are statistical or empirical in nature. Some selected PTSs are may be cation exchange capacity (CEC = a OC + bC relationship, bulk density, Db = f (OC+clay), change in organic matter, C = a + b OC and soil productivity, P1 – f (Db +AWHC +pH + EC +ARE).
* Standardize scoring function based on threshold limits and base line values: Scoring functions are based on threshold limits and base line values (Karlen and Scott. 1994). These functions are used to transform the measured indicator values into performance-based score for soil quality index. In this approach of Relative Soil Quality Index (RSQI), for example 9 indicators were combined into an RSQI. The equation for calculating RSQI value is given below:

RSQI = (SQI/SQIm) x 100, here SQI = soil quality index; SQIm = Maximum    value of SQI

The maximum value of SQI for soil is 400 and the minimum value 100 (Wang and Gong 1998). SQI is calculated from the equation:

As SQI = ∑ WiIi ; Wi = Weights of indicators; Ii = the marks of the indicators classes as shown in

SQI of every indicators arecalculated separately by multiplying weight of indicators and marks allotted to each class.

* Principal component analysis (PCA): The principal component analysis (PCA) is a useful multivariate statistical tool that has the advantage of generating relationships among many correlated variables into a few principle components (PCs). These can be classified as soil quality indicators with respect to the specific soil functions. Changes in the properties or soil attributes associated with a PC can be used to classify soil quality as aggrading, degrading or stable. In this method, four steps are followed: (i) define the goal, (ii) select a minimum data set (MDS) of indicators that best represent soil function, (iii) score the MDS based on performance of soil function and (iv)integrate the indicators scores into a comparative index of soil quality.

          Read my paper for more contents and clarity related to how developing a model soil health indicator can lead to better nutrient use efficency ultimately enhancing the fertilizer use efficiency.

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/Developing%20a%20model%20Rice%20soil%20health%20indicator.pdf>

## Brajendra Parmar, ICAR-Indian Institute of Rice Research, Hyderabad, India

Dear All

Unless platform is ready applications will go haywire. Means, your fertilizer use efficiecny is as good as your soil condtions. In this context, on world soil day, me involved , brought out a brochure for all the stakeholders to alert them abvout broader societal roles in making our soil health sound. Some excerpts:

Soil is a natural resource serving the human beings since time immemorial.  It takes thousands of years to make one meter depth of soil.  Soil is key to  eco-system services as it plays vital roles in carbon cycle, storing and filtering of water.  The organic matter content, on an average, has gone down to a critical level of 0.3 to 0.5 percent and several micro-nutrient/multinutrient deficiencies are emerging/reported from various parts of the country.  Furthermore, declining response ratios due to over use of fertilizers are being often  reported, which lead to wasteful expenditure on fertilizer subsidy meaning loss of key national resources.  This is affecting human health, apart from posing serious threats to agricultural productivity and sustainability.  Another alarming factor is, nearly 140 million hectares of soils have become problematic because of the fact that they are either acidic, saline or sodic or alkaline soils.  For India, which has over 17% of world population with limited land resources, the situation warrants immediate attention to take care of the soils.  Unless immediate attention is paid, it will pose serious threats to agricultural sustainability and to feed the beeming billions will put our already scarce resources to severe stress.

* Role of stakeholders in promoting Sustainable Management of soil

Sustainable soil management is fundamental for food/nutrition as well as water security.  The important role of soil in mitigating climate change is highly relevant in the changing scenario of climate.  The well managed soil helps in storing/sequestering carbon and reducing global greenhouse gas emissions.  The need of the hour is, to protect our soils especially in terms of their quality.  Soil should be managed in such a way that organic matter is not further deteriorated, precious top soil is not lost and water is retained.  Better managed soils sustainably support agriculture, enhance efficiency of inputs and enhance quality of agricultural produce.

* Role of Extension

                The extension system of the country should focus on the importance of soil health while they deliver advisory services to the farmers.   The State government should encourage farming practices that contribute to soil health.  Farmers who contribute to soil health also need to be incentivized. Such incentives should be built-in into various schemes implemented by the states/GOI.

* Role of Research

                The research need to focus on various methods to restore soil health and recommend simple/workable solution so that can be adapted at farmer’s level.

* Role of Urban and Rural Local Bodies

                The soils are continuously being polluted due to effluents released from the urban and rural sewerage system due to untreated drainage released into agriculture fields.  Pollution-loaded effluents from Industries including small scale industries is a matter of grave concern as soils and river  ecosystems are polluted with metals, poisonous substances which  cannot be restored for millions of years.   The local bodies shall effectively treat the effluents, and release only after harmful effluents are prevented and soil contamination minimized.

* Role of Community Action

                Soil being a national resource, the whole community needs to be involved in its upkeep and restoration. Community Action to be promoted to create awareness about Soil Health Management at various levels- Schools, Panchayats, Shopping complexes, Marketing yards so as to generate bare minimum plastic waste and promote use of bio-degradable items.

* Role of Farmers

                Since time immemorial, farmers of India have been very innovative in protecting the soils.  They have been practicing innovations like incorporating catch/cover crops, adding compost to the soils, adding green manure and green leaf manure before onset of monsoon.  The need of the hour is to restore good rational systems back so that our soils are protected and health of the soil improves.  The livelihoods of the farmers will be protected only as long as soil health is good.

 Soil Information Services

1. To place a comprehensive  uniform soil and agricultural information system  and Integration/Network/sharing of Soil date/Land use data/and relevant auxiliary data to make the system robust and useful for analytics as well as decision support.
2. Enhance Capacities to use the information on GIS platforms  and bring in Uniformity and harmonization of methods, measurements and indicators around soil health management (like soil sampling and testing, economics of land degradation, benefits and impacts of soil health in agriculture)
3. Documentation and availability of indigenous soil health management practices/knowledge

 Strategies

* In all watershed programs, soil health management shall be given top priority.

"Soil Health Cards will be updated once in 2 years and should be digitized ie Soil health status of the country should be on a mouse click. Soil health will be integral part of all natural resources management schemes and implementation.

"Heavy machinery suited to Indian soils and not deteriorating soil health will alone be encouraged as a part of mechanization.

"Encouraging integrated farming systems (IFS) and organic farming.

       "Converting urban solid waste as a nutrient after thoroughly testing for residues and Encouraging practices enhancing  levels of soil organic matter content at plot or farm level.

* Incentives for youth to establish soil health related enterprises at village level like bio-fertilizers units , compost/vermi-compost units, soil testing labs and recycling of agriculture waste and convert into organic matter
* Farmers undertaking Good Agriculture Practices (GAP), and maintaining good soil health will be given cash awards (DBT), by concern Gram Panchayat(5 farmers per Gram panchayat concern GP). Farmers who are maintaining good soil health by having cover crops, using compost and applying balanced doses of fertilizers will be considered for cash awards.  The amount will be given through State Governments.
* Subsidies to be provided to seed companies to provide cover crop seed along with main crop seeds ie companies must promote System diversification & Legume integration.

Marketing of Carbon Credits

                Suitable marketing institutes will be developed to integrate farmers to encash and sell carbon credits and ecosystem services developed by farmer.

Finance

                Need based finances will be given to encourage farmers to avail institutional loans for improving the Soil Health of Indian Soils.

Read more from our brochure attached:
<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/Social%20Action%20for%20soil%20health%20Management.pdf>

## Dick Tinsley, Colorado State University, United States of America

If you will excuse me I would like to return to the discussion and mostly reiterate my previous concerns regarding code of conduct regarding fertilizer use. This goes back to keeping careful track of the financial limits of most developing country that limits the amount of effective regulation and supervision that is possible without providing civil officer a major opportunity to extract gratuities for service assumed run, but not done. The result of this is an almost total reliance on the private sector to handle the distribution of fertilizers, with an emphasis on the village based family enterprises that are in direct contact with the smallholder farmers. They are also friends and neighbors and their best prospects for remaining in business is highly dependent on return business, which make them very quality conscience of the service they are providing.

Also, there is a need to be careful on any soil testing expected. Typically soil test cost approximately the same as a bag of fertilizer, and thus if the text in like to result in less than a bag of difference in fertilizer application, it will not be cost effective. Since most of the fertilizer in N based the difference of a whole bag of fertilizer on a one hectare or less field is unlikely. Can any host country actually get soil test results in the timely manner available in the USA (24-48 hours).

Also, be careful on your emphasis on organic fertilizer. While fully support the idea, it must be cost effective both financially and operationally. The latter being mostly associated with the labor needed to move around large volumes of low concentrated nutrients. In the context of developing country smallholder farmers that are already energy limited, the extra energy must come from the increased yield resulting from the organic nutrient application even if this is some 6 months later. I would guess that the farmer will need to gain 100 g of grain for each hour of additional labor handling the organic material. (100 g grain = 300 kcal, the energy exerted by an hour of diligent effort). Is this possible? In addition, there are limits on the amount of organic material available on farm for nutrient recovery. I think when dealing with crop residues the ratio of accumulated area to distributed area is about 3 to 1. Given all this I suspect the best means of nutrient recovery and recycling is to leave it up to the mobile composter (goats) they will take material normally burned and fairly quickly convert it to a material easily in cooperated, while actually gaining some energy from the process. Isn’t feeding rumens animals the same process as composting? Microbial de-carboning and concentration of the material. Again, please check the webpage: [http://smallholderagriculture.agsci.colostate.edu/organic-source-of-nutrients-some-simple-computations-please](http://smallholderagriculture.agsci.colostate.edu/organic-source-of-nutrients-some-simple-computations-please/)

## Fertilizers Europe, Belgium

Fertilizers Europe represents the majority of fertilizer producers in Europe and is recognized as the dedicated industry source of information on mineral fertilizers. The association communicates with a wide variety of institutions, legislators, stakeholders and members of the public who seek information on fertilizer technology and topics relating to today’s agricultural, environmental and economic challenges. The Fertilizers Europe website provides information on subjects of relevance to all those interested in fertilizers contributing to food security. “Infinite Fertilizers” guides the European fertilizer industry’s initiatives to ensure that Europe’s farmers have access to a variety of safe, high quality, locally produced fertilizers, as well as information on their use, environmental impact and nutrient recycling opportunities.

1. **Given the global scope of the CoCoFe, do you think the objectives are appropriate?  If not, how would you add to them or modify them?**
* **Objectives proposed by the FAO**

The objectives proposed by the FAO should be modified accordingly:

1. ***Increasing global food production***

Reasoning: it is broadly agreed that food production will have to increase significantly to ensure food security worldwide. From that perspective maintaining current food production would not be sufficient.

1. **Optimizing efficient and *effective* use of all plant nutrients to enhance sustainable agriculture**

Reasoning: the effectiveness in increasing crop yields is key to reach sustainable agriculture worldwide.

1. ***Preventing poor use of fertilizers in order to minimize environmental impacts* associated with nutrient losses to the environment*, while acknowledging the environmental benefits also provided by the use of fertilizers***

Reasoning: Fertilizers in general and mineral fertilizers especially are instrumental in contributing to food security worldwide. Thanks to the use of fertilizers, agriculture production becomes more efficient, thus giving more space for forests to grow.

1. **Ensuring food safety by assessing and managing risks from non-nutritive trace elements and organic contaminants in fertilizers**

Reasoning: Any objective focusing on non-nutritive elements in fertilizers must not only look at heavy metals, which are relevant a.o. for mineral fertilizers, but also at organic contaminants and pathogens. In Europe, nutrient recycling initiatives are increasing, which make it necessary to also limit the presence of organic contaminants and pathogens (such as E.coli, salmonella or pharmaceutical residues). In addition, objectives 4 and 5 are closely related and quite redundant. We would like to suggest merging them into one single objective

In addition, we suggest adding 2 new objectives:

1. **Improving food quality and nutrition security through optimal use of plant nutrients**

Reasoning: Adding a reference to food quality would be useful as good fertilizer management practices can influence positively nutritional quality of harvested crops.

1. **Managing fertilizers to maintain or increase soil structure and fertility**

Reasoning: An objective referring to the maintenance or enhancement of soil quality should be added. Nutrient management plays a key role in keeping productive soils through replacement of nutrients removed with consecutive harvests and in controlling soil organic matter levels. By providing nutrients and organic matter to the soil, fertilizers (mineral and organic) play a key role in preserving healthy soils and preventing soil degradation.

* **Second document to be developed later by the FAO**

Fertilizers Europe strongly discourages the FAO from developing “a second document, [which would] address scenarios with low or no fertilizer use under the topic of integrated soil fertility management”. First reason is that under-use of fertilizers cannot be dissociated from over-use. Second, in the European context, this document could be understood as a validation of the misbelief that low/no fertilizer use would be sustainable. However, it is obvious that such an approach would go against the fact that fertilizers are used to fill the nutrient needs of the crops grown by farmers, in order for growers to achieve good yields and high quality crops. Scientific findings comparing fertilized with unfertilized land also indicate that no or low fertilizer use would not be the right way forward for the following reasons:

1. **How should be the CoCoFe be structured to have the maximum positive impact?**

The CoCoFe should include broad recommendations and general principles on what should be considered when designing strategies to manage fertilizers sustainably, which would then have to be adapted by regional agencies and national authorities to the local farming conditions. It should provide guidance at the regulatory level to outline the roles and responsibilities of the multiple stakeholders involved in the entire value chain. The CoCoFe could be structured along the following chapters:

**1) Optimization of fertilizer use in order to increase food production globally**, since the CoCoFe should recognize the instrumental contribution of fertilization to global food security and global nutrition.

**2) Optimizing efficient and effective use of plant nutrients to enhance sustainable agriculture**, knowing that the reasons of the limited effectiveness/efficiency in the use of fertilizers can vary from situation to situation. However some general causes could be identified in a specific chapter: uncertainty of the nutrient content of organic fertilizers, limited knowledge of their nutrient availability after application, limited awareness of the cost-benefit of a better nutrient planning, great number of information required for detailed planning at field level, lack of technical assistance to farmers. It should also be taken into account that all essential plant nutrients have an influence on the yield level. A *sustainable* level of nitrogen fertilization could become *unsustainable* if another nutrient is missing and thus limiting the yield.

**3) Prevention of poor use of fertilizers in order to minimize use-related environmental impacts, with a strong focus on existing scientific findings**. For instance, several trials have shown that if nitrogen application is done in quantities that correspond to the nitrogen requirements of the crop, then leaching is not greater than from unfertilized landiii.

**4) Focus on options and approaches, which have the most rapid environmental impact – while yields and quality are maintained.** Future sustainability in agriculture (in view of SDG 2) can only be ensured if there are broad incentives towards the continuous development of principles for a smarter, more efficient and effective use of production tools in farming with greater precision. This can be achieved by striving for a full utilization of nutrients, but also of energy and water, together with appropriate conservation of the soil and environment.

The CoCoFe guiding principles should be:

* Understandable and applicable,
* The basis for guidelines, which will have to be transformed into concrete schemes in order to be implemented at local level, depending on the country, or the farming system within a country.
* Supported by an Advisory Committee, composed of representatives of the scientific and academic community, leading scientists on crop nutrition worldwide (TFRN, IPNI), farmers’ organizations (WFO), NGOs and industry representatives (IFA).
1. **Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

The CoCoFe should be both developed and disseminated thanks to a multi-actor approach i.e. the cooperation of different stakeholders. It should also build upon existing expertise of leading scientists on crop nutrition worldwide (TFRN, IPNI…), farmers’ organizations (such as the World Farmers’ Organization) and industry representatives (such as IFA, TFI or Fertilizers Europe). The best audience should be government at the policy level, fertilizer industry, NGOs, the academic community including students and training centers for farmers at the technical level.

The key aspect is of course the communication with farmers and growers, which is beneficial from the initial development of the CoCoFe right through to its implementation. Another major role could be played by extension services. Listening to farmers’ needs is necessary for an optimal promotion and development of new solutions and tools. It would also be up to agricultural advisors throughout the different regions of the globe to disseminate the CoCoFe by developing demonstration projects or operational groups towards the target public, the farmers, and, in particular to make the CoCoFe available in the region’s language/tailored on the specific conditions of the own region.

1. **What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.?  Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

The scope should be to promote resource-efficient farming which makes the best use of local (mainly organic) and external resources. Therefore, all nutrient input sources (i.e. mineral and organic) should be included on a strictly scientific basis. Also all essential plant nutrients (macro- and micronutrients) should be considered, in order to have a broad and holistic approach of crop nutrition. Other categories of products such as biostimulants, nitrification inhibitors and urease inhibitors should also be included. The responsible and judicious use of fertilizers can only be promoted by taking into account all options and products, which are available to farmers. This is especially true because the CoCoFe could also address the so-called “Nutrient Nexus”. Reduced nutrient losses and improved nutrient use efficiency across all sectors simultaneously provide the foundation for a greener economy to produce more food and energy while reducing environmental pollutioniv. Through its broad scope, the CoCoFe should also take a close look at the use of manure as fertilizer on farms, as for example even today most of the phosphorus used as fertilizer in the EU comes from manure, as does a substantial proportion of the nitrogenv.

1. **Will the CoCoFe assist in promoting responsible and judicious use of fertilizers?  Why or why not?  What other suggestions do you have to help the CoCoFe meet our objectives?**
* **Promoting responsible and judicious use of fertilizers**

The CoCoFe could be successful in promoting responsible and judicious use of fertilizers only if its audience, its scope and its aim are clearly defined, agreed and well supported by the target groups. It could only bring added-value to existing knowledge and practices by being based on rigorous scientific findings, and by being adaptable (in a second step) to regional and local conditions.

* **Other suggestions**

More information about nutrient management and balancing crop and environmental needs can be found on the website of Fertilizers Europe:

<https://issuu.com/efma2/docs/nutrient_stewardship_sept_2016_webs>.

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## Muhammad Riaz, Government College University Faisalabad, Pakistan

Escalating fertilizer prices, low fertilizer use efficiencies, low soil organic matter contents and poor soil fertility threaten crop yields and food security in arid and semi-arid climatic conditions. There is an urgent need of research involving research/academic, farmer and industrial stakeholders to adopt strategies for enhancing fertilizer use efficiency to maximize economic returns for small-land holding farmers, especially in developing countries. Famers should be made aware of using balanced fertilizers and follow the 4R approach i.e. right nutrient source, right rate of fertilizer application, right time of application and right place. Following the 4R approach would lead to precision agriculture meaning maximum economic returns and improved soil fertility and soil quality.

## Dick Tinsley, Colorado State University, USA

Please allow an additional comment to my previous one. That is I tend to get upset with the term illiterate and the implication that it means unintelligent as applied to smallholder farmers. Please note that literacy requires intelligence, opportunity and motivation to take advantage of the opportunity. Remove the opportunity does not mean lost of inherent intelligency. Thus the result is there are many poorly educated but reasonable inteligent smallholder farmers, who are actually fairly skilled practitioners in the art of farming, and can quickly sort out what is and is not in their best interest. They are quite capable of sorting out fertilizer rates best suited to their land and the decline production function as crop establishment is delayed.

Thank you

## FAO Publications

**FAO resources on soils and fertilizers**

Here is a selection of titles proposed by FAO Publications for forum participants who would like to read more on fertilizers and soil management.

[**Voluntary Guidelines for Sustainable Soil Management**](http://www.fao.org/3/a-i6874e.pdf)
An easy-to-understand and accessible reference on sustainable soil management for a wide range of stakeholders, from government officials to farmers to the private sector.

[**Status of the world’s soil resources**](http://www.fao.org/3/a-i5199e.pdf)
This 2015 report remains a benchmark for the periodical assessment and reporting of soil functions and overall soil health at global and regional level.

[**World fertilizer trends and outlook to 2020**](http://www.fao.org/3/a-i6895e.pdf)‒ Summary report‒
Estimates and projections of supply of, and demand for, nitrogen, phosphate and potassium fertilizers to 2020, with information on fertilizer use at global, regional and country level and a guide for planning and managing fertilizer resources.

[**Proceedings of the global symposium on soil organic carbon 2017**](http://www.fao.org/3/a-i7565e.pdf)
A report from the symposium on soil organic carbon (SOC), which focused on three themes: monitoring, mapping, measuring and reporting; maintaining stocks of SOC for climate change mitigation; and managing SOC.

[**Soil organic carbon: The hidden potential**](http://www.fao.org/3/a-i6937e.pdf)
On overview of soil organic carbon, and how better information and good practices can contribute to ending hunger, adapting to and mitigating climate change, and achieving overall sustainable development.

[**Soil, land and water**](http://www.fao.org/3/a-i6344e.pdf)
Data and useful information on the linkages between Sustainable Soil Management and climate change adaptation and mitigation, highlighting FAO’s global framework for action.

[**Proceedings of the FAO International Symposium on the Role of Agricultural Biotechnologies in Sustainable Food Systems and Nutrition**](http://www.fao.org/3/a-i5922e.pdf)
A review of agricultural biotechnologies, taking into account low-tech as well as high-tech approaches, to meet demand for a more sustainable agriculture while preserving and enhancing ecosystem services and biodiversity.

[**Water pollution from agriculture: a global review – Executive summary**](http://www.fao.org/3/a-i7754e.pdf)
This review points out negative impacts that agriculture can have on water and, in turn, on human health. It details different forms of pollution (including fertilizer use) and proposes responses.

[**Global assessment of the impact of plant protection products on soil functions and soil ecosystems**](http://www.fao.org/3/I8168EN/i8168en.pdf)
According to this Intergovernmental Technical Panel on Soils assessment, plant protection products remain key to reach global food production targets, provided there is a stringent regulatory framework to mitigate their impact on water quality, erosion and other areas.

[**Nature & Faune: Sustainable soil management key to food security and nutrition in Africa. Volume 30, Issue 1**](http://www.fao.org/3/a-i5292e.pdf)
About 30 papers from different African countries provide insights into the challenges to sustainable soil management in Africa, covering themes from soil surveys and assessments to soil fertility management.

[**Boosting Africa’s soils**](http://www.fao.org/3/a-i5532e.pdf)
This brochure reports on Africa’s soil status after the “Abuja Declaration on Fertilizer for the African Green Revolution” in 2006 and calls for an Integrated Soil Fertility Management (ISFM) perspective, crucial to food security and agricultural sustainability.

## Brajendra Parmar, ICAR Indian Institute of Rice Research, India

Dear All

I am introducing Customized Leaf Colour Chart for Nitrogen Management in Irrigated Rice -one very effective tool in enhancing use efficieny of urea at the field level. As we all know, rice is the major staple food crop of world. In present situation self-sufficiency in rice has been a major goal of agricultural research and development in most Asian countries. Nitrogen fertilizer is an essential input in most rice soils to achieve high yields. Farmers are inclined to apply fertilizer N in high amount to minimize the risk of deficiency, which can lead to excessive fertilizer application. To support decision-making on the timing of N application in rice, ICAR-IIRR, Hyderabad introduced the use of relatively inexpensive precision tools like LCC -a  simple and portable tool. Farmers apply nitrogen over the optimum requirements and it may leads to more losses of applied fertilizers results in lower recovery and efficiency which is already not more than 50%. Rice production in highly permeable soil profiles with alternating aerobic and anaerobic soil conditions, applied N is readily converted to Nitrate, which is prone to leaching, nitrification-denitrification etc.. When N application is not synchronized with crop demand, losses from the soil–plant system are at higher rate. Farmers can easily use the LCC for assessing foliar N status and adjust N topdressing accordingly.

Our field experiments have henceforth proved that

LCC based N management reduces N requirement and improves the Agronomic Efficiency (AE) & Partial Factor Productivity (PFP).

Enhancement of N use efficiency in rice is very important.Application of ‘N’ through leaf colour chart (LCC) and SPAD – N technique gave nearly equal grain yield. These techniques saves about 20 – 30 kg/ha.   colour charts reading recorded at critical growth stages were closely correlated with grain yield. Colour charts of different green colour gradient was prepared and made available to farmers. The customized LCC developed at ICAR-IIRR, Hyderabad on the basis of spectral evaluation of leaves of hundreds of varieties under different N levels can be used for real time N management by using the N application schedules (20-30 kg N/ha depending on the crop stage). Grain yield, AE-N and PFP-N  was enhanced in both  during  wet  and dry seasons ( 5.33 t/ha), 38.14 and 68.64 ).

How to use?

1.Start taking LCC readings from 14th day for Transplanted and 21st day for Direct seeding when basal not applied.

2.If basal ‘N’ (DAP or NPK) is applied take LCC readings at 21-25 DAT for Transplanted; 28-30 DAS for Direct Seeding.

3.Take 10 readings during (8-10 A.M.) from fully expanded, top most and healthy leaf of the 10 plants. (one reading/plant).

4.4. If 6 of 10 readings below the critical LCC 3 value apply ‘N’ as mentioned.

                             Kharif – 20-25 kg N/ha

                             Rabi : 25-28 kg N/ha

5. Repeat LCC readings for every 7 days to judge correct time of ‘N’ top dressing.

ADVANTAGES

LCC is an easy-to-use and inexpensive diagnostic tool.The LCC can be used by the farmer himself to rapidly assess leaf nitrogen status and to decide the amount and time of nitrogen application.Helps to maintain optimal leaf nitrogen content of rice crop, which can be vital for achieving higher nitrogen use efficiency and better yield. Reduces the insect pest infestation.Reduces the cost of cultivation for rice.

## Nicholas Drew, Fertilizer Australia, Australia

Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them? Yes the objectives are appropriate.

How should be the CoCoFe be structured to have the maximum positive impact? It should be a guide to developing a code of conduct that can be utilised in regions around the world to follow core principles in developing a code that is appropriate to each regions circumstances.

Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence? Government, fertilizer industry, relevant NGO’s and farmers. The greater the relevance of the code and the greater the involvement of these organisations in its development – the greater the dissemination and influence.

What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well? The principles of nutrient management should be applied consistently across all sources, so all should be included. Controlled release, slow release, and inhibitor products are increasingly a part of efficient nutrient management and should be included. Bio-stimulants are a less direct influence and perhaps it is not appropriate to include them.

Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives? If it is done well it can certainly assist, it must allow for a balance between productivity and environmental objectives appropriate to each region. A good example of public policy to manage fertilizers is the Queensland Governments Reef Regulation (<https://www.qld.gov.au/environment/agriculture/sustainable-farming/reef>). Developed in consultation with NGO’s like WWF, farmers and the fertilizer industry it mandates good management practices based on the best available scientific evidence for both productivity and environmental protection. The industry stewardship program Fertcare® (<http://www.fertilizer.org.au/Fertcare>) is an effective program in ensuring the reef regulations are understood and supported by industry advisors.

## Joseph Bagyaraj, Centre for Natural Biological Resources and Community Development (CNBRCD), India

**Given the global scope of the CoCoFe, do you think the objectives are appropriate?  If not, how would you add to them or modify them?**

Reply: The objectives are appropriate.

**How should be the CoCoFe be structured to have the maximum positive impact?**

Reply: To have representatives from different agroecological zones of the world.

**Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

Reply: People in governance, policy makers, scientists and progressive farmers.

**What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.?  Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

Reply: Not only chemical fertilizers but also organic manures including compost, green manures, biofertilizers and biocontrol agents should be included.

**Will the CoCoFe assist in promoting responsible and judicious use of fertilizers?  Why or why not?  What other suggestions do you have to help the CoCoFe meet our objectives?**

Reply: CoCoFe can assist in promoting judicious use of fertilizers.

Other suggestions: Soils and soil organisms provide a multitude of agricultural ecosystem services, including waste breakdown and release of nutrients, enhancing soil structure, biodegradation of pesticides and other chemicals, providing a sink for greenhouse gas emissions, fighting pests and soil-borne plant pathogens, and benefiting human and animal health including digestion and immunity. Nutrients such as nitrogen, phosphorus, sulfur and potassium and micronutrients contribute to the soil quality and productivity. Hence, it is important to maintain proper biodiversity and nutrient levels in the soils in order to improve the nutrition and crop productivity.

## Carolina Olivera Sánchez, FAO, Colombia

1. Los objetivos del CoCoFe son muy apropiados para lograr una regulación del uso excesivo de fertilizantes. Para lograr un impacto positivo, este documento debería ser muy concreto y específico. Por ejemplo: tres medidas: 1) exigir análisis de inocuidad frente a metales pesados (es necesario establecer una dosis máxima de uso) 2) establecer criterios para cantidades máximas de fertilizantes aplicados en el suelo 3) establecer condiciones ambientales limitantes para aplicación de fertilizantes químicos (emisión de gases de efecto invernadero, recarga de acuíferos, condiciones de escorrentía hacia ecosistemas estratégicos).
2. Las que están implicadas directamente son las instituciones encargadas de la reglamentación del uso de fertilizantes. Ellas serían directamente las encargadas de formular, aplicar y supervisar las medidas necesarias. Para ampliar estas medidas, además de la reglamentación, sería interesante proporcionar directrices técnicas para la aplicación de fertilizantes en campo. Esto sería una guía interna para los gremios agropecuarios y también para los proyectos que maneja la FAO y la cooperación internacional en general donde muchas veces se realizan compras de fertilizantes sin criterios técnicos suficientes.
3. Estas medidas se deberían aplicar igualmente a los abonos de origen orgánico, de manera específica para cada producción. Por ejemplo: control de ciertos antibióticos y hormonas de crecimiento en productos provenientes de avicultura, porcicultura o ganadería. Cada línea de productos debería ser objeto de una investigación para especificar el riesgo de contaminación asociado. De igual manera, se deberían generar criterios para evaluar las cantidades máximas a aplicar.
4. Este código de conducta puede promover el uso responsable de fertilizantes, siempre y cuando se establezcan medidas claras y realistas que se puedan aplicar y que cuenten con el apoyo de todos los actores. El riesgo es crear un documento complejo que se oponga a los intereses de la industria. Otro riesgo es fomentar la creación de una norma adicional, que no sea aplicada.

Paralelamente al código de conducta sobre fertilización es indispensable trabajar por un mejor conocimiento del suelo y una mayor autonomía de los usuarios de los suelos en el tema. Para eso, existen varias iniciativas y trabajos realizados no solamente para aprender a utilizar los análisis químicos de suelos sino para aprender a conocer las características físicas y biológicas que son indispensables para mejorar la asimilación de los nutrientes y limitar la aplicación de fertilizantes químicos. Se pueden citar varios trabajos que propenden hacia el conocimiento del suelo por parte de los agricultores como los de la Universidad de Cornell por Moebius-Clune et al. y los del geólogo Yves Herody. Estos trabajos se ponen en aplicación y se citan en la Guía de buenas prácticas para la gestión y uso sostenible de los suelos de la FAO, en curso de publicación.

## Lorenzo Faregna, Federchimica/Assofertilizzanti, Italy

Assofertilizzanti is one of Federchimica’s (National Association of the Chemical Industry) 17 Associations that safeguards and represents all the productive divisions of the fertilizers sector.

In order to pursue this aim, it gathers the main operators of the plant food sector, with a whole yearly turnover of about 1 billion euro, equal to more than the 90% of the entire national market.

At current time 55 companies join Assofertilizzanti, they are structured in the following commodity sectors:

* Group of Mineral fertilizers (nitrogenous, phosphates and potassium, compounds,
* based on secondary elements or on microelements), this group includes producers and formulatorsimporters;
* Group of organic-mineral and organic fertilizers, amendments and conditioners ;
* Group of specialized fertilizers.

Assofertilizzanti elaborates the technical, legal and regulatory guidelines related to production and use of fertilizers and promotes such lines towards public decision makers, entrepreneurial organizations, the world of communication and the scientific community.

1. Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?

**Objectives proposed by the FAO**

* maintaining or increasing global food production;
* maximizing the efficient use of plant nutrients to enhance sustainable agriculture;
* minimizing the environmental impacts from the use of fertilizers including pollution by loss of nutrients via runoff, leaching, greenhouse gas emissions and other mechanisms;
* minimizing environmental and human health impacts from pollutants such as heavy metals in fertilizers;
* maintaining and increasing food safety.

The objectives proposed by the FAO should be modified accordingly:

1. Increasing global food production

Reasoning: it is broadly agreed that food production will have to increase significantly to ensure food security worldwide. From that perspective maintaining current food production would not be sufficient.

2. Maximizing efficient and effective use of all plant nutrients to enhance sustainable agriculture

Reasoning: the effectiveness in increasing crop yields is key to reach sustainable agriculture worldwide.

3. Preventing misuse of fertilizers in order to minimize use-related environmental impacts (such as pollution by loss of nutrients via runoff, leaching, greenhouse gas emissions, ammonia emissions), while acknowledging the environmental benefits also provided by the use of fertilizers

Reasoning: Fertilizers are instrumental in contributing to food security worldwide. Thanks to the use of fertilizers, agriculture production becomes more efficient, thus giving more space for forests to grow.

4. Minimizing the presence of pollutants (such as heavy metals and organic contaminants) in order not to pose risk on human health and the environment

Reasoning: Any objective focusing on non-nutritive elements in fertilizers must not only look at heavy metals but also at organic contaminants and pathogens. In Europe, new nutrient raw materials are increasing, which make it necessary to also limit the presence of organic contaminants and pathogens such as:

* E.coli;
* Salmonella;
* Aflatoxins;
* Deoxynivalenol (DON).

5. Maintaining and increasing food safety

No comment

**Second document to be developed later by the FAO**

The aim of the CoCoFe is to assist member countries design policies and regulatory frameworks for the sustainable use of fertilizers. The focus is more on discouraging fertilizer overuse whereas a second document, to be developed later, will address scenarios with low or no fertilizer use under the topic of integrated soil fertility management.

Assofertilizzanti-Federchimica strongly discourages the FAO from developing “a second document, [which would] address scenarios with low or no fertilizer use under the topic of integrated soil fertility management”. Such a move would go against the scientific fact that fertilizers are essential to renew the nutrient level on the soil and to satisfy the natural need of the crops grown by farmers, in order to achieve good yields and high quality crops. Scientific findings comparing fertilized with unfertilized land also indicate that no or low fertilizer use would not be the right way forward for the following reasons:

* Efficient food production: yields are impossible to maintain if the exported nutrients are not replaced, and it would lead to soil depletion;
* Carbon storage in soils: It has been demonstrated that carbon levels actually decline mostly in farming practices where no fertilizers are used. The fact is that in farming without fertilizer; the yields are lower, resulting also in fewer crop residues that are raw materials for humus formation. The fertilizers limits this decline;
* Resource use: organic and mineral fertilizers are complementary products. Farmers use both in order to achieve the nutritional needs of their crops.

2. How should be the CoCoFe be structured to have the maximum positive impact?

The CoCoFe should include broad recommendations and general principles on what should be considered when designing strategies to manage fertilizers sustainably, which would then have to be adapted by regional agencies and national authorities to the local farming conditions. It should provide guidance at the regulatory level to outline the roles and responsibilities of the multiple stakeholders involved in the entire value chain.

The CoCoFe could be structured along the following chapters:

1) Optimization of fertilizer use in order to increase food production globally, since the CoCoFe should recognize the instrumental contribution of fertilization to global food security and global nutrition.

2) Maximizing efficient and effective use of plant nutrients to enhance sustainable agriculture, knowing that the reasons of the limited effectiveness/efficiency in the use of fertilizers can vary from situation to situation. However some general causes could be identified in a specific chapter: limited awareness of the cost-benefit of a better nutrient planning, great number of information required for detailed planning at field level, lack of technical assistance to farmers. It should also be taken into account that all plant nutrients have an influence on the yield level. E.g., a sustainable level of nitrogen fertilization could become unsustainable if another nutrient is missing and thus limiting the yield.

3) Prevention of the improper use of fertilizers in order to minimize use-related environmental impacts, with a strong focus on existing scientific findings. For example, several trials have shown that if nitrogen application is done in quantities that correspond to the nitrogen requirements of the crop, then leaching is not greater than from unfertilized landi.

4) Focus on options and approaches, which have the most rapid environmental impact – while yields and quality are maintained. Future sustainability in agriculture can only be ensured if there are broad incentives towards the continuous development of principles for a smarter, more efficient and effective use of production tools in farming with greater precision. This can be achieved by striving for a full utilization of nutrients, but also of energy and water, together with appropriate conservation of the soil and environment.

The CoCoFe guiding principles should be:

* Understandable,
* Form the basis for guidelines, who will have to be transformed into concrete schemes in order to be implemented at local level;
* Supported by an Advisory Committee, composed of representatives of the scientific and academic community, leading scientists on crop nutrition worldwide, farmers’ organizations, NGOs and industry representatives;
* Emphasizing the use of scientific evidence to define efficacy of inputs in providing plant available nutrients, and the efficacy of nutrient application practices in terms of the full set of their impacts on the three pillars of sustainability (people, planet, profit).

3. Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?

The CoCoFe should be both developed and disseminated thanks to a multi-actor approach

i.e. the cooperation of different stakeholders. It should also build upon existing expertise of leading scientists on crop nutrition worldwide, farmers’ organizations and industry representatives (National and European associations). The best audience should be government at the policy level, fertilizer industry, NGOs, the academic community and training centers for farmers at the technical level.

The key aspect is of course the communication with farmers and growers, which is beneficial from the initial development of the CoCoFe right through to its implementation. Another major role could be played by extension services. Listening to farmers’ needs is necessary for an optimal promotion and development of new solutions and tools. It would also be up to agricultural advisors throughout the different regions of the globe to disseminate the CoCoFe by developing demonstration projects or operational groups towards the target public, the farmers, and, in particular to make the CoCoFe available in the region’s language/tailored on the specific conditions of the own region.

4. What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?

All nutrients input sources have to be included if their efficiency is supported by scientific evidence. For this reason all plant nutrients should be considered, in order to have a broad and holistic approach of crop nutrition. Biostimulants, nitrification inhibitors and urease inhibitors should also be included as well as the responsible and judicious use of fertilizers can only be promoted by taking into account all options and products, which are available to farmers.

5. Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?

* Promoting responsible and judicious use of fertilizers

The CoCoFe could be successful in promoting responsible and judicious use of fertilizers only if its audience, its scope and its aim are clearly defined, agreed and well supported by the target groups. It could only bring added-value to existing knowledge and practices by being based on rigorous scientific findings, and by being adaptable (in a second step) to regional and local conditions.

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## Rajendran TP, Research & Information System for Developing Countries, India

The discussion forum has incited wonderful thoughts. Globally fertilisers are managed for making it available through domestic manufacture and / or import. Based on the general plan of national agriculture for each year (in the case of India for three distinct seasons, viz., rainy (kharif), irrigated / second crop (rabi) and summer seasons) in every country. The primary nutrient supply envisaged through fertilisers being nitrogen, phosphorous and potassium, their quantities for the country depends on the use pattern for various cropping systems.

Fertiliser becomes a major input in India and neighbouring South Asian countries only for commercial agriculture of cereals, pulses, oilseeds, cotton, sugarcane and for horticulture crops such as tubers, bulbs, vegetables etc., plantation crops (rubber / coffee / tea / cardamom etc.) and a host of others. The total national nutrient requirement guides the annual fertiliser business.

The present alterations in the existing policy through regulations for production, import and supply of fertilisers based on nutrients has enabled securing cost to the country as well as to the Indian farmers. The fertiliser policy of every country in terms of use pattern, farmers’ economics, soil health as well as coming out of the olden ‘green revolution’ concepts of fertiliser use pattern for crop production. The future of securing better carbon foot print in crop production by nations is the call of the day. Heavy dependence on hydrocarbon relied fertiliser manufacture could bring in instability of agriculture once that hydrocarbon stream dries up globally.

The next instability issue is the damage to soil health. Soil health is the resultant of the microbial load and biological value of soil. The need for national policy to blend nutrients from the biological resources from within and outside farms is well recognised. Probably streaming such policy with intensive agriculture system of crop production within new approach to cropping system designs could bring major shift in excessive use of fertilisers. The olden concept of discriminatory fertiliser application based on soil and plant nutrient status of given seasons may brighten chances for higher judiciousness to invoke scientific principles of crop nutrition.

Lastly this forum may focus also on the immense impact on herbivory in crop fields due to excessive and imbalanced nutrient regimes in crops. The crop health in tandem with animal health of every farm reflects on the human health (as enunciated in the W.H.O’s - ONE HEALTH – ideology of yester-years). Immense pestilence due to keeping the crops highly nutritious to the herbivores cannot be the practice in intensive agriculture. The need for scientific perception for metabolic requirements of nutrients in every crop species is fortifying the demand for corrective fertiliser policy in every country along with supportive legislative measure including for fertiliser use in crops. Introducing agro-chemicals for mitigation of pestilence in crops became another vitiating practice in combination with excessive use of fertilisers.

Let me conclude by placing on record that this FORUM may recommend to the world for redefining GOOD AGRICULTURE PRACTICE ( other than that of WTO context) to refine farming practices in developing countries.

Dr TP Rajendran

former Asst DG (Plant Protection),ICAR &

former Officer on Special Duty:ICAR-National Institute of Biotic Stress Management, Raipur, Chhattisgargh

## Carl Crozier, NCSU Soil Science, United States of America

Developing a Code of Conduct for the Management of Fertilizers (CoCoFe) should consider that agriculture consists of both agronomic science and a multitude of cultural and socioeconomic factors that govern fertilizer selection, availability, and appropriate uses. This requires a recognition that appropriate practices need to be tailored to address specific conditions at each locale.

## Lorenzo Gallo, Green Has Italia S.p.A., Italy

I'm sending Green Has Italia S.p.A consideration about CoCoFe.

We are producer of soluble and liquid fertilizers, Biostimulant and other products for vegetal nutrition

Considerations regarding the creation and implementation of CoCoFe:

**1. Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?**

the objectives proposed by the FAO should be modified as follows:

**1. Increasing global food production**

it is expected that the population will increase considerably in the near future, so maintaining current production levels will not be enough

**2. maximizing efficient and efficacious use of all plant nutrients to enhance sustainable agriculture.**

The effectiveness of increasing crop production is an essential element for achieving a global model of sustainable agriculture.

**3. prevent the improper use of fertilizers, to limit environmental impacts including pollution by loss of nutrients via runoff, leaching, greenhouse gas emissions and other mechanisms enhancing the benefits that the rational use of fertilizers in protecting the environment.**

with the correct use of fertilizers, productivity per hectare is increased, guaranteeing the availability of food without having to make additional land to be cultivated, thus preserving the forests and protected areas

**4. minimizing environmental and human health impacts reducing pollutants such as heavy metals and organic contaminants in fertilizers**

the actions aimed at reducing the non-nutritive elements in fertilizers should not only be addressed to heavy metals but also organic and pathogenic contaminants in consideration of the new usable raw materials

**5. Maintaining and increasing food safety.**

No comment.

**2. How should be the CoCoFe be structured to have the maximum positive impact?**

CoCoFe should report general principles and indications regarding the rational and sustainable use of fertilizers to be used by national authorities as guidelines for their regulations or interventions in the sector.

Therefore, indications must be provided that do not identify as a univocal solution the reduction of the use of fertilizers but their efficient use aimed at increasing production by limiting waste dispersion in the environment.

The rational use of water and energy resources and also the conservation and improvement of soil fertility must be taken into account.

**3. Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

CoCoFe should be disseminated mainly to farmers and their organizations, to scientific institutions, to legislative bodies, to fertilizer producers, to agricultural technicians working in the sector to NGOs.

**4. What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as biostimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

All types of nutrient sources that have been evaluated by the scientific point and which are environmentally safe must be included.

Among these, Biostimulants, nitrification inhibitors and all the other innovative formulas must certainly be taken into consideration

**5. Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?**

CoCoFe can successfully contribute to disseminate and support the rational and efficient use of fertilizers if it is directed towards the right target of potential users and stakeholders.

it is essential that it provides scientifically supported and authoritative indications and content.

## Renato Jiménez, Instituto Innovacion y Transferencia en Tecnología Agropecuaria-Ministerio de Agricultura y Ganadería de Costa Rica, Costa Rica

**1) Dado el alcance global del CoCoFe, ¿Cree que los objetivos son apropiados?**

Considero que se debería de incluir un objetivo relaconado con minimizar los efectos nocivos de la labranza convencional, especialmente sobre suelos de alto grado de meteorización, como Ultisoles, Alfisoles y Oxisoles, en virtud a la marcadavulnerabilidad a la erosión hídrica o eólica, y a la inversión de la morfología original de estos suelos, que generalmente contienen capas subyacentes en las cuales se incrementa considerablemente la saturación del aluminio, con las consecuentes pérdidas en fertilidad natural de estas clases de suelos, abundantes en Centroamérica y el Caribe.  Considero que CoCaFe deberá de desarrollar capacidades en agricultores, técnicos, profesionales en investigación y producción y en la clase política, el riesgo de acidificar los suelos tropicales, si de continua utilizando los sistemas convencionales de labranza.  Para esto, se deberá de impulsar proyectos de extensión a todos los niveles, que permitan incrementar los conocimientos sobre la enorme vulnerabilidad de los suelos residuales.  Indispensable será crear una estructura pública y privada que impulse el manejo agroconservacionista de los suelos residuales y la gestión del pago de servicios ambientales a los productores que utlicen la labranza reducida o cero labranza.

**2) ¿Quién sería la mejor audiencia para que el CoCoFe cumpla con nuestros objetivos y cómo podríamos ampliar y diversificar esta audiencia para aumentar su influencia?**

Considero que en Centroamérica la audiencia deberá orientarse a políticos, empresarios del sector agroproductivo e industrial y a las corporaciones de pequeños y medianos productores, directamente, utilizando la infraestructura estatal de los sistemas de extensión formales y aquellos apoyados en ONGs.  Para esto, se deberán utilizar todos los medios de difusión existentes, como los escritos, radiales, televisivos y las misma redes sociales, creando aplicaciones APPS que pueden ser accesadas por los usuarios, por teléfonos inteligentes.

**3) ¿Cual debería ser el alcance del CoCoFe? Qué fuentes de entrada de nutrientes deberían incluirse: solo los fertilizantes sintéticos o también el estiércol, biosólidos, compost, etc?  ¿Deberían contemplarse también otros productos, como los bioestimulantes, los inhibidores de la nitrificación, los inhidores de la ureasa, etc?**

Considero que para nuestras tierras Centroamericanas y el Caribe, se deberá estimular el reciclaje de nutrientes, utilizando abundantes materias primas que generalmente se pierden por mineralización (que es muy intensa en los sistemas Tropicales Húmedos y muy Húmedos abundantes en la Región).  Además, programas de aplicación de enmiendas de encalamiento de Carbonato de Calcio y de Calcio y Magnesio (es muy caro en la subregión), ya que la acidifcicación de nuestros suelos, representa un proceso constante dada las intensas tormentas tropicales y Huracanes que se están haciendo cada vez más intensos, y que dejan fuertes efectos degradantes en nuestros suelos, tanto por erosión hídrica, como por lixiviación constante de bases de intercambio, de por sí escasas en muchos de los sistemas montañosos de origen volcánico que son la mayoría del territorio Centroamericano y del Caribe.  Una vez gestionados los problemas de acidificación por aluminio intercambiable, se puede pensar en las prácticas sugeridas en la parte final de la pregunta.

**4) ¿Ayudará CoCaFe a promover el uso responsable y juicioso de los fertilizantes? Por qué o por qué no? ¿Qué otras sugerenica se le ocurren para ayudar al CoCaFe a cumplir con nuestros objetivos?**

Cree que esto podría ser posible, siempre y cuando se generalice el análsis de los suelos del área Centroamericana y del Caribe, como una práctica de rutina en el pensamiento de los productores y que los políticos pongan a disposición de los productores estos servicios y que sean de calidad.  Además, los sistemas de extensión públicos y privados, deberán de colaborar con CoCaFe, para capacitar a los usuarios de la tierras Centroamericanas y del Caribe, ya que en este tema existe mucho rezago.

## Stephen Crittenden, Agriculture and Agri-Food Canada, Canada

Further regional research is necessary to match soil test results with the nutrient requirements of new crop varieties. To increase food production, to increase resource use efficiency, and to minimize environmental impacts the nutrient requirements of emerging crop varieties need to be matched with fertilization practices. These types of studies can be expensive but continual research is necessary to synergise the needs of ever evolving varieties and their fertilization practices in order to achieve the stated objectives of CoCoFe.

## Marco Flores Maldonado, Proyecto GEF-Chaco, Bolivia

PROPIEDAD DE LOS OBJETIVOS

Debido a la realidad de muchos paises en vias de desarrollo (la foto ilustra muy bien) el objetivo 4 no solo deberia apuntar a MINIMIZAR los impactos en la salud humana, sino empujar a los paises que carecen de legislación a desarrollar una donde sea obligatorio el uso de indumentaria apropiada para la aplicación de fertilizantes. Para este efecto, será importante resaltar que el fertilizante químico constituye un agrotóxico (es decir, producto químico, agrícola tóxico para la salud humana). Con el mismo objetivo, la venta de fertilizantes químicos debe ser regulada en cada país y así como una receta médica debería existir una receta de un profesional competente indicando la cantidad necesartia de enmineda a ser comprada para su aplicación en campo.

Si el CodeCo tiene que orientar y disciplinar la conducta, considero que la estructura del CodeCo para el Manejo de fertilizantes (químicos) debe abordar desde la compra-venta (con receta profesional) hasta los cuidados para el uso adecuado (aplicación) del mismo, con la debida protección. El documento tendría que contener un anexo con los principales fertilizantes químicos y los niveles de toxicidad para la salud humana así como el implemento mínimo de protección a ser utilizado por quien aplica.

PÚBLICO META

Ministerios competentes de cada país, ONGs, y órganos de extensión rural.

Cada país debe, con apoyo técnico de FAO debe encargarse de difundir a través de cursos de capacitación y medios de difusión audiovisuales. Esto debe revforsarse especialmente en los países en vias de desarrollo, pues debe llegar hasta el pequeño agricultor usuario de la tierra. Hay uan ciudad en sudamérica cuyo cordón periurbano produce hortalizas regando con aguas de rio muy contaminadas, aplicando además fertilizantes químicos y orgánicos. Una mezcla de todo y de nada para "aumentar la productividad".

ALCANCE

Por un tema de manipulación, cuidado y efectos en la salud humana, considero mejor separar fertilizantes sintéticos de los orgánicos. No es lo mismo meter la mano sin protección a un compost que a un fertilizante químico. Ambos deben ser desarrollados con la misma amplitud y metas comunes (aumento o mantenimiento de la productividad) pero cuidados diferentes.

PROMOVER EL USO RESPONSABLE

Está claro que una iniciativa de esta naturaleza contribuirá para un uso responsable y juicioso de fertilizantes, pues existe mucha inconciencia (en unos lugares mas que en otros) en cuanto al uso y manejo de estos compuestos químicos. En tal sentido, un importante paso a ser dado está relacionado con la difusión, capacitación para el despertar de esta conciencia y comenzar a tomar los cuidados necesarios como sociedad.

## Andreas Frangenberg, European Initiative for Sustainable Development in Agriculture (EISA) e.V., Germany

Comments from EISA to the online consultation of FAO for developing the Code of Conduct for the Management of Fertilizers (CoCoFe)

The European Initiative for Sustainable Development in Agriculture (EISA) e.V. was founded with the common aim of developing and promoting Integrated Farm Management (IFM) throughout Europe. Integrated Farm Management is a sustainable system which helps farmers improve the way they farm for the profitability of their business, the benefit of the environment, and social responsibility. With National Members from six European Member States, and six Associate Members from the up- and downstream sectors of agriculture, EISA is the platform and voice for Integrated Farm Management (IFM) in Europe. EISA members are strongly committed to systems of agriculture that are economically viable, environmentally responsible and socially acceptable. They work in partnership with all stakeholders to achieve this goal through advocacy for and further development of Integrated Farm Management.

**Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?**

EISA recommends modifications to the objectives proposed by FAO as follows:

1) Increasing global food production

Maintaining current food production would not be sufficient. Food production will have to be significantly increased in order to achieve food security and reliable supply of high quality food worldwide.

2) Optimising efficient and effective use of plant nutrients to enhance sustainable agriculture

It is rather optimising than maximising, and efficiency as well as effectiveness of the use of plant nutrients both are crucial for development towards sustainable agriculture.

3) Preventing inappropriate use of fertilisers in order to minimise environmental impacts associated with nutrient losses to the environment whilst taking account of environmental benefits associated with the use of fertilisers

Fertilisers not only markedly contribute to food safety, organic matter production (for both industrial uses and soil organic matter) and hence efficient and sustainable land use but also allow to keep other areas such as forests, wildlife refuges, permanent grassland etc. out of arable production. This benefit should be clearly addressed as well.

4) Minimising environmental impacts by evaluating and properly managing potential risks associated with non-nutritive trace elements and organic contaminants in fertilisers

In addition to addressing environmental and human health issues related to non-nutritive trace elements, it should be kept in mind that there are growing efforts to recycle substances such as sewage sludge, where also organic contaminants may need efforts to limit their potential presence and impacts.

5) Maintaining and increasing food safety

This is an important issue which must be maintained either as separate objective or as issue jointly addressed in objective 4.

**From EISA’s point of view, however, it is essential to add one more objective:**

6. Understanding and managing fertilisers to maintain and increase soil structure and fertility

Proper, site- and situation-specific nutrient management plays an important role in keeping soils fertile and productive. Nutrients enhance plant growth and root development, thus adding to soil structure, soil organic matter and fertility as well as soil protection against degradation and erosion.

**General remark: EISA is neither in favour of a CoCoFe approach focussing on the discouragement of fertiliser over-use nor of a “second document” addressing scenarios with low or no fertiliser use under the topic of integrated soil fertility management.**

Whilst overuse, where it occurs and could be avoided, should be addressed by proper management practices and site- and situation-specific approaches as characterised in Integrated Farm Management, under-use per se cannot be regarded as sustainable since it depletes the soil and leads to dwindling soil fertility. EISA strongly recommends looking at potential over-use and under-use in a holistic approach which takes account of the important role of fertilisers in maintaining, and improving, soil fertility – to achieve the goal of increasing food production, food security and food safety along with minimising environmental impacts as outlined above.

There is solid scientific evidence that nutrients exported via harvested goods need to be refurbished in order to maintain soil fertility and the soil’s function as efficient carbon sink. Accordingly, EISA does by no means consider a “no fertiliser input” systems as sustainable.

**How should be the CoCoFe be structured to have the maximum positive impact?**

Based on the understanding and approach of Integrated Farm Management, the CoCoFe should provide a sufficiently big tool box of general recommendations and principles which would need to be adapted to and used by national as well as regional authorities according to the specific local farming situations. A general structure of the CoCoFe could follow aspects such as

- Optimisation of fertiliser use with the objective of increasing global food production,

- Optimisation of efficiency and effectiveness of the use of nutrients to enhance sustainability of agriculture

- Definition of measures to prevent poor use of fertilisers in terms of over- and under-use in order to minimise negative environmental impacts (over-use) as well as depletion and degradation of soils (under-use), both to be based on scientific findings on dosage and time/mode of application in order to optimise use and desired effects.

- Further developing and communicating those options which maintain and increase soil fertility and productivity whilst allowing for the most rapid positive environmental effects at the same time.

**Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

EISA recommends following a multi-stakeholder approach building on existing expertise of renowned research facilities and crop nutritionists worldwide, farmers’ organisations, and representatives of the fertiliser industry.

Farmers and growers as well as extension services, advisors and the relevant agricultural media, should be seen as key audiences.

**What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

From EISA’s point of view, the scope should be to promote resource-efficient, productive and environmentally friendly farming methods which make the best use of all resources available on any given farm at any given location. Accordingly, this approach has to include all sources of nutrients such as farmyard manure, compost, sewage sludge and other recycling materials as well as all types and kinds of mineral fertilisers. As bio-stimulants, nitrification inhibitors, urease inhibitors and the like clearly affect nutrient transformation and uptake in the soil, they also have to be included in a targeted, holistic approach. We would like to highlight once again that only such a holistic approach, as covered by Integrated Farm Management as described in the EISA Integrated Farming Framework1 allows for the optimum use – in terms of productivity, quality and environmental effects – of all resources available on a farm.

**Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?**

EISA expects the CoCoFe to deliver in terms of promoting responsible and efficient use of fertilisers, if audience, intention and scope are defined on a solid scientific base, agreed upon by the relevant target groups, and communicated to the target audiences accordingly. From our point of view, such a science-based approach is indispensible if sustainable development is to be achieved along with the objectives outlined for the CoCoFe.

## Denye Ronald, Agro-Tourism Association, Uganda

1) Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?

Yes the objectives are appropriate.

2) How should be the CoCoFe be structured to have the maximum positive impact?

The structure should be guided by code of conduct regionally and sometimes culture practices for appropriate adaptations.

3) Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversity this audience to increase its influence?

Government, Private sector and farmers. These are the most important audiences among other and responsible for the influence and guidance.

4) What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost etc? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc.. Be included as well?

Nutrients management should be applied consistently across all sources, so all should be included. This can be also tested using different soils and crops in adaptation and also can be packaged according to the crop environment.

5) Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?

It can assist when done well with proper application with balancing between improved production of the crops and environmental grading allowing eco-system movement. In Africa for example most farmers can’t afford the price of inorganic fertilizers and this leaves them with local options which most cases is not effectively maintained. In my opinion to policy makers, farmers and Government should be trained to understand the use of appropriate fertilizers for their own individual conditions. Understanding the reactions of fertilizers in the soil. Our forefathers used organic fertilizers, and there’s no doubt that the world is moving back to using natural fertilizers or combination of organic and inorganic fertilizers to reduce the chemical imprint on our soils and at the same time improve soils. With the population pressures, land ownership, we can’t now move from one area to another when the soils are exhausted. So now we have to implement techniques to sustain and look after our soil to reduce crop failures, land degradation and desertification.

## Rajendran TP, Research & Information System for Developing Countries, India (second contribution)

Code of Conduct for the Management of Fertilisers become a requirement when regulatory system perceives farmers of that nation do farming for profiteering business. Let us be candid to sense that majority of farmers have been traditional in agriculture. Modernity infused through technology / innovation invasion resulted in whichever abuse that we experience.

Self-disciplined farmers / farm families do exist and do not get into the rat-race of food production for global trade and food security (both of which are self-contradictions). All governments seek 'profitability of farmers'as socio-political rhetoric. Profitability earned due to reticence in the use of high-tech agri-inputs is out of saved money.

The conflict that has crept in over the last six decades has been the clamour for food. AS in the case of any other animals, hummans can still acquire food with smartness. Maintaining the carrying capacity with strong ecological engineering to sustain farm soil-fertility (using traditional and modern methods) may be the right solution. The Code of Conduct (not dictated) hence shall be motivational with strong impetus for managing farms for posterity and getting into the turmoil on the mission for 'feeding the rest of the world'.

Thanks and Ragards

T.P.Rajendran

## Paloma Perez, Asociación Nacional de Fabricantes de Fertilizantes (ANFFE), Spain

ANFFE is an organization representing the main Spanish manufacturers of fertilizers and foreign producers with activity in Spain. It was founded in 1977 and our mission is, among others, the promotion of an adequate management of fertilizers and the use of quality products, to achieve a sustainable agriculture. Current members are: Asturiana de Fertilizantes, Eurochem Agro Iberia, Fertiberia, Fertinagro Biotech, Fertisac, ICL Fertilizers (Iberpotash), Mirat Fertilizantes, Profersa, Repsol, Timac Agro Spain, Ube Corporation Europe and Yara Iberian, as well as Incro, an engineering company dedicated to the design of fertilizer plants. The companies of the Association have 18 production plants in Spain, with a production capacity of 7.3 million tons of products, directly employing more than 2,800 people and generating a very significant number of indirect jobs.

During more than 40 years of activity, ANFFE has developed a great deal of activities, including the preparation and diffusion of relevant information on the fertilizer sector. Of particular interest are the national fertilizer market statistics, which are sent periodically to the Spanish Ministry of Agriculture for the publication. Likewise, activities and reports related to quality, safety, environment and rational use of fertilizers are carried out. The Association promotes the efficient and responsible production, distribution and use of plant nutrients to enable sustainable agricultural systems, which contribute to a world free of hunger and malnutrition.

ANFFE wants to thank the opportunity to participate in the online consultation and to share our views on this topic. The key issue for us is how to promote effective and efficient use of fertilizers to achieve food security while minimizing nutrient losses and we are willing to cooperate with FAO on this important task.

**Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?**

We believe it is a good idea to develop a Code of Conduct for the Management of Fertilizers (CoCoFe), aimed to promote the responsible and judicious use of fertilizers, but we think that some modifications in the objectives should be introduced and new objectives should be added:

1. maintaining or increasing global food production;

We suggest modifying objective 1 as: “**Increasing global food production**”.

A reference to the objective of closing the yield gap in areas with declining soil fertility or inadequate use of fertilizers is missing. Long-term projections emphasize the need to increase the agricultural production to meet the requirements of the fast-growing world population. Part of this additional demand can be addressed by reducing food losses and wastes. But maintaining current global food production would not be sufficient, so it will have to increase significantly to ensure food security worldwide.

2. maximizing the efficient use of plant nutrients to enhance sustainable agriculture;

We suggest rephrasing objective 2 as: “**Optimizing the use efficiency and effectiveness of plant nutrients to ensure sustainable agricultural production**”.

Effectiveness in increasing crop yields is essential for a sustainable agriculture and if efficiency is achieved with a loss of crop yield, it cannot be considered sustainable. Fertilizer management has to be both efficient and effective in a sustainable agriculture model.

3. minimizing the environmental impacts from the use of fertilizers including pollution by loss of nutrients via runoff, leaching, greenhouse gas emissions and other mechanisms;

We suggest modifying objective 3 with the following wording: “**Preventing misuse of fertilizers to minimize environmental impacts due to nutrient losses and increasing the environmental benefits provided by the use of fertilizers**”.

There is no need to list the different ways of nutrient loss in objective 3. In addition, fertilizers, especially mineral fertilizers, are essential for achieving a more efficient and sustainable agricultural production and food security worldwide. This has to be highlighted, together with a reference to the positive environmental consequences of their use, such as the positive balance in CO2 and energy with the use of fertilizers and because its use avoids deforestation. More information: [http://www.anffe.com/informaci%F3n%20de%20inter%E9s/documentos%20de%20inter%E9s/POSTER% 20Fertilizantes%20y%20cambio%20clim%E1tico.pdf](http://www.anffe.com/informaci%EF%BF%BDn%20de%20inter%EF%BF%BDs/documentos%20de%20inter%EF%BF%BDs/POSTER%25%2020Fertilizantes%20y%20cambio%20clim%EF%BF%BDtico.pdf%20)

4. minimizing environmental and human health impacts from pollutants such as heavy metals in fertilizers;

We suggest the following wording for objective 4: “**Minimizing environmental and human health risks from pollutants and contaminants in fertilizers**”.

Human health, environment and food safety should be ensured not only taking into account heavy metals, but also other pollutants such as organic contaminants and pathogens (E. coli, salmonella, etc.). In Europe, as nutrient recycling initiatives from organic sources, like compost, animal manure, sewage sludge etc. are increasing, it is necessary to limit also the presence of those organic contaminants and pathogens. So a general mention to pollutants and contaminants would be enough.

5. maintaining and increasing food safety.

We would suggest modifying objective 5 with the following wording: “**maintaining and increasing food quality and nutrition security**”.

Fertilizer management practices can influence nutritional quality of food products, so it would be convenient to add a reference to the question of food quality and nutrition security.

6. New objective 6.

We suggest including a new objective with the following text: “**Managing fertilizers to maintain or increase soil structure and fertility**”

Fertilizers (mineral and organic) play a key role in preserving healthy soils and preventing soil degradation, providing nutrients and organic matter to the soil. Nutrient management is essential for keeping productive soils by replacing nutrients removed by consecutive harvests and maintaining soil organic matter levels. Although it is a very important point, there are no objectives referring to it.

**Aim of the CoCoFe and second document to be developed later by the FAO**

In the document it is stated that “The aim of the CoCoFe is to assist member countries design policies and regulatory frameworks for the sustainable use of fertilizers. The focus is more on discouraging fertilizer overuse whereas a second document, to be developed later, will address scenarios with low or no fertilizer use under the topic of integrated soil fertility management.”

The objective of “discouraging fertilizer overuse” could be misinterpreted, transmitting the wrong idea that low or no fertilizer use would be sustainable and going against the fact that fertilizers are essential for the nutrient needs of the crops and key to achieve good yields and high quality crops. On the other side, underuse of fertilizer is more widespread geographically and its bad implications on crop productivity, human health and farm income are bigger. We believe that overuse and underuse are equally important challenges and they both reflect unsustainable practices that should be addressed in the Code of Conduct. Encouraging optimum fertilizer use should be the focus, rather than discouraging fertilizer overuse. The focus may be on overuse or underuse depending on the country or the farming system within a country. As a consequence, we suggest rewording CoCoFe’s focus as “**Encouraging efficient and effective fertilizer use**”.

The possible “overuse” is in general due to inadequate nutrient management. Application rate is an important component of an efficient and effective fertilizer management, but also the other 3 areas (source, time and place) are very important. CoCoFe should focus on implementing fertilizer best management practices in those four areas: right source, right rate, right time and right place.

Moreover, we strongly oppose the elaboration of “a second document, to be developed later, will address scenarios with low or no fertilizer use under the topic of integrated soil fertility management”. Nutrients are essential for soil fertility. Scientific studies indicate that yields are impossible to maintain if the exported nutrients are not replaced, leading to soil depletion. Increased production level is needed for a growing population and even in a best case, with 100% recycling of nutrients and 0% losses, the amount of nutrient will never grow. Moreover, the nutrients cycle cannot be closed, because part of the nutrients are fixed and will not continue to move in the cycle.

On the other side, there is not enough manure, compost, and other kind of organic materials to provide nutrients. Besides, as these products have lower nutrient content, it means the addition to the soils of large amounts of materials with low nutrient content and which are not free from other components, some of them harmful and polluting.

In addition, it has been demonstrated that carbon levels decline mostly in farming practices where no fertilizers are used. In those cases, the yields are lower, resulting also in fewer crop residues that are raw materials for humus formation. Nitrogen fertilization limits this decline and carbon levels remain higher than without fertilization.

**How should be the CoCoFe be structured to have the maximum positive impact?**

The Code of Conduct should be applicable and include general principles and broad recommendations to be considered for designing strategies to manage fertilizers sustainably. The principles should be universal and the basis for guidelines that would have to be elaborated by national and regional authorities, providing more practical recommendations to farmers and their advisors and adapted to the local farming conditions.

It should assist policy makers, providing guidance at the regulatory level, to outline the roles and responsibilities of the multiple stakeholders involved in various aspects of fertilizer management, including governments, industry, universities, NGOs, traders, farmer organizations, etc. It should be supported by an Advisory Committee, composed of representatives of the scientific and academic community, experts on crop nutrition and farmers’ and industry organizations.

The CoCoFe should be focused in optimizing an efficient and effective use of plant nutrients and could be structured in different chapters to:

* enhance sustainable agricultural production,
* increase food production,
* minimize environmental impacts,
* implement possible options with a benefit to the environment, maintaining the yields and the quality of crops.

**Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

The CoCoFe should be developed and disseminated with the cooperation of different stakeholders. The primary audience would be government, policymakers and regulators, who are responsible for designing national policies, strategies and regulatory frameworks in relation to agriculture and fertilizers. The secondary audience would be scientists and the fertilizer industry, who are involved in developing fertilizer recommendations, fertilizer products, decision-making support tools, etc. The tertiary audience would be farmers and their advisors (fertilizer advisors, extension services, etc.), who would design practical recommendations or manuals.

**What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

The responsible and judicious use of fertilizers can only be promoted by taking into account all options and products that are available to farmers. The scope of CoCoFe then should include all kind of sources used to provide nutrients to feed plants: mineral, organo-mineral and organic fertilizers, including manure, compost, etc. A Code of Conduct restricted to mineral fertilizers would be counterproductive, conditioning stakeholders, as sustainable fertilization practices require integrating organic and mineral sources, using organic sources available on the farm or nearby and supplementing them with mineral fertilizers to reach the yield required. The Code of Conduct should cover all macro and micronutrients, as any deficiency in one nutrient can impact the use efficiency and effectiveness of the others. Moreover, any substance applied to agricultural land for the purpose of increasing nutrient availability to plants, including those that improve nutrient use efficiency, such as inhibitors, polymer coatings and biostimulants, should also be included.

**Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?**

The CoCoFe could promote responsible and judicious use of fertilizers only if it is based on rigorous scientific findings and include principles applied to fertilizer management that has been discussed with different stakeholders. It should be translated in practical crop specific recommendations and be adaptable to regional and local conditions. Its audience, scope and aim has to be clearly defined, agreed and well supported by the different stakeholders. The principles of 4R Nutrient Stewardship, which have been developed based on extensive consultation with several stakeholders, could serve as a starting point for the development of CoCoFe, using a process of wider stakeholder engagement.

**What would be a good way to measure or quantify the progress of distribution and adoption of the CoCoFe?**

After the implementation, some indicators could be used to monitor the CoCoFe: number of countries having translated the Code of Conduct in their national fertilizer strategy; development of decision- making support tools consistent with CoCoFe’s principles; farmers receiving advice compatible with CoCoFe’s principles; etc.

**Keeping in mind that the CoCoFe will serve as a guiding framework for all Member States, what should be included in order for the code of conduct to help address different stakeholders?**

The Code of Conduct should encourage multi-stakeholder dialogue at the national level and partnership towards commonly agreed national or sub-national objectives.

## Yuji Niino, FAO, Italy

The below summary of the status of the integrated nutrient management in Asia and the Pacific region found more than 10 years ago, but the status may stay remains the same.

**A. INM issues for Asian countries**

Asian agriculture is under persistent pressure to narrow the gap between food supplies and demand by the ever increasing human population, aggravated by significant loss of arable land from urbanization and pollution. As a consequence of this negative trend in the food supplying capacity of the regions natural resource base, Asian countries have mainstreamed into their national policies the promotion and use of genetically improved short food crops, including livestock and fishes, as the foundation of their food security programmes. This is further enhanced and fully supported by policy support for fertilizer subsidies to encourage farmers to use more and higher rates of fertilizers to ensure high crop yields. Common barriers and root causes of the decline in agricultural land productivity and the ensuing threat to food security in Asian countries include, but are not limited to the following:

1. Soil mining or internal loss of soil nutrient reserves to the plant and the groundwater induced by the imbalanced use of fertilizers, mostly through the excessive use of Urea;
2. Poor rationalization of chemical fertilizer importation to ensure easy access to appropriate, suitable and affordable fertilizer grades. In most cases, the importation and supply of Urea exceeded phosphates and potash;
3. Inadequate understanding and absence of dedicated national programmes for organic-based fertilization and balanced fertilization based on a sound soil testing programme;
4. Policy support for short maturing, high yield varieties (hybrid) without appropriate integrated nutrient management practices to avert the incidence of soil mining and soil/water degradation;
5. Fertilizer subsidies that are not based on the soil and plant nutrient needs of the country;
6. High population and rapid urbanization and declining man-arable land ratio; and
7. Global oil issues and uncontrolled increases in the price of chemical fertilizers.

**B. INM issues for Pacific Island countries**

Pacific Island countries, in contrast to their Asian counterparts, have dedicated much of their agricultural development to serving the needs of farm families and are built around the organization and success of a network of home gardens. In contrast to the capital intensive character of Asian agriculture, agricultural development in the Pacific Island countries is basically based on low external input, small-scale farming systems, supported by traditional and indigenous technologies. They are largely dedicated to home self-reliance composed of networks of small home gardens generally using simple tools and indigenous technologies to serve farm family needs and local markets. Compared to the predominance of chemical fertilizers in the more advanced Asian countries, farmers in the Pacific Islands are mainly dependent on natural fertilizer sources, recycling crop residues and natural soil fertility. Some island countries have started to experience the pressures of increasing population and rapid urbanization and declining land availability per capita, which in the long-term could become a major barrier to a long-term, sustainable agricultural development programme for food security. Increasing areas of sloping farmlands are contributing to a higher incidence of erosion and long-term loss of land productivity of scarce arable lands, particularly in coastal areas. Common issues in nutrient management and barriers to food security in Pacific Island countries, because of the very nature of small backyard or home gardens, are listed below, to wit:

1. The natural ecological convergence of upland agriculture with coastal agriculture and fishery areas justify the unique and critical role of soil erosion control and management in developing an inter-landscape transboundary INM strategy for a watershed-wide soil fertility management programme;
2. Dependence on natural soil fertility and natural fertilizer sources and traditional plants and varieties;
3. Soil erosion resulting from decreasing fallow periods, subsistence farming and increasing human demand for land and food;
4. Land use policy that protects scarce agricultural lands is in important consideration in the formulation of food security increasing population;
5. While low external inputs and multi-cropped home gardens, characterized by natural nutrient recycling and low nutrient demands, result in low food outputs, they help farmers preserve native soil nutrient reserves; and
6. Declining man-arable land ratio due to increased population and urbanization.

Three kinds of stakeholders and the manner in which information and substantive contents should be packaged and delivered.

**For the farmers:**

* Provision and packaging of appropriate and farmer-friendly extension materials (sketches and drawing illustration techniques, conduct of pilot on-farm demonstrations, preparation of easy-to-read soil fertility maps/charts, fertilizer recommendation charts, etc.);
* Establishment and promotion of Farmer Field Schools for community-based learning and development of Soil Doctors (adopted from Thailand’s experience) to facilitate farmer-tofarmer exchanges of knowledge and acquired technologies; and
* Elaboration and proper communication of monetary and environmental benefits of IPNS.

**For the decision-makers:**

* Mainstreaming of principles of nutrient management and elaboration of environmental and economic benefits derived from sound IPNS. This includes the preparation of policy briefs and position papers to elaborate the substantive economic and environmental benefits of adopting IPNS;
* Illustration of IPNS benefits through presentation of national nutrient balance analysis;
* Conduct of pilot techno-demos to showcase the impact of IPNS on yield increases supported by simple audience-friendly graphic illustrations of environmental benefits, and cost/return analysis;
* Brief on both positive and negative scenarios of IPNS adoption to address poverty and food security and long-term sustainable development; and
* Conduct and preparation of briefing materials on the environmental impacts of sound nutrient management practices.

**For support institutions and change agents:**

* Review of the extension approach (number of extension agents, extension methods);
* Promotion of the adoption of participatory approaches by all stakeholders (NGOs, the private sector, industry, researchers, academics, etc.);
* Provision of knowledge management to support IPNS networking (model, knowledge, scenario, scientific document); and
* Local campaign and support to IPNS.

**Reference:**[**http://www.fao.org/3/a-ag120e.pdf**](http://www.fao.org/3/a-ag120e.pdf)

## Vinícius De Melo Benites, EMBRAPA SOLOS - Empresa Brasileira de Pesquisa Agropecuária, Brazil

As a contribution of EMBRAPA (Brazilian Agricultural Research Company) and of a fertilizer research network led by our company in Brazil, I present below a summary of the main aspects regarding the use and sustainable management of fertilizers on tropical soils. These contributions are being discussed in the scope of a wide research network on the Fertilizers theme, called the FertBrasil Research Network, led by Embrapa and currently coordinated by me, Dr. Vinicius de Melo Benites. I currently also holds the position of Head of Research and Development of Embrapa Soils, the reference unit of Embrapa in the research of tropical soils in Brazil.

Embrapa Soils's mission is to enable research, development and innovation solutions for the sustainability of agriculture, for the benefit of Brazilian society. Embrapa Soils coordinates and executes, throughout the national territory, actions to prognosticate and promote preventive measures of environmental risks due to the inadequate use of soil and water resources. These actions are centered on the integrated vision of the soil as patrimony of present and future generations, prioritizing the planning of sustainable land use, providing subsidies for decision making and contributing to the advancement of technical-scientific knowledge in the Soil Science area.

The FertBrazil Research Network comprises a structure for research, development and technology transfer in fertilizers in Brazil that is coordinated by the Brazilian Agricultural Research Corporation - EMBRAPA. The general objective of the Network is to consolidate a national network for research and validation of fertilizer technologies, recognized by the public and private sector as the reference research network on this theme.

We suggest that CoCoFe should be structured in a transdisciplinary way so that it has the maximum positive impact, that is, it must involve actors from all segments of the fertilizer chain, such as Research Institutions, government regulators and representatives of fertilizer companies.

We understand that CoCoFe's scope of action should involve all the essential nutrients normally applied to improve crop productivity including synthetic fertilizers as well as manures, biosolids, urease inhibitors, etc. Some current challenges are primarily to advance knowledge on a technological basis to actually discover and define new routes and fertilizer production processes using alternative mineral sources of nutrients, such as marginal phosphates and potassium silicates, for industrial application, whether by biosolubilization/bioleaching processes, comminution of particles associated or not with mechanosynthesis processes, thermal processes, and the association between them. On the other hand, several organic sources of nutrients, such as animal wastes, agricultural, agro-industrial, industrial and urban wastes have shown promise for industrial use and with their direct application in agriculture, with good agronomic efficiency. The adoption of products with aggregate technology to control the release of nutrients was massive today occupy much of the delivery of NPK fertilizers in the world. However, little is known about the bases of operation of the aggregate technologies in the aspect of materials as polymers, enzymatic regulators, clay minerals, nanostructured materials, etc. and, therefore, there is no consensus on whether the products currently marketed in Brazil are actually more efficient compared to traditional ones. This barrier can be overcome with actions aimed at advancing knowledge about the technologies of control of the release of nutrients so that products suitable for the conditions of Brazil can really be developed, as well as a very important network of agronomic and environmental evaluation of the and other innovative products for their appropriate recommendation for agriculture. For this, studies in advance of the knowledge of the area of materials, techniques of fertilizer production as well as the development of laboratory methods of evaluation of this group of fertilizers, are essential.

Besides, it is necessary to create an integrated intelligence system so that the information and technologies generated are actually appropriated by the agricultural sector, fertilizer producers and society in general.

The entry of these products into the market represents economic impacts of different natures, either by adding value to raw materials or residues that are not currently marketed as fertilizers, or by increasing efficiency in the use of fertilizers by the aggregation of technologies in the new fertilizer formulations, by the selection of cultivars of greater efficiency in the absorption of nutrients or association of microorganisms to the rhizosphere.

Regarding environmental impacts, new technologies should be evaluated for their life cycles, greenhouse gas emissions (Ex N2O) and heavy metal contamination, and these results should be compared with the impacts caused by the fertilizers traditionally used. In this way, it should be possible to clearly estimate the environmental impact resulting from the adoption of the envisaged technologies. However, it is expected that with the adoption of technologies the negative impact on the use of fertilizers will be reduced, especially those related to nitrogen and organic sources.

The social impacts of the fertilizer chain should be related to the possibility of job creation in the fertilizer sector, since some of the new technologies may be related to medium and small regional companies. Some of the technologies evaluated are focused on the family agriculture segment (mycorrhizal inoculants, selection of cultivars, inoculants biosolubilizers). These technologies should promote the increase of income of this population, mainly due to the reduction of costs with the acquisition of inputs and also by the more rational use.

Our perception is that CoCoFe should act in promoting the responsible and efficient use of fertilizers in the different countries. Each country should have its own laws regarding legislation, production and use of fertilizers. However, we suggest that following the final definition of the CoCoFe's focus, actions should be set similar to the established and widely publicized follow-up system for the UN's "Sustainable Development Goals", which could act as guiding principles for international public policies aimed on sustainable use of fertilizers. These goals can then serve as a benchmark for national executive and legislative powers and serve as a basis for national and international funding for research, innovation and technology transfer in the area.

Some suggested strategies for sustainable fertilizer management NITROGEN

Together with the scenario of expansion of fertilizer production capacity, technologies can be developed to increase the efficiency of nitrogen utilization by plants. The main actors in this trend will be the public research research companies in partnership with the private sector. Technologies under development by the research in this area have the potential of having a direct impact on the fertilizer and bioinoculars market, both by increasing the efficiency of nitrogen utilization by plants and by reducing losses to soil and air through the volatilization and leaching processes.

The development of new nitrogen fertilizer formulations that present high efficiency with reduction of losses can represent a great contribution to the sector, through technologies added to conventional fertilizers based on the development of new formulations for the production of fertilizers slow release / controlled of nutrients; or of granulation technologies and biological processes for the production of fertilizers.

An important field of action is the selection and use of bacterial inoculants in crops to optimize nitrogen nutrition, such as the success of inoculation of soybeans in Brazil, which guarantees savings of about R$ 10.3 billion of annual dollars, through the process of biological nitrogen fixation. If this crop depended on nitrogen fertilization, it would make the Brazilian dependence even greater and financially impact the production, reducing the competitiveness of the Brazilian soybean. Such technological success is now expanding in the country through the development and use of new bacterial inoculants in crops such as corn, beans, wheat and sugarcane. These microorganisms promote root growth and improve the use of applied nitrogen fertilizer. Such technology became a reality in the country in 2013, primarily for maize culture inoculated with strains of Azospirilum. In 2014, the technical feasibility of soybean co-inoculation with Azopirillum was indicated. There is an indication of the launch of the sugarcane inoculant in commercial scale in 2018. Recently, research has demonstrated the high potential of inoculation to improve the efficiency of nitrogen fertilization in pastures, which in 2014 occupied a total of 1.6 million km².

PHOSPHORUS

Concerning mineral fertilizers, the main concern is the depletion of phosphate rock stocks, the raw material of phosphate fertilizers. There are several reserves of phosphate rock distributed throughout the globe, however, only 37 countries produce industrial phosphate rock, 90% of which is concentrated in 10 countries.

From the point of view of the consumption of phosphate fertilizers, in the last decade a continuous and linear growth of demand has been observed, especially for the soy, maize and sugarcane crops, which together represent more than 60% of the Brazilian demand for phosphates. The incorporation of new agricultural areas into the productive system has leveraged this demand, especially in agricultural frontiers and in the conversion of degraded pasture areas to agriculture. On the other hand, in the already consolidated agricultural areas where intensive agriculture has been practiced for several years, it can be observed that there was an accumulation of P in the soil, which represents a natural capital gain, which can be managed to reduce the doses of fertilizers to be applied in the following harvests.

It is necessary to direct the efforts of the research to new forms of management of the systems of production that increase the efficiency of use of these nutrients. Management systems that promote the sustainable intensification of agriculture, prioritizing crop rotation, soil cover aiming at the conservation or increase of organic matter levels in the soil, and the reduction of soil phosphorus losses by the fixation process, a common phenomenon in tropical soils. There is also the possibility of recycling agro-industrial waste for agriculture, mainly residues originating from animal production, which contain appreciable amounts of nutrients such as phosphorus and potassium.

POTASSIUM

In the field, the management practices currently used have been very efficient in the use of potassium fertilizer. Among the macronutrients, it is estimated that potassium is the element that presents the highest average use efficiency index. In the case of soybean crop, this index is close to 100%, which means that the addition of potassium in the Brazilian agricultural areas is basically for the replacement of the potassium extracted by the crops. Therefore, the demand for this nutrient is directly proportional to the increase in Brazilian grain production.

The reuse of recycled potassium obtained from agricultural, agro-industrial and urban wastes is still one of the best alternatives for reducing international dependence on this input. Segments such as the sugar and alcohol industry, where practically all the potassium extracted by sugarcane cutting is disposed in the residue form of the process (vinasse), there is the possibility of recovery and recycling of this nutrient in the planting of new areas or in the maintenance of existing areas. It is estimated that if all the residues from the sugarcane crop were recycled, it would represent more than one million tons of KCl equivalents per year. However, nutrient recycling within the production system represents logistical costs that can sometimes exceed the cost of purchasing and distributing potassium fertilizers, depending on the international market situation.

The development of modern industrial plants for the provision of essential nutrients, new formulations that allow the reduction of soil losses, better utilization of crops, recycling and local use of agricultural residues, and innumerable other areas of research with potential for innovation and technological development can be glimpsed.

## Tip O'Neill, International Raw Materials LTD, United States of America

On behalf of International Raw Materials LTD a Philadelphia based fertilizer distribution company that is actively involved in the SDG process through our industry association IFA, I would like to suggest including nutrient recycling under Objective 3 to read:

“minimizing the environmental impacts from the production and use of fertilizers including pollution by loss of nutrients via runoff, leaching, greenhouse gas emissions and other mechanisms; by facilitating broad scale implementation of nutrient recycling from both organic and industrial sources.”

The fertilizer industry is uniquely positioned to address environmental challenges through better management of chemical waste by recovering and transforming industrial by-products into useful re-purposed climate-smart crop nutrients.

These climate-smart fertilizers are re-introduced back into a circular economy, essentially feeding the soils that feed the crops that feed people. Prior to climate-smart fertilizer recycling, these molecules were lost to the environment.

Nowadays, for instance, our company, IRM, markets close to 1 million metric tons of climate-smart fertilizer captured from industrial production streams in the US, Canada, Australia and Madagascar every year. These recovered essential molecules are given a second life and are distributed across the globe in regions where soils are starved for crop nutrients.

## Claudia Marques-dos-Santos Cordovil, Instituto Superior de Agronomia, Portugal

Thoughts on CoCoFe from the Expert Pannel on Mitigating Agricultural Nitrogen of the of theTask Force on Reactive Nitrogen (TFRN) under the Working Group on Strategies and Review of the UNECE Convention on Long-range Transboundary Air Pollution.

The objectives of the CoCoFe are to help answer to the following questions:

1. maintaining or increasing global food production;
2. maximizing the efficient use of plant nutrients to enhance sustainable agriculture;
3. minimizing the environmental impacts from the use of fertilizers including pollution by loss of nutrients via runoff, leaching, greenhouse gas emissions and other mechanisms;
4. minimizing environmental and human health impacts from pollutants such as heavy metals in fertilizers;
5. maintaining and increasing food safety.

To contribute to answer these questions, the following comments apply:

1. The justification of fertilizer for helping to feed the current and future human population is valid. But how much of fertilizer is used for non-food amenities (e.g. lawns, Cannabis), or non-essential food crops (wine grapes, hops, raspberries) and feed crops. So perhaps focus on minimizing fertilizer inputs to non-essential crops, i.e. accept greater yield loss risk. Also, maintaining a sustainable global food production would imply an even distribution of fertilizer resources and of crop production. Nutrient imbalances are a reality within Europe and worldwide, therefore a better fertilization management and increasing nutrients use efficiency are the way to guarantee sustainable increasing need for food production. Good management implies region specific knowledge and actions.
2. We must recognize that the dialectic commercial and public good intentions of the fertilizer industry as exemplified by the various ‘Institutes’ (IPNI, CFI, EFI) responding to CoCoFe is blurred. It is very difficult to tease out this duality. For example, they support good research and technology transfer but they also lobby governments and stack the arguments in their interest (e.g. against organic agr.). They have considerable wealth and resources unlike any other comparable players. An example is promoting the 4Rs while transitioning to urea (not an ‘R’) and then marketing ‘value added’ urea products. Given fertilizer’s importance to humanity, which the industry attests, perhaps public bodies should have a greater role in the fertilizer discussion. One possible approach is a more balanced approach is to ensure that support for research on organic products including manure should match (or exceed it since it is much more complex) the resources put into fertilizer research. A special call for biobased fertilizers research and innovation projects is currently open in the EU, that will hopefully contribute to the Nutrient recovery and reuse from organic by products, including manure. This call is oriented under the circular economy concept package, which is valid for the sustainable crop fertilization.
3. The Code might say something like every kg of fertilizer used should be considered in terms of need vs. impacts on both ends of the chain: i.e. depletion of resource and exhaustion into the environment. Hence the code should be ‘use less, reuse more’ as with other materials.
4. There are ways to mitigate the need for fertilizers. Technology is helping (precision ag, diagnostics) but equally important is good management skills, and region specific knowledge. There is no question that much better yields are achieved by better managers with equivalent inputs. It is a matter of talent and education. We research efforts should shift from optimizing fertilizer use (as in 4R) to optimizing production with all tools, of which fertilizer is one.
5. Fertilizer use must always be precisely monitored on farm level and beyond and records must be kept at all levels. Farms that use fertilizer should have field and farm budgets, in addition to BMPs. Accounting at farm level is often not done in regions with excess fertilizer use and consequent excess nutrients in the environment. So, more careful fertilization plans could be mandatory, or at least strongly advised.
6. In most countries of the world, the only effective means to promote a careful use of nutrient use in agriculture is price. The price of fertiliser nutrients therefore needs to be adjusted so that it is sufficiently cheap that the cost is not a serious impediment to its use to alleviate nutrient deficiencies in food production but sufficiently expensive that it encourages efficient use of nutrients, including (via the shadow price) those in manure.
7. Several submissions suggested including the benefits of fertilizer on food quality. Consider also possible negative effects on food quality. For example nitrate in leafy crops, cadmium from P fertilizer, food quality in context of total diet, e.g. high nitrate in food and water, and dilution of bioactive molecules from rapid stress-free growth. Also, special care needs to be taken, concerning the use or treated and untreated organic residues as fertilizers, due to potential risks for chemical and/or biological contamination of the marketable products.
8. The UNECE TFRN Guidance Document on Reactive Nitrogen called Options for Ammonia Mitigation is a consensus compilation of many stakeholders (including farmers groups and European Fertilizer Association) across the UNECE and deals with conserving N with a focus on ammonia but taking the whole farm into account. The measures range from whole farm budgets and animal feeding to specific fertilizer and manure application technologies- all intended to improve management of reactive nitrogen. The TFRN believes that this document and the associate **Framework Code on Ammonia Emissions** can inform the FAO in developing the CoCoFe.

## Cecilia G. Flocco, Visiting Fellow, German Federal Research Centre for Cultivated Plants. | Head Scientist, AKF Global LLC, USA / Germany

**Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?**

Yes. Additionally, the gestation and implementation of the CoCoFe represents a great opportunity to highlight the notions of soil health and the ecosystems services and products it provides\*, to better reflect the importance of the sustainable use of that natural capital, not only in terms of food production, but for the benefit of the environment and human wellbeing in the short and long term.

*(\*) among other contributions: biogeochemical cycles, hydrological regimes, disease control and regulation, reservoir of novel genes and biomolecules of biotechnological and pharmaceutical interest.*

**How should the CoCoFe be structured to have the maximum positive impact?**

Recommendations: elaborated in consultation with scientific and technical teams representing different agricultural regions and countries. Governance and Implementation: an international body overseen by FAO officials and comprising representatives from individual countries which, in turn, coordinate the harmonization and implementation of recommendation with the local agencies managing agricultural policy, industry sectors and organizations interacting with end users (extension offices, famers associations, cooperatives, educators). The benefits of a rational use of fertilizers for all stakeholders and the environment should be highlighted.

**Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?**

Direct communication with end users, provided by trusted partners, is crucial to the adoption of CoCoFe recommendations. Depending on individual countries, agricultural systems, production scales and local circumstances, extensions officers, agricultural advisors, educators and community leaders are key information sources, supported by agencies managing and implementing agricultural policy.

**What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio- stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?**

All nutrient sources, from manure to advanced formulations should be included, with recommendations based on scientific data.

**Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?**

Yes, it should seek inclusive dialogue and input from all stakeholders, elaborating and overseeing recommendations harmonized with individual national and subnational agricultural schemes and policy frameworks.

Cecilia G. Flocco, Ph.D

Head Scientist, AKF Global LLC, US. Visiting Fellow, Julius Kühn-Institut

Federal Research Centre for Cultivated Plants, Germany.

## Bernard Vanlauwe, IITA, Kenya

I fully support the inclusion of all plant nutrients in the CoCoFe while recognizing the limited availability of other sources of nutrients besides fertilizer in many smallholder farming systems. Integration of organic inputs (and other soil mgt implements) mostly aims at addressing those soil fertility constraints that limit the uptake and use efficiency of fertilizer. Integrated Soil Fertility Management (see attached some papers with more details) also aims at optimizing not only the supply of nutrients (in line with the 4R nutrient management strategy) but also the demand for those nutrients through inclusion of the use of improved germplasm and other good agronomic practices.

*Integrated soil fertility management in sub-Saharan Africa: unravelling local adaptation*

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/Vanlauwe%20et%20al%2C%20SOIL%2C%202015%2C%20ISFM%20and%20local%20adaptation.pdf>

*Integrated soil fertility, management, Operational definition and, consequences for, implementation and dissemination*

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/Vanlauwe%20et%20al%2C%20OA%2C%202010%2C%20ISFM.pdf>

## Maria Giulia De Castro, World Farmers’ Organisation, Italy

**Written comments from the World Farmers‘ Organisation, WFO**

WFO is an international member-based organization whose mandate is to bring together farmers’ organizations and agricultural cooperatives from all over the world, representing the global farming community: small, medium and large-scale farmers. Its mission is to represent and advocate on behalf of farmers in global policy fora and create the conditions for the adoption of policies aimed at improving the economic environment and livelihoods of producers, their families, and rural communities, giving prominence to rural women and youth. The main pillars of its activities are food security, climate change and value chain, but it deals also with other topics related to agriculture as livestock, women, youth, trade among others.

**Comments from Federated Farmers of New Zealand, FEDFARM, member of WFO**

The organisation highlighted that the objectives of this initiative are good as farmers are the ones who will have to work within any code developed. All that is spread on the land in order to promote yield should be included as there may be some unintended contaminants included in all that is spread. DCD is a case in point. There may be a need to separate them out into such categories as urease inhibitors etc, as they may need to be dealt with separately. One would assume that the CoCoFe will give guidelines to manufacturers and farmers across the world about good management practices for fertiliser, which should give regulators across the world confidence that the land is being well cared for and food produced is safe. A sensible CoCoFe will mean that the industry can work under self-regulation, without government intervention. Farmers rely on manufacturers to supply them with a product that is true to label, fit for purpose and information about application rates etc. This CoCoFe should aim to deliver this.

**Comments from Canadian Federation of Agriculture, CFA-FCA, member of WFO**

The organisation pointed out that the WFO, in partnership with the International Fertilizer Association (IFA) and the Global Alliance for Climate Smart Agriculture (GACSA), produced a nutrient handbook for farmers which is available at the following link:

<https://www.fertilizer.org/images/Library_Downloads/2016_Nutrient_Management_Handbook.pdf>

CFA-FCA thinks if that were to be revisited it would offer a lot of good information to be provided to the FAO. Furthermore, in Canada they have endorsed the fertilizer industry’s 4R nutrient program: Right source, right rate, right time and right place. More information can be found here: <http://www.nutrientstewardship.com/4rs>

CFA-FCA is of the view that should the above-mentioned program should be taken into consideration by FAO as it refers to many of the themes of their proposed code of practice.

Furthermore, CFA-FCA notes that one of the stated purposes of the FAO code of practice is to assist countries to design regulatory frameworks for fertilizer use. In this regard, the organisation would recommend that this should be revised to remove any reference to the development of regulation to govern fertilizer use by farmers. It is CFA-FCA’s position that enabling policies, incentives, outreach, extension, education and other support services are a more effective means to promote sustainable use of fertilizers while recognizing the unique needs of each farm and the commodities it produces.

## Asheri Kalala, Mikocheni Agricultural Research Institute, United Republic of Tanzania

COCOFe insist on improving soil testing capability for majority of farmers to access that service. Soil testing in developing countries is still expensive to be afforded by small scale producers.

COCOFe should emphasize a need of soil fertility experts to train extension officers (village officers) who are directly in contact with famers. Majority of extension officer’s knowledge on soil fertility and plant nutrition is still low.

The COCOFe insist the use of available materials at farmer’s environment like organic residues, rock phosphates and lime materials. The knowledge of farmers utilizing them is still low, yet farmers cannot afford the industrial imported fertilizer to replenish the lost nutrients in fields.

COCOFe insist the improvement of other knowledge in agriculture like developing high yielding varieties needs to go hand by hand with research on soil fertility. Working close with plant breeders in most cases evaluation of varieties do not consider soil fertility component.

## Jessie Fagan, FAO, Italy

FAO’s Child Labour in Agriculture Prevention team, Rome, Italy

Regarding the fourth objective that focuses on human health impacts, it is also essential that the Code of Conduct adequately considers the health of all workers, including children.

Today, 71% of all child labour occurs in the agricultural sector. In Africa alone, over 72 million children are engaged in child labour, 32 million of which is hazardous work. Beyond the numbers of children engaged in child labour, many more are also working in agriculture or helping their families on the farm. The prevalence of children engaged in agricultural activities and on farms should be considered when designing responsible systems of fertilizer management.

Depending on the context, fertilizer application has the potential to create hazardous situations of child labour. This may include carrying heavy loads, excessive working hours or manually handling some chemicals that cause irritation. Unfortunately, child labour is often a hidden phenomenon, which is why the promotion of certain production systems and employment initiatives should remain child labour sensitive.

As part of SDG 8.7, it is essential that we focus on child labour prevention in agriculture. Child labour also affects our ability to reach SDGs 1 and 2 on eliminating poverty and hunger; children engaged in child labour risk their healthy development and are less likely to become educated and access gainful, decent employment as youth or adults. They can easily become trapped in a vicious cycle of poverty and low productivity with negative repercussions for the development and food security of rural communities.

## Gary Pierzynski, Debra Turner, Ronald Vargas, facilitators, FAO, Italy

Dear colleagues and contributors,

The online consultation for contributions to the Code of Conduct on Fertilizer Management (CoCoFe) is now officially closed. We had close to ninety responses during the Forum and as mentioned before they come from many different stakeholders, including the fertilizer industry, academia, the public sector, research institutions, farmer organizations and many others. It has been very interesting and enlightening to read the variety of responses received and all of them will be considered when drafting the first CoCoFe document.

Now that the consultation has ended, the Intergovernmental Technical Panel on Soils (ITPS) will lead and oversee the work of producing the CoCoFe. This will include appointing a special Task Force to provide technical and expert advice to the ITPS on various aspects related to the management of fertilizers, as well as to assist the writing team in producing a first-draft CoCoFe over the coming two months. The ITPS will conduct a detailed review of the draft in mid-April 2018.

An open-ended working group will be established to review and finalize the draft CoCoFe in late April 2018. Our member countries will select members of the open-ended working group so as to represent the global regions. The working group will also include representatives from multiple stakeholders including academia, industry and civil society.

The CoCoFe will be submitted to the Global Soil Partnership (GSP) Plenary Assembly on 11-13 June 2018. If endorsed, it will be submitted to the Committee on Agriculture (COAG) in September 2018, and subsequently to FAO Council in December 2018.

We will provide updates and any relevant information on the development of the CoCoFe through the FSN Forum and our other relevant networks, including the GSP, to let you all know how things are progressing.

Again, the ITPS, the GSP and FAO thank everyone that participated in this online discussion and for the excellent quality and highly thoughtful comments and feedback that we received. The feedback will certainly benefit the future Code of Conduct on Fertilizer Management document, as well as achieve its aim to manage nutrients more sustainably in the future for more efficient food production systems with increased food security, and with less impacts on the environment, society and and human health.

Warm regards from,

Debra, Gary, Zineb and Ronald (Facilitators of the consultation) and the Forum support team.

## Stephen Dania, Ambrose Alli University, Nigeria

Land tenure results in land fragmentation and dispute among farmers. It makes fertilizer use among farmers uneconomical due small farm size.

Fertilizer formulation should be location base. The fertility evaluation of a particular location should be ascertained. Generally, tropical soils are inherently deficient of nitrogen and phosphorus and prone to erosion and leaching which further results to soil degradation.

Tropical soils are fragile having low depth of organic matter, so organic manure should be included in fertilizer formulation and manufacture (organomineral fertilizer) to improve the soil organic matter.

Farmers must be trained in the when and how to apply fertilizer. The major constrain in fertilizer use among farmers is distribution and availability to grassroot farmers in Africa.

## Prem Bindraban, VFRC-IFDC, United States of America

See my points below that I can foresee with additional background arguments and facts if needed. This mail can be considered a contribution from the IFDC. (I did note the comments by Porfirio.) You can find the papers mentioned in the below points and other papers on <https://ifdc.org/vfrc-reports>.

Innovation in fertilizer design, packaging and delivery

* Emphasizing the use of fertilizers in minimizing externalities puts the responsibility of the problems to the users – i.e. the farmers.
* The industry supports the 4R approach which does exactly that – placing the responsibility on the shoulders of the farmers.
* Yet, investments in fertilizers have been virtually absent over the past decades (Fugli et al., 2011).
* Much (more) gain in reducing nutrient losses from fertilizers can likely be made by taking biological and ecological processes as an entry point in the design and development of (innovative) fertilizers (Bindraban et al., 2015).
* “Innovative fertilizers. There has been virtually no investment in fertilizer research and development over the past five decades. Taking plant physiological and soil processes, rather than chemistry, as a starting point, the redesign of ‘packaging’ and ‘delivery’ nutrients can result in rapid nutrient uptake by plants. Innovative fertilizers – targeted at feeding crops, rather than the soil – would provide multiple benefits, including higher content of multiple nutrients in cereals, the restoration of soil fertility, and increased system resilience and sustainability. (From Save And Grow; FAO, 2016).

Unlocking the multiple public good services from balanced fertilizers (Bindraban et al., 2018)

* We should better unlock the potentials of fertilizers (beyond NPK).
* Yield increase (and environmental side effects) are currently the only drivers in fertilizer use, YET
* The nutritional content of cereals, fruits and vegetables have collapsed over the past 5-6 decades with increasing yield levels but can be revived through micronutrient-containing fertilizers (Dimkpa and Bindraban, 2016) – and with that can contribute to human nutrition and health.
* Balanced micronutrient- containing fertilizers further
	+ enhance drought tolerance (Dimkpa et al., 2017) contributing to resilience
	+ improve plant health to resist pests and diseases – with that reducing the need for biocides (Servin et al., 2015)
	+ increased metabolite production to improve taste and shelf-life (and with that contribute to reducing food waste) (Kendristakis, 2017)
	+ suppress specific weed infestations
	+ dramatically increases water use efficiency (my slogan “the best irrigation is fertilization” that applied for most areas, especially semi-arid with the initial response to develop irrigation infrastructure rather than improving soil fertility)
	+ increases the use efficiency of NPK and reduces losses (Dimkpa et al., 2017)

A Comprehensive Nutrient Assessment to unlock fertilizer benefits (Bindraban et al., 2018)

* Currently there is much work done on N and P, but we miss all the other elements.
* Again – also – emphasis only on yield and externalities
* But look at the other functions that fertilization can contribute to (pls do realize that I am referring to fertilizer use in the context of integrated soil fertility management including organic compounds and amendments).
* We need to engage in a much more promising scope for (innovative) fertilizer products in supporting societal goals and with that to be seen more as a public good rather than simply a commodity from the industry – this view might help to engage multiple actors in pushing for change.
* It would be very important to look in more depth into the pricing mechanism of fertilizers (Hernandez, M.A., M. Torero, 2013).
* It will also be important to consider the contribution of fertilizers in reducing environmental impact from a more comprehensive approach – we will have to take a package of measures simultaneously to reduce the losses within acceptable limits as currently discussed under the Planetary Boundary concept (see our paper Conijn et al., 2018).

I have not gone into the specifics of objectives etc, that have extensively been commented on, but wanted to 1) ensure that the responsibility for action is placed on the right actor and that 2) we introduce the need for innovations, 3) the need for a comprehensive assessment and 4) “Dutch diamond type approach (<https://www.government.nl/topics/development-cooperation/development-cooperation-partners-and-partnerships/public-private-partnerships>) stakeholder meeting and 5) a societal movement. (Fertilizers are e.g. not on the agendas of NGO’s, nor of many policymakers (often only setting limits to losses rather than imposing regulations to push for innovation (except for recycling now in the EU). We need a collective action with all parties to move the sector.

Hope this helps and can still be incorporated.

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Prem S. Bindraban

## Durlave Roy, Northern Agro Services Ltd, Bangladesh

Sustainable use of renewable natural resources - to achieve the target, we have to improve the efficiency of the fertilizers and fertilizer practices by continuous research and developments and innovation. We must take into focus the balanced and targeted fertilization to improve the efficiency. We have to improve the organic of the soil to boost the root and the efficiency of the nutrient uptake the crop.   Solutions - Crop based Balanced Fertilization on soil test based northernfertilizer.org

## COPA-GECA

Dear Stakeholders and Members,

We are tasked with a unique opportunity to mould the future of fertilizer use globally and are seeking inputs on the development of a Code of Conduct for the Management of Fertilizers (CoCoFe).
The creation of the CoCoFe is being proposed to promote the responsible and judicious use of fertilizers in the interest of the following objectives:

maintaining or increasing global food production with good quality, nutritional and safe;;

maximizing the efficient use of plant nutrients according to their needs to enhance sustainable agriculture and carbon sequestration in soil and vegetation;

minimizing the environmental impacts from the use of fertilizers including, nutrient discharge byleaching, air emissions by e.g., ammonia greenhouse gas emissions and other mechanisms;

minimizing environmental and human health impacts from pollutants such as heavy metals and organic harmful substances in fertilizers;

maintaining and increasing food safety by closing the yield gaps.

The aim of the CoCoFe is to assist member countries design policies and regulatory frameworks for the sustainable use of fertilizers. The focus is more on discouraging fertilizer overuse whereas a second document, to be developed later, will address scenarios with low or no fertilizer use under the topic of integrated soil fertility management. The CoCoFe should assist policy makers at the regulatory and extension levels to outline the roles and responsibilities of the multiple stakeholders involved in various aspects of fertilizer management including governments, industry, universities, NGO’s, traders, farmers organizations, etc.

Note: The CoCoFe is not designed to provide specific recommendations on field applications of fertilizers, i.e. rates, placement, timing, etc., but rather broader recommendations on what should be considered when designing strategies to manage fertilizers sustainably.

Your input is necessary to allow the Intergovernmental Technical Panel on Soils (ITPS)1 to better frame the multifaceted needs of all stakeholders who would use the CoCoFe or be impacted by the use of the CoCoFe

This online consultation, through a series of questions, invites you to address the following:

* Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?

In compliance with the Paris Agreement legal obligation to adapt to climate change and strive for low carbon development ‘in a manner that does not threaten food production’, the CoCoFe message regarding resource efficiency and improvement of emissions intensity in food production should be made more clear.

* How should be the CoCoFe be structured to have the maximum positive impact?

The CoCOFe should be structured so that it encourages a supportive and advice led approach. Limiting application of fertilisers is almost impossible to regulate, therefore the benefits of maximising the efficient use of plant nutrients needs to be clearly demonstrated. Technology such as precision application and Nutrient Management Plans (NMP) software are examples of where support can be offered.

Who would be the best audience for the CoCoFe to meet our objectives and how could we broaden and diversify this audience to increase its influence?Research institutes and farming advisors have an important role to play in the process of productivity improvement and they should be integrated in this debate. Also it would be good to involve the fertilizer industry.

* What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?

Absolutely, all nutrient sources should be included in the CoCoFe, because it makes sense to have a holistic approach that will build on synergies between livestock and crops production with all soil functions, including nutrient cycling. Emissions reductions should not be tackled without increasing yields, hence possible options (e.g. split application, bio-stimulants, nitrification inhibitors, urease inhibitors, controlled release fertilizers etc.) and their costs should be carefully assessed vis à vis their claims in a science-based manner.

* Will the CoCoFe assist in promoting responsible and judicious use of fertilizers? Why or why not? What other suggestions do you have to help the CoCoFe meet our objectives?

*There is no carbon sequestration without nutrients*, hence when we talk about agriculture we should keep in mind that its emissions are biogenic and not fossil. For that reason agriculture will have to follow a different path to low carbon economy, than other economic sectors. By addressing emissions and soil fertility in a completely disconnected way, especially at policy level, the communication to the farmer who decides on more complex issues will be hampered.

<http://www.fao.org/fsnforum/sites/default/files/discussions/contributions/COPA-COGECA.doc>

## Amit Roy, Former President & CEO of IFDC

Before I articulate my comments in the following paragraphs, I like to commend FAO for undertaking the development of Code of Conduct on the management of Fertilizers (CoCoFe) and seeking stakeholder inputs. My comments are summarized below.

Fertilizer is a derived demand and its use is determined by several factors including profitability, marketability of produce etc. So COCoFe should be considered in the context of the entire value chain consisting of fertilizer supply, use and output markets. In the management of agricultural system all sources of nutrients (inorganic fertilizers, organic sources, manure and recycle materials) should be considered. So instead of Code of Conduct on the management of Fertilizers the title should be Code of Conduct on the management of Plant Nutrient. This change in title certainly makes the exercise more complex but the outcome would be more useful to the countries and practitioners since there is an upsurge in the use of organic materials and recycle products as a complement to and in some cases substitute for inorganic fertilizers.

In developing the recommendations for nutrient management one should consider the source, rate, placement and time of application based on soil and crop. The soil analyses is vital in determining the nutrient composition of the material and the rate of application not only of primary nutrients but also secondary and micronutrients. Both secondary and micronutrients are becoming more limiting to crop productivity particularly in Africa.

The heavy metal contents in fertilizers, recycled materials and manure need to be addressed from the environment and human health stand point as a part of the Code of Conduct exercise. I have recently done some analyses about the cadmium limits in fertilizers in countries and states. These limits vary widely. The most stringent limits under consideration is in the EU countries. The EU regulation proposes to set a limit of 20 mg Cd/kg of P2O5 in phosphate fertilizers over a time horizon on 12-15 years from current level of ~80 mg Cd/kg P2O5 . This limit is vastly lower than in other areas (Please see the diagram below). The sources cadmium in soils are several including geology of the region, rate of manure application, fertilizer etc. The uptake of cadmium by plants depends on its availability which is influenced by several factors including pH of the soil, the rate and source of organic matter, the available Zinc in the soils. Hence setting the limits for cadmium (and heavy metals) in fertilizers is quite complex and would need analysed in the Code of Conduct exercise.

While the Code of Conduct exercise is very useful and timely, it should lead to the establishment of a permanent structure to act as a clearing house of information for the management of plant nutrients. Such an information system should be 'open source' and the inclusion of information in the database should be peer reviewed.

Hope my comments are useful. Thank you for giving me the opportunity to share my thoughts.

Regards

Amit Roy

## J. Scott Angle, International Fertilizer Development Center, United States of America

IFDC Response to the FAO Online Consultation for Developing the Code of Conduct for the Management of Fertilizer (CoCoFe)

For more than 40 years, the International Fertilizer Development Center (IFDC) has been a source of information on fertilizer, soil fertility, and plant nutrition, and a source of support and technical assistance to the agriculture sector and the fertilizer industry. IFDC is a leading center for the research and development of new fertilizer products and for promoting their rational use by means of agro-economic research to improve soil fertility, increase productivity and production, and improve food security and nutrition around the world with a major focus on developing countries.

The following comments serve as IFDC’s official contributions to the CoCoFe.

IFDC scientists believe the judicious use of fertilizer calls for a holistic approach, starting with good quality fertilizer products, with reduced contaminants, which greatly depends on the source of nutrients, beneficiation of mined feedstock, and the production process. When supplied with good quality products and knowledge on their proper application, farmers’ judicious use of fertilizer can produce sufficient, quality, nutritious, and safe food for a fast-growing population while addressing environmental and human health hazards. With a finite amount of resources — namely land, fertile soil, and fresh water — and in the context of climate change, additional factors to consider for promoting the appropriate use of fertilizer are:

1. Increased investment to revamp agronomic and soil research for resilient agriculture, to innovate nutrient recycling in the context of a circular economy, and to develop the next generation of fertilizer products with lower contaminants, greater efficiency, and balanced nutrients congruent with advances in crop genetics, cropping technologies, and soil conditions.
2. A better policy, legal, and regulatory framework to guarantee not only the best quality fertilizer products but also their distribution and rational use.
3. The revamping of extension services for better technical assistance and training to encourage responsible fertilizer recommendations by the supply chain stakeholders and fertilizer use by farmers.

IFDC scientists and experts in fertilizer production, agronomy, and economics are well-positioned to support the development of the CoCoFe and its implementation through technical assistance and training to fertilizer supply and demand chain stakeholders.

SPECIFIC COMMENTS ON THE COCOFE

Given the global scope of the CoCoFe, do you think the objectives are appropriate? If not, how would you add to them or modify them?

First, IFDC suggests establishing clearer goals for the CoCoFe from which the objectives can emanate. In addition, fewer objectives will help simplify the elaboration of the CoCoFe and perhaps facilitate its adoption.

IFDC also suggests combining the stated objectives 3 and 4 and to consider the following four objectives, which we believe embrace the CoCoFe goals:

1. Increase food production by increasing yields to close the yield gap in developing countries and to supply the increasing global need of more, nutritious, and safer food;
2. Optimize the efficient use of nutrients (organic and inorganic) to maximize benefits of better natural resource conservation (land, soil, and water) and effectively promote sustainable agriculture production systems;
3. Minimize nutrient losses and the accumulation in the soil and in vegetative materials of contaminants and trace elements present in inorganic fertilizer and organic nutrient sources.

Considering the effects of climate change on agriculture, IFDC further suggests adding the following objective:

1. Support the adaptation of crops to imminent environmental changes for more resilient agriculture production systems considering balanced nutrient fertilizer products, nutrient recycling, and carbon sequestration.

In addition, although the CoCoFe is intended to address the use of fertilizer to “*minimize environmental and human health impacts from pollutants from fertilizer*,” it is necessary to clarify that the CoCoFe approach will only reduce such effects. However, a lot can be done to further reduce the impacts on environment and human health. Research and innovation should aim at improving the beneficiation of mined feedstock and the production processes of fertilizer to eliminate contaminants and non-nutritious trace elements (pathogens, organic and non-desirable chemicals) to enhance fertilizer quality.

What should the scope of the CoCoFe be? Which nutrient input sources should be included; only synthetic fertilizers, or also manure, biosolids, compost, etc.? Should other products such as bio-stimulants, nitrification inhibitors, urease inhibitors, etc., be included as well?

IFDC believes the scope of the CoCoFe should be on promoting the most efficient use of plant nutrients to effectively sustain agricultural production, which embraces inorganic fertilizer and organic nutrient sources.

Considering the aim of the CoCoFe is *“to assist member countries to design policies and regulatory frameworks for the sustainable use of fertilizers*,” and the nature of organic materials — which comprises multiple sources with erratic nutrient content depending on the organic material source — makes it difficult to standardize such materials as a source of nutrients, and therefore regulate it. On the contrary, inorganic nutrient sources/fertilizer, given their physical and chemical characteristics, facilitate standardization and regulation.

However, it is crucial to regulate organic materials (biosolids, compost, etc.) for contaminants and hazardous chemicals (heavy metals, pathogens, toxic organics —including pesticides —etc.). To that end, IFDC suggests developing a subset within the CoCoFe clearly addressing the recycling of organic materials to be used as a source of nutrients for food crops.

Recognizing that organic materials can be a valuable source of nutrients, in the traditional intensive production systems, they should be seen first as soil amendments to improve soil structure and increase microbial activity, water retention, and cationic exchange, among others, all of which facilitate the absorption of nutrients by the plant root; and second, as a source of nutrient supply to the soil and the plants. Nutrient supply from organic materials can be considered a positive externality in the context of a circular economy; therefore, organic materials should be supplementary to inorganic sources, not the main source of nutrients. The exception can be purely organic agricultural systems in which organic materials can be both soil amendments and the main source of nutrients.

With respect to the use of bio-stimulants, nitrification inhibitors, urease inhibitors, etc., they should be part of the discussion and the CoCoFe, since they can help improve nutrient use efficiency and achieve the stated environmental and perhaps human hazards objectives.

Additional comments:

- Although IFDC supports better policy and regulatory framework for the responsible use of fertilizer, it is important to recognize that the regulatory burden from the adoption of the CoCoFe has the potential to impact the cost of supplying and using fertilizer. This has greater implications for developing countries, such as in sub-Saharan Africa, considering that fertilizer production in these countries is almost non-existent, and its use is low to negligible. This is especially true among small-scale agricultural producers, due in part to fertilizers’ relatively high retail price resulting from high transaction costs along the international and domestic supply chains. Therefore, the regulatory burden could hinder the efforts of international donor and government programs to reduce the retail cost of fertilizer.

Therefore, economic analyses may be needed to weigh the impact from the potential burden introduced by the CoCoFe as opposed to the impact of a lax regulatory system that will make countries vulnerable to questionable nutrient content in organic products and to hazardous contaminants and non-nutritious trace elements in inorganic fertilizers and organic products.

- The CoCoFe has the potential to promote the responsible and judicious use of fertilizers if the right audience is brought into the consultation and discussion, and plenty of time is spent in mainstreaming the CoCoFe among the different stakeholders — a process that may take many rounds of discussions at different levels and consequently take several years before the CoCoFe comes to fruition and starts being implemented.