SUPPLEMENTARY MATERIAL

Vegetation cover change detection (2000–2020) in Raub District, Malaysia using supervised and unsupervised classification techniques

Siti Salwa Shapiaai ✉, Kean Hua Ang* ✉

[1)] University of Malaya Kuala Lumpur, Faculty of Arts and Social Sciences, Department of Geography, Lingkungan Budi, 50603 Kuala Lumpur, Malaysia

* Corresponding author

Table S1. Classification accuracy comparison between unsupervised and supervised classification

Classifier	*UA* (%)	*PA* (%)	*OA* (%)	*KC*	Observations
2000 year					
***k*-means**			72.0	0.43	moderate to high: strong performance for dense forest, but struggles with rubber and oil palm plantations; open grassy area well-classified
– dense forest	85.0	82.0			
– sparse forest	70.5	68.2			
– oil palm plantation	66.0	62.5			
– rubber plantation	64.0	66.0			
– open grassy area	72.0	70.0			
MLC			86.8	0.86	high: excellent classification of dense forest and open grassy area; strong reliability for oil palm and rubber plantations
– dense forest	90.00	100.00			
– sparse forest	70.00	100.00			
– oil palm plantation	90.00	90.00			
– rubber plantation	63.64	77.78			
– open grassy area	80.00	100.00			
MDC			61.5	0.58	low to moderate: high omission in dense forest, confusion with other classes like oil palm and rubber
– dense forest	50.00	83.33			
– sparse forest	60.00	85.71			
– oil palm plantation	70.00	70.00			
– rubber plantation	54.55	60.00			
– open grassy area	60.00	75.00			
PPC			65.1	0.59	variable: extreme purity for dense forest, but severe omissions in rubber plantation and oil palm
– dense forest	100.00	38.46			
– sparse forest	100.00	32.26			

continue Tab. S1

Classifier	*UA* (%)	*PA* (%)	*OA* (%)	*KC*	Observations
– oil palm plantation	20.00	100.00			
– rubber plantation	0.00	0.00			
– open grassy area	100.00	66.67			
2010 year					
***k*-means**			83.3	0.58	moderate to high: good separation for dense forest, but confusion with oil palm and sparse forest
– dense forest	83.0	80.0			
– sparse forest	68.5	65.0			
– oil palm plantation	67.0	63.0			
– rubber plantation	65.0	67.5			
– open grassy area	71.0	69.0			
MLC			91.3	0.82	high: accurate classification, with minimal confusion in dense forest and rubber plantations
– dense forest	66.67	100.00			
– sparse forest	73.33	91.67			
– oil palm plantation	70.00	87.50			
– rubber plantation	90.00	100.00			
– open grassy area	100.00	100.00			
MDC			47.6	0.43	low to moderate: high omission in dense forest, moderate confusion with plantations
– dense forest	46.67	77.78			
– sparse forest	46.67	70.00			
– oil palm plantation	50.00	55.56			
– rubber plantation	50.00	50.00			
– open grassy area	54.55	60.00			
PPC			52.4	0.46	variable: strong purity in open grassy area but significant omissions, particularly in rubber plantation
– dense forest	100.00	53.57			
– sparse forest	100.00	65.22			
– oil palm plantation	60.00	66.67			
– rubber plantation	90.00	56.25			
– open grassy area	0.00	0.00			
2020 year					
***k*-means**			85.3	0.61	moderate to high: slight drop in accuracy due to fragmentation in dense forest and confusion with rubber plantations
– dense forest	80.0	77.5			
– sparse forest	66.0	63.0			
– oil palm plantation	65.0	60.5			
– rubber plantation	63.5	65.0			
– open grassy area	70.0	67.0			

continue Tab. S1

Classifier	*UA* (%)	*PA* (%)	*OA* (%)	*KC*	Observations
MLC			92.7	0.79	high: highly reliable with minimal misclassifications, especially for rubber plantations and open grassy areas
– dense forest	60.00	80.00			
– sparse forest	80.00	72.73			
– oil palm plantation	40.00	57.14			
– rubber plantation	70.00	100.00			
– open grassy area	80.00	88.89			
MDC			48.9	0.44	low to moderate: poor performance for oil palm, good for sparse forest but confusion with other vegetation types
– dense forest	61.54	80.00			
– sparse forest	72.73	80.00			
– oil palm plantation	10.00	25.00			
– rubber plantation	30.00	37.50			
– open grassy area	50.00	50.00			
PPC			72.6	0.69	variable: high purity but suffers from severe omissions, especially in rubber plantations
– dense forest	100.00	26.32			
– sparse forest	100.00	62.50			
– oil palm plantation	0.00	0.00			
– rubber plantation	40.00	21.05			
– open grassy area	50.00	71.43			

Explanations: *UA* = user accuracy, *PA* = producer accuracy, *OA* = overall accuracy, *KC* = kappa coefficient, MLC = maximum likelihood classification, MDC = minimum distance classifier, PPC = parallelepiped classifier.
Source: own elaboration.