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STAP REPORT TO THE THIRD GEF ASSEMBLY ON THE BROAD
SCIENTIFIC AND TECHNICAL ISSUES THAT EMERGED DURING THE
PRECEDING PHASE OF THE GEF AND ON EMERGING ISSUES AND
GAPS

(Prepared by STAP)



United Nations Environment Programme

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PROGRAMME DES NATIONS UNIES POUR L'ENVIRONNEMENT • PROGRAMA DE LAS NACIONES UNIDAS PARA EL MEDIO AMBIENTE
ПРОГРАММА ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ ПО ОКРУЖАЮЩЕЙ СРЕДЕ

STAP Report to the Third GEF Assembly on the Broad Scientific and Technical Issues that emerged during the Preceding Phase of the GEF and on Emerging Issues and Gaps

June 2006

Prepared by STAP-3

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Preface

As the Chair of the Scientific and Technical Advisory Panel (STAP) to the Global Environment Facility (GEF), and in accordance with the Instrument for the Establishment of the Restructured Global Environment Facility, I am pleased to forward to you the STAP report to the Third GEF Assembly on the broad scientific and technical issues which emerged during the third phase of the GEF, July 2002 to June 2006. The report was prepared by the members of STAP III, with the support of the STAP Secretariat.

The report reflects STAP's important advances in its scientific understanding of the environmental and technical issues that are directly relevant to the GEF. It also identifies emerging technologies, which could play a significant role in strengthening the effectiveness of GEF activities across the world.

I very much hope the report encourages further discussions on the role of science in the GEF, as well as on the optimal ways of integrating science in the GEF's work. I am also very hopeful the report will lay the groundwork for STAP as we develop, and strengthen the delivery of our advice to the GEF in its fourth phase.

Yolanda Kakabadse
STAP Chair

Executive Summary

1. The last four years have seen important advances in our scientific understanding of environmental issues, as well as in technologies that are directly relevant for the work of GEF. There are increasing concerns that serious impacts of climate change could be more severe, and some more abrupt than was assessed by IPCC TAR in 2001, particularly in the cases of polar and high altitude regions. The recently completed Millennium Ecosystem Assessment assessed the status and trends of ecosystems and the services they provide, and found clear tradeoffs between provisioning services like food and other types of ecosystem services. There is also growing evidence that invasive species are having major impacts on island and freshwater ecosystems, a problem that is growing more acute with increasing global trade. At the same time, there have been promising advances in key technologies such as genomics, bioinformatics and low carbon/clean energy technologies, which are poised to have a major impact in developing countries and represent an opportunity for the GEF. The challenge ahead is to promote the rapid diffusion and scaling up of some of these technologies, as well as enabling societies to better understand some of these technologies, e.g. genomics.
2. The scope of science and technology issues addressed by the STAP has been expanded considerably during the last four years with the addition of the new focal areas of land degradation and persistent organic pollutants. STAP III made important progress identifying the interlinkages across focal areas, focusing on potential synergies and impacts of GEF projects across operational programs. Examples include relations between climate change and biodiversity, or between land degradation and climate change. In order to attain GEF's overall objectives it is critical that GEF take these interlinkages into account when developing new projects, moving away from projects focusing on single operational programs.
3. It is also important that the GEF strengthen its knowledge management, so that lessons learned can be shared across projects and with clients, and that special emphasis be placed on including capacity building in science and technology (S&T) as part of its portfolio.
4. STAP did a careful review of its operations and identified a number of ways to improve its advice and strengthen overall science and technology issues through the GEF. It is clear that the S&T capacity in the GEF Secretariat and Implementing Agencies is stronger now than a decade ago. However, there is also a need to build a stronger STAP Secretariat, develop a work program focused on key elements needed by the GEF and a better integration of STAP into GEF operations overall. There is also a need to ensure representation of social sciences in the STAP and strengthen STAP ties with the broader scientific community. STAP proposes to convene a science/policy forum every four years as part of the process leading up to the replenishment, so as to advise on emerging S&T issues that need to be taken into account by the GEF. There are a number of steps that can be taken within the existing instrument and that would result in a stronger STAP and a stronger GEF overall.

1. BACKGROUND

5. The STAP was established a decade ago, when the world, the role and expectations of the GEF, and Implementing Agencies' (IAs) scientific and technical needs and capabilities were very different from what they are today. The GEF family has now committed to help reach the Millennium Development Goals by mobilizing international co-operation to protect the global environment in ways that promote sustainable development and create opportunities for the world's poor. In this situation, it is not only critical for the GEF to achieve good projects on the ground with best science, but also to influence policies through those projects so that the value of GEF is not localized (through project outcomes) but institutionalized (through policy outcomes). As a result, today, more than ever, the GEF needs the best and most strategic policy and scientific & technical advice possible to help optimize the use of limited funds.
6. It is clear that environmental science has advanced and evolved in the twelve years since the creation of GEF and STAP, and that the scientific community is identifying trends and emerging issues that GEF needs to take into account in its future work program, particularly the findings of assessments such as the Millennium Ecosystem Assessment, the Report of the International Geosphere and Biosphere Programme (IGBP), the Intergovernmental Panel on Climate Change (IPCC), the World Energy Assessment (WEA), and the Millennium Project. GEF will need to devise policy frameworks to better incorporate cutting edge science and technology findings into its portfolio, refine the indicators used to measure project impact, and facilitate learning from projects' experiences.
7. In the next GEF phase, demand for financial resources available to the GEF is expected to greatly exceed availability, and the new resource allocation framework will also have a major impact on the geographic allocation of resources. GEF can take advantage of the best scientific knowledge available to be strategic in supporting catalytic actions that will have the utmost positive impact on the global environment. In order to carry out this catalytic role, the GEF community must examine whether it has the institutional capacity to respond to new and emerging environmental challenges, and develop this capacity where necessary.
8. It is increasingly clear that environmental challenges must be approached in an integrated manner that addresses the ties between environment and development, the inter-linkages between global environmental issues such as loss of biodiversity, climate change, and freshwater and coastal systems degradation at different scales, as well as factors such as trade and the movement of invasive alien species and viruses, intellectual property rights and access and benefit sharing. To address these challenges, GEF must not only develop mechanisms to engage the science and technology expertise that already exists in the countries where it works, but also make the most of the tools offered by the advances in fields such as bioinformatics and genomics.
9. This report presents an overview of some of the most relevant emerging science and technology issues and their potential implications for the GEF, and highlights the need to scale up efforts in areas like climate change and biodiversity, taking existing knowledge to practice through GEF projects aiming at providing incentives, and guidance to markets to mainstream sustainability. It also presents an overview of some of the most important contributions during STAP III and highlights some of the

priorities that could be addressed by STAP IV. Finally, it presents a summary of a review done by STAP and implementing agencies on ways to improve operations of the STAP and strengthening science and technology through the GEF overall.

2. SCIENCE AND TECHNOLOGY TRENDS AND EMERGING ISSUES

2.1 State of Science and emerging issues

2.1.1 Findings of the Millennium Ecosystem Assessment

10. The Millennium Ecosystem Assessment (MA) was a science assessment completed during STAP III and supported by the GEF. It involved more than 1300 scientists from 95 countries and was designed to analyze the condition and trends of ecosystems, the services they provide and their importance for human well-being. The conceptual framework of the MA identifies direct and indirect drivers of change and analyzed their relative importance across different biomes. The MA reached the following conclusions:

- Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth.
- The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development (for some), but these gains have been achieved at growing costs (for others). These problems will substantially diminish the benefits that future generations obtain from ecosystems.
- The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals.
- The challenge of reversing the degradation of ecosystems, while meeting increasing demands for their services, can be met under some scenarios involving significant policy and institutional changes. However, these changes are significant, and not currently under way. Many options exist to conserve or enhance specific ecosystem services in ways that reduce negative trade-offs, or that provide positive synergies with other ecosystem services.

11. The findings of the MA have important implications for the GEF. The main drivers of change vary according to major biomes, and can help focus the interventions designed for conservation. For example, invasive species are the main driver on islands, whereas climate change may be the most serious driver on mountain ecosystems. The MA also highlights the need to take into account multiple ecosystem services, and shows that provisioning services are usually given more importance than regulating or cultural services. This needs to be taken into account in GEF projects, especially those focusing on sustainable use of biodiversity. Furthermore, the MA analyzed the effectiveness of more than 60 different response options on ecosystems, and their ability to provide services for human well-being. It also included more than 30 case studies around the world.

2.1.2 Climate Change

12. There have been increasing concerns that serious impacts of climate change could be earlier, more severe, and some more abrupt than was assessed by IPCC TAR in 2001. This is particularly the case in polar and high altitude regions, but especially in the Arctic, where there are many positive feedbacks in the atmosphere-biosphere system.
13. The five warmest years on record have occurred since 1998. This has been associated with increasing number of extreme weather events. Climate sensitivities are now believed to be higher, and in order to stay within two degree Celsius temperature increase above the pre-industrial level, stabilization of GHG in the atmosphere need to be 450 ppm CO₂ eq. The probability of large sea level rise due to destabilization of the Greenland ice sheet and West Antarctic ice sheet has increased, based on, *inter alia*, observations of a significantly increased rate of flow of glaciers in Greenland and Antarctica to the oceans during the last decade. The extension of the Arctic ice reached its minimum in 2005 since measurements started in the late 1970s, with about 40-50% decrease in the ice thickness. The average intensity of hurricanes has increased. There is also increasing acidification of the oceans, threatening ecosystems, such as coral reefs and carbon sinks that oceans provide. Further large scale positive feedbacks reinforcing global warming include possible releases of methane from methane hydrates, deforestation in the Amazon, and transformation of the Indian monsoon.
14. The changes in regional temperatures, precipitation patterns, permafrost, and sea ice have impacted and will continue to impact biodiversity and human societies at greater rates than observed in 1990-2000. In many developing countries, these impacts are adverse and people have little or no capacity to cope with them. This highlights the need for the GEF to continue investments in climate change mitigation, and to look into measures for reducing impacts of climate change.

2.1.3 Invasive species

15. Another important dimension of global environmental change is related to invasive alien species (IAS), and their impacts on biodiversity, livelihoods and natural resource use. IAS can disrupt and transform natural ecosystems by changing the geographic ranges of species, by altering relative success of species, and indirectly by altering ecosystem function and disturbance patterns. The problem with IAS is increasing, largely due to growing trade and is likely to have a major impact in the future, especially on island and freshwater ecosystems.
16. Climate change is likely to introduce major additional uncertainty into the control of IAS - and other aspects of the management of ecosystems and biodiversity. But the likely direction and magnitude of some effects, and the implications for policymakers, planners and managers, are disturbingly unclear. This is an alarming gap in our understanding of ecosystem management. Given the magnitude of both threats, this lack of understanding is serious. The compound and separate effects of these two major threats will seriously transform ecosystems, most likely reduce some of the services they deliver, and foreclose development options for people. It is important that the GEF consider some targeted research projects in this area to better understand the interactions between climate change and invasive species, and identify the best interventions through projects in coming years.

2.1.4 Access to Genetic Resources and Benefit Sharing

17. One of the objectives of the United Nations Convention on Biological Diversity (CBD) is the fair and equitable sharing of benefits arising out of use of genetic resources. This objective has seen limited progress to date, although the CBD has adopted a set of guidelines and is starting a process for negotiation on an international regime. This negotiation will involve legal issues related to patents and intellectual property rights, issues that are generally dealt within the World Trade Organization (WTO), and the World Intellectual Property Organization (WIPO).
18. The ability of countries to generate benefits from genetic resources will depend on their scientific, technical and technological capacity, as well as on the collaborations with industries in developed countries. The benefits arising from this process may include capacity building, technology transfer and economic benefits, among others. The GEF will most likely be called to develop projects on capacity building of developing countries in this area in the coming years.

2.1.5 Persistent Organic Pollutants (POPs)

19. Within the environment, there are chemicals that are more toxic to human health than some of the 12 Persistent Organic Pollutants (POPs) under consideration in the Stockholm Convention. These include lindane (HCH), endosulfans, phthalates and PAHs, which should also be given serious consideration. Phthalates and PAHs could be greater threats to environment and human health if their input into the environment is not checked.
20. There are emerging threats of relatively persistent chemicals that are being widely used in consumer products that end up as persistent pollutants such as bisphenol-A, PBBs, PBDEs, and other new persistent chemicals. Most of these chemicals are often neglected in the monitoring programs, and control regulations of most countries. Therefore, efforts should be focused on identifying these chemicals, and intensifying collection of ecotoxicity data on these chemicals.
21. Endocrine disruptions as well as carcinogens are not adequately addressed by the Stockholm Convention on Persistent Organic Pollutants. There are increasing numbers of incidences of lung cancer and meso-thelomia in Canada, USA, Europe, and Japan. Threats of nanoparticles to human health with the rapid growth of nanotechnologies are real. The threat of these mostly persistent materials should be addressed quickly and earnestly.
22. National Implementation Plans (NIP) address the inventory of POP chemicals, including dioxins and furans. These unintentionally produced POPs are more toxic than the other pesticidal POPs, and it is hard to control their releases to the environment. Open burning of municipal and industrial solid waste and forest fires contribute significantly to the release of dioxins and furans and more so if land-fills are on fire. These occurrences are quite rampant in the developing countries, and in transition economy countries. The practice of burning forests and jungles to clear the land for agriculture is also wide-spread and produces not only dioxins and furans, but other chemicals such as green house gas and polynuclear aromatic hydrocarbons (PAHs) which come into the category of POPs. Concern should be focused on open

burning, forest fires and unregulated industrial processes that release much more of the dioxins and furans.

2.2 Emerging Technology Issues and Scaling Up

23. There are a number of emerging technologies that can have a major impact on the long term effectiveness of GEF projects worldwide. The GEF can play a vital role in the transfer and scaling up of these technologies. In three areas such technologies may have major impacts for GEF projects, if disseminated on a large scale: energy, bioinformatics and genomics.

2.2.1 Low-carbon/clean energy

24. Energy systems worldwide face a number of drivers for major change, including growing requirements for energy services for economic growth, poverty alleviation, security of energy services, as well as local, regional and global environmental challenges. Resources and technologies exist to meet all these challenges simultaneously. The main technology components include much more efficient use of energy, especially at the point of end use, a broad variety of renewable energies (modern bioenergy, wind, geothermal, solar, and others), combined heat/cool and power, and the next (much cleaner) generation technologies using fossil fuels, including carbon capture and storage.
25. Therefore, the main issue is scaling up existing technologies and systems that have such characteristics. The main scaling up challenge is to create market conditions that lead to investments in the technologies, and systems that support sustainability (including economic incentives, regulations, institutions, knowledge management networks, information, transparency, training and education).

2.2.2 Bioinformatics

26. Information technology is having a major impact on our capacity to gather, organize, exchange and analyze information. The costs of IT equipment and connectivity are decreasing worldwide, making these tools available to scientists, natural resource managers and decision makers. The World Wide Web provides easy access to major information resources that were limited to developed countries until a few years ago. This can have a major impact on the design and implementation of GEF projects, and can play an important role in knowledge management.
27. There is a large amount of biodiversity information available worldwide, including published literature and specimens deposited in collections, but much of this information is not easily available to the countries where this biodiversity is found. New imaging technologies enable us to obtain and share high resolution images of these collections, improving access to specimen data across countries. There have been recent efforts to integrate some of this information, such as the Global Biodiversity Information Facility (GBIF). Furthermore, new modelling tools allow us to use this data to identify critical areas for conservation, and predict potential changes over time. The GEF can have a major impact by making sure these tools are included in natural resource management projects, as well as supporting international partnerships and networks in bioinformatics.

2.2.3 Genomics

28. After the completion of decoding human genomes in 2003, DNA science and technology has become a powerful tool to provide new information to medical as well as biological societies. It can be expected that the development of genomics technology will contribute to solving the issues of global environment, such as tracing avian flu routes, understanding species classification for biodiversity conservation, detection and monitoring of genetically modified organisms, and managing hazardous chemicals on the basis of DNA toxicology. There have been major technological developments in this area, such as the use of DNA microarrays, accelerating the speed and reducing the cost of genomic analysis. The GEF can play a major role by supporting the transfer of these technologies and supporting capacity building of research centres in developing countries where these technologies can be readily available for environmental projects.

2.3 Taking Knowledge to Practice

2.3.1 Knowledge Management

29. The GEF family needs a coherent and common concept and vision for Knowledge Management (KM). Lessons learned are not systematically being identified, collected, and utilized in any cross-network, integrated way. This has been recognized as a major barrier to make effective use of and enlarge the catalytic role of the GEF. STAP especially advocates a more proactive KM strategy for the GEF as this could have the following effects:
 - Multiply the impact of projects and scarce financial resources by raising awareness, and motivating stakeholders for action.
 - Broaden the outreach of knowledge on GEF projects and on the catalytic role of GEF.
 - Support replicability, market aggregation and social marketing campaigns by knowledge sharing.
 - Raise awareness of the targets and the implementation activities of the Conventions.
 - Convince stakeholders of the socioeconomic benefits of GEF projects.
30. An Inter-agency Workshop in January 2006 brought together a group of experts working with KM-related issues in the GEF Secretariat and the IAs to take stock of the current status, identify needs and opportunities for a GEF-wide approach to KM, and to develop ideas for pragmatic steps that could be taken to achieve tangible results. An Inter-agency Working Group will follow up on these ideas. STAP has recommended conducting a pilot project on KM within the Climate Change focal area. It will be connected with the outcomes of the workshop on “Efficient Buildings”, which will take place in Beijing, China in early 2007.

2.3.2 Capacity Building

31. The long-term impacts of GEF projects, after GEF funding has ended, depend in part on the scientific and technical capacity at the country-level. It is important that GEF projects actively take into account and include effective capacity building in science and technology. Based on a review of recent GEF projects, the STAP has initially identified a few interventions that seem most appropriate:
 - Strengthen boundary institutions. These institutions focus on applying science to inform formulation, implementation and evaluation of environmental policy. There are several examples of GEF projects that are managed by boundary institutions. Strategic approaches should be developed to strengthen existing institutions and to initiate new institutions. It would be advisable to develop criteria for such strategic investments.
 - Develop S&T leaders and networks. Strong boundary institutions provide the platform that national and regional S&T experts require to effectively contribute their expertise to relevant policy arenas. But the S&T experts themselves often need carefully targeted strengthening. Such interventions should target the real S & T leaders in countries and regions. Three examples of strategic interventions at this human level are:
 - Mobilize existing S&T experts in countries to understand and experience how they can apply their knowledge and tools to address emerging issues such as biosafety and adaptation. For example, the S&T issues involved in ‘adaptation’ and in ‘biosafety’ don’t require input from new fields of science *per se*, but do require new syntheses and applications of methods, insights, and information from multiple scientific fields.
 - Promote collaborative work, through interdisciplinary teams, on S&T aspects of emerging environmental issues. This is one of the best ways to strategically and efficiently mobilize existing S&T experts, including currently recognized S&T leaders in the region, as well as up and coming leaders. Examples of this kind of collective work that have occurred via GEF support include the Millennium Ecosystem Assessment and the CABI biosafety book series, initiated by the STAP, involving environmental risk assessment methods for genetically modified organisms.
 - Facilitate S&T Networks to maintain S&T capacity; south-south and north-south networks that are interdisciplinary and organized around major issues. One example is the Global Network on Energy for Sustainable Development (GNESD), initiated at WSSD and facilitated by UNEP.
32. Special emphasis should be placed in this area in Africa, and focus should be more on human resources than on land acquisition. or capital infrastructure built. Human resources is Africa’s biggest problem. The priority should be to access financial resources through the GEF project cycle. GEF needs to devote significant resources to a full fledged “capacity for Africa” programme. Existing entities with which synergies can be developed include the Third World Academy, ICSU, IUCN, and GNESD. The existing rather weak capacity in science and technology could be rapidly strengthened through the development of an ‘invisible college’ of African decision makers and younger professionals meeting for technical briefings and

discussion. Little of sustained value will result without the existence of indigenous, in-service, in-country professional capacity.

2.3.3 Technology, Scaling Up and Lead Markets

33. To increase the impact of GEF projects and to strengthen their catalytic role a better understanding of technology diffusion, technology transfer and scaling up of projects to markets is necessary. The crucial problem that has to be solved is how the worldwide diffusion of most advanced technologies can be fostered and how success stories and good lessons learned can be replicated on a larger scale. In many cases robust technological climate mitigation options are well known, but the speed of world wide market introduction (“scaling up”), especially in the South is much too low. Humanity can solve the carbon and climate problem in the first half of this century by scaling up what we already know how to do. For example, there is a need to move away from a traditional view of “technology transfer” – that is, technology is developed in the North, reaches maturity there, and is then ripe for transfer to the South. This simplistic understanding of technology transfer connected with large-scale public investments based on foreign technology and soft loans, with minimal knowledge transfer and domestic capacity building.
34. This ‘classical’ technology transfer approach has changed in many respects, which are important for the interventions of GEF especially in the Climate Change Focal Area. Some promising examples include new ventures in small-scale, dispersed renewable energy technology and energy-efficient technology that changed the view on technology transfer, thus raising awareness of the need to increase the local content of technologies as much as possible, transfer skills as well as technology, and shifting away from isolated hardware package deals to more integrated systems solutions, including proper incentive structures for relevant actors. Furthermore, South-South technology co operations are developing as a growing number of countries in the South have rather sophisticated R&D and manufacturing capabilities which are more adapted to the conditions of developing countries.
35. The forces of market globalization have been changing the way in which R&D is performed, the way in which it gets converted into products, the way these products get manufactured, and the way in which they reach markets. This is as true of environmentally sustainable, low-carbon technologies, as it is for information & communication technology. In some cases, a first or a broader market application of a new technology happens in the developing world and could “leap frog” from the South to the South and even from the South to the North. For example, the fuel consumption standards for cars introduced in “lead markets” like in China and the necessity to develop more resource efficient production processes and products could have a tremendous impact on not only the Chinese market but also worldwide technological developments in car manufacturing industries. In these cases, the GEF could focus more on assistance and support for developing incentive structures and regulatory frameworks to create “lead markets”; thus, fostering the market diffusion of advanced and more adapted efficient technologies.
36. The role of governments in technology development and transfer is changing with liberalization, privatization and globalisation. National governments now have a key role in facilitating the diffusion of technology through creation of adequate institutional infrastructures with high-quality education, promotion of R&D, adequate industrial standards, and regulatory frameworks. A somewhat related issue is that of

the financial and organisational modalities of how projects are structured and implemented. Public-private partnerships (PPP) are getting increasing importance in the context of complex scientific projects. Such multi-country, multi-actor partnerships are emerging in pure science as well as in technology development and commercialization. Concerted efforts by multilateral agencies and local governments implementing the right legislation may trigger strategic projects, enabling private industry to finance the implementation of renewable energy and energy efficiency; thus, helping to scale up both renewable and energy efficiency. It may be useful to examine the implications of such approaches for the GEF, and to integrate them into an updated GEF private sector strategy.

3. SUBSTANTIVE SCIENCE AND TECHNOLOGY CONTRIBUTIONS FROM STAP III

3.1 Interlinkages and Multiple Benefits

37. In recent years it is clear that there are multiple interactions between the many pressures from human activities and their effect on ecosystems and human well-being. It is also recognised that to reduce the adverse impacts from these pressures (such as loss of biodiversity, climate change, water (fresh and coastal) degradation, and invasive alien species), policies and actions need to be developed to address them simultaneously rather than individually. Recognising this, STAP developed a report on Interlinkages illustrating the scientific information as well as actions needed by GEF. It highlighted not only the need for action but also challenges that need to be addressed to maximise the global benefits and reduce environmental degradation, such as:
- Develop institutional mechanisms that bridge decision making across temporal and spatial scales.
 - Develop institutional capacity, resources and ability to work across ministries and political jurisdiction and disciplines (see above).
 - Disseminate information from the global and regional levels to national and local levels on the benefits of addressing interlinkages to more effectively deliver global benefits and address local multiple pressures.
 - Tools and methods to operationalise or implement an approach that considers interlinkages, allows integration and moves away from fragmented and compartmentalised operations.
38. By including interlinkages in policies, environment, environmental change and human well-being issues can be addressed in a systematic, long-term manner and form part of sustainable development goals. This approach would help exploit the potential synergies between policy and measures of responding to many of these issues (e.g. renewable energy and energy efficiency measures, and climate mitigation responses), force quantification of the benefit that relate to other environmental objectives (e.g. indoor and outdoor air quality), impacts on foreign exchange (e.g. due to reduced fossil fuel imports, improved local and perhaps national employment, energy security, sustainable livelihoods). In many circumstances, developing activities for adaptation (to climate change) would include an interlinkages approach.

3.2 Climate Change

39. The broad S&T issues arising from STAP III activities build upon contributions to the following activities: review of the OP7 portfolio, review of GEF engagement with the Private sector, initial work on knowledge management, sustainable consumption and production, biofuels for transportation (and other applications), as well as initial work on energy efficiency in buildings.
40. Making a difference now lies in deciding how to best use the leverage of scarce GEF *grant* funds to achieve large scale uptake of renewable energy and energy efficiency practices.
 - Given the tremendous growth in demand for energy services, in all sectors (transport, buildings, and industry) it is essential to focus on energy efficiency, as much if not more on clean production.
 - Identifying “good practice models”, their conditions for success and replication, highlighting the intimate link of the technology with institutional frameworks, financing schemes, policies and incentive measures: the work on biofuels as well as on the OP 7 portfolio highlighted once again that economic and even financial viability does not necessarily imply actual investment uptake and project implementation: knowledge management needs more focussed attention to ensure high levels of replication.
 - The GEF’s added value would then lie in developing the enabling frameworks and providing the appropriate financing to leverage mainstream sources of funds.
 - More broadly, the crosscutting nature of activities under the climate change portfolio was perceived as an emerging issue, not only with social sciences related issues (financial and institutional issues), economic and technological issues but broadly interlinkages with other focal areas, which is particularly well illustrated with the biofuels issue.

3.3 Biodiversity

41. STAP III focused its efforts in this focal area on developing advice on emerging topics like biosafety and mainstreaming biodiversity to production landscapes.
42. The parties to the Cartagena Protocol on Biosafety, under the Convention on Biological Diversity (CBD) have highlighted the need for scientific advice and capacity building in this area. As a response, STAP III has developed a series of books *Environmental Risk Assessment of Genetically Modified Organisms*, which provides scientifically peer-reviewed tools that can help developing countries strengthen their own scientific and technical capacity in biosafety of GMOs. The first three volumes have focused on BT cotton, BT maize and on transgenic fish. The volumes have been published in collaboration with CABI.
43. STAP III also organized, in collaboration with the GEFSEC and the IAs, an international workshop on mainstreaming biodiversity into production landscapes, in response to the requests from GEF for advice on this area of increasing importance within the GEF. The workshop gave guidance on approaches to the development and implementation of projects within Strategic Priority 2 of the GEF Biodiversity portfolio.

44. The objective of mainstreaming is to internalize the goals of biodiversity conservation and the sustainable use of biological resources into economic sectors and development models, policies and programmes, and therefore into all human behaviour. The workshop identified ten principles for effective mainstreaming – which apply not only to biodiversity goals in production systems, but can be applied to all elements of the global or local environmental agenda.
45. Effective mainstreaming requires:
- Awareness and political will from the highest levels, providing support for implementation.
 - Strong leadership, dialogue and co-operation at all levels.
 - Mutual supportiveness and respect between biodiversity and development priorities.
 - A strong focus on economic sectors, supported by cross-sectoral approaches, securing sector-based biodiversity conservation.
 - Analysis and understanding of the changing motivations and opportunities of each sector, including the effects of globalization.
 - Identification and prioritization of entry points and the development of sector-specific tools and interventions (e.g. international codes of conduct or standards).
 - Awareness within sectors of the relevance of biodiversity conservation and the capacity needed for implementation.
 - A coherent set of economic and regulatory tools and incentives that promote and reward integration and added value, while discouraging inappropriate behaviours.
 - Sustained behavioural change within individuals, institutions and society, and in both public and private domains.
 - Measurable behavioural outcomes and biodiversity impacts.
46. The comprehensive review of mainstreaming concepts and their application in projects from around the world prepared at the workshop was published by the GEF under the title ‘Mainstreaming Biodiversity in Production Landscapes’.

3.4 International Waters

47. STAP III has focused on groundwater as well as transboundary water management activities. Overuse of ground water affects wetland sustainability that threatens biodiversity of wetland ecosystems including Ramsar sites. Ground water level decline and/or sea water intrusion may cause changes in land use patterns and degradation. Surface water contamination by POPs affects ground water contamination that leads to difficulty for drinking water supply. Managed aquifer recharge has become critical as measures against ground water level decline, but the control of recharged water quality is essential for its success. Climate change causes sea level rise that affects sea water intrusion to coastal areas. The main recommendations from STAP III focus on integrating groundwater management, particularly managed aquifer recharge, into the GEF focal areas of biodiversity, climate change, land degradation, international waters and POPs.

3.5 Land Degradation

48. STAP III analyzed and synthesized available knowledge on the socioeconomic, institutional and policy conditions influencing technology adaptation and adoption for

sustainable management and use of drylands for food production and provision of ecological goods and services. Advice was provided on strategies and measures that would help communities to make the transition to more effective, culturally-appropriate and sustainable systems of land management in drylands. Key aspects of the main recommendations are that (i) sustainable land management (SLM) interventions must encourage and support a process of innovation led by land users to devise their own solutions to land degradation problems; (ii) the GEF should favour projects that offer a number of different technologies and management practices, which individual land users can choose, test, adapt and adopt or discard as they see fit. A participatory approach to technology development, based on consultation, experimentation and adaptation, will work better in promoting SLM than pressing for the adoption of a particular technology. This work should continue to be linked to ongoing work in the GEF's Land Degradation task force on identifying appropriate programme indicators for SLM that capture both local and global environmental benefits.

49. STAP also provided advice on best practices in the restoration and rehabilitation of drylands to help enhance the impacts of future GEF projects. This led to the development of a framework to assist in defining the scope of land degradation problems in a given context, societal and environmental goals in SLM, monitoring and adaptive management practices, and decision support tools to ensure transferability of successful practices to different areas/regions. Several checklists were developed to help in designing and implementing successful land restoration and rehabilitation projects. These checklists will be useful in: identifying impaired ecosystem services; designing project aims and goals; ensuring successful implementation processes that address the causes of degradation; and, assessing the success and impact of completed land restoration and rehabilitation projects.

3.6 Persistent Organic Pollutants

50. During the past four years the scope of issues addressed by STAP was expanded to include the focal area covering POPs. Over the decades, stockpiles of obsolete POPs have accumulated in developing countries, and the most widely used approach for disposing of these chemicals has been to pack and ship them overseas for high temperature incineration, a practice not sustainable in many respects. Within this context, and at the request of the GEF, STAP III provided advice on existing and emerging, innovative and potentially cost effective non-combustion technologies for the disposal and decontamination of soils containing POPs, and also examined the feasibility of using these technologies in developing countries and analysed barriers to their uses.
51. STAP's recommendation to the GEF was that criteria relating to risks, priorities/country-drivenness, sustainability, finance, enabling environment, and partnership should be developed as a basis for supporting non-combustion technologies in a country or region. If the criteria are not met, the GEF should not support technology projects. It is likely that such criteria are met in countries such as Mexico, Philippines and China, and in the regions of East and Central Europe where the market is sufficiently large, and the capacity and finance are in place. If the criteria are not met, as is the case for most of Africa, the GEF should support packing and shipping the stockpiles to facilities that meet internationally agreed standards of destruction. The African stockpile is small, and the GEF should invest in soil remediation instead. Where capacities are low and the soil contamination is a danger

to public health, soil decontamination should be funded. The development of a science program using twinning and peer review for bioremediation technologies is also recommended.

52. STAP III also gave advice on the use of biomarkers and bio-indicators for monitoring and measuring POPs, to supplement more traditional chemical analysis. This is due to the recognition that chemical analysis does not take into consideration the synergistic and antagonistic effects of pollutants in environmental matrices, nor does it provide information about the actual bioavailability of the pollutant. The effect on ecosystems cannot therefore be correlated with concentrations of POPs in the environment. It is suggested that biomarkers can be used to devise rapid, effective screening assays which can complement other testing techniques.
53. Bio-monitoring should also not be constrained by old technologies. Immunoassay dipsticks in particular could reduce the cost of rapid assessments of specific pollutants. A recommendation therefore is to support the development of immunoassays for specific POPs. Also important is the 'new thinking' and approaches in bio-monitoring. The integration of disparate datasets and explanatory frameworks is proposed. Simulation can be used to achieve this. It is important that we integrate biological and chemical science in monitoring. From a developing country perspective, the applicability of biomarkers and bio-indicators is recognized. Further support should be given to pilot implementation, and synergies with existing initiatives identified and strengthened.

4. IMPLICATIONS AND SCIENCE AND TECHNOLOGY PRIORITIES FOR STAP IV

4.1. Climate change

54. It is clear from Section 3.2 that the GEF's role should be carefully targeted to value added activities e.g. adjusting to the specific needs in a developing country, instead of supporting technology implementation per se. Making a difference now lies in deciding how to best use the leverage of the GEF *grant* funds to achieve large scale uptake of renewable energy and energy efficiency practices.
55. As indicated in previous sections, the multiple benefits from RE and EE justify strong frameworks to make technologies, based on local, regional and global benefits. Efficient, clean, and effective energy systems, based on energy efficiency and renewables, which support development and poverty alleviation will also mitigate climate change. These frameworks include subsidies removal to conventional energies, reflection of external costs and benefits in market conditions, functioning markets (information, transparency, real competition). Integration of energy efficiency and renewables can reduce costs of projects and climate mitigation strategies as in many cases the marginal cost of energy efficiency are less than the supply of heat or electricity by conventional means. Modernisation of biomass (its conversion to modern energy carriers such as electricity and liquid/gaseous fuels) emerged as a theme of very high potential and requiring more effort, through its many different applications – biofuels, electricity, but also as an input for heating applications. Resource productivity can thus be increased and risks reduced, for example import dependency, and resource conflicts in the oil and gas markets. Innovative mechanisms are needed to change markets and their uptake of new technologies, for example delivering impacts such as the German Feed-in-Tariffs, the

knowledge management networks, energy efficiency funds (UK, Denmark), labels, training and education, Top Runner approaches, fee-bates (combining of fee and rebates), among others.

4.2 Adaptation

56. In GEF III, the STAP provided advice during the development of the Strategic Priority on Adaptation (SPA). It has however become clear, that it is not easy to state what constitutes an adaptation activity/project. Thus in the next few years, it is important to actually study the adaptation activities being implemented and developed as well as the other multiple pressures that exist in any human or natural system. There are a series of questions that also need attention, for example:

- Can the improvement in adaptive capacity be measured and in what time frame?
- What institutional conditions help to improve adaptive capacity?
- Is there a limit to autonomous and planned adaptations?
- Are there thresholds in both human and natural systems that need to be considered when developing adaptation activities?
- Are there “best practices” to illustrate how to mainstream adaptation into development plans?
- What is the relationship between “development” and “adaptation”?

4.3 Mainstreaming biodiversity in Production Landscapes and Water Systems

57. Increasingly, the need to integrate environmental conservation agendas into the diverse sectors of socio-economic development is being realised by GEF and its multiple partners. Such integrative approaches have been communicated within the concept of “mainstreaming”, where the term has particular relevance to achieving biodiversity goals. STAP IV may wish to expand the principles for effective mainstreaming developed by STAP III and design mechanisms for effective implementation to the GEF portfolio. It would also be important to review these principles for aquatic (freshwater and marine) ecosystems.

4.4 Land Degradation

58. Knowledge on how to promote sustainable land management (SLM) is improving and remarkable success has been achieved in a few cases. Systematic monitoring and evaluation of the impact of successful SLM projects is needed to provide useful indicators to further refine SLM practices. Focus on strategies for scaling-up and scaling out of successful SLM initiatives to enable wider impact will also be useful.

59. Strategies for generating global environmental benefits while addressing problems of land degradation and poverty at the local level are not well understood. Studies to improve understanding of the institutional, policy, and scale issues involved in the nexus of local-level SLM, poverty reduction, improvement of local environment and impact on the global environment will be useful for GEF.

60. There is a lack of a truly global assessment of the extent of land degradation and rates of recovery of degraded land. Currently available estimates are largely derived from small field studies that are then extrapolated. With increasing emphasis on payment for environmental services, better statistics on the rates of recovery of degraded land

will allow better estimation of payments that consumers would be willing to make for land recovery or for the prevention of land degradation in order to enjoy the environmental services provided by rehabilitated land.

4.5 Mainstreaming Integrated Chemical Management

61. Chemicals play a key role in many major sectors of the world economy including agriculture, industry, housing, transport, textiles, and the health sector and in the home. Despite the benefits they can provide, chemicals can be corrosive, explosive, flammable, an irritant, oxidizing, and otherwise dangerous to human health and the environment. Exposure to chemicals, and/or their by-products, has been associated with a range of detrimental human health and environmental effects including: cancer, teratogenic and mutagenic effects, neurological damage, endocrine system disruption, cases of acute poisonings, and effects on ecosystems.
62. The GEF needs to help identify sound management of chemicals which present particular challenge for countries with limited resources and technical knowledge. This could build on the work of the Inter-Organization Programme for the Sound Management of Chemicals (IOMC), in cooperation with UNITAR. This initiative should be one of the global priorities to realize the safe use and handling of chemicals for sustainable development and environmental well-being.

4.6 Nutrient and Waste Management

63. Soil fertility constraints resulting from soil organic matter and nutrient depletion constitute major impediments to agricultural production and biodiversity conservation and use in many developing countries. Although phosphorus and nitrogen are the most limiting nutrients, other deficiencies (potassium, trace elements) are equally important. At the same time, increased urbanization and consumption in both developed and developing countries are leading to continuous production of wastes with the risk of contamination of water and food by pathogens that breed in untreated waste and nutrient run-off and leaching arising from waste overload.
64. Research on improved nutrient cycling to reduce nutrient losses and optimise the use of available nutrients (both organic and inorganic) and technological issues pertaining to waste management in an environmentally friendly way will be useful.

4.7 Small Island Developing States – Interlinkages and International Waters

65. The main challenges arising out of STAP III and presented earlier all apply to Small Island Developing States (SIDS), especially those aspects related to interlinkages. There are substantive and strategic issues that arise for the scope and approach of STAP IV in relation SIDS:
66. **Substantive:** to advance (through S&T, enabling activities, and capacity building) understanding of and responses to the following specific challenges that are disproportionately important for SIDS:
 - Governance and management of international waters given global climate and international trade impacts.
 - Climate change (especially given concerns about earlier, more severe and abrupt changes in climate cited earlier) implications for invasive species, biodiversity,

productive assets (such as agricultural resources, ecological assets and amenity value on which their vitally important tourism sectors are based).

- Adaptation to climate change, energy efficiency, renewable energy and conducive institutional frameworks.
- Understanding impacts (from climate change, POPs, sea level rise) on freshwater, including ground water, and promoting management of surface and ground water (including S&T for managed aquifer recharge) through linkages with the portfolio areas of the GEF.

67. **Strategic:** to make use of SIDS as contexts within which:

- Interlinkages among the phenomena (presented above as challenges arising in STAP III) can be better illuminated, monitored, measured.
- Synergies among the responses to be made become evident and realizable.
- Sustainable development knowledge can be taken into practice.
- Good practice with potential for extension to other countries (a form of global benefits) can be generated.

68. STAP IV will be guided by the above scope and approach, focused through relevant GEF portfolio areas (international waters, climate change, biodiversity, POPs, land management), to advise on how to respond to the commitment of the GEF for increased attention to concerns of Small Island Developing States.

5. STRENGTHENING STAP AND SCIENCE AND TECHNOLOGY IN THE GEF

69. Yolanda Kakabadse, who was appointed as Chair of STAP in January 2005, convened a retreat for STAP members, the GEF Secretariat and heads of Implementing Agencies from 24 – 27 June 2005 in Papallacta, Ecuador, to examine how to better deliver scientific and technical advice to the GEF. The needs, diagnosis and decisions that resulted from this retreat appear in the report, “Improving the effectiveness of STAP: Decisions by STAP, the GEF Secretariat and the Implementing Agencies” (GEF/C.27/Inf.4, October 14, 2005), presented to GEF Council in November 2005. It includes the following decisions made by STAP, the GEF Secretariat and Implementing Agencies, consistent with the GEF Instrument and STAP’s mandate:

5.1 Decisions by STAP

70. STAP will convene a periodic Science Forum to examine the broader context of Environment and Development and progress being made by the world on the issues reflected in the GEF focal areas. This Forum will be scheduled to enable giving advice towards each subsequent GEF Programming Paper.

71. STAP will evolve its work program in the context of the GEF 4 Programming paper, with particular attention to the implications of challenges and objectives therein and the Plan of Implementation for the Millennium Development Goals and the Millennium Ecosystem Assessment and identify targeted research areas.

72. The challenges of the GEF 4 Programming Paper will require STAP members to work both within and across focal areas. STAP will continue to meet twice per year and will adopt working arrangements which are responsive to these challenges.

73. In addition, STAP will convene *ad hoc* workshops, in addition to those relating specifically to the focal areas, to relate to the challenges of making linkages among the focal areas and achieving synergy in the implementation of the Conventions.
74. The STAP will make a proposal to improve its scientific and technical inputs into the project review process for the June 2006 GEF Council meeting including the terms of reference for reviews, timing of reviews relative to the project cycle, composition and performance of the Roster of Experts.

5.2 Decisions by GEF Secretariat and Implementing Agencies

75. Selection of STAP members and composition of the Panel:
 - i. STAP Chairperson will be included in the committee for selecting new members.
 - ii. STAP composition will reflect expertise in the natural and social sciences. Its members will combine focal area expertise with a broad perspective on environment and development and will reflect regional and gender balance.
76. GEF Secretariat:
 - i. The GEF Secretariat and the STAP Secretariat will continue to improve the arrangements for involving STAP members in its inter-agency Task Forces and for soliciting STAP inputs to GEF policies and projects.
 - ii. The GEF Secretariat will involve the STAP Scientific Coordinator and the scientific staff of the STAP Secretariat in relevant meetings.
77. Implementing Agencies: Implementing Agencies will engage with the STAP through the inter-agency Task Forces and will establish other suitable mechanisms that provide for a closer working relationship and coordination.
78. STAP III urges that immediate steps be taken to develop a much stronger and empowered Secretariat, improve linkages with the GEF Secretariat and the Implementing Agencies, and develop a more focused work program during STAP IV focusing on implementation. The retreat concluded that there is room to vastly improve STAP's service delivery to the GEF within the existing legal instrument and urges the GEF secretariat and UNEP to take steps to implement these recommendations.