Appendix A: LandSHIFT Model description

We use the dynamic and spatially explicit land-use and land-cover change model LandSHIFT (Schaldach et al. 2011) to quantify potential changes in land-use and land-cover for the developed socio-economic scenarios. The model has successfully been applied in different impact assessments (e.g. Alcamo et al. 2011; Schaldach et al. 2012; Heubes et al. 2013) but was explicitly adjusted to the South-East-Asian study region to operate at a spatial grid cell resolution of 1km2. LandSHIFT provides maps in 5 year time steps from the year 2005 to the year 2050. It consists of three sub-models, crop, urban and livestock. Each sub-model uses weighted multi-criteria analysis at the grid cell level which considers biophysical, geographical and socio-economic conditions. The most suitable cells calculated in the multi-criteria analysis are primarily used if land demands of a sector increase. The multi-criteria analysis of the crop sub-model merges spatial information on crop yields, proximity to existing agricultural land, population density, distance to nearest road and terrain slope; the urban sub-model merges information on population density, distance to nearest road and terrain slope; the livestock sub-model merges information on terrain slope, river network density, grassland net primary production, proximity to cropland and population density. We calculate terrain slope from Shuttle Radar Topography Mission elevation data (Jarvis et al. 2008), utilize population density data from the Global Rural Urban Mapping Project (GRUMPv1; CIESIN, 2011), and road maps from the Global Roads Open Access Data Set (gROADSv1, CIESIN, 2013) to calculate the distances of each cell to the nearest road. Crop and pasture yields are simulated with the LPJmL model (Bondeau et al. 2007).

For the base map initialization, we used FAO crop area and pasture area statistics at the country level (FAO 2014) and the Global Land Cover 2000 dataset (GLC2000; Bartholome and Belward 2005) to differentiate between land-cover classes at the grid-cell level. For initialization, LandSHIFT allocates all areas from the FAO statistics primarily to cells classified as cropland in GLC2000. Land-use and land-cover change in the scenarios is driven by the quantified future crop and livestock demands as well as by the assumed population growth in the scenario. These demands are spatially allocated according to the cell`s suitability ranking in the multi criteria analysis. We refer to Schaldach et al. (2011) for a more detailed model description.

**References**

Carlsen, H., K.H. Dreborg, and P. Wikman-Svahn. (2013) “Tailor-made scenario planning for local adaptation to climate change”. *Mitigation and Adaptation Strategies for Global Change*, 18(8), 1239–1255. DOI: 10.1007/s11027-012-9419-x

Alcamo, J.; Schaldach, R.; Koch, J.; Kölking, C.; Lapola, D.; Priess, J. (2011) Evaluation of an integrated land use change model including a scenario analysis of land use change for continental Africa. *Environmental Modelling and Software* 26, 1017-1027

Bartholomé E and Belward AS (2005) GLC2000: A new approach to global land cover mapping from Earth observation data. *International Journal of Remote Sensing* (26), 9: 1959-1977

Bondeau A, Smith P, Zaehle S, Schaphoff S, Lucht W, Cramer W, Gerten D, Lotze-Campen H, Müller C, Reichstein M, Smith B (2007). Modelling the role of agriculture for the 20th century global terrestrial carbon balance. *Global Change Biology* 13:679–706

CIESIN (2011) Center for International Earth Science Information Network, Columbia University; International Food Policy Research Institute (IFPRI); the World Bank; and Centro Internacional de Agricultura Tropical (CIAT); Global Rural-Urban Mapping Project, Version 1 (GRUMPv1): Population Density Grid. Palisades, NY: Socioeconomic Data and Applications Center (SEDAC), Columbia University. Available at <http://sedac.ciesin.columbia.edu/data/dataset/grump-v1-population-density>

CIESIN (2013) Center for International Earth Science Information Network, Columbia University, and Information Technology Outreach Services (ITOS)/University of Georgia; Global Roads Open Access Data Set, Version 1 (gROADSv1). Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). Downloaded from <http://sedac.ciesin.columbia.edu/data/set/groads-global-roads-open-access-v1>

FAO (2014) Food and Agricultural Organization -Statistic Division. [http://faostat.fao.org/site/291/default.aspx Assessed 01.04. 2014](http://faostat.fao.org/site/291/default.aspx%20Assessed%2001.04.%202014)

Heubes, J.; Schmid, M., Stuch, B., Garcia Marquez, J.R., Witig, R., Zizka, G., Thiombiano, A., Sinsin, B., Schaldach, R., Hahn, K. (2013) “The projected impact of climate and land use change on plant diversity: An example from West Africa”. *Journal of Arid Environments* 96, 48-54.

Jarvis A, Reuter HI, Nelson A, Guevara E (2008) Hole-filled SRTM for the globe Version 4, available from the CGIAR-CSI SRTM 90m Database

Schaldach, R.; Alcamo, J.; Koch J.; Kölking, C.; Lapola, D.; Schüngel J.; Priess, J. (2011) “An integrated approach to modelling land-use change on continental and global scales” *Environmental Modelling and Software* 26, 1041-1051

Schaldach, R.; Koch, J.; aus der Beek, T.; Kynast, E.; Flörke, M. (2012) “Current and future irrigation water requirements in pan-Europe: A comparative analysis of influencing factors” *Global and Planetary Change* 94-95, 33-45

Appendix B

Table B.1 Lists key issues, which were identified by country participants in a regional workshop where policies were reviewed using the regional scenarios. Cells where issues fell within the scope of the three elements of the original set of Southeast Asian regional scenarios (primary factor/factor-states, complete factor sets, and 3 models used to quantify the scenarios).

Table B.1 Comparing the scope of regional scenarios and Southeast Asian policies

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Combined policy priorities | All Scenario Outputs | PrimaryFactors of Change | Full set of scenario factors | Combined Model Coverage | GLBOIOM | IMPACT | LANDSHIFT |
| Food Security | X |  | X | X | X | X |  |
| Farmer Livelihoods | X | X | X |  |  |  |  |
| Poverty levels | X |  | X | X | X | X |  |
| Poverty alleviation measures | X |  | X |  |  |  |  |
| Labor | X |  | X |  |  |  |  |
| Rural Development | X | X | X |  |  |  |  |
| Migration | X |  | X |  |  |  |  |
| Population | X |  | X | X | X | X | X |
| Health | X |  | X | X |  | X |  |
| Equity | X | X | X |  |  |  |  |
| Economic growth | X | X | X | X | X | X | X |
| Service industry productivity | X |  | X |  |  |  |  |
| Economic policy | X | X | X |  |  |  |  |
| Economic zoning | X | X | X |  |  |  |  |
| Eco-tourism |  |  |  |  |  |  |  |
| Infrastructure | X |  | X |  |  |  |  |
| Increased Crop yield/productivity | X | X | X | X | X | X | X |
| Irrigation infrastructure | X |  | X | X | X | X |  |
| Water resources for irrigation | X |  | X | X | X | X |  |
| Levels of adoption of Climate Smart Agriculture | X |  | X | X | X | X |  |
| Extension services | X |  | X | X | X | X |  |
| Capacities of farm input providers | X |  | X |  |  |  |  |
| Types of agro-ecosystems | X |  | X | X | X |  | X |
| Export-driven production | X | X | X | X | X | X |  |
| Eco-friendly/green production | X | X | X |  |  |  |  |
| GHG emissions from agriculture | X |  |  | X | X |  |  |
| Use of high-value crops | X | X | X | X | X | X |  |
| Crop quality (quality standards) |  |  |  |  |  |  |  |
| Funding/investment (public/private) | X | X | X | X | X | X |  |
| Levels of sustainable finance (public/private) | X |  | X |  |  |  |  |
| Productivity of natural resources | X |  | X | X | X | X | X |
| Conservation/protected areas | X | X | X | X | X |  | X |
| Protection of local genetic diversity |  |  |  |  |  |  |  |
| Pollution | X | X | X | X | X |  | X |
| Levels of restoration of degraded landscape and forest | X | X | X |  |  |  |  |
| Deforestation and forest degradation | X | X | X | X | X |  | X |
| Reforestation levels | X | X | X |  |  |  |  |
| Overhunting |  |  |  |  |  |  |  |
| Overfishing |  |  |  |  |  |  |  |
| Illegal logging |  |  |  |  |  |  |  |
| Over-exploitation of NTFPs and firewood |  |  |  |  |  |  |  |
| Water pollution |  |  |  |  |  |  |  |
| Wetland degradation | X |  | X |  |  |  |  |
| Blocking waterways (hydropower) | X | X | X |  |  |  |  |
| Biodiversity | X |  | X | X | X |  | X |
| Land Management and Use | X | X | X | X | X | X | X |
| Land use planning | X | X | X | X | X | X | X |
| Land conversion | X | X | X | X | X | X | X |
| Bioenergy | X |  |  | X | X | X |  |
| Land concessions |  |  |  |  |  |  |  |
| Land tenure (communal lands) |  |  |  |  |  |  |  |
| Availability of cropland | X |  | X | X | X | X | X |
| Mining |  |  |  |  |  |  |  |
| Processing of mining products |  |  |  |  |  |  |  |
| Hydropower |  |  |  |  |  |  |  |
| Market access | X | X | X |  |  |  |  |
| Access to services | X |  | X |  |  |  |  |
| Markets and prices | X | X | X | X | X | X |  |
| Trade | X | X | X | X | X | X |  |
| Competitiveness | X | X | X |  |  |  |  |
| Marketing | X |  | X |  |  |  |  |
| Economic diversification |  |  |  |  |  |  |  |
| Exports | X | X | X | X | X | X |  |
| Inter- ministerial communication/ collaboration | X | X | X |  |  |  |  |
| Levels of coordination between sectors | X | X | X |  |  |  |  |
| Normative and regulative frameworks for mitigation |  |  |  |  |  |  |  |
| Land and water regulations related to food | X |  | X | X | X | X | X |
| Issues covered | 52 | 27 | 50 | 29 | 28 | 23 | 14 |
| Percent covered | 78% | 40% | 75% | 43% | 42% | 34% | 21% |