Report of the Chair of the Scientific and Technical Advisory Panel (STAP) to the 54th GEF Council

1. Introduction

This report provides an update on STAP's work since the last Council meeting in November 2017.

Over the last six months STAP has:

a) continued work on eight papers for the Assembly;
b) clarified and codified its guidelines for screening projects;
c) contributed further to the Food Security Integrated Approach Pilot;
d) begun developing its work program for GEF-7; and
e) reviewed projects for the June GEF work program [4 concur; 4 minor revision required].

2. Papers for the GEF Assembly

STAP has completed five papers, which were written by Panel members and externally reviewed. These are:

(i) Integration to solve complex environmental problems;
(ii) Managing knowledge for a sustainable global future;
(iii) A future food system for healthy human beings, and a healthy planet;
(iv) Plastics and the circular economy; and
(v) Environmental security: dimensions and priorities.

Work continues on the other three papers, which will be submitted to the December GEF Council. These are:

(vi) Innovation;
(vii) Novel entities; and
(viii) Local commons for global benefits.

The papers were conceived of as a linked set and discussed with the GEF family over the last year as they were developed (see for example STAP's Report to the 53rd Meeting of the GEF Council). Together, these papers should help guide the transformational change GEF seeks to stem environmental degradation. The starting point is the science which indicates that several planetary boundaries have already been breached[1] and that large-scale, transformational change is needed to deal with these inter-related problems[2]. Without a stable and healthy earth system, the Sustainable Development Goals will not be achieved. Environmental challenges are complex and interlinked, not only in themselves but also with social and economic issues. Addressing these interconnected and interacting environmental and social challenges requires 'systems thinking'; this is fundamental to better integration. Knowledge management[3] is also an essential element of successful integration – to ensure that what has already

[1] Steffen, W. et al. 2015. Planetary boundaries: Guiding human development on a changing planet. *Science* 347(6223), 1259855. DOI: 10.1126/science.1259855.
[2] Bierbaum, R. et al. 2018. Integration: to solve complex environmental problems. Scientific and Technical Advisory Panel to the Global Environment Facility. Washington, DC.
[3] Stocking, M. et al. 2018. Managing knowledge for a sustainable global future. Scientific and Technical Advisory Panel to the Global Environment Facility. Washington, DC.

been learned is applied to new investments, and for successful scaling up of impact. Given rapid changes in technology, policy, and systems thinking, STAP examined how the concepts of the circular economy[4] – in both food and plastics[5], and environmental security[6] could be incorporated into GEF-7 thinking. Each of these elements could help the GEF deliver greater global environmental benefits, more effectively and efficiently.

Innovative approaches, such as the Integrated Approach Pilots and the Impact Programs are being tested now in the GEF. Different finance and business models could also be considered in the coming years. Varied governance regimes can assist or hinder achievement of sustainability goals, and understanding what policies work best in which settings can maximize impact. Finally, technology is changing rapidly and GEF must keep current with these changes; for example, the emerging area of novel entities (such as nanoparticles and gene-splicing) can have both positive and negative or disruptive effects on the Earth's system. GEF will need to consider all these issues in GEF-7.

Transformational change necessarily entails risk: the two are intertwined and lie at the core of the GEF's capacity to respond to change and making it resilient. The GEF can strengthen its organizational capacity to deal with change and to deal with uncertainty through experimentation and innovation, including by encouraging a greater diversity in the risk profile of projects.

Each of STAP's completed papers addresses four key questions:

- What is the issue?
- What does the science say?
- Why is this important to the GEF?
- How can the GEF respond?

Summaries of papers are below.

(i) Integration to solve complex environmental problems

Science indicates that several planetary boundaries have already been breached or are approaching the danger zone, including genetic biodiversity, biochemical (nitrogen and phosphorus) flows, land-system change, and climate change. Large-scale, transformational change is needed to deal with these problems, and without a stable and healthy Earth system, the Sustainable Development Goals will not be achieved.

In the World Economic Forum's *Global Risks Report 2018,* 6 of the 10 greatest risks, in terms of likelihood and impact, are environment-related. Food and water crises are both intertwined with the

[4] A circular economy is an alternative to a traditional linear economy (make, use, dispose), in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life (WRAP UK).

[5] Sims, R. 2018. A future food system for healthy human beings and a healthy planet. Scientific and Technical Advisory Panel to the Global Environment Facility. Washington, DC; Barra, R. et al. 2018. Plastics and the circular economy. Scientific and Technical Advisory Panel to the Global Environment Facility. Washington, DC;

[6] Ratner, B. 2018. Environmental security: dimensions and priorities. Scientific and Technical Advisory Panel to the Global Environment Facility. Washington, DC.

environment, and also in the top 10 risks. A deteriorating global environment poses significant threats to environmentally sustainable development.

Addressing these interconnected and interacting environmental and social challenges requires systems thinking; this is fundamental to better integration. Systems thinking examines the relationships between the different parts of a system - for example, the food supply system or a commodity supply chain – and examines cause and effect relationships such as positive or negative feedback mechanisms among the biophysical and socio-economic features of the system. Systems thinking also considers the interactions between components of a system across different locations and organizational levels, over time. Understanding the connections between variables helps to identify points for effective intervention.

The GEF has made considerable progress in successfully designing and implementing integrated projects: in biodiversity, international waters, land degradation, and in multi-focal area projects, and in the Integrated Approach Pilot (IAP) Programs. The Independent Evaluation Office's OPS-6 report, "The GEF in the Changing Environmental Finance Landscape", recommended a continued focus on integration: "The GEF should continue pursuing an integrative principle in its programming based on scientific and technical merits. A strong, cogent rationale for designing integrated programs and multi-focal area projects—based on demonstrated additionality, GEF experience, GEF comparative advantage, innovative contributions, environmental need, and national relevance — must be the basis for such interventions."

To improve integration further in the design of future GEF projects, STAP recommends the following:

STAP's recommendations	
1	Apply systems thinking: i.e. address inter-connected environmental, social, economic, and governance challenges across sectors with an eye towards resilience and transformational change.
2	Develop a clear rationale and theory of change to tackle the drivers of environmental degradation through assessing assumptions and outlining causal pathways – and have a 'Plan B' ready, should desired outcomes not materialize.
3	Assess the potential risks and vulnerabilities of the key components of the system, to measure its resilience to expected and unexpected shocks and changes, and the need for incremental adaptation or more fundamental transformational change.
4	Devise a logical sequence of interventions, which is responsive to changing circumstances and new learning (adaptive implementation pathways). Develop clear indicators that will be monitored to determine progress and success in achieving lasting outcomes.
5	Develop explicit plans and funding for good quality knowledge management including: sustainable databases; simple, useful and usable common indicators; face-to-face consultations; and building stakeholder capacity. This is essential for 'lessons learned', and scaling up.
6	Apply exemplary stakeholder engagement, including with local communities, not just government officials, from inception and design, through to project completion. This is crucial for identifying diverse needs and managing trade-offs.

The GEF is uniquely placed to lead the way in applying and strengthening evidence on the science of integration and systems thinking to deliver global economic, social and environmental benefits.

(ii) *Managing knowledge for a sustainable global future*

Maximizing global environmental benefits, and delivering transformational change at scale requires the GEF to ensure that it makes full and effective use of the knowledge and learning it has accumulated from its previous investments, and applying that to its current and future projects.

Knowledge Management (KM) is the systematic management of an organization's cumulative knowledge and experience, i.e. its knowledge assets. This is valuable for meeting an organization's operational and strategic objectives, by ensuring that what the organization already knows is applied to future actions. Done well, KM provides the right knowledge to the right person at the right time, so it can be usefully applied.

Knowledge management has been a key goal of the GEF since 2011. Improving KM will make the GEF a more powerful, effective and efficient institution in tackling complex environmental problems, and delivering global environmental benefits, and sustainable development. This requires:

- Embedding KM more systematically into the project cycle, as an essential part of project design. STAP has provided advice on what it looks for when it screens for KM in project proposals at the PIF stage and has provided additional guidance on the three principal topics expected to be elaborated within an overall KM strategy, i.e. baseline learning; results assessed and documented; and sharing with stakeholders. Adequate resources, training, and incentives of GEF and agency staff would also help to embed KM and feed information into a KM system.

- More easily searchable PIFs, CEO-endorsed projects, mid-term evaluations, and terminal evaluations to compare strategies, compile 'lessons learned' from both successes and failures, and better link practitioner and academic research. The new GEF portal provides an opportunity to strengthen the ability to extract, edit, and file information in order to generate knowledge.

However, KM has often been treated as an afterthought. It remains an under-exploited resource, whereas it should be a primary source of value for the GEF. Going forward, KM should be central to all projects and programs.

As the GEF moves further towards integrated approaches, multi-focal projects, and impact programs, it is increasingly important to facilitate the acquisition of formal and tacit knowledge, organize knowledge assets from complex situations and make them available to inform future investments. The IAPs and IPs impose greater needs for connections between 'child' projects and program objectives. KM is an obvious means to tie these connections together, to collect evidence-based learning, and to achieve sustained impact that deliver benefits far into the future. The new IAPs have embedded KM in their structure from the outset and require that 5% of funding be allocated for KM, which the STAP applauds.

STAP's recommendations	
1	Strengthen knowledge-sharing and learning across the GEF partnership.
2	Apply guided learning questions to support knowledge management using STAP's seven learning questions.
3	Mainstream KM systematically into the GEF project cycle from the PIF stage onward.
4	Include KM and knowledge management system (KMS) functions in project/program monitoring and evaluation activities from the PIF stage.
5	Develop an Open Data Policy so that GEF project information is freely accessible.
6	Include KM progress indicators in the GEF Results-Based Management system.
7	Adopt an enterprise-wide GEF KM system. The new GEF portal offers the chance to create an enterprise-wide system across all agencies with features that improve the functionality to extract, edit, and file information for the purposes of generating knowledge.
8	Consider incentives for successful dissemination of project outputs, for example, prizes, and pay awards.

The GEF has made some progress on KM, but further work is needed to extend the scope and depth of KM in the GEF to exploit its full power to develop, manage, track, share and, above all, learn from its projects and programs.

(iii) A future food system for healthy human beings and a healthy planet

Food production will need to increase by more than 50% by 2050 to feed a global population of more than 9 billion people by 2050, and rising incomes will drive the demand for more protein. However, the current linear food production and consumption model has had significant deleterious effects on the environment. The agri-food sector contributes about 25% of total global greenhouse gas (GHG) emissions, and a further 10 to 15% from land use change, e.g. converting forests, and peatlands to agricultural use. The sector causes almost two-thirds of biodiversity loss, and extensive land and water degradation. And over 70% of freshwater withdrawals are for agriculture. Clearly, the global goals of the GEF on land degradation, clean water, sustainable forest management, climate change mitigation and adaptation, and biodiversity conservation cannot be met if the agri-food sector is not much better aligned with these objectives.

Transitioning to a more sustainable system would conserve soil, water, energy, and biological resources, and re-use them in a circular economy model. The GEF is already attempting to reconcile increased food production with fostering long-term sustainability and resilience through the Food Security and the Commodities IAPs. These integrate management of land, water, soil and genetic resources with maintaining ecosystem services and should yield important 'lessons learned' to build upon.

STAP's short-term recommendations	
	Improved sustainability of the food supply system could be achieved by the more efficient use of resources. Reducing inputs per unit of food production whilst increasing productivity would help avoid negative impacts on biodiversity, soil quality, freshwater supplies, and the atmosphere
	Some practical examples:
1	Conservation tillage
2	Efficient food processing operations and transport logistics
3	Sustainable land management practices
4	Precision farming to apply fertilizer, water, and chemical inputs judiciously
5	Improved post-harvest storage
6	Reduced consumption of animal protein
7	Better access to markets to reduce food losses.

STAP suggests that the GEF encourage one or more of these short-term recommendations be incorporated into food-related projects in GEF-7. This experience will provide useful information to inform complex projects attempting to achieve a full circular economy.

Looking ahead, the Impact Program (IP) on Food Systems, Land Use, and Restoration will focus on promoting: sustainable food systems to tackle negative externalities; deforestation-free agricultural commodity supply chains; and large-scale restoration of degraded landscapes for sustainable production and ecosystem services. STAP recommends that child projects under this IP should include involvement of both key stakeholders and circular economy specialists at an early stage of project preparation. Together they would help assess the practicalities of achieving key outputs and outcomes for the project and help develop the project proposal accordingly.

In the longer term, more ambitious actions will be required to improve sustainability and avoid further degradation of land, water and nutritional quality of food. Adopting the circular economy approach for the agri-food sector will involve the development of agro-ecological systems and instigating innovative energy-smart and climate-smart production systems to reduce competition for productive land and freshwater and avoid further loss of soil fertility.

(iv) Plastics and the circular economy

The production of plastics increased by more than twenty-fold between 1964 and 2015, with annual output reaching up to 322 million metric tonnes (Mt), and is expected to double by 2035, and almost quadruple by 2050. Plastics contribute to economic growth, but their current production and use pattern, on a linear model of 'take, make, use, and dispose', is a primary driver of natural resource depletion, waste, environmental degradation, climate change, and has adverse human health effects.

Conventional plastic production is highly dependent on virgin fossil feedstocks (mainly natural gas and oil) as well as other resources, including water - it takes about 185 litres of water to make a kilogram of plastic. Plastic production uses 6% of global oil production, and this is expected to increase to 20% by 2050.

Some plastics contain toxic chemical additives, including persistent organic pollutants (POPs), which have been linked to cancer, mental., reproductive ailments, and developmental diseases. It is difficult to recycle some plastics without perpetuating their chemicals.

About 4900 Mt of the estimated 6300 Mt total of plastics ever produced have been discarded either in landfills or elsewhere in the environment. This is expected to increase to 12,000 Mt by 2050 unless action is taken. The ocean is estimated to already contain over 150 Mt of plastics; or more than 5 trillion plastic particles. The amount of oceans plastic could triple by 2025 without further intervention. By 2050, there will be more plastics, by weight, in the oceans than fish, if the current 'take, make, use, and dispose' model continues.

Plastics stay in the environment for a long time; some take up to 500 years to completely break down. Plastics break down into tiny pieces (microplastics) which end up in the food chain, with potentially damaging effects on human health. Plastics are now a major feature of the various ocean gyres, with the garbage vortex in the Pacific Ocean reported to be over twice the size of Texas, US[7]. Microplastics are already a well-documented problem in the marine environment and an emerging source of freshwater pollution. Recent studies show most seafoods are contaminated with microplastics with 70 particles of microplastic found in every 100 grams of mussels analyzed in the United Kingdom[8]. The contamination of tap and bottled water by microplastics is already widespread, and the World Health Organization is assessing the possible effects on human health[9].

The continued rapid growth in the production, and use of plastics could have a significant deleterious effect on the GEF's ability to deliver its objectives in the focal areas and in the integrated programs.

The circular economy model offers an opportunity to minimise the negative impacts of plastics while maximising the benefits, and providing environmental, economic, and societal benefits. Elements of a circular economy approach include: using alternative non-fossil fuel feedstocks; re-using plastic wastes as a resource; redesigning plastic manufacturing processes/products to enhance longevity, reusability and waste prevention; increasing recycling rates; and supporting business models which promote plastic products as services, and encourage sharing and leasing.

In the short term, the GEF can play a significant role in promoting a transition to the circular economy in the plastics sector in the following ways:

[7] Lebreton et al. 2018. Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic. Scientific Reports, 8, 4666. DOI:10.1038/s41598-018-22939-w and https://nypost.com/2018/03/23/great-pacific-garbage-patch-is-now-twice-the-size-of-texas/

[8] Li, J. et al. 2018. Microplastics in mussels sampled from coastal waters and supermarkets in the United Kingdom. Environmental Pollution 241: 35 – 41 and https://www.theguardian.com/environment/shortcuts/2018/jun/08/microplastics-in-our-mussels-the-sea-is-feeding-human-garbage-back-to-us.

[9] Tyree, C and Morrison, D. 2017. Invisibles: the plastic inside us (https://orbmedia.org/stories/Invisibles_plastics); Mason et al. 2018. Synthetic polymer contamination in bottled water (https://orbmedia.org/sites/default/files/finalbottledwaterreport.pdf); and https://www.theguardian.com/environment/2018/mar/15/microplastics-found-in-more-than-90-of-bottled-water-study-says.

STAP's recommendations	
1	Mainstream circular economy principles into GEF's overall programming strategy, by including circular principles as a tool and criteria for priority setting and decisionmaking in chemicals and waste, international waters, biodiversity, climate change, and land degradation, and in the Sustainable Cities, and Food Security IAPs.
2	Invest in projects that promote circular principles in: plastic reuse and recycling projects (e.g. in integrated waste management for the safe collection, sorting, separation, handling and processing municipal solid waste); and plastic waste prevention and minimisation investments (e.g. the production of plastics from alternative feedstocks, and redesigning plastics to eliminate the use of POPs.)
3	Create an enabling environment to overcome barriers and promote the adoption and implementation of the circular economy in the plastics sector (e.g. facilitate technical assistance and capacity building for a circular economy such as waste management, sustainable plastic manufacturing, and public-private cooperation).
4	Integrate the mitigation of plastics pollution into the Sustainable Cities IAP.

In the longer term, the GEF should consider: collaborating with and supporting partnerships with the private sector to tackle plastics pollution; facilitating and supporting innovation and applied research to implement the circular economy into the plastics sector; and supporting the development of circular economy indicators.

(v) Environmental security: dimensions and priorities

Environmental security is a topic that STAP raised at the last Assembly as an important issue for the GEF. Environmental security involves the role that the environment and natural resources can play in peace and security, including environmental causes and drivers of conflict, environmental impacts of conflict, environmental recovery, and post-conflict peacebuilding. The scope of security and insecurity is by no means limited to violent conflict or its absence but includes the roots of sustainable livelihoods, health, and well-being.

Many GEF operations are exposed to conflict risk. Half of GEF recipients (77 countries) experienced armed conflict since the GEF's inception in 1991, and over one-third of GEF recipients (61 countries) proposed and implemented GEF projects while armed conflict was ongoing somewhere in the country. Nearly one-third of all GEF funding has been invested in projects during years of active conflict somewhere in the recipient countries.

However, to date, the GEF does not appear to have addressed environmental security in an integrated manner across its program areas. One reason may be the lack of a common framework or language to differentiate the various dimensions of environmental security and, thus, evaluate the case for different strategies of engagement. In its report to the 5th GEF Assembly (2014), STAP noted the importance of action to "enable improved human well-being, health, security, livelihoods and social equity at the same time as environmental benefits" and recommended increased attention to environmental security.

There are four dimensions of environmental security that are of particular relevance to the GEF:

(i) the degradation of ecosystem goods and services often causes significant harm to human well-being and human security;
(ii) conflict, irrespective of its source, affects the viability or sustainability of investments in environmental protection and their outcomes;
(iii) resource competition, or inequitable distribution of benefits increase vulnerability and conflict risk; and
(iv) environmental cooperation can increase capacity for conflict management, prevention, and recovery.

Clearly, environmental security is relevant to all the GEF's focal areas. The international waters portfolio has given most explicit attention to investment in institutions for transboundary cooperation, in international river basins as well as large marine ecosystems. The biodiversity portfolio addresses direct threats to food security and well-being: studies indicate there is significant overlap between biodiversity hotspots and areas of civil strife. Land degradation, including deforestation and desertification, offer direct routes to support the food and livelihood security of populations living in marginal environments. About 30 % of the total global land area is considered degraded, with approximately 3 billion people residing in areas with land degradation hotspots. These have serious implications for food and water security, aggravated by climate change.

Environmental security underpins the rationale for investment in global environmental benefits. It is essential to maintain the earth's life-supporting ecosystems generating water, food, and clean air. The environment is better protected when activities to generate global environmental benefits – as in the GEF mandate – are analyzed to ensure that negative social and economic impacts are either minimized or mitigated. Reducing environmental security risks also depends on GEF investment to achieve global environmental benefits depends on effective management of environmental security risks as an element of human security.

In the short term, STAP recommends the following:

STAP's recommendations	
1	Explicitly address environmental security in projects and program design: Expressing the benefits of GEF investment in terms of environmental security, as a component of broader human security, can link global environment benefits to the more immediate concerns of employment and livelihoods, equity, social stability and effective governance.
2	Assess conflict risk routinely among investment risks beyond the scope of GEF intervention: GEF agencies usually carry out such analyses in their non-GEF financed portfolios. The GEF should consider how to make the best use of protocols used by some agencies, including UNDP, UN Environment, and the World Bank, when designing relevant projects.
3	Evaluate the relationships between environmental change and vulnerability within GEF interventions using tools such as the Resilience, Adaptation Pathways, and Transformation Assessment (RAPTA) framework.
4	Contribute to conflict prevention through environmental cooperation: There are opportunities for the GEF to mitigate the vulnerabilities affecting particular stakeholder groups and also to strengthen institutions of environmental cooperation and equitable resource governance.

In the longer term, the GEF might consider: developing environmental security indicators to monitor progress; developing methodologies for analyzing conflict risk drawing on the experiences of GEF agencies; integrating capacity building for disaster preparedness and contingency planning into project investments (e.g. to avoid exploitation of biodiversity hotspots or release of chemical pollution); and enabling proactive stakeholder engagement in assessing risks and developing shared action plans to build patterns of cooperation that may prove critical when crises emerge.

(vi) Innovation

The notion that the GEF would be innovative – in its design, governance, and operation – was fundamental to its creation. While the GEF has evolved in many ways – expanding its scope, greatly increasing the number of agency partners, testing new modalities, and more—the world in which it operates has changed even more dramatically. However, remaining innovative is more challenging.

The financial landscape has expanded many fold, with philanthropic and new forms of finance focused on social investment, with much greater resources (although rarely as grants). New technologies are evolving rapidly, some with unanticipated potential application to address global environmental problems, e.g. drones, GPS systems, and high-speed computing. New initiatives with donor, commercial, and even philanthropic support now focus on the early, highest risk stage of new ventures and often provide support for guiding, mentoring, and piloting ideas that otherwise would have little chance of mainstream funding. And the commitment of funds to initiatives with some social purpose is accelerating and while not defined and measured consistently, is unquestionably in the many billions of dollars, much of it in emerging markets.

The GEF has accomplished a great deal but global environmental problems remain daunting and in some cases, are accelerating. "Business as usual" will not lead to sustainable development; solutions with greater impact need to be found. Barring the unexpected commitment of much greater resources, this means doing much more with the funds available – finding ways to leverage much greater investment for each GEF dollar; identifying creative uses of emerging technologies to address global environmental problems; and engaging a much wider range of partners with shared interests.

STAP commisioned a study which looks at how the GEF might identify and support innovation, and also held a follow-on expert workshop. In the final paper in November 2018, STAP will make additional specific recommendations for innovation in the GEF on finance, technology, business models, and policy.

The obvious incentives for greater innovation in the GEF are to increase environmental effectiveness (to achieve deeper and wider changes), economic efficiency (to achieve more benefits for the same amount of investment) and the longevity of results (to secure self-sustaining mechanisms with durable outcomes).

A key issue for innovation in the GEF is risk. Innovation brings with it the possibility of better outcomes, but also the potential for failure. The incentives, for both agencies and countries, then, are to fall back on trusted and true solutions which have been proven to work. This discourages innovation.

In OPS6, the IEO reported that 82% of projects were rated satisfactory or better. This raised questions about why the remaining 18% were not more highly rated.

For example, one option raised in STAP's workshop on innovation (March 2018) could be to aim for 75% of projects rated as satisfactory and above, with 5% of the funding allocated to projects which are

explicitly recognized as high-risk, high reward. This could be done by setting aside funding for specific innovations and inviting applications, for example, on Artificial Intelligence. Another option would be to establish a pool or fund for risky projects on the understanding that some would fail, akin to the portfolio approach adopted by venture capitalists.

Innovation in the GEF comes from diverse sources, including the GEF Secretariat, agencies, STAP, IEO, private sector, academia, and NGOs. But it is not clear where responsibility lies for coming up with innovative ideas or assessing them.

Innovative ideas are sometimes included in the initial PIF, or added at a later stage. Project proponents are explicitly asked about innovation in the PIF, but the extent to which this is addressed varies greatly. Requiring a better explanation of what is new in a proposed project might trigger more serious consideration of innovation.

The GEF would benefit from a more systematic approach to innovation. Being aware of and keeping up to date with what's happening in innovation is a substantial task, and may require particular skills and specialized knowledge. Other organizations have adopted (or have access to) mechanisms to identify and evaluate emerging technologies and innovations, for example, the UN "technology alert system".

(vii) Novel entities

Novel entities are broadly defined as, *"things created and introduced into the environment by human beings that could have positive or negative disruptive effects on the earth system; and may include synthetic organic pollutants, radioactive materials, genetically modified organisms, nanomaterials, micro-plastics"*.

The Global Environment Facility (GEF) needs to be aware of the opportunities and potential benefits that new entities and technologies can offer in delivering global environmental benefits, and also to be mindful of the potential for novel entities to become major global environmental problems. STAP commissioned a study to identify novel entities relevant to GEF's work, and held an expert workshop in Mrach 2018.

Seven novel entities were selected for GEF's consideration on the basis of three criteria: novelty – newness of the entity or new knowledge about the entity; impact – scale, timing, scope, and complexity of impact; and relevance - how the entity might affect the GEF's work, both positively, and negatively. The entities are:

(i) technology-critical elements[10], for example, rare earth elements, which are used in emerging and green technologies, but which when released into the environment have potentially harmful effects on plants, ecosystem and human health.

(ii) next generation nanotechnology[11] which could help increase agricultural productivity, reduce dependence on chemical pesticides, and improve freshwater supplies by using less energy than conventional desalination. But there could be potential environmental effects if nanomaterials leak into the environment.

[10] Technology-critical elements (TCEs) include: most rare-earth elements (REEs) - a group of 17 elements including the lanthanides, scandium, neodymium, dysprosium, terbium and yttrium; the platinum group elements, for example, platinum, palladium, rhodium, ruthenium, iridium, and osmium; and the elements gallium, germanium, indium, tellurium, niobium, tantalum and thallium. They are needed for many modern and green technologies such as electric cars, solar panel and wind turbines

[11] Nanotechnology related to the manipulation of individual atoms and molecules at dimensions and tolerances of less than 100 nanometers.

(iii) blockchain technology[12] is a decentralised, digital log that promotes secure, transparent, and efficient transactions, with possible applications in monitoring chemicals and waste, energy microgrids, reducing illegal fishing, and tracking genetic resources.

(iv) gene editing[13], including Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR), offers the possibility of better control of vector-borne diseases, improved animal husbandry, and helping plants adapt to climate change, but could pose a threat to biodiversity.

(v) cellular agriculture to produce livestock products like meat, leather, and fur without using the animal itself, which could help reduce the environmental effects associated with the current food production system.

(vi) engineered bio-based materials which uses organic resources enhanced by synthetic biology to produce biofuel, chemicals, plastics, and construction materials.

(vii) nano-enabled energy[14] improves the capture and conversion of solar and waste heat energy.

STAP initially recommends that GEF should: focus on managing the risk, and harnessing the opportunities offered by technology-critical elements; get a better understanding of, and consider how to exploit blockchain technology, gene editing/CRISPR, and engineered bio-based materials; and monitor the development of next-generation nanotechnology, cellular agriculture, and nano-enabled energy. Fuller recommendations will be forthcoming in November.

(viii) Local commons for global benefits

Globally, drylands and forests are of critical importance to the GEF, because much of the world's carbon and biodiversity are in these biomes. Drylands host many endemic plant and animal species and include about 20% of the major centers of global plant diversity and over 30% of the designated endemic bird areas. Approximately 2.5 billion people live in drylands and are faced with scarce natural resources, land degradation, and frequent droughts, which pose a serious challenge to food production. Forests are the most diverse ecosystems on land, covering about 30% of the Earth's land surface, but with up to 90% of the world's terrestrial biodiversity, and as much as 46% of the world's terrestrial carbon stores. At least 50% of the world's land area is held under customary or community-based regimes and 25% are rangelands are managed by pastoralists.

Gains or losses in biodiversity are related to the strength of institutions – the formal and informal rules governing society. Evidence suggests that environmentally deleterious practices are fewer where there are strong governance institutions. As well, evidence is emerging that natural systems such as intact forests and wetlands, as well as wildlife, can have considerably more economic value than if they are converted to alternative uses.[15]

The Sustainable Governance Approach (SGA) was developed in southern Africa as an alternative (and complementary approach) to public wildlife management. The objective of this approach is to translate the economic value of wild resources into the prices that drive land use decisions. Its cornerstone is the

[12] Blockchain technology is a digital log that decentralises data and eliminates intermediaries typically required to validate transactions. It uses a distributed database to store information securely, transparently, and efficiently and can, therefore, improve any process that requires a safe sending, storing, accessing, or verification of information.

[13] Genome editing or gene editing involves the use of biotechnological techniques to make changes to specific *DNA* sequences in the *genome* of a living organism, through DNA insertion, deletion, modification or replacement.

[14] Enhancing the ability to harness energy from sunlight or heat using nanotechnology.

[15] Costanza, R. et al., 2014. Changes in the global value of ecosystem services. Global Environmental Change 26: 152 – 158.

denationalization of wild resources, i.e. establishing private and private-community ownership, and measures to correct the underpricing of wildlife. The SGA has four key elements: proprietorship (devolution rights to land holders and communities); price (maximizing the value of wild resources); subsidiarity (functions carried out at the lowest effective level); and co-learning and adaptive management.

STAP proposes that the GEF should support the strengthening of local commons to provide global benefits including considering – where possible: devolving and delineating rights and responsibilities for resources; maximizing the financial and non-financial incentives for wild resources and ecosystem services; corruption and elite capture[16]; ensuring that local voices are heard in global decision-making processes; and adopting effective principles for community governance and capacity building.

3. STAP clarified and codified its guidelines for screening GEF projects

At the STAP Retreat in January 2018, the Panel discussed the screening of GEF projects with members of the GEF Secretariat, and has now revised its guidelines to ensure a standardized and consistent approach, which follows the same structure as the new PIF template. By being clear about what it expects to see in PIFs, and disseminating the guidelines, STAP believes that this will contribute to improving the quality of project proposals.

The guidelines answer the question, "what does STAP look for when it screens projects?", and provide prompts for project proponents to address scientific and technical issues that are important for designing projects. For example, the guidelines assist with the problem analysis and help develop an impact pathway (theory of change) to achieve the project objective.

The guidelines can be accessed from the new GEF portal for projects, via a hot link, and are also on the STAP website. STAP will apply the revised guidelines for the GEF-7 work programs.

4. STAP support for the Food Security Integrated Approach Pilot

At the meeting of the Food Security Integrated Approach Pilot (IAP), 8-11 May in Nairobi, Annette Cowie, STAP land degradation member, made a presentation on resilience thinking to provide countries with a tool they can use to assess progress in enhancing the resilience of food security.

During the overview of country approaches on monitoring and assessing resilience for food security, Dr. Cowie presented an example of the program's theory of change. and demonstrated how the principles of resilience thinking (adaptation and transformation) can be used to meet the program's goal of achieving sustainable and resilient food security by 2025. Dr. Cowie's presentation emphasized the presentations made earlier on how the hub project can support the program's resilience measurements at the national and regional level. The presentation also was used to inform the country project exercises on monitoring the resilience of food security interventions. The technical advisory group of the Food Security IAP, of which STAP is a member, also met and discussed how to review and consolidate approaches and indicators at the program level, particularly indicators for measuring impacts on resilience for food security.

[16] 'Elite capture' refers to the phenomenon whereby resources transferred for the benefit of the masses are usurped by a few, usually politically and/or economically powerful groups, at the expense of the less economically and/or politically influential groups (See Diya, D. 2009. Elite capture and corruption: concepts and definitions. National Council of Applied Economic Research.

The meeting brought together the twelve IAP countries, agencies, and STAP, with the aim to positioning the program within the New Partnership for Africa's Development, the Sustainable Development Goals, and the objectives of the multilateral conventions. There was peer-to-peer learning between country teams on designing project components for gender mainstreaming, incentives for ecosystem services, and monitoring for food security resilience.

5. STAP's work program for GEF-7

At its Retreat in January 2018, STAP developed some preliminary ideas for its GEF-7 work program on what advice the GEF partnership might most benefit from in the next two years. The following ideas were discussed and will be developed further in consultation with the GEF Council, Secretariat, and agencies.

(a) land degradation neutrality guidelines for projects

In 2015, the United Nations Convention to Combat Desertification (UNCCD) adopted the goal of Land Degradation Neutrality (LDN) to advance its implementation. To support the GEF's objective of "…establishing baselines, identifying indicators, or metrics, for monitoring and assessing GEF interventions", STAP will provide guidance on LDN implementation for use by GEF project developers. This guidance will facilitate the design and implementation of land-based projects enhancing natural capital. In addition, it will support UNCCD's objectives by targeting countries' capacity to pursue and monitor LDN. The guidelines will be based on the "Scientific Conceptual Framework for Land Degradation Neutrality" developed by the Science-Policy Interface of the UNCCD.

(b) climate risk screening

A preliminary study by University of Maryland graduate students, guided by STAP, applied the World Bank Climate and Disaster Risk Screening Tool and the USAID Climate Risk Screening and Management Tool to 24 GEF-6 PIFs and CEO-endorsed projects to evaluate climate risks that might have been identified before implementation. The initial findings indicated that while some projects demonstrated innovative strategies for addressing climate risk, other projects did not provide enough information to draw conclusions about whether they had, or had not, thought about and addressed climate risk adequately. STAP will suggest ways to improve climate screening in future projects and programs.

(c) science for integrating vulnerability reduction and climate adaptation into GEF programming, and develop adaptation metrics across the GEF portfolio

This will develop: adaptation metrics (especially early and intermediate) across the whole GEF portfolio, i.e. not just for the LDCF and SCCF; and indicators and composite indices to measure progress, efficiency, and effectiveness of climate adaptation. It will also provide advice on measuring and addressing uncertainty, and suggest methods for designing responsive and sustainable projects where climate projections are limited, or uncertain.

(d) the science of multi-stakeholder dialogue and transformation in social-ecological systems

Drawing from the science of stakeholder engagement and transformations in social-ecological systems, STAP will develop guidance for project/program design, monitoring and assessment, and learning.

Cases of purposeful transformation and innovations in policies, institutions, and markets will be reviewed as well as the roles and responsibilities of civil society, industry, and public sector in social-ecological change and transformation. This work will build on the RAPTA foundations and apply RAPTA concepts and guidelines in the analysis, going beyond land degradation and food security. The RAPTA guidance (or elements of it) on stakeholder engagement and governance will be strengthened through this activity.

(e) the application of remote sensing to assess and monitor global environmental change

In recent years, data from remotely sensed satellites has become more available and accessible via a number of emerging platforms. Drawing on the experience of the GEF agencies, and other bodies, STAP will produce a scientific primer on the potential use of remote sensing data and technologies, and on which remotely-sensed data products are most applicable for GEF projects and programs for design, monitoring, and measurement.

(f) development of a global mercury knowledge platform Phase II

Phase I assessed the feasibility of developing a platform and identified the scope and elements which were required. Phase II will develop a functional online mercury knowledge platform which will: provide a node for baseline data and information on mercury emissions and mitigation; support monitoring and reporting on implementation and compliance efforts under the Minamata convention, as well as the development of Mercury Initial Assessments (MIAs) and National Action Plans (NAPs); and improve Increased awareness among experts, decision-makers, and other stakeholders, about the available data and information on mercury emissions sources, impacts, and potential mitigation efforts.

(g) guidance on how to estimate the environmental impact of chemicals and waste projects

STAP will provide guidance, through an extensive review and synthesis of existing methodologies, for agencies and countries on how to estimate broader global environmental benefits from chemical and waste projects, e.g. benefits in addition to the immediate clean-up of a contaminated site in water, land degradation, and biodiversity.

(h) Aquaculture potential contributions to nutrition security, climate mitigation, and land restoration

STAP will consider innovative aquaculture options, e.g. farming the marine water column, novel plant- or animal-based nutrients, and the link to marine biodiversity, algae, seaweeds and alternative food sources. It will also look at the climate mitigation potential of sustainable aquaculture in the new protein economy, and opportunities to boost nutritious food production while reducing pressure on land and freshwater resources, as well as risks and requirements for sustainability.