Investigating the Land Use and Land Cover Changes Influencing the Carbon Storage in Phnom Prich Wildlife Sanctuary, Mondulkiri Province

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Background and objectives

Background

Phnom Prich Wildlife Sanctuary (PPWS) is an important habitat for wildlife, it is also of great endangered social, economic and cultural importance to the local communities who live there; with people harnessing the natural resources in the forest and providing much needed income for their households. PPWS is facing severe threats from illegal logging, poaching, agricultural expansion, and infrastructure development. However, PPWS is facing severe threats from illegal logging, poaching, agricultural expansion, and infrastructure development.

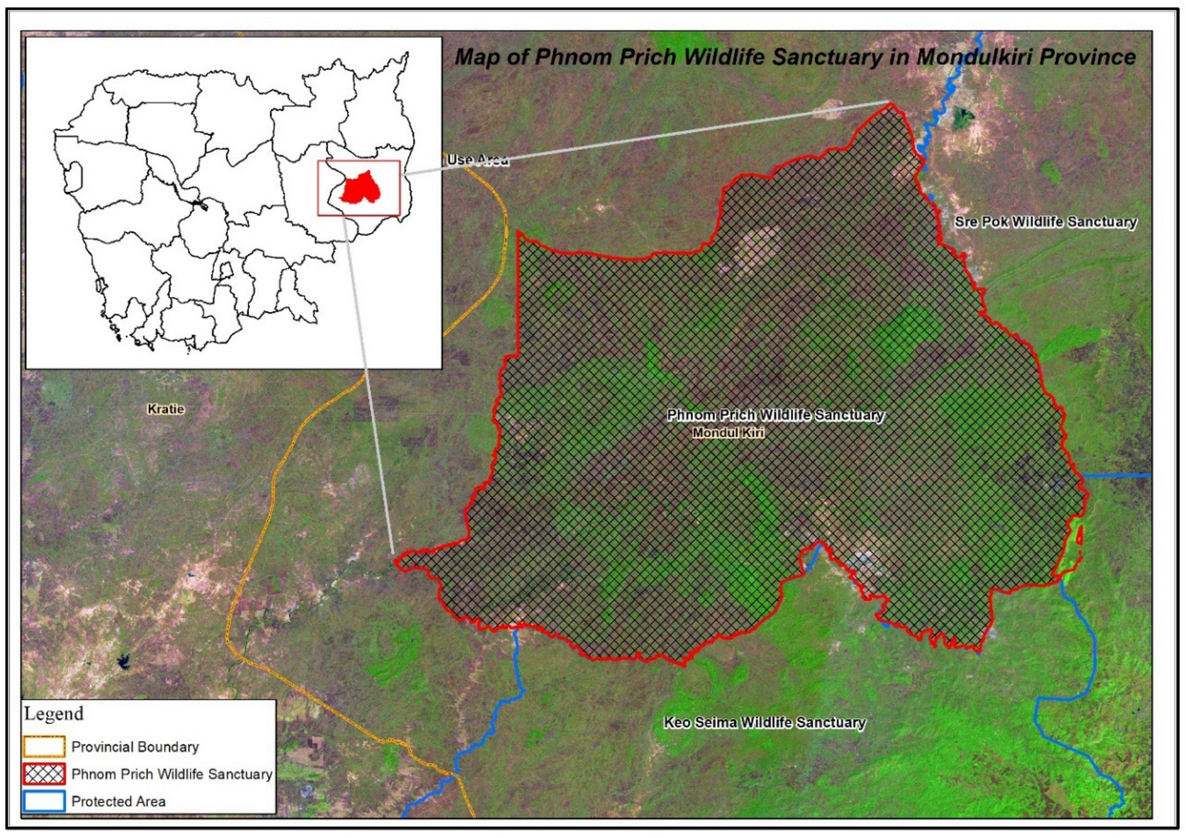

Figure 1. Map of Phnom Prich Wildlife Sanctuary

Land Use Land Cover (LULC) information and its changes are vital for reporting Green House Gas (GHG) emissions and documenting climate change. Land use land cover change (LULCC) is the term for human-induced alterations of Earth's terrestrial surface.

Land Cover and Land Use are two related but distinct concepts: land cover refers to the biophysical features of the land, while land use refers to the human activities and functions on the land. Detecting LULC changes is important for understanding the landscape dynamics and managing them sustainably. LULC changes also affect the carbon balance, especially when natural systems are converted into managed systems.

Objectives of this research

This research aims to detect the LULC based on IPCC classes in PPWS from 2016 to 2020 by using RS and GIS techniques and their effects on the carbon storages that have been change. The specific objectives of this research are:

- To produce the LULC map from 2016 to 2020
- To identify the main drivers of LULC change from 2016 to 2020
- To estimate the changes of carbon storage in PPWS from 2016 to 2020

Research Methodology

In this study, the method used to archive the objectives of the research were begun acquisition of Landsat 8 OLI/TIRS and Sentinel-2A satellite for the year from 2016 to 2020 from the GEE application. The images acquired was cloud free image and combined the whole year data.

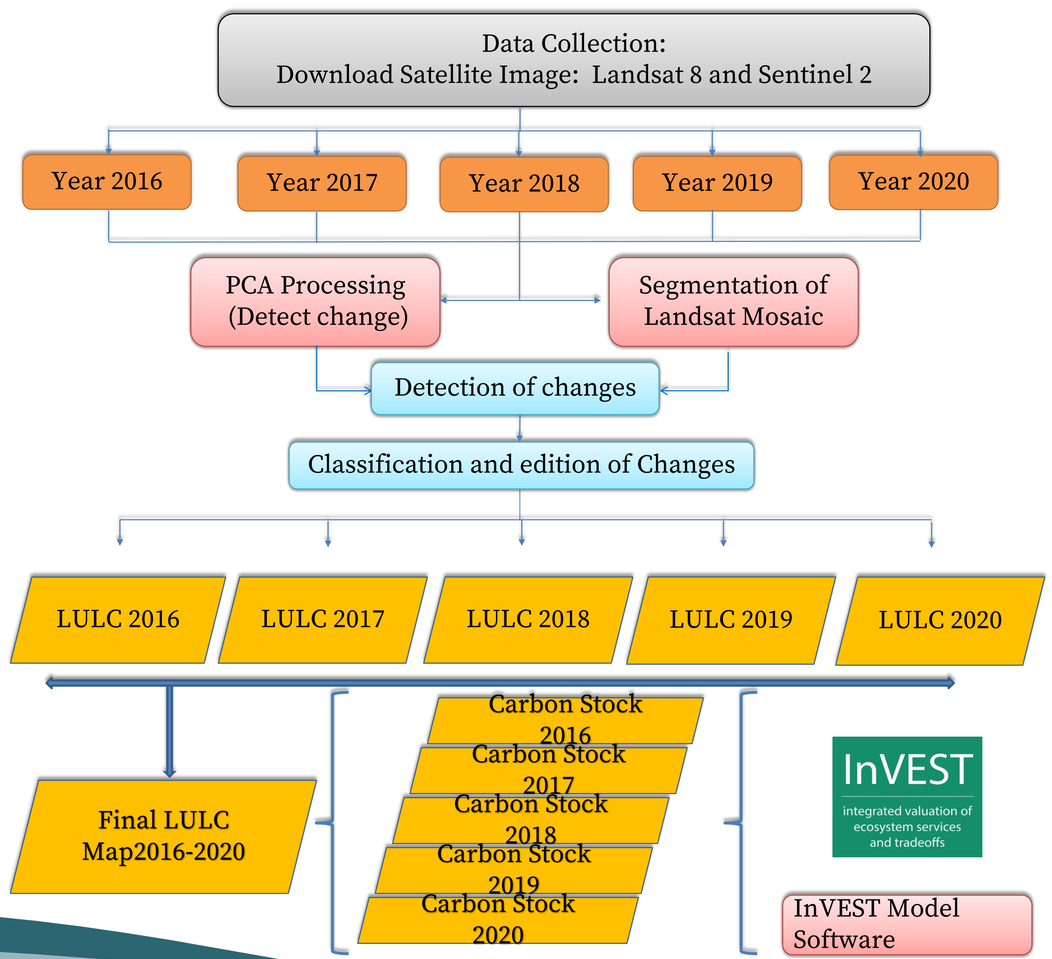

Figure 2. The methodology procedure of the study

Results

Finally result of producing the LULC was classified into 6 categories such as: Forest land, Cropland, Grassland, Other land, Settlement, and wetland in PPWS. The result show that the dominant LULC classes were forest land in PPWS from 2016 to 2020. The most significant loss of the forest area is the extent of cropland class and followed by the other LULC classes.

Table 1. Statistical analysis of LULC rate in PPWS from 2016 to 2020

N	Description	2016		2017		2018		2019		2020	
		ha	%	ha	%	ha	%	ha	%	ha	%
1	Forest land	213341	95.88	212678	95.59	211942	95.26	211426	95.02	210179	94.46
2	Cropland	5638	2.53	6348	2.85	6950	3.12	7563	3.40	8662	3.89
3	Grassland	3148	1.41	3076	1.38	3109	1.40	3001	1.35	3115	1.40
4	Other land	81	0.04	106	0.05	207	0.09	218	0.10	230	0.10
5	Settlement	90	0.04	90	0.04	90	0.04	90	0.04	111	0.05
6	Wetland	202	0.09	202	0.09	202	0.09	202	0.09	202	0.09

The forest land from 2016 to 2020 in PPWS, declined from almost 96% to 94.5% while cropland has increased from 2.5% to 3.98%. The percentage maybe seen as minor, but the impact is huge leading to major consequences if the number keep expanding. There are many motives behind transformation, however, great majority of cases are the increase in population, settlements, development, ELC for agro-business and forestry as the approach of development and poverty reduction in the targeted area and most of which caused by constitute human activities or immediate actions that originate from intended land-use and directly affect LULC.

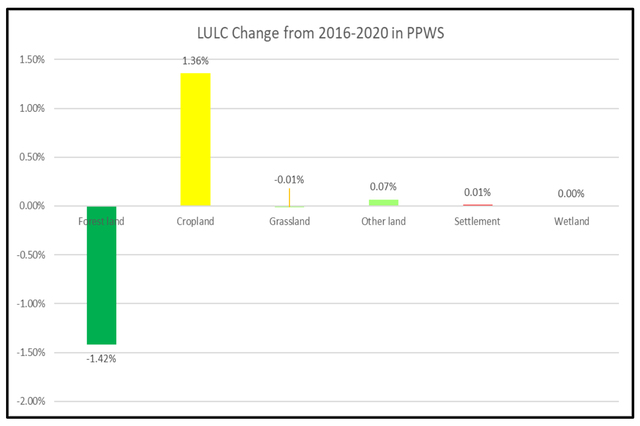

Figure 3. LULC change rate from 2016 to 2020

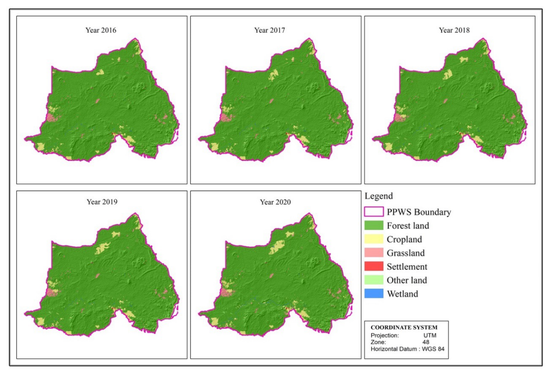

Figure 4. Map of land use land cover change from 2016 - 2020

Total carbon stock in PPWS is the compilation of above ground biomass (AGB) and below ground biomass (BGB) carbon stock. The percentage carbon stock was dominant tree. The InVEST carbon storage and sequestration model uses LULC raster data and stocks in carbon pools to estimate the amount of carbon. From 2016 to 2020, forest land is the highest total carbon cover 298.38 in AGB while BGB cover by 80.69. So, the total amount of carbon storage in PPWS is 401.080 ton per hectare with the average of 80.216 ton from 2016 to 2020.

Table 2. Total carbon storage in PPWS (ton)

LULC	2016	2017	2018	2019	2020	Total	Avg per Year
By year	18,114,731.61	17,880,612.47	17,876,344.83	17,760,529.70	17,608,015.92	89,240,234.53	17,848,046.91
By hectare	81.415	80.362	80.343	79.823	79.137	401.080	80.216

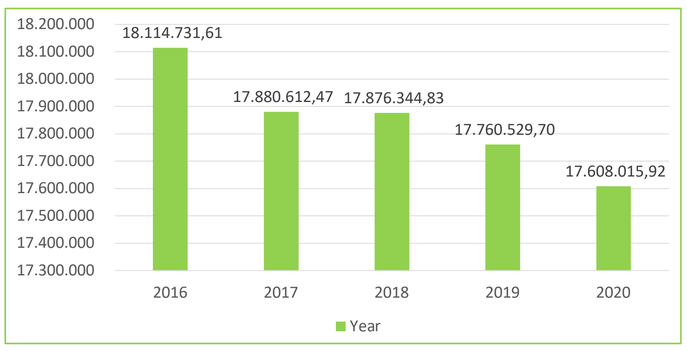

Figure 5. Total carbon storage in PPWS from 2016 to 2020

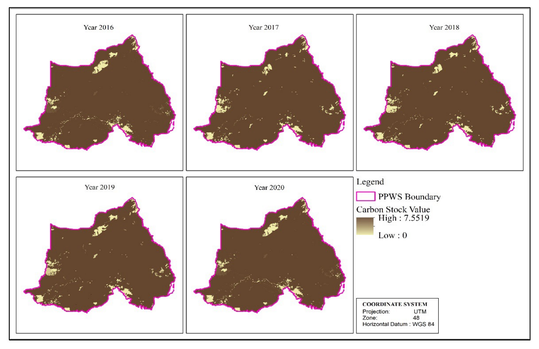

Figure 6. The carbon stock value in PPWS

Scale up plan

The decrease in the forest land areas from 2016 to 2020 in PPWS is the result of socio-economic growth, increase in the use of agriculture land, population increase, and expansion of resident areas, development of infrastructure, and illegal logging. On the other hand, forest loss in PPWS is caused by many factors which influence and have complex relationship with economic development and swift change in the use of forest land, especially conversion of forest land into large-scale agro-industrial plantation by private investors. In addition, if no effective measurement and policy intervention are taken to address LULCC in PPWS, it will face further deforestation and fragmentation, resulting in loss of habitat, carbon stocks, and wildlife populations. ELC were a predominant driver of deforestation in PPWS and influenced the trajectory of illegal forest conversion. This suggests that implementing REDD+ projects in PPWS could be an effective way to conserve the forest and its biodiversity, while also generating income for local communities and the government. Therefore, it is recommended that the following actions are taken to prevent further LULCC in PPWS:

- Strengthen law enforcement and monitoring to deter illegal logging and poaching
- Support community-based natural resource management and alternative livelihoods
- Develop and implement a REDD+ project in PPWS with stakeholder participation and benefit-sharing mechanisms
- Conduct regular assessments of forest cover, carbon stocks, and wildlife populations.

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