

ASFAP Final Report Workshop 15 – 17 December 2024

Community Engagement Contribution

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INTRODUCTION

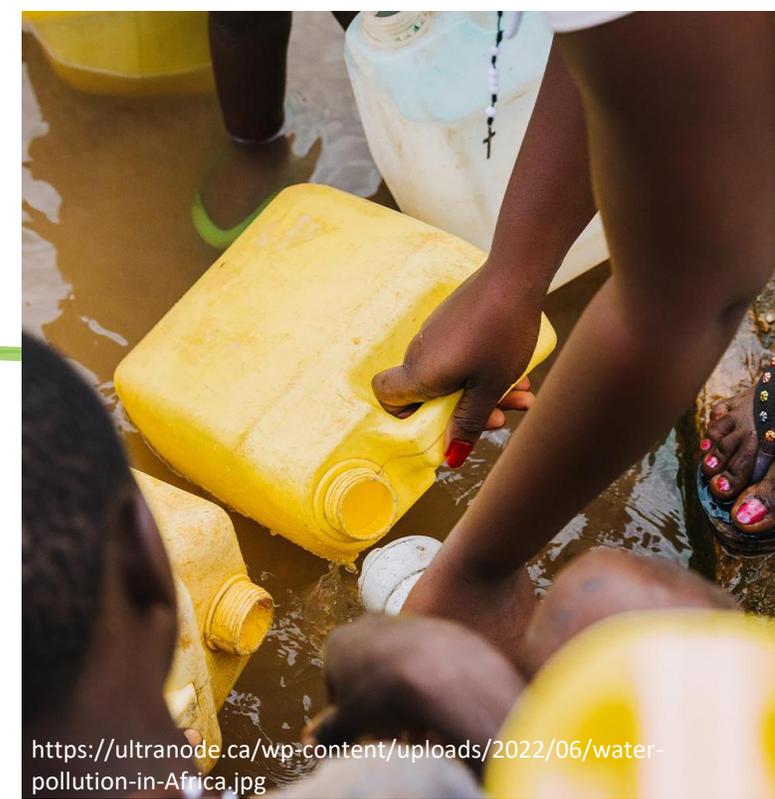
- In 2015, countries adopted the UN 2030 Sustainable Development Goals to end poverty.
- Poverty is a major challenge in Africa, with 80% of those in extreme poverty located in Sub-Saharan Africa.
- Africa has the potential to end poverty due to its young population and vast natural resources. (Coulibaly & Golubski, 2020).



<https://www.un.org/en/sustainable-development-goals>

INTRODUCTION

- Factors contributing to poverty in Africa:
 - ✓ Inadequate infrastructure & resource management.
 - **Water pollution; climate change; etc.**
 - ✓ Poor education systems. (Heckman, 2004)
 - ✓ **Inadequate science and technology education.**
- Adequate education in STEM subjects is essential to unlock sustainable development.
- We need to address the gaps in science and technology skills.
 - **Improving the teaching and learning of Physics.** (Babalola and Folasade, 2022)



<https://ultranode.ca/wp-content/uploads/2022/06/water-pollution-in-Africa.jpg>



<https://cdn08.allafrica.com/download/pic/main/main/csiid/00631855:781626d66db0b3cddfa4a9475efe1547:arc614x376:w735:us1.jpg>

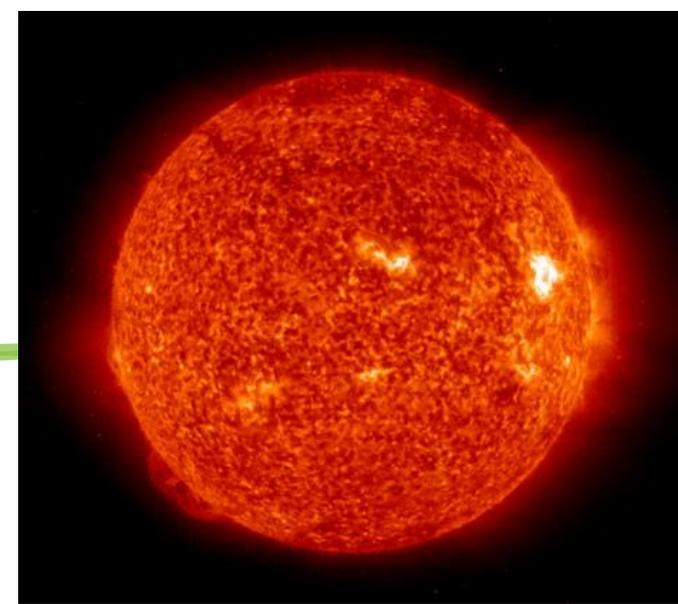
Importance of STEM education in Africa

- Adequate STEM education is essential for sustainable development.
- Investing in education has a payoff in terms of income. (Heckman, 2006)
- Improving Physics education can help break the cycle of poverty in Africa.
 - by addressing social and environmental issues such as:
 - Water pollution
 - Climate change
 - Food shortage
 - etc.

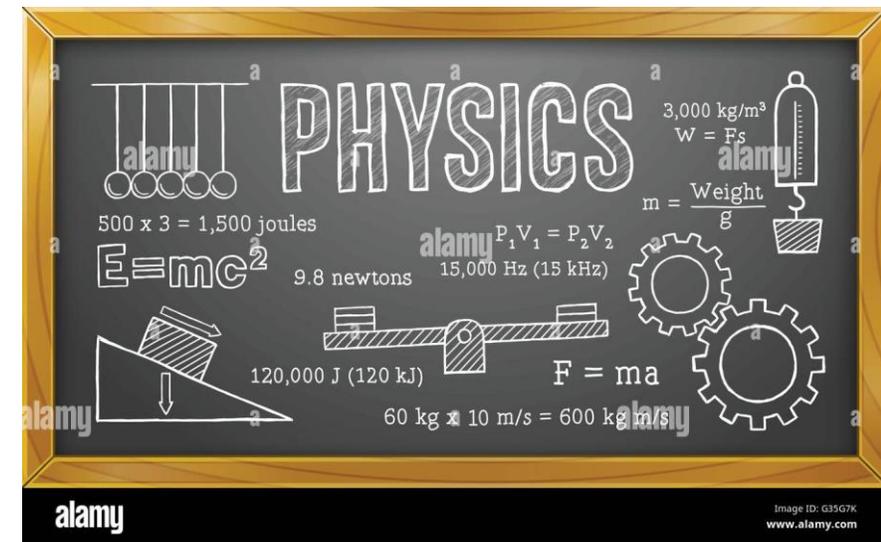


Why Physics Education?

- Physics is a fundamental science; it tries to explain fundamental concepts that govern the universe.
- Whatever we do, physics is involved:
 - ✓ For everyday living
 - ✓ All the technologies exploit the rules of physics: mechanical devices, transportation, communications, telematics, food technology, etc.
- It is considered as the foundation of many other disciplines:
 - ✓ The Material Sciences
 - ✓ The Earth Sciences
 - ✓ The Biological Sciences
 - ✓ The Sciences of the Universe
 - ✓ Engineering, etc.



<https://visibleearth.nasa.gov/images/45072/solar-storm-on-august-1-2010>



<https://c8.alamy.com/comp/G35G7K/physics-science-school-education-blackboard-G35G7K.jpg>

Importance of Physics in development

- Physics can help break the cycle of perpetual poverty in Africa
- Physics is a cross-cutting discipline with applications in many economic development sectors:
 - ✓ Health (e.g. cancer treatment),
 - ✓ Agriculture,
 - ✓ Environment (climate change; water pollution; etc.),
 - ✓ Energy (renewable energy),
 - ✓ Information technology, etc.

“Physics improves our quality of life by providing the basic understanding necessary for developing new instrumentation and techniques for medical applications, such as computer tomography, magnetic resonance imaging, positron emission tomography, ultrasonic imaging, and laser surgery.”

Statement adopted by IUPAP, March 1999

Potential Contribution of Physics to Meet Development Objectives



❖ Agriculture

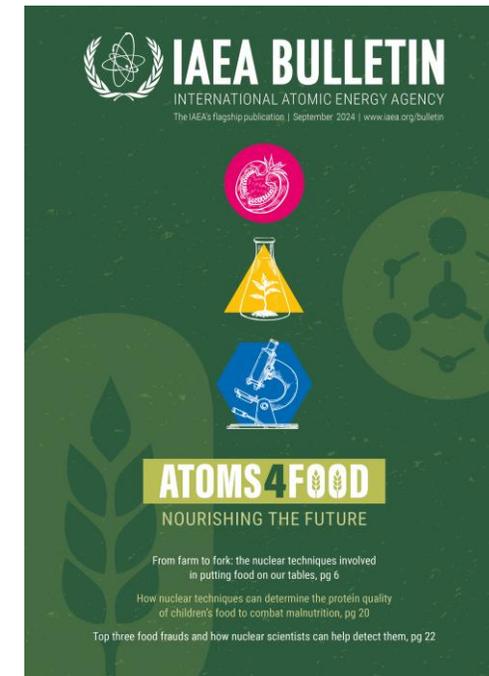
- Agriculture accounts for 32% of Africa's GDP. The sector offers the greatest potential for poverty reduction and job creation:
- ✓ **Digital agriculture:** IoT can be important in introducing “**Smart Agriculture**” to farmers (automating the irrigation system, monitoring the fields with sensors, etc.).
- ✓ **Agrophysics:** one of the branches of natural sciences dealing with applying physics in agriculture. It can help limit hazards to agricultural objects and the environment. It uses different tools, from electron microscopes to satellites.
 - Using ZnO-Nanomaterials for Enhancing Value-Added Agricultural Products,
 - Using ion beams generated by a compact low-energy ion accelerator to induce rice mutants.

“To transform Africa from simply being a raw materials supplier for the rest of the world to a continent that actively uses its own resources to ensure the economic development of Africans.”

Potential Contribution of Physics to Meet Development Objectives

❖ Nuclear technology

- Can be used to improve agricultural practices
 - ✓ Using isotopes or radiation techniques to control pests and diseases, increase crop production, protect land and water resources and ensure food safety.
 - Launch of a new initiative, "**Atoms4food**", by the AIEA and FAO in 2023.
 - The World Bank, under the West Africa Agricultural Transformation Project, is using nuclear technology to combat disease-causing pests as part of its Pest Management Plan (PMP) to increase food security nationwide.
 - ✓ Using stable isotopes for fertilizers to improve soil and water management and monitor fertilizer uptake.
 - ✓ Plant Breeding and Genetics: seeds can be irradiated with gamma rays, X-rays, ions or electron beams to initiate genetic changes.



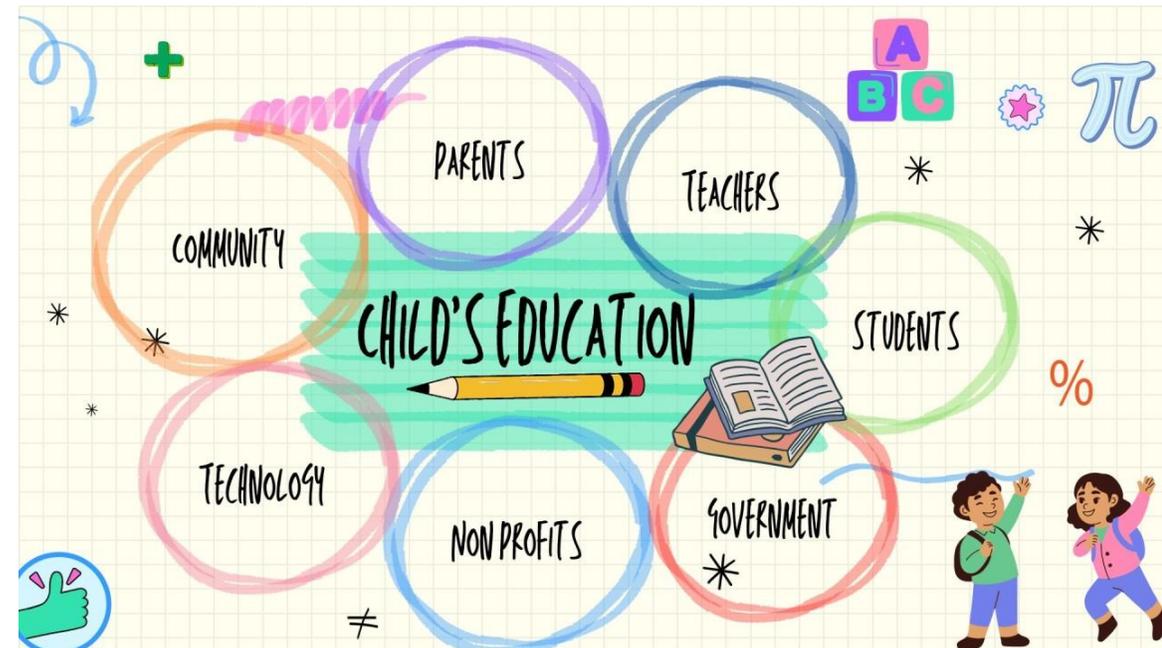
<https://www.iaea.org/services/key-programmes/atoms4food>

Potential Contribution of Physics to Meet Development Objectives

- ❖ **Energy:** From energy generation, conversion and storage to sustainability and resources, physicists play a key role:
 - ✓ Photovoltaic and solar fuel sciences; Wind/ wave/ tidal/ oceanic/ hydro-based power sources;
 - ✓ Energy harvesting and storage technologies; Hydrogen production and fuel cells;
 - ✓ Geothermal power and heat pumps; Nuclear-sciences-based power cycle;
 - ✓ Desalination and water treatment; Carbon-capture sciences;
 - ✓ Recyclable, biodegradable, low-toxicity and sustainable materials.
- A new generation of far smaller and cheaper nuclear technologies may offer more appropriate options for African countries to accelerate the deployment of reliable, low-carbon electricity (Small Modular Reactors (SMRs) and microreactors).
 - Ion-based quantum computers could boost battery performance: How fuel cells are decarbonizing energy. *"Physics World"*, Weekly Podcast, February 10, 2022)
 - Combining Artificial Intelligence with Physics-Based Methods for Probabilistic Renewable Energy Forecasting. *Energies* 2020, 13(8), 1979. <https://doi.org/10.3390/en13081979>

Problem with Physics Education in Africa

- The main problems hindering physics education in Africa are:
 - ✓ Low enrollment in Physical Sciences (high school & university).
 - ✓ Lack of proper facilities & equipment
- To mitigate this, we need collaboration among all stakeholders:
 - ✓ local communities,
 - ✓ scientists,
 - ✓ policymakers,
 - ✓ international partners. (Sa'id et al., 2020)



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Community Engagement and STEM Education

What is community engagement?

“A process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting their well-being.”

(CDC, 1997)

- Community engagement initiatives can help to enhance STEM education by providing real-world applications.
- These initiatives can empower the youth and make STEM subjects more accessible and interesting.



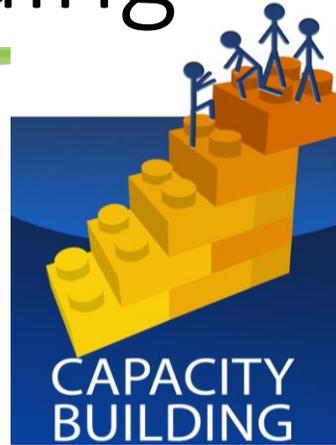
<https://www.redcliffeandtemplebid.co.uk/wp-content/uploads/2023/01/Untitled-design-3-e1673257974711.png>

Community Engagement and Physics Education

- Community engagement initiatives are “*powerful vehicles for bringing about environmental and behavioral changes*” (CDC, 1997)
- “*Communities count; they are key to improving everything from education and economic development to health care and race relations.*” (Matthews, 2008)
- In physics education, community engagement initiatives can help:
 - ✓ Improve the understanding and practice of Physics
 - ✓ Mobilize resources and influence systems
 - ✓ Change policies and programs
 - ✓ Mobilise people on environmental problems
 - ✓ Break cultural bias on girls’ education.

Community Engagement & Capacity Building

- Each community engagement initiative involves capacity building of the concerned community.
- Community engagement and capacity building are intertwined in their efforts to:
 - ✓ empower individuals,
 - ✓ promote collaborative learning
 - ✓ foster sustainable development.
- By combining these approaches,
 - ✓ communities can harness their collective potential
 - ✓ drive positive change in Physics education in Africa.



[Community Capacity-Building Clip Art - Search](#)



[Community Building Activities Clip Art - Search Images](#)

The ASFAP Community Engagement Working Group



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The ASFAP Community Engagement Working Group

- **Objective:**

- To draw a broader engagement and participation of communities in the development of the African Strategy.
- To address issues of physics education and research collaborations.

- We had 12 working topics; we were able to identify seven potential areas of possible common action:

1. Physics communication and outreach
2. Technology transfer; internet connectivity/ internet start-up resources applications and industry
3. E-lab & e-learning
4. Business development and entrepreneurship
5. Public education and outreach; diversity, inclusion and equity
6. Government engagement and public policy
7. Career pipelines & development; retention; capacity development.

Physics at the service of communities

- The C.E Group discussed some areas where the community can be involved in using physics to solve societal problems.
 - Fight environmental pollution & climate change
 - Education outreach activities
 - Introduce astronomy to the people/communities
 - Introduce the ASFAP initiative to local governments
 - Invest in open science?

Physics and environmental problems

How can we use physics to resolve the problems of environmental pollution and climate change?

- Physics can be used to find solutions to reduce plastic and pharmaceutical pollution.
 - ✓ Recycling methods for plastics
 - ✓ Waste burning facilities (e.g., incineration of pharmaceutical wastes)
 - ✓ Pharmaceuticals return to pharmacists or clinics
 - ✓ Special collection programs for pharmaceutical waste (old and unused)
 - ✓ Education and Awareness campaigns on the safe disposal of plastics and pharmaceutical
- Physics can be used to fight climate change?

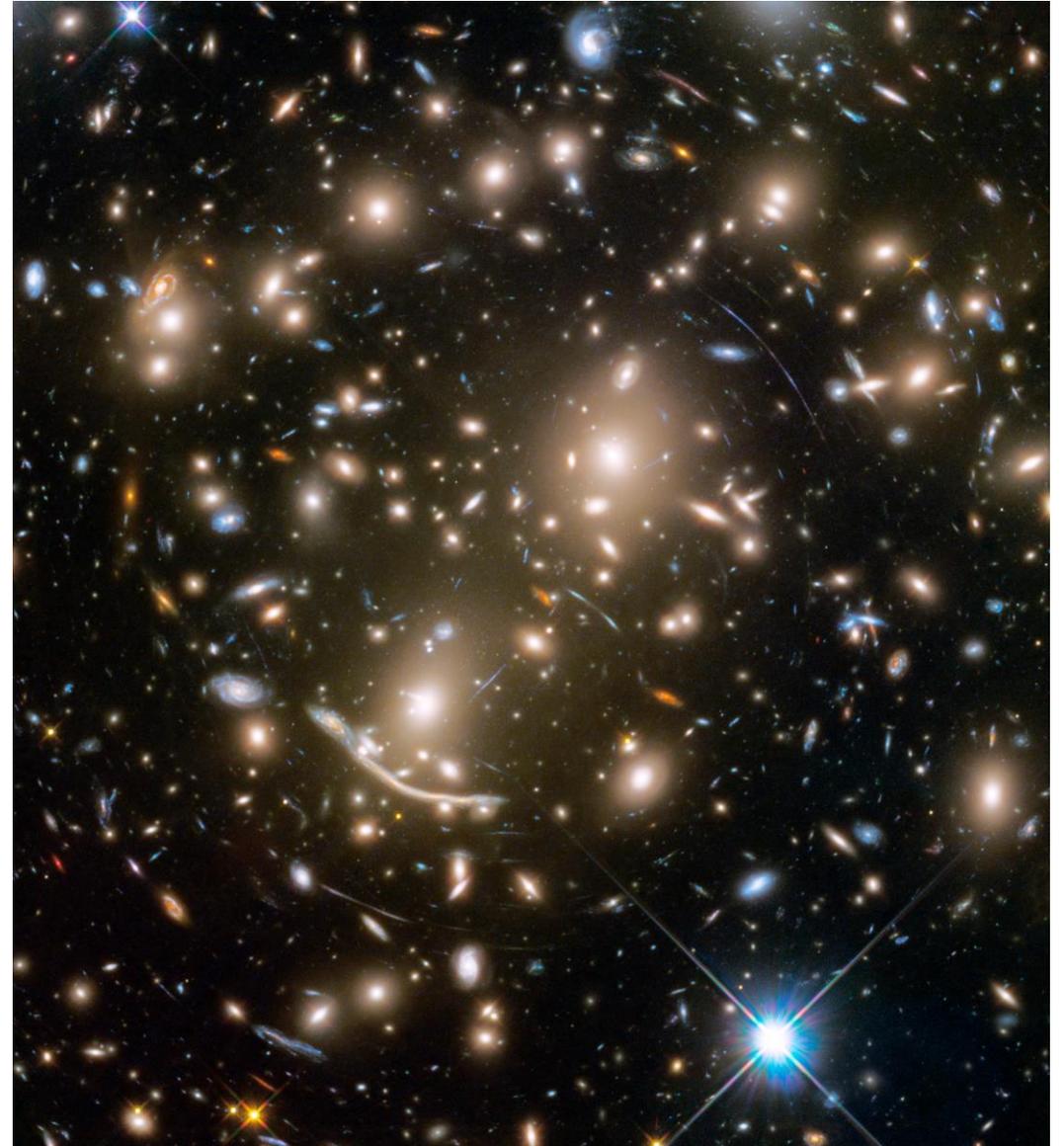
Physics outreach and education

To create awareness and broaden the community's understanding of Physics

- Survey on the views of physics teachers in Africa
- Periodic Training of physics teachers in Africa
- *Virtual Physics laboratories*: for those schools where there is no access to laboratories (+ internet access): classroom demonstrations for teachers and students;
- *Annual Physics community fairs*: to show the local community how Physics can help them in everyday life and introduce children to the fun of Physics;
- *Campus visits* for high school children to observe some fun physics experiments; Weekend and holiday science classes

Bring astronomy to local communities

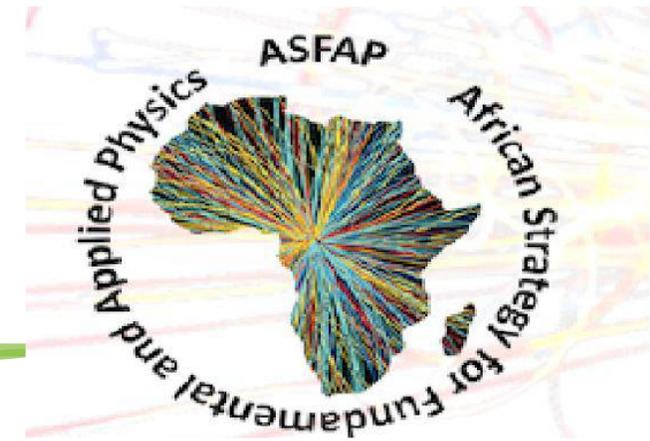
- The cosmos is the largest laboratory in the World
- It is a great stage to use various physics branches to illustrate its cognitive.
- Local facilities such as community telescopes can bring physics to people so they can observe the universe.
- Astronomy can be used to help people with mental health problems.



<https://science.nasa.gov/mission/hubble/impacts-and-benefits/astronomical-community-impacts/>

Introduce the ASFAP initiative to local governments

- Develop a blueprint for engaging various physicist bodies or governments at in each country.
- This task needs strong connections, and we did not attempt to engage with those important actors as it needs members in various countries and regions we did not have.
- The ASFAP initiative should inform the African Agenda 2063 Goals.



Agenda
2063
The Africa we Want



THE AGENDA
2063 ACADEMY
Driven by
Africa's Future

AGENDA 2063 GOALS



Community Goals and Priorities

- The C.E received letters of intent (LOIs) identifying Key community goals to focus on for promoting Physics Education in Africa:
 - Accessible and inclusive education.
 - Local relevance of Physics education.
 - Teacher training and professional development.
 - Gender equity and inclusion.
 - Practical learning and laboratories.
 - Collaboration with local industries.
 - Public awareness and outreach activities.
 - Scholarships and financial support.
 - Research and innovation.
 - Sustainable development.
 - Stopping the brain drain.
 - **Open Science**



<https://thelawyer.africa/2024/02/22/problems-hindering-realization-of-agenda-2063/>



https://en.wikipedia.org/wiki/Open_science