OFFICIAL FEEDBACK FORM

FOOD SYSTEMS SUMMIT 2021 DIALOGUES

DIALOGUE DATE	Tuesday, 11 May 2021 09:00 GMT +01:00
DIALOGUE TITLE	Is a Circular Economy approach a 'risk free' means of meeting future global food demand in a sustainable manner?
CONVENED BY	Dr Laura Carter, University Academic Fellow in Soil Science at the University of Leeds. Dr Sarah Dennis, Global Food and Environment Institute, University of Leeds.
DIALOGUE EVENT PAGE	https://summitdialogues.org/dialogue/7236/
DIALOGUE TYPE	Independent
GEOGRAPHICAL FOCUS	China, United Kingdom of Great Britain and Northern Ireland

The outcomes from a Food Systems Summit Dialogue will be of use in developing the pathway to sustainable food systems within the locality in which they take place. They will be a valuable contribution to the national pathways and also of interest to the different workstreams preparing for the Summit: the Action Tracks, Scientific Groups and Champions as well as for other Dialogues.

1. PARTICIPATION

TOTAL NUMBER OF PARTICIPANTS	29

PARTICIPATION BY AGE RANGE

	0-18	5	19-30	17	31-50	7	51-65	0	66-80		80+

PARTICIPATION BY GENDER

18	Male	11	Female		Prefer not to say or Other

NUMBER OF PARTICIPANTS IN EACH SECTOR

	Agriculture/crops	16	Education		Health care
	Fish and aquaculture		Communication		Nutrition
	Livestock		Food processing	8	National or local government
4	Agro-forestry		Food retail, markets		Utilities
1	Environment and ecology		Food industry		Industrial
	Trade and commerce		Financial Services		Other

NUMBER OF PARTICIPANTS FROM EACH STAKEHOLDER GROUP

	Small/medium enterprise/artisan		Workers and trade union
	Large national business		Member of Parliament
	Multi-national corporation		Local authority
	Small-scale farmer	1	Government and national institution
	Medium-scale farmer		Regional economic community
	Large-scale farmer		United Nations
	Local Non-Governmental Organization		International financial institution
	International Non-Governmental Organization		Private Foundation / Partnership / Alliance
	Indigenous People		Consumer group
28	Science and academia		Other

2. PRINCIPLES OF ENGAGEMENT

HOW DID YOU ORGANIZE THE DIALOGUE SO THAT THE PRINCIPLES WERE INCORPORATED, REINFORCED AND ENHANCED?

While the dialogue was convened by the University of Leeds it was done in partnership with multiple universities that were part of the UK-China Critical Zone Programme. These included: University of Sheffield, Queens Belfast University, Nanjing University, Chinese Academy of Sciences and Research Center for Eco-environmental Sciences and Jiangsu Academy of Agricultural Sciences. The dialogue built on work previously done in the UK-China project. Each of the partner institutes put forward 10 names to be specifically invited to the event due to their knowledge and expertise in the topic area and supporting subject areas. The names put forward were from a range of stakeholder groups including fertiliser companies and government agencies. This multi-university and continent organising team ensured a wide range of people were invited to the dialogue from both academia as well as government and industry stakeholders. The range of views from a diverse group of people allowed for very open and productive discussions. The dialogue was set up to be a safe space for all views and the transparency on the next steps and potential to be involved in the collective research paper output helped build trust in the group.

HOW DID YOUR DIALOGUE REFLECT SPECIFIC ASPECTS OF THE PRINCIPLES?

The UN Food Systems Summit Principles were incorporated throughout the Dialogue. Breakout groups ran under Chatham house rules and we asked that everyone was respectful of each other and sought and allowed time for everyone to put forward their opinion. While we recognised the complexity of the food system and how making changes was difficult and we welcomed differing views from soil scientists as well as water network and sanitation experts. We acknowledge that China has a number of years' experience with applying organic fertilisers in the field and thus were a good case study to share their experience and data collected from this with the wider world. By building on existing partnerships and work conducted by participants, this brought added-value to the Dialogue. As well as enhancing existing relationships, the dialogue facilitated new connections and broadened future partnerships in this research area. We also envisaged that the language barrier (Mandarin – English) could potentially exclude some dialogue participants. Many academics in China have a good standard of English so can participate in events like this but stakeholders outside of academia may struggle. To ensure stakeholder inclusivity and trust was gained by all participants the event was convened in English but we made sure that strong multi-lingual participants were in each of breakout groups to allow for translation if needed. Facilitators were prepared to allow time for translation and were asked to check and summarise key points before moving on to the next topic. We pushed the "act with urgency" principle by making sure we discussed what needed to be done in the next 5 years to improve the system and make change promptly. Discussions were framed in the context of achieving the 2030 Sustainable Development Goals.

DO YOU HAVE ADVICE FOR OTHER DIALOGUE CONVENORS ABOUT APPRECIATING THE PRINCIPLES OF ENGAGEMENT?

3. METHOD

The outcomes of a Dialogue are influenced by the method that is used.

DID YOU USE THE SAME METHOD AS RECOMMENDED BY THE CONVENORS REFERENCE MANUAL?

✓	**Yes**		**No**

4. DIALOGUE FOCUS & OUTCOMES

MAJOR FOCUS

Our drive to increase agricultural production, has been at the expense of long-term sustainability. Under a circular economy the production of agricultural commodities uses a minimal amount of external inputs and nutrient loops are closed to reduce discharges to the environment. By creating an economy in which waste is reused and pollution is mitigated, natural systems can recover. This approach supports the drive to produce food commodities in an environmentally sustainable manner, ensuring the needs of a growing population are met today without any long term negative impacts on food production in the future. The potential benefits for food security under a circular economy approach are therefore enormous. However, this can result in changes to greenhouse gases and nitrogen-related discharges, as well as inadvertently introducing into agricultural systems a suite of emerging contaminants, such as antimicrobial resistance determinants, pharmaceuticals, and plastics. As part of the UN Food Systems Summit 2021, this dialogue explored the concept of a circular economy, with a focus on Chinese agricultural systems. China has rapidly transformed their food production systems to meet a "Zero Increase Action Plan" for fertilizers and pesticides, and therefore provides an excellent case study to explore the concept of a circular economy in sustainable food systems further. China is predicted to reduce mineral N use between now and 2050 and organic fertilisers are assumed to help this transition.

The aim was to: Share knowledge on the feasibility and risks of using organic fertiliser in agricultural production through adoption of a Circular Economy approach.

Discussions in breakout groups focussed on the three key themes:
1. Current policy frameworks and future policy drivers
2. Technical adaptions in waste recovery and use of resources
3. Potential risks and mitigation measures

ACTION TRACKS

	Action Track 1: Ensure access to safe and nutritious food for all
✓	Action Track 2: Shift to sustainable consumption patterns
✓	Action Track 3: Boost nature-positive production
	Action Track 4: Advance equitable livelihoods
	Action Track 5: Build resilience to vulnerabilities, shocks and stress

KEYWORDS

	Finance	✓	Policy
	Innovation		Data & Evidence
	Human rights		Governance
	Women & Youth Empowerment		Trade-offs
		✓	Environment and Climate

MAIN FINDINGS

Several key themes emerged from the Dialogue discussions, in the context of understanding existing knowledge of participants, the possibility of translating knowledge from on-going sustainable agricultural systems in China to UK relevant scenarios and exploration of future opportunities to address identified knowledge gaps.
Participants could see the benefit and value of adopting a circular economy in agricultural systems as it offered a means of ensuring that current and future food demands are met. This then lead to a discussion considering the risk-benefit of a circular economy. This revealed we need more data to comprehensively understand the risks as well as the benefits but so far research demonstrates that these practices can introduce contaminants into our agricultural systems. This presents a risk to human and ecosystem health. Of particular concern were emerging contaminants. As their name suggests these contaminants are ‘emerging’ and our understanding is only in its infancy in terms of knowledge surrounding the associated fate and risks in agro-environments. We need to continue our work characterising these chemicals in the environment by developing analytical capabilities to ensure we can detect these chemicals at low, environmentally relevant concentrations.
A key message was that we need to work with a transdisciplinary focus. This is a complex topic and understanding the risks and benefits of adopting a circular economy cannot be achieved by working solely on our areas of interest and in isolation. We need to adopt a nexus approach bringing together expertise in food, energy, sanitation, environment, human health, and policy. Collaborative thinking will require funding mechanisms to be put in place support future interdisciplinary research initiatives.
A key theme emerged that we need to work with a solutions focus moving forward. We have a growing body of knowledge surrounding the risks of using sustainable agricultural systems and in particular the use of organic fertiliser but the benefits of adopting these practices are significant in terms of meeting global food demands. We therefore need to work on developing mitigation options to ensure that these practices are done in a safe and sustainable manner. Participants discussed mitigation options and put forward their own work investigating mitigation options such as additional wastewater treatment and use of biochar to adsorb some of the contaminants. This is an area where future work is needed and there is the potential to build collaborations through this Dialogue to explore this further.
New policy developments are underway in the UK, largely driven by the new national strategy following the recent departure from the European Union. Focus areas are carbon reduction, driving down synthetic fertiliser use and pursuit of a circular economy. These mirror the efforts currently underway in China to ensure a zero increase in chemical fertiliser use. However, on a global scale, very little policy exists in terms of regulating the release of emerging contaminants in the environment even though sustainable agricultural practices, such as the application of organic fertilisers, provides a pathway by which these chemicals can enter the agro-environment. Environmental regulators therefore need to harness the latest scientific developments to establish research informed thresholds allowing for the safe use and application of organic fertilisers. This is going to require research outputs to be disseminated to regulators and presented in an accessible format.
The Dialogue built on existing relationships and most importantly facilitated new connections with stakeholders and academics in the UK and China who have an interest in the use of sustainable agricultural practices to support future agricultural development. This will allow for combined expertise to address the crucial knowledge gaps identified in our discussions.

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OUTCOMES FOR EACH DISCUSSION TOPIC - 1/3

Current Policy Framework and Future Policy Drivers
There are current policies and frameworks in place concerning a circular economy in agricultural systems, in both the UK and China, although further development is needed given the complex nature of this system. Policies are driven by the need to reduce our reliance on chemical based fertilisers, recover nutrients and the need to become carbon neutral and reduce our greenhouse gas emissions. Existing policy is also in place to protect the environment from the presence of contaminants although this policy area is largely fragmented.
In China farmers are given 100-500Y per tonne to use organic water-derived fertilizer though these aren't always evenly distributed. There are also penalties in place for poultry/pork farmers who do not recycle waste and pollute water ways. The Chinese government also produces technical documents which advise farmers on how to use wastewater-derived fertilizers, i.e. how to apply and maximize benefit whilst minimizing risk.
UK legalisations set environmental quality standards for contaminants and restrictions on the usages of animal manures given local climate and weather conditions. The UK plans to mitigate flooding partly though soil management policies such as reducing compaction. In the UK the drive to recover nutrients is part of the net zero by 2050 targets. In response to Brexit, new environmental and agricultural bills are in the pipeline which are in line with carbon reduction commitments and in pursuit of circular economy. UK policies include driving down synthetic fertiliser use and to making fertiliser use more efficient, e.g. full life-cycle analysis for nutrient additions.
Whether existing legislations are followed is hard to judge or even control. We need to ensure guidance and regulations are clearly communicated and incentivised to ensure maximum support from farmers and land managers. In the UK water treatment companies and government are considering carbon credits to encourage better resource recovery and facilitate farmers to use organic fertilizers and increase soil carbon.
Issues have been identified concerning heavy metals (Pb and Cd) and the build-up of these within soils over repeated application of fertilizer. Organic fertilisers can also introduce emerging contaminants into the environment however legislation permitting safe levels of these chemicals in the environment is largely missing. It is therefore important to consider the impacts on human and ecosystem health in development of new policies to account for this.
When considering policy implementation in the context of supporting a circular economy, we need to consider nexus solutions. We need to link sectors together (waste and agricultural sector along with food, water, energy, human health and soil) to address relevant systemic issues and identify the primary drivers, concerns and points of intervention. Organic fertilizer is fundamental for improved soil health within agriculture, it also serves as a suitable waste removal technique and therefore has potential to be widely adopted in modern day agriculture over that of synthetic fertiliser. However more attention is needed in order to reduce greenhouse gas emissions and to better control nutrient and contaminant concentrations. Ultimately, organic wastes need to be used in a safe and sustainable manner.
In order to both improve global food demand and preserve/improve environmental quality we need to enforce environmental legislation. However we suggest a reduced focus on standardised guidelines, and instead increase awareness and train people to be local problem solvers. Previous experience has shown it is often the implementation of the policies which fail. We need positive incentives and support needs to be in place with a focus on education to reduce barriers to social change in practices which incorporate circularity principles which are nexus-smart.
Current legislations and policies only assess the toxicology of single contaminants, more work is required to make this realistic by looking at mixtures of both inorganic and organic contaminants and the risk of antibiotic resistant genes to society.

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OUTCOMES FOR EACH DISCUSSION TOPIC - 2/3

Technical Adaptations in waste recovery and use of resource?

There is much potential to apply technical adaptation in waste recovery. Ultimately, we need to embrace new, more sustainable approaches to farming, rather than trying to alter a broken system. However, this will require a change of approach, focusing on the role of wastewater treatment in terms of making the waste products safe in terms of human and environmental health whilst maximising nutrient recovery to realise the benefits of this reuse. A balance needs to be met here. Current processes which are optimised for effluent waste safety may include significant nutrient losses (e.g. denitrification). We need to investigate how the benefits of waste reuse can be met with only minimal risks. New technologies will need to be developed to complement existing waste infrastructure to ensure we can use these waste products as a resource.

When considering waste reuse a significant barrier is the location and transportation of wastes suitable for fertilizer use. This may require significant infrastructure in place to support widespread use. Concerns were raised regarding the transportation and mixing of wastes as this may result in the loss of information regarding quality of the waste and contaminants present. An overarching governance is required in order to achieve this.

It is important that research and industry work together in partnership with regulators to collaborate and address these issues. This needs to be supported by appropriate funding required for a sustainable future -is this funding coming from the consumer or cross sector funding primarily supported by waste and agriculture sectors?

ACTION TRACKS

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OUTCOMES FOR EACH DISCUSSION TOPIC - 3/3

Potential risks and mitigation measures
Both the UK and China have considerable expertise in understanding the risks associated with use of organic fertilisers in sustainable agricultural systems. There is a longstanding research programme in China on the risks associated with wastewater derived fertilizers, from field sites in Nanjing and Ningbo. Hazards include the introduction of inorganic contaminants (e.g. metals), organic chemicals, including emerging contaminants (e.g. pharmaceuticals and personal care products), as well the presence of pathogens (e.g. bacteria, viruses). Use of organic fertilisers can also introduce antimicrobial genes (ARGs) into the agricultural environment. ARGs can enter the food system via uptake into crops but can also damage soil structure by altering the soil microbial community and breaking the soil microaggregates held together by microbial activity. There is a need to both reduce the ARG load in fertilizer manufacturing, and to research how mitigation options can limit the risk of ARGs associated with wastewater derived fertilizers.
We need to consider the legacy of existing contaminants and emerging contaminants as these both present a risk to ecosystem and human health e.g. heavy metals are often high in concentration and do not degrade whereas organic contaminants such as antibiotics are low in concentration but still remain bioactive and cause selection pressure on antibiotic resistance genes.
Our research has shown that the build-up of Cd and Pb from waste products has resulted in impacts on soil health and the reduction in crop yield. It is important to consider these to achieve food goals as well as retain soil health. It is also critical to consider the effects of transformation products and not just the parent contaminants. Often these transformation products contain bioactive properties and still can influence soil health and organisms present within the environmental matrices. We also need to consider the influence of mixtures of contaminants. We know very little about how chemicals can interact, especially inorganic-organic chemical combinations. This is largely due to the difficulties in addressing mixture effects as well as detections of complex samples. We therefore need to advance our experimental and analytical capabilities to deal with this challenge.
Mitigation measures exist which focus on reducing the concentration of contaminants in organic fertiliser through advanced treatment technologies such as anaerobic digestion, liquid-solid separation, and electrolysis. The extraction of struvite is the most advanced commercial operation globally. There is a need to address regional challenges when considering mitigation options as in some cases enhanced waste treatment is not an option when a country has limited sewage connectivity and sanitation options. In this case, bioremediation options may be more appropriate such as pollutant removal via wetlands or composting of faecal sludge from pit latrines. Research in China has evaluated the potential of biochar to become a suitable sustainable method in removing contaminants from environmental matrices. More research is needed to understand currently overlooked issues such as the potential for contaminants to desorb and release slowly into the environment, ecotoxicology (earthworms mortality rate with high biochar %) and the bioavailability of contaminants adsorbed to biochars.
In order to overcome potential risks we need to integrate research and industry application and have integrated planning to move forwards. While we could focus on developing sustainable, low cost technology to remove contaminants from the waste stream; perhaps we should stop focusing on adding new processes and innovation to selectively capture an ever-increasing list of contaminants. Instead, focus should be on upstream causes of this contamination, ask why they are present in the waste stream and how we can rectify this. The focus should be placed on the risks of NOT making change (business as usual), rather than focusing solely on the risks of doing something ('least worst'). This allows a more balanced decision going forward.

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AREAS OF DIVERGENCE

There were a couple of areas of divergence. The first was around the focus on developing sustainable, low cost technology to remove contaminants from the waste stream. It was suggested that we should stop focusing on adding new processes and more innovation to selectively capture an ever-increasing list of contaminants and instead, focus should be on upstream causes of this contamination. We should be asking why they are present in the waste stream in the first place and how we can rectify this (e.g. source reduction, not mixing waste streams in the first place, rather than paying to fix them further down the line. e.g. producing new, less persistent pharmaceuticals).

The second disagreement was over the suggestion of increasing the cost of synthetic fertiliser to make it less economical to overuse. Making fertiliser more expensive will encourage farmers to generate their own free Nitrogen (better crop rotations, cover cropping etc.) which will in itself have numerous benefits and be cheaper anyway for the same Nitrogen production. Counter points focused on instead making diagnostics cheaper to reduce indiscriminate and over-application.

Lastly the presentation of the risks and benefits of the reuse of excreta needs to be presented in balance. There is already an overwhelming narrative about the health risks of reusing excreta for agriculture, and it's the dominant argument used by those who oppose the idea. To encourage and improve the uptake of this very practice it needs to be framed in a more positive light rather than constantly discussing the health risks. There are known risks which need to be mitigated against, but industrial agriculture comes with its own health and environmental risks too. There was a feeling that the risks of excreta shouldn't be blown out of proportion, and should be compared against the risk of continuing with "business as usual" and to degrade our soil resources and wider environment from industrial farming practices. It was suggested that we shouldn't wait to be certain it is 100% safe before starting to think about implementing this in a safe and sustainable manner.

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