PROGRESS REPORT

2017 - 2019

UN environment programme

International Ecosystem Management Partnership

国际生态系统管理伙伴计划

About UNEP-IEMP

The United Nations Environment Programme - International Ecosystem Management Partnership (UNEP-IEMP) is the first UN Environment Programme Collaborating Centre in the South and for the South mobilizing science to support policy setting for sustainable ecosystem management in all developing countries. It has been mandated to support UN Environment Programme's Ecosystem Management and Climate Change Sub-programmes, promoting a green economy and enhancing South-South Cooperation.

OUR VISION

To enhance the role of ecosystem management as a vital approach to working with nature for a world with a green economy.

OUR MISSION

To provide science, policy and capacity support to developing countries to integrate ecosystem management approach into their national policies and development plans to enhance the delivery of ecosystem services for human well-being.

OUR NICHE

Nexus approaches of Climate, Ecosystems and Livelihoods for SDGs and Paris agreement implementation

South-South Cooperation, engaging China with other developing/developed countries

Evidence-based science for policy

A Word from the Director

The past 2017-2019 were remarkable as the first three years for the implementation of the flagship programme on Climate, Ecosystems and Livelihoods (CEL). It's my hornor to claim that, by taking full advantages of existing and emerging funding opportunities provided by various South-South cooperation initiatives, UNEP-IEMP has been successfully delivering services in more than 20 countries across Asia and Africa. We have developed more than twenty projects and initiatives to assess the baselines of climate, ecosystems and livelihoods in the regions along the Belt and Road, especially in Africa and the Greater Mekong Subregion. A solid foundation has been laid for the implementation of CEL programme in its first phase.

Linxiu Zhang
Director

None of this would have been possible without the hard work of our staff and steadfast support of our partners. UNEP-IEMP has built a substantial network of partners, such as the Chinese Ecosystem Research Network of Chinese Academy of Sciences, to greatly extend its expertise and skills in implementing the CEL programme. With such a delivery mechanism, UNEP-IEMP provides a unique and strategic partnership to bring together the expertise and innovation among developing countries to deliver science-based policy impacts for Sustainable Development Goals in the Global South.

To make the CEL a great success in future, key actions are needed to develop a wider portfolio of projects, build strategic partnerships with public and private stakeholders, strengthen the interface between science, policy, business and society, and so on.

Since I took office as the Director of UNEP-IEMP at early 2018, I am deeply grateful to each one of you for your extraordinary contribution and invaluable support to UNEP-IEMP, and to me personally. I and my team will dedicate all our efforts to work with people and institutions, especially those in impoverished and most vulnerable settings, on the journey to a green and sustainable world.

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Years in Review - 2017

February 2017

The founding Director Mr Jian Liu left the post as the UNEP-IEMP Director and shifted to the UNEP Chief Scientist post in Nairobi. Monika MacDevette from the Ecosystems Division became the Officer in Charge at UNEP-IEMP appointed by UNEP.

June 2017

The GEF Funded EbA South Project continue to support interregional cooperation in Global South and three pilot countries (Nepal, Seychelles and Mauritania) through Ecosystem-based Adaptation.

UNEP-IEMP through the host institute signed a contract with UN Convention on Combating Desertification (UNCCD) in conducting a China pilot project on sand and dust storm vulnerability assessment.

July 2017

Led by Prof. Linxiu Zhang, a joint research team of UNEP-IEMP and the Center for Chinese Agricultural Policy (CCAP), Chinese Academy of Sciences (CAS) conducted a field mission in Naban River Watershed National Nature Reserve in the South of Yunnan Province.

An “Inception Workshop for Vulnerability Mapping of Sand and Dust Storms (SDS)” was organized. The meeting witnessed participants from UNCCD secretariat, UN Environment Programme headquarters, Iran, USA, State Forestry Administration of China (SFA), China Meteorological Administration (CMA), Chinese Academy of Forestry (CAF) and CAS, etc.

August 2017

The 5th Steering Committee meeting and 3rd Science Advisory Group meeting of UNEP-IEMP was successfully organized in Beijing on 20-21 August 2017.

September 2017

The Conference on Climate, Ecosystems and Livelihoods for Africa was convened 4-5 September 2017 at the UN Environment Programme headquarters in Nairobi, Kenya. It was sponsored by UN Environment Programme, CAS, the National Natural Sciences Foundation of China, and The World Academy of Sciences, and organized by UNEP-IEMP.

October 2017

UNEP-IEMP & UN Environment Programme Beijing Office jointly organized the annual retreat during 16-17 October 2017 in Beijing. They reported their major activities and achievements of the past year. UNEP-IEMP also discussed its mid-term strategy of the next years and received comments and suggestions.

Dongying Eco-community project was as launched as part of the Pilot Project on Green Economy in Dongying, China (Phase II). Funded by Dongying Municipal Government, the project aims to assess the status quo of eco-community development in Dongying through a comprehensive survey at the community level, as well as to establish an assessment index system and an action plan to guide community development policy and interventions in Dongying.

Concept proposal ‘Mekong EbA South: Enhancing Climate Resilience in the Greater Mekong Sub-region through Ecosystem-based Adaptation in the Context of South-South Cooperation’ was endorsed at the 30th Meeting of the Adaptation Fund Board.

The project team meeting of EbA South Project funded by GEF was organized in Hangzhou, China from October 23 to 25, 2017. The meeting primarily focuses on: i) assessing progress under each pilot country in terms of achieving targets, and ii) planning to achieve targets in the project’s short time remaining.

February 2018

Ms. Linxiu Zhang, through global recruitment process was selected by UNEP, and took office as the Director of UNEP-IEMP on 1 February 2018.

March 2018

UNEP-IEMP conducted 2 consultations with the Ministry of Environment in Phnom Penh, Cambodia. The first consultation was a scoping meeting on the project to be launched shortly with funding from the Government of China, entitled "Improving Ecosystem Management for Sustainable Livelihoods in the Framework of Lancang-Mekong Cooperation", in which Cambodia is selected as one of the pilot countries, together with China and Lao PDR.

April 2018

Validation workshop of Dongying Green Economy Demonstration Project (II Phase) was organized by UNEP-IEMP at Beijing Olympic Forest Park. 30 representatives from UN Environment China office, governmental agencies, research institutes, universities and NGOs attended the workshop.

A "south-south exchange workshop: ecosystems for climate change adaptation and sustainable livelihoods knowledge sharing" was successfully organized in Beijing, China. This workshop is sponsored by UN Environment Programme, Chinese Ecosystem Research Network (CERN), and National Ecosystem Research Network of China (CNERN). It is organized by UN Environment-International Ecosystem Management Partnership (UNEP-IEMP).

UNEP-IEMP organized the "Consultation Workshop: Improving Ecosystem Management for Sustainable Livelihood in the Framework of Lancang-Mekong Environmental Cooperation" and a regional consultation for full proposal development of the project "Mekong EbA South: Enhancing Climate Resilience in the Greater Mekong Sub-region through Ecosystem-based Adaptation in the Context of South-South Cooperation" in Beijing, China.

May 2018

In the call of concepts by Ministry of Science and Technology of China, UNEP-IEMP through Chinese scientists submitted three concepts of South-South Cooperation, namely "International Cooperation Research and Demonstration of Key Technologies of Post-disaster Ecological Restoration and Scientific Rebuilding in Jiuzhaigou World Natural Heritage" , "Lake-Watershed integrated management for sustainable use of water in East Africa great lakes basins", and "Joint research on Practical Technology to Combat Desertification for African Priority Countries of the Great Green Wall".

July 2018

An exchange visit to Mauritania was organised by EbA South from 5 July to 7 July. This visit gathered project members from Seychelles and Nepal, and provided an opportunity for them to share experience and lessons learnt from the implementation of EbA interventions in a South-South Cooperation perspective.

Under the EbA South Project, the EbA Planning Tool 'ALivE – Adaptation, Livelihoods and Ecosystems' (version 1.0) was launched on July 3rd with IISD and IUCN at the side event: "Better Tools and Standards: Enhancing the Effectiveness and Mainstreaming of Ecosystem-based Adaptation" during the Twenty-second meeting of the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention for Biological Diversity in Montreal.

August 2018

The study “Sustainable Livelihood and Green Development Strategies in Environment-Economic Vulnerable Areas” was launched in Lijiang, Yunnan Province from August 10th -16th, including a kick-off meeting and a field visit to Baoshan Stone Village.

September 2018

The Project ‘Strengthening Qinghai Women Farmers’ Income Security and Resilience in a Changing Climate” officially launched, with the kick-off meeting being held in Xi’ning, Qinghai Province on the 3rd of September.

October 2018

On 16 October 2018, the EbA South project, with the key resource persons from IISD, organised a training workshop on the Ecosystem-Based Adaptation (EbA) planning tool ‘ALivE – Adaptation, Livelihoods and Ecosystems’ in Victoria, the Seychelles.

“Nepal Advances Ecosystem-based Adaptation in Cooperation with China”, the case study under the GEF-funded EbA South project, was selected to feature in the United Nations Office for South-South Cooperation (UNOSSC) publication “Good Practices in South-South and Triangular Cooperation for Sustainable Development – Volume 2”, which was launched on the United Nations Day for South-South Cooperation, 12 September 2018, organised by UNOSSC and the Government of Argentina.

An International Workshop of the Global Dryland Ecosystem Programme (Global-DEP) was convened during 21-22 October 2018 in Beijing, with the support by UNEP-IEMP as part of the Secretariat of Workshop Organizing Committee.

UNEP-IEMP held a closure workshop of the Dongying Eco-community project on 25 October 2018 in Dongying City, Shandong Province of China.

November 2018

UNEP-IEMP organized its annual retreat on 6-9 November 2018 inYucheng City, Shandong Province, China.

EbA South conducted the field visit and workshop on “Ecosystem services assessment and cost-benefit analysis of Ecosystem-based Adaptation (EbA) interventions under the EbA South project in Nepal”.

December 2018

UNEP-IEMP participated in the side events at the 24th Conference of the Parties (COP24) to the United Nations Framework Convention on Climate Change, which was held during 2-14 December 2018 in Katowice, Poland.

Years in Review - 2019

January 2019

A demonstration site on sustainable livelihoods was announced to be launched at a workshop on traditional ecological culture research and exchange in Lijiang City, Yunnan Province of China. The workshop was jointly organized by UNEP-IEMP and CCAP and the Kunming Institute of Botany of CAS, under the study “Sustainable Livelihood and Green Development Strategies in Environment-Economic Vulnerable Areas”.

April 2019

The UN Women China-funded project ‘Strengthening Qinghai Women Farmers’Income Security and Resilience in a Changing Climate’ was lauched and enter into full implementation.

May 2019

The South-South Knowledge Exchange Workshop on Ecosystem-based Adaptation, was successfully organised as the closing event of the GEF-funded EbA South project. The workshop was attended by representatives from 11 countries, including the EbA South pilot countries – Mauritania, Nepal and Seychelles, and 5 international agencies, including UNFCCC. It was organised by the UNEP-IEMP, as the project management unit within the Institute of Geographic Sciences and Natural Resources Research (IGSNRR) of CAS.

The Adaptive Management of Agro-ecosystems in Bangladesh, India and Myanmar (BIM) in the Context of Climate Changes and Regional Food Security project, funded by the National Natural Science Foundation of China (NSFC) under its collaborative programme with UN Environment Programme, held its inception workshop in Beijing.

July 2019

An inception workshop of the project "Evaluation and Sustainable Management of Wetland Ecosystem Services in Dongying City" was held at the IGSNRR of CAS. The project is a half-year study to be performed by UNEP-IEMP during June to December 2019, as part of the Pilot Project on Green Economy in Dongying (Phase III), with financial support from the Foreign Affairs Office of the People’s Government of Dongying City, Shandong Province.

August 2019

Dr. Linxiu Zhang and her team visited Nepal to attend an international workshop and meet with partners related to the “Assess the Impacts of Environmental Change and Policy Recommendations for Green Silk Road” project. This project is implemented by UNEP-IEMP, taking Nepal as one of country cases for study on sustainable livelihoods and green development strategy in vulnerable regions, in collaboration with the IGSNRR of CAS.

The Inception Workshop on The Economics of Ecosystem and Biodiversity (TEEB): Promoting a Sustainable Agriculture and Food Sector – Implementation in China (TEEBAgriFood Project) was successfully held in Beijing, China.

September 2019

UNEP-IEMP participated in the ASEAN-China Environmental Cooperation Forum 2019 “Promoting Regional Green Growth: Best Practices of Eco-friendly City Construction and Sustainable Management of Marine Ecosystem” on September 17-18, 2019 in Guangxi, China.

The African Regional Workshop of Global Dryland Ecosystem Programme and the Second Conference on Climate, Ecosystems and Livelihoods in Africa was convened during 23-25 September 2019 in Dakar, Senegal. It was

attended by about 100 researchers, administrative and technical staff from more than 10 African nations and China, representing about 30 national and regional organizations.

October 2019

Researchers of UNEP-IEMP visited village primary schools in Yunan and Guizhou Province for a survey on the project “Principal Capacity Promotion in Village Primary Schools”.

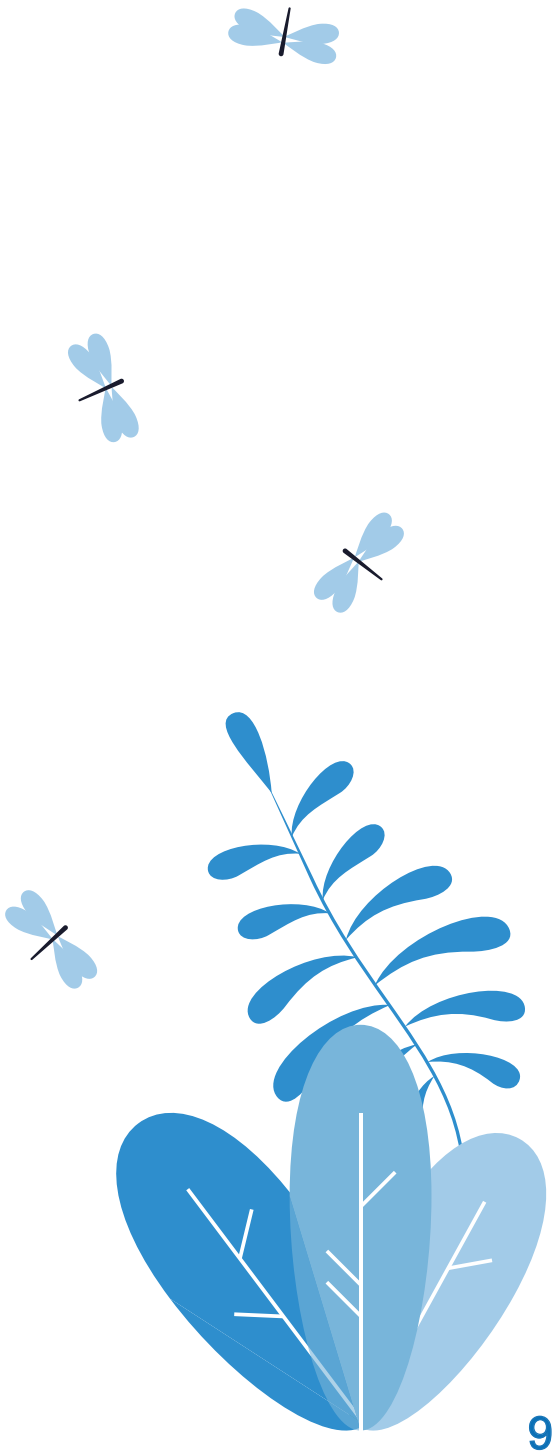
The Second Working Meeting of Global-DEP Scientific Committee was convened from 19 to 20 October 2019 in Xi’an City, China, with the support by UNEP-IEMP as part of the Secretariat of Global-DEP Scientific Committee.

UNEP-IEMP organized a consultation workshop on enhancing climate information services and early warning for resilience on 21-23 October 2019 in Beijing. This workshop brought in around 30 experts from Green Climate Fund (GCF), UN Environment Programme, China and Central Asia countries to exchange information and brainstorm on opportunities and concrete ideas for South-South cooperation on climate information and early warning for resilience through GCF and UN Environment Programme.

November 2019

Two projects engaging UNEP-IEMP as one of key international partners, that is, ‘Sustainable Utilization of Water Resources and Comprehensive Management of Lake Basins in the Great Lakes Region of East Africa’ and ‘Joint research on Practical Technology to Combat Desertification for African Priority Countries of the Great Green Wall’, were approved by the Ministry of Science and Technology of China under the National Key Research and Development Programme for International Cooperation (with UN Environment Programme).

UNEP-IEMP 4th Science Advisory Group & 6th Steering Committee Meeting were organized in Beijing on 18-19 November 2019.



Highlights of Progamme Development

By the end of 2019, a total number of 28 projects and initiatives have been developed at different stages – on-going, funded, or pipelined, by taking the full advantages of both existing and emerging funding opportunities from China's South-South cooperation initiatives. With a combination of these projects and initiatives, the CEL promotes interdisciplinary studies of ecology, economics and climate science and develops methods, tools and models to address cross-cutting issues of ecosystem degradation, climate change and poverty. According to their themes and focus areas, current projects and initiatives could be divided into 3 portfolios as described below:

- **Africa**

  With an aim to enhance China-Africa cooperation, we works to facilitate the development integrated solutions that address both economic and environmental challenges to ensure transformation and sustainable development in Africa. This portfolio currently covers three sub-regions (Sahel region, Zambezi river basin and the upstream of Nile basin), with the CEL in Africa Conference as a standing mechanism of multiple stakeholders dialogue and engagement.

- **Greater Mekong Sub-region (GMS)**

  In this portfolio, we work to make the case of engaging partners from GMS countries to collaborate on common interests on such issues as ecosystem management will bring benefits for local communities to improve their livelihoods while adapt to the impacts of climate change. Continuous regional engagement and policy dialogues are in progress, with an aim to seek for funding from the Adaptation Fund and Chinese government, respectively.

- **Belt and Road (B&R)**

  In this portfolio, we work to provide science-based evidence on the impacts of multiple environmental factors (climatic, ecological, socio-economical and others) on poverty and livelihoods in the Belt and Road region. This portfolio, including 14 projects in 15 countries, is expected to vigorously support the two themes of South-South cooperation —biodiversity and ecosystem management.

In the implementation of CEL programme, UNEP-IEMP is acting as a coordinating, facilitating and/or catalyzing body, apart from project implementation. UNEP-IEMP always strengthens collaboration with new partners by learning from the experience with existing ones. Currently, UNEP-IEMP is working in more than 20 countries across Asia and Africa, with more than 30 partners at international, regional, national and local levels.

Distribution of key projects and partners of UNEP-IEMP

1. Africa

1.1 Desertification Control Using Multi-Use Greenbelts in Mauritania

Sitting on the west edge of the Sahara, Mauritania is subject to a climate characterised by hot and dry winds all year round. In Benichab and Trarza, the settlements are highly threatened by the strong wind erosion. Moreover, the deficit rainfall (less than 100mm per year) made the climate conditions severe for both the survival of plants and the livelihoods of communities (e.g. pastoralism), particularly in rural areas. As both aspects are highly dependent on natural resources, a slight shift in the timing and intensity of seasonal rainfall can have a disastrous impact.

In response, concrete, on-the-ground dryland restoration EbA technologies by EbA South project were implemented at selected sites in Benichab (Inchiri) and Trarza. With strong support from local government and active participation from the local communities, tangible results were achieved as follows:

- Desertification control by establishing 250 hectares of multi-use greenbelts (using drought resilient species) on the degraded desert, dunes and savannah to stabilise soils against wind erosion, and to eventually protect communities as well as their livelihoods against silting and sand encroachment;
- New livelihood options explored, including fruit harvesting (e.g. Ziziphus mauritiana), collection of gum arabic, and processing of plant products (e.g. Balanites seeds) for producing cosmetics and food products (including products for own consumption and marketable products).

Due to the very harsh environment, maintenance should emphasize frequent watering and well protection from grazing, both crucial for the stabilization of newly planted plants at an early stage.

With governmental co-financing, fencing enforcement was employed and alternative water saving irrigation such as drip irrigation was sought. In addition, the research team proactively initiated an experiment on water-smart irrigation system using two recycled drinking water bottles.

In parallel to the interventions, research activities for measuring the short- and long-term effects (ecological, hydrological and socio-economic) of EbA interventions being applied within the project were conducted by the École Normale Supérieure de Nouakchott (ENS Nouakchott) in partnership with the Ministry of Environment and Sustainable Development (MEDD). The research group, comprising leading professors and students, set up a permanent monitoring site at Benichab and a greenhouse at ENS for botany experiments (on topics of optimisation of germination conditions for indigenous species and use of symbiotic microorganisms), in order to measure the tolerance of species in arid environment as well as the effectiveness of watering techniques.

A survey on the perceptions of ecosystem services at the project site Benichab was conducted, which showed that the landscapes preferred by the Benichab populations were those that are green, clean and well maintained. Among the landscapes of the area, these characteristics were only found in the reforestation sites of the project. This points to the importance of the restored sites as heritage that should be preserved for future generations.

In terms of policy, the project was pioneering in its approach to long-term monitoring and adaptive management of EbA in a rigorous scientific manner and also contributed to mainstreaming EbA into national policies and/or strategies. Three policy briefs, namely on water, pastoralism, as well as agriculture and food security, were delivered. The main findings of the policy briefs were discussed within the newly established Centre National d'Observation Environnmental et des Zones (CNOEZA) of MEDD and accepted as part of its mandate.

CNOEZA and the Great Green Wall Initiative of Mauritania have taken over the long-term maintenance and potential upscaling of the sites to ensure project sustainability.

Planted seedlings of indigenous drought resilient species in Mauritania

1.2 Mangrove Restoration in Seychelles

The Seychelles is a nation of 115 islands located in the Indian Ocean, known for glistening beaches and stunning biodiversity. Many of these islands are low-lying and most of the infrastructure including schools, roads and hotels are located within one kilometre of the coastline, which put the country in a high risk of climate change. Healthy coastal wetlands and mangroves therefore play an important role in buffering against the climate change impacts from sea level rising and flooding, as well as enhancing the security of coastal livelihoods.

In adapting to climate change, concrete, on-the-ground mangrove restoration EbA technologies were implemented by the EbA South at ten selected sites across three islands in Seychelles. With active participation of local communities and the public sector, tangible results were achieved as follows:

- Culverts and channel desilting and re-profiling (1.7km) to improve hydrological flow through mangroves/wetlands fragments;
- Nursery of indigenous and terrestrial tree seedings;
- Mangrove restoration and rehabilitation (ca 34.5ha) for soil stabilisation; for degraded mangroves replantation; and for protection of low-lying housing, commercial areas and other infrastructure from coastal erosion.

There is no denying that some challenges were faced during the implementation phase and one unexpected was the animals (i.e. tortoises and crabs) eating young mangrove seedlings. In tackling this issue, the country team upgraded and reinforced the nursery in Curieuse and also applied PVC pipes while planting to protect seedlings from crabs, which proved effective in the end after several rounds of trials and adjustments. This adaptive management approach successfully ensured the sustainability of restoration.

In parallel to the interventions, research activities, for measuring the short- and long-term effects (ecological, hydrological and socio-economic) of EbA interventions being applied within the project, were conducted by the University of Seychelles, in partnership with the Ministry of Environment, Energy and Climate Change. The research group, comprising leading professors and students, set up a permanent monitoring site including seven water sampling plots at Anse Royal, and carried out studies monitoring coastal habitat for mangroves and wetlands, and investigating forest composition, species diversity and survivorship. As a main legacy, the methodologies and monitoring activities developed through the EbA South project were further taken up and integrated into the courses of Bachelor programme in Environmental Science for the long-term research.

To support the implementation, a range of training events as well as extracurricular activities involving secondary schools were organised through awareness campaign. Field activities including visit-

ing nurseries to learn about indigenous coastal plants and propagation techniques, and household surveys to assess environment issues engaged people widely, not only students but also NGOs, hotels and the general public. Clearly, the project sites showed potential for both recreation and education. Mangroves not only protect our land and coral reefs, but also bring other benefits for local communities such as fishing as an alternative livelihood. The EbA South project conducted a study in 2018 on ecosystem services assessment and cost-benefit analysis at the site Petit, which showed that the current interventions, if combined with catchment management (a hybrid option), could result in a 41% increase in human benefits, countering climate change losses and offsetting the loss of wetland functionality.

Mangrove restoration in Seychelles

1.3 Coupling Conservation and Livelihoods for Sustainable Management of Protected Areas in East Africa

East African nations have expanded the coverage of protected areas (PAs) and established a complex set of PA management systems over the past century. The mandate for PAs in some East African nations (e.g. Tanzania, Kenya) has changed dramatically from protecting biodiversity in the 1980s and 1990s to more recently alleviating poverty and supporting the livelihoods of the people living nearby. Concurrently, there has been rapid growth in the number of people living around PAs in the East African region and many of the PAs in East African countries are located in areas of high population density. A combination of human activities and natural processes inside and outside of PAs may not only impact biodiversity and ecosystem functions over the long term, but also pose a threat to the capacity of PAs to support the livelihoods of nearby residents and alleviate poverty in the local communities around them. Thus, there is an enormous need for additional research to help PA managers and policy-makers in East Africa understand how to achieve win-win outcomes for both ecosystems and human well-being.

As an example of such efforts, in 2014 the Chinese Academy of Sciences (CAS), the Kenya Wildlife Service (KWS) and the United Nations Environment Programme (UN Environment) jointly initiated the “Sustainable Management of Protected Areas in East Africa” project. Taking Kenya as a typical study area, the research team of UNEP-IEMP and three research institutes of CAS conducted both regional assessments using remote-sensing data and models and case studies through investigations in the fields, in order to investigate the change of ecosystems in and around PAs, analyze the relationship between the change in ecosystem services and human activities, and particularly, understand the coupling between conservation and livelihoods in the region around the Massai Mara National Reserve (MMNR) and identify successful practices for the synergy of conservation and development. By the end of 2018, The project was concluded and some research results produced with wide-ranging policy implications as follows:

1) The project detected the spatiotemporal evolution of NDVI trends in East Africa and explored the main drivers based on the ensemble empirical mode decomposition method. Results showed that greening (restoration) and browning (degradation) coexisted in East Africa during 1982–2013. After 2000, vegetation browning prevailed in East Africa. The effectiveness of different types of PAs on vegetation change varied, depending to some extent on management policy (legal laws and on-site patrols).

2) The project used species richness as a surrogate for biodiversity and mapped the key ESs in East Africa. The results showed that PAs represented well for species richness and regulating services, but underrepresented for provisioning services. Regions identified as conservation priorities that are represented poorly in the current PAs network require more attention in future conservation actions.

3) The project assessed a national pattern of human-wildlife conflicts (HWC) in Kenya using a decade-long (2005-2016) monitoring dataset. Out of 29,647 total number of reported HWC cases, most conflicts were reported to have occurred in the type of crop raiding, on the land of 10 counties out of 47, and during June, July and August in each year. We suggest that counties that experienced most HWC cases should be given priorities when implementing measures to mitigate HWC.

4) Questionnaire survey was conducted with 423 randomly selected households around MMNR (Fig. 2) and found that the PA did not have statistically significant effect on the welfare and poverty levels of PA-adjacent households (living within a 5-km radius of the PA boundary) relative to more distant households. In contrast, PA-adjacent households incurred significantly higher losses from crop raiding and livestock depredation than did distant households. Interventions are needed to reduce losses caused by MMNR and improve its socio-economic benefits for the community.

5) Comparative study on the livelihoods of local communities around PAs between East Africa and China was conduced using the questionnaire survey data gathered from households around MMNR and those around PAs in China. On average, the livelihood capital of households around PAs in China was higher than that in East Africa, and the livelihood outcome (level of income and quality of life) of Chinese households was significantly higher as well. The key lies in the improvement of human capital and the effective implementation of transfer payment and other policies for PAs management in China.

Based on the above results, several interventions and suggestions have been proposed to strengthen the synergy of conservation and development in East Africa, and the region around MMNR has been identified and consolidated as a typical area for case study, which can provide theoretical and practical references for the sustainable management of PAs in other developing countries.

Field survey in rural villages around the MMNR in Narok County, Kenya in March 2017

1.4 Agriculture development and water resources under climate change in the Zambezi Basin

Zambezi River Basin is the fifth largest river basin of Africa and has suffered from serious food insecurity under climate change and population expansion, the former of which can be characterized as the “warming and drying” trend that has negatively affected agriculture in the last decades, and the latter has been at rates far above the world average, which required more land being appropriated for agricultural uses. Owing to ambitious agricultural development policies, the area of cropland has increased steadily in Zambia and Mozambique, comprising a high percentage of irrigated farmland that becomes the major water using sector. However, the study on the impacts of these policies on land and water resources under climate change have been lacking until now. What are the current area of cropland and the potential area for cropland expansion in the Basin? How much water is available for irrigation and is it enough to support the potential area of irrigated cropland? These are among the key questions to be answered by scientists to support sound policy making in the future.

Typical landscapes of Zambezi River Basin

With the support of NSFC and UN Environment Programme, the CropWatch research team led by Prof. Bingfang Wu, Co-director of UNEP-IEMP, has been working with researchers from the Chinese Academy of Sciences, University of Zimbabwe, University of Zambia, and the Catholic University of Mozambique to study the above issues since 2016. They combined satellite data, crowdsourced data, and in-situ measurements to monitor the area of cropland in the Zambezi River Basin. It was found that the cultivated cropland area was 17.84 million hectares in 2016-2017, indicting a significant increase by 16.4% compared to the previous year. Using the water balance approach with remote-sensing-based data on precipitation, evapotranspiration, and water storage, they also assessed the water availability in the basin and found that average annual runoff from 2003 to 2016 reached 109.8 billion cubic meters at the Zambezi Delta. furthermore, they assessed the potential of irrigated agriculture development in the basin considering the availability of water resources. Most of the agricultural land in the basin is now rainfed, but more water is expected to be consumed by the expanding irrigated agriculture. Based on the calculated gap in water consumption between irrigated and rainfed agriculture (650 mm ha-1), they estimated that the available water resources (average annual runoff) could support up to 16.89 million hectares of irrigated cropland. Although just a simple calculation, it indicates great potential for irrigated-agriculture development in the basin.

This study was a good example of applying the CropWatch Cloud Platform (cloud.cropwatch.com.cn) in the monitoring of regional crop production and agricultural development using remote sensing and ground-based indicators. Along with information and knowledge generation, the research team has also conducted plenty of capacity building in Mozambique to carry out crop monitoring using the CropWatch Cloud. More than 50 staff members of national and provincial crop and early warning departments participated in 5 technical training workshops organized by the team. Information on crop conditions was provided for all districts and regions of Mozambique in Portuguese. CropWatch also provided the rapid assessment information, such as the estimated inundated land area, soon after the tropical Cyclone Idai disaster in March 2019. Going forward, the team will provide further support for monitoring land and water resources and agricultural development in the Zambezi River Basin through PhD scholarship and system customization, etc.

Joint field trip and in-situ training with local partners in the Zambezi River Basin

2. Greater Mekong Sub-region

2.1 Extensive Engagement of UNEP-IEMP in the GMS

During 2017-2018 the GMS portfolio was remarkably strengthened with many new concrete initiatives being developed, strategic partnership enhanced and research projects approved.

Although the GMS has been a geographical focus of UNEP-IEMP since its establishment in 2011, it was not until 2015-2016 when the first concrete project was successfully implemented in the region. This UNEP-China Trust Fund Phase 1 project "South-South Capacity Building for Ecosystem Management in the Greater Mekong Sub-region" served as an entry point for IEMP to be strongly involved in the Lancang-Mekong Cooperation Mechanism, and initiated the networks for ecosystem management from regional to national levels in all six GMS countries, paving the way for further project development in the region. Owing to its success, in 2017 UNEP-IEMP co-led the initiation of the project "Improving Ecosystem Management for Sustainable Livelihoods in the Framework of Lancang-Mekong Cooperation" under the UNEP-China Trust Fund Phase 2, in collaboration with UNEP Ecosystems Division, UNEP Regional Office for Asia and the Pacific and, the strategically important Lancang-Mekong Environmental Cooperation Centre. The identified pilot countries, Cambodia and China, were consulted throughout the process, particularly on the pilot site selection. A consultation workshop was organised in Beijing in April 2018 before proposal submission, and funding eventually earmarked to kick off in 2019. The project aims to increase awareness and institutional, technical and financial capacity of the Lancang-Mekong countries to adopt an integrated ecosystem management approach, with demonstrated ecosystem management for sustainable livelihood through pilot activities at selected transboundary areas.

Another project in the GMS that had been the focus of UNEP- IEMP since its start, "Mekong EbA South: Enhancing Climate Resilience in the Greater Mekong Sub-region through Ecosystem-based Adaptation (EbA) in the Context of South-South Cooperation", accomplished an important step. Comprehensive development of the project, including intensive consultations with potential partners at the regional level as well as with national and local partners in pilot countries – Thailand and Vietnam, were conducted. The concept proposal was endorsed by the Adaptation Fund in October 2017. UNEP-IEMP then organized a regional consultation workshop in Beijing in April 2018 and supported national consultations to further obtain necessary information to develop the full proposal, which has been submitted in 2019. UNEP-IEMP will be the executing entity for the regional components, facilitating knowledge sharing, awareness raising and regional cooperation in the GMS on climate change adaptation, particularly EbA. The Lancang-Mekong Environmental Cooperation Centre is also expected to be engaged in the regional cooperation activities.

Research-wise, there were substantial progress and success as well. The research proposal on "Adaptive Management of Agro-ecosystem in Bangladesh, India and Myanmar in the Context of

Climate Change and Regional Food Security" was approved for funding by the NSFC-UNEP in October 2018. Moreover, the ongoing NSFC-UNEP research project "Water Resources Change and Adaptive Management in the Greater Mekong River Drainage Basin" (2016-2020) had completed its intensive field investigations in the GMS countries of water resources and land use, and has started to conduct assessment of potential impacts of climate change and socio-economic development on regional water resources with recommendations on adaptation options in water resources within the context of ecosystem management. Furthermore, the doctoral dissertation of UNEP-IEMP's PhD Candidate "Spatial-Temporal Analysis on the Land Use Pattern Change of Typical Cities in the Greater Mekong Sub-region" completed in 2017 offered research results on urban expansion intensity, urban expansion type, land use pattern change, driving forces of land use change and further assessed the characteristics and problems of typical cities in the GMS.

In addition, there were several other project development efforts that were not successful for funding during this period but would be adjusted for re-submitting for the upcoming occasions. More ideas were also initiated for further project formulation to strengthen the portfolio in order to improve the livelihoods and ecosystem management in the GMS countries anticipating climate change in the coming years.

Consultation with local communities in the Mekong river basin

2.2 South-South Knowledge Exchange in the GMS

With an overall aim to facilitate the exchange of knowledge, experiences and tools of ecosystem-based approach towards climate change adaptation and sustainable livelihoods among China and neighbouring GMS countries (namely Cambodia, Lao PDR, Myanmar, Thailand and Vietnam), over 50 scientists, researchers, government technical officers, policy makers and development practitioners from the GMS countries and international organizations came together during April 23-24, 2018 in Beijing at the "South-South Exchange Workshop: Ecosystems for Climate Change Adaptation and Sustainable Livelihoods Knowledge Sharing". The workshop was organised by UNEP-IEMP and the Institute of Geographic Sciences and Natural Resources Research (IGSNRR) of CAS, and co-sponsored by UNEP, Chinese Ecosystem Research Network (CERN) and Chinese National Ecosystem Research Network (CNERN).

The event provided a platform to discuss major priorities and actions on ecosystem management, climate change adaptation and improvement of livelihoods, as well as associated challenges and opportunities. With comprehensive presentations and interactive discussions, the participants expressed lively their ideas and views on the topics of ecosystem assessment, ecosystem-based interventions, ecosystem-based planning, and evaluation of interventions. Participants appreciated CERN and CNERN`s sharing of the knowledge and experience in the past decades on ecosystem monitoring, research and ecosystem management, which has proven that long-term investment in ecosystem management can be rewarded with both enhanced ecosystem services and more sustainable livelihoods. At the same time, Chinese participants also learned from other GMS countries on relevant policy instruments, traditional/local practices that could potentially address the common issues in the region. The workshop saw the dynamic flow of knowledge, learning and exchange occurred in all directions.

Participants applauded the UNEP-IEMP platform for South-South Cooperation and made a number of potential follow-up recommendations to enhance South-South Cooperation in the GMS. These included capacity building on ecosystem approach by sharing China's experience, building concrete demonstrations, regular policy exchanges through existing mechanisms, organizing exchange visits and field studies, and using inter-disciplinary approach to address multi-stakeholder concerns. Potential topics for collaboration were also defined, including climate change adaptation (particularly EbA), agroforestry, ecosystem monitoring and restoration (e.g., in forest, mountain, wetland, coastal areas), among others. Several funding opportunities researchers and students in other GMS countries to work and study in China as well as to conduct joint research with Chinese scientists were also identified. In this regard, UNEP-IEMP was deemed to have played a significant role in facilitating capacity building on technical aspects (e.g. EbA planning, ecosystem monitoring for researchers and practitioners) and exchange at policy level for uptake in the GMS through bilateral cooperation and joint projects. These identified topics and proposed means of cooperation have provided solid foundation for UNEP-IEMP to further develop initiatives to address the common needs in the region.

To realize the tangible GMS cooperation, the workshop was followed by two project-level consultation meetings on April 25-26. Participants discussed in detail to formulate concrete GMS regional projects on ecosystem-based adaptation and ecosystem management for sustainable livelihoods. Such regional projects by engaging Chinese partners can potentially enhance the linkages between the upper and lower reaches of the Asia's largest transboundary river basin through policy dialogue, knowledge exchange, technology transfer and capacity building.

Participants in the South-South exchange workshop and the regional consultation workshop held in April 2018

3. BRI Region

3.1 Community-based Watershed Restoration and Livelihoods Improvement in Nepal

As a mountainous country on the slope of the Himalayas, Nepal has a stunning landscape, with forests, terraced croplands, rivers and settlements, which attracts trekkers from all around the world. Three quarters of Nepal's population are directly dependent on agricultural activities on the beautiful but at the same time climate sensitive land. Local communities are experiencing the increased monsoon and more intense rainfall. Crop losses from droughts or floods, and top soil loss from increased soil erosion and landslides, pose risks to future food security. Comprehensive measures are urgently needed to protect the communities at risk.

In response, concrete, on-the-ground watershed restoration EbA technologies were implemented by the EbA South project at selected sites in Lamjung district. With active participation from local communities and the public sector. Tangible results were achieved as follows:

- Reforestation of degraded or barren lands for soil stabilisation and runoff reduction;
- Cropland conversion to agroforestry on private lands to improve water retention and soil fertility
- Nursery of indigenous and terrestrial treeseedings;
- Practice of alternative livelihood options (for 187 households) to diversify communities' income in order to better withstand the climate change impacts and market fluctuation, including beekeeping, orchards, vegetables, cardamom, etc.

In parallel to the interventions, research activities for measuring the short- and long-term effects (ecological, hydrological and socio-economic) of EbA interventions being applied within the project were conducted by Tribhuvan University in partnership with the Ministry of Forests and Environment (MoFE). The research group, comprising leading professors and students, set up a permanent forest monitoring site to generate baseline data on vegetation and monitor changes over time. Facilitated by the Department of Hydrology and Meteorology within MoFE, an automatic weather station and a hydrological station were established to monitor rainfall, the impacts of project interventions on runoff, soil erosion as well as landscape change. This research programme, which pioneered the collaboration between government and research institute, enabled better access of science to policy. Moreover, the experts from China (Chengdu Institute of Mountain Hazards and Environment, Chinese Academy of Sciences) also contributed to the research methodology development and data analysis, strengthening the existing collaboration and knowledge exchange between China and Nepal. In this regard, the South-South Cooperation element between China and Nepal of the EbA South project was selected to feature in the United Nations Office for South-South Cooperation (UNOSSC) publication "Good Practices in South-South and Triangular Cooperation for Sustainable Development – Volume 2", which was launched on the United Nations Day for South-South Cooper-

ation in September 2018, organised by UNOSSC and the Government of Argentina. Presenting under the SDG 13 Climate Action, the EbA South case demonstrates the good practices in one of the project pilot countries, Nepal, on improving community resilience through watershed restoration, livelihood improvement and long-term research highlighting collaboration with China and knowledge sharing with other developing countries.

In terms of community involvement and education, more than 1,000 households participated in various training events, and a number of extracurricular activities involving secondary schools were organised through the awareness campaign. Dynamic events such as painting competition and field activities including visiting nurseries to learn indigenous plants and propagation techniques were highly welcomed by students and teachers.

The watershed restoration also generates considerable co-benefits for local communities such as providing non-timber forest products (NTFPs), securing the dry-season water supply and climate-proofing the hydropower plant downstream. The EbA South project conducted a study in 2018 on ecosystem services assessment and cost-benefit analysis at the project site in Chiti ward (Lamjung district), which showed that without remedial interventions, most of the ecosystem service would deteriorate by 20% to 60% in 30 years, whereas if expanded interventions were to be implemented most services would be retained, especially water supply and water quality.

A nursery with multi-use species at the demonstration site in Nepal

3.2 Strengthening Qinghai Women Farmers' Income Security and Resilience in a Changing Climate

Women farmers that constitute approximately 60% of the agricultural labor force in China, are largely vulnerable in the rural areas of China, where the fragile ecological environment is sensitive and vulnerable to climate change.

The 2.5-year 'Strengthening Qinghai Women Farmers' Income Security and Resilience in a Changing Climate' project is jointly funded by the UN-Women China and the Chanel Foundation, executed by the Chinese Academy of Sciences (& IEMP). This project was designed to alleviate poverty among women farmers through increasing their accessibility to climate-resilient financial and social capitals for moving up the value chain. The project addresses both China's national poverty reduction goals and the SDGs for promoting gender equality and women's economic empowerment in targeted counties in Qinghai Province.

In the first half year, we have done the baseline study and found that: Women farmers have limited adaptive solutions to climate change. For example, In August 2018 in an agricultural cooperative led by women in Qinghai, abnormal long-lasting heavy rainfall resulted in sclerotinia rot of the unripe sunflowers and damaged the majority of plants that caused over CNY 600,000 in losses. Women farmers are also in need of market channels as current marketing of agricultural products and handicrafts is very basic and limited. At the same time, the service providers lack gender awareness. These are the context of our project.

From April 2019 onward, the project organized a series of Comprehensive Training and Exchange Workshop for Qinghai Rural Women Leaders and Service providers. We also tried to enhance women farmers' abilities through Farmers Field School. These activities provided an opportunity and platform for the rural women leaders to learn and exchange with local government officials from Qinghai province Poverty Alleviation and Development Bureau, non-government organizations, and e-commerce platforms, and increased rural women's economic empowerment and cultural confidence.

One of the women leader, Ms. Lingmei Tie, said "We have been struggling with climate change and learned a lot from other women and cooperatives through support of the project, what's more important is that we have become more confident and capable through leadership training and our own organization building. We will continue to actively pursue pathways to adapt and respond to climate and social changes and empower our members via income increase and social network building."

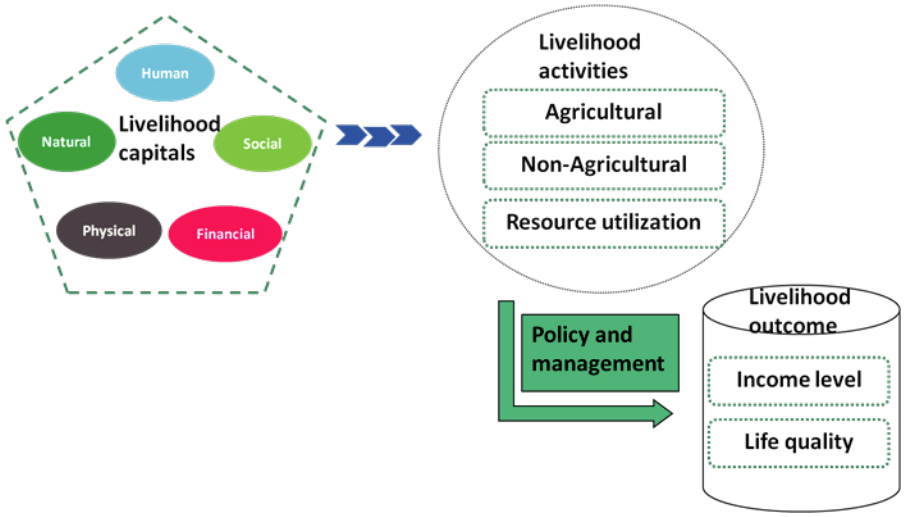
Visit at a local handicrafts factory in Qinghai, China

3.3 Providing Policy Support on Sustainable Livelihood and Green Development Strategy in Environment-Economic Fragile Areas along the Silk Road

Most countries along the silk road are developing countries with per capita GDPs under USD 5,200 according to the 2017 World Bank data, which was less than half of the global average. Improving the livelihoods in these countries is a crucial but challenging component of achieving the global SDGs due to their vulnerable ecosystems and soci-economic levels. To this end, more research is needed to identify the status and determinants of the livelihood in these areas.

Beginning March 2018, the research unit of UNEP-IEMP has carried out the project Sustainable Livelihood and Green Development Strategy Research in Environment-economic Fragile Areas Along Silk Road. In 2018 and 2019, the project team collected data based on the analytical requirements of the sustainable livelihood framework, and conducted empirical and case studies in China, Kyrgyzstan, Nepal, Thailand, and Cambodia. The framework offers important theory and method for studying poverty reduction and sustainable livelihood promotion. In a vulnerable environment, livelihood capital is affected by policies and institutions, which determine the livelihood strategies and activities of the local population. At the same time, livelihood strategies and activities affect local livelihood capital and the livelihood's susceptibility to environmental change. The goal of this program is to improve people's ability to sustain their livelihoods using various capitals and gradually rid the local people of their dependence on natural environment and single living modes, and finally achieve stable and sustainable poverty alleviation and livelihood improvement.

The above work has been supported by the Chinese Academy of Sciences (CAS). So far, the project team has finished the field survey and data collection in China. Data collection in other countries is going. Demonstration sites in Yunnan, China and Nepal have been identified. Further data analysis will be conducted in the 2020, the accompanying report will also be submitted in the same year, which will contain major policy recommendations on how to promote livelihoods in the region.



Theoretical framework for case study on sustainable livelihoods (drafted by UNEP-IEMP)

Field survey in Guangxi Province, Inner Mengolia, Qinghai Province, and Yunnan Province, China

3.4 Central Asian eco-climate-land assessment project establishes research foundation for further cooperation in the region

A five-year (2014-2018) eco-climate-land assessment project, funded under the collaborative programme between UN Environment Programme and the National Nature Science Foundation of China and executed by Xinjiang Institute of Ecology and Geography of the Chinese Academy of

Sciences, has enhanced the level of understanding on eco-environmental changes over the past five centuries in Central Asia under natural and social-economic drivers.

Central Asia, which includes Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan, is the world's largest inland arid area, as well as one of the top seven climate change sensitive regions of the world. The research found that, in the past century, temperature in the area increased 1.5℃ on average, leading to rapid glacier retreat and declined water-resources stability. Land use and land cover have changed immensely – both the areas of farmland and water body declined while grassland area increased – desertification of the Aral Sea became a key issue.

More importantly, in terms of the ecological responses to the above changes, ecosystem's primary productivity in the area has been found to have decreased in the past five decades, and land use and land cover change has been identified to be a carbon-releasing process.

Scientist proposed several thematic areas for further research to fill in: 1) water and ecosystems; 2) integrated research on water, ecosystem and socio-economic factors in the Aral Sea area; 3) monitoring of salt dust source and its spreading path; and 4) restoration of dry lake bed of the Aral Sea.

This project research results were presented with its report released at the UNEP Science-Business-Policy Forum during the fourth session of the UN Environment Assembly (UNEA4) in Nairobi, Kenya, together with all project partners from the Central Asia.

The project helps establish the research foundation for further cooperation between Central Asian counties and China on various topics including ecological conservation, resource utilization, agricultural development as well as early warning and disaster management. It also contributed to the formation of partnerships among different agencies in the area.

An micrometeorological station at a research station in Xinjiang, China

Institutional Development

1. The Third Science Advisory Group Meeting & the Fifth Steering Committee Meeting

The third meeting of the Science Advisory Group was held on August 20, 2017. It was co-chaired by Mr. Arthur Hanson, Chief International Advisor to the CCICED (Council for International Cooperation on Environment and Development)and Mr. Bojie Fu, Acedimician of the Chinese Academy of Sciences. After reviewing the annual progress 2016 and the way forward for UNEP-IEMP, members commended the progress made by the Centre; particularly in the transition period. The key recommendations for the Centre include:

- preparing to consolidate key themes under CEL into a few ecosystem types, notably river basin, dryland agricultural areas, grasslands, etc;
- linking efforts across geographic regions by promoting greater exchange of capacity building and training, comparative research;
- strengthening IEMP links with centres of excellence such as CERN, TWAS;
- bolster links with SDGS proposed in the 2030 agenda;
- continue to strengthen operational capacity of UNEP-IEMP.

The Third Science Advisory Group Meeting held in Beijing, China

The fifth Steering Committee Meeting was held on August 21, 2017. It was co-chaired by Mr Ibrahim Thiaw, Deputy Executive Director of UN Environment Programme and Mr Xiaohan Liao, Deputy Director of the Institute of Geographic Sciences and Natural Resources Research, CAS. SC members applauded UNEP-IEMP for its outstanding performance and expressed satisfaction on the implementation of various portfolios and programme. In light of China's recently launched Belt and Road Initiative, members advised the UNEP-IEMP staff to continue doing impactful work by focusing on the niche for the Centre, identifying priority areas to be relevant, fund mobilization, strengthen partnership with the private sector.

Decisions:

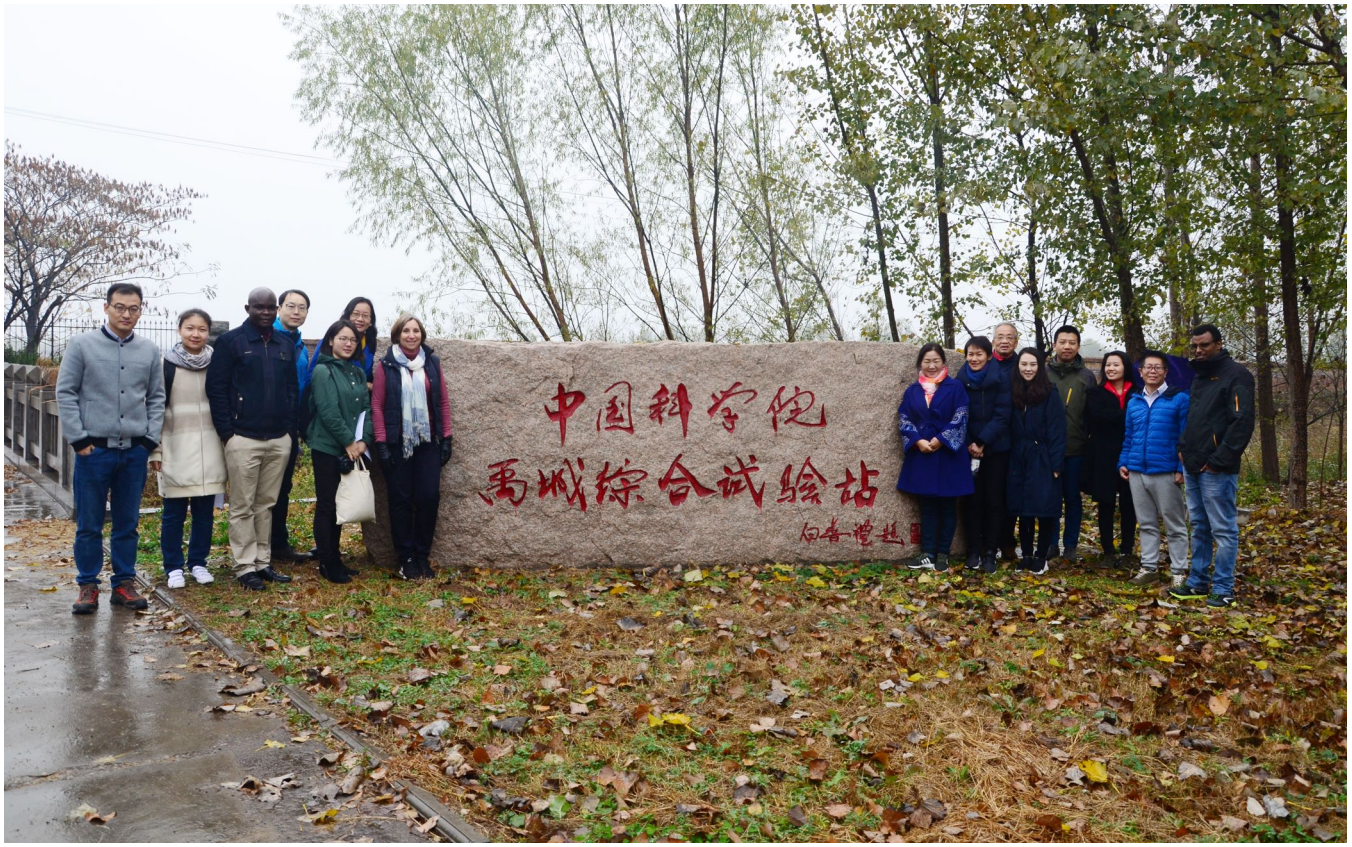
- **Approved** the Annual Work Plan 2017 and budget, with its 22 projects spread across Africa, Greater Mekong Subregion and the Belt and Road portfolios and institutional development plans.
- **Requested** UNEP-IEMP management team to identify relevant people to replace the existing Steering Committee members.
- **Requested** UNEP-IEMP management team to develop the second Medium Term Strategy (2018-2021) according to the 10 year "Climate, Ecosystems and Livelihoods Flagship Programme" framework and suggestion received from this SC meeting, and circulate it to Steering committee members before end of November to allow it effective adoption before end of 2017.

The Fifth Steering Committee Meeting heldin Beijing, China

2. Team building

Ms. Linxiu Zhang, Director
Mr. Bingfang Wu, Member of Programme Coordination Group
Mr. Xiubo Yu, Member of Programme Coordination Group
Mr. Shaohong Wu, Member of Programme Coordination Group
Mr. Fadong Li, Member of Programme Coordination Group
Mr. Chang Qing, Senior Advisor
Mr. Yutian Zhang, Senior Advisor
Ms. Yiqing Song, Senior Research Fellow
Ms. Qian Zhang, Research Fellow
Mr. Liang Wu, Research Fellow
Ms. Guoqin Wang, Programme Manager
Mr. Chao Fu, Head of Research Unit
Ms. Qinghe Qu, Chief Operation Officer
Ms. Silvia Cazzetta, Programme Manager (moved on in July 2017)
Mr. Yu Ma, Assistant to Director (moved on in December 2017)
Mr. Yisong Guan, Chief Operation Officer (moved on in October 2018)
Ms. Xigui Huang, Administrative Assistant (moved on in May 2018)
Ms. Jialin He, Program officer
Ms. Tatirose Vijitpan, Climate Change Adaptation Specialist
Ms. Diwen Tan, Project Officer
Ms. Zainab Naeem, Communication Officer (moved on in August 2017)
Mr. Ran He, Assistant to Director (moved on in April 2017)
Ms. Jingchun Liu, Administrative Assistant
Ms. Jing Zhao, Administrative Assistant
Ms. Haifan Huang, Project Assistant
Ms. Yanyan Zhang, Research Assistant
Ms. Yunli Bai, Assistant Professor
Mr. Xiangbo Xu, Assistant Professor
Mr. Mingxing Sun, Assistant Professor
Mr. Li Li, Postdoctoral Research Fellow
Mr. Ayub Oduor, Postdoctoral Research Fellow (moved on in Dec 2018)
Mr. Dagne Mojo Yadate, Postdoctoral Research Fellow (moved on in April 2019)
Mr. Mulubrhan Balehegn, Postdoctoral Research Fellow (moved on in April 2018)
Mr. Diwediga Badabate, Postdoctoral Research Fellow
Mr. Hui Cao, PhD Candicate (graduated and moved on in July 2017)
Ms. Hina Aslam, PhD Candicate (graduated and moved on in July 2018)
Mr. Huaping Long, PhD Candidate
Ms. Xinwei Jiang, PhD Candidate (moved on in August 2017)
Mr. Ce Xu, PhD Candidate
Mr. Qijia Lv, PhD Candidate
Ms. Yueming Cao, PhD Candidate
Ms. Zhiyuan Ma, PhD Candidate
Mr. Dorje Palden, Master Degree Candidate

UN Environment IEMP & UN Environment Beijing Office jointly organized an annual retreat on 16-17 October 2017 in Beijing.



UNEP-IEMP organized its annual retreat on 6-9 November 2018 in Yucheng, Shandong Province of China. The team also visited Yucheng Agriculture Station, one of the CERN stations.

3. Our publications during 2017-2019

Research papers

1.**Cao, H., Liu, J., Fu, C.**, Zhang, W., Wang, G., & Yang, G., et al. (2017). Urban expansion and its impact on the land use pattern in Xishuangbanna since the reform and opening up of China. Remote Sensing, 9(2), 137.

2.Wang, A., **Zhang, L.**, Shi, Y., Rozelle, S., Osborn, A., & Yang, M. (2017). Rural solid waste management in china: status, problems and challenges. Sustainability, 9(4), 506; doi:10.3390/-su9040506.

3.Yue, A., Shi, Y., Luo, R., **Zhang, L.**, Johnson, N., & Rozelle, S., et al. (2017). The impact of investment on drinking water quality in rural China. China Agricultural Economic Review, 9(2): 255-269.

4.**Fu, C.**, Bai, Y., Zhang, L., Wang, S., & Yan, X. (2018). Coupling Conservation and Livelihoods for Sustainable Management of Protected Areas in East Africa. Journal of Resources and Ecology, 9(3): 266–272.

5.**Wang, G., Fu, C., Liu, J., Zhang, L., Oduor, A. M. O., & Mojo, D.**, et al. (2018). Promoting the Nexus Approach of Climate, Ecosystems and Livelihoods in Africa through China-Africa Cooperation. Journal of Resources and Ecology, 9(3): 232–236.

6.**Zhang, L., Liu, J., & Fu, C**. (2018). Calling for Nenux Approach: Introduction of the Flagship Programme on Climate, Ecosystems and Livelihoods. Journal of Resources and Ecology, 9(3): 227–231.

7.Wei, F., Wang, S., Fu B., **Zhang L., & Fu, C.**, et. (2018) Balancing community livelihoods and biodiversity conservation of protected areas in East Africa. Current Opinion in Environmental Sustainability, 33:26–33.

8.**Cao, H., Fu, C.**, Zhang, W., & **Liu, J**. (2018) Characterizing Sand and Dust Storms (SDS) Intensity in China Based on Meteorological Data. Sustainability, 10(7), 2372.

9.**Li, L.**, Wu, W., Giller, P., O'Halloran, J., Liang, L., Peng, P., & Zhao, G. (2018). Life Cycle Assessment of a Highly Diverse Vegetable Multi-Cropping System in Fengqiu County, China. Sustainability, 10, 983.

10.**Aslam, H., Liu, J.**, Mazher, A., **Mojo, D.**, Imran, M., & **Fu, C.** (2018). Willingness to Pay for Improved Water Services in Mining Regions of Developing Economies: Case Study of a Coal Mining Project in Thar Coalfield, Pakistan. Water, 10, 481; doi:10.3390/w10040481.

11.**Wu, L., Zhang, L.**, Wang, M., Kanga, E., Du, C. (2018). The Development of Wildlife Community Conservancies in Kenya: A Preliminary Review. Journal of Resources and Ecology,Vol. 9 (3): 250-256.

12.**LI Fadong**, LENG Peifang, ZHANG Qiuying, SONG Shuai, QIAO Yunfeng, GU Congke, ZHANG Qian, **WU Liang, Mulubrhan Balehegn, Dagne Mojo**, ZHU Nong, ZHAO Xin. (2018). Understanding Agriculture Production and Food Security in Ethiopia from the Perspective of China. Journal of Resources and Ecology, Vol. 9 (3): 237-249.

13.Salif Diop, Aliou Guisse, Claude Sene, Birane Cisse, Ndeye Rokhaya Diop, Sokhna Dié Ka,

Amady Gnagna Cisse, Saly Sambou, Ousmane Ndiaye, Adandé Belarmain Fandohan, **FU Chao, WANG Guoqin**, WANG Yongdong. (2018). Combating Desertification and Improving Local Livelihoods through the GGWI in the Sahel Region: The Example of Senegal. Journal of Resources and Ecology, Vol. 9 (3): 257-265

14.**Balehegn**, M., Hintsa, K. (2018). Patterns of Changes to Woody Vegetation near Resettlement Sites in Semi-arid Northwestern Ethiopia. Journal of Resources and Ecology, Vol. 9 (3): 317-329

15.**Sun, M.** , Wang, Y. , Shi, L. , & Klemešd Jiří Jaromír. (2018). Uncovering energy use, carbon emissions and environmental burdens of pulp and paper industry: a systematic review and meta-analysis. Renewable and Sustainable Energy Reviews, 92, 823-833.

16.Zhuo, C. , Dan, W. , **Mingxing, S.** , Huu, H. N. , Wenshan, G. , & Guangxue, W. , et al. (2018). Sustainability evaluation and implication of a large scale membrane bioreactor plant. Bioresource Technology, 269, 246-254.

17.Jia, M. , **Sun, M.** , Li, X. , **Xu, X.** , Wang, Y. , & Shi, L. , et al. (2018). A new era of straw-based pulping? evidence from a carbon metabolism perspective. Journal of Cleaner Production.

18.Chen, Z., Wang, D., **Sun, M.**, Ngo, H. H., Guo, W., et al. (2018). Sustainability evaluation and implication of a large scale membrane bioreactor plant. Bioresource technology, 269, 246-254.

19.Yu, H., Wang, Y., Li, X., Wang, C., **Sun, M.**, & Du, A. (2019). Measuring ecological capital: State of the art, trends, and challenges. Journal of Cleaner Production, 219, 833-845.

20.**Xu, X.**, Shi, Y., Li, Q., et al. (2018). Integrated regional ecological risk assessment of multiple metals in the soils: A case in the region around the Bohai Sea and the Yellow Sea. Environmental pollution, 242: 288-297.

21.**Xu, X.**, Wang, T., **Sun, M.*, Bai, Y., Fu, C., Zhang, L.**, Hu, X., & Hagist, S. (2019). Management principles for heavy metal contaminated farmland based on ecological risk—A case study in the pilot area of Hunan province, China. Science of The Total Environment, 684: 537-547.

22.**Xu, X., Sun, M.*, Zhang, L., Fu, C., Bai, Y., & Li, C.** (2019). Factory employment exposure and human health: Evidence from rural China. Environmental Pollution (Accepted)

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24.**Zhang, L., Cao, Y., Bai, Y*.** (2019). The impact of the land certificated program on the farmland rental market in rural China. Journal of Rural Studies, In Press, doi: https://doi.org/10.1016/j.jrurstud.2019.03.007.

25.Dong, Y., Luo, R., **Zhang, L.***, Liu, C., & **Bai, Y.** (2019). Intergenerational transmission of education: The case of rural China, China Economic Review, 53: 311~323.

26.Wang, W., Dong Y., Luo, R., **Zhang, L.***, **Bai, Y.** (2019). Changes in returns to education for off-farm wage employment: Evidence from rural China, China Agricultural Economic Review, 11(1): 2~19.

27.Balehegn, M.*, Balehey, S., **Fu, C.**, & **Wu, L.** (2019). Indigenous weather and climate forecasting knowledge among Afar pastoralists of north eastern Ethiopia: Role in adaptation to weather and climate variability. Pastoralism: Research, Policy and Practice, 9:8.

28.Hu, T., **Li, L.**, Hui, G., et al. (2019). Selenium biofortification and its effect on multi-element change in Auricularia auricular. Food Chemistry, 295: 206-213.

Assessment reports

1.**Hui Cao, Chao Fu, Linxiu Zhang, Guoqin Wang** (2018). Vulnerability Mapping of Sand and Dust Storms – A Pilot Study in China. A report produced for the secretariat of the United Nations Convention to Combat Desertification (UNCCD) by UNEP-IEMP.
2.Min Jin, Mingming Su, Huan Ni, **Chao Fu, Jialin He.** (2018). Ecological Community Development in Dongying. A report prepared as part of the Pilot Project on Green Economy in Dongying, China (Phase II).
3.Xinjiang Institue of Ecology and Geography (XIEG) of Chinese Academy of Sciences & **UNEP-IEMP**. (2018). Ecosystem Assessment in Central Asia. The Ecological Responses to Climatic Change and Land-cover Change in Arid and Semiarid Central Asia during the Past 500 Years Project Report.

EbA South project publications

1.Mander, M. (2018). Assessment of Ecosystem Services Supply, Demand and Values: Seychelles. Document produced as part of the GEF-funded EbA South project.
2.UNEP-IEMP and IISD. (2018). EbA planning tool 'ALivE – Adaptation, Livelihoods and Ecosystems' (version 1.0). www.iisd.org/project/ALivE Computer-based tool and user manual produced as part of the GEF-funded EbA South project.
3.Swiderska, K., King-Okumu, C. and Monirul Islam, M. (2018). Ecosystem-based adaptation: a handbook for EbA in mountain, dryland and coastal ecosystems. IIED, London. Document produced as part of the GEF-funded EbA South project.

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