Science for the

AU–EU
Partnership

Building knowledge for sustainable development

Executive Summary

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Building knowledge for sustainable development

People, planet, prosperity and peace are four priorities shared by Africa and Europe, and areas where opportunities for beneficial cooperation abound. Over the past three decades, the European Commission's Joint Research Centre (JRC) has worked with many organisations and institutions across Africa.

This report and its accompanying interactive online service, 'Africa StoryMaps', present the key findings from this collaboration, and set out options the decision-making, research, and education communities may consider.

The report focuses on the African dimension of the partnership. It explores the opportunities and challenges arising from the fact that Africa has over twice the population of the European Union (EU), is the world's most youthful continent, has an economy that is growing faster than that of the EU, is almost seven times larger geographically, yet is vulnerable to diverse internal and external stresses.

PEOPLE, PLANET, PROSPERITY AND PEACE: WIN-WIN OPTIONS

Africa is changing: economic, social and infrastructural advances, natural capital management, climate change and energy choices are among the opportunities and challenges facing African decision-makers. Alternative pathways to development are always open. Sharing African and European experience can help to identify sustainable options, and facilitate access to them.

Development issues and sectoral policies are often interlinked, as are components of the human, natural, physical and economic worlds. Interdisciplinary thinking and cross-sectoral approaches to planning and decision-making are thus indispensable, but not often followed. Integrated approaches that bring together knowledge and the capacity to deal with interdependencies are required.

Many key sustainable development variables have strong location and time dimensions, which can be linked using geographic information and knowledge-management systems. These must operate at local and national scales (to account for the enormous variability within and between nation states), as well as at regional and pan-continental levels (to address transboundary issues and provide context for global initiatives such as the Rio Conventions and the 2030 Agenda for Sustainable Development). Integrated systems that include up-to-date geospatial and multi-sectoral information can document past and current situations, provide a basis for developing forecasts and scenarios, guide choices, and support strategic planning. They contribute to transparency and can facilitate cross-sectoral dialogue and underpin governance systems.

For example, efficient urban planning and better roads improve market access, facilitate trade, reduce agricultural waste, boost productivity, provide jobs and reduce accidents. But new roads and towns threaten natural capital and bring new challenges in terms of energy demand, water needs and the sealing of productive, fertile soils. Interlinked geographic information and knowledge-management systems can help to determine where the balance between outcomes rests.

Water availability can vary enormously with geographic location and over time. This variation should be accounted for in any country, yet transboundary aspects can also be critical. Accurate information over time is needed to prevent conflicts and promote stability, to plan urban, industrial and irrigation supply, to address food security, nutrition and public health issues, to orient agricultural choices and livestock and wildlife management, to regulate seasonal grazing schemes, to cope with seasonal rainfall anomalies, and to enable the monitoring of possible outbreaks of disease.

Good governance, integrated planning, monitoring and sustainable development go hand in hand. Information gathering, including from satellites, plays a crucial role. Aligning African Union (AU) and EU space policies can lead to improved data sharing, infrastructure development

and security. Jointly building up pertinent knowledge and developing and maintaining information systems will reinforce AU and EU efforts towards sustainable development. This will also support education and capacity-building, enhance media and computer literacy, and promote youth employment and access to high-quality jobs.

PEOPLE

Key findings

Demographic dynamics will be one of the most significant structural changes in the world in the 21st century. Africa's current population of just over 1.2 billion will continue to grow, although different scenarios predict different rates of population change. A medium scenario estimates that, by 2050, one in four people in the world will be African.

About half of Africa's people live within 100 km of the coast. Between 1990 and 2015, migration from rural to urban areas increased (urban populations grew by over 480 million during this period), but migration between African states fell from 2.1 to 1.4 % of the population. Migration from Africa to surrounding regions remained relatively stable as a share of the population (rising from 0.7 to 0.8 % for Europe), although because of population growth, absolute numbers increased by 60 %.

High-density living puts pressure on the built infrastructure and services, including water and sanitation, education, transport, health, and the labour market. Built-up area per person varies substantially across the continent. For example, rapid population growth in Ethiopia, accompanied by a slight increase in built-up areas, has resulted in high population concentrations, with only 2 m^2 of built-up area per person. In contrast, there are on average 29 m^2 of built-up area per person in South Africa.

Average road density in Africa is just over 20 km of roads per 100 km^2 of land, only a quarter of which is paved; the world average is just under 95 km per 100 km^2, with over half paved.

In the past 40 years, droughts, floods, disease outbreaks and cyclones have affected almost 500 million people in Africa. In spite of efforts to reduce vulnerability and build resilience, disaster risk is likely to increase, as population grows and becomes more geographically concentrated, as assets increase with the expanding economy, and as the effects of climate change and extreme weather events are felt.

Cereal production in Africa has largely kept pace with population growth. Although some 20 African states have achieved Millennium Development Goal 1 of hunger reduction, undernourishment is still widespread. The food security situation in 2017 is particularly alarming, especially in Somalia, South Sudan and Nigeria.

Gaps, future actions and priorities to be considered

While population growth in the coming years is certain, education has been shown to accelerate fertility transition (as well as reduce mortality rates), and thus improve future population structures by moderating youth dependency rates.

Urban planning to improve access to energy and adaptation to climate change can be supported through shared experience. The Covenant of Mayors for Climate & Energy is one established experience-sharing mechanism. This coalition of cities and local governments shares best practices and a long-term vision for sustainable urban living.

Further expansion of built-up areas and roads will continue to take land away from other uses, such as agriculture and forests. Spatially detailed and regularly updated information on human settlements and road networks, especially when combined with information

on the state of the natural environment, can support strategic planning that aims to maximise societal benefits while minimising environmental costs and protecting natural capital.

Assessing exposure and vulnerability to risk of natural and man-made disasters helps to improve preparedness and mitigation efforts. Composite indicators are being developed that enable progress in benchmarking, comparative analysis and mapping, which in turn help to assess levels of exposure.

Collaboration between major food-security agencies to provide standardised and synthesised information (such as the Global Report on Food Crises) helps to develop coordinated responses. Early-warning systems that facilitate rapid reaction to food-security emergencies are of particular value and should be enhanced wherever possible.

PLANET

Key findings

Africa is highly vulnerable to climate change, although the continent's greenhouse gas (GHG) emissions of 4 tonnes per person per year are far below the global average of 7.3 tonnes per person per year. Africa will become hotter by the end of the 21st century – warming of over 3.5 °C is possible for most of the continent for the January-March period, with temperatures in northern Africa and the Sahara increasing by up to 6 °C in the July-September period. Predictions for rainfall change are uncertain for large parts of the continent, although for some areas the predicted changes are robust and significant: for instance, models indicate that southern Africa will experience longer dry spells interspersed with more extreme rainfall events.

1-2 °C in Africa during the period 2002-2013. Expanding urban areas and more roads increase access to forests, and deforestation rises dramatically when population density exceeds 8.5 people per km^2.

Fires (most of which are deliberately started by humans) burn between 150 000 and 200 000 km^2 of forest, savannah and grassland in Africa each year, which contributes to deforestation, removes carbon sinks, increases black carbon emissions and can drive ecosystem changes over time.

Thirty-eight African countries are coastal states. With 700 000 vessels, Africa's fishing fleet is the second largest in the world, although the majority of these are small-scale vessels. Fish accounts for as much as 70 % of the daily intake of animal protein in certain coastal countries. However, fish stocks are in decline, notably in the north-western African coastal and shelf areas and in the Mediterranean.

After Australia, Africa is the driest landmass in the world, although only 5.5 % of its renewable water resources are currently being used. Water distribution across the continent is very uneven, with three major arid regions, several 'water towers' with regular, abundant supply, and large regions where inter- and intra-annual variability are high. Over the past 30 years, Africa's overall surface-water area experienced a small increase of almost 3 % as a result of new dam construction and flood irrigation, although some natural wetlands are contracting and several important aquifers are being emptied faster than they fill. Growing demand for water resulting from population growth, rising living standards, increasing economic activity and reduced availability due to climate change will lead to greater water scarcity in several regions. Droughts are likely to become more severe and persistent.

Deforestation (Africa recorded a net loss of 31 million hectares of forest from 1990 to 2010) generates substantial carbon losses into the atmosphere (estimated at 148 million tonnes per year for sub-Saharan Africa in the 2000s). Beyond the impact on the global climate, deforestation has been linked to local warming of around

About 8 % to 13 % of Africa's soils are free of natural constraints to agriculture – the rest needs to be improved, for instance through fertilisation or irrigation. Yet overall use of inorganic fertilisers in sub-Saharan Africa is the lowest in the world. Some fertile areas are shrinking due to climate change and land degradation, which affects

24 % of cropland and 25 % of rangeland areas, and results in a diminished capacity of natural ecosystems to provide goods and services. However, consistent data on the state of soils are often lacking.

Investment in land has increased and the value of farmland is rising. Clearance for agriculture drives deforestation, while the collection of wood for fuel and charcoal production causes forest degradation.

Forest loss and the degradation and conversion of savannah to other forms of land use are among the threats to Africa's rich and unique biodiversity. Africa has the world's second largest rainforest and vast savannah areas with unique megafauna, yet the continent loses over 3 million hectares of natural habitat each year to other uses, including farmland, roads, built area, logging, mining, dam building and reservoir creation.

Gaps, future actions and priorities to be considered

Climate observations should be enhanced, models improved and climate services put in place to reduce uncertainties, as well as to inform policymakers and support adaptation strategies.

Monitoring, reporting and verification tools can reinforce the effectiveness of treaties and charters instigated to strengthen the sustainable management of natural resources.

Sustainable management of tropical forests will help to mitigate global climate change and regulate climates. Measuring forest change accurately, including forest degradation, is essential to inform decision-making.

Protected area management can counter biodiversity loss, help to maintain the ecosystem services on which many communities depend, and promote job creation in sectors such as conservation, park management and tourism. A well-connected system of protected areas at continental scale is particularly valuable, especially when combined with tools to map and monitor protected area management effectiveness and combat wildlife crime.

Mapping large-scale marine features and monitoring potential productivity from fisheries would help to fill gaps in fish-stock data and contribute to sustainable marine resource management.

In a context of growing demands and the changing availability of freshwater, mitigating risks to water security requires management strategies that take account of the interdependencies between different uses.

Cooperation is also crucial to prevent the emergence of conflicts where water abstraction depends on cross-border supply. Maps and up-to-date statistics are key to informing the decision-making process. Uneven, and sometimes restricted access to water-resource information between countries that share transboundary river basins and between national institutions, as well as a wide disparity of data, hamper integrated approaches to water-resource management.

Drought forecasts and warnings should be targeted to provide users with key information. Traditional knowledge can be integrated to supplement drought forecasts and early-warning systems.

Information on changes in land cover helps to allocate land among competing uses, especially when combined with cadastre and tenure information. Data-sharing and capacity-building are necessary to ensure equitable access to these technologies, and can also generate considerable education and employment benefits.

Reducing nutrient depletion in soils should increase agricultural production. For Africa, such an increase could be over 5 % within 15 years, compared to the 2010–2012 levels. Incentives would be needed for sustainable soil management and protection practices. Furthermore, harmonised soil-monitoring programmes and strengthened national and regional soil surveys could help to assess the suitability of soils for various uses and monitor the effects of land-use policies on soil resources.

PROSPERITY

Key findings

During the past decade, agriculture employed 40 % to 65 % of the labour force in most sub-Saharan African countries. Estimates of the farming sector's contribution to sub-Saharan Africa's gross domestic product (GDP) range from 18 % to 25 %. Because of population growth and economic advances, demand for dairy products, meat, fish and eggs is expected to double by 2035. Much of the demand will come from expanding urban areas. Production will have to be balanced with growing demands for fibre and fuel. This may lead to competition among production systems (and regions and countries), as well as food-price volatility and inequality between subsistence and commercial farming sectors.

Over 600 million people living in Africa have no access to electricity, and half of the continent's energy consumption comes from biomass (wood, charcoal and dung).

Sub-Saharan Africa has only 0.3 million km of power lines, compared to the EU's 10 million km. Expansion of the grid should be accompanied by renewable energy expansion. Africa has a wealth of renewable energy resources; the same photovoltaic panel in Africa can produce twice the electricity it would in central Europe. To date, only 8 % of Africa's considerable hydropower potential has been harnessed.

Solar power is the most competitive technology option for almost 40 % of the African population. Reducing dependence on wood for fuel and using more efficient stoves will also reduce the negative health impacts of emissions from cooking stoves, alleviate pressure on woodland ecosystems, and free up time spent in gathering wood for fuel.

Over the past five years, 30 % of the world's gas and oil discoveries were made in Africa. While oil production is expected to fall between 2020 and 2040, gas production could continue to grow, although this will require new pipelines.

Africa is a major global supplier of several critical raw materials. Six African countries are in the top 10 of the Mining Contribution Index, which ranks countries according to the importance of mining and metals to their national economies. Exports of EU construction and mining equipment to Africa doubled between 2005 and 2011.

Every year, 1.3 million tonnes of electrical and electronic waste leave Europe, part of which ends up in African countries where it adds to the economy through raw-material recovery, but also has adverse local environmental and health impacts.

Africa has a burgeoning entrepreneurial sector, especially in information and communications technology (ICT), wholesale and retail. Telecommunications networks and broadband internet services are essential for this. In 2012, there were already over 650 million mobile phone subscriptions, and in 2017, more than 60 % of the population has access to ICT infrastructure.

The widespread use of mobile devices, plus a large young population (with a median age of 19.5 years), mean that e-commerce and online services industries may expand to an estimated US$75 billion by 2025 (EUR 62.3 billion at September 2017 exchange rates), promising to be one of the fastest and strongest boosts for the African economy. Africa is already a world leader in terms of money transfers using mobile phones (14 %

of all Africans regularly receive money through mobile transfers), although this also makes mobile devices a target for cybercrime.

Gaps, future actions and priorities to be considered

Sustainable intensification of agriculture (including improved inputs, e.g. through fertilisation of soils, use of quality seeds, and better irrigation), land-management tools and appropriate land-use policies are required to ensure food supplies. Accurate data on agricultural production (area, yields, and location) and food prices help planning, competition and more stable pricing processes.

Land-tenure systems which can be monitored and regulated play an important role because uncertainty concerning land tenure, or the extension of granted tenure, acts as a disincentive for investments such as soil conservation and irrigation schemes.

Improved infrastructure (roads, storage and cold chains) can reduce waste in agricultural produce, increase its value, encourage local markets, and reduce dependence on imports.

Spatial-analysis systems can help to evaluate the availability and economic potential of modern renewable energy sources. Off-grid and micro-grid systems, particularly those powered by renewable sources (solar, wind, biomass and hydropower), can complement the development of energy-grid infrastructure. The renewable energy sector also provides high-quality jobs.

Mineral industries can foster economic growth, but different factors influence how they contribute to sustainable development, such as the creation of qualified skills, their environmental impacts and how revenues are used. Geo-referenced information concerning critical raw material sources and exploitation plans, when routinely gathered and combined with trade-flow data, along with information concerning environmental, health and social impacts, can all help to inform decision-making concerning the mineral industry.

A favourable business environment and basic infrastructures (electricity and internet access) are also essential for growth and development. Mobile telecommunications, supported by an adequate regulatory framework, could improve internet access. In addition, enhanced infrastructure for wireless broadband through spectrum-sharing technologies can improve digital connectivity in remote areas.

Digital infrastructures and ICT services must be secure, parties to digital transactions need to be accountable and identified, and critical services must be standardised. An overarching cybersecurity strategy helps to ensure interoperability, stability and preparedness in case of digital system breaches (e.g. cyberattacks and cyber failures). Monitoring the geographic spread of internet coverage, alongside an assessment of user experience over time, helps to track and avoid network congestion and associated reduced performance as the user base expands in any given location.

The increasing use of mobile technology for financial transactions is more sustainable when accompanied by legislation and best practices to promote cybersecurity and fight cybercrime. Digital skills enhancement, awareness training and media literacy programmes also help to reinforce the sustainable and socially valuable expansion of the technology.

PEACE

Key findings

Conflicts have a massive detrimental impact on development efforts, and create conditions that lead to population displacement and migration. Worldwide, about one-third of all refugees are African nationals.

The Global Conflict Risk Index, an integrator of known drivers of violence, ranges from 0 (very low likelihood of conflict occurrence) to 10 (very likely). The global average is 3.7 while Africa's average is 5, with only seven African countries falling within the very-low to low-risk categories. Violent histories and environmental factors, such as water stress and the location of hydrocarbon resources, are particular contributors to the continent's elevated risk levels.

The diamond trade has helped to finance some African conflicts, but the Kimberley Process has reduced the conflict diamond trade to less than 1 % of the overall total.

Over 90 % of Africa's imports and exports are transported by sea. Maritime security is a prerequisite for trade, fishing, tourism, and other sea-based activities. While regional and international cooperation must play a role, a sustainable solution to general maritime security relies primarily on the capacities of national authorities. Technical tools for monitoring the maritime situation at sea, and for sharing and analysing piracy incidents, have been developed and tested over recent years with authorities in several African locations.

The risk of global threats in the chemical, biological, radiological and nuclear (CBRN) area is increasing. In Africa, chemical risks associated with the industrial and agricultural sectors have intensified, and exposure to health risks (epidemics and disasters) remains high.

Radioactive sources are widely used in healthcare institutions and industry. Uranium is mined in many African countries, and there are 10 nuclear research reactors in operation across the continent. However, only South Africa operates a commercial nuclear power plant, while several countries have plans to embark on developing nuclear power production. Safety and security risks associated with the use, transport and storage of radioactive and nuclear material, in particular uranium mines, remain a concern in Africa.

Gaps, future actions and priorities to be considered

Early warning, supported by tools that provide an integrated view of the factors driving conflict in a specific region at a specific time (such as the Continental Early Warning System), can help in conflict prevention.

Statistical conflict modelling should further investigate the link between natural resource location and armed conflict occurrence. Crowdsourcing and big data analytics can improve such analysis, by providing more and better data to feed conflict-measurement methodologies.

International initiatives (such as the Kimberley Process) must continue to be supported, as these ensure transparency and accountability.

The ongoing development and use of space-based maritime monitoring systems make it possible to collect information about shipping activities over large areas in an affordable manner.

Initiatives that aim to share experience and best practices, and strengthen national policies and capacities – such as the European Union's Chemical Biological Radiological and Nuclear Risk Mitigation Centres of Excellence

initiative EU (CBRN CoE) – must be sustained. Dedicated instrumentation, procedures, communication campaigns and training should all accompany these.

EU cooperation activities focus on strengthening the capabilities of the national regulatory authorities with respect to nuclear safety and safeguards.

PEOPLE, PLANET, PROSPERITY AND PEACE: BRINGING IT ALL TOGETHER

During the past decade, African countries have actively engaged in research, development and innovation, although Africa still has less than 100 researchers per million people, compared to the global average of 1 100. The low indicators regarding traditional research and development (R&D) for Africa may not capture the actual dynamics of innovation, especially in the service and informal sectors. Research and innovation capabilities should be monitored and evaluated at different geographic levels. Cooperation in innovation that addresses local population needs and territorial development is a priority; education and research conditions should be improved in parallel.

As the number of Africans aged 15-24 is projected to increase by 44 % between 2015 and 2030, developing skills through education and training is a major priority. Maintaining the growth in primary, secondary, and tertiary education, along with vocational training, especially in science, technology and engineering, will require sustained efforts.

Knowledge sharing is essential for addressing the interconnected challenges facing Africa – and Europe – bringing together people and planet to bring about prosperity and peace. This need is reinforced by the recent explosion of information and technological progress. ICTs have the potential to promote the development of knowledge-sharing initiatives. Developing scientific collaboration and networks can help to strengthen

research (and increase the availability of education and training). Initiatives such as centres of excellence foster the development of capacities and can play a role in strengthening the science-policy interface, along with regional observatories and the development of information systems.

Earth-observation infrastructure in Africa is expanding, with technical assistance from the JRC. Dedicated satellite data transfer and data analysis systems have been installed and are operating in over 180 sites across the continent. These support applications are specifically tuned to local and national needs, and have already provided ICT training for over 2 200 Africans.

Information platforms that strengthen the capacity to mobilise and use satellite Earth observations and the information acquired from these data must be further developed and distributed, so that they can be readily accessible to policymakers, managers, researchers and other users across Africa.

Many of the activities considered under the different priority areas seek to address the drivers of fragility that affect vulnerable populations. Resilience thinking provides a useful system perspective to help to develop lasting solutions to complex challenges and to make progress towards the achievement of the United Nations Sustainable Development Goals (SDGs).

Resilience-based initiatives, which combine anticipation and crisis response with long-term actions that aim to address the root causes of vulnerability, should be further developed. Efforts to better measure resilience can help to integrate such an approach into policies.

The means of implementation need to be strengthened if the SDGs are to be fully achieved in Africa and Europe, as

recognised by SDG 17: 'Revitalise the global partnership for sustainable development'. The AU-EU Partnership can play an important role in supporting initiatives identified under this Goal: finance, technology and capacity, policy and institutional coherence, multi-stakeholder partnerships and data, monitoring and accountability.

Most of the findings, outlook and knowledge needs set out above could be placed under more than one priority area, and some (such as food security) could appear under all four. There is no unique grouping because all four areas are interdependent; people, planet, prosperity and peace cannot be treated in isolation. Similarly, the economic, social, environmental and governance paths followed by the AU and EU aim to be as coherent and synergistic as possible. This connectivity is captured in the current view of the European Commission's Directorate-General (DG) for International Cooperation and Development (DEVCO) on how key policy goals and drivers are interlinked (the figure below provides a schematic overview).
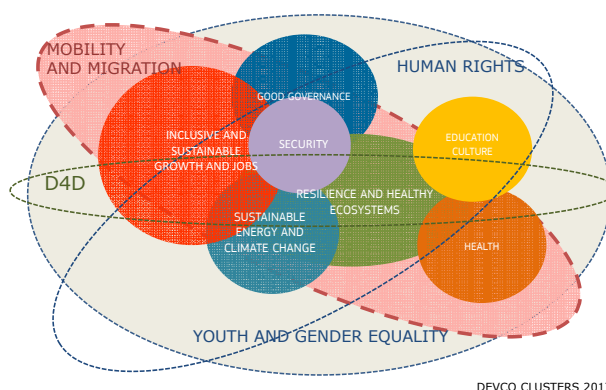
Connectivity between policy goals and drivers.
Note: D4D means Digital for Development (Source: DG DEVCO).

The areas of AU-EU research cooperation discussed in this report can be considered independently, but the main strength arises from the collective picture the chapters paint, and the opportunities for joined-up responses they offer. Three avenues for a connected response are immediately apparent: 1) sharing experience of using scientific evidence for integrated policymaking (where JRC experience can be tapped along with key initiatives such as the International Network for Government Scientific Advice, in particular its Africa Chapter); 2) providing geographic information and knowledge-management systems (such as on human settlements, surface-water occurrence, protected areas, solar energy potential, soils, etc.) through a dedicated entry point and dedicated in-country infrastructure (such as satellite communications systems); and 3) providing customised training and capacity-building linked to avenues 1 and 2.

Collectively, the three actions outlined above would improve access to innovation and education, which in turn would advance knowledge and skills in youth employment areas (such as computer and Earth observation sciences, cybersecurity, e-commerce and the development and roll-out of renewable energy). They would provide the means to map, monitor, report and validate the outcomes of any common charter on the sustainable management of natural resources, strengthen cooperation on global governance issues in the context of multilateral environmental agreements (especially the Rio and Ramsar Conventions), the Sendai Framework for Disaster Risk Reduction and the SDGs, help to identify threats and crisis-triggering factors, and lead to more productive and sustainable agriculture.

Other opportunities for harnessing research cooperation for sustainable development are bound to emerge. Partnership is the common thread throughout the work detailed in the report. The scope of the report mainly reflects the evidence collected and the scientific work conducted by the JRC together with its counterparts in Africa and international partners. It aims to present reliable data, information and analysis based on the JRC's expertise in specific domains – while putting it in a broader perspective and referring to a variety of sources. The report will support and inform an evidence-based dialogue and further engagement with Africa's policymaking and scientific communities, and thus further strengthen, with a solid knowledge base, the renewed AU-EU Partnership.

"IF YOU WANT TO GO QUICKLY, GO ALONE.
IF YOU WANT TO GO FAR, GO TOGETHER "

– African proverb

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Abstract
People, planet, prosperity and peace are four priorities shared by Africa and Europe, and areas where opportunities for beneficial cooperation abound. Over the past three decades, the European Commission's Joint Research Centre (JRC) has worked with many organisations and institutions across Africa. This Executive Summary provides a succinct summary of the report, which presents the key findings from this collaboration, and sets out options the decision-making, research and education communities may consider.

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