Systems Analysis in Asia

Booklet of Poster Abstracts

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Poster 1

Title: Effects of Environmental Protection Policies on Nutrient Export in the Yangtze River Basin

Authors: Li Jincheng*, Peking university; Yong Liu, Peking university; Ting Tang, International Institute for Applied Systems Analysis;

Theme: Defining systems analysis methods and using them in the Asian context.

Abstract:
The study has constructed a 0.1° nutrient production model of China (CEIN) with county-level data in 2017. On the basis, the study refined the existing MARINA model for the Yangtze River Basin, and the nutrient export was calculated and calibrated. The effects of different environmental management policies, such as "Comprehensive Planning of Yangtze River Basin (2012-2030)", were analyzed on the nutrient export. The results illustrated that the hot spots were mainly concentrated in the middle and estuary of the Yangtze River basin. The central region was relatively developed in agriculture and industry and had a large population. The estuary was economically developed, mainly in the tertiary industry, with a high level of urbanization and a large yield of nutrients. Non-point source was the main source of pollution. For nutrient loading production, cropland, livestock, soil erosion was more than 50%, 20% and 10% of non-point source respectively. and poultry breeding was more than, soil erosion is more than. In terms of contributions to nutrient flux, the proportion of cropland non-point sources increased further, exceeding 60%, while the proportion of livestock and poultry breeding and soil erosion decreased. For the whole basin, cropland-related environmental protection policies were more effective in controlling nutrient pollution. For TN, a 25% increase in manure recovery would reduce nutrient flux in the watershed by 12%. The nutrient fluxes were reduced by 24% upstream, 9% midstream and 13% downstream. For total phosphorus, a 25% increase in livestock and poultry manure recovery would reduce nutrient flux in the watershed by 8%. The nutrient fluxes were reduced by 7% in the upstream, 4% in the midstream and 8% in the downstream. The improvement of treatment standards of sewage treatment plants had little effect on nutrient flux. For TN, only 0.06% flux is reduced, and for TP, only 0.05% flux is reduced.

Poster 2

Title: Coastal resilience: land-water-biodiversity nexus

Authors: Yangfan Li*, State Key Laboratory of Marine Environmental Science, Fujian Institute for Sustainable Oceans, College of the Environment & Ecology, Xiamen University

Theme: Defining systems analysis methods and using them in the Asian context.

Abstract:
Coping with climate change and urbanization impacts, managing coastal cities and urbanization from increasing human activities in coastal areas is a critical issue in balancing global ocean conservation and blue economy. Resilience-based integrated coastal management (R-ICM) was presented as an effective, holistic, ecosystem-based and knowledge-based approach to manage the expansion of human footprints in coastal areas, coordinating land and sea spatial planning to achieve coastal urban regional resilience and provide guidance for the transformation. Resilience focuses on the dynamic changes (e.g. regime shifts) of nonlinear systems, it helps to measure the multiple factors and identify complex pressures and potential risks to coastal areas. We build a new resilience framework based on Land-Water-Biodiversity (LWB) Nexus, which enables the measurement of coastal resilience on multi-scale and the transformation of coupled social-ecological system under the impact of coastal human activities (e.g. land reclamation). We further established a system resilience measurement model based on stress-strain curve to reveal the new mechanism of system resilience regression caused by specific resilience factors such as impervious surface, size of land reclamation, size of built-up area. Our researches have been included in Blue Paper named as Integrated Ocean Management, commissioned by High Level Panel for a Sustainable Ocean Economy. Some research outcomes were further applied to the eastern coastal region of China based on the experiences from the pilot cities, including Xiamen, Shenzhen, Ningbo, Haikou, Lianyungang and Taihu Lake watershed. We now focus on Guangdong-Hong Kong-Macao Greater Bay Area, the urban agglomeration on the west coast of the Taiwan Straits and countries on the Silk Road. We aim to adapt R-ICM to Chinese conditions and promote the international development of ecological civilization theory.

Poster 3

Title: Decarbonizing China's Iron and Steel Industry from the Supply and Demand Sides for Carbon Neutrality

Authors: Ming Ren*, College of Environmental Sciences and Engineering, Peking University; Pantao Lu, College of Environmental Sciences and Engineering; Xiaorui Liu, College of Environmental Sciences and Engineering, Peking University; M. S. Hossain, College of Environmental Sciences and Engineering, Peking University; Yanru Fang, College of Environmental Sciences and Engineering, Peking University; Tatsuya Hanaoka, Center for Social and Environmental Systems Research, National Institute for Environmental Studies; Brian O'Gallachoir, Energy Policy and Modelling Group, MaREI Center, Environmental Research Institute, University College Cork, Energy Engineering, School of Engineering, University College Cork, Co.; James Glynn, Energy Systems Modeling, Center on Global Energy Policy, Columbia University; Hancheng Dai College of Environmental Sciences and Engineering, Peking University

Theme: Defining systems analysis methods and using them in the Asian context.

Abstract:
Iron and steel production in China contributes to 14% of China's total energy-related CO2 emissions. Decarbonizing the iron and steel sector will therefore play an important role in achieving the goal of carbon neutrality. This study explored possible low-carbon transition pathways for China's iron and steel industry to achieve carbon neutrality by 2050. An integrated approach was developed that combined a computable general equilibrium model and a bottom-up technology-selection module. The results indicated that although energy-saving technologies can reduce CO2 emissions in the short term, in the long term, adopting breakthrough technologies (e.g., carbon capture and storage (CCS) and hydrogen-based direct reduction (DR)), increasing the share of scrap-based electric arc furnace (EAF) steel production, and decarbonizing upstream energy-supply sectors will be crucial for climate change mitigation. Hydrogen-based DR could be an effective option for CO2 emission reduction in scenarios where CCS is not available, with its share increasing to 23%–25% by 2050. System-wide cross-sector decarbonization can help achieve climate targets at lower costs through flexible technology combinations and avoid carbon leakage into upstream energy-supply sectors.

Poster 4

Title: Probabilistic Estimation of the Spread of COVID-19 using a Proposed Compartmental Model, Monte Carlo Method, and Bootstrap Sampling

Authors: Mahdi Shadabfar*, Center for Infrastructure Sustainability and Resilience Research, Department of Civil Engineering, Sharif University of Technology; Mahsuli, M., Center for Infrastructure Sustainability and Resilience Research, Department of Civil Engineering, Sharif University of Technology; Sioofy Khoojine, A., Department of Economics and Business Management, Yibin University; Hosseini, V.R., Institute for Advanced Study, Nanchang University; Kordestani, H., Department of Civil Engineering, Qingdao University of Technology

Theme: Defining systems analysis methods and using them in the Asian context.

Abstract:
This paper presents a probabilistic model for estimating the spreading profile of COVID-19 in Thailand, taking into account the effects of social distancing and vaccination. For this purpose, a compartmental model is built in which the population is divided into nine mutually exclusive compartments, including susceptible, insusceptible, exposed, infected, vaccinated, recovered, quarantined, hospitalized, and dead. The interaction between the compartments is modeled in terms of conversion rate through a system of fractional partial differential equations. Next, a Monte-Carlo based optimization method is proposed to fit the fractional compartmental model to the actual COVID-19 data of Thailand collected from the World Health Organization. Further, 40 optimal samples resulting from the optimization analysis are selected as model parameters. Then, the bootstrap sampling method is employed to generate 10,000 samples via random permutations from the selected model parameters. Next, by introducing the generated random dataset into the compartmental model, 10,000 realizations of the system response are calculated over time. The dataset of system realizations is then used to estimate the exceedance probability of the number of infected, recovered, and dead cases over time. The resulting exceedance probability diagrams can immediately be used to estimate the future level of disease transmission at a given acceptable risk.

Poster 5

Title: China's future food demand and its implications for trade and environment

Authors: Hao Zhao*, Center for Agricultural Resources Research, Institute of Genetic and Developmental Biology, Chinese Academy of Sciences; Chang, J., Zhejiang University; Havlík, P., International Institute for Applied Systems Analysis etc.

Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
Satisfying China's food demand without harming the environment is one of the greatest sustainability challenges for the coming decades. Here we provide a comprehensive forward-looking assessment of the environmental impacts of China's growing demand on the country itself and on its trading partners. We find that the increasing food demand, especially for livestock products (+16%~+30% across all scenarios), would domestically require 3~12 Mha of additional pasture between 2020 and 2050, resulting -2%~+16% growth in agricultural greenhouse gas (GHG) emissions. The projected 15%~24% reliance on agricultural imports in 2050 would result in 90~175 Mha of agricultural land area and 88~226 Mt CO2eq yr-1of GHG emissions virtually imported to China, which account for 26%~46% and 13%~32% of China's global environmental impacts, respectively. The distribution of the environmental impacts between China and the rest of world would substantially depend on development of trade openness. Thus, to limit the negative environmental impacts of its growing food consumption, besides domestic policies, China needs to also take responsibility in the development of sustainable international trade.

Poster 6

Title: To Achieve Sustainability through Biodiversity Conservation: A Case Study of Ranthambhore Tiger Reserve

Authors: Bhanwar Vishvendra Raj Singh*, Department of Geography, Faculty of Earth Science, Mohanlal Sukhadia University

Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
Climate change has been connected to the endangerment and extinction of many flora and fauna. This rapid and widespread phenomenon is extremely challenging for global biodiversity ecosystems and the future earth. One of the prime threats to wildlife habitats, however, is climate change, as desertification and sea-level rise could wipe out most of the limited territory that remains. One of the most vulnerable habitats is located in the Ranthambhore, Rajasthan, India.
Meanwhile, tiger landscapes are significantly undervalued in global and national agendas by us. As a result, degradation, fragmentation, human-wildlife conflicts, loss of natural habitats, and depletion of prey animals have been rapidly increasing.
Meanwhile, we are building million dollars from the tiger conservation program, because the tiger is an umbrella species in the ecosystem. Its conservation automatically ensures the conversation about flora and fauna and the entire ecosystem is conserved.
The Ranthambhore Tiger reserve is capable of ironic natural capitals, biodiversity, and attractive beauty; therefore, the region can provide a wide range of ecosystem services regarding supporting, provisioning, regulating, and cultural services. But cultural services are most strong among all of them.
At present, the growing demand for these services has put an immense burden on the ecosystem, and under such a scenario; eco-tourism is the best social, economic entrepreneurship for the sustainable development of tiger territory.
The research would identify the geographical, social, economic indicators, which determine the thriving of sustainable ecosystem services. As well as the main outcome of ecosystem services will provide a valuable framework for analyzing and acting on the linkages between local people and authority other stakeholders with their environment, which is based on inclusive, holistic, and sustainable development of human wellbeing and future earth.

Poster 7

Title: Global Land Use Change and Food Security Implications of China's Bioenergy Development under 2060 Carbon Neutrality Target

Authors: Yazhen Wu*, Peking University; Andre Deppermann, International Institute for Applied Systems Analysis; Petr Havlík, International Institute for Applied Systems Analysis; Ming Ren, Peking University; Hancheng Dai, Peking University

Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
Bioenergy would play an important role in China's decarbonization toward the Paris Agreement targets. However, the domestic and spillover impacts of rapid bioenergy developments in China for its 2060 carbon-neutrality target have not been comprehensively investigated.
This study applied the Global Biosphere Management Model (GLOBIOM) developed by IIASA to explore the impacts of different biomass production and import portfolios for China's increased bioenergy demand under the net-zero emission target. A series of stylized biomass trade scenarios were developed to quantify the possible effects of rising import for short-rotation plantation biomass in China on global land-use change, GHG emissions from land, food system, and implications on food security.
Our analysis indicates that pursuing high biomass production in any single region could lead to certain sustainability concerns. For example, if the excess biomass for China's increased demand is to be produced and imported from South Asia, the number of undernourished people across the world could increase by 34 million in 2030 and 17 million in 2060, mostly in India. Importing more from Europe would lead to significantly intensified competition for cropland in Latin America and Africa.
A more diversified importing portfolio with an optimized global allocation of biomass production could help reduce the negative trade-offs. An optimized bioenergy import portfolio combined with stricter forest regulation could fulfill the increased biomass demand for China, while simultaneously achieving food security and forest protection targets, avoiding 32.6 million (or 17.5 million) cumulative undernourishment from 2030 to 2060 compared with the domestic production scenario (or a fixed global biomass trade scenario).
Besides, the induced land-use change and food security impacts are most severe in 2030 and 2040, possibly due to population peaking and technology advances. Therefore, introducing biomass as a mitigation option on large scales only after 2040 might be better timing for attaining multiple SDGs.

Poster 8

Title: Adoption of rice auto seeding machinery benefits Asian urban food security in multiple ways

Authors: Yuquan Zhang*, Shanghai Jiao Tong University; McCarl, B, Texas A&M University; Li, Y, Shanghai Jiao Tong University; Li, Q, Shanghai Jiao Tong University; Cao, Z, Shanghai Jiao Tong University

Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
Mechanization of agricultural production saves labor and increases output in general. In peri-urban areas, smart mechanization has become increasingly a must for the agricultural sector, due to limited labor supply, high wage rates, and prohibitive land opportunity costs. Amidst the background of rapid urbanization in Asia, the rising bar to perform peri-urban agricultural activities presents threats to urban dwellers' food security (SDG2). This study takes Shanghai as a case study to explore how a new technology that auto-mechanizes seed planting for rice production may influence urban food security. Sitting in the densely populated East China, the metropolitan area of Shanghai has witnessed notable reductions in crop acreages during 2015 – 2019. To investigate the potential of the above-mentioned technology, this study employs the newly developed Shanghai Agricultural Sector Model (SH-ASM) that covers 15 crops across 9 suburban districts. The model simulates the decision-making of representative farmers regarding the land use allocation between crops, under a sectoral market welfare optimization framework. Scenarios with varying levels of technology diffusion for rice production are examined. Here we find that: 1) higher adoption rates increases rice production, meanwhile releasing more labor for other enterprises such as oil crops and vegetables; 2) wider technology diffusion also leads to greater savings of chemical inputs usage on an aggregated basis, potentially ameliorating non-point source pollution. These results have implications for SDG2 and beyond. First, improving the technical efficiency of rice production is of importance, especially for subsistence-oriented farming households. Second, by saving labor hours and reducing physical demands, the introduction of rice auto seeding machinery potentially releases labor for other opportunities such as vegetables and non-rural employment. In turn, urban dwellers' regular access to fresh produce could be better secured, and farming households may diversify their income sources. Third, the stability of urban food supply would get improved.

Poster 9

Title: Environmental and Health Benefits of Clean Heating Plan in Northern China

Authors: Wenjun Meng*, Peking University; Tao, S, Peking University

Theme: Systems analysis applied to sustainable energy transition and resilient urban growth.

Abstract:
North China has the highest regional levels of air pollution in the country due to intensive industrialization, dense population, and its long heating season. The rapid transition from traditional fuels to LPG (liquefied petroleum gas), biogas, and electricity for cooking, is resulting in much lower emissions. Still, solid fuels remain a dominant energy source for heating. To address the issue, a campaign (Clean Heating Plan for Northern China in Winter for 2017-2021) was launched to substitute electricity or pipeline-based natural gas (PNG) for heating in northern China. The campaign was divided into two regions, one is focusing on the so called 2+26 (Beijing, Tianjin, and 26 other municipalities in the surrounding area) region (R28), the other is the rest 128 municipalities in northern China (R128). This study evaluates the impacts of the campaign on rural residential energy use, emissions, ambient and indoor air quality, population exposure and health. Although only a single penetration rate (60% for rural) was initially planned in R28 for all municipalities, outcomes in the different municipalities varied considerably from 38% to 97%. And based on the progress already made for R28, the factors that affected the penetration rates were quantified to develop an intervention scheme with differentiated targets for R128. It evidenced that a differentiated scheme would be more environmentally beneficial. Although the same number of rural households (40% for rural) can achieve clean heating under both intervention scenarios, the proposed differentiated strategy can prevent 30 000 (23 000−34 000) premature deaths associated with residential heating annually compared to the 26 000 (21 000−31 000) premature deaths prevented under the fixed-rate scheme.

Poster 10

Title: Carbon neutrality turns water resource redline greener in China

Authors: Xiaoyu Liu*, Peking University; Hancheng, D, Peking university; Yong, L, Peking university; Yoshihide, W, International Institute for Applied Systems Analysis; Taher, K, International Institute for Applied Systems Analysis; Jinren, N, Peking university; Yan, C, Chinese Academy of Environmental Planning; Pan, C, Chinese Academy of social sciences; Chaoyi, G, Peking university

Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
As the backbone of economy, industrial sectors use substantial amounts of energy and water, and play a vital role in cutting carbon emissions and water withdrawal. This study uncovers how carbon reduction will benefit or threaten industrial water savings across China's 31 provinces by incorporating enterprise-level census datasets into a macroeconomic general equilibrium model. The results show that while co-benefits exist for most sectors and provinces, especially the power generation in the southern region. Overall, carbon reductions aligned with the Carbon Neutrality target could achieve the great co-benefit by saving 38 km3 (24%) of national industrial water withdrawal by 2060. On the other hand, trade-offs would arise with the industry relocation across China and excessive production from outdated capital stock, causing water demand to rise, partially or even completely offsetting water savings. This study calls for stricter admittances and restrictions of water-intensive industry expansion and preferential policies to further promote water-saving technologies.

Poster 11

Title: Probabilistic Framework for Evaluating the Seismic Resilience of Transportation Systems

Authors: Taghizadeh, M, Sharif University of Technology; Mojtaba Mahsuli*, Sharif University of Technology

Theme: Defining systems analysis methods and using them in the Asian context.

Abstract:
This paper proposes a probabilistic framework for evaluating the seismic resilience of transportation systems. The framework quantifies the community resilience by integrating hazard models, risk models, and recovery models within an agent-based simulation. In this framework, probabilistic models predict the occurrence and intensity of earthquake hazard, damage and capacity of network components, network travel demand, and economic, social, and socioeconomic consequences. The hazard models characterize the occurrence, magnitude, and rupture location on the seismic sources, and consequently, the ground shaking and ground failure at the location of network components as well as the components of other infrastructure systems. Then, the risk models assess the initial post-hazard state of the community including the transportation system. To this aim, a group of risk models predicts the damage of vulnerable components of the transportation network, including bridges and tunnels, as well as the damage state of the building stock in each urban block and the ensuing debris width in adjacent links. Moreover, another group of probabilistic models compute the residual traffic capacity of network links given the damage state of bridges and tunnels and the debris width. The travel demand of the network is then determined at different time periods in the aftermath of the seismic event. Thereafter, given the modified capacity and demand of the network, the traffic assignment model predicts the travel time in the links of the network. Given the travel time of each link, the operation of transporting the injured to the hospital is simulated using an agent-based model. Through this model, the social losses due to the delay in the transportation of the injured and the ensuing health degradation and increase in fatalities are computed. The framework is showcased by a comprehensive application to a virtual community comprising a population of 125,000, a portfolio of residential, commercial, and industrial buildings, transportation system, and healthcare system subject to an earthquake.

Poster 12

Title: Modeling pathways to low and zero CO2 emissions in China's iron and steel industry and their impacts on resources and energy

Authors: Shaohui Zhang*, School of Economics and Management, Beihang University and International Institute for Applied Systems Analysis; Bowen Yi; Fei Guo, International Institute for Applied Systems Analysis

Theme: The future of systems analysis in Asia.

Abstract:
The increasing energy and material consumption associated with global economic growth has resulted in the need for more severe efforts at mitigating global climate change. The iron and steel industry consumes 8% of energy and emits 7% of total CO2 globally. China's iron and steel industry contributes to 15% of that country's total CO2 emissions. Therefore, there is an urgent need to explore the possibility of net zero emissions in the iron and steel industry in China to meet China's goal of carbon neutrality before 2060. In the study, the MESSAGEix–China iron and steel model was developed by integrating the process-based technology of the sector into the IIASA's MESSAGEix framework to explore zero CO2 emission pathways and their associated impacts on resources, energy in China's iron and steel industry up to 2100. We found that there are multiple pathways to achieving zero CO2 emissions in the Chinese iron and steel industry by the end of the 21st century. The CO2 emissions decreased significantly between 2030 and 2060 due to the rapid application of 100% scrap-based Electric Arc Furnaces (EAFs) and hydrogen-based Direct Reduced Iron (DRI)-EAFs steel-making technologies. However, by 2060, there will still be 70–360 Mt of CO2 emissions from China's iron and steel industry; consequently, carbon sink or negative emission technologies are required to offset this and achieve the country's carbon neutrality goal. Furthermore, technologies for achieving zero emissions differ widely in terms of their impacts on the consumption of materials and energy. Compared to the electric (ELE) scenarios, 25–40% of extra iron ore is consumed in the new national policy (NPS) scenarios and the DRI scenarios, but 25–220% of scrap is required. At the same time, 20–150% more energy will be saved in the ELE scenarios than in the NPS and DRI scenarios.

Poster 13

Title: Integrated System Modelling for Desirable Housing

Authors: Ghafory-Ashtiany, M., International Institute of Earthquake Engineering and Seismology; Amir Shahmohammadian*, Islamic Azad University Science and Research Branch

Theme: Systems analysis applied to sustainable energy transition and resilient urban growth.

Abstract:
Housing is one of the most basic needs of communities. Buildings used for housing represent the highest percentage of all buildings in communities, and this holds true at the state, country, and local scales. Safety of a home, as the largest household's financial investment, has high impact on the financial and physical resilience of a society; and its damage makes up a significant portion of disaster losses. Facts show that access to desirable housing has been one of the biggest problems for governments in many developing countries. Many governments have failed in solving the housing problem in their communities due to having one-dimensional and traditional view of the housing issue. Beside the level of desirability, in general, the desirable housing means: "Safe" against natural and human-made disasters (such as earthquakes, floods, hurricanes), "Affordable" and "Acceptable Quality". These criteria provide comfort and convenience for its tenant and ensure the safety, resiliency and sustainable growth and development of the society. A closer look at these two goals indicates that many parameters and variables are effective in achieving desirable housing. Desirable housing has different social, political, economic, legal, and technical, and engineering aspects, and such aspects are directly and indirectly related to each other. A change in one aspect may cause a change in other aspects. Achieving desirable housing which involves many stakeholders with differences objective have become a major challenge for many governments. Considering the variable parameters that are effective in desirable housing and the existence of stakeholders with different goals, it can be stated that desirable housing is a complex phenomenon. This paper presents an attempt to provide a comprehensive look at housing issues in developing countries using the systemic thinking approach by examining all parameters and their interactions with each other, in order to provide short-term and long-term solutions to achieve desirable housing.

Poster 14

Title: Food and feed trade has greatly impacted global land and nitrogen use efficiencies over 1961-2017

Authors: Zhaohai Bai*, Center for Agricultural Resources Research, Institute of Genetic and Developmental Biology, The Chinese Academy of Sciences; Ma, W. Hebei Agriculture University; Ma, L, Center for Agricultural Resources Research, Institute of Genetic and Developmental Biology, The Chinese Academy of Sciences etc.

Theme: The future of systems analysis in Asia.

Abstract:
International trade of agricultural products has complicated and far-reaching impacts on land and nitrogen use efficiencies. We analyzed the productivity of cropland and livestock and associated use of feed and fertilizer efficiency for over 240 countries, and estimated countries' cumulative contributions to imports and exports of 190 agricultural products for the 1961-2017 period. Crop trade has increased global land and partial fertilizer nitrogen productivities in terms of protein production, which equaled savings of 2270 M ha cropland and 480 Tg synthetic fertilizer nitrogen over the analyzed period. However, crop trade decreased global cropland productivity when productivity is expressed on an energy (per calorie) basis. Agricultural trade has generally moved towards optimality, i.e. has increased global land and N use efficiencies during 1961-2017, but remains at a relatively low level. Overall, mixed impacts of trade on resource use indicate the need for re-thinking trade patterns and improving their optimality.

Poster 15

Title: The relationship of energy-water-carbon emissions in the Beijing-Tianjin-Hebei region by the IEWC model under low-carbon transitions

Authors: Yingying Liu*, Beijing university; He Lv, Shuqi Yan, Sha Chen, Beijing University of Technology

Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
The availability and security of energy and water resources are two key factors in the Sustainable Development Goals. With the industrialization process, the consumption of energy increases fast, resulting in global warming by emitting carbon dioxide into the air. At the same time, there is a close relationship between energy, water and carbon emissions. In order to exploring coherent and coordinated planning policies which can achieve both climate change mitigation and sustainable development, this study builds an integrated energy-water-carbon assessment (IEWC) model to simulate the energy, water and CO2 emissions in the Beijing-Tianjin-Hebei region (BTH) under the policy scenario (PO) and low-carbon development scenario (LC) from 2017 to 2050. The demand for water resources of energy transformation under different scenarios are quantitatively analyzed and the synergistic impact of energy, water and carbon emissions are explored. The results show that current policies are not enough to mitigate the continued growth in energy demand, CO2 emissions, water demand in the BTH region. The LC scenario has a better effect on energy and water conservation than the policy scenario. Compared to the PO scenario, the BTH region in the LC scenario would save more than 28% of energy consumption and reduce by more than 46% of CO2 emissions, while its energy sector would save more than 33% of water resources. At the same time, nutrification potential and aquatic ecotoxicity will decrease by more than 12 % and 37 %.

Poster 16

Title: Systems Analysis for the Management of Mine Tailings in Small-Scale Gold Processing in Caraga Region, Philippines

Authors: Mark Anthony Lavapiez*, Caraga State University; Balbin, A, Caraga State University; Varela, R, Caraga State University; Balanay, R, Caraga State University; Halog, A, University of Queensland

Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
Mine waste can contaminate the soil, air and water that eventually cause environmental hazards in nearby ecosystems. In Caraga Region, Philippines, the impact of gold mining wastes has created social pressures as wastes affect the health and safety of people. The mine tailings and wastewater are the major wastes in gold processing posing hazards to the environment which can be magnified when the heavy metals in tailings move to adjoining areas during heavy rains. Lead, cadmium and arsenic are among the most prevalent heavy metals in mine tailings which can be toxic at high concentrations. This study, therefore, highlights the ecological approaches in the development of a sustainable mine tailings management by utilizing the wastes as raw materials for the production of innovative ceramic items and landscaping bricks. The approach includes cleansing the tailings using green chemistry/green technology to separate the heavy metals from the soil part. The extracted heavy metals from the tailings will be used for a specific purpose while the soil part is used for innovative product development. Industrial ecology concepts have been adopted as the basis for the approaches in configuring the mine tailings management framework. Industrial symbiosis and systems thinking in managing gold processing waste are emphasized to address the issues relating to sustainability. The applications of the concepts of industrial symbiosis and systems thinking to promote sustainable mine tailings management are envisioned to provide sustainability in reducing the environmental hazards associated with heavy metals from mine tailings and in providing economic benefits to the people in the host mining communities.

Poster 17

Title: Cost-optimized pathways to achieve the carbon neutrality and PM2.5 air quality targets in Southern China

Authors: Xiaorui Liu*, College of Environmental Sciences and Engineering, Peking University; Fabian Wagner, International Institute for Applied Systems Analysis; Shaohui Zhang, International Institute for Applied Systems Analysis; Hancheng Dai, College of Environmental Sciences and Engineering, Peking University

Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
China's newly proposed carbon neutrality target in September 2020 puts provinces facing the challenge of deep decarbonization because the country is still on a path towards peak carbon emissions in approximately 2030. At the same time, although significant results have been achieved in recent years in the prevention and control of air pollution, the air quality situation remains serious, with PM2.5 concentrations as high as 34ug/m3 in 2020 even under the impact of the epidemic. How to achieve carbon neutrality and air quality goals simultaneously in a cost-effective way is essential for China. This study explores cost-optimized pathways for achieving the dual targets in the rapidly developing but unevenly balanced southern China including Guangdong, Guangxi, Hunan, Hainan, Jiangxi and Fujian provinces. We use a multi-model assessment approach which consist of the macro-economic model (IMED|CGE), the GAINS model, multi-objective cost optimization model and public health model (IMED|HEL) to investigate the costs and benefits of achieving the carbon neutrality and the PM2.5 air quality goal. We found that in the baseline without carbon emission constraint under the current control measures, all 6 provinces cannot achieve National Ambient Air Quality Standard class I (15ug/m3) by 2050. Only by implementing the strictest control measures can it be possible to approach the air quality level under the carbon neutral scenario, which will increase the control cost by 62%. While in the Net zero carbon scenarios, Fujian, Guangxi, and Hainan are expected to reach the WHO guidance value under the current control measures. The contribution of end-of pipe measures will gradually decrease. In the long run, the transition of the transportation, industrial and energy structure in line with the carbon neutrality target would lay an important foundation for further improvements in air quality.

Poster 18

Title: Multiple Cropping System and Crop Structure Changes in China from 1980 to 2017

Authors: Minghao, Bai*, Watershed Science Laboratory, College of Environmental Sciences and Engineering, Peking University; Yong, Liu, Watershed Science Laboratory, College of Environmental Sciences and Engineering, Peking University; Hancheng, Dai, Laboratory of Energy & Environmental Economics and Policy, Peking University

Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
Large population base, insufficient arable land areas accompanied by land degradation, and limited water resources with unbalanced spatio-temporal distribution all pose severe challenges to the agricultural sustainable development in China. As an important means of intensive agricultural production, the multiple cropping system not only improves the efficiency of water, land, and heat resources, but also greatly improves food supply. In order to adapt to the rapid socio-economic development and climate change, the spatio-temporal optimization of multiple cropping system is an important aspect of agricultural production in China. However, the lack of long-term crop distribution dataset with high spatio-temporal resolution cannot support us to provide accurate decision-making basis for agricultural sustainable development. Therefore, the dataset - China Monthly Irrigated and Rainfed Areas of Crops in the Cell-specific (5 arcmin) Cropland from 1980 to 2017 (MIRACLE) is developed. Under crop characteristics, cropland suitability, water available, and temperature constraints, we used a spatio-temporal combination optimization method with crop growth periods and crop areas as input variables to drive the area allocation of 17 crops. Based on the analysis of dataset, it is found that the multiple cropping index of irrigated cropland in the multi-cropping zone showed a downward trend from 1980 to 2017, but the area of irrigated cropland increased by years. It indicates food production increase in China was by the area expansion rather than by intensity strengthening. And this shift led to large potential cropland loss, which had increased sharply after 2000 and peaked in 2017 with a loss around 15 MHa. In terms of crop structure, non-food crops proportion has significantly increased, and all non-food crops showed an expansion trend in triple cropping system. In food crops, double-cropping rice were gradually replaced by single-cropping rice, and the proportion of maize was also increased sharply.

Poster 19

Title: Assessing strategies for reducing the carbon footprint of textile products in China under the Shared Socioeconomic Pathways framework

Authors: Si-Yu Peng*, Shanghai Jiao Tong University; Jing-Yu Liu, Shanghai Jiao Tong University; Yong Geng, Shanghai Jiao Tong University

Theme: Defining systems analysis methods and using them in the Asian context.

Abstract:
To realize China's target of carbon neutrality by 2060, the country's domestic textile industry faces tremendous pressure to reduce emissions. We assessed the potential of socioeconomic conditions and climate policies for reducing the greenhouse gas (GHG) emissions of textile products in China up to 2050 using a life cycle assessment (LCA) approach and integrated assessment model (IAM) within the Shared Socioeconomic Pathways (SSP) framework. The results showed that a combination of socioeconomic conditions and climate policies can reduce annual carbon emissions by 89.1% and reduce accumulate emissions by 34.5% by 2050. Among the strategies examined in this study, energy decarbonization and power conservation exhibited the highest potential for reducing emissions. We also demonstrated the importance of improving industry interconnectivity, developing textile recycling frameworks, and promoting sustainable consumption.

Poster 20

Title: Modeling and predicting the effects of human developments on social-ecological systems (Case study: Varjin Protected Area, Iran)

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Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
Human disturbances and habitat availability are strongly related to each other for species distribution and abundance. Based on the Sustainable Development Goal 15 of the 2030 Agenda, "devoted to sustainable use of terrestrial ecosystems and halting biodiversity loss," in this research, we propose a framework to analyze the habitat quality of the mountainous landscape by considering human disturbances. In Varjin protected area, Iran, habitat loss due to human pressures is the main factor in the rapid decline of Ovis orientalis (wild sheep) population. First, we identify the land uses and land covers (LULCs) in two different time series of 2000 and 2020 using the index-based and supervised approach. Land Use change is modeled for 2040 using the cellular automata and Markov chain (CA–Markov) model. Then, the InVEST habitat quality model will be applied to better understand complex feedback in human-ecological systems in the three mentioned time series. In other words, present and future LULCs impacts on the habitat service (habitat quality) are mapped. Finally, patches with high habitat quality change are identified for more intense conservation, and a habitat conservation ranking map is developed. Our methodology provides a habitat-based conservation approach by combining spatial-temporal analysis of LULC changes and habitat quality modeling. The results present a procedure to identify habitat patches for conservation priorities and support decision-makers in the planning development process. Considering the interactions between human development and quality of habitats, special attention should be given to selecting habitat patches for conservation and restoration measures.

Poster 21

Title: Presenting a framework for resource planning based on the ecosystem services concept

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Theme: Defining systems analysis methods and using them in the Asian context.

Abstract:
Today Asia and especially the middle east face different challenges, including population, natural resources, water shortage, climate change, and other economic and social issues. Developing a comprehensive framework helps to manage these concerns and lead to the SDG's. Based on the ecosystem services concept, we presented a framework to identify the resources and their interactions. The population dynamics, water resource condition, climate change, and land use in a semi-arid area are applied to define this framework. The Sirvan basin located on the west border of Iran in two Kurdistan and Kermanshah provinces with 13,407 square kilometers, is selected as a case study. First, the population dynamics are detected. Then, land use changes are identified and predicted for the future, spatially. Climate parameters changes are identified in the past and predicted for the future, based on IPCC scenarios. Finally, the framework is equipped for decision-making by ecosystem services planning such as water yield, carbon storage and sequestration. The results show that the population has grown by 59 percent from 1989 to 2020 and will grow by 25 percent by 2040, according to the most likely forecast scenario. The critical issue is the ratio of urban to the rural population, which was about 30 to 70 in 1989 and 70 to 30 in 2020. Climate change in the last three decades has caused a significant decrease in precipitation and increase in temperature. This trend will continue in the future, temperature will increase by 2.25 degrees and precipitation will decrease 10% by 2040. Accordingly, water yield will be reduced, and water scarcity would be increased, especially in residential areas. Based on the population growth, land-use dynamics, climate changes, and their interactions, we proposed strategies to land developments such as cities, industries, infrastructures and dams in line with adaptions, resilience, and sustainable development goals.

Poster 22

Title: Time series analysis of the co-evolution of humans and water from socio-hydrologic perspectives: a case study of the Tashk-Bakhtegan basin, Iran

Authors: Behzad Rahnama*, Tarbiat Modares University; Nasiri Saleh, F, Faculty of Civil and Environmental Engineering; Tarbiat Modares University, Tehran, Iran; Koosheshi, M, Department of Demography, Faculty of Social Sciences, University of Tehran, Tehran, Iran; Nasseri, M, School of Civil Engineering, College of Engineering, University of Tehran, Iran

Theme: Systems analysis in Asia to achieve the SDGs.

Abstract:
Drought and the destruction of wetlands and rivers in Iran indicate the poor state of the water resources and water crisis, one of the main obstacles to achieving sustainable development. In Tashk and Bakhtegan lakes, excessive agricultural development as the most critical anthropogenic activity has increased pressure on the watershed system due to livelihood issues. The trend coincidence with the droughts of the 2000s dried out the lakes and decreased the inflow. Indeed, development plans have been balanced regardless of regional capacity.
Socio-hydrology seeks to change conventional modeling approaches by observing, understanding, and predicting future pathways of co-evolution of human-water coupled systems. Before developing the socio-hydrological model of the catchment area, understanding the water-human system's state can lead to considering the model's influential factors.
The purpose of this paper is to investigate the status of the Tashk-Bakhtegan semi-arid basin from a socio-hydrological perspective using a time series analysis of available data. For this purpose, the socio-hydrological system of the basin is classified into four subsystems: meteorology and hydrology, population, agricultural economics, and ecology. The data analysis period is from 1996 to 2016. Due to the government's supportive policies for wheat production, competition has been held between farmers in different parts of the basin to produce more crops.
Our results show that Land-use change and increased cultivated areas after the drought of 2008 have not had the same trend in all areas. This issue is highlighted when the behavior of different areas is evaluated along with the lakes' MNDWI index. In general, the data analysis shows no dominant approach to environmental challenges in different areas of the basin. In some parts of the basin, the short-term interests of individuals are preferred to the long-term benefits of society.