BOOK OF ABSTRACTS

1. SESSION DESCRIPTION

ID: T5

Title of session:

Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Hosts:

	Title	Name	Organisation	E-mail
Host:	Academic Programme Officer	Osamu Saito	United Nations University Institute for the Advanced Study of Sustainability	saito@unu.edu
Host:		Kazuhiko Takeuchi	The University of Tokyo	takeuchi@ir3s.u-tokyo.ac.jp
Co-host:		Shizuka Hashimoto	The University of Tokyo	ahash@mail.ecc.u-tokyo.ac.jp

Session description:

What does the future hold for the world's natural capital and ecosystem services? While the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) has identified the development of scenarios as a key to helping decision makers identify potential impacts of different policy options, it currently lacks accumulation of scenario-approach

studies. As IPBES has been emphasizing the importance of indigenous and local knowledge (ILK) and the social-ecological dynamics of biodiversity and ecosystem services, it is essential to engage with the great diversity of local contexts through participatory process. This session will offer an opportunity to present and share the updated science-policy issues on biodiversity and ecosystem services (BES) scenarios and modelling, the case studies at local to regional scales, capacity building efforts for BES scenarios and modelling, and policy support examples by using BES scenarios and modelling. This session will contribute to mobilizing and activating researchers and policy makers to strengthen network and partnership of BES scenarios and models beyond local and national scales.

Goals and objectives of the session:

This session will offer an opportunity to present and share the updated science-policy issues on biodiversity and ecosystem services (BES) scenarios and modelling, the case studies at local to regional scales, capacity building efforts for BES scenarios and modelling, and policy support examples by using BES scenarios and modelling. This session aims at mobilizing and activating researchers and practitioners to strengthen network and partnership of BES scenarios and models beyond local and national scales.

Planned output / Deliverables:

Selected presentations from this session will be invited to full paper submission for the special feature of *Sustainability Science* journal (http://www.springer.com/environment/environmental+management/journal/11625/PSE?detailsPage=press) and eBook series “Science for Sustainable Societies” (http://www.springer.com/series/11884) published

by Springer Nature.

Related to ESP Working Group or National Network:

TWG 5 – Modeling ES

2. SESSION PROGRAM

Date of session: 14 December 2017
Time of session: Part 1: 10:30 – 12:30; Part 2: 14:00 – 17:00

Timetable speakers

1st part				
Time	**First name**	**Name**	**Organization**	**Title of presentation**
10:30	Osamu	Saito	United Nations University	Overview and Progress of "Predicting and Assessing Natural Capital and Ecosystem Services"(PANCES) Project

1st part				
Time	First name	Name	Organization	Title of presentation
10:40	Shizuka	Hashimoto	University of Tokyo	Exploring alternative futures for the social-ecological production landscapes of Noto: implications of land use change on the provision of ecosystem services
11:00	Chihiro	Haga	Osaka University	A Development of Future Scenario Simulation System of Natural Capital and Ecosystem Services on LANDIS-II —Linking Qualitative Scenarios and Landscape Change Model in Japan

1st part				
Time	**First name**	**Name**	**Organization**	**Title of presentation**
11:20	Michio	Oguro	Forest and Forest Products Research Institute	Modelling provisioning services and their relationship with socio-ecological factors in Japan.
11:40	Rei	Shibata	Research Institute for Humanity and Nature	Modelling and Mapping Recreation Services Using Multi-Scale Natural and Social Metrics in Japan
12:00	Ronald	C. Estoque	National Institute for Environmental Studies, Japan	Future changes in Southeast Asia's forest cover and its ecosystem service value under the shared socioeconomic pathways (SSPs)

2st part				
Time	**First name**	**Name**	**Organization**	**Title of presentation**
14:00	Rajarshi	Dasgupta	University of Tokyo	Scenario-based land change analysis of the lower Gangetic Delta: An exploratory investigation into alternative regional futures
14:20	Xinli	Ke	Department of Land Resources Management, Huazhong Agricultural Unviersity	Inner-Provincially or Inter-Provincially? An ex-ante assessment of impacts of China's Arable Land Requisition-Compensation Balance Policy on trade-offs between ecosystem services and economic benefits
14:40	Ilkwon	Kim	National Institute of Ecology	Estimation of urban land use changes and their impacts on ecosystem services as a consequences of urban green space policies
15:00	Anna	Duden	Utrecht University	Impact of wood pellet demand on biodiversity in the southeastern US

2st part				
Time	**First name**	**Name**	**Organization**	**Title of presentation**
15:20	Francesco	Accatino	INRA	Addressing the conflict between food production and other ecosystem services: scenarios on multiples spatial levels
15:40	Yuchen	Zhang	National University of Singapore	Meeting global agricultural demand in 2050: what will we sacrifice?
16:00	Discussion			

3. ABSTRACTS

Part 1

Type of submission: *Abstract*

T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Future changes in Southeast Asia's forest cover and its ecosystem service value under the shared socioeconomic pathways (SSPs)

Author(s): Ronald C. Estoque
Affiliation(s): National Institute for Environmental Studies, Japan
Other author(s): Makoto Ooba, Takuya Togawa, Shogo Nakamura, Yasuaki Hijioka
Country: Japan
Contact: rons2k@yahoo.co.uk

Forests are important sources of ecosystem services that contribute to human well-being. However, forest ecosystems are vulnerable to climate change. Various socioeconomic factors, such as rapid population growth, urbanization and land conversions, also create an immense pressure to the

world's remaining forest cover. Over the past years, various climate change scenarios have been developed. These are also continuously being evaluated for their potential impact to the society and the environment and so that mitigation and adaptation measures can be formulated. There has also been a growing interest in the academic and scientific community on socioeconomic scenarios, including the recently developed and published five shared socioeconomic pathways (SSPs). In the effort to integrate these SSPs with the climate change scenarios, scientists have recently produced sets of environmental and socioeconomic data, including the potential future extent of forest cover under each SSP (https://tntcat.iiasa.ac.at). However, the decadal projected quantities of forest cover up to the year 2100, along with other land cover types, are available only at the regional and global levels. Since mitigation and adaptation are best done at the local level, it is necessary to downscale the projected land cover changes, e.g. forest gains and losses, so that they can be allocated spatially and locally. This study attempts to downscale the projected forest cover changes by 2050 under the SPPs, i.e. without radiative forcing, to the national and provincial levels in Southeast Asia. The results include maps and tables of projected losses and gains in forest cover and forest ecosystem service value per country and province in

Southeast Asia by 2050.

Keywords: forest, ecosystem services, SSPs, climate change, vulnerability

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Type of submission: *Abstract*

T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

A development of future scenario simulation system of natural capital and ecosystem services on LANDIS-II — linking qualitative scenarios and landscape change model in Japan

Author(s): Chihiro Haga

Affiliation(s): Osaka University

Other author(s): Takahiro Inoue, Wataru Hotta, Rei Shibata, Shizuka Hashimoto, Hiroko Kurokawa, Takashi Machimura, Takanori MATSUI, Junko Morimoto, Hideaki Shibata

Country: Japan

Contact: chihiro.haga@ge.see.eng.osaka-u.ac.jp

Quantitative future scenario analysis of Biodiversity and Ecosystem Services (BES) plays the key role in facilitating decision making for sustainable management of landscapes. In Japan, climate change and underuse of natural resources are the critical driving forces of forest

degradation. Therefore, to simulate plausible future scenarios under the Japanese societal context by using terrestrial ecosystem models, we need to represent both 1) vegetation response to climate change and 2) impacts on vegetation dynamics caused by management and abandonment.

In this study, we developed a scenario simulation system based on LANDIS-II model (a Landscape Change Model). This system can model landscape change process considering with Land-Use and Land-Cover (LULC) change and management of forest and grassland and evaluate BES. We selected Bekanbeushi watershed in Hokkaido prefecture as a representative region where is vulnerable to climate change and underuse. First, we created future scenarios of 2050. The scenarios consisted of climate change scenarios based on RCP2.6 and 8.5 from CMIP5, and management scenarios of timber and pasture production. Regarding climate scenarios, we input monthly climate data in 1 km resolution from statistically downscaled MIROC5 and MRI-CGCM3. Moreover, in association with management scenarios, we translated the qualitative scenarios to quantitative dataframes, and linking them to the input interface of LANDIS-II. We localized LANDIS-II v6.2, NECN

succession v4.2, and Biomass Harvest v3.2, and simulated forest succession at 100 m resolution. Finally, we evaluated the expected yields of timber and pasture, carbon stock in the forest and grassland, species composition, and LULC change.

The results imply that our simulation system can visualize the plausible future of natural capital in regional scale and quantify the available ecosystem services under different scenarios. This system expected to contribute to decision making and sustainability design for regional scale.

Keywords: climate change, underuse, forest and grassland management, decision support

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Type of submission: *Abstract*

T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Exploring alternative futures for the social-ecological production landscapes of Noto: implications of land use change on the provision of ecosystem services

Author(s): Shizuka Hashimoto
Affiliation(s): University of Tokyo
Other author(s): Rajarshi DasGupta, Kei Kabaya, Takanori Matsui, Chihiro Haga, Osamu Saito, Kazuhiko Takeuchi
Country: Japan
Contact: ahash@mail.ecc.u-tokyo.ac.jp

This study explored the plausible alternative future of land use and ecosystem services of Noto, Japan. The study area has been designated as one of Globally Important Agricultural Heritage Sites by FAO, due to its rich ecosystem services, cultural and natural assets, that have long been maintained through various human activities,

such as agriculture and fisheries. However, since the 1950, when the population of this area peaked to 350 thousand, there has been a sharp declining trend, which is estimated to a mere 79 thousand by 2060. Thus, to understand the plausible impacts, the study employed scenario analysis to examine how the present ecosystem services would change under the alternative socioeconomic development pathways, including a business-as-usual or baseline scenario. Future land use of the year 2050 was projected with Land Change Modeler, TerrSet 18.3, using historical land use maps of 1997 and 2006, with the spatial resolution of 100-meter x 100-meter. InVEST 3.2.0 was used to estimate spatial variations of ecosystem services for the projected land use images, which included (1) water yield, (2) nutrient retention, (3) sediment retention, and (4) carbon sequestration. Our analysis suggested that in the most of the municipalities, farmland (paddy field and upland field) and wasteland will decrease, while forest cover will increase in exchange. Residential land, as a whole, will increase slightly even under the declining trend of the population but has substantial variations across municipalities. Regarding ecosystem services, our analysis suggested that the reduction of farmland will cause the

decrease in sediment retention in most of the municipalities, while carbon sequestration will increase due to the increase in the forest area. Nutrient retention will increase in municipalities where the upland field will increase. Water yield will increase slightly, affected by various land use changes.

Keywords: exploratory scenario, scenario analysis, ecosystem services, land change simulation, spatial analysis

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Type of submission: *Invited speaker abstract*

T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Modelling provisioning services and their relationship with socio-ecological factors in Japan

Author(s): Michio Oguro

Affiliation(s): Forest and Forest Products Research Institute

Other author(s): Hisatomo Taki, Takuya Furukawa, Hiroko Kurokawa, Takashi Masaki

Country: Japan

Contact: mog@ffpri.affrc.go.jp

Terrestrial ecosystems such as forests and agricultural lands provide several provisioning services. Agricultural ecosystems cover ca. 40% of terrestrial lands globally and produce food resources for human societies. The production of crops depends on several socio-ecological factors. For example, climate conditions including temperature and rainfall can affect crop production. Also,

social factors such as demographic composition can affect crop production via demand for crops and provision of labor force. Moreover, production of crops depends on other ecosystem services such as pollination and pest regulation services provided by surrounding landscapes including forests. To achieve sustainable production of crops and predict future production in the changing world, modeling and understanding relationship between these factors and production of crops is essential.

In this study, we compiled a database of production of major crop species in Japan using publicly available data provided by the Japanese government. We also collected climatic, demographic and vegetation data which may explain crop production. By applying a machine learning method, we modeled relationship between the crop production and the explanatory factors for each crop species. In the presentation, we will present relative importance of the factors and their relationship with crop production for each species and will discuss difference in patterns in the results among the crop species. Future studies need to include other provisioning services such as production of timber and non-timber forest products to obtain integrated understanding of terrestrial provisioning

services.

Keywords: provisioning services, agriculture, crop production, landscape, machine learning

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Type of submission: *Abstract*

T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Overview and progress of "Predicting and Assessing Natural Capital and Ecosystem Services"(PANCES) Project

Author(s): Osamu Saito, Shizuka Hashimoto
Affiliation(s): United Nations University, The University of Tokyo
Other author(s): Kikuko Shoyama, Kazuhiko Takeuchi
Country: Japan
Contact: saito@unu.edu

While the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) has identified the development of scenarios as a key to helping decision makers identify potential impacts of different policy options, it currently lacks accumulation of scenario-approach studies in Asia. The new five-year research project has launched to predict and assess natural capital and ecosystem services in Japan through integrated social-ecological systems approach

with participation of 15 research institutions and over 100 researchers. This PANCES project consists of four thematic components: 1) Building an integrated model of social-ecological systems and strengthening science-policy interface, 2) Prediction and assessment of the natural values from terrestrial natural capital and ecosystem services, 3) Prediction and assessment of the natural values from marine natural capital and ecosystem services, and 4) Multi-level natural capital governance through prediction and assessment of socioeconomic values from natural capital and ecosystem services. The project develops future scenarios at both national and local scales to explore potential changes in natural capital, ecosystem services and human well-beings up to 2050 under key direct and indirect drivers including climate changes, depopulation and super aging, globalization and techonological innovation. Delphi method was applied to generate key drivers which may determine different future pathways. Population sub-model and landuse sub-model were developed to translate multiple and qualitative scenario storylines into qunatitiative simulation. Terrestrial and marine ecosystem service assessment and prediction are now going on under different future scenarios. Local and

traditional knowledge associated with provision and management of natural capital and ecosystem services have been considered when developing local scenarios through participatory approach. This project provides useful scientific evidences and insights for effective policy support which eventually leads building a sustainable society in harmony with nature.

Keywords: scenarios, social-ecological systems, natural capital, multi-level governance, valuation

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Type of submission: *Invited speaker abstract*

T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Modelling and mapping recreation services using multi-scale natural and social metrics in Japan

Author(s): Rei Shibata
Affiliation(s): Research Institute for Humanity and Nature (RIHN)
Other author(s): Masahiro Aiba, Michio Oguro, Tohru Nakashizuka
Country: Japan
Contact: rei@chikyu.ac.jp

Outdoor recreation is among the most studied cultural ecosystem services, because of its direct contribution to human well-being. In this study, we estimated the outdoor recreation values from the distribution of campgrounds across Japan to address the following unsolved questions: (i) Do quality and quantity of natural conditions contribute to the existence of campgrounds? (ii) Which spatial scale of natural and social conditions affects the location of campgrounds? (iii) Does the most important spatial scale

differ between the natural and social conditions?

We applied a machine-learning method to natural and social metrics at multiple spatial scales across Japan to assess outdoor recreation values. We used existence probability of a campground in 10 km grid as an indicator of outdoor recreation services. Natural and social metrics, which include climate, vegetation cover, water body, topography, road density and population density, are summarized in scales of 10 km to 410 km grid.

Preliminary results revealed that quantity of local natural environment (e.g., percent forest cover at 10km grid) have a positive effect on the existence of campgrounds, while quality (e.g., natural forest ratio) have only a limited effect. We showed that natural metrics were effective as an explanatory variable at local scale (e.g., lake coast density at 10 km grid) while social metrics were so at the larger spatial scale (e.g., population density at 210–410 km grid). We successfully depicted the areas with high outdoor recreation values, where have high values of percent forest cover, lake coast density, percent natural park cover, and mean altitude at 10 km grids. However, the areas with low population density at the large special scale realized

relatively low outdoor recreation values even if the areas have adequate natural environment, reflecting lower demand.

Keywords: cultural ecosystem services, outdoor recreation, camping, machine-learning, GIS

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Part 2

Type of submission: *Abstract*

T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Addressing the conflict between food production and other ecosystem services: scenarios on multiples spatial levels

Author(s): Francesco Accatino
Affiliation(s): INRA
Other author(s): Muriel Tichit
Country: France
Contact: francesco.accatino@inra.fr

Increasing food production while maintaining the same level of ecosystem services is a great challenge of this century, given the higher request of proteins from an increasing population and the need for a sustainable use of resources. Such a challenge could be addressed at different spatial levels, i.e., the spatial boundaries within which food production should be increased with no-loss of other

ecosystem services can be more or less extended. In this work, we investigated how the conflict between food production and other ecosystem services can be addressed at different spatial levels. For doing this, we calibrated ecological production functions for predicting animal production, crop production, carbon sequestration, and timber growth starting from land cover and land use management variables. We then ran scenarios optimizing animal production on the French territory posing constraints of no-loss on other ecosystem services. The scenarios differed by the spatial level at which the no-loss constraints were posed: at the department level (NUTS 3, the smaller level), at the regional level (NUTS 2, medium level), and at the national level (largest level). Our findings showed, on the one hand, that constraints posed at larger spatial levels allowed higher values of animal production than constraints posed at smaller spatial levels. On the other hand, constraints posed at smaller spatial levels allowed a homogeneous distribution of ecosystem services in the territory, whereas with constraints posed at the larger level, ecosystem services were more heterogeneously distributed, leading to social inequalities. Our study implies that extending the spatial level can

indeed help solving conflicts between ecosystem services, but the price to pay is social inequality. Research is needed to find the best spatial level into which defining the conflict between ecosystem services, finding the best tradeoff between food production and social equality.

Keywords: food production, ecosystem service tradeoff, multi-level scenarios, modelling, land cover/land use

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T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Scenario-based land change analysis of the lower Gangetic Delta: an exploratory investigation into alternative regional futures

Author(s): Rajarshi Dasgupta
Affiliation(s): The University of Tokyo
Other author(s): Shizuka Hashimoto, Toshiya Okuro
Country: Japan
Contact: rajarshidg1@yahoo.co.in

In this study, we develop spatially-explicit, exploratory landscape scenarios for the lower Gangetic delta in India (aka the Indian Sundarban) – a globally renowned biodiversity hot-spot consisting the largest contiguous mangrove forest and 4.37 million people within its immediate vicinity. Historically reclaimed out of mangroves, the delta currently hosts multiple production landscapes of diverse economic and conservational

interests, including vast extent mangroves, rivers, agricultural land, aquaculture ponds, mud-flats etc. The study adhered to the 'story and simulation approach' to build three plausible alternative futures, involving dominant spatial drivers of change. This includes a 'Business as Usual' scenario with no policy interventions, and two alternative scenarios depicting 'Market forces' and 'Sustainability measures' as the theme of future development. The storylines were developed through rigorous screening of policy documents, research papers and national decrees which were translated into specific spatial features and/or attributes. Landcover simulation was conducted using Multi-layer perception-Marcov chain Analysis (MLP-MCA) model with multitude of factors, constraints and attributes for each scenario. Historical and current land use maps of 2006 and 2016, derived from Landsat series (ETM+ and OLI), were used as the fundamental input to the model which were used to locate decadal changes, calculate the future transition potentials and ultimately, to develop future land use maps (2030) under each scenario. The results indicate substantial increase in agricultural land, loss of mudflats and viz.-a-viz. increase in river/water areas and moderate expansion

of aquaculture ponds under all scenarios. On the other hand, the loss of mangrove cover is greatly halted under the 'sustainability measures', in sharp contrast to more than 10% thinning in the BAU and even more under 'Market Forces'. As such, the study remains imperative to understand, plan and prepare for desirable regional futures, conserve the vital mangrove ecosystem services and plan for inclusive development of the region.

Keywords: landscape scenarios, story and simulation approach, Multi-layer perception-Marcov chain Analysis (MLP-MCA) model, mangroves, Indian Sundarbans

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T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Impact of wood pellet demand on biodiversity in the southeastern US

Author(s): Anna Duden

Affiliation(s): Utrecht University

Other author(s): Floor van der Hilst, Pita Verweij, Nathan Tarr, Matt Rubino

Country: Netherlands

Contact: a.s.duden@uu.nl

Exports of wood pellets from the United States (US) have grown rapidly in the last few decades, and are expected to continue to increase in the future. In the southeastern US (the main pellet producing region in the US), increased demand for wood pellets may lead to changes in land use and forest management. In particular, a shift from natural forests to pine plantation is expected. This, in turn, may have an impact on biodiversity in the area. The aim of this

study is to determine the impact of increasing demand for wood pellets on biodiversity, while taking into account potential developments in markets for other wood products and developments of other land uses. To this end, projections of land use change under different scenarios of wood pellet demand were combined with a large biodiversity database. Biodiversity impacts were assessed based on total potential species richness, endangered species richness and endemic species richness for mammals, birds, reptiles and amphibians.

We find that pine plantation has a significantly lower potential species richness than natural forest types, and is comparable to cropland. Even in the absence of a growing demand for wood pellets, potential species richness is expected to decrease between 2010 and 2030, mainly due to urbanization. This trend is found for all taxonomic groups, as well as endangered and endemic species. Added wood pellet demand leads to more changes in species richness, both positive and negative, especially in the absence of a strong demand for wood from the housing market. Increased richness due to pellet demand is expected mostly in northern Alabama, while decreased richness is expected along the Gulf Coast and in South

Carolina. Areas of species richness loss partly overlap with regional hotspots of species richness, particularly for reptiles and amphibian species, many of which are endemic.

Keywords: wood pellets, biodiversity, species richness, spatial analysis, southeastern US

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T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Inner-provincially or inter-provincially? An ex-ante assessment of impacts of China's Arable Land Requisition-Compensation Balance Policy on trade-offs between ecosystem services and economic benefits

Author(s): Xinli Ke, Lanping Tang
Affiliation(s): Department of Land Resources Management, Huazhong Agricultural Unviersity
Other author(s): Liye Wang, Bangyong Xiao
Country: China
Contact: kexl@igsnrr.ac.cn

China launched its new Arable Land Requisition-Compensation Balance Policy (ALRCBP) in January 2017. Different from the old one, the new ALRCBP loosed the strict requirement of inner-provincial balance of arable land requisition-compensation. In the new ALRCBP, the

inter-provincial balance is permitted when it is hard to meet inner-provincial balance of arable land requisition-compensation. Therefore, trade-offs between ecosystem services and economic benefits exist in both the old policy and the new one. However, the trade-offs should be different in scenarios of the old policy and the new one since inter-provincial balance may bring more opportunities for improving cost-efficient of land use allocation in both economic benefits and ecosystem services than inner-provincial balance does.

In this paper, trade-offs between ecosystem services and economic benefits in both China's old ALRCBP and the new one were projected by a land use change model and an ecosystem services assessment model. Firstly, we used the LAND System Cellular Automata model for Potential Effects (LANDSCAPE) to project land use change in scenarios of both old ALRCBP and new one. Secondly, we input projected land use maps in the two scenarios into the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) model to figure out ecosystem services such as carbon storage, water yield, crop production, and et.al. in the two scenarios. Thirdly, economic models were implied to calculated economic benefits from land use in both

scenarios. Finally, we figured out trade-offs between economic benefits and ecosystem services in the both scenarios. Results show that tradeoffs between economic benefits and ecosystem services in scenarios of old policy is more serious than that in scenarios of old one.

Therefore, we can safely draw the conclusion that inter-provincial balance of arable land requisition-compensation is significantly better to reduce conflicts between economic benefits and ecosystem services from land use than that of inner-provincial one.

Keywords: land use policy, tradeoffs, ecosystem services, economic benefits

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Estimation of urban land use changes and their impacts on ecosystem services as a consequences of urban green space policies

Author(s): Ilkwon Kim, Hyuksoo Kwon
Affiliation(s): National Institute of Ecology
Country: Korea
Contact: ikkim@nie.re.kr

With growing urbanization over the world, importance of urban ecosystem services (UES) are increasingly considered in ecosystem service studies. However, rapid land use and cover changes (LUCC) with urban expansion cause loss of natural vegetation in peri-urban area, which causes degradation of UES. Because urban green spaces provide various regulation and cultural UES to human society, urban green spaces should be necessarily considered in land management plans. Enough provision of urban green

spaces can improve a quality of life of residents and contribute sustainable urban development with regard to environmental justice and UES. To support effective and environmental-friendly urban land management plans, it is needed to simulate spatio-temporal urbanization patterns and their impacts on UES based on applicable policy scenarios.

We develop integrated LUCC models based on Cellular-automat (CA) and agent-based models (ABM) to simulate object-based LUCC, which can reflect variety characteristics of land, and estimate potential impacts on UES according to scenarios on urban green space policies. We set different policy scenarios on urban green spaces such as business as usual (BAU), natural protection (S1) and green space construction near residential districts (S2) scenarios. When we apply the BAU scenario, urban green spaces are slightly increasing and improve UES, but they cannot follow urban growths. When we apply the S1 scenario to control urban expansion, UES are improved but environmental injustice are not solved because protection areas are concentrated in certain areas. As for S2 scenario, regulating UES are less improved than S1 scenario, but it can improve cultural UES and environmental justice. As a

case study of Ansan (in South Korea) with “urban forest policy”, we simulate UES based on LUCC scenarios in urban areas and estimate environmental justice of green space access, which can support sustainable environmental plans to increase qualify of life of urban residents.

Keywords: land use change model, environmental justice, urban ecosystem services, Agent-based model (ABM), scenario assessment

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T. Thematic Working Group sessions: T5 Future Scenarios and Modelling of Natural Capital and Ecosystem Services

Meeting global agricultural demand in 2050: what will we sacrifice?

Author(s): Yuchen Zhang
Affiliation(s): National University of Singapore
Other author(s): L. Roman Carrasco, Melissa Pang
Country: Singapore
Contact: zhangyuchen@u.nus.edu

In the near future, agricultural production will expand in order to meet the demand of a steadily increasing global population that might exceed 9 billion by 2050. Expanding the area of agricultural cropland is expected, but little is known about how it will unfold. We model the pattern of global agricultural expansion of 17 important crops from 2015 to 2050 based on a new contagion von Thünen model. We estimate that more than 295 million hectares of new agricultural cropland will be added by 2050. Around 70% of these

conversion is expected to occur at the expense of existing forests. We find that many of the crops that will have the largest increase in area of cropland are sub-tropical/tropical crops such as sugarcane and oil palm. Consequently, tropical forests are at the greatest risk of agricultural conversion. The threat is particularly great for the Southeast Asian region encompassing Indonesia and Malaysia, and the Middle Africa region including Nigeria, Central African Republic, and Congo. In addition, forests in China are projected to be under high pressure of cropland expansion. We also find that model-projected future agricultural cropland has substantial overlaps with existing biodiversity hotspots and key biodiversity areas, especially in the tropical belt. Our results help project the spatial distribution of losses of ecosystem services and carbon emissions globally. This deserves attention from conservation scientists due to the high ecological value associated with.

Keywords: agricultural expansion, food security, biodiversity and ecosystem services impacts, deforestation