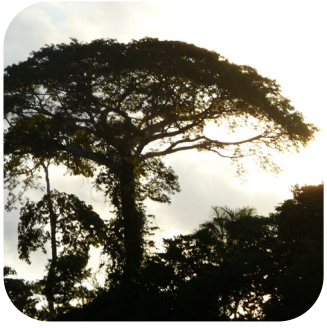
Knowledge for People, the Planet and Prosperity through Partnerships

K4P Alliances

https://k4palliances.com/

White Paper

January 2023



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Knowledge for People, the Planet and Prosperity through Partnerships

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A White Paper aiming to promote an **international joint venture** to strengthen the transatlantic dialogue and the **cooperation with the Global South**, with emphasis in **Africa and Latin America**

It always seems impossible until it´s done.
Nelson Mandela

This White Paper resulted from the follow-up of the meeting organized in the Arrábida Convent, September 5-7, 2022, by the "Institute for Prospective Studies", https://institutoprospectiva.pt/en/index.html . It has benefitted from collaboration with the Centre for International Cooperation of the Vrije Universiteit Amsterdam and the support of the Orient Foundation, the Luso-American Development Foundation, the Fundação Oswaldo Cruz – Fiocruz (Brazil), CONFAP - National Council of State Funding Agencies (Brazil), CNPq – National Council for Scientific and Technological Development (Brazil), The Futures Institute and COPPE (UFRJ, Brazil), SANSA (South Africa Space Agency), Cabo Verde Government and TINIGUENA (Guinea Bissau), together with that of AIR Center - Atlantic International Research Centre, Ciência Viva, CEiiA – Engineering Centre and of the Center for Innovation, Technology and Policy Research, IN+ @Tecnico, University of Lisbon.

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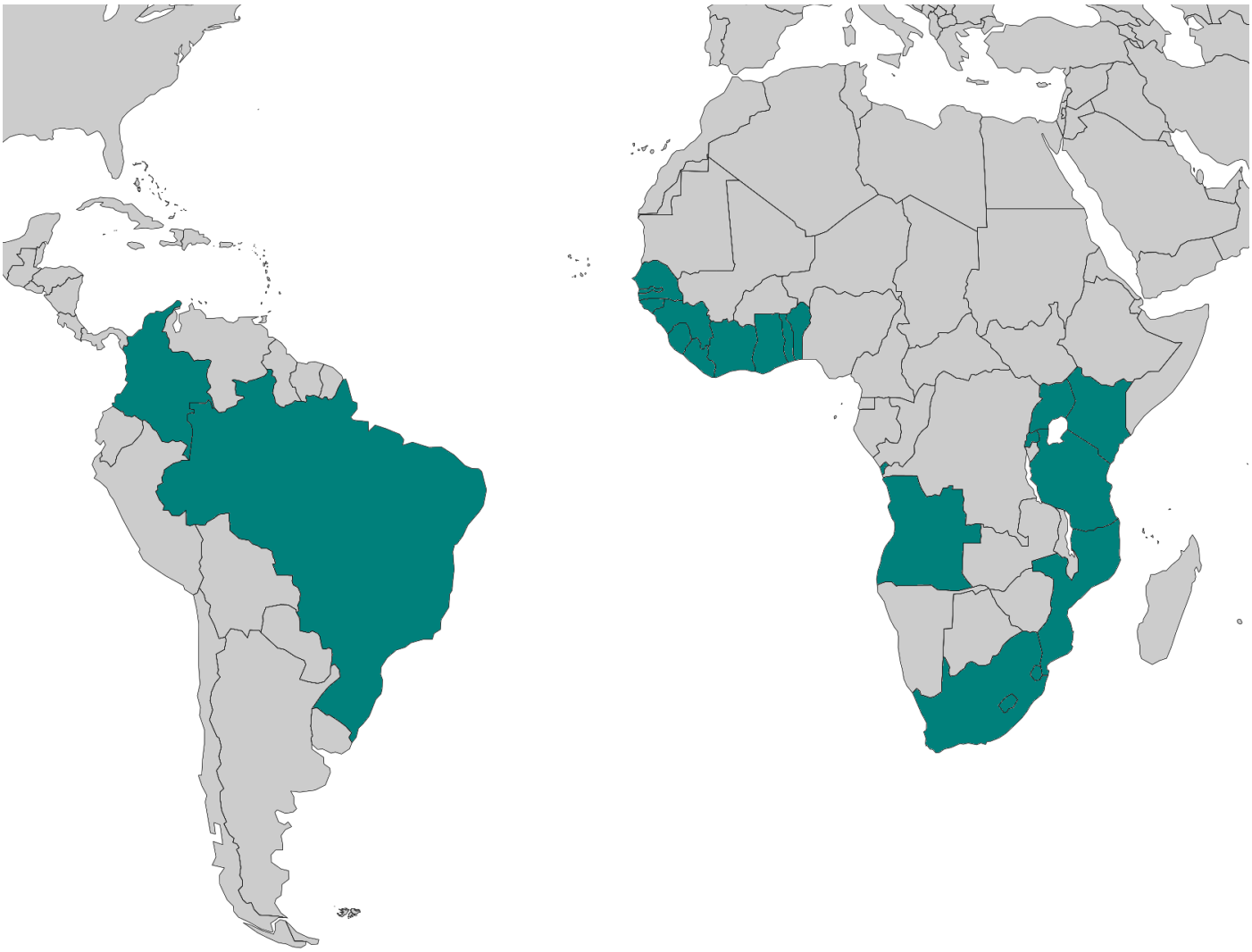
The mission of K4P Alliances is to promote collaborative projects fostering Human Agency and the governance of data ecologies to achieve Sustainable and Healthy Territories and reduce inequalities in the digital age, together with “Net Zero” societies.



It considers a cultural movement throughout all areas of knowledge to promote the use of data derived from Earth Observation systems in combination with other advanced data acquisition and processing systems, enabling innovative policies and practices driven by new research dealing with complex landscapes, including those in vulnerable urban areas and rural landscapes

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The lead author and coordinator,
Manuel Heitor

Sun set, River Purus, Amazon, Brasil, 2022; by Rui Ribeiro

Contents

Summary (English)

Knowledge for People, the Planet and Prosperity through Partnerships (K4P Alliances)

Eradicating poverty, reducing inequalities and achieving sustainable development in the Global South should mobilize our common interests, in a way fostering an **inclusive and green transition in the emerging digital age**. It requires a ***cultural movement*** throughout all areas of knowledge to promote the use of data derived from Earth Observation systems in combination with other advanced data acquisition and processing systems, to enable **innovative policies and practices** driven by **new research** dealing with complex landscapes, including those in vulnerable urban areas and rural landscapes.

K4P Alliances is a joint venture aiming to stimulate **institutional collaboration and initiatives** aimed at achieving the goal of carbon neutrality, or "**net zero**", by 2050, through long-term sustainable **pilot projects in Latin America and Africa** that foster research and innovation activities with the **active participation of local communities.**

The pilot projects and their sustainability will be implemented through forms of collaborative institutional frameworks promoting **"data ecologies" oriented towards sustainable urban growth, as well as blue and green growth**. They may take the form of "**Collaborative Laboratories**" engaging people and experts throughout **all areas of knowledge** and involving **interface and intermediation activities** with the public and private sectors, as well as civil society organizations and local actors.

The ultimate goal is to promote ***Sustainable and Healthy Territories*** giving priority to "**Human Agency**", through research and innovative social practices, together with job creation and initiatives stimulating the ecological transition of the economy and society.
K4P Alliances has been designed and launched with 4 main lines of action, as follows:

- **Line of Action 1 – Collaborative Innovation:** promoting institutional innovation and community-based participatory research and innovation, through an international network of collaborative projects and collaborative laboratories, as centers of excellence to foster new and healthy jobs.

  Potential sample topics include:

  - **innovation in sustainable and healthy territories, using social cartographies**

- as participatory method for collective research;
- **open access libraries of natural products and components**, together with ways of economically valuing these products and components;
- **digital modelling for low carbon economies**, including the systematization of the digital representation of urban and agroforestry areas in the form of "Digital Twins", together with modelling scenarios oriented towards sustainable development;
- **low carbon bio economies and innovation in land usage**, facilitating better sustainable exploitation of biological assets in agroforestry structures in Tropical Biomes and in the Tropical rainforest in Africa;
- **innovation in coastal bio economies and blue carbon**, including tropical mangroves and green aquaculture, along with innovation in land use and wetland/mangrove carbon mapping;
- innovation in **sustainable and renewable energies** and other breakthrough technologies, including those fostering **sustainable urban landscapes**; and
- **innovation in "green finance"**, promoting sustainable financing of "net-zero" economies.

- **Line of Action 2 – Transdisciplinary data observatories:** building data ecologies with advanced observation methods.

  Potential sample topics include:
  - **land use, soil and carbon observatory**, which aims to provide a new satellite-based and data-driven land-use monitoring system and carbon mapping designed to dynamically map **forest/agroforestry** structures and **coastal areas** (i.e., tropical mangroves, saltmarshes). The goal is to consider soil monitoring, water management and vegetation fuel loads with high temporal and spatial resolution, as well as **carbon stock and sequestration levels.**
  - **community-centered innovation observatory for sustainable and healthy territories**, which aims to provide a systematic identification, description and analysis of emerging innovation paths engaging communities and people at large in eradicating poverty, reducing inequalities, and achieving sustainable development.
- **Line of Action 3 – Capacity building:** fostering new knowledge creation and skills development.

  Potential sample topics include:
  - **Educational programmes**, including visiting scholarships program, joint master degree programs, joint and/or double PhD programmes, joint and/or double post-graduation diplomas (short, non-degree diplomas);
  - **Training for capacity building and skills development**;

- **Competitive collaborative research initiatives**, including initiatives aiming to strengthen community engagement and the development of science and innovation culture;
- **Policy and data briefs**, including on portfolio development for sustainable, inclusive and collaborative educational development to foster sustainable and healthy territories through innovation and data management.

- **Line of Action 4 – Regional Chapters:** Implementation, assessment, and reporting.
  The program will be co-designed, organized and implemented in terms of "Regional Chapters", following a stepwise approach and making use of the experience of partner institutions in various regions:
  - **Latin America and Caribbean Chapter**;
  - **Sub-Saharan Africa Chapter**;
  - **Ocean Chapter**;
  - Other chapters to be considered, may include: i) **Indo-Pacific**; ii) **Europe**; and iii) **California chapter**, particularly for international comparison.

Sun set, River Purus, Amazon, Brasil, 2022; by Rui Ribeiro

Sumário (em Português)

Conhecimento para as Pessoas, o Planeta e a Prosperidade através de Parcerias (Alianças K4P)

Erradicar a pobreza, reduzir as desigualdades e alcançar o desenvolvimento sustentável no Sul Global deve mobilizar os nossos interesses comuns, de forma a promover uma transição inclusiva e verde na era digital que emerge. Requer um ***movimento cultural transdisciplinar***, envolvendo todas as áreas do conhecimento, que promova o uso de dados derivados de sistemas de sensoriamento remoto e de observação da Terra em combinação com outros sistemas avançados de aquisição e processamento de dados. Pretende-se estimular ***políticas e práticas inovadoras*** tendo por base novos conhecimentos para lidar com ambientes complexos, incluindo aqueles em zonas urbanas e/ou rurais de elevada vulnerabilidade social, económica e ambiental.

O Programa K4P Alliances pretende estimular a **colaboração institucional e iniciativas** orientadas para atingir a meta da **neutralidade carbónica**, ou "zero líquido", até 2050, através de **projetos-piloto sustentáveis no longo prazo** em associação com formas de cooperação com a América Latina e África que estimulem atividades de pesquisa e inovação com a participação ativa de comunidades locais.

Os projetos-piloto e a sua sustentabilidade serão implementados através de **arranjos colaborativos que funcionem como *centros de excelência*** de base transdisciplinar e que promovem "ecologias de dados" e a integração de formas avançadas de sistemas de Observação da Terra, sensorização remota e dados in situ para compreender o presente e construir o futuro. Devem assumir, assim, a forma de "**Laboratórios Colaborativos**" envolvendo pessoas e peritos em todas as áreas do conhecimento, juntamente com atividades de interface e intermediação com os setores público e privado, assim como organizações da sociedade civil.

Esta iniciativa lançará uma série de ações concretas e explorará novos resultados ao longo do tempo e com base num processo gradual, baseado num pensamento integrado e transdisciplinar, incluindo: i) a construção e desenvolvimento de novas ecologias de dados com **métodos avançados de observação**, incluindo dados de satélite e serviços em órbita, juntamente com sistemas avançados de coleta e processamento de dados in-situ, juntamente com interfaces de usuário adequadas; ii) a promoção de **inovações institucionais** relevantes de forma a contemplar quadros institucionais distribuídos,

plurais e colaborativos; e iii) o estímulo ao desenvolvimento de **novos conhecimentos e a capacitação de recursos humanos**. O programa será organizado e implementado em termos de "**Capítulos Regionais**", seguindo uma abordagem gradual, como listado seguidamente.

O objetivo último é promover ***Territórios Sustentáveis e Saudáveis*** através da pesquisa e práticas sociais inovadoras, juntamente com a criação de novos empregos e iniciativas que estimulem a transição ecológica da economia e da sociedade, dando total prioridade à "Agência Humana".

- **Linha de acção 1 – Inovação Colaborativa:** Promover a inovação institucional e a pesquisa e inovação participativa de base comunitária para fomentar novos empregos.
  Inclui promover uma **rede internacional de projectos e laboratórios colaborativos** na forma de centros de excelência de base transdisciplinar em estreita colaboração com atores locais e mecanismos de cocriação, bem como atividades de interface, intermediação e divulgação, visando a criação de empregos e mercados, juntamente com a capacitação a nível institucional e humano.
  Os vários temas e laboratórios a promover devem abranger os seguintes tópicos:
  - **inovação** em **territórios sustentáveis e saudáveis**, usando **cartografias sociais participativas**;
  - **bibliotecas de acesso aberto de produtos e componentes naturais**, juntamente com formas de valorização económica desses produtos e componentes;
  - **modelação digital para economias de baixo carbono**, incluindo a sistematização da representação digital de áreas urbanas e agroflorestais na forma de "Gêmeos Digitais", juntamente com a modelação de cenários orientados para o desenvolvimento sustentável;
  - **bioeconomias de baixo carbono e inovação no uso da terra**, facilitando uma melhor exploração sustentável dos ativos biológicos em estruturas agroflorestais em Biomas Tropicais e na Floresta Tropical da África;
  - **inovação em bioeconomias costeiras e carbono azul**, incluindo manguezais tropicais e aquicultura verde, juntamente com inovação no uso da terra e mapeamento de carbono de áreas húmidas/manguezais;
    inovação em **energias sustentáveis e renováveis** e outras sistemas disruptivos, inclui do para a promoção da sustentabilidade urbana; e
  - inovação em "**financiamento verde**", promovendo o financiamento sustentável de economias "net-zero".
- **Linha de acção 2 – Observatórios transdiciplinares de dados:** desenvolvimento de Ecologias de Dados com métodos avançados de Observação (Terra/Pessoas):
  - **Observatório do Uso da Terra e dos dos Solos, da Biodiversidade e do**

Carbono, com o objetivo de mapear o monitoramento do solo, a gestão da água e as cargas de combustível da vegetação com alta resolução temporal e espacial, bem como os "stocks" e a capacidade de sequestro de carbono.

- **Observatório de Inovação Centrada em Comunidades e dinâmicas de territórios** sustentáveis e saudáveis, com o objetivo de mapear dinâmicas de inovação emergentes envolvendo comunidades e as pessoas em geral na erradicação da pobreza, redução das desigualdades e na promoção do desenvolvimento sustentável. Inclui ainda o desenvolvimento e a disseminação de pesquisa e práticas comunitárias inovadoras, baseadas em cartografia social e estudos intersetoriais.

- **Linha de acção 3 – Capacitação de Recursos Humanos:** promover novos conhecimentos e a formação de competências
  - **desenvolvimento de programas educacionais**, incluindo: programa de bolsas de estudo, programas conjuntos de mestrado, programas conjuntos e/ou duplos de doutorado, diplomas conjuntos e/ou duplos de pós-graduação (diplomas curtos, sem graduação) ;
  - **formação para capacitação e desenvolvimento de competências**;
  - **programas competitivas de I&D e pesquisa colaborativa**, com o objetivo de fortalecer o envolvimento da comunidade e o desenvolvimento da ciência e da cultura de inovação;
  - **Breves publicações sobre políticas e dados** sobre o desenvolvimento educacional sustentável, inclusivo e colaborativo para promover territórios sustentáveis e saudáveis por meio de inovação e gestão de dados.

- **Linha de acção 4 – Capítulos Regionais**: Implementação, avaliação e reporte.

  O programa será co-concebido, organizado e implementado em termos de "Capítulos Regionais", seguindo uma abordagem gradual em várias regiões:

  a) **América Latina e Caraíbas**

  b) **África Subsaariana**

  d) **Oceano**

  e) Outros capítulos podem vir a incluir ***Indo pacífico; regiões europeias*** e a ***Califórnia***.

ACRE (Amazônia) Ecosystem Restoration by Rui Ribeiro

FREQUENTLY ASKED QUESTIONS (FAQs) - Communication Profile

- **What is this initiative?**
  An international joint venture to strengthen cooperation with the ***Global South***, with emphasis in **Africa and Latin America**, through **collaborative projects** fostering Human Agency and the governance of data ecologies towards **greening our economies, promoting healthier societies and reduce inequalities in the digital age.**

  It is an international alliance to promote ***Sustainable and Healthy Territories*** through research and innovative social practices, together with the **creation of new jobs** and initiatives that stimulate the **ecological transition of the economy and society** and the understanding of its dynamics in the "Anthropocene":
  - It considers a ***cultural movement*** throughout all areas of knowledge to promote the use of data derived from Earth Observation systems in combination with other advanced data acquisition and processing systems, to enable **innovative policies and practices** driven by **new research** to deal with complex landscapes, including those in vulnerable urban areas and rural landscapes;
  - It includes a ***collaborative innovation network*** based on ***transdisciplinary data centers*** and related scientific, technological and innovation activities in association with advanced remote sensing systems oriented to sustainable urban growth, as well as blue and green growth. The data centers are expected to operate in **fully compliance with cybersecurity standards**, aiming to become potential regional hubs of cybersecurity.

- **What is its main objective?**
  The goal is to help accomplish the target of greening our economies and promoting ***Sustainable and Healthy Territories***, together with achieving carbon neutrality, or "net zero", by 2050, through a network of data centers and pilot projects in Latin America and Africa and, eventually, in the Indo-Pacific, stimulating a cultural movement and providing capacity building and fostering new jobs through **community-based participatory research and innovation.**

- **What are the three secondary objectives?**
  The pilot projects will be implemented through an international network of centers of excellence promoting:
  i) **a network of collaborative projects and collaborative laboratories** involving local actors, in the form of centers of excellence involving the public and private sectors, as well as NGOs to f**oster interface and intermediation activities** with the public and private sectors;
  ii) ***transdisciplinary data centers to foster new data ecologies*** through the combination and integration of advanced forms of satellite-based remote sensing and Earth Observation systems in close articulation with other data collection systems and skills; and
  iii) **collaborative initiatives of people and experts throughout all areas of knowledge** to help stimulating a cultural movement promoting Human Agency and the governance of data ecologies towards greening our economies.

- **What should this project become in the short term (1 to 2 years)?**
  The initial seeds of an international network of **collaborative projects and collaborative laboratories in Africa and Brazil**, as centers of excellence including ***transdisciplinary data centers*** equipped with Earth Observation capacity and skills for practical actions towards sustainable urban growth, blue growth and green growth.

  Potential sample projects include: i) **innovation in sustainable and healthy territories**, integrating **participatory social cartographies**; ii) ***open access libraries*** of natural products and components, together with ways of economically valuing these products and components; iii) **digital modelling for low carbon economies**, including the systematization of the digital representation of urban and agroforestry areas in the form of "Digital Twins", together with modelling scenarios oriented towards sustainable development; iv) **low carbon bio economies and innovation in land usage**, facilitating better sustainable exploitation of biological assets in agroforestry structures in Tropical Biomes and in the Tropical rainforest in Africa; v) **innovation in coastal bio economies and blue carbon**, including tropical mangroves and green aquaculture, along with innovation in land use and wetland/mangrove carbon mapping; and vi) Innovation in **sustainable and renewable energies** and other breakthrough technologies, including those fostering **sustainable urban landscapes**;

- **And in the midterm, after 5 years?**
  An international alliance **with 4 lines of action, as follows**:
  1. **An international network of collaborative projects and collaborative laboratories,** through the engagement of local actors, public and private and ONGs, in the constitution of new Collaborative Laboratories, in collaboration with the laboratories of the Atlantic International Research Centre – AIR Centre.
  2. **Two major international and transdisciplinary data observatories:**
     a. Land use, Soil and Carbon Observatory, to provide a new satellite-based and data-driven land-use monitoring system and carbon mapping designed to dynamically map urban zones, forest/agro-forestry structures and coastal areas;
     b. Community-centered Innovation Observatory, to provide a systematic identification, description and analysis of emerging innovation paths engaging communities and people at large in greening the economy and society.
  3. **A program to foster capacity building and new skills development together with new knowledge**, including: i) Visiting Scholarships Program; ii) Research Students Program; iii) Joint and double post-graduation diplomas (short, non-degree diplomas) and potential joint Degree programs (Master level); iv) Competitive Program for Collaborative Research; v) Policy briefs; vi) Workshops, conferences, outreach and community engagement.
  4. **An organizational structure of "Regional Chapters"**, including Latin America and Caribe; Sub-Sharan Africa; international comparative studies in Europe and USA.

- **And by 2030?**
  An international network of **collaborative projects and collaborative laboratories** and **two major international and transdisciplinary data observatories**, together with **a program to foster new knowledge and capacity building**, organized in **regional Chapters.**

- **What words are associated with this initiative?**
  - **People:** promoting the basic human right of access to public security and healthy working conditions for all, with experimentation, observations and recommendations of public policies on ***planetary health*** and ***sustainable and healthy territories***, as well as on health and disease determinants that affect the most vulnerable populations;
  - **Planet:** guaranteeing the **minimization of emissions** through reduced use of fossil fuels, and the capture and conversion of CO2 in complex rural and coastal landscapes in association with **land use change and management, soil monitoring,**

water management and carbon observation, together with the stepwise experimentation and development of ***smart regulatory regimes*** towards the effective implementation of carbon markets;

- **Prosperity:** sustainable **land, water and soil management** (e.g. biomes, mangroves and biodiversity in tropical areas), together with the social and economic valorization of **biological assets** (e.g. natural products) and the development of regional **bioeconomies**;
- **Partnerships: Engaging people and experts throughout all areas of knowledge** to help stimulating a ***cultural movement*** promoting Human Agency and the governance of data ecologies towards greening our economies through an international network of "Collaborative Laboratories". These centers aim to operate as effective centers of excellence in close collaboration with local actors, involving interface and intermediation activities with the public and private sectors, aimed at creating jobs and markets, together with capacity building at institutional and human levels.

- **What are the target audiences, in order of priority?**
  - ONGs and Non-for profit associations with local action in terms of the Sustainable Development Goals (SDGs) and the 2030 Agenda;
  - Public and private sectors;
  - Researchers, practitioners, end users and students worldwide;

- **What kind of behaviour do you hope to promote in each audience?**
  - ONGs and Non-for profit associations: engagement and active participation, namely to help building a network of Collaborative Laboratories;
  - Public and private sectors: institutional support, co-funding and active participation;
  - Researchers, practitioners, end users and students: engagement and active participation for pilot project development and implementation.

- **What values do you associate with this initiative?**
  Sustainable Development Goals (SDGs) that shaped the 4 main pillars of the 2030 agenda, with emphasis in the principle "**leaving no one behind**", that is the bulk of development for providing a shared global vision towards sustainable development for all.

- **Are there any other projects/programs that it resembles?**
  - **CEGA – Centre for Effective Global Action,** https://cega.berkeley.edu/ ;
  - **CLUA – Climate and Land Use Alliance**, https://www.climateandlandusealliance.org/, focused on Tropical Forests (Brazil, Indonesia, Mexico and Central America, Colombia and Peru) and sponsored by a group of four major US private foundations, including the Climateworks Foundation, The David and Lucile Packard Foundation, the Ford Foundation and the Gordon And Betty Moore Foundation.
  - **AGRA – Sustainable Growing Africa´s Food systems** (previously, "Alliance for the Green Revolution in Africa"), sponsored by the USAID and the Belinda and Gates foundation, https://agra.org/;
  - **Afrialliance – Africa-EU Innovation Alliance for Water and Climate**; https://afrialliance.org/about-afrialliance, sponsored by the European Union's Horizon 2020 research and innovation programme;
  - **Global Alliance Africa**, https://ktn-uk.org/programme/africa/, sponsored by the UK´s Foreign, Commonwealth and Development Office (FCDO);
  - **Africa Digital Earth**, https://www.digitalearthafrica.org/;
  - **Carbon Mapper**, https://carbonmapper.org/.

- **Which recent research is associated with this initiative?**
  - ***Human Climate Horizons, 2022***, https://horizons.hdr.undp.org/, a data platform launched in November 2022 providing localized information on future impacts of climate change across several dimensions of human development and human security. It is fed by an evolving stream of multidisciplinary frontier research.
  - ***Steering Research and Innovation for Global Goals (STRINGS, 2022)*** project, http://strings.org.uk/: a major global study into the alignment between science, technology and innovation (STI) and the Sustainable Development Goals (SDGs). It highlights a glaring mismatch between STI and the SDGs; warns that, if this mismatch is not addressed, it will undermine progress on the SDGs; and makes recommendations about how to tackle this imbalance; October 2022;
  - ***Do the science on sustainability now*** (Nature, Vol. 610, 27 October 2022, pp 605-606): https://www.nature.com/articles/d41586-022-03389-x , shows that since 2015 the rate at which research from high-income countries on, or about, the SDGs is being published has mostly either plateaued or is falling. Two-thirds of research published in the poorest countries has some connection to the SDGs. That compares with around 35% in high-income countries, although these shares are rising slowly.

- ***An Industrial Policy for Good Jobs*** (September 2022), The Hamilton Project, at the Harvard´s Kennedy School of Government and the Brookings Institute: a modern approach to industrial Policy to target "good-jobs externalities", https://www.brookings.edu/wp-content/uploads/2022/09/20220928_THP_Proposal_Rodrik_GoodJobs.pdf;
- ***Uncertain Times, Unsettled Lives: Shaping our Future in a Transforming World***; UNDP (September 2022), "The Human Development Report 2021-22", UNDP, New York; https://hdr.undp.org/content/human-development-report-2021-22: it shows that a new "uncertainty complex" is emerging, never before seen in human history. Constitut¬ing it are three volatile and interacting strands: the desta¬bilizing planetary pressures and inequalities of the Anthro¬pocene, the pursuit of sweeping societal transformations to ease those pressures and the widespread and intensi¬fying polarization;
- ***Stewardship of global collective behavior*** (June, 2021), by Joseph B. Bak-Coleman, Mark Alfano, Wofram Barfuss, Carl T. Bergstrom, MIgue Centeno, Iain D. Couzin, Jonathan F. Donges, Mirta GAlesic, Andew S Gersick, Jennifer Jacquet, Albert B Kao, Rachel E. Moran, Pawel ROmamnczuk, Daniel I. Rubenstaein, Kaia J Tombak, Jay J Van BAvel and Elke U weber, PNAS, June 21, 2021: argues that it is necessary to guarantee a transdisciplinary approach to collective behaviours in a way that citizens, at large, improved user responsibility in an emerging digital age;
- ***In AI we Trust: power, Illusion and Control of predictive algorithms*** (2021), Polity Books: Helga Nowotny argues that the massified use of AI-enabled innovations is not free of additional questions because the power it has to make us act in the ways it predicts, reduces our agency over the future.

Feminist Climate Action in West Africa; TINIGUENA, Guinea Bissau

Participative Innovation with local communities, TINIGUENA, Guinea Bissau

1. Introduction

The evolving context

Recent unexpected threats to our common safety and public goods, including public health, such as the Covid-19 pandemic, the increasing activity of individual digital terrorism or the Russian invasion of Ukraine, have shown that our societies are not as safe as we thought. In association with the **climate disaster** we all are facing, the tensions resulting from increasing water scarcity affecting the most vulnerable communities of the world, **demographic forecasts** and emerging **nationalistic movements**, such as BREXIT among many other, **we are facing unprecedent threats that should foster a clear call for action**. Any deep reflection on these issues must lead us to safer, cleaner and more resilient **and cooperative societies**, making use of novel forms of digital governance that must necessarily consider **human agency**[1], be **centered on people** and **based on changing collective behaviours**[2].

Under this context, eradicating poverty, reducing inequalities and achieving sustainable development in the Global South should mobilize our common interests in a way fostering an inclusive and green transition in the emerging digital age.

The goal of K4P Alliances is to promote ***Sustainable and Healthy Territories*** through collaborative research and innovative social practices fostering Human Agency and the governance of data ecologies towards greening our economies, promoting healthier societies and reducing inequalities in the digital age. This will be achieve through the implementation of pilot projects oriented towards the target of carbon neutrality, or "net zero", by 2050, providing capacity building and fostering new jobs through community-based participatory research and innovation.

The pilot projects will be implemented through an ***international network of centers of excellence*** promoting "***data ecologies***" through the integration of advanced forms of remote sensing and ***Earth Observation*** systems in close articulation with other data collection systems and local actors. They will consider engaging people and experts through **all areas of knowledge**, together with forms of institutional innovation, namely

1 UNDP (2019), "The Human Development Report", UNDP, New York
2 Joseph B. Bak-Coleman, Mark Alfano, Wofram Barfuss, Carl T. Bergstrom, MIgue Centeno, Iain D. Couzin, Jonathan F. Donges, Mirta GAlesic, Andew S Gersick, Jennifer Jacquet, Albert B Kao, Rachel E. Moran, Pawel ROmamnczuk, Daniel I. Rubenstaein, Kaia J Tombak, Jay J Van BAvel and Elke U weber (2021), "Stewardship of global collective behavior", PNAS, June 21, 2021.

through independent and autonomous **collaborative laboratories** involving **interface and intermediation activities with the public and private sectors**. The focus is on the multi-dimensional and interlinked SDGs that shaped the 4 main pillars of the 2030 agenda:

- **People:** promoting the basic human right of access to public security and healthy working conditions for all, with experimentation, observations and recommendations of public policies on ***planetary health*** and ***sustainable and healthy territories***, as well as on health and disease determinants that affect the most vulnerable populations;
- **Planet:** guaranteeing the **minimization of emissions** through reduced use of fossil fuels, and the capture and conversion of CO2 in complex rural and coastal landscapes in association with **land use change and management, soil** monitoring, water management and carbon observation, together with the stepwise experimentation and development of smart regulatory regimes towards the effective implementation of carbon markets;
- **Prosperity:** sustainable **land, water and soil management** (e.g., biomes, mangroves and biodiversity in tropical areas), together with the social and economic valorization of **biological assets** (e.g. natural products) and the development of regional **bioeconomies**;
- **Partnerships: Engaging people and experts throughout all areas of knowledge** to help stimulating a ***cultural movement*** promoting Human Agency and the governance of data ecologies towards greening our economies through collaborative innovation and an international network of "Collaborative Laboratories". The goal is to consider adequate social norms at local level and encourage people and local actors to generate new ideas and insights, involving interface and intermediation activities with the public and private sectors, together with capacity building at institutional and human levels create new jobs and markets.

The rationale of the program relies on the fact that the **climate crisis** is probably the biggest challenge humanity is facing. Its effects in the field of health led the World Health Organization, WHO, to declare that "the climate crisis threatens to annihilate the progress of the last 50 years in global health and poverty reduction and to further widen the inequalities in health that exist between and within different populations" and to recognize that "climate change is the greatest global threat to human health and the Paris Agreement is potentially the most impactful health agreement of the 21st century" (WHO, 2021). In turn, there is no sustainable development without guaranteeing

the rights of all people, which requires taking into account the connection between the "ecological footprint" indicators and those associated with the "social footprint" (i.e., poverty, inequality, violation of basic rights).

This program's main focus is to foster new initiatives that accelerate the achievement of carbon neutrality. We live with carbon, we need and produce carbon in most of our daily activities and achieving the ideal situation of "net zero" means **change**, together with the development of green/blue economies and healthier societies. It means changing our daily routines and work habits, as well as our cities, transport, agriculture, and industry in a way achieving a balance between the carbon emitted into the atmosphere, and the carbon removed from it. This balance – or net zero – will happen when the amount of carbon we add to the atmosphere is no more than the amount removed.

To reach net zero, together with greening our economies and promoting healthier societies, emissions from homes and cities, transport, agriculture, and industry will need to be significantly reduced in the coming decades, together with the suppression of forest fires and other non-economic highly pollutant situations. During this change process over the coming decades, the 'residual' emissions will need to be removed from the atmosphere: either by **changing how we use our land so it can absorb more carbon dioxide**, or by being **extracted** directly through technologies known as **carbon capture, usage, and storage - CCUS**.

For this change to happen, we need to understand better "**Human Agency**" and our emerging collective behaviours, particularly in the Global South, in a way to guarantee the sustainability of the populations, simultaneously with their right to become developed. And this requires the governance of complex and massive amounts of data and their synergies(i.e., "**data ecologies**"), including new satellite-based data, together with the necessary knowledge and innovation to improve land use management through carbon mapping. Large amounts of data that require new technological tools such as cloud computing, data analysis, artificial intelligence, and machine learning for handling, processing, understanding and exploitation, together with new in situ information systems and the knowledge and innovation needed to improve land use management and the development of sustainable and healthy territories.

Motivation: *the Global South*

To complement the increasingly relevant role of international development funds and intergovernmental organizations[3], there is a need to **leverage international networks acting in the Global South** and foster cross-interactions of people at large with scientists, governments, industry and policy actors.

K4P Alliances focuses on ***complex urban environments and landscapes*** in Africa and Latin America, which are particularly critical for the required green transition and our global well-being[4]. It will include urban systems[5], value chains associated with food production, processing and circulation and the resources required to all the steps, farming, forests and the ocean, taking into account emerging forms of knowledge production and diffusion in a decentralized and AI-supported digital age.

In particular, promoting new fundamental research fostering our global safety and the prevention of natural disasters and other uncertainties associated with climate change have garnered a growing interest over the last few years[6]. This includes the absolute need to ***accelerate the transition to carbon neutrality*** and to better use advanced **Earth observation systems** if adequately integrated with in situ sensors and modelling.

To save lives, predict natural disasters, prevent fires, control erosion of coastal areas, as well as providing quality food and services for all, can only be secured effectively through a new generation of user-driven, low-cost, space-based observation and human-based participatory systems, which require adequate resources that can only be obtained if **citizens become an integral part of future developments**. In addition, dealing with climate change dramatic biodiversity loss (i.e., species extintion induced by human action), health and economic crisis, uncertainty and risks, together with ensuring security and safe conditions for our populations can only be addressed if **new digital initiatives move forward in full alignment with a required green transition.**

3 see, for example the recent case of the European Space Agency, https://vision.esa.int/the-matosinhos-manifesto-accelerating-the-use-of-space-in-europe/
4 See, for example, Zhao, J, Gladson, L. and Cromar, K. (2018),"A Novel Environmental Justice Indicator for Managing Local Air Pollution", Int. J. Environ. Res. Public Health 2018, 15(6), 1260.
5 Bettencourt, L. (2021); "Introduction to Urban Science", MIT Press
6 Gates, W. (2021), "How to avoid a climate disaster: the solutions we have and the breakthroughs we need", Alfred A. Knopf. New York: Penguim Books

Overall, evolving forms of technology governance and the introduction of digital standards should be oriented to guarantee improved ***collective user responsibility*** in an emerging decentralized digital age boosted by AI-enabled innovations. Promoting "Human Agency" and empowering people and users at large will promote the need to educate and train every single user and this can only be achieved by boosting research and innovation, growth and competitiveness. It should include smaller companies and start-ups, stimulating forms of free and open competition with very large players. In addition, technology governance should facilitate access and use of data by consumers, while providing incentives for them to invest in ways to generate value through data, as well as to safeguard situations of illegal transfer of data and to fight against mendacity (e.g., Jay, 2010).

It should be emphasized that **Earth observation systems** are important for society and economy for several reasons:

1. First, remote sensing and data derived from Earth Observation systems in combination with other advanced data acquisition and processing systems facilitate the development of social cartography, enabling innovative policies and practices to deal with complex and vulnerable urban areas;
2. Second, satellite data adequality integrated in advanced information systems can be used to monitor and protect coastal areas, maritime traffic and the biodiversity of the ocean, as well as to create the "digital twin" of the ocean to model and promote new activities under the scope of the blue economy. For example, satellite data can be used to track the movements of fish stocks, identify areas of illegal fishing, and monitor the health of coral reefs. This information can be used to improve the management of fisheries and to support the sustainable development of the blue economy.
3. Third, satellite data adequality integrated in advanced information systems can also help us better understand and manage our natural resources if adequality integrated with in-situ data and advanced information systems. For example, satellite data can be used to build "digital twins" of agro-forestry structures and mountains, which will allow to monitor natural products and to foster sustainable agricultural production and help farmers optimize their use of water and fertilizer.This can lead to increased crop yields and improved food security.
4. Last, but not least, satellite data can be used to monitor and mitigate the effects of climate change through the effective use of "digital twins" of the ocean and other specific landscapes. For example, satellite data can be used to track the expansion of deserts and the effects of drought and floods. This information can be used to support the development of adaptation and mitigation strategies.

Rio Purus Acre by Rui Ribeiro

Science and innovation for development: a cultural movement to be driven by transdisciplinary collaboratories

Some fifty five years after John Ziman launched the discussion on Public Knowledge[7] and forty five years after his work on *Reliable Knowledge*[8], to appreciate the significance of scientific knowledge one must understand the nature of **science as a complex whole**. In *Real Science*[9], we are reminded that "science is social", referring to "**the whole network of social and epistemic practices where scientific beliefs actually emerge and are sustained**".

Overall, because science- and technology-based innovation is a socio-cultural process, ***science and innovation for development*** is best served when we understand the importance of tradition (including ancestral knowledge), as well as of **critical links across communities** in the creation of new innovative practices. Therefore, there is much to believe from the study of past experiences about the role of economic and social conditions in contributing to the success of technical innovations and diffusion of new technologies in developing societies. Many new technologies result from the reuse of old innovations in new contexts. Thus, we shall stress the importance of ***historical and cultural backgrounds***, as a source of guidance and inspiration for innovation.

Joseph Henrich (2016)[10], among others, have clarified that the "secret of our species´ success resides not in the power of our individual minds, but in the collective brains of our communities. Our collective brains arise from the synthesis of our cultural and social natures – form the fact that we readly learn from others (are cultural) and can, with the right norms, live in large and widely interconnected groups (are social)". He shows that larger and more interconnect societies produce more "know-how" and that "the challenge has always been how to pevent communities from fragmenting and social networks from dissolving". It is under this context that K4P Alliances aim to foster a ***cultural movement*** based on ***collaborative innovation*** and a **trans-disciplinary approach** that joins people at large and citizens at local levels with scientists and engineers, as well as with artists, historians, social scientists and other academics; researchers with entrepreneurs and professionals, and students with experienced academicians in a range of research and teaching initiatives on the interface

7 J. Ziman (1968), Public Knowledge: The Social Dimension of Science, Cambridge University Press
8 J. Ziman (1978), Reliable Knowledge: an exploration of the grounds for belief in science, Cambridge University Press
9 J. Ziman (2000), Real Science: What it is, and what it means, Cambridge University Press
10 J. Henrich (2016), "The secret of our success: how culture is driving human evolution, domesticating our species, and making us smart-er", Princeton University Press.

between theoretical analysis and hands-on practices.

Understanding **humans as "cultural species"** and their collective development as a "**cultural process**" require understanding the ***social norms*** under which different societies evolve. It requires, above all, understanding that science and innovation for development depend on the ability to encourage people and institutions to produce and difuse ideas, insights and practices in every sinngle region (Joseph Henrich, 2016).

In addition, it should be recognized that the potential new opportunities for science and innovation for development in the increasing ***digital era*** are associated with the ability to create **scalable environments for learning** that engages the tacit and the explicit dimensions of knowledge. The term that Brown and Douglas (2010)[11] have used for this, borrowed from Michael Polanyi[12] is "indwelling". Understanding this notion requires to connect experience, embodiment, and learning:

- First, the world is increasingly characterized by a sense of constant change, which demands rethinking the notions of interaction with new knowledge towards a deeper understanding of participation ("**knowing**");
- Second, the notion of experience (and participation) within new media contexts has shifted from a traditional sense of experiencing content to using content as context to construct a social world with others ("**making**");
- Third, understanding the means by which networked media supports a kind of play that allows people to navigate the complexities of a constantly shifting world ("**playing**").

What may be most important to understand is that each of these dimensions of learning is in the process of evolving in response to societal demands[13]. In our societies, knowing, making, and playing emerge as critical components of "becoming".

In relation to this, the development of local capacities to foster learning (including by students) requires training of a robust and flexible teaching body that can be easily adapted to satisfy changing contextual and learning requirements while making use of new tech-nological opportunities[14].

The implications for many regions and developing countries is the need to give constant

11 Brown, J. S. and Douglas, T. (2010), A New Culture of Learning: Cultivating the Imagination for a World of Constant Change, CreateSpace 2011.
12 Polanyi, M. (1958), "Personal Knowledge. Towards a post-critical philosophy", Routledge & K. Paul. See also, M. Polanyi (1939), The rights and duties of Science, Contempt of Freedom; M. Polanyi (1962), The Republic of Science, Minerva; M. Polanyi (1966), The Tacit Dimension, Doubleday.
13 Thomas, D. and Brown, J.S. (2011), A New Culture of Learning – cultivating imagination for a world of constant change, Authors edition
14 Bellanca, J. and Brandt, R. (2010), 21st century skills – rethinking how students learn, Solution Tree Press, Bloomington.

priority to people and knowledge in a way that provides networks of institutions with the necessary critical mass to foster adequate learning paths. A particular attention is to be given to **Sub-Saharan Africa**, as the world´s youngest region, with 60% of its population under the age of 25. By 2030, the continent´s working age population is set to increase by two thirds, from about 370 million adults in 2010 to over 600 million in 2030[15].

In addition, that priority needs to be driven by ***endogenous sources***. In other words, it requires understanding local mechanisms and policies that may drive endogenous growth of knowledge networks and related sources of social, cultural and economic support. Following Joseph Ki-Zerbo[16], a well-known African historian, it requires the adequate lightning of the historical path of each region, as well as the full responsibilities of local actors. In the specific case of Africa, it certainly requires a major task force to set knowledge networks that will consider the endogenous development of local institutions and gradually reverse the long-term process of brain drain affecting the full continent for many centuries[17].

Recent literature also suggests that ***learning how to manage uncertainty*** is necessary, including forms of ***institutional corruption***. This has also become part of the main challenges facing adequate instituional frameworks promoting science and innovation for development. In this sense, "**illities**" represent a movement of "rupture", emphasizing forms of thinking and action that go beyond the immediate temporal frame, apparent functionality or success, and the constraint to fundament decisions solely on what is measurable[18].

nspired and conditioned by a myriad of global, national and local challenges that implicitly or explicitly rely on knowledge and learning for potential solutions, institutions are required to be both increasingly ***adaptable and resilient*** (two important illities). Thus, institutions at large have to consider accommodating new configurations of knowledge production by establishing alliances with an increasingly large range of **"knowledgeable" institutions**[19]. Moreover, they require to secure a sufficiently stable environment to train and supply talented people, including researchers, for that growing range of "knowledgeable" institutions. This leads to the need, more relevant than ever, for public policies promoting effective institutional ***autonomy and integrity*** (i.e., two other important illities) of modern institutional frameworks. This is particularly relevant as institutional partnerships gain significant prominence.

15 See, for example, WEF (2017), "The future of jobs and skills in Africa – preparing the region for the fourth industrial revolution", World Economic Forum, 2017. Also, https://skillsafrica.org/ .
16 Joseph Ki-Zerbo (2003), "À quando l´Àfrique: entertien avec René Holestein", Paris, Édition de l'Aube, Collection Essai.
17 Ki-Zerbo, Joseph (1990), "Éduquer ou périr", Paris, L'Harmattan.
18 Rouse, W. and Serban, N. (2014), Understanding and Managing the Complexity of Healthcare, Cambridge: MIT Press
19 Nowotny, H., Scott, P., and Gibbons, M. (2001) Rethinking science: knowledge in an age of uncertainty, Cambridge: Polity

In order to achieve this goal, the projects to be considered under K4P Alliances will emphasize the need and scope for improving the ***learning capabilities of young adults*** in ways that foster socio-economic resilience through better integrating social and human values in technical education, in a society increasingly dependent on technology and knowledge.

Knowledge networks and their inherent complexity relate to **interactions between people and organizations,** which influence economic development and political relationship[20]. This resides increasingly in the capacity to access and use knowledge and technologies in distributed knowledge bases, which are increasingly spread through a wide network of sources[21]. It is under this context that democratizing higher education maybe used as a catalyzer of knowledge-based developments, by promoting the exposure of emerging societies to experts and other communities aimed to foster processes of inclusive development.

The issue is certainly how far we all take advantage of opportunities that arise with the increasingly dynamic and globally distributed geography of innovation, as well as how it fosters a new global order and help others to use similar advantages at local levels.

This is because one must take up the challenge of probing deeper into the relationships between knowledge and the development of our societies at a global scale.

Our inspiration comes from, among others, the seminal work of Lundvall and Johnson[22], who challenge the commonplace by introducing the simple, but powerful, idea of learning. Lundvall and Johnson speak of a "**learning economy**", not of a "knowledge economy". The fundamental difference is to do with a **dynamic perspective**. In their view, some knowledge does indeed become more important, but some also becomes less important. There is both knowledge creation and knowledge destruction. By forcing us to look at the process, rather than the mere accumulation of knowledge, they add a dimension that makes the discussion more complex and more uncertain, but also more interesting and intellectually fertile in an international context[23].

The richness of the concept of the learning economy has been demonstrated in recent decades throughout the world, by both leading scholars and policy makers. It has been addressed in the Global South. For example, MGK Menon, former Indian Minister of S&T wrote about the conditions necessary for innovation to thrive, which require specific local action through a process of "**communitization**".

20 Hidalgo, C.A. and Hausmann, R. (2009), 'The building blocks of economic complexity', Proceedings of the National Academy of Scienc-es of the United States of America, vol. 106, no. 26, pp. 10570-10575.
21 Conceição, P., Heitor, M. and Veloso, F. (2003), 'Infrastructures, Incentives and Institutions: fostering distributed knowledge bases for the Learning Society', Technology Forecasting and Social Change, vol. 70, no. 7, pp. 583-617.
22 B.-Å. Lundvall and B. Johnson (1994), "The Learning Economy", Journal of Industry Studies, 1/2: 23-42.
23 Lundvall, B.A: (2011), "The Changing Global Knowledge Landscape and the Need for a Transatlantic Vision and a New Pragmatism", Aalborg Universit

This closely follows the lessons Eric von Hippel, a well-known professor at MIT, has provided based on the American experience that ***user-centered innovation*** is a powerful and general phenomenon[24]. It is based on the fact that users of products and services - both firms and individual consumers - are increasingly able to innovate for themselves. It is clear that this is growing rapidly due to continuing advances in computing and communication technologies and is becoming both an important rival to and an important feedstock for manufacturer-centered innovation in many fields[25].

Eric von Hippel has also shown that the trend toward democratization of innovation applies to information products such as software and also to physical products, and is being driven by two related technical trends: first, the steadily improving design capabilities (i.e., innovation toolkits) that advances in computer hardware and software give to users; and second, the steadily improving ability of individual users to combine and coordinate their innovation-related efforts via new communication media such as the Internet.

In other words, beyond suitable technical infrastructure, the process of "**democratization of innovation**" at a global scale requires people with the ability to engage in knowledge-based networks without borders. It is about people and knowledge beyond national borders, and this constant interaction has gained particular importance in recent years[26]

It is clear that the emerging patterns of innovation require new perspectives for public policies, which in the US and other developed countries have in the past relied on supporting manufacturers and their intellectual property. Certainly, we need to move on from those days and consider better ways to integrate policies for the Global South, as well as to diversify them at a global scale to better consider "win-all" approaches. A potential way to achieve this is to avoid overemphasizing current rival sectors and competitive strategies, but rather to look at science, education and innovation policies towards new challenges that require a strong ***collaborative approach across disciplines and among different and diversified institutions***.

The question that does arise is how far can we help transforming R&D and human capital into productivity gains everywhere and, in particular, in the Global South?

It is not a trivial matter to understand the processes that enable investments in R&D and human capital to be transformed into productivity gains everywhere, at a global scale. Actually,

24 von Hippel, Eric (1988) The Sources of Innovation (New York: Oxford University Press).
25 Harhoff, Dietmar, Joachim Henkel and Eric von Hippel (2003) "Profiting from voluntary information spillovers: How users benefit from freely revealing their innovations," Research Policy vol 32, No.10 (December) pp.1753-1769
26 Gault, Fred & Eric von Hippel, 2009, The Prevalence of User Innovation and Free Innovation Transfers: Implications for Statistical Indica-tors and Innovation Policy, MIT Sloan School of Management Working Chapter no. 4722-09, Cambridge, MA: MIT. pp. 29

there is a widespread view among economists in many world regions that this kind of investment is too costly for the economic efficiency gains it provides.

This however is a too naïve and superficial approach. Viewed from a wider perspective, in the longer-term R&D and human capital investments do matter and are probably the most important factor in explaining economic growth. However, the naïve view has a point: the transition of human capital to growth is not automatic. Specific policies and actions are needed to make this transition happen successfully.

As mentioned above, this challenge is particularly true in what concerns small and transition economies worldwide and, above all, developing countries without knowledge-intensive critical masses.

River Meandro, Amazon, Brasil, 2022, by Rui Ribeiro

2. Rational and Focus

The overall issue: data science for development

Which structural changes must be considered in the design of public and private policies and strategies, as well as in the processes of knowledge production, diffusion and governance, so that we move effectively towards safer, cleaner and more resilient, cooperative and knowledge societies? In particular, which specific initiatives should be considered in the Global South?

This question drives the work plan associated with "K4P Alliances", which relies on the hypothesis that current challenges associated with increasing uncertainties in modern societies require **a novel understanding of "Human Agency" and the dynamics of emerging data ecologies integrated with complex network systems, adequate social norms and collective behaviours, in a way to promote the global well-being and accelerating the path towards carbon neutrality, avoiding a climate disaster.**

This is because geospatial data and advanced data analytics can enable real-time measurements of trends in complex landscapes, including those in vulnerable urban areas and rural landscapes. This includes the use of high-resolution satellite-driven images and data driven by other sources, including georeferenced mobile phones combined with advanced data processing systems, artificial intelligence and computer vision approaches integrated with "ground truth" data from several sources[27].

It is becoming well known that the virtuous combination of geospatial data, advances in AI and blockchain can lead to a better governed digital age that achieves a higher level of common good than would otherwise be possible. It is a basic fact that data science and AI have been changing our lives for the past few years and the revolution they are provoking tends to evolve exponentially. Some sixty years after the first scientific papers on AI have been published, we now see numerous knowledge-intensive business services being developed and deployed at fast pace. And this is not limited to the private sector, with the digital transformation of the public sector is also ramping up at unprecedent levels.

27 See, for example, the work at CEGA at UC Berkeley, as in https://cega.berkeley.edu/research/mosaiks-a-generalizable-and-accessible-ap-proach-to-machine-learning-with-global-satellite-imagery/ . In particular, Rolf et al (2021), "An generalized and accessible approach to ma-chine learning with global satellite imagery", NATURE COMMUNICATIONSl (2021) 12:4392 | https://doi.org/10.1038/s41467-021-24638-z | www.nature.com/naturecommunications11234567890.

Examples include data handling and analysis in public health, land register and sustainable land management for fire prevention, biodiversity management, protection of space assets, data analysis for consumer protection, or accident and disaster prevention, among many other areas of critical relevance in the public domain and public-private interactions. On the one hand, states as political authorities are designing policies and regulations to protect citizens from AI-related harms and risks, whilst on the other hand public administrations are showing a clear interest in using AI-enabled systems and technologies in order to improve their processes, services and policies.

It is under this context that the experience of many initiatives worldwide has shown that it is becoming critically relevant the need to foster research of public interest among the AI research communities in close cooperation with public administration. In addition, the social character of scientific knowledge is its greatest strength and the greatest reason we can trust it[28].

However, the massified use of AI-enabled innovations is also not free of additional questions because the "power it has to make us act in the ways it predicts, reduces our agency over the future"[29]. In predicting our behaviour, AI systems can end up changing it. Consequently, collective human wisdom needs to be strengthen in a way that **emerging regulatory issues for a decentralized digital age should help promoting critical approaches to AI**, with clear **accountability and clarity** about boundaries and purpose, as well as **responsibility**[30]. Requires rethinking of the techno-centric narrative of progress, embracing and harnessing **uncertainty**, as well as abandoning the fantasy of control over nature and the illusion of techno-centric dominance of AI-enable innovations[31].

The issue is clear in that it creates **tensions** between developers/promoters and human-led policy making, which need to be informed by negotiations of trade-offs. Above all, it requires a **transdisciplinary approach to collective behaviours**[32] and consideration of "human agency" across economics, philosophy, law, science and technology studies, history and sociology to engage with the **all** necessary ingredients of an emerging **decentralized digital age and AI-enabled innovations.**

Understanding **knowledge as our common public good** will allow **citizens to be an integral part and a key stakeholder of future developments** and will drive policy-makers to

28 Naomi Oreskes (2019); Why Trust Science?, 2019 (Princeton University Press)
29 Helga Nowotny (2021), "In AI we Trust: power, Illusion and Control of predictive algorithms", Polity Books
30 Thelisson, E., Morin, J.-H., Rochel, J. (2019), "AI Governance: digital resposability as a building block", 2 DELPHI 167
31 Karamjit S. Gill (2022), Book review, "Nowotny 2021: In AI we trust", AI& Society, January 2021
32 See, for example, the work of Bak-Coleman et al (2021), "Stewardship of global collective behavior", PNAS, June 21, 2021.

better understand how decentralized digital networks and AI can be used and further developed to make public services more effective and deliver seamless services, cutting down on digital bureaucracy and giving citizens back their most precious asset, namely their time. In addition, it will drive new policy options targeted to enhance the governance and regulation of decentralized digital networks, including in the public sector, aimed at ensuring high standards of conduct across all areas of public sector practice, promoting public sector effectiveness and delivering better service to its users.

The key idea is that decentralized digital networks together with AI have the potential to contribute significantly to the problem solving of long-standing issues in the public sector, such as large unmanageable caseloads, administrative burdens, delays in service delivery and language barriers including automated working processes, as well as improved decision-making and service quality. For this vision to become a reality, the associated risks and challenges must be better understood, so that secure and successful implementation and application of AI can be assured at large. Ultimately, the reliance of decentralized digital networks and AI developments in terms of design, production and even management must be combined with the unshakeable commitment to uphold transparency and accountability standards in the public sector, which ultimately sustain our democratic institutions.

These challenges and associated risks will be possibly mitigated in implementations using practices, methods and tools generated by a new trend in research and innovation: that of "**Responsible AI**", underscoring principles such as **fairness, transparency and explainability, human-centeredness, privacy and security.**

Favela, Brazil, 2019; by Bruno Thethe on Unsplash

Sustainable Urban growth: Sustainable and Healthy Territories for the Global South

With global population expecting to reach 10 billion in 2050 and over 11 billion in 2100, with virtually all this growth in urban areas in the Global South, the fight against the spread of poverty in association with urban expansion deserves all of our attention in terms of research and innovation efforts to be coupled with innovative practices and policies[33].

The development of pilot projects fostering ***sustainable and healthy territories*** under K4P Alliances aims to provide a systematic identification, description and analysis of emerging innovation paths of "**community-based participatory research and innovation**" to promote well-being in urban contexts in Latin America and Africa.

The initiatives to be launched and promoted under K4P alliances consider interinstitutional, transdisciplinary and collaborative innovation aimed to achieve structural change at medium and long term in **complex urban contexts, including slum areas**. The combination of emerging technologies with decisive participation of local communities will be applied in real living conditions, being monitored, and evaluated with the purpose of generating positive impact on the most vulnerable population and on the design and implementation of public policies.

Emphasis will be given to **leverage existing initiatives, including those of non-governmental organizations, to guarantee the basic right of "access to public security for all"**. This includes: i) access to public health; ii) access to quality water and adequate sanitation conditions; iii) access to education; and iv) access to quality jobs; beyond v) access to a secure daily life[34].

It should be noted that in most of the slums and other vulnerable urban landscapes in Latin America or in Africa there is **no participation of the population in local processes of institutional corruption**, including those associated with the occupation of the territories by drug dealers and armed groups, as well as their complex relations with local security forces. The process is authoritarian, private and established through military power, just like dictatorships are installed. In view of the absence of the regulatory public power

33 See, for example, UN (2003), "The Challenge of Slums" and David, M. (2006), "The Planet of Slums".
34 See Eliana S Silva (2019), "Testemunhos da Maré", Mórula editores, Rio de Janeiro.

in the popular spaces of many slums, the social relations established there have been associated to the construction of **their own regulatory mechanisms**.

Consequently, **public security cannot be left to security forces alone**, and it will not be transformed by local corporations. It is increasingly necessary that locally recognized social actors (e.g., NGOs, public and private foundations), especially civil society, education institutions (including universities), the media, co-design and implement alternative security initiatives, based on a strong participatory process and people´s engagement.

The rational for the proposed work relies on the fact that many civil society organizations continue to adopt a merely demanding and "denunciator" stance in relation to police practices, without seeking to build dialogue channels, methodologies and conceptual propositions that contribute to the effective construction of other paradigms. There is simply the desire to remain in a "comfort zone" and not face the sophisticated set of tensions and challenges posed by the various actors of contemporary social reality.

As a result, it is necessary to overcome the traditional and conservative representations, but also the so-called progressive ones, which rely on a simplifying and deterministic logic of the social reality of the slums and of the State itself. Thus, only with **creative, integrated proposals that articulate different social actors** will it be possible to produce innovative public policies for popular spaces in the field of public security. It is, in fact, a matter of also "re-signifying" all the policeman's work and his professional condition.

The work under K4P Alliances will rely in innovative organizational arrangements involving citizens, civil society organizations, academia, government agencies and private sector. The ultimate goal is to foster pilot projects using advanced data acquisition and processing systems combined with data derived from Earth Observation systems to enable innovative policies and practices driven by new research dealing with the complex social landscape of slum territories in Latin America and Africa.

To work creatively and have impact to attempt changing the spread of poverty in association with urban expansion in the Global South, recent analysis clarifies the need to understand ***local social norms*** that characterize most of the slums and related complex landscapes[35]. Consequently, the adoption of forms of **collaborative innovation** under K4P Alliances aims to foster **strong interactions** with the local context and to promote effective transdisciplinary ***cultural learning*** processes. For example, the engagement of artists and related activities, among many other skills and competences, in the adoption of new technologies and practices should be planned to facilitate entering into unexplored intellectual territories fostering *science and innovation for development*.

35 See, for example, Henrich, J. (2016), "The secret of our success: how culture is driving human evolution domesticating our species and making us smarter", Princeton Univ Press.

Amazónia High resolution imagery obtained by Geosat 2 satellite (GEOSAT), 2022

Green Growth: sustainable land and ecosystem management

K4P Alliances aim to contribute to **green growth** and ***green structural transformations*** together with **sustainable land management and forest preservation** in Africa and Latin America. Analysis shows that this must be accomplished in a way enhancing ***human well-being*** together with the ***conservation and sustainable use of ecosystems***[36]. This includes a full range of ecosystems, from those relatively undisturbed, such as natural forest, to landscapes with mixed patterns of land use, as well as to ecosystems intensively managed and modified by humans, such as agricultural territories.

The ultimate goal is to help developing projects oriented to foster and use **ecosystem services** that contribute to promote **resilient economies** and that enhance **sustainable human wellbeing** in the Global South[37].

It should be noted that ***green structural transformation*** is increasingly understood as combining green growth and structural economic transformation strategies, which encompass critical steps in the development process of many regions in the Global South, including the ***least developed counties***[38]. This includes actions to enhance the preference of increasing resources use and reducing waste production with balancing these processes with nature and conservation, as well as by increasing the capacity to fix and, above all, sequester CO2. In addition, it includes the **stimulus of nature-based solutions**, for example in agriculture and in forest management, as well as in the economic valorization of **natural products**.

- the **stimulus of nature-based solutions**, for example in agriculture and in forest management, as well as in the economic valorization of **natural products**;
- the **stimulus to in situ and ex-situ preservation of ecosystems and biodiversity** through studies that quantify patterns of biological diversity and foster the maintenance and expansion of preserved areas and conservation of biodiversity.

36 It refers to the dynamic and complex relationships of plan, animal and microorganism communities and the nonliving environment inter-action as a functional unit. See, for example, Intergovernmental Platform on Biodiversity and Ecosystem Services [IPBES] (2019a). IPBES Conceptual Framework. Available online at: https://www.ipbes.net/conceptual-framework . See, also, the Millenium Ecosystem Assess-ment (2005), "Ecosystems and Human Well-Being Synthesis, The World Resources Institute, Washington.

37 **See, for example, Sangha et al (2022), "Ecosystem Services and Human Wellbeing-Based Approaches Can Help Transform Our Economies", Front. Ecol. Evol., 15 April 2022.**

38 UNCTAD (2022), "The low carbon transition and its daunting implications for structural transformation - The Least Developed Countries Report 2022", UNCATD.

Moving towards **carbon neutrality** will greatly depend on the way we will be able to guarantee adequate use of digital tools and remote sensing for sustainable land management in the Global South in that all relevant stakeholders have access and are equipped with adequate systems for sustainable water, land and integrated forest management. First of all, it is widely known that carbon neutrality necessarily requires keeping the tropical forests standing. This involves civil protection services, environmental, agriculture and forest regional services and their delegations, forest guards, farmers, agri-food companies and advisory services as well as other public and private land users and actors (including municipalities and land governance institutions, as well as firms and individual landowners).

Such efforts have been attempted worldwide[39] in close cooperation with local authorities in land use planning, forest management, fire prevention and land register in order to contribute to:

i. Characterizing and monitoring forest biodiversity. This is because there is still much we don't know about the tropical forests biodiversity (the so-called biodiversity shotfalls), particularly the Amazonia rainforest. So, fostering basic research aimed to characterize tropical biodiversity at its multiple components and taxonomic groups (e.g., field expeditions to sampling gaps and remote areas to inventory biological diversity across taxonomic groups, taxonomy studies, species descriptions, biological collections, etc), is a priority focus.
ii. decreasing the likelihood of extreme and severe fire events;
iii. support forest fire risk governance and management mechanisms to minimize the impact of forest fires;
iv. monitor fuel management efforts in wildland/rural-urban interfaces, as well as in forest areas, undertake risk assessment and support real-time fire risk monitoring and exposure of highly sensitive areas; and
v. support law enforcement operations towards the compliance of fuel management regulation around building and critical infrastructures and support a flexible tasking of surveillance and suppression resources considering risk and uncertainty, while encapsulating intra-spatial and temporal variability.

The debate on greenhouse gas (GHG) mitigation in agriculture is to a great extent focused on livestock, especially on ruminant production. 61% of global contributions of GHG emissions is currently associated with livestock production to beef production. However, there is a lack of field measurements regarding the importance of ruminant livestock farms in Latin America, northern Africa, as well as Mediterranean regions and other territories mostly based on extensive grazing, at least in a way to facilitate estimates of soil organic carbon stocks.

39 ISee, for example, the Copernicus/Sentinel missions of the European Space Agency (ESA), as well as the EC`s Joint Research Centre information system, particularly regarding farming and grazing systems.

There is also a very low number of life cycle assessments (LCA) for livestock production in relation to the high percentage of GHG emissions associated with livestock. In addition, the estimation of environmental impacts in highly diverse and complex systems, such as extensive grassland-based livestock systems, is a complicated task and requires estimations for specific systems and regions.

Understanding the **triangulation of new knowledge, institutional innovation and new observation methods** will be critically relevant because:

- Forests, shrubland and pastures can play different roles in the carbon cycle, from net emitters to net sinks of carbon, because forests sequester carbon by capturing carbon dioxide from the atmosphere and transforming it into biomass through photosynthesis. Sequestered carbon is then accumulated in leaf's, branch's, trunks and roots in (biomass) deadwood, litter and in forest soils. The release of carbon from forest ecosystems results from natural processes (respiration and oxidation) and deliberate or unintended results of human activities (i.e., harvesting, fires, deforestation, soil mobilization);
- Forests, shrubland and pastures and their role in the carbon cycle are affected by changing climatic conditions. Evolutions in rainfall and temperature can have either damaging or beneficial impacts on forest health and productivity, which are very complex to predict. Depending on circumstances, climate change will either reduce or increase carbon sequestration into forests, which causes uncertainty about the extent to which forests are able to contribute to climate change mitigation in the long term. Also, forest management activities have the potential to influence carbon sequestration by stimulating certain processes and mitigating impacts of negative factors;
- As an example, forests, shrubland, pastures and natural lands ecosystems in the European Union play multiple significant roles, including carbon sequestration. It is estimated that the forest biomass in the EU27 countries contains 9.8 billion tons of carbon (tC). The total CO2 emissions of the EU27 countries in 2004 was 1.4 billion tons of carbon equivalent. This means that the amount of carbon emitted every year by the EU27 equals to nearly one-seventh of the carbon stored in the EU27 forests. As a result, the value placed on forests in the EU can be seen as a viable way of mitigating GHG emissions through carbon sinks and sequestration.

Overall, improved public services coupled with public-private interactions on sustainable land management depend on a responsible combination of specialized knowledge of land management with advanced digital systems integrating satellite imagery and the management of large data sources with advanced machine learning algorithms oriented to:

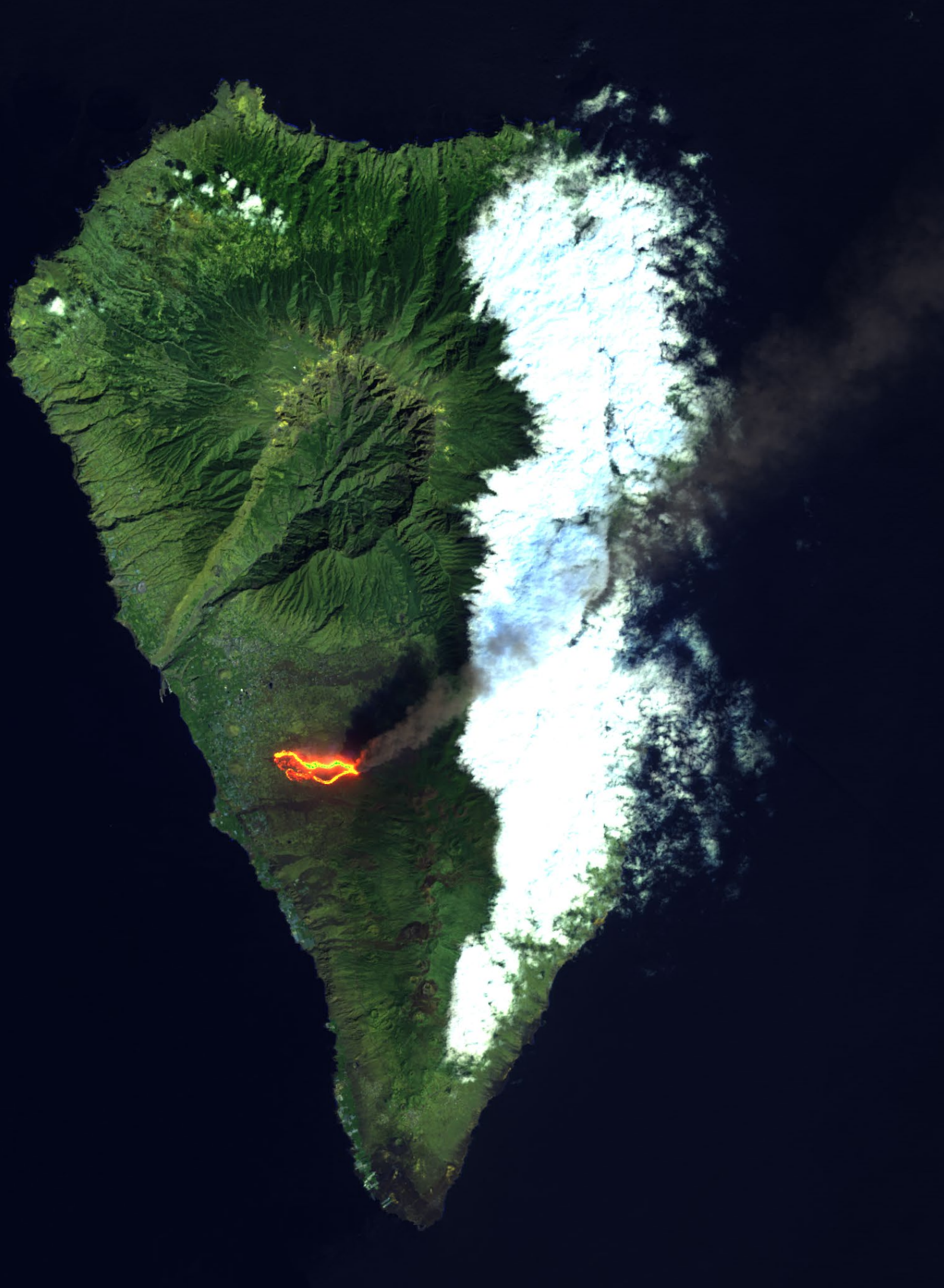
i. Assure the monitoring of CO2 sequestrated in soil and vegetation through a very high-

resolution database, aiming for a sustainable forest by contributing for an effective 55% reduction of CO2 emissions by 2030 and full carbon neutrality in 2050; and

ii. Promote a new market for very high-resolution (i.e., sub-metric) satellite-based Earth Observation systems fully integrated with advanced Information systems, through revised legal systems imposing that all municipalities and land governance institutions, as well as firms and individual land owners, are properly equipped with high-resolution, space-based fire prevention and sustainable land management tools.

One of the benefits of using **digital systems** would be to enable new business models that make it attractive for firms and land owners to participate in government-led land management efforts. But these goals can only be achieved through a concerted action oriented to promote:

- The development and deployment of tools for the monitoring of forest-induced carbon credits and their corresponding monetization;
- Advanced decentralized digital networks, information systems and Artificial Intelligence methodologies: on-line forecast/AI modelling of "fire risk level" with a capacity of 90% accuracy prediction over 3 days in advance and the necessary release of early warnings, together with on-line capacity for dynamic forecast of carbon cycle and the prediction of levels of carbon stock and sequestration into forests; Machine learning algorithms crossing information from different sources and types, to accelerate land identification;
- High performance computing capacity: capacity for near real time weather forecast and massive calculations of soil parameters and levels of carbon sequestration;
- Providing users with a decision support system that, through probabilistic risk modelling and scenario planning trade-off analysis, using the best available information (e.g., sub-metric resolution and near real-time data of weather conditions and land use and landcover) and processing capacity, allows practitioners to prioritize investment decisions regarding landscape planning and fuel management at national, regional and sub-regional scale. The core value of such a decision support tool, resides in using a quantitative wildfire exposure assessment to map, compare, and inform management priorities in vast areas;
- Interoperability platforms that enable better land management by providing information from land owners but also from central administration (fostering the "once only" principle) and municipalities.



CumbreVieja - Landsat8 NASA processed by SentinelHub EO Browser

Blue growth: *the critical relevance of coastal areas*

Blue Growth is a long-term strategy to support sustainable growth in coastal areas in articulation with the marine and maritime sectors as a whole. Large rivers, seas and oceans are drivers for many regional economies and have great potential for innovation and growth.

The blue economy encompasses all sectoral and cross-sectoral economic activities related to rivers, the oceans, seas and coasts, including those in the outermost regions and landlocked countries. This includes the closest direct and indirect support activities necessary for the sustainable functioning and development of these economic sectors. It comprises emerging sectors and economic value based on natural capital and non-market goods and services. For example, just for Europe, the 'blue' economy represents roughly 5.4 million jobs and generates a gross added value of almost €500 billion a year.

Under the K4P alliances, the context for promoting the blue economy for sustainable development of coastal and marine areas in the Global South includes stimulating forms to diversify local economies in products and activities as well as in ocean services.
Potential actions include: i) **Maritime surveillance**, supporting maritime traffic and help abolishing illegal attention; ii) **Harvest of living resources**; supporting fisheries to ensure food security and supply proteins demand; iii) **Generation of new resources**: as a response to the demand for alternative sources of energy, technological raw materials, and potentially pharmaceutical bio compounds; iv) **Ocean health & protection**: to enhance the protection and conservation of coastal areas (e.g. to protect livelihoods, mitigation of climate change), including forms of coastal protection and preservation; and v) **development of "digital twins" of the ocean** to model and promote new activities under the scope of the blue economy. For example, satellite data can be used to track the movements of fish stocks, identify areas of illegal fishing, and monitor the health of coral reefs. This information can be used to improve the management of fisheries and to support the sustainable development of the blue economy.
Key-potential activities include:

- Aquaculture -> to ensure food security, to reduce overfishing
- Desalination -> to increase the supply of fresh water, as solution for water scarcity
- Blue carbon -> to support fish stocks and food security, sustain livelihoods, filter water flowing into the oceans
- Technology and R&D -> to promote growth in coastal and ocean activities by R&D in ocean technologies (e.g., submersibles, ROVs, diving/scuba gears, buoys, water column samplers, sea floor mapping)

Port of Mindelo 2007, by Manuel de Sousa

Digital networks: *an evolving process*

Analysis clearly shows that every forecast for world societies in the coming decades will be strongly affected by the emerging trends on the **increasing digitalization of our societies and economies**[40,41].

In particular, it must consider that moving from the current version of the internet most of us know today, with an internet dominated by companies that provide services in exchange for our personal data (i.e., "**Web2**", including large firms such as Google, Facebook, Amazon, Airbnb, Uber, among others) to a context of **decentralized apps that run using blockchain** (i.e., "**Web3**", including Bitcoin, as a digital currency, and decentralized applications built on top of networks, such as Ethereum, as well as Helium, Maker and Ocean brings with it the potential advantage, among others, of no one being blocked or having access denied to the service (at least in theory). In addition to blockchain, the emerging next-generation world wide web will leverage machine learning and artificial intelligence even more to achieve real-world human communications and transactions[42].

However, although global digital platforms have become an integral part of our lives, with evident benefits, but also with emerging threats to democracy, fundamental rights, societies and the economy including raising inequalities. It is under this context that emerging decentralized digital platforms bring new collective challenges and opportunities across all sectors of activity and all our daily life, with a particular relevance for the Global South. Although most of the debate is dominated by new technological advancements of products and services in the financial industry (i.e., Fintech and related issues associated with blockchain in the context of cryptocurrencies, it covers a wide range of activities from industry to the arts (e.g., NFTs, non-fungible tokens).

But Web3 has some **limitations**, at least for the moment, including: i) ***scalability***, because transactions are still slower than traditional ones; ii) ***larger "time to value" than incumbent technologies***, because of the need for extra steps, new software, and, above all, education and further research; iii) ***accessibility***, due to the current lack of integration in modern web browsers; and iv) ***cost***, because the dominant blockchain technologies (i.e., "proof of work")

40 Kontokosta, C., & Harrison, C. (Eds.) (2017). Urban Intelligence: How Data and Information Can Shape Urban Planning, Design, and City Operations. Routledge
41 Helga Nowotny (2021), "In AI we Trust: power, Illusion and Control of predictive algorithms", Polity Books
42 Max Mersch and Richard Muirhead (2019), "What Is Web 3.0 & Why It Matters", 31 December 2019, https://medium.com/fabric-ven-tures/what-is-web-3-0-why-it-matters-934eb07f3d2b

are still expensive in terms of **energy consumption** and negative climate impact[43]. In particular, increased energy consumption and the inherent CO2 footstep is a clear blockchain drawback that cannot be forgotten, although a new generation of blockchain technologies is emerging (i.e., "proof of stake"). In addition, decentralized and distributed systems are prone to hacker attacks, particularly associated with critical infrastructures (like electric grid, water distribution, financial networks, gas pipeline infrastructures.

Although advantages and disadvantages of centralized and decentralized digital networks are still subject to many uncertainties and require comprehensive technical and policy debates, it is clear that **decentralization and blockchain control is not completely immune to biases** - blockchain algorithms incentivize and ultimately end up giving preference to participants that have access to more nodes, therefore, to the most active ones. **Artificial Intelligence (AI) can help by modelling the information flows and learning the critical patterns of use by different participants**. Such patterns can then provide input to the setting of the parameters that govern the behaviour of blockchain algorithms.

Overall, the emerging uncertainties are associated with lack of regulation, which resulted from a few dominant economic or political interests, as well as digital terrorism and related individual malfunctions, disregarding people at large and, above all, our collective behaviours[44]. We argue that the role and scope of **regulation must be revisited**, considering an increasingly complex global network of actors and sophistication of AI algorithms. The role of regulators must be reshaped towards a **time-sensitive, people-centered and climate-aware approach for our common good**, in order to better protect citizens from abuses and manipulation.

In other words and following Helga Novotny (2021), they should be oriented to promote "**digital humanism**" and **guarantee a transdisciplinary approach to collective behaviours and consideration of "human agency"**[45]. In addition, DeLanda (2009; 2017[46]) argues that **human agency** requires frameworks that help us better understand complex relationships among communities, interpersonal networks and institutional organizations, as well as involving the engagement of central and regional/local governments.

43 See, for example, Sam Richards (2021), "Web2 VS Web3", https://ethereum.org/en/developers/docs/web2-vs-web3/.
44 See, for example, Joseph Bak-Coleman at al. (2021), "Stewardship of global collective behavior", PNAS, June 21, 2021.
45 See, for example, UNDP (2019), "The Human Development Report", chapter 6; UNDP, New York
46 Manuel DeLanda (2009), A New Philosophy of Society. Assemblage Theory and Social Complexity, Bloomsburry, London, UK; Manuel DeLanda (2017), Assemblage Theory. Edinburgh University Press, UK.

Drone for forest observation in Amazon, by Rui Ribeiro, Elio Technologies

3. Collaborative Innovation

Goals

K4P Alliances consider the need to promote **institutional innovations** and the development of **new collaborative institutional frameworks and arrangements** fostering new practices and new policies driven by new knowledge in increasingly complex network systems in the Global South.

Our approach is based on the fact that collaborative arrangements may act as **agents of change** to foster the human ability to rise innovation. They consider institutional innovations oriented to innovation-based growth through the diversification and densification of the research landscape in a global system of increasing fragmented production.

It aims to consider **distributed, plural and collaborative institutional frameworks** with local communities and experts worldwide.

The ultimate goal is to stimulate the development of effective ***centers of excellence***, sustainable in the long term and, thereby, adopting the form of "**Collaborative Laboratories**". These must encompass interface and intermediation activities with the public and private sectors, as well as civil society organizations.

The following overall principles are considered under K4P Alliances:

1. Collaborative Laboratories aim to foster the effective **densification of the territories in terms of knowledge-based activities**, through a growing institutionalization of forms of collaboration between science, technology and higher education institutions and the economic and social fabric, namely companies, the hospital and health system, cultural institutions and social organizations. It is associated to the need to promote the **development of public and semi-public goods**, through collaborative spaces between public and private institutions.
   Collaborative Laboratories must, therefore, consolidate and promote the capacity and potential that the scientific, academic and business communities have to face the the opportunity to relate knowledge with well-being and social and economic development. It is an opportunity for scientific and academic institutions, in close collaboration with economic, social and cultural actors, to contribute to the sustainable

development of locally and globally relevant initiatives, with an effective impact on society, stimulating the local creation of qualified employment.

2. Second, they aim to **diversifying the research and innovation landscape, complementing** the existing structure and the performance of traditional research Laboratories. The ultimate goal is to stimulate the active participation of scientific and academic systems in better understand **complex and large-scale problems**, generally not susceptible of being solved within a single disciplinary, scientific, technological or institutional strand. They imply the coordination of different scales and a business, social and cultural intervention with a view to implementing effective solutions with a socio-economic impact. Thus, Collaborative Laboratories have a complementary and supplementary role to that of research centers, as well as technological centers or the most traditional public State Laboratories and, naturally, companies.
3. Third, the role to be played by the Collaborative Laboratories is especially important to stimulate "**flows of global-local knowledge**", between demand and supply, supply and demand, in association with **new forms of interaction** and a **non-linear relationship** between research, innovation and social and economic development activities. In this respect, the analysis considers processes stimulating the co-design and co-accountability of participating institutions for knowledge transfer and diffusion processes and improving the value of products and services provided by companies, as well as facilitating the social relevance of research activity and its appropriation by society.
4. Last, but not least, the development and promotion of Collaborative Laboratories has been stimulated in many regions worldwide to foster the **mobilization of research and innovation** agendas and programs of **international relevance and local impact**. Their ultimate goal is to encourage qualified employment and the creation of economic and social value in terms of innovation-based growth.

Sample criteria for setting collaborative projects and laboratories

The preparation of collaborative arrangements and, in particular, "Collaborative Laboratories" to be considered in K4P Alliances, encompass the identification and definition of the following tasks:

1. **Strategic Vision**, major topics to be addressed and region of influence, fostering **digital connectivity infrastructures** in **fully compliance with cybersecurity standards**;
2. Brief and Detailed Presentation of the Work Plan, including strategy for qualified job creation and to foster "sustainable and healthy territories", through a network of **Data Centers for Earth Observation** and related scientific, technological and innovation activities for blue and green growth;
3. **Research and Innovation Agenda**;
4. **Potential impact** foreseen and/or expected.
5. Evolution **plan of qualified and scientific employment** to be created directly in the CoLAB (i.e., staff of the CoLAB) and indirectly (i.e., in other institutions and in the regional markets);
6. Brief **plan for "environmental certification"** of activities;
7. Analysis of major **strengths, weaknesses, opportunities and threats** (i.e., type of SWOT analysis; or similar narrative);
8. Selected information regarding the characteristics of "**bootstrapping team**" (i.e., team) and the role of the members of participating entities;
9. **Governance and Management**, including future relationships with main promoters of the K4P Alliance (e.g., "Air Centre affiliation")
10. **Financial and Business Plan**, with detailed analysis of plan for the diversification of funding sources and identification of main Key Performance Indicators (KPIs) to be achieved;

The evaluation and selection process is based on 4 main review criteria:
A | SCIENTIFIC and TECHNICAL MERIT and RELEVANCE
B | IMPLEMENTATION, GOVERNANCE AND SUSTAINABILITY
C | POTENTIAL SOCIAL and ECONOMIC IMPACT, namely in terms of eradicating poverty and the creation of qualified employment to be created directly and indirectly.
D | POTENTIAL ENVIRONMENTAL IMPACT, namely in terms of conditions for sustainable development, including the capacity to foster carbon sequestration and promote carbon markets.

Application of these criteria shall take into account, among other considerations, the following aspects:

<u>Criterion A:</u>

- **Relevance, soundness and potential of the strategic vision:** Clear identification and characterization of the challenge and extent to which the problem to be addressed is of relevant dimension and complexity; Clarity of stated goals, objectives and priorities;
- **Scientific, technological and innovation potential of the proposed activities:** Extent to which these activities contribute to achieve the established goals and are beyond the state of the art and demonstrate innovation and technological potential driven by the identification of economic, social and cultural needs and challenges; Appropriate consideration of interdisciplinary and inter-sectorial approaches;
- **Potential for knowledge-based value creation:** Ability to translate knowledge into novel concepts, approaches, processes, products, technologies, services, businesses, organizational models, among others;
- **Appropriate measures for the dissemination and/or exploitation** of scientific and technological results;
- **Appropriate measures for the internationalization** of the national scientific and technological capacity, including the potential to foster high value exports.

<u>Criterion B:</u>

- **Ability of the consortium to implement the action plan.** Complementarity of the participants and extent to which the consortium as whole brings together the necessary expertise and resources; Effective mobilization and collaboration with entities of the productive, social and cultural fabric and the adequate articulation with the higher education institutions and research centers;
- **Appropriate plan for Human Resources development**, in special (HR Hire Plan) that guarantees the success of the workplan; Adequate plan for specialized training and job creation as well as to establish the conditions to attract and retain qualified human resources.
- **Appropriate allocation of tasks**, ensuring that all participants have a valid role and adequate resources in the project to fulfil that role; Feasibility and effectiveness of the work plan including the extent to which the resources assigned to work packages are in line with their objectives and deliverables;
- **Appropriate business and financial plan** to successfully implement the action plan proposed and guarantee the project medium- and long-term sustainability. This includes the adequacy of the budget to accomplish the proposed R&D Agenda and the suitability of the strategy to attract and diversify the funding sources during 5 years and secure the adequate revenues;

- **Appropriate management structures and procedures**, including risk and innovation management and the definition of KPIs to be achieved;

<u>Criterion C:</u>

- **Conditions and actions** for eradicating poverty and promote "sustainable and healthy territories";
- **Level and nature of qualified and scientific employment created**, including employment established directly by the Collaborative Laboratories and potential indirect impact in the markets;
- **Potential to stimulate knowledge-based economy and its diffusion** throughout the territory together with relevant actors from these territories; Mobilize the entrepreneurial capacity, create new market opportunities and strengthen competitiveness and growth of companies.
- **Develop innovative solutions to complex societal challenges** creating economic, social and cultural value;
- **Creation of critical mass and new centralities for R&D and innovation activities** throughout the national territory, especially in areas of lower population density;
- **Strengthen the institutional collaboration** of interface and knowledge transfer centers, ensuring the collaboration between NGOs, technology and engineering centers with scientific and higher education institutions and with the productive fabric and cultural and social institutions;

<u>Criterion D:</u>

- **Conditions and actions for sustainable development**, including the capacity to foster carbon sequestration and promote carbon markets;
- **Potential to stimulate greening the society and economy and its diffusion** throughout the territory together with relevant actors from these territories; Mobilize "green entrepreneurial capacity", create new "green market opportunities" and strengthen competitiveness and growth of "green companies".
- **Develop innovative solutions to complex environmental challenges** creating new economic, social and cultural values following the SDGs and the Agenda 2030;
- **Creation of critical mass and new centralities** for "Green finance" and "Green innovation" and activities throughout the regions addressed;
- **Strengthen the institutional collaboration among "Green have"**, ensuring the collaboration between NGOS, technology and engineering centers with scientific and higher education institutions and with the productive fabric and cultural and social institutions;
- **Potential to stimulate the "environmental certification" of activities;**

"Cumaru" tree - Amazon, Brasil, 2022; by Rui Ribeiro

4. Research

An overall transdisciplinary challenge

Our ability to respond creatively to challenges, human and environmental, for the Global South imposes **new transdisciplinary knowledge**, which should contribute definitely to foster **Human Agency** and a ***cultural movement*** based on ***collaborative innovation*** and a **trans-disciplinary approach**. This requires understanding **collective behaviours** and the ***social norms*** under which diferent societies evolve. It addition, it requires:

- understanding that science and innovation for development depend on the ability to encourage people and institutions to produce and difuse ideas, insights and practices in every single region (Joseph Henrich, 2016);
- understanding the **governance of decentralized digital networks** and an increasingly ***responsible use* of Artificial Intelligence**;
- **revisiting regulatory systems** fostering behavioral changes and inclusive growth paths for a number of quite diversified contexts.

K4P Alliances has been driven by recent research analysis, including the following:

- **Human Climate Horizons, 2022**, https://horizons.hdr.undp.org/, a data platform launched in November 2022 providing localized information on future impacts of climate change across several dimensions of human development and human security. It is fed by an evolving stream of multidisciplinary frontier research.
- ***Steering Research and Innovation for Global Goals (STRINGS, 2022)*** project, http://strings.org.uk/: a major global study into the alignment between science, technology and innovation (STI) and the Sustainable Development Goals (SDGs). It highlights a glaring mismatch between STI and the SDGs; warns that, if this mismatch is not addressed, it will undermine progress on the SDGs; and makes recommendations about how to tackle this imbalance; October 2022;
- ***Do the science on sustainability now*** (Nature, Vol. 610, 27 **October 2022**, pp 605-606): https://www.nature.com/articles/d41586-022-03389-x, shows that since 2015 the rate at which research from high-income countries on, or about, the SDGs is being published has mostly either plateaued or is falling. Two-thirds of research published in the poorest countries has some connection to the SDGs. That compares with around 35% in high-income countries, although these shares are rising slowly.

- ***An Industrial Policy for Good Jobs (September 2022)***, The Hamilton Project, at the Harvard´s Kennedy School of Government and the Brookings Institute: a modern approach to industrial Policy to target "good-jobs externalities", https://www.brookings.edu/wp-content/uploads/2022/09/20220928_THP_Proposal_Rodrik_GoodJobs.pdf;
- ***Uncertain Times, Unsettled Lives: Shaping our Future in a Transforming World; UNDP (September 2022)***, "The Human Development Report 2021-22", UNDP, New York; https://hdr.undp.org/content/human-development-report-2021-22: it shows that a new "uncertainty complex" is emerging, never before seen in human history. Constitut¬ing it are three volatile and interacting strands: the desta¬bilizing planetary pressures and inequalities of the Anthro¬pocene, the pursuit of sweeping societal transformations to ease those pressures and the widespread and intensi¬fying polarization.;
- ***Stewardship of global collective behavior (June, 2021)***, by Joseph B. Bak-Coleman, Mark Alfano, Wofram Barfuss, Carl T. Bergstrom, MIgue Centeno, Iain D. Couzin, Jonathan F. Donges, Mirta GAlesic, Andew S Gersick, Jennifer Jacquet, Albert B Kao, Rachel E. Moran, Pawel ROmamnczuk, Daniel I. Rubenstaein, Kaia J Tombak, Jay J Van BAvel and Elke U weber, PNAS, June 21, 2021: argues that it is necessary to guarantee a transdisciplinary approach to collective behaviors in a way that citizens, at large, improved user responsibility in an emerging digital age;
- ***In AI We Trust: Power, Illusion and Control of predictive algorithms (2021)***, Polity Books: Helga Nowotny argues that the massified use of AI-enabled innovations is not free of additional questions because the power it has to make us act in the ways it predicts, reduces our agency over the future;

It is under this context that the initiatives to be developed under "K4P Alliances" should be designed together with **new research work** to consider the following issues:

- Innovators and skills;
- Users and behaviours;
- Institutional innovation;
- Regulators.

Innovators and skills

Expanding research activities is fundamental to help improving our understanding of **emerging new dynamics of knowledge production and diffusion**, which are being driven by the massified use of Artificial Intelligence and complex data ecologies by both scientists and innovators, as well as by people, artists and experts throughout all areas of knowledge.

K4P Alliances aim to deepen research and innovation activities to promote **"data ecologies" oriented towards sustainable urban growth, as well as blue and green growth**. The goal is to promote the development and adequate integration of advanced forms of **Earth Observation** and ***in situ data*** to understand the present and looking into the future in close articulation with other data collection systems and local actors.

Emerging forms of knowledge production and diffusion, together with adequate institutional frameworks, offer us **new tools to define future technological governance towards carbon neutrality and a safer world**. However, this requires that the role of regulators is reshaped towards a **time-sensitive, people-centered and climate-aware approach for our common good**, in order to better protect citizens from increasing uncertainties, abuses and manipulation. In addition, it requires an adequate articulation with the emergence of decentralized digital networks and the power of Artificial Intelligence algorithms combined with data science.
Any deep reflection on these issues must lead us to safer, more resilient forms of digital governance that must necessarily be centered on people and based on collective knowledge. Overall, human-centered, research- and innovation-driven developments must guarantee a **transdisciplinary approach to collective behaviours and consideration of "human agency", coupled with properly governed *intergovernmental scientific organizations.***

Users and behaviours

To save lives, predict natural disasters, prevent fires, control erosion of coastal areas, as well as providing quality food and services for all, can only be secured effectively through a new generation of user-driven, low-cost, space-based observation and human-based participatory systems, which require adequate resources that can only be obtained if **citizens become an integral part of future developments.**

In addition, dealing with climate change, dramatic biodiversity reduction, health and economic crisis, uncertainty and risks, together with ensuring security and safe conditions for our populations can only be addressed if **new digital initiatives move forward in full alignment with a required green transition.**

Nevertheless, analysis call for our attention towards a revisted "**digital humanism**"[47], together with rethinking potential techno-centric narratives of progress, embracing and harnessing **uncertainty**[48,49], as well as abandoning the fantasy of control over nature and the illusion of techno-centric dominance of digital systems and AI-enable innovations[50].

In this context, a leading group of American and European scholars have recently called our attention to guarantee a **transdisciplinary approach to collective behaviours**[51] in a way that citizens, at large, have better knowledge of digital services and digital providers, together with improved ***user responsibility*** in an emerging **decentralized digital age and AI-enabled innovations.**

Understanding **paths of "collective behaviours"**, together with new transdisciplinary approaches, moving beyond a dialogue between the sciences and the arts. It requires the design of new data collection and analysis systems across different disciplines (including the humanities and the arts, exact, natural and social sciences with engineering), integrated with other forms of knowledge and adequate user-interfaces.

47 Nussbaum, M. (1997) Cultivating Humanity: a classical defense of reform in liberal education, Cambridge: Harvard University Press.
48 Nowotny, H., Scott, P., and Gibbons, M. (2001) Rethinking science: knowledge in an age of uncertainty, Cambridge: Polity.
49 Morgan, M.G. and Henrion, M. (1990), "Uncertainty: a guide to dealing with uncertainty in quantitative risk and policy analysis", Cam-bridge Univ. Press, Cambridge, New York.
50 Nowotny, H. (2021), "In AI we Trust: power, Illusion and Control of predictive algorithms", Polity Books.
51 Bak-Coleman, J. B., Mark Alfano, Wofram Barfuss, Carl T. Bergstrom, MIgue Centeno, Iain D. Couzin, Jonathan F. Donges, Mirta GAlesic, Andew S Gersick, Jennifer Jacquet, Albert B Kao, Rachel E. Moran, Pawel ROmamnczuk, Daniel I. Rubenstaein, Kaia J Tombak, Jay J Van BAvel and Elke U weber (2021, "Stewardship of global collective behavior", PNAS, June 21, 2021.

In addition, it requires coupling with adequate understanding of Human Agency and the need to help people, at large, to feel satisfied through contributing to science and keep engaged and productive. Empowering users and citizens, at large, will promote the need to educate and train every single citizen, while ultimately avoiding dominant economic or political interests, as well as related individual malfunctions (e.g., digital terrorism);

The opportunity to access and engage in knowledge networks in the Global South, particularly in Africa, relate to interactions between people and organisations, which influence economic development and political relationships[52]. This resides increasingly in the capacity to access and use knowledge and technologies in distributed knowledge bases, which are increasingly spread through a wide network of sources[53]. It is under this context that higher education maybe used as a catalyser of knowledge-based developments, by promoting the exposure of emerging societies to experts and other communities aimed to foster processes of inclusive development.

In other words, empowering users and citizens, at large, **will promote the need to educate and train every single citizen**, while ultimately avoiding dominant economic or political interests, as well as digital terrorism and related individual malfunctions. The rules of governance must **boost research and innovation**, foster **growth and competitiveness** and help smaller companies and start-ups to compete with very large players, in particular those who have the ability to copy their features, acquire them or block their business.

52 Hidalgo, C.A. and Hausmann, R. (2009), 'The building blocks of economic complexity', Proceedings of the National Academy of Scienc-es of the United States of America, vol. 106, no. 26, pp. 10570-10575.
53 Conceição, P., Heitor, M. and Veloso, F. (2003), 'Infrastructures, Incentives and Institutions: fostering distributed knowledge bases for the Learning Society', Technology Forecasting and Social Change, vol. 70, no. 7, pp. 583-617.

Institutional innovation

Assessing emerging **institutional innovations** and the development of **innovative collaborative frameworks and institutional arrangements** requires new research in increasingly complex network systems.

Recent literature also suggests this has also become part of the main challenges facing adequate instituional frameworks promoting science and innovation for development. In this sense, new research on "**institutional illities**", such as ***adaptability, resilience, autonomy and integrity***, represent a movement of "rupture", emphasizing forms of thinking and action that go beyond immediate temporal frames, apparent functionality or success, and the constraint to fundament decisions solely on what is measurable[54].

Inspired and conditioned by a myriad of global, national and local challenges that implicitly or explicitly rely on knowledge and learning for potential solutions, **collaborative frameworks and institutional arrangements** are required to be both increasingly ***adaptable and resilient*** (two important illities. Thus, they to consider accommodating new configurations of knowledge production by establishing alliances with an increasingly large range of **"knowledgeable" institutions**[55].

Moreover, they require to secure a sufficiently stable environment to train and supply talented people, including researchers, for that growing range of "knowledgeable" institutions. This leads to the need, more relevant than ever, for public policies promoting effective institutional ***autonomy and integrity*** (i.e., two other important illities) of modern institutional frameworks. This is particularly relevant as institutional partnerships gain significant prominence.

In addition, autonomy and integrity may be self-enforced within collaborative frameworks and institutional arrangements, and not based on coercion imposed from the outside or mandated by ethical principles. Overall, they require a **clear and adequate financial and economic structure of incentives**, properly defined in a way to avoid dependence from any single external source of funding.

54 Rouse, W. and Serban, N. (2014), Understanding and Managing the Complexity of Healthcare, Cambridge: MIT Press
55 Nowotny, H., Scott, P., and Gibbons, M. (2001) Rethinking science: knowledge in an age of uncertainty, Cambridge: Polity

Analysis of large transnational and intergovernmental organizations and related worldwide science networks suggests that the practice of independent and open science calls for effective networks of scientific institutions with external actors, including private foundations, disruptive startups, and other business institutions, if adequate internal integrity routines and self-imposed codes of conduct are established at institutional level. In other words, new research on modern institutions need to focus on emerging forms to promote Human Agency and human-centered innovations, in association with emerging societal discussions about wealth creation and distribution.

Regulation

Promoting reference models for the evolution of new governance models for participatory research and the experimentation of innovative systems requires ***new research on the design and implementation of related regulatory systems***. The work will focus on forms to **regulate and promote "carbon markets"**, as well as facilitate access and use of data by consumers, while providing incentives for them to invest in ways to generate ***value through data*** **in association with "Human Agency"**.

This includes the combination of anonymized data from different sources to produce new and valuable insights and services. In addition, rules should evolve in a way to fight against "mendacity" and, in contrast, to foster "fact checking". Also, to promote safeguard situations of illegal transfer of data without notification, for example by the "cloud" service provider without traceability, while promoting the development of interoperability standards so that data is reused across sectors.

In addition, the rules of governance must **boost research and innovation**, foster **growth and competitiveness** and help smaller companies and start-ups to compete with very large players, in particular those who have the ability to copy their features, acquire them or block their business.

Overall, this requires understating new regulatory systems and evolving forms of technology and innovation governance, including the regulation of carbon markets together with digital platforms and digital standards.

It should also be noted that **emerging regulatory issues and related forms of *"smart regulation"* should help promoting critical approaches to decentralized digital networks and AI**, with clear accountability and clarity about boundaries and purpose, together with individual responsibility.

Forest management operation, Amazon, Brasil, 2022; by Rui Ribeiro

5. Action Plan

The Opportunity: *a global agenda with local impact*

K4P Alliances aim to promote a transatlantic dialogue to better understand "Human Agency" and the need to guarantee responsible, climate-aware systems in complex landscapes in a decentralized and AI-supported digital age.
It is under this context that K4P Alliances will promote projects and initiatives seeking to:

- engage the public and private sectors;
- foster academic collaborations with social and economic actors at large; and
- international collaboration across north-south, south-north, south-south and north-north regions. It will leverage the momentum on transatlantic related issues and mobilize a wide network of industry and innovation stakeholders across the Atlantic.

Building on the experience of the promoters, this initiative will launch a series of new concrete actions and will explore new outputs over time and in a stepwise process, including an integrated thinking across disciplines and unprecedented interconnectivity, including:

- Promoting relevant **institutional innovations** in a way to consider **distributed, plural and collaborative institutional frameworks**;
- **Building new data ecologies with advanced observation methods**, including satellite-data and in-orbit servicing, coupled with advanced in-situ data collection and processing systems, together with adequate user interfaces and **far front technical tools of analysis**; and
- Fostering **new knowledge** and **capacity building**.

The goal is to launch a stepwise process towards an international **"Think and Do Tank"** to foster tomorrow's Human Agency through new research, scientific diplomacy and advocacy. The initiative is organized and implemented in terms of **"Regional Chapters"**, following a stepwise approach, as described in the following paragraphs.

Line of Action I: Collaborative Innovation

Action 1 aims to promote forms of institutional innovation and community-based participatory research and innovation to foster new and healthy jobs in the Global South.

The ultimate goal is to promote an **international network of collaborative projects, initiatives and laboratories**, in the form of ***centers of excellence*** in close collaboration with local actors, including data centres equipped with Earth Observation capacities and skills.

Potential sample topics include:

- **innovation in sustainable and healthy territories**, using **social cartographies** as participatory method for collective research;
- **open access libraries of natural products and components**, together with ways of economically valuing these products and components;
- **digital modelling for low carbon economies**, including the systematization of the digital representation of urban and agroforestry areas in the form of "Digital Twins", together with modelling scenarios oriented towards sustainable development;
- **low carbon bio economies and innovation in land usage**, facilitating better sustainable exploitation of biological assets in agroforestry structures in Tropical Biomes and in the Tropical rainforest in Africa;
- **innovation in coastal bio economies and blue carbon**, including tropical mangroves and green aquaculture, along with innovation in land use and wetland/mangrove carbon mapping;
- innovation in **sustainable and renewable energies** and other breakthrough technologies, including those fostering **sustainable urban landscapes**; and
- **innovation in "green finance"**, promoting sustainable financing of "net-zero" economies.

Line of Action 2:
Transdisciplinary data observatories

Action 2 aims to build **"data ecologies"** with advanced observation methods oriented towards two fundamental issues, as follows:

- **Land use, soil and carbon observatory:** aims to provide a new satellite-based and data-driven land-use monitoring system and carbon mapping designed to dynamically map **forest/agroforestry** structures and **coastal areas** (i.e., tropical mangroves, saltmarshes). The goal is to consider soil monitoring, water management and vegetation fuel loads with high temporal and spatial resolution, as well as **carbon stock and sequestration levels**. It will be implemented through pilot projects in Latin America, and Africa, as well as in the Global North, to be gradually leverage to entire regional contexts.
- **Community-centered innovation observatory and dynamics of sustainable and healthy territories:** aims to provide a systematic identification, description and analysis of emerging innovation paths engaging communities and people at large in eradicating poverty, reducing inequalities, and achieving sustainable development. It will focus on initiatives oriented to foster the concept of "One Health" together with sustainable and healthy territories oriented towards greening the economy and society. It considers the observation of "Living Labs" and co-creation mechanisms, in a way to guide novel user-centered approaches to green research and innovation across the Atlantic. It also includes the development and dissemination of **innovative community research and practices**, based on emerging methodologies, such as social cartography, intersectoral studies, ecologies of knowledge and sustainable and healthy territories.

Line of Action 3:
Capacity Building

Action 3 aims to foster **capacity building, skill development and new knowledge**, including the following potential activities oriented towards the Global South, particularly **Africa and Latin America**:

- **Educational programme development**, including:
  - Joint and double post-graduation diplomas (short, non-degree diplomas) and potential joint degree programs (Master level): aims to facilitate the development of joint post-graduation programs (degree and non-degree) around the program themes and oriented to contribute to train "leaders of the future", with special emphasis on the training and qualification of "knowledge managers", in order to train and qualify human resources for the management of science, technology and innovation, together with the planning of forms of sustainable development;
  - Visiting scholarships program: aims to provide an annual program of selected visiting scholars in leading institutions worldwide, for periods until nine months, oriented to foster new insights in the program;
  - Research students' program: aims to provide an annual program for six to 12 months scholarships for selected research students in leading institutions worldwide oriented to contribute to promote doctoral research training concerning the program;
- **Training for capacity building and skills development**, which includes enabling local participation in skills and competence development for stimulating human agency and inclusive local development;
- **Competitive program for collaborative research**: aims to facilitate the development of joint multidisciplinary research and innovation projects around the program, including researchers' mobility, oriented to contribute to foster new knowledge and to apply it. It should be based on periodic "Calls for Proposals" for collaborative research projects of one to three years, to be assessed by a panel on international experts;
- **Policy and data briefs**: includes the preparation and publication of a series of three to four data and policy briefs per year, oriented to foster the interaction of policymakers with communities, scientists, and people at large, oriented to operationalize policy strategy and science-based policy making. It considers data briefs about carbon sequestration in different types of forest/agroforest and consistent plots along time, as well as data on the development of regional bio-economies and of sustainable and

healthy territories. Emphasis will be on "**data briefs**" about: i) carbon sequestration in different types of forest/agro-forestry structures and wetlands (i.e., mangroves); ii) data on regional development of bio-economies; iii) equitable and sustainable health, which articulates the environmental, economic, political and social determinants associated with health and disease in terms of the development of sustainable and healthy territories;

- **Workshops, conferences, and other ways of outreach aiming to strength community engagement and the development of science and innovation culture**, through a diversified set of initiatives, including: i) public talks and meetings to contribute to deepen technical and policy debates, increase the visibility of the program and to foster science diplomacy; ii) science events to bosting science-led competences in communities at large; and iii) participatory research activities.

K4P Alliances consider a critically relevant set of actions to engage and sponsor **visiting scholars, research students** and to train and qualify **human resources for the management of science, technology and innovation**, together with the planning of forms of sustainable development for the Global South. This includes researching new understandings of the governance of emerging risks and new futures for complex systems and "data ecologies", with emphasis on potential **paths towards carbon neutrality of urban[56] and rural landscapes[57]**, including the agglomeration of people and skills in urban contexts to help developing forms of sustainable land management and "knowledge-based landscape urbanism"[58]. It will be conducted in close articulation with leading institutions worldwide, to attempt contributing to reduce the gap between design innovation and societal impact by addressing societal and cultural conditions associated with contemporary living standards and income distribution.

The research and training programs will consider emerging trends in technology policy and paradigms in technological innovation in terms of the uncertainties we all face to deal with digital, ecological and demographic transitions, including those in association with the convergence of digital systems with physical, natural and medical sciences, as well as data and urban sciences, but in a context of a required improved understanding of "Human Agency"[59] and related collective behaviours[60].

The challenge is to establish **"Technology, Policy and Human Agency"** as a field of study that focuses on complex systems and products, viewing those systems and products in their broad human, social, cultural and economic context. This requires a revisited

56 See, for example, Waldheim, C. (2016), "Landscape as Urbanism: A General Theory", Princeton Univ Press; New jersey; and Bettencourt, L. (2021), "Introduction to Urban Science"; MIT Press, Cambridge.
57 See, for example, Benedito, S. (2021), "Atmosphere Anatomies: On Design, Weather, and Sensation", Lars Muller Publs.
58 Cromar, K.,Howard,P: Vásquez, V-N. and Anthoff, D. (2021); "Health Impacts of Climate Change as Contained in Economic Models Estimating the Social Cost of Carbon Dioxide", GeoHealth, Volume 5 (8).
59 UNDP (2019), "The Human Development Report", chapter 6; UNDP, New York.
60 Bak-Coleman, J. et al, (2021), "Stewardship of global collective behavior", PNAS, June 21, 2021.

approach of skill development, behavioural analysis, institutional innovation and smart regulation, based on a transdisciplinary commitment towards integrative analysis of data ecologies, systems design and policy research.

The analysis will take into account emerging forms of knowledge production and diffusion in a decentralized and AI supported digital age[61] and will be **focused on complex landscapes**, including urban systems and rural landscapes among other complex systems (e.g., forests and the ocean), which are particularly critical for the required green transition of our societies, together with our global well-being.

Following the growth of urban areas worldwide, cities and rural landscapes have become increasingly complex and their evolution towards carbon neutrality require interdisciplinary approaches that builds upon new "data ecologies". This requires making use of satellite-based high-resolution images, oriented towards **carbon sensing**, integrated with in-situ information and new data collection systems, which may offer a new way of thinking about cities and other landscapes if conveniently integrated with advanced analysis of social, economic and cultural interactions together with forms of "Responsible AI". Different typologies of cities and emerging developments in low-density rural areas provide sample case studies for **new** in-depth analyses based on high-resolution **carbon mapping and observation.**

In addition, understanding patterns of potential technical change in urban and rural areas in any world region requires a comprehensive analysis of **landscape design** in terms of related socio-political and cultural dynamics, including the levels and paths of social stratification, income distribution and the opportunities for social mobility across our diversified regional contexts.

Potential projects to be developed include:

1. **Risk communication and capacity building** based on high-resolution satellite-based carbon mapping and observation strategies, integrating advanced data ecologies and modelling oriented towards **forest fire prevention and related health issues**, in a way fostering case studies worldwide with potential local impact. The ultimate goal is to help incorporating the health impacts of climate change into greenhouse gas mitigation and climate adaptation policymaking;
2. Advanced analysis of **urban expansion** processes and related **capacity building strategies towards urban densification** patterns leading to effective carbon neutral cities in highly diversified north and south contexts;
3. Policy research and development in association with emerging forms of **carbon modelling, mapping and observation** in complex urban contexts leading to

61 Helga Nowotny (2021), "In AI we Trust: Power, Illusion and Control of predictive algorithms", Polity Books.

comprehensive forms of urban observation, integrated with advanced analysis of social, economic and cultural interactions together with forms of **"Responsible AI"**;

4. Policy research and development oriented towards **sustainable land management**, including the analysis of the social, economic and scientific context associated with specific local and endogenous cultures in diversified world regions (e.g., Amazonia; Northern Portugal; California).

The research work will be reported as an example of the need to focus upon in-depth knowledge of real social, political and economic processes of successful science, technology and knowledge-based developments over the last decades in Europe, the Americas and Africa. The foreseen critical policy framework will address key policies and policy instruments aimed at reinforcing and consolidating knowledge based economies in emerging societies in Atlantic regions.

Line of Action 4:
Regional Chapters

K4P Alliances has been designed, organized and implemented in terms of "Regional Chapters", following a stepwise approach and making use of the experience of partner institutions in various regions:

- **Latin America and Caribbean Chapter**, including specific actions in: i) **Tropical Biomes** (Amazônia; Cerrado; Mata Atlântica; Caatinga; Pampa; Pantanal); ii) **Tropical mangroves in coastal areas**; iii) different ecosystems in the **Caribbean Sea**, including the region between the main port cities of Cartagena, Barranquilla and Santa Marta; iv) main and **vulnerable bay areas** (e.g., Guanabara bay, in Rio de Janeiro; Todos os Santos Bay, in Bahia).
- **Sub-Saharan Africa Chapter**, including specific actions in **sub-Saharan África** (including Senegal, Cape Verde; Guinea Bissau, Benin, Ghana, S. Tomé e Príncipe, Angola, Mozambique, South Africa, Rwanda) aiming to : i) **characterization of biodiversity levels** through changes in natural land use, pollution, and variations in CO2 concentrations in the atmosphere, changes in the nitrogen cycle and acid rain, climate change, and the introduction of exotic species; ii) development of **pilot projects for local bioeconomies** in a wide variety of climate zones and precipitation patterns, based on the characterization of landforms from rift valleys to mountains and deserts; and iii) development of **pilot projects oriented to foster human nutrition** and related influence on world food production, in a way to ensure the sustainable productivity of soils and to provid the genetic resources for all crops, livestock, and marine species harvested for food.
- **Ocean Chapter**, including specific actions with: i) Pilot projects for **ocean and marine biology mapping** making use of advanced, satellite-based, ocean observation methods; ii) Pilot Projects for **"ocean interactions"** to better map ocean-energy-climate interactions; and iii) Pilot Projects for **offshore aquaculture**;
- Other chapters to be considered, may include:
  - **Indo-Pacific**;
  - **Europe**, including specific actions and pilot projects in **Portugal**, the **South European Mediterranean Forest** and in the **Nordic Forests**;
  - **California**, through the "California Forest Observatory", particularly for international comparison;
  - others to be identified.

6. Proposed Pilot Projects and Initiatives, at launching phase

The initiative K4P Alliances is based on the implementation of **long-term sustainable collaborative projects** in Latin America and Africa that stimulate research and innovation activities with the active participation of local communities.

The projects are expected to **leverage existing activities** developed by governmental and/or non-governmental organizations over the last few years, in a way that builds on existing capacities and experience.

Their future expansion and sustainability consider ***collaborative institutional frameworks*** promoting ***cultural movements*** throughout all areas of knowledge to foster the use of data derived from Earth Observation systems in combination with other advanced data acquisition and processing systems. The ultimate goal is to enable ***innovative policies*** and **practices** driven by ***new research*** dealing with complex landscapes, including those in vulnerable urban areas and rural landscapes.

The paragraphs below briefly describe projects in different stages of preparation and development, some of which will take the form of ***collaborative laboratories*** engaging people and experts throughout all areas of knowledge and involving interface and intermediation activities with the public and private sectors, as well as civil society organizations and local actors.

Most of projects described below resulted from the follow-up of the meeting and related discussions organized in the Arrábida Convent, September 5-7, 2022, by the Institute for Prospective Studies[62]. All the projects leverage existing activities and build on activities developed over the last few years. They are being subjected to assessment processes and funding reviews, in a project-by-project base, to be followed by their potential implementation in the coming years.

62 https://institutoprospectiva.pt/en/index.html

River Meandro, Amazon, Brasil, 2022; by Rui Ribeiro

Maio, Cape Verde 2021 by Victor Svistunov on Unsplash

Western Sub-Saharan Africa: CAVIC - Cape Verde Innovation Centre for Green and Blue Growth

The Cape Verde Innovation Centre for Green and Blue Growth - CAVIC aims to foster the sustainable growth of Sub-Saharan Western Africa together with innovation activities for blue and green growth in the Mid Atlantic.

CAVIC will be focused on the use of digital advanced information and Earth Observation systems for four main areas of interest:

- sustainable urban growth, promoting Sustainable and Healthy Territories in the expanding urban contexts of Sub-Saharan Western Africa through research and innovative social practices;
- the blue economy, including the monitoring and protection of coastal areas, maritime surveillance, and monitoring of maritime traffic, as well as the monitoring of the biodiversity of the ocean;
- the green bioeconomy, including the development of an open access library of natural products to contribute to the valorisation of biological assets, while fostering a low carbon bioeconomy and innovation in land use to develop sustainable agrobusinesses; and
- sustainable energy, promoting the adoption of renewable energies and their integration in the electricity networks through smart energy grids.

To achieve these goals, CAVIC will consider and include the development of innovation services and capacity building initiatives, while complying with European cybersecurity standards to become part of the cybersecurity preparedness facility of Cabo Verde.

The Centre will be focused in addressing the conditions towards the sustainable economic, social and environmental development of West Africa, which have been discussed in recent years by ECOWAS and resulted in the establishment of ECREEE has a specialized agency with headquarters in Cabo Verde to help improving access to modern, reliable and affordable energy services, energy security and reduction of negative environmental externalities of the energy system.

Emphasis will be on the following actions in the short term:

- Deployment of dedicated equipment in existing **Data Centre for Earth Observation and related scientific, technological and innovation activities for blue and green growth**, pooling existing ***digital resources*** in Cabo Verde and in Western Sub-Saharan Africa, in close cooperation with main public and private regional actors in the area of green economy. The Data Centre will also be tailored to address local needs and ensure highest possible energy efficiency of operations;
- An effective **international network and international connectivity pathway**, including the **EurAfrica Gateway**), through the engagement of the **Atlantic International Research Centre, AIR Centre**, and its main role as coordinator of an European funded CSA under the mission "EU Mission Restore our Ocean and Waters by 2030" (with EC´s Horizon Europe funding for 2023-2027). CAVIC will become fully integrated in the AIR Centre network;
- Fostering a **Digital connectivity infrastructure**, including international connectivity (the EurAfrica Gateway), the Regional Fiber backbones and Satellite connectivity, together with **Secure EurAfrica Gateway Cable**; CAVIC will comply with **European cybersecurity standards and the 5G Toolbox**, aiming to become part of the ***cybersecurity preparedness facility of Cabo Verde***;
- Strengthening **regional cohesion and networks in Western Sub-Saharan Africa** in the area of **urban expansion, environmental monitoring, natural resources management and support to fisheries**, through remote sensing services using geospatial technologies to provide decision support and planning tools for sustainable social and economic development. This will include a close **articulation with existing services in Western Africa**, including in Senegal, Ghana and Nigeria, as well as with inter-governmental organizations, such as the ***Sub-Regional Fisheries Commission*** (SRFC);
- Further reinforcing **Cabo Verde's ambition on becoming a Digital Hub** in Sub-Saharan Western Africa and increasing digital connectivity for underserved countries, leveraging capabilities to create social impact and bring value to industry (SMEs, start-ups) and society. Through an investment opportunity in the Amilcar Cabral submarine cable, connecting Cabo Verde to the underserved countries of Guinea, Guinea-Bissau, Liberia, Sierra Leone and The Gambia increasing their resilience and connecting them to EllaLink. Evaluated with the ongoing feasibility study by ECOWAS to identify operating model, model for implementation and corresponding funding requirements.

CAVIC will explore the experience of the Atlantic International Research Centre – AIR Centre, including its "Earth Observation Laboratory" (in the Terceira Island of Azores) and related activities in Brazil (e.g., Rio Janeiro, Ceará) and Africa (e.g., South Africa and Nigeria), to help strengthening regional cohesion and networks in Western Sub-Saharan Africa, including a close articulation with exiting services in Western Africa, including in Senegal, Ghana and Nigeria. Major partners in Cabo include NOSI, The Institute of the Sea (IMar) through the Ocean Science Centre Mindelo (OSCM), The National Institute for Agrarian Research and Development (INIDA), INMG - National Institute of Meteorology and Geophysics, and ENAPOR - Cabo Verde Port Authority.

A joint assessment plan involving regional institutions and the European Space Agency has been organized in the final quarter of 2022 and should result in a detailed implementation plan to be launched in the first semester of 2023.

Main contact points:

- **Emir Sirage**
  AIR Center, Atlantic International Research Center, https://www.aircentre.org/
- **Luis Correia**
  NOSI, Data Centre director; Cabo Verde

Seed Guardians of Agricultural Biodiversity at AMPC, Urok, TINIGUENA Guinea BIssau

Participative innovation with local comunities, TINIGUENA, Guinea Bissau

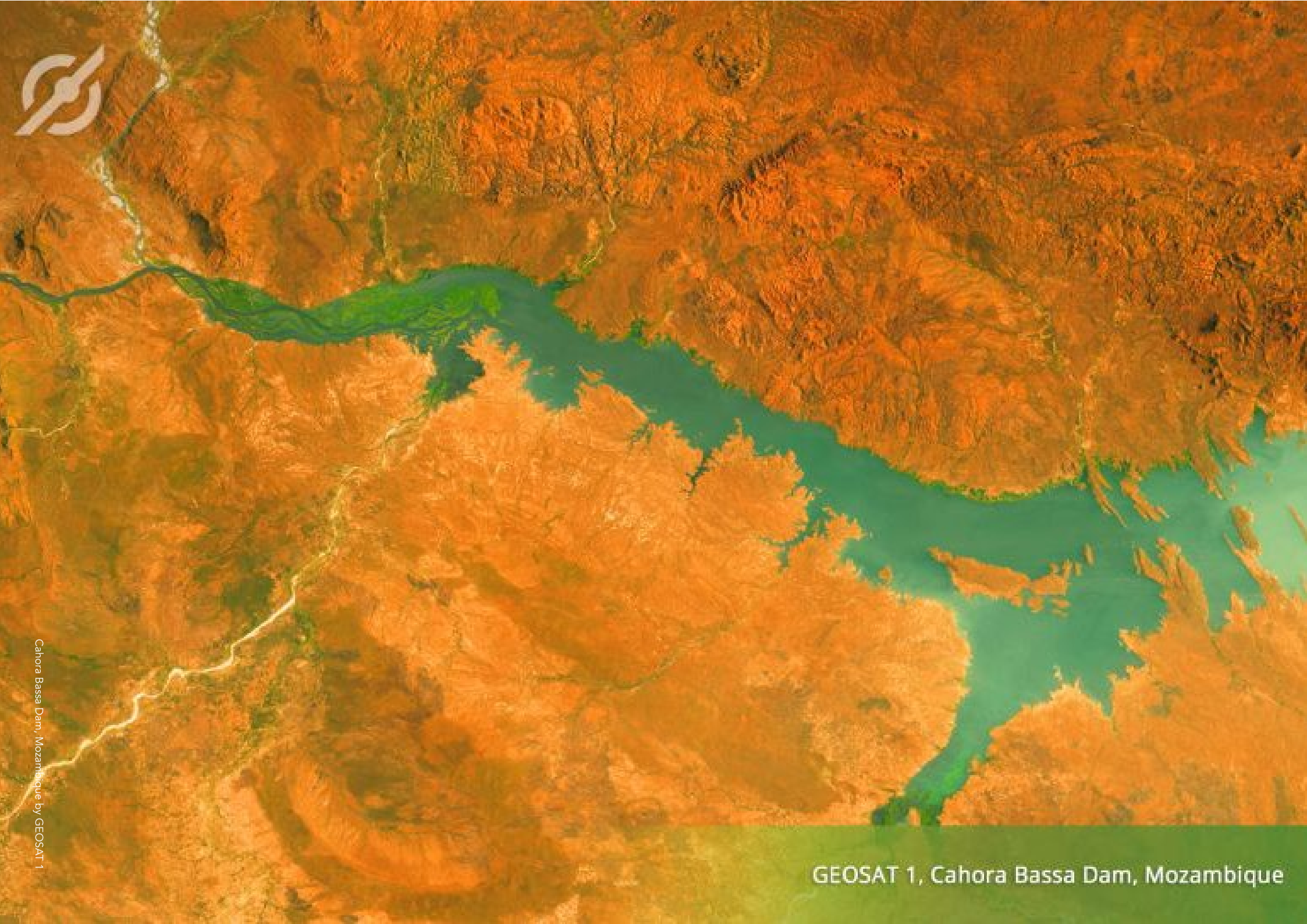
Western Sub-Saharan Africa: Guinea Biodiversity Laboratory

The Biodiversity Laboratory at Guinea-Bissau is a pilot initiative to foster the conservation of biodiversity and natural, cultural, economic and historical heritage in selected areas of Western Sub-Saharan Africa. It aims to leverage different elements of Tiniguena's experience based in the Urok Islands of Guinea-Bissau (i.e., in the northern area of the Bijagós Archipelago), strengthening environmental governance in Guinea-Bissau.

The initiative intends to offer possibilities for professional training, people exchange and skills reinforcement, together with new knowledge production and diffusion and the development of innovative resources for the expansion of citizenship and cultural identities. It has been planned to be based on four distinct interconnected structures: a) the Biodiversity Laboratory in Protected Areas and APAC sites (i.e., "Areas and Territories of Autochthonous Community Heritage"); b) the Biodiversity Documentation Centre, including the installation of a digital biodiversity library; c) the Observatory of Natural Resources; and d) Specialized and professional training and capacity building. It will be focused in specific actions involving local communities addressing the conditions towards the sustainable economic, social and environmental development of Sub-Saharan Western Africa.

Main contact points:

- **Miguel Barros, Emanuel Ramos, Erikson Mendonça** and **Rugui Baldé**
  TINIGUENA, Guinea Bissau



Cahora Bassa Dam, Mozambique by GEOSAT 1

Sub-Saharan Africa: African Institute of Innovation and Digital Systems for Green and Blue Growth (Angola/Mozambique

The Institute aims to promote the sustainable growth of Angola and Mozambique in the context of Sub-Saharan Africa through the development and implementation of digital systems that promote the modernization of public administration, together with energy sustainability, sustainable and healthy urban expansion, sustainable use of land and the blue economy. It will operate in collaboration with the sustainable development of the agro-food sector.

Its creation and implementation follows demographic dynamics in an increasingly digital age supported by **advanced Earth Observation systems integrated with information acquisition and processing systems.** The Institute's activity will include the development and application of new forms of "Responsible Artificial Intelligence" (i.e., "Responsible AI", as well as the digital planning of territories and social and economic activities through "digital twins".
The Institute is intended to promote an inclusive and green transition in the emerging digital age, using new space Earth Observation systems in order to promote ***Sustainable and Healthy Territories*** through research and innovative social practices, together with the creation of new jobs and initiatives that encourage the ecological transition of the economy and society and the understanding of the dynamics emerging in sub-Saharan Africa, giving full priority to "Human Agency"[63].

The Institute will leverage and expand current initiatives and networks of the Atlantic International Research Centre – AIR Centre in Angola, in order to help strengthening regional cohesion and networks in Sub-Saharan Africa, including a close articulation with existing services in South Africa.

The installation of the Institute includes a **gradual and multi-annual work plan**, aimed at implementing and promoting three lines of action, namely: i) **Innovation**, through a network of **collaborative laboratories in various regions of Angola and Mozambique**, involving local actors to stimulate new knowledge and innovation activities; ii) **observation**, namely of land usage, soils and carbon monitoring, as well as of forms of innovation focused on communities and dynamics of sustainable and healthy territories; and iii) **capacity building,** at individual and institutional levels.

The overall project is under assessment in association with an investment effort by the Portuguese cooperation in articulation with European and international programs for cooperation with the Global South.

Main contact points:

- **Emir Sirage**
  AIR Center, Atlantic International Research Center, https://www.aircentre.org/

63 See, for example, UNDP 2022, https://hdr.undp.org/content/human-development-report-2021-22?gclid=EAIaIQobChMI9Jy97_rp-gIV8_LjBx3W4Q3JEAAYASABEgKHevD_BwE; and UNDP 2019, https://hdr.undp.org/content/human-development-report-2019?utm_source=EN&utm_medium=GSR&utm_content=US_UNDP_PaidSearch_Brand_English&utm_campaign=CENTRAL&c_src=CENTRAL&c_src2=GSR&gclid=EAIaIQobChMItY7il_vp-gIVjP7jBx0_6AB0EAAYASAAEgJKGvD_BwE .

Rural Women Guarantees of Production, Secure in Rights and Consolidation of Peace, TINIGUENA, Guinea Bissau

Sub-Saharan Africa: Collaborative laboratory BE-SUSTAIND Africa - Breakthrough technologies for sustainable food systems transformation in Africa

The initiative BrEakthrough technologies for SUSTAINable Food Systems Transformation in Africa focuses on achieving (radical) change in terms of new capacity building, new knowledge implementation and new social behaviour to build resilient, robust and food secure societies.

It considers sustainable food systems as systems that delivers food security and nutrition for all, while using natural resources without damaging the planet and its people, and at the same time contributing to the growth of a country's economy. This is because sustainable food systems transformation through (breakthrough) technology is a socio-cultural process formed and perpetrated through: a) community and participatory inclusion and involvement in implementation of sustainable technological advancements in e.g. water, land, energy systems and b) cultural technological accommodation whereby normative and social conditions contribute to the success of sustainable technological innovations and diffusion of new technologies in the agri-food sector. Many new technologies in the agricultural sector result from the reuse of existing innovations in new contexts so it becomes relevant to stress the historical and cultural backgrounds, as a source of guidance and inspiration for development and innovation.

Africa has an agricultural economy which employs 65–70 percent of Africa's labour force and typically accounts for 30–40 percent of GDP. The continent is uniquely positioned to double or even triple its current agricultural productivity: it is a continent rich in natural resources and has a youthful population of approximately 60 percent. However, Africa has been steadily losing its share of the global market over the last 50 years, with increasingly limited opportunities to use its labour-cost advantage to balance its technology backlog or move towards higher value-added trade. As global agricultural value chains become more knowledge intensive, it becomes more difficult for developing economies with limited access to a skilled workforce and other relevant capabilities to retain a market share.

Africa is heavily dependent on foreign support and investment for its technological development. There are examples of success, but these are mostly small-scale setups ranging from context-specific water collection systems to improve agricultural productivity, to solar panels that provide energy for the processing of agricultural products, to mobile payment systems to provide market access for farmers in rural areas, for example. Meeting future demands, improving Africa's economic position and reducing its reliance on foreign dependency will require societal changes and breakthrough technologies that address the uneven impacts of climate change, the dramatic decline of biodiversity and the health

and economic crisis to guarantee a safe and secure food environment for the population in Africa. These include new digital initiatives and technologies for climate- and energy-smart and nutrition-sensitive agriculture, aligned with the socio-cultural process needed to promote the implementation and diffusion of technology for sustainable agricultural development.

More concretely, this initiative focus on **SUSTAINABLE food system transformation** through technology-driven and socio-culturally acceptable modernization of African agriculture. Within this domain, it builds on work of past and on-going projects, such as, Spatial Planning for Agribusiness and Policy Development – SPADE; Partnerships in evidence-based higher Education on food systems and climate change - INSSPIRE; Jardin Pauvre on community allotment gardens in Africa; sustainable livelihood improvement in Humid and Semi-Arid areas of Kenya - ASALI; natural resource management and conflict mitigation in Great Lakes Region - 3C project in Uganda, Rwanda and DR Congo.

The initiative builds on ongoing and current projects in East Africa (Kenya, Uganda and Tanzania - with other potential future ventures in West and South Africa):

- ***Growing cities, growing food: the role of urban agriculture in secondary cities in East Africa*** (urban-urban food linkages). The focus is on knowledge sharing among collaborative actor networks, e.g. local municipalities, social and economic stakeholders and academics) in middle sized cities like Kisumu (fish and vegetable farmers) in Kenya; Mbarara (vegetable farmers) in Uganda and Dodoma (community gardens) in Tanzania with linkages to large cities of, respectively, Nairobi, Kampala and Dar Es Salaam.
- ***Urbanisation as driver of food system transformation and opportunities for rural livelihoods in East Africa*** (urban – rural food linkages). The focus here is on connecting rural areas to agricultural value chains, both in terms of food production and value addition, to contribute to food and nutrition security in urban areas, without jeopardizing food and nutrition security in the rural areas nearby cities (Kisumu and Nairobi in Kenya, Mbarara and Kampala in Uganda, and Dodoma and Dar Es Salaam in Tanzania).
- ***Sustainable water management through social innovation and smart technological solutions in East Africa)***. (water and food linkages) This topic will address societal water-related challenges arising from climate change that disproportionately affects the semi-arid areas of Kenya (Kitui and Kajiado County), Uganda, and (Dodoma region) in Tanzania (e.g., Kenya and Tanzania), by combining appropriate social innovation and smart technological solutions to achieve adaptation to climate change in a sustainable way.

More specific information per city and relevant collaborations within the proposed Collaborative Laboratory are listed below:

Kenya:
Kisumu as medium city (located along Lake Victoria; 367,000 inhabitants) and Nairobi (4,922,192 inhabitants)

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Kisumu as medium city (located along Lake Victoria; 367,000 inhabitants) and Nairobi (4,922,192 inhabitants)
Interested people:

- Maseno University (Kisumu): Dr Lilian Omondi, Prof George Onyango
- South Eastern Kenya University (Kitui): Dr Moses Mwangi, Dr Harun Kiruki
- Moi University: Dr Rose Ramkat, Prof Ambrose Kiprop
- University of Nairobi: Prof Madara Ogot
- SPADE's Multistakeholder platform (founded through Nuffic funded project)
- Food Liaison Advisory Group (FLAG), a food policy-oriented platform with extensive network (70+ partners). supported by the FAO to promote urban agriculture for food security in Kisumu County
- Mango producer Mr Francis Kiplagat in Kerio Valley, Elgeyo Marakwet County
- Livestock breeder= - entrepreneur Mr Willy Kirwa
- Biogas International Limited: Mr Dominic Wanjihia Kahumbu (CEO)

Uganda:
Cities to be considered in Uganda: Kampala (1,208,544 inhabitants); Mbarara (91, 867 inhabitants)

- Interested people:
- Mbarara University of Science & Technology (MUST: Dr Ronald Twongyeirwe
- Makarere University, Kampala: Dr Shamilah Namusisi, Dr Charles Drago Kato
- Makerere University Private Sector Forum
- Institute of Tropical Forest Conservation (ITFC), Mbarara: Dr Robert Bitariho, Dr Dennis Babaasa
- Participatory Ecological Land Use Management (PELUM) Uganda
- AgriProFocus Uganda

Tanzania:

- Tanzania Engineering and Manufacturing Design Organization (TEMDO): Dr Frederick Cassian Kahimba, Director General, Dr. Sigsbert Mmassy (Marketing/Agrosytems, TEMDO), Eng. Patrick Kivanda (Climate-Smart Technologies/Cold-rooms technologies/ Energy Engineering, TEMDO)
- Sokoine University of Agriculture: Soil-Water management research group

Coordination:
Dr. Denyse Snelder, Center for International Cooperation, Vrije Universiteit Amsterdam, The Netherlands
Dr. Sandra Hasanefendic, Research group Breakthrough Technologies and Sustainable Innovation, Faculty of Science Vrije Universiteit Amsterdam, The Netherlands,

The team at the Center for International Cooperation and Faculty of Science Vrije Universiteit Amsterdam facilitating and scientific coordination staff, includes: Dr Henk van den Heuvel; Dr Bart Bossink; Ms Sabina Di Prima; Ms Mekky Zaidi; and Ms Colette Gerards.

Cattle by the water, Taré, Burkina Fasso 2013 by CIFOR on Flickr

Sub-Saharan Africa: South African Collaboratory on Applied Remote Sensing for Sustainable Growth

This initiative is intended to help promoting the green transition and sustainable growth of South Africa, making use of advanced remote sensing and Earth Observation systems in the context of sub-Saharan Africa. It will leverage and expand current initiatives and networks among SANSA (South Africa Space Agency), Digital Earth Africa and CSIR, together with the networks established by the Atlantic International Research Centre – AIR Centre in South Africa. Emphasis will be in monitoring blue carbon ecosystems to support green growth and grey infrastructures.

It should be noted that a SANSA "user needs" study has recently showed that over 100 users from over 50 institutes across a wide array of public and private organizations in South Africa aspire to have access to:

- highly multi-thematic decision support systems indicating risk, vulnerability and opportunity across built and ecological infrastructures;
- Actionable intelligence for decision making across user archetypes, providing co-designed, highly-synthesized information using easily-used interfaces;
- More highly skilled and predictive decision support systems, based on the use of multi-thematic artificial intelligence;
- Intelligence available more frequently and at higher spatial resolution, with dynamic risk & opportunity assessment a high priority;
- Ability to plan infrastructure based on predictive climate risks and socio-economic impact.

The Earth Observation (EO) value stack refers to the sequential process of adding greater user-focused intelligence to EO data, which is a process critical to broader uptake and economic impact. Ideally this approach maximizes the co-design aspects of development, and allows iterative development along the emerging services value chain.

The installation of the *Collaboratory* includes a **gradual and multi-annual work plan**, aimed at implementing and promoting three lines of action, namely: i) **Innovation**, through a network of new and sustainable business innovations in various regions of South Africa, involving local actors to stimulate new knowledge and innovation activities; ii) **observation**, namely

of land usage, soils and carbon monitoring, as well as of forms of innovation focused on communities and dynamics of sustainable and healthy territories; and iii) **capacity building**, at individual and institutional levels.

The overall project will benefit from the experience of the following main partners:

- SANSA:
  - DE Africa & DESA (emerging high-resolution cube);
  - NEO Frontiers (±€4M EO R&D programme);
  - Africultures services & data ecologies;
  - School outreach ±35K students per year;
  - Existing & emerging services, mandate & network;
- DIGITAL Earth Africa:
  - Established continental EO cloud platform providing powerful & scalable African ownership of cloud & service development;
  - Existing data ecologies, product & services development group;
  - Ability to implement & co-design new ecologies and services;
- CSIR:
  - Providers of existing MarCoSio (GMES-Africa marine services) and OCIMS (SA national marine services);
  - Strong capabilities in co-designed marine service development and HCD;
- Atlantic International Research Centre – AIR Centre:
  - International cooperation and network, south-south and south-north/north-south;
  - Existing & emerging services, including through the AIR Centre EO Laboratory in Azores (ESA lab);

Main users in the South African innovation ecosystem include relevant "Actors", critical "resources" and "enabling environmental institutions", as follows:

- AGRI SA – Agriculture industry federated association
- SADSTIA, SAPFIA, AASA – Fisheries & aquaculture industry associations
- AGRIKOOL – Agriculture e-commerce platform for small scale
- ABALOBI – Tech startup adding substantial value to small scale fishers
- SBWQFT – Community NGO Saldanha Bay Water Quality
- SACGLF - Southern African Community Grantmakers Leadership Forum
- SANSA – School science outreach programme
- CSIR, SAEON, ARC NMU, CPUT, UCT, UP, among others – South Africa tertiary and R&D institutes
- DBSA, PICC – African development finance & infrastructure

- SASAE, DALRRD – Agriculture extension services
- DFFE, DALRRD, DSI, DWS, DoD, DMRE, DoD, among others – National government
- SANBI - System of Environmental – Economic & Ecosystem Accounting
- COGTA & District Delivery Model – Local & municipal government

The ultimate goal of the Collaboratory is to leverage and expand current activities on building data ecologies across application domains, such as those from SANSA, DE Africa, MarCoSio/OCIMS, Africultures & NEOFrontiers. This requires bringing together sufficient and appropriate high resolution EO products, through a multi-scale approach in order to be able demonstrating "multi thematic intelligence", including innovative forms to address the following issues:

- Food security sustainability & equity for provisioning ecosystem services;
- Ecosystem restoration for supporting ecosystem services;
- Carbon bioeconomies & blue carbon;
- One health approaches to sustainable development;
- Intelligent integrated risk guidance for development.

Main contact points:

- **Stewart Bernard**
  SANSA, South Africa Space Agency; CSRI.
- **José Luís Moutinho**
  AIR Center, Atlantic International Research Center, https://www.aircentre.org/

All Saints Bay, Bahia, Brazil. Image CBERS-4MUX, Processed by INPEOceans

Brazil: Collaborative laboratory on data ecologies towards environmental health

This initiative aims to leverage new types of data and analytical approaches to address challenges related to Brazil´s environmental health conditions. It includes the development and dissemination of novel approaches to deal with inequalities and facilitating the development of "sustainable and healthy territories", in association with the development of innovative policy frameworks. The ultimate goal is to use advanced data acquisition and processing systems combined with data derived from Earth Observation systems to enable innovative policies and practices driven by new research dealing with environmental health. It considers innovation in sustainable and healthy territories, integrating the "One Health" concept and the development of innovative systems for the safety of populations, with the involvement of communities and including food security, health security, job security, access to education and culture, together with sustainable development of vulnerable communities and community security policies.

The design of the initiative considers leveraging existing activities of Fiocruz in Brazil with different scopes, length scales and focus (national; metropolitan and regional mixed urban/rural; urban/local), as follows:

i. Scope 1 - Data analysis at national level, with comparative regional and international analysis;
ii. Scope 2 - Southeastern Regional level: Bocaina Region (i.e., the Brazilian southeastern region between Rio de Janeiro and São Paulo);
iii. Scope 3 - Northeastern Regional level: All Saints Bay, Salvador, Bahia State; and
iv. Scope 4 - Urban/Local level: "Comunidade da Maré", Rio de Janeiro;

It should be noted that Fiocruz took scientific knowledge to all social sectors during the pandemic, but at the same time strengthened network actions. The initiatives undertaken made it possible to reduce the impact of Covid19 in situation of great social vulnerability. It is clear today that it is not possible to think about inequality without recognizing social diversity and unequal access to basic rights, this an effective committed to defending those in the margins. In societal terms, this means the critical need to effectively empower change. Health and education, with technology and innovation, provide means to change the current situation in slums and outskirts, but need to have societal commitment at large.

<u>Scope 1 - national level:</u> Data analysis at national level, with comparative regional and international analysis

This component considers leveraging the activities at the main Fiocruz´s data Centre, CIDACS (https://cidacs.bahia.fiocruz.br/en/, located in Salvador, Bahia), in partnership with actors across Brazil. It includes the identification and processing of "data sets" with the necessary temporal, spatial, social and individual resolutions, together with the development of innovative research, policy and practice, encompassing the following themes:

- **Effects of social policies on health outcomes:** making use of Brazilian and other databases to generate scientific knowledge and provide comparative evidence to support: i) public policymaking; and/or ii) individual/collective decision-making;
- **Effect of public security policies and police behaviour on public security in vulnerable urban contexts** (i.e., Brazilian Favelas): making use of Brazilian and other databases to generate scientific knowledge and provide comparative evidence to support: i) public policymaking; and/or ii) individual/collective decision-making;
- **Effect of income inequality on health outcomes:** looking at specific data sets in vulnerable urban landscapes (e.g., in Southeast Brazilian favelas of Rio de Janeiro / São Paulo favelas) in comparison with average population indicators to support: i) public policymaking; and/or ii) individual/collective decision-making;

The analysis will consider specific data sets in vulnerable urban landscapes (e.g., in Southeast and Northeast Brazilian favelas) in comparison with average population indicators, including:

a. targeting **"ETHNO-RACIAL INEQUALITIES"** (e.g., Quilombola Families; Indigenous Families; Gypsy Families), with **"environmental health issues "**,
b. targeting **"ENVIRONMENTAL INEQUALITIES, including RURAL ENVIRONMENT"** (e.g., Family Farmers; Artisanal Fishermen Families; Riverside Families; as well as Extractive Families), including in specific zones affected with forest dismantling (e.g. State of Acre in the border of Amazonia) or in specific wetlands (i.e., "manguezais");
c. targeting **"WATER QUALITY INEQUALITIES"** (e.g., in Southeast Brazilian favelas of Rio de Janeiro) in association with the level of adoption of water management/sanitary policies.

In addition, it will consider interdisciplinary research and analysis on the effects of social, labour and environmental policies on different health and human outcomes (including quality of job creation), making use of integrated Brazilian and/or international databases to generate scientific knowledge and provide evidence to support: i) public policymaking; and/or ii) individual/collective decision-making.

Since its creation in December, 2016, CIDACS has continuously developed robust infrastructure, data governance and sharing frameworks, and operational protocols for the acquisition, management, and linkage of large-scale, nationwide, administratively collected electronic health and social records in Brazil. CIDACS currently houses two core biomedical data resources:

- The 100 Million Brazilian Cohort (N=131,697,800 low-income individuals, 2001-2018), which was initially developed to investigate the impact of social policies and social determinants on the health of the low-income population of Brazil who apply for social benefits through the Unified Registry of Social Programs (Cadastro Único). The dynamic cohort links (i) geocoded individual-level health records, including information on deaths, births, notifiable infectious diseases and their treatments, hospital admissions, and anthropometrics, (ii) neighbourhood-level, household-level, and individual-level socioeconomic data, and (iii) intervention-related data on social policies, such as the Bolsa Família conditional cash transfer programme, the Cisternas water collection programme, and the Minha Casa Minha Vida affordable housing programme.
- The CIDACS Birth Cohort (N=28,631,390 liveborn children, 2001-2018), which was initially developed to investigate the impact of prenatal and early life events on health-related outcomes for infants, children, adolescents, and pregnant persons in the context of social inequalities. The dynamic cohort links birth records from the Information System of Live Births (SINASC, Sistema de Informação sobre Nascidos Vivos) with socioeconomic data from The 100 Million Brazilian Cohort and health outcome-related data on deaths, notifiable infectious diseases and their treatments, hospital admissions, and anthropometrics.

The resources offer unique advantages for conducting research to improve the health of low-income populations:

- Size. The CIDACS data resources provide unparalleled power to investigate rare health outcomes (e.g., leprosy), health services and outcomes in disadvantaged groups (e.g., migrants, indigenous communities, persons experiencing homelessness), and interactions between social and climate-mediated exposures on health (e.g., interaction of local deprivation and temperature on burden of arthropod-borne virus infections).
- Follow-up. The CIDACS data resources include individual-level longitudinal data from as early as 2001. This long-term follow-up facilitates research that uses a life course perspective (e.g., from infancy to adolescence in the CIDACS Birth Cohort), considers changes over time (e.g., rural-to-urban internal migration), and investigates temporal effects (e.g., COVID-19 pandemic-related disruptions to health services and outcomes).
- Resolution. The CIDACS data resources enable nationwide comparisons of social, environmental, and health inequalities at a local resolution. Individual-level information on socioeconomic and health outcomes has the potential to be linked with neighbourhood-level exposures (e.g., small area deprivation index, primary care quality, weather station data).
- Setting. Although they share some similarities with available resources in the United Kingdom, Denmark, and other high-income countries, the CIDACS data resources are unparalleled within the Low- and Middle-Income Country (LMIC) context. The setting of Brazil -- a large and socially diverse country with extraordinary diversity in terms of socioeconomic, geographical, climatic, and ecological factors -- enables investigators to test hypotheses that are currently impossible to evaluate or insufficiently tested given the limitations of existing cohorts.

The focus will be on health impact of policies designed to affect socio-economic factors, including labour markets (e.g., quality of job creation), as well as new research with data science and related methods using AI using the CIDACS data set of 100 million Brazilian Cohort. The goal is to particularly address the issues of "unsettled minds" (see, for example, UNDP 2022) and mental health, in association with "quality of jobs" (created and existing), as well as overall socio-environmental conditions. Examples of analysis to be made may include targeting social determinants using cash transfer programs, leveraging the experience of CIDACs over the last few years.

Scope 2 - Southeastern Regional level: Observatory of Sustainable and Healthy Territories of Bocaina (OTSS).

The Observatory of Sustainable and Healthy Territories of Bocaina (OTSS) is located in the largest remnant of preserved Atlantic Forest between the states of Rio de Janeiro and São Paulo. This territory is home of more than 100 traditional indigenous and quilombola communities, recognized as the first living mixed World Heritage site in South America. It is also a territory marked by conflicts and impacts from large undertakings in the areas of energy, critical infrastructures and tourism.

Since 2009, Fiocruz and the Fiocruz Traditional Communities Forum (FCT), the most relevant representation of traditional people of Bocaina, joined efforts that led to the creation in of the Observatory of Sustainable and Healthy Territories of Bocaina (OTSS). The initiative has evolved in the last few years as an advanced campus of Fiocruz and FCT to promote the territorialization of the 2030 Agenda and the effective improvement of sustainability andhealth indicators in the traditional territories of Bocaina.

OTSS works with a methodology for promoting sustainable and healthy territories based in "ecologies of knowledge", shared governance, networks of solidarity and social cartography, including the following activities: i) **strengthening traditional communities forum**; ii) promoting **agroecology**; iii) stimulating **health promotion**; iv) promoting **territory defense's**; v) fostering **community-based tourism**; vi) promoting **ecological sanitation**; vii) promoting **specialized education**; viii) development of a social technologies business incubator and ix) promoting **international cooperation**.

There is a growing number of projects being developed by OTSS, such as: i) Peoples Project, with the characterization of 64 traditional communities; ii) Environmental Education Project (PEA Costa Verde); iii) Capacity Building for Healthy and Sustainable Territories; iv) Learning Territories Platform, with the goal of creating collaborative labs based on nature based social technologies related to promotion, monitoring and evaluation of 2030 Agenda; and v) International Cooperative University (L'UCI); and vi) Social Technology Incubator Platform. The ultimate goal is to use advanced data acquisition and processing systems combined with

data derived from Earth Observation systems to enable innovative policies and practices driven by new research dealing with the complex landscape of Bocaina territories.

Scope 3 - Northeastern Regional level: All-Saints Bay (BTS - "Baía de Todos os Santos")

All-Saints Bay (i.e., "Baía de Todos os Santos – BTS", or "Kirimurê Tupinambá") is a large bay located on the edges of Salvador, the third largest Brazilian city, capital of the state of Bahia. The region had suffered the impact of human actions for many centuries and fails to receive priority attention from public development policies. It exceeds three million inhabitants, with a large part located in Salvador, and current trends in population growth, together with very high levels of poverty deserve attention at local, regional and international levels.

The All-Saints Bay project (i.e., "BTS Project") started in November 2008, with an expected completion date of 30 years, although related results are far from being successfully achieved. The goal is to consider the integrated analysis of data towards improving the quality of the environment together with the quality of life of the population.

The project involves: i) **risk monitoring, communication and capacity building** based on high-resolution satellite-based carbon mapping and observation strategies, integrating advanced data ecologies and modelling; ii) **determination of risk areas for human health** using primary health care electronic health records (PHC EHR); and iii) **modelling with ecological and bioclimatological data** in distinct BTS areas.

The ultimate goal is to use advanced data acquisition and processing systems combined with data derived from Earth Observation systems to enable innovative policies and practices driven by new research dealing with the complex landscape of All-Saints Bay.

It considers methods for: i) combining molecular characterization of environmental microorganisms for monitoring both human and animal health and environmental pollution, as well as capacity building on risk management active-learning methodologies; ii) community-based risk identification, damage reduction and approaches for sustainable land management; iii) advanced analysis of urban expansion processes and related capacity-building strategies toward urban densification patterns leading to effective carbon neutral cities in highly diversified contexts.

Scope 4 - Urban/Local level: Maré, Rio de Janeiro.
The territory of Maré, localized in the northern sector of Rio de Janeiro, involves 16 slums and around 140 thousand inhabitants. It considers a relatively high population density, surpassing more than 96% of Brazilian municipalities.

The initiative to be launched under K4P Alliances considers an interinstitutional,

transdisciplinary and collaborative laboratory aimed to achieve structural change at medium and long term, especially through social technologies connected to innovations in data and knowledge ecologies. The combination of emerging technologies with decisive participation of local communities will be applied in real living conditions, being monitored, and evaluated with the purpose of generating positive impact on the most vulnerable population and on the design and implementation of public policies.

Emphasis will be given on actions to guarantee the basic right of "access to public security for all", which includes access to public health, access to sanitation and water quality, access to education and access to quality jobs, beyond access to a secure daily life. It requires two fundamental investments: i) working with the symbolic field, with the population's imagination, and; ii) valuing the police officer[64].

It should be noted that in the territory of Maré there is **no participation of the population in local processes of institutional corruption**, including those associated with the occupation of the territories by drug dealers and armed groups, as well as their complex relations with local security forces. The process is authoritarian, private and established through military power, just like dictatorships are installed. In view of the absence of the regulatory power of the State in the popular spaces of Maré (as in many other favelas), historically the social relations established there were constituted from the construction of their own regulatory mechanisms.

Consequently, **public security cannot be left to the security forces alone** and it will not be transformed by local corporations. It is increasingly necessary that locally recognized social actors (NGOs, foundations), especially civil society, universities, the media, co-design and implement alternative security initiatives, based on a strong participatory process and people´s engagement.

The rational for the proposed work relies on the fact that many civil society organizations, for example, continue to adopt a merely demanding and "denunciator" stance in relation to police practices, without seeking to build dialogue channels, methodologies and conceptual propositions that contribute to the effective construction of other paradigms. There is simply the desire to remain in a "comfort zone" and not face the sophisticated set of tensions and challenges posed by the various actors of contemporary social reality.

As a result, it is necessary to overcome the traditional and conservative representations, but also the so-called progressive ones, which rely on a simplifying and deterministic logic of the social reality of the "favela" and of the State itself. Thus, only with creative, integrated proposals that articulate different social actors will it be possible to produce innovative public policies for popular spaces in the field of public security. It is, in fact, a matter of "re-signifying" all the policeman's work and his professional condition.

64 See Eliana S Silva (2019), "Testemunhos da Maré", Mórula editores, Rio de Janeiro.

The work will rely in an innovative organizational arrangement involving citizens, civil society organizations, academia, government agencies and private sector. The ultimate goal is to use advanced data acquisition and processing systems combined with data derived from Earth Observation systems to enable innovative policies and practices driven by new research dealing with the complex social landscape of Maré territories.

The initiative will be based on increasingly relevant collaborative efforts among Fiocruz Foundation and Redes da Maré, a civil society organization (i.e., NGO) created by locals in the 1980s, which was formalized in 2007 with the goal of establishing the necessary networks to enforce population basic rights.

Main contact points:

- **Mário Moreira** (Vice President), **Paulo Gadelha** (coordinator, Agenda 2030,) **Fernando Bozza, Romulo Paes, Valcler Rangel, Manoel Barral** (CIDACS- coordinator); and **Maurício Lima Barreto** (CIDACS)
  Fundação Oswaldo Cruz, Fiocruz, Brasil, https://portal.fiocruz.br/
- **Eliana Sousa Silva** (Diretor) and **Luna Arouca**
  Redes da Maré, Rio de Janeiro, Brazil

Chapéu Mangueira Zona Sul do Rio, Brazil

Brazil: Rio Janeiro Metropolitano – A Collaborative Laboratory on sanitation, water quality and environmental risk governance

The initiative Rio Janeiro Metropolitano considers a collaborative laboratory oriented to the challenges of the metropolitan region of Rio de Janeiro, with emphasis on sanitation, water quality and environmental risk governance.

The focus will be on the highly diversified and complex metropolitan area of Rio de Janeiro (with about 7 million people), but considering its complex relationships within the Guanabara Bay, as an oceanic bay in southeastern Brazil, with about 400 km2 and 16 million population. Emphasis will be on the need to guarantee the access to sanitation and quality water for all, which has been a long-standing process of many decades. Water supply systems in Rio de Janeiro have evolved over time, but still lagging behind: i Fountains; ii small local springs; and iii) large systems. This last phase includes the "Guandu System", as the largest world treatment plant, which remains to work properly in terms of the ultimate goal of providing a quality water system for all.

The ultimate goal is to use advanced data acquisition and processing systems combined with data derived from Earth Observation systems to enable innovative sanitation policies and practices driven by new research dealing with the complex landscape of the water system of Rio de Janeiro.

It should also be noted that Rio de Janeiro is one of the most vulnerable cities in Latin America regarding climate change related impacts[65]. Climate scientists at COPPE/UFRJ and the city's own planners believe the city's built environment is at risk of sea level rise, flooding, increased precipitation, and heat islands making large parts of it virtually uninhabitable. Rio de Janeiro's present climate vulnerability is partly a legacy of its historically chaotic and unequal urban development. After ceding the title of national capital to Brasília in 1960, Rio began to sprawl uncontrollably. Within five decades, the metro area's population tripled. Population growth exacerbated the shortage of affordable housing and contributed to the steady expansion of unplanned and improvised neighborhoods westward and northward. Informal settlements, or favelas, proliferated alongside waterways and on hillsides.

Coastal cities such as Rio de Janeiro need to experiment with different strategies to strengthen

65 See, for example, https://foreignpolicy.com/2021/03/27/rio-de-janeiro-natural-disasters-climate-change-urban-planning-adaptation/

climate resilience. There are plenty of ideas out there – including sponge-cities that deploy a combination of repurposed built space, rain gardens, ponds, and wetlands to store excess water, and ambitious eco-restoration projects, such as favela green roofs and green corridors. Nature-based solutions are not just an add-on; they are key to the city's survival and an on-ramp to sustainable economic renewal.

Under this context, the project aims to leverage existing activities in a myriad of government and non-governmental institutions, to be coordinated through a Collaboratory involving the Municipality of Rio de Janeiro and UFRJ/COPPE, among other partners. It will build on relational infrastructures for collective action, but the main focus will be on building a knowledge-based view of the territory to foster adequate sanitation, water quality and environmental risk governance through a community-based participatory process oriented towards promoting a metropolitan system of innovation and competence building.

It will refer to different levels of analysis and implementation, including infrastructures, access, application and services, content development, and digital skills development. The process considers network societies as wide social and economic processes, occurring across time and space, as it requires the dynamic adaptation of water infrastructures, incentives and institutions, in a way that calls our attention for the need to foster learning societies.

The following main initiatives are planned for the Collaborative Laboratory Rio Janeiro Metropolitano:

Action 1: Ganabara Bay Living Laboratory for Sustainable Development:

The Living Lab has as main goal the development and implementation of an operational digital platform for the provision of environmental, social and economic information in and around the Guanabara Bay region. The diagnostic and prognostic information generated comes from different sources, such as: historical databases, in situ and remote data acquisition platforms and numerical computational models.

In addition to the dissemination of such information, the digital platform also involves extension, technical and academic training activities in different research areas. Such activities allow the continuous operation, development and optimization of the platform involving professionals and students from different educational levels.

The digital platform is public available, allowing both the visualization and acquisition of relevant information for different segments of society that use the region of

Guanabara Bay and its surroundings. The project aims to attend demands in different sectors such as: environment, mobility, health, education and others seeking alignment with the UN Sustainable Development Goals.

Data acquisition:

Remote and local data acquisition platforms will be used to monitor in real time the marine and atmospheric conditions of the Guanabara Bay region and its surroundings. Such information, besides being used directly for studies that aim to understand the environmental dynamics of the region, is also used to evaluate the predictions produced by the implemented numerical models. In addition, data of other nature such as social, economic and health will be stored, made available and used for future monitoring of the study region on such aspects.

Environmental Modeling. Atmospheric and oceanic regional models are used to represent temporally and spatially the marine and atmospheric dynamics of the Guanabara Bay region. The models are executed in an operational manner ensuring predictions of up to 48 hours for conditions of surface sea currents, sea level rise, waves, winds, precipitation and other variables for the region of interest. It is intended from the application of data science techniques to use the numerical results generated and the observed data acquired to identify patterns and the consequent development of prediction indices.

Training and Education

The platform will be developed and improved from the interaction between professionals from different areas of science and students from different educational levels. Such interaction will be based on the development of monographs, dissertations and theses that potentially use the platform for the production of knowledge by investing in the technical and scientific training of researchers. In addition, extension activities involving students from the school segment will be planned in order to promote scientific culture from the knowledge of Guanabara Bay.

Action 2: The SisBaHiA®:

Environmental Hydrodynamics Base System is a system registered by Coppe/UFRJ that can be obtained free of charge through the item "Installation, Training and Support" on the website www.sisbahia.coppe.ufrj.br.

The SisBaHiA® has been expanded and improved at Coppe/UFRJ since 1987, through several master's dissertations and doctoral theses, in addition to many research projects. The system has already been adopted in hundreds of studies and projects involving

modeling of natural water bodies, including several on the coast of Rio de Janeiro and specifically in Guanabara Bay. The analyzes include modeling with mean values in the water column (2DH) in the Guanabara Bay and adjacent coastal zone coupled with one-dimensional modeling (1D) in the tributary watersheds. Validated models, that is, calibrated and verified with field data and analyzed by experts, are indispensable tools for studies and projects, for the management and management of natural water bodies, as they allow: diagnostic analyzes and prognostic analyzes.

Action 3: The Guanabara Bay Observatory

This observatory aims to form a pole agglutination and radiator of technical knowledge and scientific with a view to the continued recovery of Guanabara Bay and its basins contributing river basins, in support of the environmental agencies, regulatory agencies, the Committee on Basin and NGOs operating in the region.

Using the water monitoring quality and of the Guanabara Bay biota and contributing watersheds, with the use of techniques and technologies to detection, quantification and biodiversity documentation aquatic, with an emphasis on imaging underwater in areas of high turbidity, in underwater photogrammetry in hydroacoustics, and in the use of environmental DNA (eDNA).

Development of hydrological models and water quality for process simulations of eutrophication caused by launch of loads organics and nutrients in rivers and in the bay of Guanabara. The main objectives of the Guanabara Bay Observatory include: Production and availability of scientific information for opinion public, NGOs, environmental bodies and regulatory agencies, institutions of research and the press in general about the environmental situation of BG; Continuous monitoring on the status of the BG; Governance: Support for the water resources management system conducted by the Guanabara Bay Hydrographic Region Committee and Lagoon Systems of Maricá and Jacarepaguá; Disclosure of data with autonomy and exemption.

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Hortas Comunitarias, Morro do Sossego, Cidade de Duque de Caxias, Baixada Fluminense, RJ

River Meandro, Amazon, Brasil, 2022; by Rui Ribeiro

Brazil – Amazon: Amazon Collaboratory

The imperative: the current model of Amazonian development is leading to a rapid destruction of its unique and incredibly biodiverse ecosystems.

The preservation of the Amazon Rainforest ecosystem is critical for limiting global mean temperature rise to within 1.5 °C, as the region stores 120 billion tons of carbon, or the equivalent of about ten years of all the world's burning of fossil fuels. However, changes in land use and cover, associated with poorly planned mining, agriculture, logging, and hydroelectric projects are quickly contributing to biodiversity and ecosystem services loss in the region. As a key nexus in global climate, the Amazon presents itself as one of the great complex problems of today.

Research projects about the Amazon region have the potential to support and underpin public policy decisions, as well as evidence-based public and private investments. But the articulation between the outcomes of research with other economic sectors is still considered a huge bottleneck to the full enjoyment of the region's vast resources.

The project aims to leverage existing activities promoted through the Amazonia +10 Initiative (https://agencia.fapesp.br/amazon10-initiative-issues-first-call-for-proposals/38991/) through a myriad of government and non-governmental institutions. It is to be coordinated through a Collaboratory involving local partners and cofunding from FAPESP (São Paulo Research Funding Foundation) and other Funding Foundations members of CONFAP (National Council of State Funding Agencies), and CNPq (National Council for Scientific and Technological Development).

The Pan-Amazon is home to 47 million people and Brazilian Legal Amazon is home to 30 million people. Land-use changes reinforce global climate change, leading to positive feedback mechanisms that reduce forest resilience. As a result, the development of a dynamic bioeconomy requires strengthening the value chains of biodiversity products by merging scientific and traditional knowledge.

The Amazon+10 Initiative was recently launched (June 2022) to support collaborative research

projects oriented to biodiversity conservation, adaptation to climate change, protection of traditional peoples and communities, urban challenges, and the bioeconomy as contributions to economic development policy for the Amazon. Initially comprising FAPESP and the nine states of the Brazilian Amazon region, the initial projects involved the participation of public research funding agencies in 20 Brazilian states (São Paulo, Amazonas, Rio de Janeiro, Pará, Paraná, Maranhão, Mato Grosso, Rio Grande do Sul, Amapá, Federal District, Alagoas, Goiás, Paraíba, Pernambuco, Rondônia, Espírito Santo, Piauí, Santa Catarina, Acre, and Tocantins).

Revolving around four main pillars (Biodiversity and Climate Change; Protection of Traditional Communities; Urban Challenges of the Legal Amazon and Bioeconomy as an Economic Development Policy) the Initiative already congregates 20 subnational states in Brazil, all of them represented by their public agencies for the funding of research. In the next months, a series of activities are being programmed to form a community of public and private actors (both local and foreign to the Amazon) that will help to define the research priorities of the region and the main outcomes and outputs of the Initiative.

In doing so, we expect that, through transdisciplinary research and focus on the implementation of its results, science can be the main drive for the transition to sustainable development in the Amazon Region. In the long run, the unique set of natural resources located in the Amazon can serve as a basis for the establishment of an actual Silicon Valley of biodiversity, that is, a world reference center for low carbon agriculture, nature-derived materials, bioengineering, genetics and biochemistry, and the establishment of new regulatory frameworks that reward both the protection of genetic heritage and the offer of ecosystem services – ultimately, a world-renowned center for all things considered as biotechnology.

The initiative has recently finalized its first call, with the following results:

- 39 research projects were selected in three major thematic areas: Territory, Peoples of the Amazon and Strengthening sustainable production chains.
- The first call for proposals of the +10 Amazon Initiative mobilized more than 500 researchers in 20 Brazilian states. 39 proposals were selected from 18 states, plus the Federal District, with investments from State Funding Agencies (FAPs) totaling R$ 41.9 million.
- In addition to the FAPs' investments, the National Council for Scientific and Technological Development (CNPq) announced the contribution of R$ 12 million in research grants for projects approved in the states that compose the Legal Amazon Region.

Overall, the purpose of Amazon+10 is to mobilize researchers throughout Brazil, but especially

in the Amazon, to study and offer concrete solutions to the challenges to sustainable development in the Amazon, including alternative job creation and opportunities for income generation for the people who live in the region. It focuses on solutions considered indispensable to the advancement of sustainable development of Amazonia, observing three priorities:

- Territories with infrastructure and logistics that facilitate multiscale sustainable development;
- Inhabitants of the Amazon as protagonists of biodiversity knowledge and valorization and of adaptation to climate change;
- Strengthening of sustainable supply chains by inhabitants of the Amazon.

The most important action to be taken has been considered to be focused on the commitment to conserve, restore, remediate the rainforest and invest in knowledge to create economically and environmentally sustainable activities to keep the rainforest standing. Under this context, the goal of the new initiative includes leveraging the existing projects and consider two main tasks, as follows:

- ***Amazon Data Centre, including a Natural Product Library and physical/digital collections on the socio-biodiversity of Amazon,*** including:
  - Biological collections (zoological collections; herbaria; viruses and fungi);
  - Anthropology (~50 unknown languages, about of the world, with the largest global number of isolated populations);
  - Digitization of available collections;
  - Development of digital twins of existing biomes;
  - Capacity Building and Training: establish a professional and specialized training program for biodiversity research, including field biology, taxonomists, curatorial activities, and bioinformaticians;
  - The Amazon natural Product Library will consider diversified approaches and including:
    - biodiversity mapping, and scientific expeditions;
    - expansion and safeguarding of available biological collections;
    - bioeconomy chains, and natural products chemistry;
    - metabolomics, high throughput screening;
    - digitization of collections;
    - development of forest digital twins.
- **Improved understanding of the physics of climate change in Amazon**, through advanced remote sensing, technological developments and applications, including the development of radar satellites, artificial intelligence, data science and mapping, taking into consideration the following:

- Further development of Brazilian competencies, including those at INPE and groups at universities, as well as through related activities (Landsat, Saci, SSR, SCD, CBERS) and Deforestation actions (Prodes, Deter);
- Promotion of new NGO actors, including MapBioma and Imazon;
- Further development of Large-Scale Biosphere-Atmosphere in the Amazon (LBA), with several countries;
- Further participation in the reports of the Intergovernmental Panel on Climate Change (IPCC) and leadership of the scientific committee of the International Geosphere Biosphere Program (IGBP).

- **Scale-up / spill-over phase of most promising solutions, with the support of SENAI's Innovation Institutes**, including:
  - Development of match funding mechanisms, with public and industrial sector;
  - Development of pilot-plants for most promissing chemicals that were identified from the Amazon Data Centre;
  - Development of value chains, in partnership with with public and industrial sector;
  - Hosting international researchers;
  - Development of human capital in Brazil, mostly focused on tradicional / local communities in the Amazon Region;
  - Development of solutions for traceability of origin (e.g. with the use of blockchain).

Existing repositories and libraries to be considered under the future Collaboratory include:

- MPEG – "Museu Paraense Emílio Goeldi" (Belém, Pará): The 150-year-old collections, with 1.75 million records, more than 775,000 deposited and digitized in eleven biological collections;
- INPA – "Instituto Nacional de Pesquisas da Amazônia" (Manaus, Amazonas): major reference for Amazonian biodiversity. Biological Scientific Collections Program (PCCB) organized into curatorship on three main thematic areas: Microorganisms, Herbarium, and Zoological (Invertebrates, Fishes, Amphibians and Reptiles, Birds, Mammals and Genetic Resources), that together house > 1.2 million records of its ever-expanding collections. The INPA Herbarium is the largest in the Brazilian Amazon, with more than 237,000 registered copies and is available online;
- JBRJ - "Jardim Botánico, Rio de Janeiro": connecting with the "Flora e Funga do Brasil" Project, which gathers online a list of species of Brazilian Flora and Funga, including nomenclatural information, diagnostic morphology and geographic distribution (coverage in Brazil, endemism and biomes), as well as valuable data regarding life forms, substrate and vegetation types for each species;

- CPA: Digital Repositories of Tropical Forests for the development of scientific, technological and innovation research, oriented to solving problems in tropical forest regions and Amazon;
- SiBBr – Brazilian Biodiversity Information System (MCTI/RNP): 23.8 million records – 161 institutions and 412 collections
- LNBio – "Laboratório Nacional de Biociências": 1,000 active principles - high throughput screening (HTS)
- UNESP: 3,000 active ingredients
- FioCruz Foundation: Collection of Bacteria from the Amazon (CBAM)
- Embrapa
- Instituto Evandro Chagas (MS) – Belém
- SENAI: Institute for Biosynthetics (Rio de Janeiro), Institute for Biodiversity (Brasília), Institute for Mineral Technologies (Belém, Pará), Institute for Microeletronics (Manaus, Amazonas).
- Fraunhofer IGB - Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB

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  CNPq (National Council for Scientific and Technological Development), Brazil - https://www.gov.br/cnpq/

Deforestation fire, Amazon, Brasil, 2022; by Rui Ribeiro

Brazil – South Western Amazon: Acre Ecosystem Restauration Collaboratory for People, Nature and Climate

foster sustainable forest management making use of pilot projects of ecosystem restauration as a tool to revert deforestation vectors on an critically relevant REDD+ Reference Region (i.e., "Reduce Emissions from Deforestation and Forest Degradation" in developing countries, integrated on the United Nations Ecosystem Restauration Decade 2020-2030, of the United Nations Framework Convention on Climate Change, UNFCCC https://redd.unfccc.int/). The pilot projects will use data derived from Earth Observation systems in combination with other advanced data acquisition and processing systems, to enable innovative policies and practices driven by new research dealing with ecosystem restauration and community engagement.

The Brazilian Acre state is located in the westernmost part of Brazil, in the Amazonia Legal, at a two-hour time difference from Brasília. It is bordered clockwise by the Brazilian states of Amazonas and Rondônia to the north and east, the Bolivian department of Pando to the southeast, and the Peruvian regions of Madre de Dios, Ucayali and Loreto to the south and west.

The Acre's REDD+ Reference Area covers 212.213 hectares with a total deforestation area of 31.500 (an average deforestation annual rate of about two thousand hectares since 2005) and an equivalent area of degraded forest areas, where 4 deforestation and forest degradation vectors have been identified, as follows:

1. Expansion of Sena Madureira City;
2. River local population;
3. Settlements in REDD+ project vicinity;
4. Trans-acreana road constriction.

The rationale for the project relies on recent assessments on the linkages between ecosystems and human well-being and, in particular, on "ecosystem services", following the framework provided by the Millennium Ecosystem Assessment[66].

ACRE CoLAB will leverage activities developed by Canopée and CEiiA/Elio Tecnology over the last few years, including the use of digital sensors installed in unmanned autonomous

66 Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. World Resources Institute, Washington DC

space platforms specially built for high resolution ortho-photogrammetry. Recent projects have included the analysis of 15.000 hectares, including the detection of deforestation and, especially, forest degradation rates.

ACRE CoLAB aims to stop and revert deforestation and forest degradation rate, recovering at least ten thousand hectares of deforested or degraded land in 4 years through a well establish ecosystem restauration plan, including the following steps:

- **Observation:** Monitoring of biodiversity, ecosystem health and integrity, and human well-being responses to restoration will be established to determine whether objectives and goals are being met. The engagement of stakeholders in monitoring will be prioritized to promote social learning, capacity development and communication among stakeholder groups and communities of practice.
- **Open Access library:** Establish a base for ecosystem regeneration species in Western Amazon Region, making use of an open access library of basic characteristics and forms of economic exploitation of bioproducts, including existing knowledge bases, as well as through new research. It considers relationships with consumer markets for bioproducts;
- **Research & innovation:** Promote new research and innovation activities oriented towards forest-based housing, clean water access and sanitation;
- **Capacity Building and Training:** Establish a professional and specialized training program for plant production and ecosystem regeneration;
- **Community engagement:** Engaging local communities and establish sustainable forest management teams;
- **Outreach:** Promote cooperation with other degraded and deforested areas in the "Amazon Arch", reaching a total deforested area of about 83 million hectares, as well as to other Amazon countries, like Bolivia, Peru, Ecuador, Colombia, Venezuela, Suriname e as Guianas.

The CoLAB Impact will be documented and shared both locally and globally. Knowledge about effective practices and innovative approaches will be systematically captured and shared to develop, adapt and replicate successful experiences, and to avoid repeating mistakes.

This will also allow for the identification of knowledge gaps and strategic research and capacity-development priorities. To facilitate the exchange of knowledge and information, platforms and networks for documenting, integrating and sharing that knowledge and information will be developed and made widely available through regularly updated, easily accessible, understandable and culturally appropriate communication and dissemination channels (taking into account languages and literacy levels).

Main implementation principles have been designed and assessed to include the following:

- Guarantee that ecosystem restoration activities result in a net gain for biodiversity and ecosystem integrity, together with human well-being, sustainable production of goods and services. They must consider activities to replace forest degradation and assist recovering activities, accounting for environmental change;
- Enhance (and not replace) nature conservation, especially in areas with high ecological integrity and high value of ecological connectivity. Particular attention is to be considered in Indigenous territories and traditional communities. This is because management practices intended to be restorative should support and assist natural recovery processes and not cause further degradation. For example, the use of genetically appropriate germplasm of native species should be favored, whereas non-native species potentially or already proven to be invasive should be avoided;
- Address the direct and indirect causes of ecosystem degradation and fragmentation, as well as losses of biodiversity and ecosystem goods and services. If the causes are not properly addressed, restorative activities may fail over the long term. During the planning phase of restoration projects, the degree and causes of degradation should be identified, and actions should be developed to reduce and mitigate their impacts at the appropriate scale. These actions should include eliminating incentives that directly or indirectly promote ecosystem degradation;
- Guarantee knowledge integration to foster inclusive and consensual decision-making throughout the process, while enabling full participation of local stakeholders and right-holders. Likewise, capacity-development efforts should be focused on promoting mutual learning, as well as knowledge-sharing among stakeholders and communities of practice at local, national and global levels;
- Adequately address land-level factors, including threats from the larger landscape, exchanges of energy and organisms across ecosystem boundaries, ecological and hydrological connectivity, and transboundary effects;
- Contribute to achieve the climate and land-degradation neutrality goals of the Rio Conventions – CBD, United Nations Convention to Combat Desertification (UNCCD) and United Nations Framework Convention on Climate Change (UNFCCC);
- Engage diversified stakeholders, including under-represented groups (e.g., local communities, Indigenous peoples, ethnic minorities).

Main challenges to guarantee maximizing long-term net gain from restorative activities require:

- coordinating actions among institutions, sectors and stakeholders, through a well-functioning governance system;

- fostering local, national and international political commitment and transboundary agreements;
- providing capacity-development opportunities to empower people, organizations, institutions and networks involved in restoration;
- mainstreaming effective practices to have broad influence and allow replication;
- identifying, mobilizing and maintaining adequate funding (from government, the private sector, international organizations, or other sources) to complete all phases of the process;
- developing income mechanisms (e.g., through sustainable production, ecotourism, payment for ecosystem services and other sustainable uses of natural resources) that do not compromise the integrity of the restoration process and support its financial viability; and
- protecting the security of stakeholders and right-holders, especially in areas of political conflict or conflict over natural resources. Likewise, promoting and replicating successful ecosystem restoration activities and approaches will facilitate and influence the design of laws, policies and measures – at local, national and global levels – to help prevent, halt and reverse ecosystem degradation.

Main contact points:

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Female empowerment in the fight against hunger, Rio de Janeiro, Brazil

Low-Carbon Agriculture and Livestock Production in Brazil (Serrado + Mata Atlântica)

Brazil – Sustainable territories for low carbon agriculture and livestock production Collaboratory

The project aims to leverage existing activities promoting Low-Carbon Agriculture and Livestock Production in Brazil, with a focus in the regions of the Serrado and Atlantic Forest biomes. The rational of the project derives from the fact that Brazil is the world largest producer of several commodities, including animal and vegetal proteins, with a potential for the recuperation of degraded "green areas" (i.e., "Pastos") of about 48 million hectares. In addition, the production areas are far away from consumer and exporting regions, leading to a huge impact of food logistics and transportation on climate change.

The project relies on recent assessments on the linkages between ecosystems and human well-being and, in particular, on "ecosystem services", following the framework provided by the *Millennium Ecosystem Assessment*[67], as well as the UN´s Global Livestock Environmental Assessment Model (GLEAM)[68]. In addition, it considers the "Livestock Environmental Assessment and Performance – LEAP" partnership[69], as a multi-stakeholder initiative that seeks to improve the environmental sustainability of the livestock sector through harmonized methods, metrics, and data. LEAP leads a coordinated global initiative to accelerate the sustainable development of livestock supply chain and to support coherent climate actions, while contributing to the achievement of the 2030 Agenda for Sustainable Development and the Paris Agreement.

The Sustainable Territories for Low Carbon Agriculture and Livestock Production Collaboratory will leverage activities developed by Conexión Bioceanica, EMBRAPA and CEiiA/Elio Tecnology over the last few years, including the use of digital sensors installed in unmanned autonomous space platforms specially built for high resolution ortho-photogrammetry. In particular, the experience of Embrapa´s "ILPF - Innovation, with Integration of Agriculture, Livestock and Forest" (i.e., "ILPF - Inovação, com Integração de Lavoura, Pecuária e Floresta") will be leveraged under the following context:

- The valorisation of agricultural resources is one of the biggest challenges for production in Brasil and Latin America;
- Integrate sustainable territories in food logistics to support low-carbon agriculture and livestock production, developing optimization routes, low-carbon energy transportation,

67 Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. World Resources Institute, Washington DC
68 https://www.fao.org/gleam/dashboard-old/en/
69 https://www.fao.org/partnerships/leap/en/

bioceanic integration for logistics optimization;

- The recovery technology that allows the production of high added-value products will have a huge impact on production and additional income for producers, with relatively low levels of investment. It may also allow for the production of biochar (i.e., "Biocarvão") which will reduce the ecological footprint of crops, if properly used together with regenerative agriculture techniques.

Expected outcomes, include:

- Poverty alleviation and local job creation and employment;
- Increase of carbon stocks in the recovered areas, promoting new levels of carbon sequestration, with maintenance of carbon stocks in existing forests areas in food production farms (APP´s Permanente Preservation areas, and RL – Legal Forest reservation);
- Increase in soil carbon stocks through the incorporation of biochar;
- Reduction of waste odors with reduced acute lower respiratory infections, together with improved quality of life for farmers;
- Establishing "ecosystem corridors" for wildlife;
- Promote "sustainable territories" of food production integrating low-carbon agriculture with log-carbon food logistics along the food value chain (i.e., between food production areas and consumers, including the exporting infrastructure).

Main contact points:

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Hortas Comunitárias, Morro do Sossego, Cidade de Duque de Caxias, Baixada Fluminense, RJ

Amazónia High resolution imagery obtained by Geosat 2 satellite (GEOSAT), 2022

Brazil – Mangrove ecosystem management for blue carbon stocks growth dynamics in Southern Brazil

This initiative aims to foster regional bioeconomies in Southern Brazil based on adaptation measures for mangrove restoration and coastal resilience, together with the creation of new jobs in regional contexts strongly affected by climate change. It considers the development of a "collaborative laboratory" with local institutions to promote the use of advanced digital systems integrated with in-situ techniques for the analysis, quantification and valorisation of the variation in mangrove carbon stocks[70], as well their loss and recovery due to natural and(or) land-use changes. The ultimate goal is to foster Mangrove Ecosystem Management through the sustainable and natural growth/ exploration of blue carbon in natural mangroves.

The project is focused in two of the most important subtropical estuarine environments in Southern Brazil, respectively Bay of Paranaguá, in the state of Paraná, and Babitonga Bay in Santa Catarina.

The rational of the project derives from the fact that Brazil has the third mangrove extension in the world[71], and mangrove forests are one of the most productive and efficient long-term natural carbon sinks and as such have been identified alongside seagrasses and saltmarshes as key 'blue carbon' ecosystems[72]. Typically, they store up to 15 times more carbon per hectare than terrestrial soils and sequester carbon 10–50 times faster than terrestrial forests[73].

The regional context is affected by high level of social and economic vulnerability, which can only be tackled through new forms of ecosystem management and social intervention through the economic valorisation of carbon stocks in the mangroves (i.e., "blue carbon). The project will introduce and leverage the use of new methodologies, making use of an "user-driven", people-centred approach, for mangrove ecosystems exploration in Brazil[74].

70 defined as the quantity of carbon held in a habitat pool (e.g., in biomass) at any specified time
71 de Lacerda, L. D., Ferreira, A., Borges, R., & Ward, R. (2022). Mangroves of Brazil. In S. Chandra Das, Pullaiah, & E. C. Ashton (Eds.), Mangroves: biodiversity, livelihoods and conservation (pp. 521-563). Springer, Singapore. https://doi.org/10.1007/978-981-19-0519-3_20
72 Lovelock, C. E., & Duarte, C. M. (2019). Dimensions of blue carbon and emerging perspectives. Biology Letters, 15, 20180781. https://doi. org/10.1098/rsbl.2018.0781
73 da Silva Copertino, M. Add coastal vegetation to the climate critical list. Nature 473, 255 (2011). https://doi.org/10.1038/473255a
74 https://naturalcapitalproject.stanford.edu/software/invest

This project will leverage ongoing activities developed in the South of Brazil by +Atlantic, governmental institutions (Chico Mendes Institute – ICMBIO; Brazil National Council for Scientific and Technological Development – CNPQ, industry and NGO's (APPIX – Innovation and Technology, or Pró-Babitonga Group – GPB, respectively, together with local universities (Federal University of Santa Catarina, UFSC; University of the Vale de Itajaí, UNIVALI). They have considered, over the last few years: i) the development of web-tool Coastal Analyst System from Space Imagery Engine (CASSIE[75]); ii) the development of several projects focused on coastal risks, coastal communities and sea level rise;, and iii) adaptation measures using nature based solutions (mangrove restoration) to improve coastal resilience (e.g., Baysqueeze project[76], RiskPorts project[77]).

The project will contribute to several ongoing activities at local, regional, and national scale, including:

- Local Economy: foster regional bioeconomies in Southern Brazil based on adaptation measures for mangrove restoration and coastal resilience; Foster, develop and implement blue carbon market at local, regional, and national scale.
- Innovation: promote the use of advanced digital systems integrated with in-situ techniques for the analysis, quantification and valorisation of the variation in mangrove carbon stocks
- Outreach: Ocean literacy (e.g., private and public schools) regarding the importance of mangrove ecosystem and all the services provided to society and impacts due to climate changes and coastal management. Engage with local population, NGO's and companies to support preservation and restoration activities.
- Public policy: Contribute to National, Federal, and local public sector actions regarding key coastal managements activities such as PROCOSTA and ORLA project; Contribute to several actions stated in the National Action Plan for Mangroves (PAN Manguezal) coordinated by ICMBio.

Main contact points:

- **Andre Oliveira, Pedro Almeida** – Colab +Atlantic;
- **Rui Ribeiro** CEiiA/Elio Tecnologia, São Paulo, Brazil
- **Marcio Spinosa**
  Fundação Auracária, CONFAP (National Council of State Research Funding Foundations), Brasil; https://confap.org.br/pt/confap

75 https://cassiengine.org/
76 https://baysqueeze.ufsc.br/en/
77 https://riskports.ufsc.br/

Brazil 3D Map

Amazónia High resolution imagery obtained by Geosat 2 satellite (GEOSAT), 2022

Brazil - Araucaria Chair for Sustainable Territory Development

Sustainable Territorial Development (STD) arises from the union of the territorial approach with the principles of sustainability and highlights the need for effective proposals for application, taking into account the specificities of the place, such as political, social, environmental, economic and territorial issues (Flores, Shana Sabbado, 2011).

A critical challenge on STD is the identification of road maps for transformation of territories, urban and rural areas, involving spatial, institutional, political, among other contexts. When dealing with pre-existing territories the challenge is greater, and transition of one scenario to a more healthy scenario ascends in significance.

According to European Environment Agency:

- The environmental challenges ahead of us are global and systemic. Therefore, to achieve long-term sustainability goals, the core systems of our societies will have to change dramatically. That is especially true for the systems related to food, energy, mobility and construction.
- Achieving such transitions will require much more than incremental efficiency improvements. It will instead demand long-term, profound changes in dominant practices, policies and ways of thinking, which will in turn demand new knowledge. It will mean overcoming the short-termism currently dominating political and economic thinking, and instead embracing long-term, integrated, global perspectives.

Such a drive is also true for Latin American countries, mainly for Brazil.

The Araucaria Chair for STD, configures an important ground for international common effort on R&D, coordinated by Brazil (Araucaria Foundation) and France (Institut Mines Telecom). It is a sociotechnics answer for a balanced development concerning K4P. Two main axes will be considered:

1. Occitanic Foresight Laboratory for Territorial Sustainable Development – to subsidize decision making for the development of the regions comprising the Araucaria Chair. It involves "Data Ecologies" towards sober economies, promoting healthier societies, reducing inequalities and improving the interoperability among systems, in the Digital

age. The Laboratory will be inspired and integrated with the Industry Observatory (Observatório da Indústria at Industry Federation of Paraná) located in Curitiba, an asset with more than 18 years of experience.

2. New R&D Arrangement on Territorial Sustainable Development, a collaborative network for Learning, Science and Technology developments. It is a network of researchers and partnerships with people, public and private institutions, national and international, for the implementation of the actions, both academic and project, and with municipalities and regional organizations. The Arrangement started with about 30 S&T Institutions, involving Brazil, Argentine, Paraguay and France.

Main contact points:

- **Marcio Spinosa**
  Fundação Auracária, CONFAP (National Council of State Funding Agencies), Brasil; https://confap.org.br/pt/confap

Envisat Mosaic May – November 2004, ESA

7. Specific alignment with funding mechanisms and sponsoring organizations

Alignment with Global Europe

The initiative K4P Alliances has been designed in terms of the recently revised **International Partnerships funding program launched by the European Commission- DG INTPA** (as in https://ec.europa.eu/international-partnerships/global-europe-programming_en) , among other potential funding sources and a set of private foundations.

In particular, it takes into consideration the revised work plan for DG INTPA, focusing on "Neighbourhood, Development and International Cooperation Instrument (NDICI) – Global Europe", as follows:

> *"In line with the EU global approach to research and innovation, this work programme will tap into the opportunities offered by international cooperation in order to maximise the impact of its actions. It includes dedicated actions to support and strengthen cooperation through international initiatives in areas such as renewable energies, advanced materials and future internet, cybersecurity, global health, environmental observations, ocean- coastal and arctic research, disaster management, and fair, healthy and environment-friendly food systems. It also builds on the ambitious and comprehensive 'Africa Initiative' [...].*
>
> *The openness of the work programme to international cooperation will be balanced with the need to safeguard EU interests in strategic areas, in particular to promote the EU's open strategic autonomy and its technological leadership and competitiveness. In a limited number of cases for actions related to Union strategic assets, interests, autonomy or security, actions will be limited to cooperation between legal entities established in Member States only, Member States and Associated Countries, and/or certain third countries. For duly justified and exceptional reasons participation can also be limited to legal entities established in the Union or in Associated Countries that are not directly or indirectly controlled by non-associated third countries or by legal entities of non-associated third countries, or make the participation of the controlled entities subject to conditions set out in the work programme."*

The process has considered the identification and selection of potential local actors in Africa and Latin America since April 2022, with the capacity and leadership able to

a "Collaborative Laboratory", oriented towards job creation and social/economic development in terms of local contexts. In addition, the program will be organized and implemented in terms of **"Regional Chapters"**, following a stepwise approach and under the terms of the revised work plan for DG INTPA.

The goal is raise about 100 million euros of EC investment for the first phase, 2023-2027 (5 years), to be continued with EC investment at least until 2035.

The collaborative laboratories to be promoted under the K4P Alliances are expected to emphasize the following actions:

- A network of **Data Centers for Earth Observation** and related scientific, technological and innovation activities for blue and green growth, in **fully compliance with European cybersecurity standards and the 5G Toolbox**, aiming to become part of ***local cybersecurity preparedness facilities*** and potential Global Europe regional hubs of cybersecurity;
- An effective **international network and international connectivity pathway** (including the EurAfrica Gateway), through the engagement of the ***Atlantic International Research Centre***, ***AIR center***, and its main role as coordinator of the European funded CSA on "All Atlantic" (with EC´s Horizon Europe funding for 2023-2027). The new laboratories will become fully integrated in the AIR Centre network;
- Fostering a **Digital connectivity infrastructure**, including international connectivity, the Regional Fiber backbones and Satellite connectivity, together with ***Secure EllaLink***, as an optical submarine cable linking the European and South American continents, with very low latency and a newly direct data transfer routes between Europe and South America, as well as **EurAfrica Gateway Cable**.

Potential support from the European Commission considers actions under the following Directorates:

- **DG INTPA – International Partnerships**, https://ec.europa.eu/international-partnerships/global-europe-programming_en;
- **DG RTD – Horizon Europe**

Government Agencies, Public and Private Foundations

K4P Alliances involves several actions with Government Agencies, Public and Private Foundations in Europe, The USA, Africa and Brazil.

The initiative was launched in 2022 with the support of, among others, FLAD – Luso American Development Foundation, https://www.flad.pt/en/.

The initial brainstorm meeting, in September 2022, was organized with the joint support of Orient Foundation, https://www.foriente.pt/, the Fundação Oswaldo Cruz – Fiocruz, CONFAP - National Council of State Funding Agencies (Brazil), CNPq – National Council for Scientific and Technological Development (Brazil), the Futures Institute and COPPE (UFRJ, Brasil), SANSA (South Africa Space Agency), Cabo Verde Government and TINIGUENA (Guinea Bissau), together with that of AIR Center - Atlantic International Research Centre, Ciência Viva, CEiiA – Engineering Centre and of the Center for Innovation, Technology and Policy Research, IN+ @Tecnico, University of Lisbon.

Activities in 2023/24 will consider the support of the Tinker Foundation, through CLAS – Center for Latin America Studies, University of Chicago.

The support of public foundations and institutions in Brazil has been particularly critical in the design of the initiative, including:

- Fundação Oswaldo Cruz, Fiocruz, Brasil, https://portal.fiocruz.br/
- CONFAP, Brazil, https://confap.org.br/en
- CNPq, Brazil, https://www.gov.br/cnpq
- FAPESP, São Paulo, Brasil, https://fapesp.br/en
- Fundação Araucária, Curitiba, Paraná, Brasil, https://www.fappr.pr.gov.br/
- Instituto Rio Metropolitano, Governo do Estado do Rio de Janeiro

Forest storm, Amazon, Brasil, 2022; by Rui Ribeiro

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Revolusolar – Energia Solar no Morro da Babilônia, Brasil

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(Promoters and affiliates listed in alphabetic order)

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    - **José Moutinho**, Network & Business Development
    - **João Bentes Jesus**, Project Officer
    - **Pedro Silva**, Earth Observation Laboratory, Terceira Island, Azores, Portugal
    - **João Pinelo**, Earth Observation Laboratory, Terceira Island, Azores, Portugal

- **Bureau Veritas**
  - Contacts:
    - **Pedro Teixeira**, CCE, BV Portugal
    - **Vinicius Parmezani Lopes**, CCE, BV Brasil,
    - **Magda Pavlak-Chiaradia**, Vice President, Sustainability Global Service Line

- **CEIIA Collaborative Laboratory**, Matosinhos, Portugal and Brazil; https://www.ceiia.com/
  - Contacts:
    - **José Rui Felizardo**, CEO;
    - **Rui Pedro Ribeiro**

- **Center for Innovation, Technology and Policy Research, IN+,** https://in3.dem.ist.utl.pt/;
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- **Ciência Viva – National Agency for Scientific and Technological Culture, Portugal**, https://www.cienciaviva.pt/
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    - **Pedro Russo**, Board Member

- **CNPq – National Council for Scientific and Technological Development**; Brazil - CNPq – https://www.gov.br/cnpq
    - **Maria Zaira Turchi**, Director for Institutional Cooperation, CNPq

- **CONFAP (National Council of State Research Funding Foundations)**, Brasil; https://confap.org.br/pt/confap
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    - **Ramiro Wahrhaftig**, President, Fundação Auracária
    - **Carlos Pacheco**, President, FAPESP
    - **Marcio Spinosa**, Scientific Director, Fundação Auracária
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- **Fundação Oswaldo Cruz, Fiocruz**; Brasil; https://portal.fiocruz.br/
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    - **Mário Moreira**, Vice President
    - **Paulo Gadelha**, coordinator, Agenda 2030
    - **Fernando Bozza**
    - **Romulo Paes**
    - **Valcler Rangel**
    - **Manoel Barral**, CIDACS- coordinator
    - **Maurício Lima Barreto**, CIDACS

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Annex 2: Team, Scientific Coordination and Strategic Advice, at the launching phase

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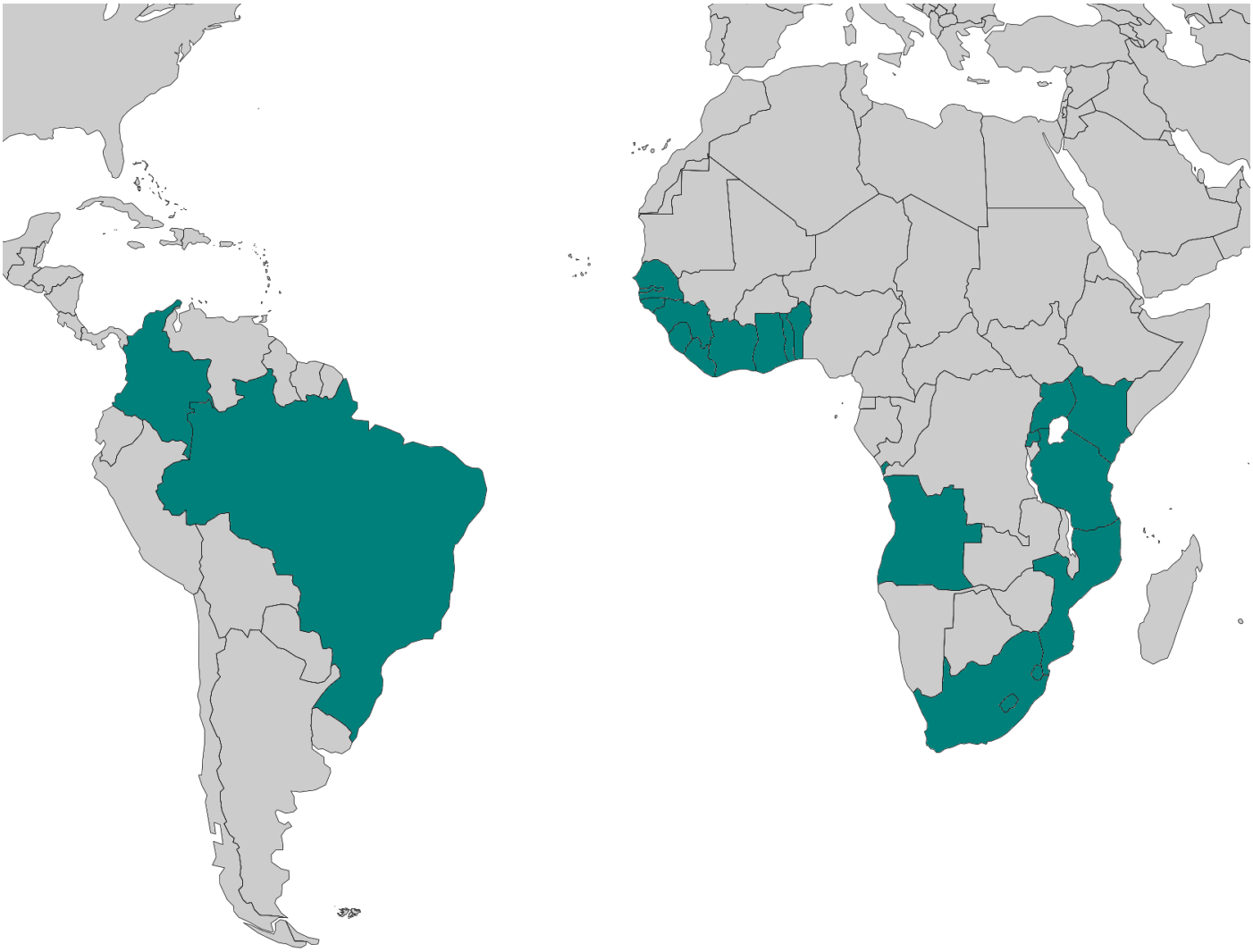

K4P Alliances

Knowledge for People, the Planet and Prosperity through Partnerships

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