



**Centre for
Ecology & Hydrology**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Will Brownlie : wilown@ceh.ac.uk





OUR PHOSPHORUS FUTURE

a n d t h e S c i e n t i s t s ' C a l l

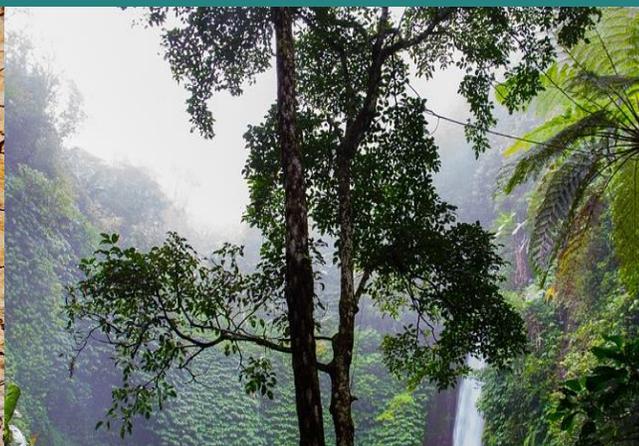
Webpage: www.opfglobal.com

Email: opf@ceh.ac.uk

Two year project 14 months in (concludes in March 2019).

PROJECT AIMS

- Raise awareness of global phosphorus sustainability.
- Bring together scientific evidence to support policy development, and
- Contribute to consensus development.



Funding



Executing partners



THE UNIVERSITY
of EDINBURGH

The European Nitrogen Assessment

Sources, Effects and Policy Perspectives

Edited by

Mark A. Sutton

Clare M. Howard

Jan Willem Erisman

Gilles Billen

Albert Bleeker

Peringe Grennfelt

Hans van Grinsven

Bruna Grizzetti



CAMBRIDGE

COMMENT

Vervuiling met stikstof kost miljarden

Nitrogen taint alert

Warning over nitrogen footprint

Pollution à l'azote : une lourde facture pour l'Europe

Too much of a good thing

Curbing nitrogen emissions is a central environmental challenge for the twenty-first century, argue Mark Sutton and his colleagues.

Nature 14 April 2011

Union defends use of nitrogen in high-octane climate change debate

www.nine-esf.org/ENA

UN says fertiliser crisis is damaging the planet

Scientists urge rich world to halve its meat consumption

The shape of nitrogen to come

An analysis reveals the huge impact of human activity on the nitrogen cycle in China. With global use of Earth's resources rising per head, the findings call for a re-evaluation of the consumption patterns of developed societies.

Nature doi:10.1038/nature11954

More environment-friendly nutrient use could save \$170bn a year

18 Feb 2013: *Independent*, *Guardian*,
Herald Tribune, *Times of India*
and **300 articles worldwide**

Our Nutrient World

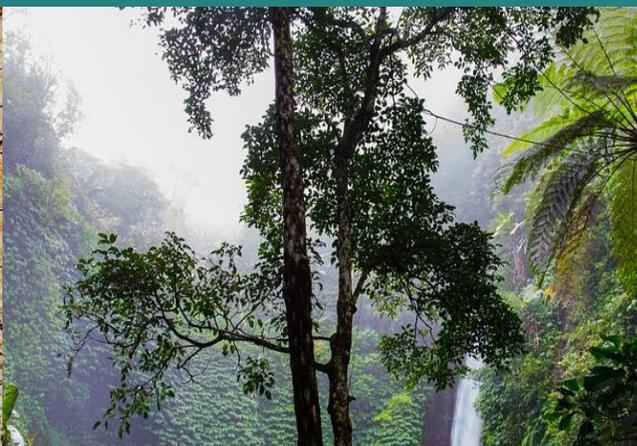
The challenge to produce more food and energy with less pollution



Prepared by the Global Partnership on Nutrient Management
in collaboration with the International Nitrogen Initiative

CORE PROJECT OUTPUT - a synthesis report (briefing notes + media), which will outline why we should, and how we can move towards a more phosphorus secure future.

AUDIENCE: Policy makers, environment agencies, the public and the media



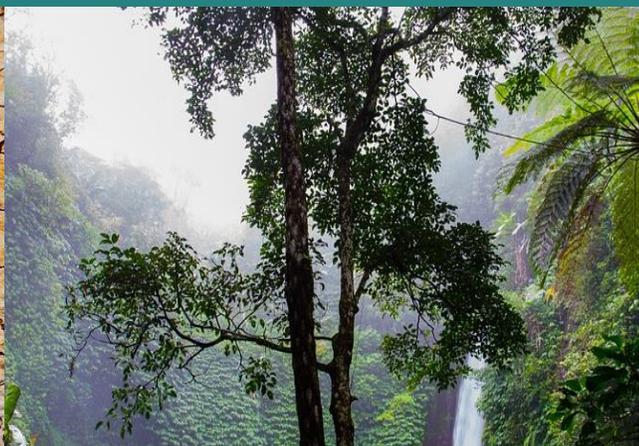
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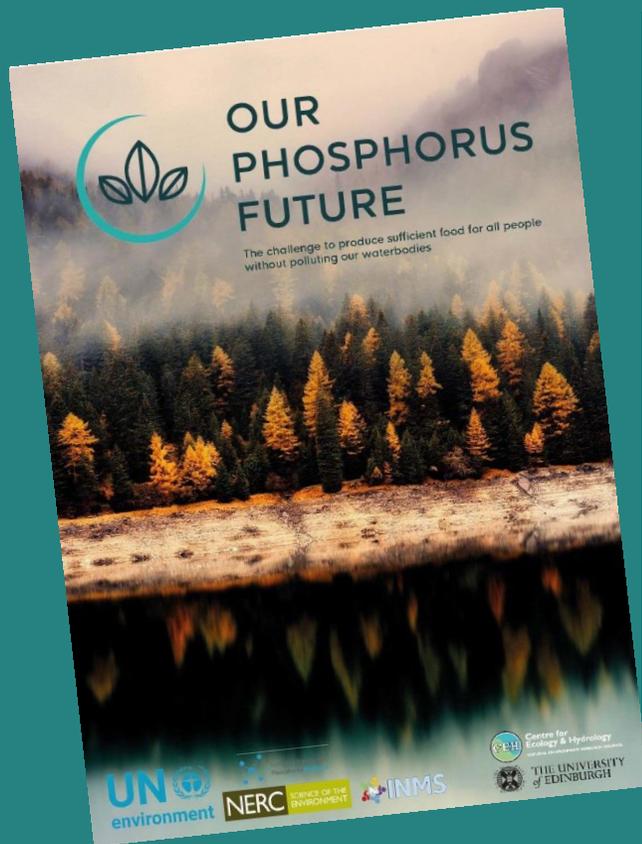
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WHAT IT WILL LOOK LIKE:

- Concise, highly visual, easily accessible/readable.
- (50-100 pages)
- briefing notes for each theme

- Printed Interactive PDF versions
- Web-based versions
- Explainer videos





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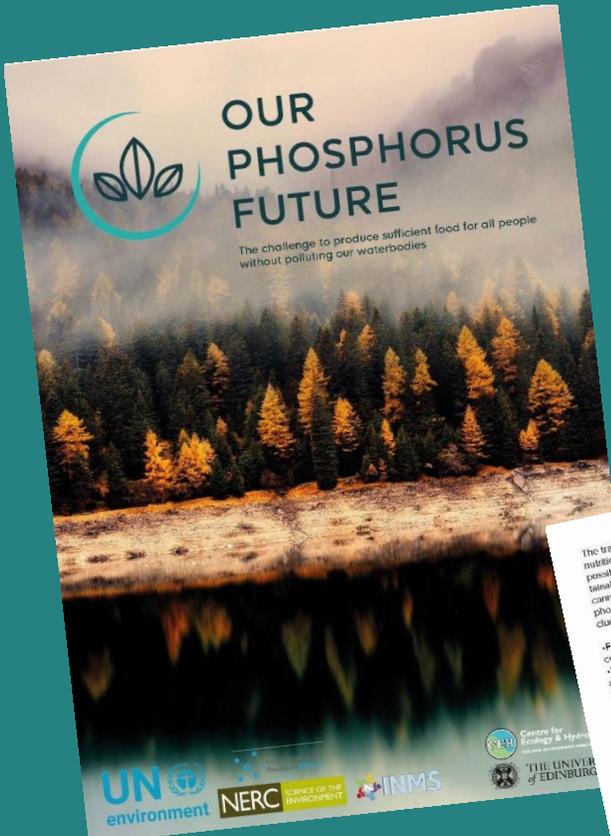
THE ROLE OF PHOSPHORUS IN ACHIEVING FOOD SECURITY





OUR PHOSPHORUS FUTURE

The challenge to produce sufficient food for all people without polluting our waterbodies



3

THE ROLE OF PHOSPHORUS



The transition to food systems that provide nutritious food for everyone, sustainably, is not possible without significantly improving the sustainability of our phosphorus use. Simply put, we cannot achieve food security without addressing phosphorus security. Phosphorus security includes:

- **Fertiliser security** – ensuring farmers have access to nutrients/fertilisers.
- **Nutritional security** – ensuring people have access to healthy diets with optimal phosphorus intake.
- **National security** – countries have reliable access to phosphorus resources.
- **Water security** – aquatic ecosystems are protected from the damage caused by excess phosphorus.

Food systems need to transform to grow more nutritious foods with lower environmental footprints (more shifting from diets, with public health implications), shorter food value chains and increased local resilience. Climate change and increased food-related health and non-communicable disease-related disease epidemics (i.e. diabetes and cardio-vascular health), cancers means 'business as usual' agricultural growth of commodity-crop based food in sustainable ways can reduce the burdens of malnutrition and environmental impacts generally.

As reflected in the Sustainable Development Goals (SDG), reducing poverty (SDG1) and hunger (SDG2) are among the critical challenges facing humanity. Most of the world's hungry are rural smallholder farmers, therefore supporting rural livelihoods by investing in family farmers and rural women can simultaneously address poverty and hunger. For phosphorus, such investment could include extension services to improve productivity such as phosphorus use efficiency, improved access to credit, insurance and loans for fertilisers/investments in addition to other inputs; and employment diversification such as vulnerable farmers (e.g. to less phosphorus use) or farm off-farm employment in needed sectors. Importantly, change is needed across the whole food system, not just in the agricultural sector, such as shifts to low phosphorus-footprint diets and improvements in the capacity to recover and reuse phosphorus from

organic waste streams.

THE PROBLEMS

Food production in nearly every country is reliant on phosphate imports from only a few countries. Five countries control 75% of the world's phosphate rock reserves, leaving food systems in most countries dependent on phosphorus imports and vulnerable to fertiliser price fluctuations and geopolitical instabilities in producing countries.

In many regions, a lack of phosphorus inputs to soils restricts crop production. Like water, carbon and nitrogen, phosphorus is vital for growing the crops that underpin food systems. Of the approximately 800 million people who face the risk of frequent hunger, some 80% are smallholder farmers in the developing world (FAO 2017). The same group are most vulnerable to phosphorus scarcity (1 in 7 farmers lack access to phosphorus fertilisers (Cordell and White 2016); IAASTD 2009).

Fluctuation in phosphate fertiliser price is a risk to food security in the short term. In 2008, the phosphate fertiliser price spiked by 800%. This affected the livelihood of many of the world's poorest farmers, for example, in Haiti and India. This spike was the result of many factors, including the introduction of US ethanol in 2007, which saw a sharp rise in demand for fertilising fast-growing biofuel crops.

The increasing cost of mining our planet's phosphate rocks reserves and extracting phosphate is a risk to food security. In the long term, depletion of high quality 'easy to mine' phosphate reserves will force mining of lower quality ores that are 'hard to get to' and of lower quality, with additional processing costs potentially transferred to farmers and consumers.

Long food value chains, based on globalised commodity based agriculture, have led to low phosphorus use efficiency. Four thirds of the mined phosphate used in agriculture is wasted or lost in the food chain between mine, farm and fork (Cordell et al. 2009). Much of this ends up in rivers, lakes and oceans where it



can cause toxic algal blooms, in turn destroying aquatic ecosystems and costing the fisheries and recreation industries billions.

Nutritional insecurity is complex; more people are obese in the world today than undernourished. Obesity is often associated with poverty and a reliance on calorie-dense but nutrient-poor foods. Malnutrition in all its forms occurs in every country in the world (FAO/IFAD/UNICEF/WFP and WHO, 2013). Human dietary phosphorus intake in the developed world is at double the recommended levels, and maybe harming some vulnerable people. In the developing world, lack of accessibility to adequate phosphorus inputs is undermining both food quantity and quality.

THE SOLUTIONS

Achieving food security will require transforming food systems to grow more nutritious foods with lower environmental footprints, making the food system more efficient (such as reducing food waste), with shorter food value chains and increased food access. This means explicitly shifting from a production-oriented paradigm to one

that seeks to incentivise low waste, coupled with healthy eating of sustainably produced food.

For phosphorus, this means ensuring resource security for all parts of the food system:

- **Fertiliser access** – farmers have financial and physical access to phosphorus fertiliser;
- **soil security** – soil phosphorus is maintained at optimal levels in plant-available forms;
- **national security** – resources underpinning national security – people have access to phosphorus resources underpinning food supply;
- **nutritional security** – people have access to balanced diets including optimal phosphorus intake; and
- **environmental security** – avoiding dangerous eutrophication, climate change, and food chain waste.

Implementing change across the whole food value chain – not just within agriculture. This will include improving phosphorus-use efficiency, reducing waste, improving food processing and distribution efficiency, producing food closer to end markets, improving recycling of food waste streams and more stringent minimum limits in food. This means producing low phosphorus-demanding foods, supporting



THE ROLE OF PHOSPHORUS IN ACHIEVING WATER SECURITY

4

Achieving water security is not possible without significantly reducing the amount of anthropogenic phosphorus flowing into our waterbodies, globally. Phosphorus is a non-substitutable, non-renewable natural resource, essential for fertilisers and animal feeds, and so for global food security. But only a small part of the phosphorus input to agricultural systems reaches the food we eat. Phosphorus losses throughout the agriculture – food – bio-waste system can lead to major environmental damage, through eutrophication. Eutrophication is one of the greatest causes of surface freshwater quality failure, as well as an ecological menace for enclosed seas and estuaries, and contributes to marine dead zones. Climate change is likely to exacerbate eutrophication, unless phosphorus emissions are reduced

As reflected in Sustainable

Development Goal 6 (SDG 6), access to safe water and sanitation and sound management of freshwater ecosystems are essential to human health and to environmental sustainability and economic prosperity. Indeed, healthy waters underpin many, if not all, of the SDGs (Water and Sanitation Interlinkages across the 2030 Agenda for Sustainable Development). Swiftly addressing the systems that are increasing phosphorus concentrations in our freshwater ecosystems will reduce risk of an array of environmental, societal and economic disasters in both the short and long term. Fortunately, the 'know how' to deliver significant water quality improvements across sectors and scales is available; furthermore, many of the solutions provide multiple synergies and co-benefits. The challenge now lies in mobilising policy development, investment and public support for change.

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Children collect water at dusk in Kuajok, Warrap State, Sudan. With few functioning boreholes in the Gogrial State, pressure on the ones that work can be intense. When disagreements occur, they can escalate quickly and violence is not uncommon as families and communities step in to defend their side. Out of seven boreholes built in the area in 2011, the one pictured above is the only one that still works. NGOs have been instructed to wait for the new government water system. With now borehole drilling on hold, the new system delayed, and existing water points falling into disrepair, an essential daily task has become a trigger for conflict. Photograph taken by Marcus Perkins (www.marcusperkins.co.uk)

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5 GLOBAL PHOSPHORUS RESERVES AND RESOURCES

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OPPORTUNITIES FOR TECHNICAL RECOVERY OF PHOSPHORUS FROM WASTES 8

Phosphorus (P) loops can be largely closed saving millions of tonnes of P-rock borne fertiliser supplies from slowly degrading natural resources. Current waste, sludge and manure handling practices frequently lead to losses due to putting excessive P loads on already P rich soils, landfilling P rich waste and transferring P to construction materials. P losses to water bodies eventually threaten aquatic life and human food security. Achieving the SDGs requires decoupling the use of natural resources - land, fossil fertilisers and water - from food supply for all. P recycling is a key enabler of the Circular Economy. Numerous farm-based and centralised processes enable P recovery and recycling from sewage sludge, slaughterhouse residues and farmyard manure

with a low footprint. They facilitate producing clean and efficient fertilisers in replacement of rock based products, reducing pollutant flows to soils and crops. Separating, recycling and re-distributing P from manure eliminates excessive nutrient loads to soils in intensive livestock farming regions. Innovative processes can contribute to soil fertility, food security and human health. Implementation of more or less sophisticated processes creates quality jobs in urban and rural areas, enhances technical progress and innovation and boosts SME development, (re-)industrialisation and economic growth.

Microscopy of algae Volvox aureus Chlorophyceae. Photograph taken by Steffen Claus

©Phosphorus mine in Western Sahara at dusk. Award winning photo, kindly supplied by Pegasus Capital (www.pegasuscapital.com)



Acknowledged support and review

Small print: content will authors/editors opinions



Photographers



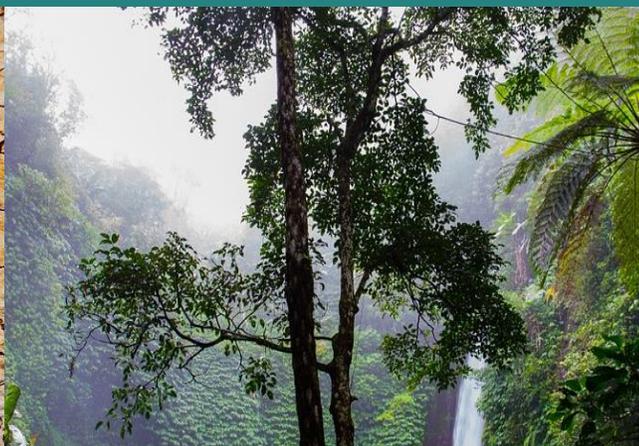
Film makers



Web and App designers



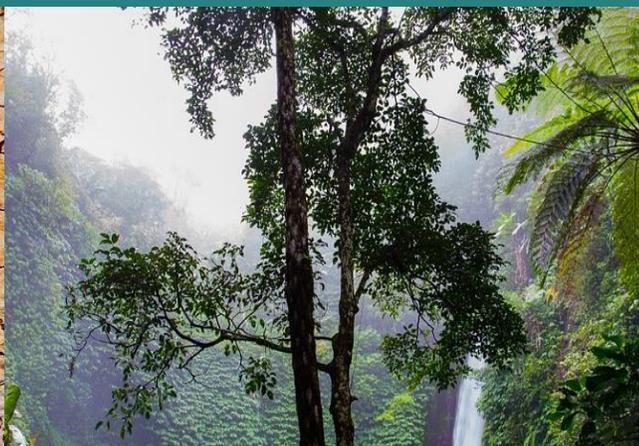
- Novel dissemination strategy (still developing) – including a two day event in December – Royal Society, London
- In support of the ‘Scientific Call’



The Scientists Call

The global call for a science initiative
on phosphorus, 2018

www.opfglobal.com



The global call for a science initiative on phosphorus, 2018.

The undersigned scientists and researchers call on policy makers worldwide to support progression towards more sustainable phosphorus management, in coherence with the global action on carbon, nitrogen, food and water.

We, the undersigned, identify:

- 1) **Phosphorus is a non-substitutable, non-renewable natural resource, essential for fertilisers and animal feeds, and so for global food security.** It is also important (in much lower quantities) in industrial applications.
- 2) Only a small part of the phosphorus input to agricultural systems reaches the food we eat, especially in meat production.
- 3) **Phosphorus losses** throughout the agriculture – food – sewage and waste systems **lead to major environmental damage**, through eutrophication. This is one of the greatest causes of **freshwater quality failure**, as well as an ecological menace for enclosed seas and estuaries, and contributes to **marine dead zones**. Climate change is likely to exacerbate eutrophication problems, if phosphorus losses are not reduced.
- 4) Currently, much of the phosphorus in sewage, food and crop waste or animal manure is **not effectively recycled**. Recycling rates are further threatened by urbanization, intensive livestock production and societal and food industry rejection of nutrient recycling from organic wastes.
- 5) **Many farmers** in parts of the world **cannot access** or cannot afford the phosphorus fertilizers they need to **produce sufficient food**.
- 6) Phosphorus today, like nitrogen, is **significantly exceeding planetary boundaries**.
<http://www.stockholmresilience.org/research/planetary-boundaries/>
- 7) Despite a widening awareness, the global phosphorus resource is insufficient, and the global phosphorus budget is exceeding that of carbon or nitrogen.
- 8) **Phosphorus is a finite resource**, and its availability is declining. This is a global issue that requires a coordinated response.
- 9) **Solutions** are needed to address the phosphorus challenge. These include:
 - a) Using phosphorus more efficiently through improved agricultural practices.
 - b) Increasing phosphorus recycling and recovery.
 - c) Ensuring phosphorus is used in a sustainable and circular manner.
 - d) Reducing phosphorus losses from agriculture, industry and households.
 - e) Improving phosphorus management in urban and industrial areas.
- 10) **Policy and governance** offers multiple opportunities to address the phosphorus challenge. These include:
 - a) Improved sanitation, essential for reducing phosphorus losses from human excreta.
 - b) Healthier diets for some individuals.
 - c) New employment opportunities through the nutrient circular economy.
 - d) More sustainable management of other nutrients i.e. nitrogen and potassium.
 - e) Return of organic carbon to soils, contributing to soil fertility, climate resilience and carbon dioxide mitigation.
 - f) Reduced geopolitical dependency on the limited regions with phosphate rock reserves.
 - g) Reduced mobilization of contaminants contained in phosphate rock reserves.
- 11) We, the undersigned, support the need for a global initiative to:
 - a) develop **further scientific evidence** to support phosphorus stewardship,
 - b) **develop collaboration**, coordinate and utilize available networks,
 - c) engage with UN-Environment and global governance,
 - d) **identify and elaborate**, with stakeholders and industry, **opportunities and solutions**.

We need your help.... Aiming for 300 hundred signatures



Call on policy makers to support sustainable phosphorus management

- Background in 250 words
- Suggest solutions
- the multiple benefits of action

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- **develop collaboration**, coordinate and utilize available networks,
- engage with UN-Environment and global governance,
- **identify and elaborate**, with stakeholders and industry, **opportunities and solutions**.



Will help to leverage phosphorus sustainability onto the GPA IGR-4 agenda

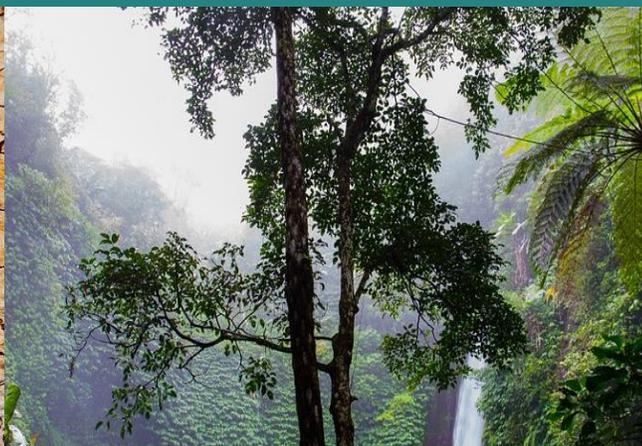
GPA – (Global Programme for the protection of marine the environment from land based activities)
The only global intergovernmental mechanism directly addressing the connectivity between terrestrial, freshwater, coastal and marine ecosystems. UNEP Hosts the coordination unit.

1995 – 108 countries signed up

They meet every 4 years at “Intergovernmental Reviews” (IGR)

Inclusion of ‘phosphorus sustainability’ within the IGR-4 agenda will encourage policy makers to respond.

Presented to the media at the OPF Royal Society meeting (Dec. London, UK)





The global call for a science initiative on phosphorus, 2018

Home » News & Media » News

Submitted by **Dr. Will J Brownlie** on Tue, 05/06/2018 - 15:44

Welcome to the sign up page for 'The global call for a science initiative on phosphorus, 2018'

This is a global call to policy makers worldwide to support progression towards more sustainable phosphorus management. Please **download the 'call'** by [clicking here](#).

To add your name to the list of individuals that support this global initiative, simply provide your details below and click 'Submit'.

Full name *

E-mail *

Scientific discipline

Institute

Country

Where your institute is based

(Please note: it is the named individual ONLY that supports the call and not their affiliated institution or employer.)

CAPTCHA

This question is for testing whether or not you are a human visitor and to prevent automated spam submissions.



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Our Phosphorus Future



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Webpage: www.opfglobal.com (in July)

Email: opf@ceh.ac.uk

Will Brownlie : wilown@ceh.ac.uk

Kiitos

