Spatial Modeling and Scenario Analysis to Simulate Forest Cover in Cambodia

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Abstract: Tropical countries like Cambodia require information about forest cover and biomass for successful implementation of climate change mitigation policies related to Reducing Emissions from Deforestation and forest Degradation (REDD+) as well as successful implementation of various goals of Sustainable Development Goals (SDGs), which lies in accurate monitoring of what is happening and where, which can be looked at by using Geospatial Techniques. Modeling and scenarios and modeling of forest resources play an important role in implementation of IPBES and science-decision making based on evidences. In this study, we aim to examine the deforestation process in Cambodia and develop a spatial model to simulate future forest patterns under various scenarios. Spatial modeling tools have been used to model present scenario and future scenario considering Business as Usual (BAU). The model generated landscape spatial patterns mirrored the possible locations and extent of deforested areas by 2040 and provided time-series crucial information on forest landscape under BAU scenarios for future landscape management projects. The results suggested that the current deforestation process is in a critical stage where some sub-regions may face unprecedented stress on forest. This study utilizes Phased Array-type L-band Synthetic Aperture Radar fine beam dual (PALSAR FBD) temporal data for Above Ground Biomass estimation in Cambodia for 2009 and 2015. Further monitoring and future projection of variation in forest cover and biomass in various scenarios such as concession land, community forestry and conservation in Cambodia will be done while considering different forest policy frameworks.

INTRODUCTION

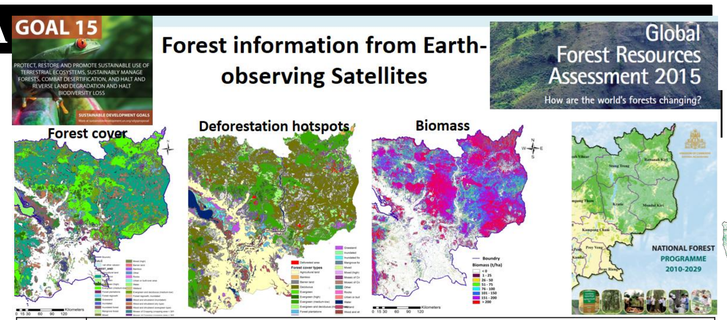
Forest cover change is an important factor in global environmental change because of rapid deforestation in tropical areas. Deforestation activities are driven by both anthropogenic activities and natural phenomena that adversely impacts biodiversity and ecosystem services. In 2008, United Nations Reducing Emissions from Deforestation and forest Degradation (REDD+) programme were launched to curb deforestation and forest degradation in tropical countries. Recent COP-21 Paris agreement highlighted “encouragement for Parties to implement existing frameworks for REDD+ mechanism”. For effective implementation of REDD+ mechanism, a robust cost effective Measurement, Reporting and Verification (MRV) system should be developed.

Geospatial data has been a key for the implementation of REDD+ MRV system. Launch of L-band Synthetic Aperture Radar (SAR) sensor by Japan Aerospace Exploration Agency (JAXA) has opened a wide opportunities in forestry sector to accurately monitor various biophysical parameters of tropical forest such as forest cover, deforestation, forest biomass etc. without limitations of clouds. This study is focused on monitoring of forest cover and forest biomass in Cambodia using PALSAR (Phased Array L-band Synthetic Aperture Radar) and Landsat data. Furthermore, spatial modeling techniques have been used to visualize and quantify the future variation in forest cover and forest biomass.

Future trends of biomass and forest cover depends on past processes of deforestation and represents a consolidation of relationships between time, space, and various driving factors. Logically developed spatial model has been used to extrapolate the likelihoods of various forest spatial patterns into the future scenario. These models are useful to offer a means to examine future change in the forest scenarios with the implementation of various policies and can be used to predict the usefulness of various policies at national to regional level. Moreover, this will allow appropriate measures to control deforestation at different time scale as well as implementation of various goals related to SDGs. Monitoring and future projection of variation in forest cover and biomass in Cambodia has been done while considering Business as Usual (BAU) scenario.

STUDY AREA: CAMBODIA

- Cambodia has one of the highest deforestation in Indo-China countries (FRA, 2015).
- Cambodia has signed REDD+ agreement in 2009 therefore study of forest cover and biomass is necessary for REDD+ policies implementation.
- Most of the Cambodian forests are on flat land where PALSAR can be applied without limitation of topography.
- Implementation of various targets under SDGs requires geospatial data for development and making evidence based policies.



Country	FOREST COVER (Source: FRA, 2015)											
	Area					Annual change rate						
	1990	2000	2005	2010	2015	1990-2000		2000-2005		2005-2010		2010-2015	
	1000 ha	1000 ha	1000 ha	1000 ha	1000 ha	1000 ha/yr	%	1000 ha/yr	%	1000 ha/yr	%	1000 ha/yr	%
Cambodia	12,944	11,546	10,731	10,094	9,457	-140	-1.1	-163	-1.4	-127	-1.2	-127	-1.3
Lao PDR	17644	16525	16869	17815	18761	-78	-0.5	-78	-0.5	-78	-0.5	189	1.0
Myanmar	39,218	34,868	32,321	31,773	29041	-435	-1.2	-309	-0.9	-310	-0.9	-546	-1.9
Thailand	14005	17011	16100	16249	16399	-55	-0.3	-21	-0.1	15	0.08	30	0.2
Viet Nam	9,363	11,727	13,077	14128	14773	236	2.3	270	2.2	144	1.08	129	0.9

RESULTS AND CONCLUSION

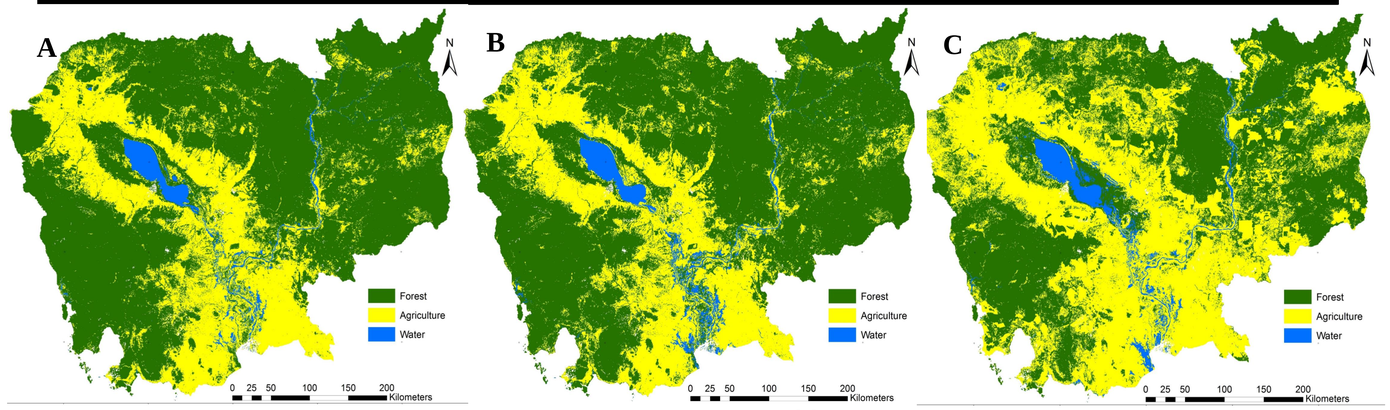


Fig. Forest cover maps (A. 1989, B. 2000, and C. 2014) and trend of forest cover change observed between 1989-2014

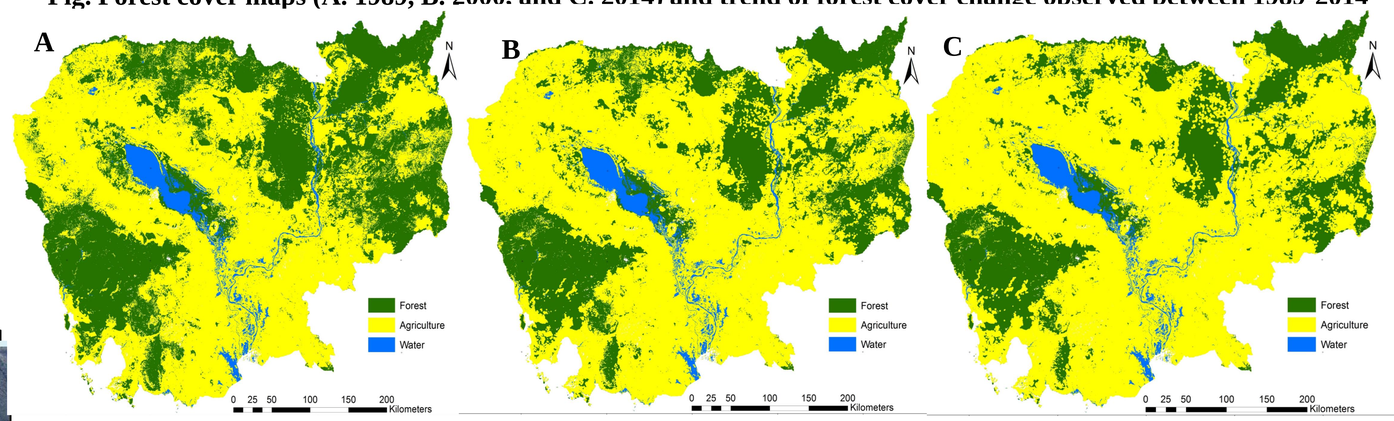
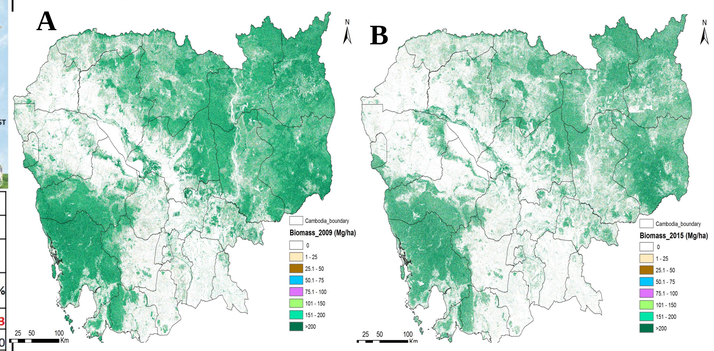


Fig. Observed and simulated landscape spatial patterns (A. 2020 B. 2030, and C. 2040) under BAU scenario



PALSAR based forest biomass (A. 2009 and B. 2015)

Geospatial techniques are robust in mapping and monitoring Earth System Dynamics. It can provide accurate and reliable scientific knowledge which can be helpful for identification of the vulnerable areas and such evidence based implications can be used by different agencies to design effective sustainable policies. This study demonstrates dynamic patterns of forest cover and biomass. Simulated forest cover under BAU can provide useful information for REDD+ implementation. It is important to understand how future deforestation process may affect forest patterns in long run while implementing different plans, policies, and strategies. Scenario analyses enable a range of potential issues and outcomes, in order to help visualize possible patterns of forest land cover change and their impacts in time and space. This information will enable better decision making process for implementation of sustainable forest management policies.