Roots

Botanic Gardens Conservation International Education Review

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Putting theory into practice

BOTANIC GARDENS CONSERVATION INTERNATIONAL

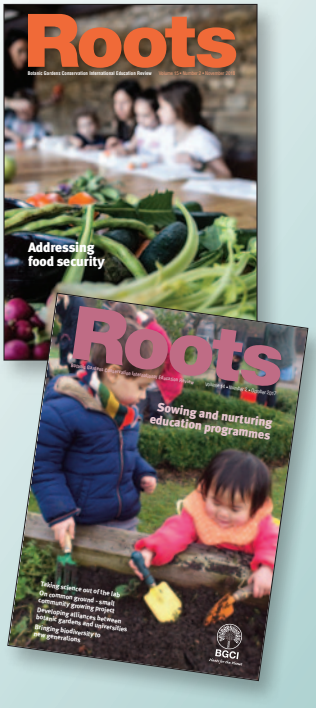
Contribute to the next issue of Roots

Have you got an exciting citizen science project you want to share?

Citizen science comes in many forms, from volunteer-led monitoring to crowd sourced analysis. Each degree of participation has important implications for research and public engagement with it. The next issue of Roots will look at how informal learning sites can benefit from, support and create opportunities for the public to be active in scientific research.

If you have an inspirational citizen science project at your site, then we want to hear about it. We are currently looking for a variety of contributions including articles, education resources and a profile of inspirational garden staff.

To contribute, please send a 100 word abstract to **Liliana.derewnicka@bgci.org** by 1st June 2019



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FIRST WORD
WHAT DO WE MEAN BY RRI?

Liliana Derewnicka

We live in trying times, the potential trajectory of our planet and our politics are concerning to say the least. But, I'd like to think all is not lost, just yet. So much of the work we do in informal learning and environmental education is directed by sincere and honest goals to reach out to people, to share the things we care about with as many people as possible, for their benefit, society's and the planet and science. In recent years, research based organisations have been doing the same.

During my masters in science communication, I learnt about how some scientists and commentators had been calling for a more open approach to science (Wilsdon and Willis, 2004). One that reconsiders what we mean by expertise and seeks to engage citizens in directing it. So, when I first read about Responsible Research and Innovation (RRI) during the development of the BigPicnic project proposal, I was encouraged to see how the EU had embraced these ideas.

In this issue of Roots we look at how organisations in Europe and beyond have embraced the concept of RRI or the ideology associated with it. We also take the opportunity to look at the achievements of BGCI's BigPicnic project in relation to advancing RRI in the area of food security. (see article on page 6)

Since the term began to gain visibility nearly 10 years ago, RRI, as a concept, has taken some considerable refinement. It can be difficult to get your head around. The RRI Tools project aimed to tackle this, by developing a framework of six policy agendas – Ethics, Open Access, Gender Equality, Governance, Public Engagement and Science Education. By focussing on and working within these parameters, it is hoped that Research and Innovation (R&I) will become more responsive and adaptive to change (RRI Tools, n.d.).

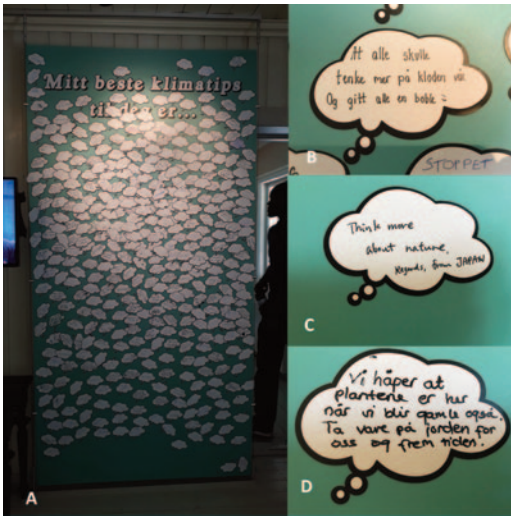
So what is RRI? Well, different people view it differently, depending on their role in it, I suppose. The RRI Tools website describes it as:

- **Involving society in science and innovation:** 'very upstream' in the processes of R&I to align its outcomes with the values of society.
- **A wide umbrella connecting different aspects of the relationship between R&I and society**: public engagement, open access, gender equality, science education, ethics, and governance.
- **A cross-cutting issue in Horizon 2020**: the EU Programme for Research and Innovation 2014-2020. (*ibid.*)

← *Collecting people's ideas about food ©Royal Botanic Garden Edinburgh*

In this issue of Roots we look at how organisations in Europe and beyond have embraced the concept of RRI or the ideology associated with it. We also take the opportunity to look at the achievements of BGCI's BigPicnic project in relation to forwarding RRI in the area of food security.

RRI policy agendas:
Ethics, Open Access, Gender Equality, Governance, Public Engagement and Science Education.
(RRI Tools, n.d.)



↑ *Opinions on food and food security have been gathered through a variety of methods, like this comment wall ©Natural History Museum, University of Oslo*

For me, RRI is a response to a need for science to be more democratic and socially responsive. To achieve this, we need to do two things:

1. Engage everyone in conversations about where we are going as a society and how we are going to get there.

2. Those delivering the outputs (the scientists, engineers, policy makers, etc.) need to be reflective and reflexive to those conversations. They need to consider the impact of their work and adapt to what the populous is saying.

As you will see in the article on page 25 about the CETAF RRI framework, much of the work of collections-based organisations like natural history museums and botanic gardens is already aligned with the RRI policy agendas.

Botanic gardens and museums have the opportunity to reach a broad cross-section of society and it is in this capacity that botanic gardens and museums are so essential to RRI. There can be many mechanisms for this. For example, the Copernicus Science Centre developed the reverse science café model which turns the tables on a well accepted format and first asks the public what they think about controversial issues surrounding science (see page 22). Then there is the Doing it Together Science project's Together Science Bus (see page 19), which brings interactive science to the door step.

What is important is that we continue to bring more voices into the debate and it is through the work of organisations like Waag Society, that we can learn to do this better. In their article on page 28 they describe the development of the Co-creation Navigator, an essential tool, supporting organisations to develop projects and products with their audiences and other stakeholders.

Although RRI as a term, and its accompanying framework have been developed by and for the EU, its ideology is far reaching and, as such, in this issue of Roots we also take a trip to Malaysia to see how they are applying the same ideas (see page 15).

We are in the middle of rethinking the way research and innovation progresses. We may not be there yet and there are certainly some barriers to break down, which is the subject of the article about the the EU-funded project PROSO (page 12).

It can be daunting to think about the issues facing society and the distance we have to travel to solve them. Is RRI as a framework the way to achieve this? That remains to be seen. Certainly, the pillars upon which it stands are honourable and in working under RRI's codes of conduct we can certainly do a world of good for R&I. As Dreyer and Kosow (see page 9) put it "we are convinced that joint efforts appear worthwhile in the light of worrisome antiscientific tendencies". By developing a landscape where everyone in society is responsible for science and science and innovation are responsive to society, we can (together) forge a brighter future.

↑ *BigPicnic exhibitions came in different shapes and sizes, like this mobile kitchen ©National Museum of Natural History and Science, University of Lisbon*

For me, RRI is a response to a need for science to be more democratic and socially responsive.

By developing a landscape where everyone in society is responsible for science and science and innovation are responsive to society, we can (together) forge a brighter future.

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THREE YEARS WELL SPENT: THE LEGACY OF BIGPICNIC

For three years, the BigPicnic partnership and the people we have engaged on the way have been working hard to support RRI in food security. Not only has this occurred through documenting public views in the area and developing policy recommendations, but also through organisational development and learning in terms of process related to generating and recording public dialogue.

Writing the BigPicnic recommendations was the culmination of three years of hard work on the part of a significant number of people. There were the staff from BigPicnic partner organisations, of which there were 18 in Europe and one in Uganda. As well as this, there were all the varied and interesting individuals that each botanic garden partner worked closely with; co-creating exhibitions, science cafés and other activities to engage people with the topic of food security. We had Food Security Advisory Groups in each of the 13 partner countries who helped to select the areas of food security to focus on. There was an international group of experts, from global, food-related organisations, who ensured our work was relevant to current research efforts. And, finally, there were all the (literally) thousands of people that interacted with the project's outputs; those who visited exhibitions and science cafés, shared their thoughts online, completed questionnaires, etc. Their ideas, thoughts and opinions have been painstakingly analysed and used to put together a set of seven two-page briefs and a report on Public views and recommendations for RRI on food security to inform policy in food security across Europe and beyond. So, yes, the BigPicnic Management Board wrote these documents, but they are not ours, they belong to the nearly 200,000 people who took part in the project, in some way, and they seek to represent an even larger group.

↑ BigPicnic partners co-created exhibitions about food security with their local communities ©Natural History Museum, University of Oslo
Top: BigPicnic recommendations

They seek to document what is important to the European population, when it comes to research and innovation in food and present how we should proceed in a way that is sensitive to their interests and needs. It is through these and through the process that resulted in them that BigPicnic is and has sought to contribute to RRI.

BigPicnic is a three-year, EU funded project (2016-2019) that brings together the public, scientists, researchers, food and agriculture industries and NGOs to talk about food security. The term 'BigPicnic' is used as a metaphor throughout the project and reflects the importance of maintaining sustainable food production and distribution, as well as the social dimension of sharing food between friends and family.

The focus area 'Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy' in Horizon 2020 states: "A transition is needed towards an optimal and renewable use of biological resources and towards sustainable primary production and processing systems. These systems will need to produce more food, fibre and other bio-based products with minimised inputs, environmental impact and greenhouse gas emissions, and with enhanced ecosystem services, zero waste and adequate societal value." (European Commission, n.d.a)

Food security is a large-scale and multifaceted challenge facing the whole of society. As such, there can be significant benefits achieved from adopting RRI practices. BigPicnic's ideology and approaches embody what the European Commission terms 'inclusive innovation' supported by 'multi-actor approaches' to 'ensure the necessary cross-fertilising interactions between researchers, businesses, farmers/producers, advisors and end-users' (New Horizon n.d.) and, as such, support RRI in food security.

To achieve this, the 15 botanic garden partners worked with varied audiences and stakeholders, including those that are commonly considered to be hard to reach, to co-create exhibitions and science cafés (informal science communication events) about a wide range of topics related to food security.

↑ BigPicnic documented conversations about food and food security held across Europe and in Uganda ©Tooro Botanical Gardens

↑ BigPicnic stretched the boundaries of what we think of as science cafés, opening them up to new groups ©Botanical Garden of the University Vienna

This process and these activities and events started conversations about food, what concerns people about the future of food and its production, what motivates people to make the choices they do, and what direction they would like research and innovation to proceed in.

Through mainly qualitative research techniques, the botanic gardens recorded these conversations and, with the support of the Management Board, drew out some key themes. These can be broadly classified into:

- **Food and heritage**
  - Cultural diversity in food use and food systems
  - Traditional eating
  - Context of eating
  - Food stories/memories
  - Migration
- **Climate change**
- **Sustainable food production**
  - Urban gardening
  - Supply chains
  - Food waste and circularity
- **Education and food security**

These have been used to structure the BigPicnic Recommendations (see page 10)

Above all, it is important to highlight the key theme of Food and heritage. The BigPicnic findings make a strong case for the cultural and social values attributed to food. The cultural value of food and the notion of food as cultural heritage emerged distinctively from the data. This is a parameter that is to a great extent omitted by the prevalent European and global policies that deal with food and sustainable development but is strongly linked with the growing awareness of the significance of cultural diversity and recognition of intangible cultural heritage by UNESCO (UNESCO, n.d.). To highlight how the BigPicnic findings complement existing policies and frameworks the key-themes that emerged have been mapped to the United Nations Sustainable Development Goals (SDGs) and Food 2030 priorities identified by the European Union. Note that, although all partners provided data related to the key theme of Food and heritage, these aspects are lacking in the existing European and global policies and therefore cannot be aligned with them.

Full details of the BigPicinc findings and recommendations can be found in our report *D5.2 Public views and recommendations for RRI on food security*.

By illustrating what the European and Ugandan population consider to be important, in relation to food security in a way that complements existing structures and frameworks and illuminating their shortcomings, it is hoped that the project will support responsive policy and R&I in this area.

Finally, it is not only through the findings of the project that we hope to support RRI. Throughout the three years of BigPicnic a lot of learning in terms of process has occurred. To build trusting relationships with audiences, in order to start open discussions about research and innovation in food, BigPicnic partners needed to build new skills in public engagement. Each botanic garden is now highly skilled in co-creation. By practising co-creation, BigPicnic partners not only generated awareness of food security, but also created shared ownership on this subject, identifying more sustainable practices, and ultimately influencing the behaviour of their visitors (see page 28 for more information).

↑ BigPicnic partners used a variety of co-created events and activities to spark conversations about food ©Bergamo Botanical Garden photo Archive

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Partners have redefined what we mean by science café. Traditionally, science cafés were science communication events in which a speaker, or panel, presented their research, in an informal style and setting (usually a bar or a café), to an audience who were then able to ask questions and start a conversation. With the Sparks project, the reverse science café was born (see page 20). However, BigPicnic partners have stretched the boundaries of these types of events, opening them up to larger numbers and new settings; reconsidering what we assume to be 'experts'.

Furthermore, BigPicnic partners have become highly skilled in a participatory form of evaluation called Team-Based Inquiry, which has supported them to enhance their public engagement activities and development processes (co-creation) as well as capture public dialogue.

These processes have supported BigPicnic partners to encourage new audiences to be part of the research and innovation process, hopefully sparking long-term relationships with science, not only related to food security. These approaches have been documented and presented in a range of resources aimed at practitioners. The techniques developed are not only suited to generating and recording conversations about food security, but can support other organisations to involve themselves in any area of RRI. This, as well as our recommendations for food security, is BigPicnic's legacy.

The term 'BigPicnic' is used as a metaphor throughout the project and reflects the importance of maintaining sustainable food production and distribution, as well as the social dimension of sharing food between friends and family with food as a cultural and social link.

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↓ BigPicnic partners used a range of techniques to put people at ease and get them talking, like conversations over knitting ©Hortus Botanicus Leiden

BIGPICNIC **RECOMMENDATIONS**

FOOD AND HERITAGE

- **FOOD AND HERITAGE:** The cultural heritage dimension of food should be embedded in food policy.

CLIMATE CHANGE

- **CLIMATE CHANGE:** Increase the resilience of citizens, especially vulnerable groups, to climate change and increase climate neutrality of food systems.

SUSTAINABLE FOOD

- **SUSTAINABLE FOOD PRODUCTION:** Future funding frameworks should address more efficient food loss and waste management, small scale food production and sustainable supply chains.

EDUCATION AND FOOD SECURITY

- **EDUCATION AND FOOD SECURITY:** Food and food security should be topics embedded throughout the formal and informal learning systems.

PARTICIPATORY APPROACHES

- **USING PARTICIPATORY APPROACHES:** Use participatory approaches to raise unheard voices and broaden our perception of expertise.

ORGANISATIONAL CHANGE

- **ORGANISATIONAL DEVELOPMENT FOOD SECURITY:** Organisations should embrace new approaches and draw on a broad spectrum of expertise as catalysts for change.

UGANDA

- **FOOD SECURITY IN UGANDA:** Increase capacity in climate smart agricultural approaches to address challenges posed by climate change and the impact on livelihoods and nutrition.

↑ *©Hortus botanicus Leiden*

↑ *©Birgit Schlag-Edler*

BigPicnic

Food security is one of the greatest challenges facing society today. According to the Food and Agriculture Organization: (FAO) "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"[1]. Yet, decisions about food policy are often top down and do not provide all societal actors with a chance to contribute or engage with the debate. BigPicnic used participatory approaches to facilitate dialogue between different actors and ensure future research, innovation and policy reflects the opinions and needs of these wider audience groups. Using participatory approaches addresses different needs, supports organisations to develop and grow, and empowers all actors to take responsibility to address the big issues facing our society.

Using the BigPicnic project data, a series of policy briefs have been developed. Food production, sustainability and the climate, participation, education and organisational development were all shown to be important in the context of the project and food security. The common thread that unites all of these individual areas is heritage and the role that food plays in our individual lives. To address food security, heritage and its overarching influence in all aspects of the debate must be acknowledged.

There are seven BigPicnic policy briefs. Four aim to support policy makers to shape future food policies and funding frameworks and two seek to support informal learning sites to apply the learning that occurred throughout the project. A seventh policy brief specifically addresses issues raised by the Ugandan project partner to illustrate how their context complements and contrasts the European. To highlight where BigPicnic findings link to existing frameworks and illuminate gaps in current policy, each policy brief maps the BigPicnic recommendations to the most relevant United Nations' Sustainable Development Goals (SDGs) and the European Union's Food 2030 Priorities.

[1]FAO (1996). *Rome Declaration on World Food Security*. World Food Summit, 13th-17th November 1996, Rome.

The BigPicnic recommendations

For policy makers

- BigPicnic policy brief 1: Food and heritage
- BigPicnic policy brief 2: Climate change
- BigPicnic policy brief 3: Sustainable food production
- BigPicnic policy brief 4: Education and food security

For informal learning sites

- BigPicnic policy brief 5: Using participatory approaches
- BigPicnic policy brief 6: Organisational development through food security

Country specific

- BigPicnic policy brief 7: Food security in Uganda

↓ *©Kamil Zielinski*

Authors: Marion Dreyer and Hannah Kosow

HOW TO PROMOTE PUBLIC ENGAGEMENT IN RESEARCH?

Create relevance

Build trust and mutual understanding

RRI calls for the engagement of civil society organisations, and also of individual citizens in research-related activities. What motivates or hinders members of the broader public to engage in research? This article identifies important barriers to societal engagement and presents policy and practice options to lower these barriers. The work identifying these barriers and possible ways to address them are the result of the EU-funded project PROSO. The project has shown that citizen engagement in research is not just a question of time and opportunity but also of relevance, trust, legitimacy, and impact.

Since the turn of the millennium, one can observe in some parts of Europe and in some research areas increasing efforts to invite citizens to interact with others around issues and processes related to research and innovation. The idea of RRI as it has been promoted by the European Union (EU) has given new impetus to such efforts. RRI carries the vision that science and society mutually relate to each other throughout the whole research and innovation process. This vision includes the idea that the broader public enriches this process with their values, needs and expectations.

What are the views of citizens of such engagement? Do they see a role for themselves in research? Under what conditions would engagement be attractive to them? The EU-funded PROSO project has addressed such questions (Dreyer, Kosow and Dratsdrummer, 2018). It conducted national citizen panels in five European countries. The panel discussed fictitious invitations to different engagement formats (Chonkova, *et al*., 2017).

↑ *©Dreyer, Kosow and Dratsdrummer, 2018*

We should seriously consider public engagement in research as a way to enhance the resilience of the wider public to fake news and defamation of science. Importantly, citizens should be invited only in those cases in which they can be expected to meaningfully contribute, and engagement needs to happen on a fully voluntary basis.

Through this research, we have gained a deeper understanding of a widely acknowledged challenge: citizens need to be actively interested and motivated to engage in research, and several factors may hinder such engagement. Within PROSO we have identified six key barriers to citizen engagement. We refer to these barriers as lack of relevance, lack of trust, lack of knowledge and skills, lack of time and financial resources, lack of legitimacy and lack of impact. PROSO has also identified a range of potential policies and practices to address these barriers. These options are informed by multiple exchanges with those actors that appear most relevant to taking action. These include research policy makers, research funding organisations, and public engagement organisations. We exemplify in the following, how these actors can help lower barriers to citizen engagement in research.

RELEVANCE

An engagement opportunity may be more attractive when it is relevant to citizens' own interests, concerns, and goals. When engagement processes deal with practical issues and have a clear relation to every-day life, this can be an incentive to participate. Research funding organisations could take care to issue calls for research which relate to something of direct concern to citizens, for instance on how to combine a healthy diet with a busy life. In our highly dynamic world, citizens may wish to exchange views with others on how we want to live in the future. These concerns can be an incentive to get involved in what is called 'participatory agenda-setting'. Research funders can issue calls for research in which citizens can contribute to the design of research agendas by co-shaping visions for what are desirable futures. One example of such research is the EU-funded project CIMULACT (Rosa, Gudowsky and Warnke, 2018).

TRUST

An engagement opportunity may be more attractive when citizens have reason to trust the agendas of sponsors and organisers of the engagement process. A fully transparent engagement process is essential to create trust. Research organisations or other engagement performing organisations need to ensure that possible misunderstandings about the process are avoided at the point of recruitment. Citizens should, for instance, not fear that they are expected to speak 'for society'. Our research has shown that some citizens might be more inclined to participate when they are invited to exchange personal views with other citizens and thereby produced more reflected views 'from within society' that can inform research or research policy.

KNOWLEDGE & SKILLS

An engagement opportunity may be more attractive when citizens do not fear they lack the necessary knowledge and skills for the engagement process. For organisations that engage with the public it is advisable to combine dialogue and information in engagement processes, and to use information and attractive stimuli to support dialogue. More generally, policy makers and governments can contribute to building knowledge and skills by promoting scientific literacy of society as a whole. One option is to strengthen science journalism by making it an integral part of the education of journalists at universities. Governments could also embed engagement more widely in the educational systems. Teaching on civic engagement and engagement in research can be included in classes on science, citizenship or similar subjects in secondary schools. This can promote citizens' awareness, interest, and willingness to be engaged in scientific debates from an early age.

Build knowledge and skills

Provide and save resources

Provide and save resources

↑ *©Dreyer, Kosow and Dratsdrummer, 2018*

Citizens need to be actively interested and motivated to engage in research, and several factors may hinder such engagement.

RESOURCES

An engagement opportunity may be more attractive when citizens do not fear they lack the necessary time and financial resources to engage. Organisations that focus on public engagement can work with citizens in their 'natural habitats'. Lack of time is one of the reasons why engagement processes end up with smaller numbers of participants or less diversity than intended. One way for researchers to address this barrier is to seek out citizens, instead of asking citizens to come to them. This can be done, for instance, by targeting schools, contacting and speaking with people in the streets or at informal learning sites such as museums and botanic gardens. Funding organisations can recognise financial compensation for the efforts of citizens in engagement processes as eligible costs.

LEGITIMACY

An engagement opportunity may be more attractive when citizens do not doubt the legitimacy of the engagement process or their own involvement. We have found that individuals may shun engagement if they feel that the broader public should not have a say about research, and that the only legitimate participants in research are scientifically trained professionals. They may also feel that the views, concerns and interests they have, are not relevant to the development of research and research policy. Policy makers and governments, research funding organisations and research organisations can reassure citizens and build legitimacy of public engagement by providing awards for outstanding engagement projects. Another option for governments is to visibly commit to public engagement through national strategies or guidelines.

IMPACT

An engagement opportunity may be more attractive when citizens have reason to expect real impact in terms of political or societal effects. Currently, there is limited knowledge concerning the question of how to achieve, demonstrate or even measure societal and scientific impact of public engagement in research. Since recently, research on processes and methods to help achieve and show impact is emerging. Policy makers and governments can establish transnational infrastructures for exchanges on the results of this research and good impact practices.

These examples show: Different actors can contribute to building supportive conditions for citizen engagement in research. Possible contributions include adaptations also in wider structures, for instance in educational systems. We are convinced that joint efforts appear worthwhile in the light of worrisome antiscientific tendencies. We should seriously consider public engagement in research as a way to enhance the resilience of the wider public to fake news and defamation of science. Importantly, citizens should be invited only in those cases in which they can be expected to meaningfully contribute, and engagement needs to happen on a fully voluntary basis.

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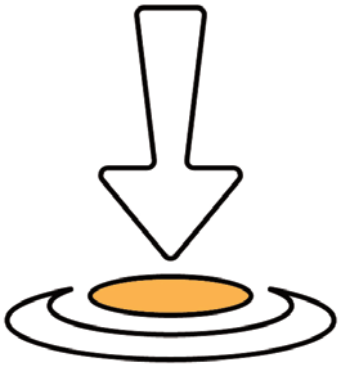

Provide for impact

↑ *©Dreyer, Kosow and Dratsdrummer, 2018*

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THE RIMBA PROJECT: TRANSLATIONAL RESEARCH THROUGH STUDENT VOLUNTEER ENGAGEMENT

In the wake of funding cuts, University of Malaya's (UM) Rimba Ilmu Botanic Garden initiated the Rimba Project to support its education and outreach efforts. The alumni- and student-driven initiative has since grown into a multi-stakeholder platform connecting researchers, volunteers, local communities and municipal authorities. It has revived and revitalized volunteer engagement through mentoring and apprenticeship. It has successfully executed urban land use and placemaking interventions, raised fieldwork proficiency among undergraduates and reached new audiences through interdisciplinary partnerships. Many challenges remain and we look briefly here at prospects for medium- and long-term sustainability.

Over the last ten years, UM in Kuala Lumpur, Malaysia, has seen a shift in funding priorities towards research output in journals and other publications. Consequently, education and outreach work at university institutions like UM's Rimba Ilmu Botanic Garden have had to take a back seat. Unlike public or independent botanic gardens, Rimba Ilmu's wellbeing is directly affected by institutional priorities. The funding cuts have also impacted classroom teaching, with reduced practical and field training sessions for undergraduates.

↑ Working with the Rimba Ilmu Herbarium, volunteers learn to prepare plant specimens for preservation ©Benjamin Ong

The University put its trust in youth – students and young alumni.

Alongside these developments was the University's push towards embracing environmental sustainability in the face of institutional inertia, as well as encouraging translational research with wider societal impact.

In 2015, UM's Sustainability Science Research Cluster introduced the Living Labs grant programme in an attempt to reconcile the many strands of this hodgepodge of institutional foci. Indeed, universities are a microcosm of society and an ideal testing ground for sustainability transitions (White and Harder, 2013), and university botanic gardens ought to take advantage of this. Through the Living Labs, Rimba Ilmu funded the Rimba Project, a programme to address three challenges:

- Maintaining a mission of education and outreach at the garden, amidst shifting institutional priorities.
- Improving institutional estates management in line with sustainable development.
- Complementing classroom teaching impacted by funding cuts.

The Project tackled these challenges by:

1. Linking up with UM's Estates office to create translational impact in greenspace management (Musacchio, 2008).
2. Making volunteer engagement a core element of education and outreach at the botanic garden.

LAND USE IMPACTS

Two examples demonstrate the Rimba Project's impact. The first is an urban land use intervention. From 2014 to 2015, the project conducted biodiversity surveys in a University-owned land bank adjacent to a residential area known as Section 12. These studies on behalf of UM Estates were conducted by student volunteers working with young researchers from the University's Institute of Biological Sciences. Through this work, students were able to pick up field skills seldom taught in the classroom. The survey results informed a successful campaign to relocate a proposed development earmarked for the land bank, and enabled the University to better engage with residents who would be affected by the development. Estates used this intervention as the basis for introducing biodiversity impact assessments into its development protocol. One aspect of the study, on bats, was published in a peer-reviewed journal (Lim *et al*., 2017), while the project as a whole was worked into a case study on systems thinking (Ong & Adikan, 2018).

Universities are a microcosm of society and an ideal testing ground for sustainability transitions – university botanic gardens ought to take advantage of this.

↑ *Volunteer Shang Ming Goh measures a large Ficus callosa in Section 12 ©Benjamin Ong*

By focusing on accessible study sites within and around the University, the Rimba Project was able to facilitate the development of field skills at minimal cost.

The Living Labs framework created space for small experiments and unorthodox ideas.

← *Volunteers map trees on a site earmarked by Estates for redevelopment ©Benjamin Ong*

↑ *Rimba Project staff and volunteers assist graduate researcher Voon-Ching Lim on a study of bats in Section 12 ©Benjamin Ong*

The second example is capacity building for Rimba Ilmu itself. In 2016, student volunteers designed and developed trails in the garden through two previously inaccessible collections planted on steep slopes. The Trailblazers project, as it was known, saw the creation of the Wild Fruits Trail and the K. M. Wong Botanist Trail, and once they were opened to the public, our volunteers took the lead in guiding visitors. This project was doubly beneficial, resulting in new infrastructure for the garden and the development of soft skills (such as communication) in our student volunteers.

YOUTH POWER

Since its foundation, the Rimba Project has encouraged institutional and individual capacity building. Engaging with Estates has helped to improve their sustainability performance while developing students' fieldwork proficiency; the transformative work in Rimba Ilmu enhanced its public education and outreach while improving student skills. The project has since grown into a multi-stakeholder platform connecting researchers, volunteers, local communities, and municipal authorities beyond the University. It continues to engage student volunteers through mentoring and apprenticeship, address urban land use and placemaking issues, and broaden the appeal of urban nature conservation through interdisciplinary partnerships. The cross-pollination of academia and activism is nothing new (Lachmund, 2013), but these are positive and significant developments in a country where the ivory tower tends to be disconnected from societal issues.

The Living Labs framework encouraged RRI by creating space for small experiments and unorthodox ideas. Two instances are particularly noteworthy. First of all, the University put its trust in youth – the students and young alumni who drive the Rimba Project. Top-down management is the norm in Malaysian education institutions, and it is difficult to get academics and university leaders to hand over the reins to students. In bringing this about, the Rimba Project was able to inspire and empower a new generation of student volunteers, giving them agency to develop solutions to problems.

The Rimba Project was one of the few soul-driven Living Laboratories that the Estates office relied upon heavily to provide clarity.
Professor Faisal Rafiq Mahamd Adikan, UM Deputy Vice-Chancellor (Development)

↑ *Volunteers clear a path during the creation of the Wild Fruits Trail in Rimba Ilmu ©Courtesy of Trailblazers*

The willingness to risk shifting power to the grassroots also enabled better utilization of resources – for example, alleviating time and energy constraints on experts and full-time staff – and promoted volunteer agency (Barnes & Sharpe, 2009; Bonney *et al*., 2014).

OPENING DOORS

The second innovation is the reappraisal of place and scale. The Section 12 study subverted the usual practice of Malaysian biologists to focus on sites further from cities, thereby opening doors for exploring urban ecology (Goddard, Dougill & Benton, 2009). By focusing on accessible study sites within and around the University, the Rimba Project was able to facilitate the development of field skills at minimal cost. While large-scale events are popular, the choice of working with a modest cohort of 20–30 volunteers enabled deep capacity building. A number of graduate volunteers continue to be involved as mentors.

A couple of programme sustainability issues remain. The Rimba Project has hitherto been dependent on University funding and grants, making it susceptible to fluctuations driven by institutional policy shifts. Furthermore, the conditions tied to institutional funding make it inflexible for innovative growth. The Rimba Project must look beyond the University for its long-term survival. While many botanic gardens have benefited from the involvement of 'friends' groups, here we struggle due to institutional barriers and bureaucracy that limit the agency of external, informal groups. In light of this, the Project has made a key contribution – by building trust with the University, and through community engagement, education and outreach, it has succeeded in laying a promising foundation for the formation of a para-institutional support group in the near future.

↑ *Trailblazers leader Yong Xin Loo guides visitors through the newly-opened K.M. Wong Botanist Trai ©Benjamin Ong*

← *Volunteer-driven creation of new trails helped revive public interest in the Rimba Ilmu Botanic Garden ©Benjamin Ong*

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DEMOCRATISING SCIENCE BY "DOING IT TOGETHER"

We are coming to the end of three years of Doing It Together Science, a coordination and support action to widen and deepen public participation in science across Europe. This article explores our efforts to expose half a million people to a wide variety of types and depths of citizen science, and how to bring together people from science, industry, policy making and the general public to share information and ideas and bring us closer to the democratisation of science.

As we celebrate the conclusion of BigPicnic, we also take a look at its "sister" project, Doing It Together Science or DITOs for short. It was funded in the same call from the European Commission Horizon 2020 programme, and ran for the same period. The call was part of the focus on *Science with and for Society* that aims to link the Horizon 2020 programme with ordinary people. Like BigPicnic, DITOs has been collecting and sharing best practices for public participation in science.

We saw in May's 2018 issue of Roots how constructivist or sociocultural learning can happen in an informal learning environment such as a botanic garden. DITOs takes members of the public - from all walks of life - a step beyond informal learning and into discussion, decision-making, and even the production of scientific knowledge. This has occurred through over 700 events, which engaged over 500,000 people across Europe (and many more online).

↑ A BioBlitz run by DITOs, as part of our >700 events ©Waag Society (DITOs partner)
Top: Making a seedbomb at a DITOs workshop ©DITOs consortium

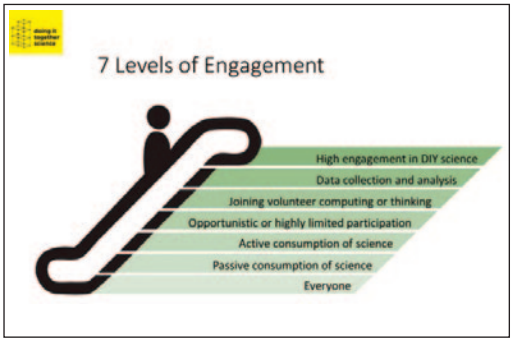
← *A Together Science Bus workshop: discussion ©UCL Extreme Citizen Science*

"Common conceptualisations of participation assume high-level participation is good and low-level participation is bad. However, examining participation in terms of high and low levels of knowledge and engagement reveals different types of value in each case."
Muki Haklay, Citizen Science: Innovation in Open Science, Safety and Policy

Citizen science is a process where research or scientific processes happen outside traditional scientific institutions, or is undertaken by people who are not working scientists. Citizen science is enormously varied, ranging from using phone apps to record light levels all the way up to the citizens defining the problem to research, carrying it out, analysing it and disseminating the findings. DITOs runs a variety of events aimed at introducing people to a wider range of scientific activities in which they can participate. Examples are exhibitions that encourage people to make observations of nature in their homes, discussion groups about films that show how people use science to solve problems, and bioblitzes where people join professional scientists in recording nature.

DITOs addresses the major role citizens have to play in creating a sustainable future, by raising awareness and building capacity for citizens to study their environment and new innovations such as DIYBio - Do-It-Yourself Biology - in which people experience the ability to analyse and manipulate DNA and other molecules. The project also runs roundtables for policy makers to meet and work with citizen scientists, and think about their needs. Like BigPicnic, DITOs brings people from policy, science and industry together with the public, to promote dialogue and collaboration and ensure that future policy is informed by a broad range of perspectives - including that of citizen scientists, who may be aware of local issues that academic scientists are not. Such issues may be instances of pollution, or of the growing field of biotechnology, the latter of which is a subject of excitement and suspicion (DITOs consortium, 2017) but also an activity often undertaken outside the professional laboratory. Our areas of focus, therefore, include both people and science: engagement with the public; engagement with policy makers; Biodesign (DIYBio and biotechnology) and environmental sustainability (nature and wider environmental observations and analysis). All the events we hold are a cross-section of at least two of these four areas.

One of our most enjoyable - and best remembered - DITOs creations was the Together Science Bus, which toured Europe over the summer and early autumn of 2017. This bus transformed into an open scientific laboratory, similar to the XperiLab bus developed by the Natural History Museum in Belgium, which has been visiting schools all over Belgium since. The Together Science Bus visited multiple locations in nine countries, stopping at locations chosen for their lack of easy access to scientific activity but accessible by the public. For example, outside community centres. We ran friendly workshops that asked people to make things: sunscreen, pH meters, phone chargers. These not only demonstrated scientific principles, but also empowered people to use their hands and simple ingredients to observe or make small changes to the world around them.



↑ *The "escalator" envisioned by DITOs, in which participation in science can exist at different levels ©Muki Haklay*

"Citizen science projects actively involve citizens in scientific endeavour that generates new knowledge or understanding."
Lucy Robinson, 10 Principles of Citizen Science

↑ *The Together Science Bus ©UCL Extreme Citizen Science*

The bus was driven and workshops run by 'bus captains', nearly all of whom were students with an interest in science communication. As well as talking to the public, however, the bus captains listened to them. They built up a collection of 'life hacks' and 'folk remedies' (roughly translated from the traditional Dutch phrase for 'garden and kitchen wisdom' or 'grandmother's wisdom') as told to them by people from different areas, and these and all the experiments from the workshops were shared on social media and the bus's website for people to use and compare.

Of course, sharing a life hack about how to keep your basil plant alive or a folk remedy for curing bee stings is very different from informing policy makers about gene editing or pollution recording. This variety is deliberate. One of DITOs's aims is to introduce people to both a variety of types of citizen science as well as different levels of participation.

The study of public participation in science has been compared to Arnstein's ladder of public participation (Arnstein, 1969; Haklay, 2018), which compares proper citizen-led involvement in public decision-making to unsatisfactory appearances of involvement, such as tokenism and placation. It is true that many citizen science projects are top-down, set by the scientist, and have a specific and often simple task for the citizen scientist, who has no say in the problem definition, evaluation, or any of the many other steps (Robinson, 2018). However, this is not necessarily a problem. Many people come to citizen science facing many barriers, including prior education, time, equipment, access and confidence, and are therefore not ready for a high level of participation (Krebs, 2010; Newman *et al,* 2012).

DITOs thus visualises an "escalator model" of participation in citizen science, with the general public. From the bottom, a large number will step onto the lowest step, where people might read or watch the science bulletins on the news or visit a science museum. As people move to higher levels, they might reach a point where they are ready to classify galaxies on Galaxy Zoo, download the World Community Grid, or be members of the British Trust for Ornithology. At the very top, a small number remain, and they are participating at an extremely high level, such as DIY Biology. Such people are currently likely to have a very high level of education and access to collaboration and equipment.

Importantly, it should not be assumed that any level has any higher value than another. DITOs offers people entry to whichever level each individual feels comfortable. From attending an exhibition to taking part in a wetlab, for example. By exposing them to both higher and lower levels (they might wish to move a level up - or they might face some new barrier, such as having less time, and need to move a level down to keep participating) people can find their own niche. This then allows for a process by which individuals can gain experience and confidence, and then become more ready to reach the level of decision-making in science, such as by meeting policy makers.

← A Together Science Bus workshop: making sunscreen ©UCL Extreme Citizen Science

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THE REVERSE SCIENCE CAFÉ – DIALOGUE WITH A TWIST

The reverse science café was born from the desire to shift the public and expert roles in dialogue events to encourage fuller engagement. This advancement has helped the Copernicus Science Centre to develop our role as a forum for discussion about RRI. Here we share our experiences with this method, its limitations and potential.

In 2012 the Copernicus Science Centre decided to run a programme of debates[1] about contemporary biotechnology. One of the hot topics was GMO crops and we invited some of the leading experts in Poland to join us for a science café event about this issue. They were hesitant. Having had experience of numerous science communication events, they did not want to take part in another where they would be bombarded by the same questions about GMOs all over again. Hence a new idea was born – we could modify the event format so that for once, they, the experts, would be asking questions of the public, rather than the other way round. And this is how the reverse science café was born.

The twist was simple. We adapted a well known world café format, where people engage in discussions in small groups sitting round tables. All the invited experts were tasked to think of a question they would like to put to the public. During the event they were to ask this question at a table, then leave the discussion – to give space to the group to deliberate on the answer. The conversations that followed proved valuable for all involved.

NEW PERSPECTIVE

Two years later we were invited to contribute to the Sparks project.[2] Funded by the European Commission it was aimed at promoting the concept of RRI to wider audiences. The project specifically asked, amongst other things like a touring exhibition and participatory actions, for a dialogue event and we decided that the format tested in 2012 would be ideal to engage people with this complicated topic.

We were not experts on RRI at this point. What we knew, and wanted to get across, was that RRI introduced a new perspective on how the research and innovation process occur, to be more in line with societal values.

↑ *Paweł Szczęsny Ph. D. live presentation of EMG sensor ©Agata Steifer*
Top: The first reverse science café in 2012 ©Adam Kozak

"In my opinion, the Centre has entered into a completely new role - a platform for fresh (...) thinking in science and about science. It ceased to be for "science", and became a part of it"
Pawel Szczesny Ph. D.

Also, from our own lay point of view, we saw that it paints a complex, multi-stakeholder view of the research and innovation ecosystem – in which science engagement institutions play only a partial role. To fully show RRI to the public we would need to go beyond our comfort zone and open up to working with new topics, institutions and people.

A guideline for this came from the structured concept proposed by the European Commission[3] and later developed by the RRI Tools project,[4] among others. The commission introduced six policy areas in which changes should happen to reach RRI aims: Ethics, Gender Equality, Governance, Open Access, Public Engagement and Science Education. We planned to show people what kind of issues are present in all those areas and try to get their opinion on improving them.

BEYOND RESEARCH

We chose the overarching topic of healthy lifestyle and medical innovation and decided to focus the event around one case study in technology. For the event in Warsaw we worked with Paweł Szczęsny Ph.D, who is researching early diagnostic tools for newborns using EMG measurements to detect symptoms that can lead to sudden infant death syndrome (SIDS). In itself the technology would address an issue that new parents dread. But from RRI perspectives it is also interesting. Szczęsny uses 'off the shelf' sensors, that anyone can buy and use to monitor EMG data. This kind of technology raises a lot of questions that go beyond pure research practice, touching on different RRI policies. Therefore we invited an interdisciplinary group of experts – philosophers, gender anthropologists, doctors, people working in patient NGOs, open data specialists, hackers, engineers from the business world and science engagement professionals. This way we could enable a discussion around the main case study from many not always very obvious angles.

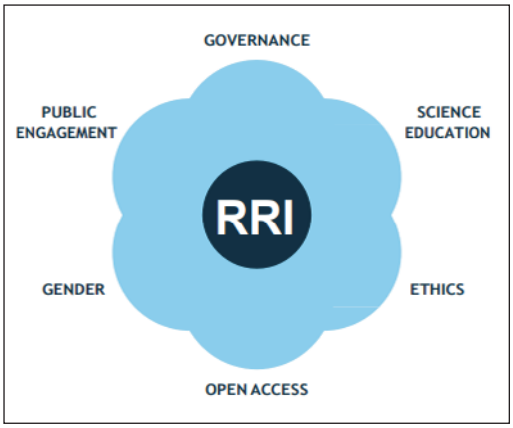
The questions that our experts prepared for the public touched on data privacy and control, responsibility for hardware malfunction, patient participation in research, trust and agency. The format was aimed at producing a set of recommendations for the author of the main case study, based on the round-table discussion and voting. During this event the public said that the following were important.

- to strengthen positive doctor-patient relations that would enable more patients to participate in medical research;
- to take into consideration effects (like social fears) of new technology that go beyond medicine itself;
- to strive to give full control over medical data to patients so they can agree on every instance of its use and to introduce more interdisciplinarity in research teams.

It is easy to see that all the recommendations are very much in the spirit of RRI. Szczęsny later commented, 'no conference organiser, nor the traditional panel of experts, would have risked gathering together a young doctor, a child psychologist, a corporate director, and a technological expert (not to mention an academic) to discuss the problems of new technologies in medicine. In my opinion, the Centre has entered a completely new sphere – a platform for fresh thinking in science and about science. This ceases to be an "experiment" and becomes reality.'

PROS AND CONS

The reverse science café was rolled out in 29 countries in Europe and project experiences were gathered to create a toolkit (that can be accessed online)[5]. During the course of the project the format evolved – it was adjusted by different organisers and its limitations were revealed.



↑ *RRI Policy Agendas ©RRI Tools project, https://www.rri-tools.eu/documents/10184/16806/RRI+Tools+Project+Brief.pdf/183c8a96-c414-4fab-80b9-31ccecedaa47*

We adapted a well known world café format, where people engage in discussions in small groups sitting around tables.

If organisers do not have a plan on what to do with the results of public discussion, on how to convey the message to the people and institutions who make decisions, the reverse science café becomes just a vehicle to practise dialogue.

↑ *Copernicus Science Centre Air Fountain ©Agata Steifer*

Firstly, especially in the context of RRI, it proved very useful in painting a detailed picture of the research and innovation ecosystem, but was not so good for synthesizing this overview. Discussions tended to go in several directions at the same time and reaching a conclusion, or final recommendations, did not prove easy. We were happy that the main message of RRI being a multi-stakeholder, policy-spanning endeavour came through clearly – but at the same time this makes the event hard to follow up. If organisers do not have a plan on what to do with the results of public discussion, on how to convey the message to the people and institutions who make decisions, the reverse science café becomes just a vehicle to practise dialogue.

Secondly, it is not a very user friendly format. It takes a couple of hours to run in full and the topic, fragmented into different questions from the experts, can be unclear and hard to communicate. We struggled with low attendance for our events and always had to put in a lot of work to directly invite participants who would be interested in discussing the particular topics. Yet with enough resources, experts to ask the questions and room for the tables, it is potentially viable to scale it out to large numbers of the public. And the twist – the reversing of public and expert roles – has proved to be a successful tool for creating discussion.

The main lesson we learned, besides becoming more aware of the sheer intricacies and complications of RRI processes, concerns exactly what our role in this field could be. We, as a science centre, can design tools that enable people to be heard, we can motivate research and innovation stakeholders to open up to consultation with the public, and we can also connect people from different RRI areas and invite them to collaborate and look on their role, whether it is in science, business or policymaking, from new perspectives. We have strengthened our role as a forum for dialogue.

Links

[1]http://www.kopernik.org.pl/projekty-specjalne/archiwum-projektow/projekt-genesis/
[2]http://www.sparksproject.eu/about-project
[3]https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation
[4]https://www.rri-tools.eu/about-rri
[5]http://sparksproject.eu/sites/default/files/SPARKS%20TOOLKIT.pdf

↑ Copernicus Science Centre aerial ©Agata Steifer
↓ Copernicus Science Centre park and planetarium ©Agata Steifer

The twist – the reversing of public and expert roles – has proved to be a successful tool for creating discussion.

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RESPONSIBLE RESEARCH AND INNOVATION (RRI) IN EUROPEAN NATURAL HISTORY INSTITUTIONS: THE CETAF RRI FRAMEWORK

©Natural Sciences Museum Brussels (RBINS). Photo taken by Xavier Vermeersch

RRI, promoted by the European Commission in support of societal challenges becoming a primary focus of scientific research, encompasses scientific and/or technological development processes that take into consideration effects on the environment and society. To raise awareness on RRI across its membership, the Consortium of European Taxonomic Facilities (CETAF) held a RRI workshop that explored the application of RRI principles within natural history museums and botanic gardens. As the main outcome of this endeavour, the CETAF RRI Framework was established, a document that provides community-agreed guidelines aimed at facilitating integration of RRI principles and compliance with EU funding regulations.

RRI is defined as "the on-going process of aligning research and innovation to the values, needs and expectations of society" (European Commision, 2014). RRI is an ever-increasing component of the European research funding landscape. It intends to bring researchers, citizens, policy makers, and businesses together to better align research processes and outcomes with societal advancement, as well as jointly contributing to tackling urgent global challenges. RRI seeks to ensure the coherence and interconnection between scientific research and/or development pathways, the underlying needs of society, and the demand for economic growth.

RRI is defined as "the on-going process of aligning research and innovation to the values, needs and expectations of society".
European Commission, 2014

← *Striving for gender and ethnic balance in scientific research*

↑ *The CETAF RRI Framework – a community approach to RRI principles ©CETAF*

↑ *Botanic gardens at the heart of public engagement ©M.Price- CJBG 2019*

Under the European Union RRI framework, research institutions are progressively adopting the concept of RRI as a guiding force, to inform their behaviour and shape their future involvement in the evolving landscape of European scientific research and research funding. CETAF, a long-standing organisation that acts as a platform and communication hub to support European natural history institutions (natural history museums, science centres, botanic gardens), has taken up the challenge. CETAF has recently showcased the good practices, in alignment with the guiding principles of RRI, that are commonly undertaken by its more than 30 members, representing over 60 natural history institutions that hold collections and conduct scientific research from 21 EU member states and associated countries.

FIVE DOMAINS

In response to the integration of RRI into the Horizon 2020 Programme of the European Commission, CETAF organised a RRI workshop during one of its governing board meetings and CETAF members took the opportunity to reflect on current and potential good practices within natural history institutions, and on how the community can better promote RRI principles and ensure that they are routinely embedded into daily work and standard practices. For more information on the CETAF RRI workshop and RRI in European natural history institutions see the CETAF webpage on RRI (https://cetaf.org/responsible-research-and-innovation). The pillars that underpin RRI refer to areas that are, for the most part, already key to the practices of CETAF members, namely: Public engagement, Open science, Gender equality, Ethics and Science education. These themes form an integral part of the numerous activities, from exhibitions and educational programmes to collection curation and scientific research, which take place within natural history institutions across Europe. The CETAF Framework on RRI, entitled “CETAF Framework for Responsible Research and Innovation – 5 principles to guide 5 domains” aims to establish common ground and a shared understanding of RRI in the natural history specific environment, providing guidance on both the engagement in and integration of RRI principles. It outlines five basic principles – derived from the natural history museum-specific environment – for each of the five RRI domains, as endorsed by the community. The CETAF RRI Framework also aims to fulfil the goals of the European Commission Research and Innovation Policy, namely to:

Under the European Union RRI framework, research institutions are progressively adopting the concept of RRI as a guiding force, to inform their behaviour and shape their future involvement in the evolving landscape of European scientific research and research funding.

- engage society more broadly in research and innovation activities,
- increase access to scientific results,
- ensure gender equality, in both the research process and research content,
- take into account the ethical dimension,
- promote formal and informal science education.

Natural history institutions are inherently devoted to science education and public engagement, with visitors ranging from scientifically informed persons to school children or other education-based groups and the general public who are curious about the natural world. Over 10 million people visit CETAF member institutions every year, benefiting from the exhibitions and explanations of the specimens or scientific discoveries, as well as more targeted events that explain biodiversity, evolution, conservation and the means by which to address societal challenges. Natural history institutions are also involved in targeted education, helping to increase scientific literacy and offering expert information on scientific issues to the future generations of scientists and informed citizens. Natural history institutions equally contribute to ensuring stronger societal attachment to the issues of conservation and the preservation of nature, informing the public on the importance of biodiversity for human welfare, and on the sustainable, equitable and ethical use of it. CETAF member institutions collectively receive more than 6,000 scientific visitors a year who work directly with natural history collections. CETAF member institutions employ more than 2,000 full-time systematics and biodiversity researchers, and have achieved an almost equal gender balance in their collections and scientific staff. Scientists from CETAF member institutions network with their peers and strive to provide open access to their scientific findings, thus facilitating the transfer of knowledge and the enhancement of research capacity and quality, both in Europe but also internationally.

THINKING DIFFERENTLY

RRI implementation goes, however, beyond our routine activities. It outlines the need for change in attitudes or approaches, and may also require structural or functional improvements that bring about different ways of thinking – whether as individuals, institutions, or social groups. The CETAF commitment towards RRI has only just begun, having set out our guiding principles, our mission will evolve over time as the RRI landscape matures. The CETAF community will keep abreast of current initiatives surrounding RRI and will review outcomes, disseminating their future relevance to museums and botanic gardens.

← *Education and outreach using collections ©RBINS 2016*

↑ *Exhibitions promote science education and scientific literacy ©M.Price- CJBG 2019*

Natural history institutions are also involved in targeted education, helping to increase scientific literacy and offering expert information on scientific issues to the future generations of scientists and informed citizens.

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INTRODUCING THE CO-CREATION NAVIGATOR

Co-creation is a method to engage stakeholders by way of thinking, designing, and building together in multidisciplinary teams in which personalised and unique experiences arise. In the BigPicnic project partners used co-creation to facilitate new participatory processes in their gardens.

The *co-creation navigator* guides you through the different stages of co-creation, from preparation to execution, and directs you to tools and methods that help you in each stage. You will learn how to build your project foundation, how to get in the right frame of mind and how to remain innovative throughout the co-creation process.

↑ *The co-creation navigator interface ©Waag*
Top: Lego-challenge with BigPicnic partners ©Waag

Most cultural organisations want to be relevant for society, but many contemporary societal issues are too complex for a simple top-down approach. There is a need for customisation to connect to audiences, to gain insights into needs and wants and to hear stories. These are sentiments that lay the foundations for both RRI and co-creation. BigPicnic introduced a co-creation approach to our 15 botanic garden partners in Europe and Uganda, to help facilitate the process of RRI by helping them connect with audiences, and work towards scientific outcomes and technological advances that match their audience's values and needs. These gardens all have a different social and cultural context, and face different obstacles to building relationships with (new) audiences.

← *Co-creating with stakeholders ©Waag*

Waag regularly share their approach to co-creation and design thinking and facilitate co-creation sessions and processes for museums, care institutions, municipalities and companies. Co-creation's aim is to create shared value in collaboration with relevant communities. It starts from the idea that everyone is an expert, first and foremost on their own life. Different levels of expertise are equally valuable. Relationships are built, and the exchange of ideas and values is vital. Through co-creation, innovation approaches can move from incremental to transformative, allowing the general public, as a key component of society, to design and debate potential futures with policy makers, scientists, industry and experts.

Over the years, Waag has trained educators, programme makers, policy makers, developers and community workers in co-creation on many topics. Working towards a food secure, sustainable future requires cross-sectoral collaboration, which includes the involvement of the public and community groups. In BigPicnic, Waag coached people working in botanic gardens on co-creating with local stakeholders to understand their concerns on food issues. Since food security was a new issue for most gardens, engaging in co-creation processes with the public and experts allowed them to get a better understanding of the societal relevance of food. It gave the gardens a better sense of potential strategies to raise awareness, to connect existing knowledge and to create an actionable perspective on food security for their audiences.

Co-creation is, in principle, a practical approach: working with (real) people to get to a shared solution for the issue at hand. To be able to do that requires some theory and context – which can become quite abstract, quickly.

'Co-creation is not a one-off event, like a referendum in which the community decides what should be done. [...] Nor is co-creation just a question of formal consultation in which professionals give users a chance to voice their views on a limited number of alternatives. It is a more creative and interactive process which challenges the views of all parties and seeks to combine professional and local expertise in new ways.'[1]
Hillary Cottam, Charles Leadbeater (2004)

[1]Cottam, J., Leadbeater, C., 2004. RED PAPER 01 HEALTH: Co-creative Services. London: Design Council.

↑ *Co-creative activity in BigPicnic ©Waag*

I realised that researchers are often a bit egotistical and don't consider the needs of the others or the environment. We think we know how to solve problems. We should pay more attention to how we work out what to research and think about what other groups of people can bring to this discussion.
Eleni Maloupa, Director Balkan Botanic Garden of Kroussia (2017)

← *Portrait drawing exercise ©Waag*

To ground those abstractions, Waag started mapping the process of co-creation in a five-step working structure. This structure looks beyond the incidental work sessions with a community that most people would associate with co-creation. It looks at the bigger picture. What is needed to get a co-creation process started and embedded in an organisation, and how choices validated on the way?

For clarity's sake, the structure has been presented as a linear process, but needs to be considered as a guideline that allows for iteration and going back to previous stages.

The first two stages ('foundation' and 'context') are important at the beginning of the process as these reference the internal structure of the organisation and the skills of people hosting the co-creation process. These also help define the scope and limitations of a project. The third and fourth stage ('community' and 'workspace') cover the community involvement and the execution of co-creation with external co-creators (stakeholders, experts, artists, etc.). The fifth stage ('assessment') helps to reflect on ambitions and results of the efforts in the process.

The five stages are cyclical and can be performed, on a smaller scale, within the 'workspace' – as iteration is essential to a good co-creative process.

For each of these stages, methods and tools can be used to facilitate the process. Of course, not all methods and tools can be demonstrated during a face-to-face training. But many existing methods can be found online in various toolboxes and kits. The problem is that you would need to know what type of method you are looking for, and then identify whether or not it is actually good or useful. This can be challenging.

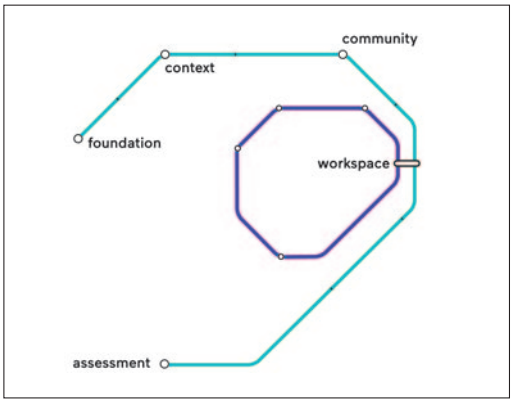
With that in mind we explored the options to develop an online repository, following the above structure. Rather than creating yet another toolbox, we decided to curate those existing materials and reference them, which would help a co-creation facilitator to navigate through the forest of tools and methods. This resulted in an interactive platform, 'the co-creation navigator': an open source, visual representation of the co-creative process, with, in each phase of that process, references to tools, methods and best-practices that can support facilitation. Experienced co-creation facilitators are featured and share their testimonials and experiences, which in turn could inspire others.

BigPicnic partners have been using the platform actively in the last year, as they are now confidently co-creating themselves. Through the dialogues supported by exhibitions and participatory events, the gardens have highlighted the potential for informal learning sites, like botanic gardens, to embrace multi-stakeholder collaboration. All partners stress the importance of perseverance to host a successful co-creation process; regularly doing co-creation, experimenting with different methods and making choices in the methods that work for them individually and for their context. The co-creation navigator will continue to support their process, as the platform will remain open to all – and will continue to evolve.

We encourage other institutions to experiment with co-creation as well, and use the navigator, to create strong, lasting relationships, with engagement as a catalyst for change. We are excited to learn about your experiences, as we continue to add new methods and functionalities to the co-creation navigator in order to further empower (cultural) professionals to work more regularly and directly with local communities.

Check the co-creation navigator at: https://ccn.waag.org

'It's like cooking not for your guests but with your guests. This allows you to find out what their tastes are, their skills and preferences, and to share yours. You make them feel more protagonists, even if the ingredients, the house, the appliances make them dependent on you. It is different if you prepare everything yourself, imagining what their tastes may be, or how to prepare the table or dishes. This is more comfortable and maybe faster, but co-creation is more creative, participatory, socializing. It is not necessarily that everything always works perfectly, but it also offers surprises and solutions that you could not have imagined.'
Gabriele Rinaldi, director Bergamo Botanical Garden (2018)



↑ *Waag's co-creative structure ©Waag*

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CO-CREATION WITH PEOPLE OF AFRICAN ORIGIN

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Jutta Kleber

Meise Botanic Garden

↑ Discovering the Garden with people from Café Combinne team ©Sien De Meuter

Within the context of BigPicnic, we decided to organise co-creation sessions with people of African origin, living in Belgium. This choice was inspired by:

1. The wish to reach a new target audience. Even though approx. 600,000 people of African origin live in Belgium, and many of them in Brussels, we don't have a lot of Afro-Belgians visiting our garden.

2. The fact that our botanic garden has an important collection of African tropical plants and a recently renewed part of our 'Plant Palace' entirely dedicated to these plants. We found it interesting to learn what these plants meant to people with roots in the countries where the plants grow, and to share this knowledge with our other visitors.

3. The wish to discover what food security means to people with a migration background.

We organized these sessions for several groups from FAAB (Federation of Anglophone Africans in Belgium) and two groups from Café Combinne (discussion groups for people with a migration background that want to learn Dutch).

The co-creation sessions were much appreciated by participants. They said they had a 'coming home' experience when visiting the glasshouses. The willingness to share knowledge and experiences about tropical food plants and medicinal plants was very high. The groups from Café Combinne were particularly motivated to express themselves in their new language, because they had a chance to share their knowledge with us.

For the Garden, the co-creation sessions had unexpected and rewarding outcomes:

- We created a short film, called 'The face behind the food', in which people of African origin talk about their food memories and about how migration affected their relationship with food.
- We created two exhibitions (one on roots, tubers and bananas, and one on edible insects) and several science cafés based on topics that resulted from the co-creation sessions.
- We organised an 'African diaspora agro-food forum', where people discussed projects and problems in the African agro-food sector and the situation of African diaspora people related to food and food security.
- On several occasions, people with African backgrounds that set up food projects in their homeland could exchange knowledge with researchers from our garden.
- We shared the gathered knowledge with the guides and educators of our garden, who will in turn share it with visiting groups.

Outcomes of the different activities have been used to inform the BigPicnic recommendations.

DEVELOPING SCIENCE CAFÉS WITH EXTERNAL PARTNERS

AUTHOR

Antonia Humm

↑ Construction of an insect hotel during the accompanying workshop in the museum village ©Jonathan Augustin

The Botanical Garden and Botanical Museum Berlin organised all six BigPicnic science cafés in collaboration with external partners. Such a cooperative approach offered many advantages, as we could take advantage of both our partners' expertise during the planning phase, and their venue to host the event. Through the collaboration with these partners, we were not only able to reach new target groups, but also better tailor our events to them. Last but not least, the partnership opened our eyes to new aspects of content and new ideas for a science café - for example by combining them with practical workshops.

This article will discuss the benefits of the partnerships we developed through planning and delivering some of these events.

Collaborating with "Kunstgewerbemuseum", a local arts and crafts museum was an obvious choice. In 2018 they had a design exhibition "Food Revolution 5.0", which was thematically similar to BigPicnic. We had the opportunity to run our science café, which took place in a central public square with a food market. In this way, we were able to reach visitors interested in art as well as visitors to the food market. This science café, which we developed with museum staff, had the theme: 'The preservation of food as a way to more food sovereignty'. The cooperation proved to be particularly fruitful for the selection of the panel speakers. We were not only able to recruit one of the exhibitors, but the museum was also able to provide us with other interesting experts, such as a top chef who works with fermented food and a representative of a social organisation that helps those in poverty to preserve surplus food.

We planned another science café with the Association of Berlin Allotment Gardeners. Many elderly people and urban gardening enthusiasts whom we would otherwise not have reached are involved in the association. Our science café took place in an allotment and dealt with a topic that is currently being discussed very intensively in Berlin - the preservation of allotment gardening and urban gardening areas for vegetable cultivation, which are threatened by development. The association gave us access to Berlin politicians and garden activists who made themselves available as experts for the science café. In addition, they provided publicity in advance as well as after the event through the association's newspaper, which reaches around 70,000 allotment gardeners.

Another science café took place in the "Futurium" museum village, which is mainly visited by families. The most interesting aspect of this collaboration was the planning of the event. Generally, we planned science cafés alongside full-time staff of institutions, whereas here we worked with volunteer groups, who normally demonstrate practical handicraft activities. Together we defined the topic "bees and biodiversity" and held a practical workshop on bee-friendly measures. The topic was ideal because some of the volunteers are involved with a beekeeping group and a garden group. Thus we benefited from the expertise of the group and the idyllic location of our partner and managed to reach a new audience.

CHALLENGE TO MOTIVATE SUSTAINABLE FOOD COMPETITION

AUTHOR

Hanneke Jelles,

Head of education Hortus botanicus Leiden

↑ The director of Van der Linde, the restaurant chef and a Hortus employee came to taste and judge ©Hanneke Jelles

In 2017, the first group of 60 secondary school students joined a two-month competition 'Who can develop the best sustainable menu for the Hortus botanicus Leiden restaurant? In 2018, 60 new students accepted the challenge.

In order to increase motivation around the subject of sustainable food in 15-16 year olds in line with the aims of BigPicnic, Hortus botanicus Leiden, Technasium Da Vinci College and Van der Linde catering developed the competition. Twelve groups of five students were tasked to develop a meal, suitable for the Hortus restaurant. The meal should be affordable, realistic to produce, sustainable, healthy, taste nice and look inviting. The winning recipe was served in the Hortus restaurant.

Guided tour
The first step was for all 60 students to visit the restaurant and the garden. They had a tour of the kitchen, restaurant, vegetable garden and glasshouses. During the tour advice was given on how to make a recipe attractive. Over the next month the groups developed their menus. They tested them at home, then at school. Following director of Van der Linde, the restaurant chef and a Hortus employee visited the schools to taste and judge. The best thing was that after the tasting by the jury, the children could eat the food they made. They were very eager to try their own and their classmates dishes.

Winter menu
In 2018, the winning three recipes were on our restaurant's menu for four months. On each table there was a menu card with information on the competition and BigPicnic. Visitors could take the menu home to show others.

Competition
It is not difficult to reach a group of high school students, but it may be difficult to get them really involved at this age. The competition element helped to get them engaged and connect with the sustainability aspects.

Visibility
The project had good visibility: there was quite a lot of publicity, people relaxing in the restaurant ordered the menu many times and read the information. The school was proud and made the menu on their open day (to attract new students), and they presented it at a congress for teachers.

As the school changes its main project every two years, it is not likely that the competition will be repeated in 2020. But thanks to the publicity, we are involved in new, similar projects.

www.hortusleiden.nl/eng

CO-CREATION KICK OFF

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María Majadas Matesanz - Juan Carlos I Royal Botanic Gardens, Alcalá de Henares University

↑ Creating a relaxed and participative atmosphere was vital for getting the most out of our advisory group ©RJB-CSIC

Over the last couple of decades, businesses and organisations worldwide have been using co-creation to help them achieve specific goals in their projects. This approach has also become very effective in design of science communication and is one of the main methodologies implemented in BigPicnic.

CONNECTED KNOWLEDGE

The Spanish partners of the project, The Royal Botanic Garden of Madrid and Juan Carlos I Royal Botanic Gardens, Alcalá de Henares University, brought together an advisory group at the beginning of the project to help them identify the hot topics in food security in Spain. This group of experts was made up of twenty-six members belonging to different areas of expertise: agriculture and environment, food production and health, socio-economics, education and science communication.

CO-CREATION SESSION DYNAMICS

Creating a relaxed and participative atmosphere was vital for getting the most out of our advisory group and this was our aim for the first meeting.

A dynamic session with a directed debate in two rounds was organised. First, advisors were divided into homogeneous groups of experts that were asked to point out issues around food security in their field, and highlight the top three. Second, participants were mixed around and divided into heterogeneous groups of experts, and were then asked to propose solutions to the problems posed by the previous groups. Results from each table were presented to all participants to encourage debate.

OUTCOMES: HOT TOPICS ON FOOD SECURITY

Several topics related to the production food chain emerged which helped us to shape our future activities. These included biodiversity, soil, climate change, sustainability, agrochemicals, food safety, access to food, myths and legends, food culture, information and advertising, amongst others.

The information gathered through the session helped us design an initial set of informative panels covering different aspects of food security:

1. Together for food security: the Big Picnic project
2. What is food security?
3. Food life cycle
4. How is the food we consume produced?
5. Access to food
6. Labelling: information for consumers
7. Food waste
8. Food and the environment
9. Responsible consumption and good practices
10. Food and health

These panels served as the basis of our first outreach exhibitions and inspired different co-created activities to inform and engage the public on food security. For example, we ran workshops on local food production and food sovereignty and science cafés on access to food, consumer information, the pollinator crisis in agriculture and many others.

BE CREATIVE, BE CO-CREATIVE

Involving experts at the beginning of the project and co-creating with them, when we knew so little about food security, was certainly a success! Not only was the result of teamwork much more creative and productive than having worked individually, but also their knowledge and ideas triggered the production of outreach activities. And unpredictably over half of the advisory group collaborated with us later on!

RESOURCES

IMPLEMENTING RRI

Journal of Responsible Innovation

If you are looking to improve your academic understanding of RRI and developments in the field, this is the place to come. The Journal of Responsible Innovation looks at ethics, technology assessment, governance, sustainability, socio-technical integration, and other areas with the aim of shaping this newly emerging community of research and practice.

https://www.tandfonline.com/loi/tjri20#.Ve2RSJdmFo0

CETAF Framework for Responsible Research and Innovation

This document, from the Consortium of European Taxonomic Facilities, maps the work of natural science institutions to the five dimensions of RRI (open science, science education, public engagement, gender and ethics) to highlight how institutions like this can support and are supporting this approach.

https://cetaf.org/sites/default/files/documents/cetaf_framework_for_rri.pdf

Options for strengthening Responsible Research and Innovation

This report from the European Commission focusses on how RRI should develop over the coming years. It looks at the need for RRI, important objectives that need to be developed in order to implement RRI across Europe, various possible models for its implementation and their possible impacts and how policies can be monitored.

http://ec.europa.eu/research/science-society/document_library/pdf_06/options-for-strengthening_en.pdf

IMPLEMENTING RRI

Co-creation Navigator

Co-creation has been shown to be a great way to develop projects and activities that bring a range of stakeholders together, and, therefore support RRI. The Co-creation Navigator, developed through a number of EU projects, compiles learning and resources to help you try co-creation at your organisation.

https://ccn.waag.org

Science café Toolkit

Science cafés are a tried and tested way to get experts and non-experts to share their thoughts and knowledge. There are now many formats these informal science events can take. This toolkit, developed as part of BigPicnic, guides you through planning and implementing a science café in a way that suits your organisation, audiences and context.

https://www.uibk.ac.at/test/big-picnic-science-cafe-tool-kit/science-cafe-tool-kit/

RRI Toolkit

From the RRI Tools project, this online platform contains resources from projects and organisations that can help you to adopt an RRI focussed approach.

https://www.rri-tools.eu/

The Hypatia Toolkit

Teenagers and, in particular, teenage girls, can be a hard to reach audience when it comes to engagement with STEM subjects. This toolkit includes creative, ready-to-use, gender-inclusive activities that can support you to enhance your learning offer for young people.

http://www.expecteverything.eu/hypatia/toolkit/

Responsible Research and Innovation: A quick start guide for science engagement organisations

This guide was developed as part of the RRI Tools project and aims to support engagement organisations, like botanic gardens, to embrace RRI. This process is not always easy, and so the guide includes important elements of RRI you will need to consider as well as real-life examples of how other organisations have supported RRI, to give you some inspiration.

https://www.ecsite.eu/sites/default/files/quick_start_guide_in_rri.pdf

Reach Out Toolkit

An important part of public engagement and RRI projects is supporting other organisations to follow your model. However, achieving this is not always easy and requires effective and targeted dissemination. This helpful guide provides information about how best to reach important stakeholders like teachers, other project managers, policy makers and professionals from science museums.

http://desire.eun.org/c/document_library/get_file?uuid=19f37a23-d566-4a49-8106-5a29857a16f3&groupId=12834

FIT4RRI

This project seeks to strengthen RRI through offering training and by promoting diffusion of appropriate practices in governance. The training materials include a series of webinars, which will be held throughout 2019, as well as videos, tutorials and guidelines.

https://fit4rri.eu/training/

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BigPicnic Recommendations

Using the BigPicnic project data, we have developed a series of policy briefs. There are six BigPicnic policy briefs. Four aim to support policy makers to shape future food policies and funding frameworks and two seek to support informal learning sites to apply the learning that occurred throughout the project.


Natural History Museum, University of Oslo Frank Vassen

For policy makers:

- BigPicnic policy brief 1: Food and heritage
- BigPicnic policy brief 2: Climate change
- BigPicnic policy brief 3: Sustainable food production
- BigPicnic policy brief 4: Education and food security

For informal learning sites

- BigPicnic policy brief 5: Using participatory approaches
- BigPicnic policy brief 6: Organisational development through food security

FOOD AND HERITAGE | CLIMATE CHANGE | SUSTAINABLE FOOD | EDUCATION AND FOOD SECURITY | PARTICIPATORY APPROACHES | ORGANISATIONAL CHANGE | UGANDA

BigPicnic resources All of the resources developed through BigPicnic are now on the BGCI website. **www.bgci.org** This includes toolkits and guidance in co-creation, evaluation and science cafés that will help you to reach new audiences and enhance your public engagement.