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# Forecasting deforestation risks in Cat Tien National Park



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### **On behalf of the**

German Federal Ministry for Economic Cooperation and Development (BMZ)

### **In cooperation with**

UNIQUE forestry and land use

Institute of Resources and Environment, Hue University

Cat Tien National Park

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## I. SUMMARY

Forests cover approximate 30% of land surface and are home of more than 80% of terrestrial biodiversity of the world (FAO, 2006). Products and ecological services provided by forest ecosystems are essential for human beings and other creatures on the earth. Notwithstanding, deforestation and forest degradation have been still ongoing problems both at regional and global scales, causing far-reaching consequences environment, biodiversity and human life. Carbon emission from forest loss may also accelerate global warming and climate change (Stern, 2007). Thus, sustainable forest management and biodiversity conservation are fundamental and effective solutions for maintaining ecological services, enhancing local livelihoods and resilience, and climate change mitigation and adaptation.

Vietnam situated in a cross-place of four biodiversity zones, thus it is considered as one of countries with diverse forest resources and biodiversity in the world (Sterling và Hurley, 2005). In the past, forest resources in Vietnam have been severely reduced in terms of quantity, quality and diversity of flora and fauna (Salek and Sloup, 2012). In recent years, Vietnam has made several efforts to restore forest resources and conserve biodiversity, especially in nature reserves and national parks.

Cat Tien National Park (CTNP) is a Special-Use Forest (SUF) with international importance in terms of biodiversity conservation and provision of forest ecosystem services. Cat Tien National Park is characterized by humid tropical forest ecosystem in a large lowland region with diversity and richness in flora and fauna (Polet and Ling, 2004). Despite great efforts in forest management and protection, deforestation and forest degradation in CTNP have still occurred, mainly due to encroachment and illegal logging and poaching (Dinh et al, 2012). With increasing pressures on forest resources, predicting deforestation risk from available data is a useful approach to support for forest protection and management planning. In this context, with funding and coordination from the project "Conservation and Sustainable Use of Forest Biodiversity and Ecosystem Services in Viet Nam" jointly implemented by the Ministry of Agriculture and Rural Development (MARD) and GIZ and data provided by CTNP, we conducted the study of " Deforestation risk prediction in Cat Tien National Park" to provide useful information for forest resource protection and biodiversity conservation in the park.

## II. METHODOLOGY

In this study, the statistical learning, GIS-based techniques and remote sensing (RS) was integrated to develop deforestation risk map in CTNP, using available spatial data. In order to identify changes in natural forests in CTNP between 2016 and 2020, we used Sentinel-2A satellite image captured in December 2020 for classifying forest cover types. Ten bands of the satellite image were combined with Normalized Difference Vegetation Index (NDVI) and Modified Normalized Difference Water Index (MNDWI) as input data for classification task. We employed Support Vector Machine model (SVM) to classify forest cover types in CTNP.

Based on previous study on deforestation risk, we used seven spatial variables as predictors including slope, elevation, distance to road, distance to water flow, distance to forest edge, distance to previously deforested area and forest types (poor, medium and rich forest) in risk model. The response variable is binary showing non-loss (0) and loss (1) of natural forests during the period of 2016-2020 in CTNP. Artificial neural network (ANN) model was used to assess part deforestation rates from 2016 up to now and predict deforestation probability in the park until

2025. The model performance was evaluated by using three criteria including the accuracy, Cohen’s Kappa and AUC statistic (Area under the Curve).

### III. KEY FINDINGS

The support vector machine model for forest cover classification showed a high accuracy of 0.96, indicating a good reliability of the classification results. In this study, the natural area of Cat Tien National Park (71,187.95 ha) was classified into 18 forest cover types defined in Circular No. 33/2018/TT-BNNPTNT of The Ministry of Agriculture and Rural Development. The mixed bamboo and natural wood forests (HG2) had the largest area (22233.93 ha), occupying about 31.23% of the total natural area of CTNP (Figure 1). The total area of natural bamboo forests (LOO, NUA and TNK) had a fairly large area (7668.68 ha), accounting for about 10.77% of the park. Noticeably, the area of freshwater wetland and waterbody was about 1085.52 ha.

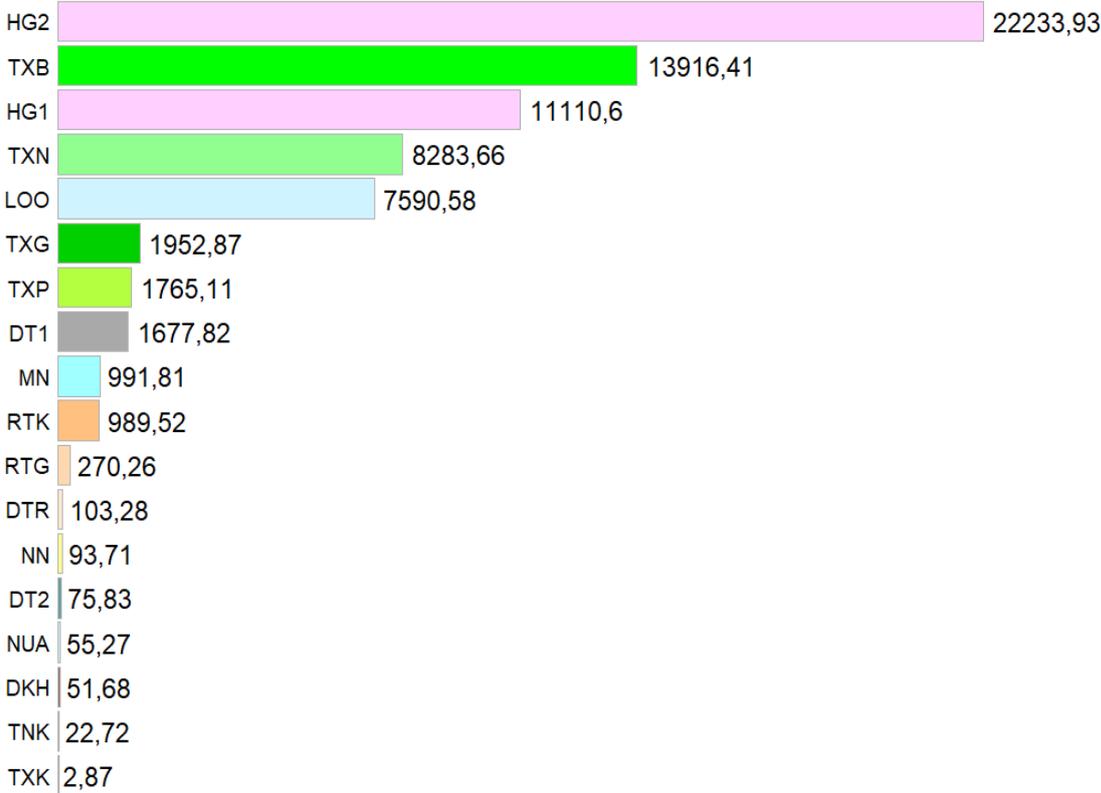


Figure 1. Area of forest cover types in Cat Tien National Park in 2020 (ha)

The developed ANN model for deforestation risk prediction showed the relatively high values in the accuracy (0.92), Cohen’s Kappa coefficient (0.74) and AUC index (0.96), thus the model could predict well the risk of deforestation in CTNP. Deforestation risk was divided into three levels including low (probability threshold 0 - 0.25), medium (0.25 - 0.5) and high-risk (> 0.75).

The area of the high risk was about 2079.9 ha, accounting for 2.92% of the total area of CTNP (Table 1) In 11 communes sharing area with CTNP, Ta Lai commune had the highest proportion of high risk that accounted for 53.04% of the commune’s area. The communes with large area of high risk included Phuoc Cat 2 (781.83 ha), Dong Nai Thuong (502.96 ha) and Dak Lua (435.41 ha). Meanwhile, three communes of Da Kho, Phu Ly and Thanh Son did not have high risk area.

No	Commune	Risk level (ha)			Proportion of the high risk (%)
		Low	Medium	High	

1	Đạ Kho	56,38	0.00	0.00	0,00
2	Đắk Lua	35480,12	965,53	435,41	1,18
3	Đăng Hà	3873,34	485,59	32,07	0,73
4	Đồng Nai Thượng	5935,59	767,94	502,96	6,98
5	Gia Viễn	592,55	193,38	95,50	10,84
6	Lộc Bắc	5371,58	57,22	34,64	0,63
7	Phú Lý	2248,38	5,77	0.00	0,00
8	Phước Cát 2	10940,62	1248,32	781,83	6,03
9	Tà Lài	79,22	13,36	104,55	53,04
10	Thanh Sơn	13,79	0,00	0,00	0,00
11	Tiên Hoàng	381,53	397,77	93,02	10,66
<b>In total</b>		<b>64973,09</b>	<b>4134,87</b>	<b>2079,99</b>	

Table 1. Area of risk levels in 11 communes sharing area with CTNP (ha)

#### IV. RECOMMENDATIONS

In areas with a high risk of deforestation, Cat Tien National Park should strengthen patrol activities to minimize negative impacts on forest resources and biodiversity. The digital database of forest cover types and deforestation risk map are products of the study. Technicians and rangers should use and update these data frequently via using smartphone applications, thereby improving the database of the park.

As lessons learnt from the study, we suggest that nature reserves and other forest protection and management units should pay attention in fixing error if have and updating GIS database to better protect forest resources and conserve biodiversity. Training courses on GIS and remote sensing techniques should be organized yearly for nature reserves and other equivalent units.

Programme on Conservation, Sustainable Use of  
Forest Biodiversity and Ecosystem Services in Viet Nam

Unit 021, 2<sup>nd</sup> Floor, Coco Building  
14 Thụy Khue Str., Tay Ho District, Hanoi, Viet Nam

T: +84 24 39 32 95 72  
E: [office.biodiversity@giz.de](mailto:office.biodiversity@giz.de)  
I: [www.giz.de/viet-nam](http://www.giz.de/viet-nam)

