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Supplementary Material

Integrating Analytical Frameworks to Investigate Land-Cover Regime Shifts in Dynamic Landscapes

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1. Aggregation of detailed land cover categories into the six broad categories used in the study

We aggregated the 23 detailed land cover classes present in the Tanintharyi Region into six broad land cover classes as shown in the table below.

Table A1. Aggregation of ESA CCI land cover classes into six broad classes used in this study.

ESA CCI classes (23)	Aggregated classes (6)
Tree cover, broadleaved, evergreen, closed to open (>15%)	Forest
Tree cover, broadleaved, deciduous, closed to open (>15%)	
Tree cover, broadleaved, deciduous, closed (>40%)	
Tree cover, needleleaved, evergreen, closed to open (>15%)	
Tree cover, needleleaved, deciduous, closed to open (>15%)	
Tree cover, flooded, fresh or brackish water	
Tree cover, flooded, saline water	
Mosaic cropland (>50%) / natural vegetation (tree, shrub, herbaceous cover) (<50%)	Mosaic Vegetation
Mosaic natural vegetation (tree, shrub, herbaceous cover) (>50%) / cropland (<50%)	
Mosaic tree and shrub (>50%) / herbaceous cover (<50%)	
Mosaic herbaceous cover (>50%) / tree and shrub (<50%)	
Shrubland	Shrubland
Shrubland, evergreen	
Shrubland, deciduous	
Grassland	Other Vegetation
Sparse vegetation (tree, shrub, herbaceous cover) (<15%)	
Shrub or herbaceous cover, flooded, fresh/saline/brackish water	
Cropland, rainfed	Cropland
Cropland, herbaceous cover	
Cropland, tree or shrub cover	
Cropland, irrigated or post-flooding	
Urban areas	Non-Vegetation
Water bodies	

2. Mathematical notations and equations used for Intensity Analysis

The following section outlines all mathematical notations (Table A2) and equations (Table A3) utilised in this study, in accordance to Aldwaik & Pontius [1], who detailed the usage of 42 equations present in the complete Intensity Analysis results generated by the program. Although we adopted the same notations and formulas for our study, we selected 20 equations that we deemed quintessential to our study. We recommend Aldwaik & Pontius [1] for readers who wish to comprehensively understand the mathematical mechanics performed in the Intensity Analysis.

Table A2. Summary of mathematical notations used.

Notation	Meaning
T	Total number of time points
Y_t	Year at initial time point of interval
Y_{t+1}	Year at final time point of interval
J	Total number of categories
i	Index of category at initial time point of interval
j	Index of category at final time point
m	Index of losing category
n	Index of gaining category
C_{tij}	Number of elements observed in the transition from i to j in interval
S_t	Change intensity in interval
U	Hypothesized uniform intensity in interval
G_{tj}	Gain intensity of j in interval
L_{ti}	Loss intensity of i in interval
Q_{tmj}(From m)	Annual transition intensity for a transition from m to j in interval
V_{tm}(From m)	Hypothesized uniform intensity for a transition from m to j in interval
E^{Q}_{tmj}(From m)	Number of elements hypothesized as commission errors
O^{Q}_{tmj}(From m)	Number of elements hypothesized as omission errors
R_{tin}(To n)	Annual transition intensity for a transition from i to n in interval
W_{tn}(To n)	Hypothesized uniform intensity for a transition from i to n in interval
E^{R}_{tin}(To n)	Number of elements hypothesized as commission errors
O^{R}_{tin}(To n)	Number of elements hypothesized as omission errors

		Y_{t+1}		
		Category 1	Category j	Category J
Y_t	Category 1	C_{t11}	C_{t1j}	C_{t1J}
	Category i	C_{ti1}	C_{tij}	C_{tiJ}
	Category J	C_{tJ1}	C_{tJj}	C_{tJJ}

Figure A1. The cross-tabulation matrix shows the number of elements observed in the transitions between all J categories.

Table A3. List of formulas used in this study.

Interval

$$S_t = \frac{\text{change in interval } (Y_t \text{ to } Y_{t+1}) \times 100\%}{(\text{duration from } Y_t \text{ to } Y_{t+1})(\text{domain of } [Y_t, Y_{t+1}])} = \frac{\sum_{j=1}^{J}\left[\left(\sum_{i=1}^{J} C_{tij}\right) - C_{tjj}\right] \times 100\%}{(Y_{t+1} - Y_t)\left(\sum_{j=1}^{J}\sum_{i=1}^{J} C_{tij}\right)} \quad (1)$$

$$U = \frac{\text{weighted sum of changes in intervals}}{(\text{duration from } Y_1 \text{ to } Y_t)(\text{weighted sum of domains})} = \frac{\sum_{t=1}^{T-1}\left\{(Y_{t+1} - Y_t)\sum_{j=1}^{J}\left[\left(\sum_{i=1}^{J} C_{tij}\right) - C_{tjj}\right]\right\} \times 100\%}{(Y_T - Y_1)\sum_{t=1}^{T-1}\left[(Y_{t+1} - Y_t)\left(\sum_{j=1}^{J}\sum_{i=1}^{J} C_{tij}\right)\right]} \quad (2)$$

Category

$$G_{tj} = \frac{\text{annual gain size of } j \text{ in interval } (Y_t \text{ to } Y_{t+1}) \times 100\%}{\text{size of } j \text{ at } t+1} = \frac{\left\{\left[\left(\sum_{i=1}^{J} C_{tij}\right) - C_{tjj}\right] \div (Y_{t+1} - Y_t)\right\} \times 100\%}{\sum_{i=1}^{J} C_{tij}} \quad (3)$$

$$L_{ti} = \frac{\text{annual loss size of } i \text{ in interval } (Y_t \text{ to } Y_{t+1}) \times 100\%}{\text{size of } i \text{ at } t} = \frac{\left\{\left[\left(\sum_{j=1}^{J} C_{tij}\right) - C_{tii}\right] \div (Y_{t+1} - Y_t)\right\} \times 100\%}{\sum_{i=1}^{J} C_{tij}} \quad (4)$$

Transition (from m)

$$Q_{tmj} = \frac{\text{annual transition size from } m \text{ to } j \text{ in interval } (Y_t \text{ to } Y_{t+1}) \times 100\%}{\text{size of } j \text{ at } t+1} = \frac{C_{tmj} \div (Y_{t+1} - Y_t) \times 100\%}{\sum_{i=1}^{J} C_{tij}} \quad (5)$$

$$V_{tm} = \frac{\text{annual loss size of } m \text{ during the in interval } (Y_t \text{ to } Y_{t+1}) \times 100\%}{\text{size of } '\text{non } m' \text{at } t+1} = \frac{\left[\left(\sum_{j=1}^{J} C_{tmj}\right) - C_{tmm}\right] \div (Y_{t+1} - Y_t) \times 100\%}{\sum_{i=1}^{J}\left[\left(\sum_{j=1}^{J} C_{tij}\right) - C_{tim}\right]} \quad (6)$$

Transition (to n)

$$R_{tin} = \frac{\text{annual transition size from } i \text{ to } n \text{ in interval } (Y_t \text{ to } Y_{t+1}) \times 100\%}{\text{size of } i \text{ at } t} = \frac{C_{tin} \div (Y_{t+1} - Y_t) \times 100\%}{\sum_{j=1}^{J} C_{tij}} \quad (7)$$

$$W_{tn} = \frac{\text{annnual gain size of } n \text{ in interval } (Y_t \text{ to } Y_{t+1}) \times 100\%}{\text{size of } '\text{non } n' \text{at } t+1} = \frac{\left[\left(\sum_{i=1}^{J} C_{tin}\right) - C_{tnn}\right] \div (Y_{t+1} - Y_t) \times 100\%}{\sum_{j=1}^{J}\left[\left(\sum_{i=1}^{J} C_{tij}\right) - C_{tnj}\right]} \quad (8)$$

Transition Commission Error (from m)

$$E_{tmj}^{Q} = \frac{\left(\sum_{i=1}^{J} C_{tij}\right)(Y_{t+1} - Y_t)(Q_{tmj} - V_{tm})}{100\% - [(Y_{t+1} - Y_t)(V_{tm})]} \quad (9)$$

$$\text{Observed annual transition from } m \text{ to } j \text{ in interval } (Y_t \text{ to } Y_{t+1}) = \frac{\left(C_{tmj} - E_{tmj}^{Q}\right) + E_{tmj}^{Q}}{Y_{t+1} - Y_t} \quad (10)$$

$$\text{Commission intensity of } j \text{ at } t+1 = \frac{E_{tmj}^{Q} \times 100\%}{C_{tmj}} \quad (11)$$

Transition Omission Error (from m)

$$O_{tmj}^{Q} = \frac{\left(\sum_{i=1}^{J} C_{tij}\right)(Y_{t+1} - Y_t)(V_{tm} - Q_{tmj})}{100\% - [(Y_{t+1} - Y_t)(V_{tm})]} \quad (12)$$

$$\text{Uniform annual transition from } m \text{ to } j \text{ in interval } (Y_t \text{ to } Y_{t+1}) = \frac{C_{tmj} + O_{tmj}^{Q}}{Y_{t+1} - Y_t} \quad (13)$$

$$\text{Omission intensity of } j \text{ at } t+1 = \frac{O_{tmj}^{Q} \times 100\%}{O_{tmj}^{Q} + C_{tmj}} \quad (14)$$

Transition Commission Error (to n)	
$E_{tin}^{R}=\frac{\left(\sum_{j=1}^{J}C_{tij}\right)(Y_{t+1}-Y_{t})(R_{tin}-W_{tn})}{100\%-[(Y_{t+1}-Y_{t})(W_{tn})]}$	(15)
Observed annual transition from i to n in interval (Y_t to Y_{t+1}) $=\frac{(C_{tin}-E_{tin}^{R})+E_{tin}^{R}}{Y_{t+1}-Y_{t}}$	(16)
Commission intensity of i at $t=\frac{E_{tin}^{R}\times 100\%}{C_{tin}}$	(17)
Transition Omission Error (to n)	
$O_{tin}^{R}=\frac{\left(\sum_{j=1}^{J}C_{tij}\right)(Y_{t+1}-Y_{t})(W_{tn}-R_{tin})}{100\%-[(Y_{t+1}-Y_{t})(W_{tn})]}$	(18)
Uniform annual transition from i to n in interval (Y_t to Y_{t+1}) $=\frac{C_{tin}+O_{tin}^{R}}{Y_{t+1}-Y_{t}}$	(19)
Omission intensity of i at $t=\frac{O_{tin}^{R}\times 100\%}{O_{tin}^{R}+C_{tin}}$	(20)

3. Results of Interval-level Intensity Analysis for the three districts of Tanintharyi Region, Myanmar

The following plots show the rates of annual landscape change and the occurrence of land-cover regime shifts between 1997 and 2004 in the three districts of the Tanintharyi Region, Myanmar, namely: (a) Dawei District, (b) Myeik District, and (c) Kawthoung District.

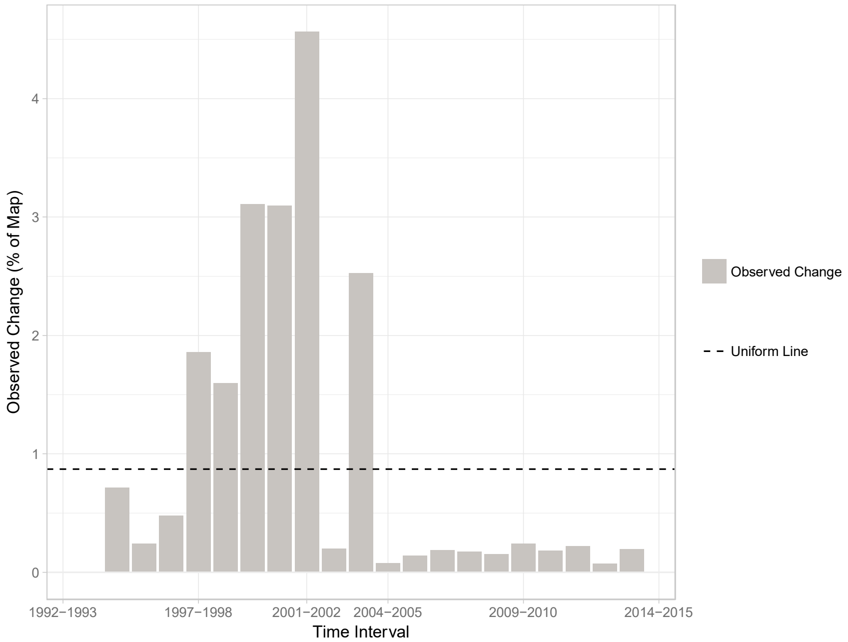

Figure A2. Interval-level Intensity Analysis showing the rate of annual landscape change in Dawei District, Tanintharyi, Myanmar. The time interval plot shows the land-cover regime shift occurred between 1997 and 2004.

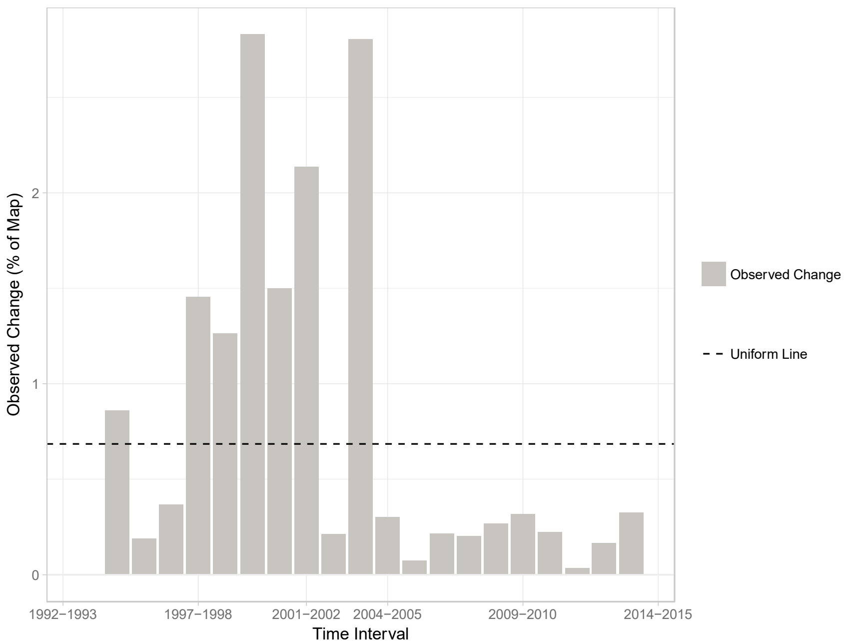

Figure A3. Interval-level Intensity Analysis showing the rate of annual landscape change in Myeik District, Tanintharyi, Myanmar. The time interval plot shows the land-cover regime shift occurred between 1997 and 2004.

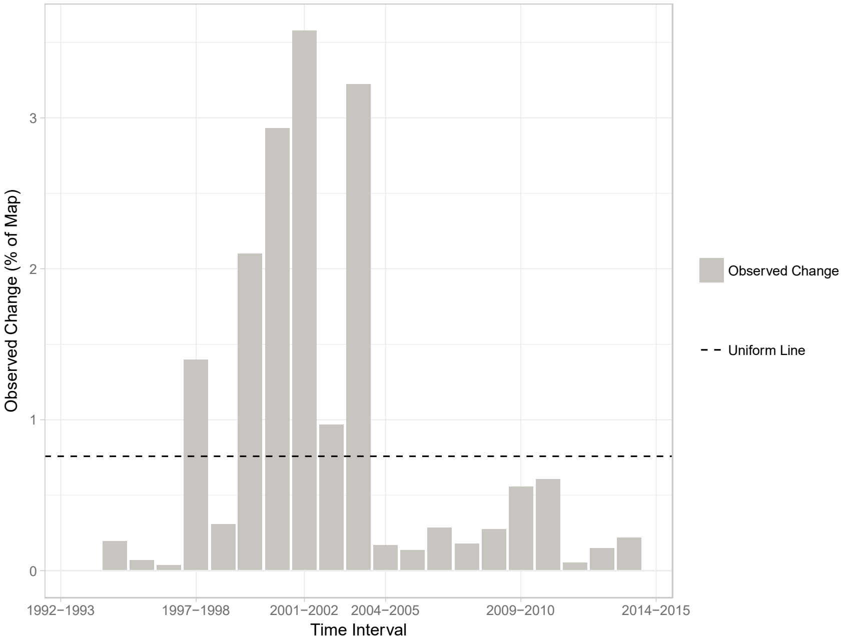

Figure A4. Interval-level Intensity Analysis showing the rate of annual landscape change in Kawthoung District, Tanintharyi, Myanmar. The time interval plot shows the land-cover regime shift occurred between 1997 and 2004.

4. Results of Category-level Intensity Analysis for (a) Tanintharyi Region, Myanmar, and (b) its three districts

4.1. Tanintharyi Region, Myanmar

4.1.1. Pre-land-cover regime shift (1992-1997).

Category-level IA revealed that Forest was actively losing yet dormantly gaining in three intervals preceding the land-cover regime shift (1994–1997). Cropland, Mosaic Vegetation, and Shrubland were actively gaining yet dormantly losing in three intervals prior to the regime shift (1994–1997), except Cropland in 1993–1994 where it actively lost yet dormantly gained (with a loss intensity of 0.01%). Non-Vegetation was both dormantly gaining and losing before the regime shift, except in 1993–1994 where it actively gained yet dormantly lost (with a gain intensity of 0.01%), and in 1994–1995 where it actively lost yet dormantly gained (with a loss intensity of 2.39%). Other Vegetation was both dormantly gaining and losing in all intervals before the regime shift, except in 1994–1995 and 1996–1997 where it actively gained yet dormantly lost (with gain intensities of 4.65% and 1.46%, respectively).

4.1.2. Land-cover regime shift (1997–2004).

Category-level IA revealed that Forest was actively losing yet dormantly gaining in all seven intervals during the land-cover regime shift. Forest loss intensities were markedly higher during the regime shift (0.48% to 4.77%) than those during the pre-regime shift (0.23% to 0.73%) and post-regime shift (0.18% to 0.49%) periods. Cropland, Mosaic Vegetation, and Shrubland were actively gaining yet dormantly losing in all seven intervals during the regime shift, except in 2001–2002 and 2003–2004 where Cropland both dormantly gained and lost. Cropland experienced gain intensities (0.54% to 6.36%) that were comparable to those during the pre-regime shift (1.45% to 8.37%) but were markedly higher than those during the post-regime shift (0.29% to 0.89%). Mosaic Vegetation gain intensities were markedly higher during the regime shift (1.07% to 10.13%) than those in the pre-regime shift (0.91% to 2.19%) and post-regime shift (0.22% to 1.32%) periods. Shrubland was actively gaining yet dormantly losing in all seven intervals during the regime shift, with gain intensities (1.07% to 11.92%) that were markedly higher than those in the pre-regime shift (0.55% to 1.37%) and post-regime shift (0.25% to 0.76%) periods. Non-Vegetation was both dormantly gaining and losing in all seven intervals during the regime shift. Other Vegetation was both dormantly gaining and losing in all seven intervals during the regime shift, except in 1997–1999 and 2001–2002 where it actively gained yet dormantly lost (with gain intensities of 1.60% to 3.27%).

4.1.3. Post-land-cover regime shift (2004–2015).

Category-level IA revealed that Forest was actively losing yet dormantly gaining in all the intervals after the regime shift, except in 2005–2006, 2007–2008, and 2011–2012 where Forest dormantly gained and lost. Cropland and Mosaic Vegetation were actively gaining yet dormantly losing in all intervals after the regime shift, except in 2008–2009 where Cropland both dormantly gained and lost. Shrubland was actively gaining yet dormantly losing in the following intervals: 2004–2005, 2006–2007, 2008–2011 and 2012–2014. Interestingly, after the regime shift, Shrubland (1) actively lost yet dormantly gained in 2005–2006 and 2011–2012 (each with loss intensities of 0.24%), and (2) both actively gained and lost in 2007–2008 (i.e., swapping; with gain and loss intensities of 0.23% and 0.25%, respectively). Non-Vegetation was both dormantly gaining and losing in all intervals after the regime shift, except in 2008–2009 where it actively lost yet dormantly gained (with a loss intensity of 0.27%), and in 2012–2015 where it actively gained yet dormantly lost (with gain intensities of 0.01% to 0.36%). Other Vegetation displayed mixed trends during this period: (1) both dormantly gaining and losing in 2004–2006, 2007–2008 and 2013–2014; (2) actively gaining yet dormantly losing in 2006–2007 and 2010–2011 (with gain intensities of 0.81% and 1.08%, respectively); and (3) actively losing yet dormantly gaining in 2009–2010, 2011–2013, and 2014–2015 (with loss intensities of 0.09% to 0.45%).

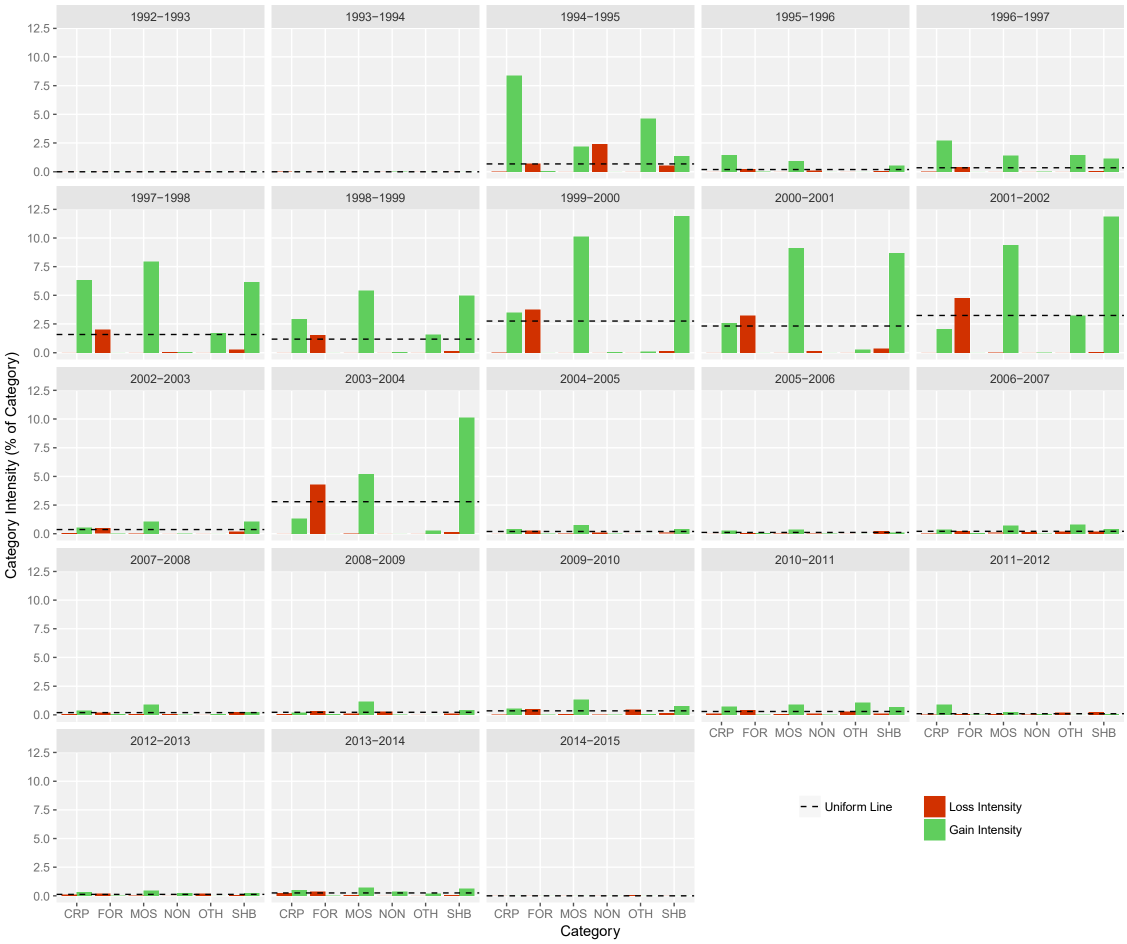

Figure A5. Category-level Intensity Analysis. Annual gross losses and gross gains per land cover category in Tanintharyi Region, Myanmar during 1992–2015 period. Land cover categories include Cropland (CRP), Forest (FOR), Mosaic Vegetation (MOS), Non-Vegetation (NON), Other Vegetation (OTH), and Shrubland (SHB).

4.2. Dawei, Myeik, Kawthoung Districts of Tanintharyi Region, Myanmar

4.2.1. Pre-land-cover regime shift (1992-1997).

Category-level IA revealed that Forest was actively losing yet dormantly gaining in three intervals preceding the regime shift for all districts (1994–1997), except Kawthoung where Forest dormantly gained and lost in 1994–1995. Cropland and Mosaic Vegetation were actively gaining yet dormantly losing in 1994–1997 for all districts, except in Dawei where Cropland actively lost yet dormantly gained in 1993–1994 (with a loss intensity of 0.01%). Shrubland was actively gaining yet dormantly losing in 1994–1997 for all districts, except (1) in Dawei in 1994–1995 where Shrubland actively gained and lost (with a gain and loss intensity of 1.17% and 0.93%, respectively), and (2) in Kawthoung in 1994–1996 where Shrubland dormantly gained and lost. Non-Vegetation was both dormantly gaining and losing in 1994–1997 for all districts, except when it actively lost and dormantly gained in both Dawei and Kawthoung in 1994–1995 (with loss intensities of 5.63% and 1.41%, respectively) and also in Myeik during 1994–1996 (with loss intensities of 0.21% to 2.21%). Interestingly, Non-Vegetation was actively gaining yet dormantly losing only in Dawei in 1993–1994 (with a gain intensity of 0.08%). Other Vegetation displayed mixed trends across the districts in 1994–1997. In both Dawei and Myeik, Other Vegetation was actively gaining yet dormantly losing in 1994–1995 and 1996–1997 (with gain intensities of 1.64% and 4.23% for Dawei and 0.91% and 6.45% for Myeik). Although Other Vegetation dormantly gained and lost in 1995–1996 in all districts, this trend was observed throughout all three intervals in Kawthoung.

4.2.2. Land-cover regime shift (1997–2004).

Category-level IA revealed that Forest was actively losing yet dormantly gaining in all seven intervals during the regime shift for all districts. At the district level, Forest loss intensities for Dawei, Kawthoung, and Myeik were markedly higher during the regime shift (0.25% to 7.89%, 0.38% to 4.74%, and 0.26% to 3.98%, respectively) than those during the pre-regime shift (0.33% to 0.73%, 0.04% to 0.09%, and 0.23% to 0.98%, respectively) and post-regime shift (0.09% to 0.32%, 0.15% to 0.88% and 0.04% to 0.46% respectively) periods.

Cropland, Mosaic Vegetation and Shrubland were generally actively gaining yet dormantly losing during the regime shift. Cropland displayed this trend in all intervals for Kawthoung and Myeik (except 2001–2002 and 2003–2004 where Cropland dormantly gained and lost), whereas Dawei was the only district where Cropland dormantly gained and lost in all intervals in this period (except in 1997–1998 where it actively gained and lost with a gain intensity of 3.00%). The Cropland gain intensity for Dawei during the regime shift is comparable to the gain intensities during the pre-regime shift period (0.85% to 5.85%) but higher than those during the post-regime shift period (0.10% to 2.01%). Cropland gain intensities for Kawthoung and Myeik were markedly higher during the regime shift (3.89% to 17.71% and 0.28% to 7.79%, respectively) than those during the pre-regime shift (1.08% to 5.70% and 2.02% to 11.41%, respectively) and post-regime shift (0.41% to 4.46% and 0.08% to 0.69%, respectively) periods.

Mosaic Vegetation was actively gaining and dormantly losing in all seven intervals during the regime shift for all districts, with gain intensities for Dawei, Kawthoung, and Myeik being markedly higher during the regime shift (0.32% to 10.28%, 1.81% to 15.16% and 1.02% to 10.75% respectively) than those in the pre-regime shift (0.81% to 1.53%, 0.35% to 1.33%, and 0.95% to 3.59%, respectively) and post-regime shift (0.25% to 0.63%, 0.30% to 2.51%, and 0.26% to 1.86%, respectively) periods.

Shrubland was actively gaining yet dormantly losing in all seven intervals during the regime shift for all districts, except Dawei where Shrubland actively gained and lost in 2002–2003 (with a gain and loss intensity of 0.41% and 0.22%, respectively). Shrubland gain intensities for Dawei, Kawthoung, and Myeik were markedly higher during the regime shift (4.34% to 11.97%, 1.63% to 16.84%, and 0.76% to 14.59%, respectively) than those in the pre-regime shift (0.65% to 1.42%, 0.07%, and 0.62% to 2.07%, respectively) and post-regime shift (0.10% to 0.43%, 0.10% to 1.41%, and 0.05% to 1.03%, respectively).

Non-Vegetation was both dormantly gaining and losing in all intervals during the regime shift for all districts. Similarly, Other Vegetation was dormantly gaining and losing in all intervals during the regime shift for all districts, except in Dawei (1997–1998) and Myeik (1998–1999) where it actively gained yet dormantly lost (with gain intensities of 2.22% and 2.23%, respectively).

4.2.3. Post-land-cover regime shift (2004–2015).

Category-level IA revealed that Forest was actively losing yet dormantly gaining after the regime shift in all intervals for all three districts. Some exceptions were observed for this overall trend: in Dawei where Forest both dormantly gained and lost (2007–2008 and 2011–2012) and where Forest actively gained yet dormantly lost (2005–2006 with gain intensities of 0.17%); in Kawthoung where Forest both dormantly gained and lost (2006–2007 and 2011–2013); and in Myeik where Forest dormantly gained and lost (2005–2006).

Cropland showed mixed trends across the three districts after the regime shift. In Dawei, three trends were observed: (1) actively gaining yet dormantly losing in six intervals; (2) both dormantly gaining and losing in 2005–2007 and 2008–2009; and (3) actively losing yet dormantly gaining in 2012–2013 (with a loss intensity of 0.09%). In Kawthoung, four trends were observed: (1) actively gaining yet dormantly losing in six intervals; (2) both dormantly gaining and losing in 2006–2007; (3) actively losing yet dormantly gaining in 2011–2012 (with a loss intensity of 0.11%); and (4) both actively gaining and losing in 2012–2014 (with gain intensities of 1.24% to 2.07% and loss intensities of 0.41% to 0.45%). In Myeik, two trends were observed: (1) actively gaining yet dormantly losing in eight intervals; and (2) both dormantly gaining and losing in 2008–2010.

Mosaic Vegetation was actively gaining yet dormantly losing in all districts after the regime shift, except in Kawthoung where it actively gained and lost in 2007–2009 and 2011–2012 (with gain intensities of 0.11% to 1.26% and loss intensities of 0.15% to 0.31%).

Shrubland showed very mixed trends across the three districts after the regime shift. In both Kawthoung and Myeik, two similar trends were observed: both actively gaining and losing, and actively gaining yet dormantly losing. However, Shrubland actively gained and lost in four intervals in Kawthoung (2005–2008 and 2012–2013, with gain intensities of 0.20% to 0.37% and loss intensities of 0.17% to 0.56%), but only in two intervals in Myeik (2005–2006 and 2007–2008, with gain intensities of 0.14% to 0.38% and loss intensities of 0.16% to 0.24%). During this period, Dawei showed multiple trends that were more temporally heterogenous than the other districts, specifically: (1) actively gaining yet dormantly losing in four intervals (2006–2007, 2010–2011, and 2012–2014, with gain intensities of 0.10% to 0.43%); (2) both actively gaining and losing in 2009–2010 (with a gain and loss intensity of 0.26% and 0.32%, respectively); (3) actively losing yet dormantly gaining in four intervals (2004–2006, 2007–2008, and 2011–2012, with loss intensities of 0.11% to 0.51%); and (4) both dormantly gaining and losing in 2008–2009.

Non-Vegetation showed various trends after the regime shift: (1) both dormantly gaining and losing in the majority of the intervals for all districts; (2) actively losing yet dormantly gaining in Dawei (2010–2011 with loss intensities of 0.57%), Kawthoung (2004–2005 with loss intensities of 0.21%), and Myeik (2005–2006 and 2008–2009, with loss intensities of 0.10% to 0.45); and (3) actively gaining yet dormantly losing in all districts, which was observed to be most intense in Dawei (2012–2014 with gain intensities of 0.81% to 1.60%), followed by Kawthoung (2011–2013 with gain intensities of 0.09% to 0.24%), and Myeik (2011–2012 with a gain intensity of 0.08%).

Other Vegetation showed various trends after the regime shift: (1) both dormantly gaining and losing in the majority of the intervals for all districts; (2) actively losing yet dormantly gaining in Dawei (2009–2011 with loss intensities of 0.35% to 0.58%) and Myeik (2011–2013 and 2014–2015 with loss intensities of 0.87% to 0.88%); (3) actively gained yet dormantly lost in Dawei (2006–2007 with a gain intensity of 0.92%), in Kawthoung (2010–2011 with a gain intensity of 48%), and in Myeik (2007–2008, 2009–2010, and 2013–2014, with gain intensities of 0.44% each). Interestingly, Myeik was the only district where Other Vegetation actively gained and lost in 2006–2007 (with a gain and loss intensity of 0.44% and 0.88%, respectively).

Figure A6. Category-level Intensity Analysis. Annual gross losses and gross gains per land cover category in Dawei District of Tanintharyi Region, Myanmar during 1992–2015 period. Land cover categories include Cropland (CRP), Forest (FOR), Mosaic Vegetation (MOS), Non-Vegetation (NON), Other Vegetation (OTH), and Shrubland (SHB).

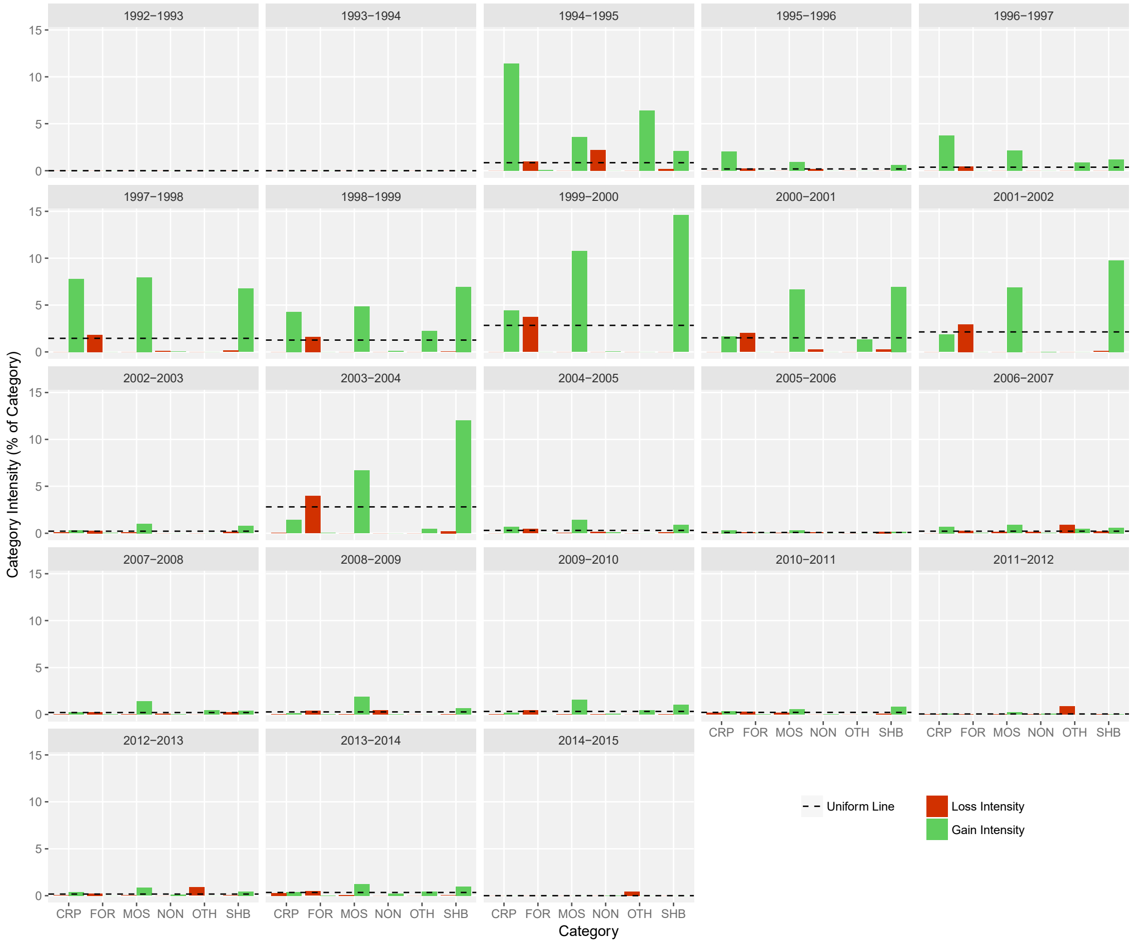

Figure A7. Category-level Intensity Analysis. Annual gross losses and gross gains per land cover category in Myeik District of Tanintharyi Region, Myanmar during 1992–2015 period. Land cover categories include Cropland (CRP), Forest (FOR), Mosaic Vegetation (MOS), Non-Vegetation (NON), Other Vegetation (OTH), and Shrubland (SHB).

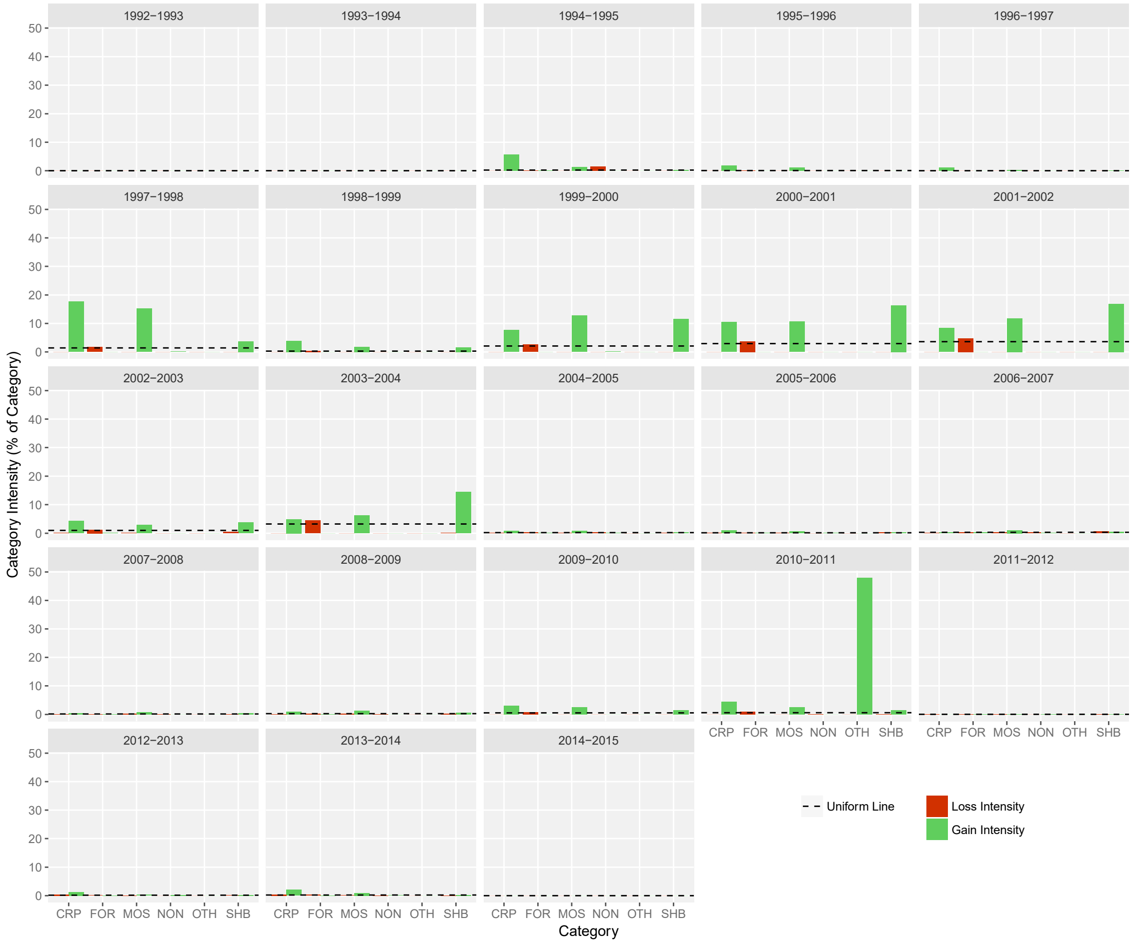

Figure A8. Category-level Intensity Analysis. Annual gross losses and gross gains per land cover category in Kawthoung District of Tanintharyi Region, Myanmar during 1992–2015 period. Land cover categories include Cropland (CRP), Forest (FOR), Mosaic Vegetation (MOS), Non-Vegetation (NON), Other Vegetation (OTH), and Shrubland (SHB).

5. Results of Transition-level Intensity Analysis for Tanintharyi Region, Myanmar

5.1. Procedure for transition-level IA

This section provides a brief summary of the procedure for conducting the transition-level IA for Tanintharyi Region, Myanmar. For each transition e.g., category A to category B, two sets of data are used: (1) transition level from category A ("From A") and its reciprocal; (2) transition level to category B ("To B"). Each transition was evaluated in three main steps:

(1) The observed transition intensities were compared against a calculated uniform intensity. Transition intensities above the uniform were interpreted as "Targeted" while those below the uniform were interpreted as "Avoided". This step was performed for both "From A" and "To B".

(2) These interpretations were tested for reciprocity i.e., if the interpretation for "From A" and "To B" match with each other. Only transitions that displayed reciprocity were deemed systematic. For example, the loss of A is intensively targeting B and its reciprocal, and the gain of B is intensively targeting A; thus, the transition from A to B is systematic.

(3) Of these systematic transitions, the hypothesised errors calculated from the IA were used to test whether a systematic transition was truly systematic. Transitions that displayed high levels of hypothesised errors (close to 100%) reflected strong evidence of true systematicity whereas low errors (close to 0%) reflected strong evidence of non-systematicity (Aldwaik & Pontius, 2013). Commission and omission errors were used when investigating targeting and avoidance transitions, respectively.

For example, for a transition where category B systematically targets category A between timepoints 1 and 2, both the data for "From A" and "To B" have to be evaluated. A commission error of 90% (To B) is interpreted as follows: 90% of B pixels in timepoint 2 that were previously A in timepoint 1 are required to be commission errors in order to explain its deviation past the uniform intensity. Since having erroneously misclassified 90% of the pixels that were observed transitioning from category A in timepoint 1 to category B in timepoint 2 is highly unlikely, this represents strong evidence to support that this transition is truly systematic.

The reciprocal (i.e., "From A"), however, must also be tested in the same manner before concluding whether a transition is truly systematic. This reciprocity test is necessary because although the number of pixels recorded transitioning from A to B between timepoints 1 and 2 are the same, the uniform intensity differs for these two transitions (i.e., "From A and "To B") since different categories could be gaining from A or losing to B differently within their time intervals. Only when both transitions "From A" and "To B" reflect strong evidence that the transition is truly systematic, this suggests that a mechanism is responsible for driving this transition exists over the spatiotemporal landscape.

On the other hand, low commission errors ("To B") indicate that a transition only requires a low percentage of the A pixels to be wrongfully committed as category B in timepoint 2. Since such a possibility is relatively more likely than the former scenario, there is poor evidence that this transition is truly systematic. Again, the reciprocal ("From A") should be tested in this same manner. If both the commission errors are low, then the conclusion is that the transition from A to B between timepoints 1 and 2 is non-systematic. The same process was applied for transitions where a class is avoided (instead of targeted), except this time that the hypothesised omission errors are used to explain why a transition intensity is beneath the uniform intensity.

Aldwaik & Pontius [1], however, did not specify a hard rule for a minimum threshold value to decide if a transition is truly systematic; hence, the conclusions drawn from this level could be subjective for each transition. In this present study, the hypothesised commission and omission errors derived from the IA were generally low, the reason possibly being that this study investigated land cover change at annual intervals over a 24-year period. To eliminate subjectivity and bias in our assessment of true systematicity, we compared the calculated hypothesised errors for that interval against the mean errors observed in the respective periods that the interval belongs to among the three time periods identified at the interval-level IA, namely 1992–1997, 1997–2004, and 2004–2015.

5.2. Results of transition-level IA

This section presents the results of the transition-level IA, mainly on determining the truly systematic transitions within each of the three periods (1992–1997, 1997–2004, and 2004–2015). A total of 33 out of 115 transitions from Forest to other categories were truly systematic, which are presented in detail below in accordance to Table 2 in the main text.

5.2.1. Pre-land-cover regime shift dynamics (1992–1997).

(1) Mosaic Vegetation systematically targeted Forest in 1995–1996

Examining the transitions from Forest in 1995–1996, Mosaic Vegetation experienced a gain intensity of 0.904%, above the uniform of 0.715%, which meant that Forest loss was targeted by Mosaic Vegetation in 1995–1996. This was further supported by good evidence where a commission error of 21.0% (above the mean of 5.08% in this period) was required in 218 pixels lost from Forest to Mosaic Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Mosaic Vegetation in 1995–1996, Forest experienced a loss intensity of 0.0606%, above the uniform of 0.0487%, which meant that the gain of Mosaic Vegetation targeted Forest in 1995–1996. This was further supported by good evidence where a commission error of 19.5% (above the mean of 11.4% in this period) was required in these 218 pixels gained by Mosaic Vegetation from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Mosaic Vegetation and (2) the gain of Mosaic Vegetation targeted Forest, this transition where Mosaic Vegetation targeted Forest in 1995–1996 was truly systematic.

(2) Cropland systematically targeted Forest in 1995–1996

Examining the transitions from Forest in 1995–1996, Cropland experienced a gain intensity of 1.40%, above the uniform of 0.715%, which meant that Forest loss was targeted by Cropland in 1995–1996. This was further supported by good evidence where a commission error of 49.4% (above the mean of 32.7% in this period) was required in 270 pixels lost from Forest to Cropland to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Cropland in 1995–1996, Forest experienced a loss intensity of 0.0750%, above the uniform of 0.0614%, which meant that the gain of Cropland targeted Forest in 1995–1996. This was further supported by good evidence where a commission error of 18.1% (above the mean of 6.73% in this period) was required in these 270 pixels gained by Cropland from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Cropland and (2) the gain of Cropland targeted Forest, this transition where Cropland targeted Forest in 1995–1996 was truly systematic.

(3) Cropland systematically targeted Forest in 1996–1997

Examining the transitions from Forest in 1996–1997, Cropland experienced a gain intensity of 2.50%, above the uniform of 1.34%, which meant that Forest loss was targeted by Cropland in 1996–1997. This was further supported by good evidence where a commission error of 47.1% (above the mean of 32.7% in this period) was required in 494 pixels lost from Forest to Cropland to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Cropland in 1996–1997, Forest experienced a loss intensity of 0.138%, above the uniform of 0.119%, which meant that the gain of Cropland targeted Forest in 1996–1997. This was further supported by good evidence where a commission error of 13.5% (above the mean of 6.73% in this period) was required in these 494 pixels gained by Cropland from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Cropland and (2) the gain of Cropland targeted Forest, this transition where Cropland targeted Forest in 1996–1997 was truly systematic.

(4) Other Vegetation systematically targeted Forest in 1996–1997

Examining the transitions from Forest in 1996–1997, Other Vegetation experienced a gain intensity of 1.46%, above the uniform of 1.34%, which meant that Forest loss was targeted by Other Vegetation in 1996–1997. This was further supported by good evidence where a commission error of 8.69% (above the mean of 8.01% in this period) was required in 15 pixels lost from Forest to Other Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Other Vegetation in 1996–1997, Forest experienced a loss intensity of 0.00418%, above the uniform of 0.00318%, which meant that the gain of Other Vegetation targeted Forest in 1996–1997. This was further supported by good evidence where a commission error of 23.9% (above the mean of 4.79% in this period) was required in these 15 pixels gained by Other Vegetation from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Other Vegetation and (2) the gain of Other Vegetation targeted Forest, this transition where Other Vegetation targeted Forest in 1996–1997 was truly systematic.

(5) Non-Vegetation systematically avoided Forest in 1996–1997

Examining the transitions from Forest in 1996–1997, Non-Vegetation experienced a gain intensity of 0.0103%, below the uniform of 1.34%, which meant that Forest loss was avoided by Non-Vegetation in 1996–1997. This was further supported by good evidence where an omission error of 99.2% (above the mean of 59.8% in this period) was required. This meant that 131 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 1996–1997, Forest experienced a loss intensity of 0.000278%, below the uniform of 0.000431%, which meant that the gain of Non-Vegetation avoided Forest in 1996–1997. This was further supported by good evidence where an omission error of 35.5% (above the mean of 27.1% in this period) was required. This meant that 1 pixel had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 1996–1997 was truly systematic.

5.2.2. Land-cover regime shift dynamics (1997–2004)

(6) Mosaic Vegetation systematically targeted Forest in 2000–2001

Examining the transitions from Forest in 2000–2001, Mosaic Vegetation experienced a gain intensity of 8.89%, above the uniform of 7.06%, which meant that Forest loss was targeted by Mosaic Vegetation in 2000–2001. This was further supported by good evidence where a commission error of 22.1% (above the mean of 12.6% in this period) was required in 3058 pixels lost from Forest to Mosaic Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Mosaic Vegetation in 2000–2001, Forest experienced a loss intensity of 0.921%, above the uniform of 0.710%, which meant that the gain of Mosaic Vegetation targeted Forest in 2000–2001. This was further supported by good evidence where a commission error of 23.09% (above the mean of 23.06% in this period) was required in these 3058 pixels gained by Mosaic Vegetation from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Mosaic Vegetation and (2) the gain of Mosaic Vegetation targeted Forest, this transition where Mosaic Vegetation targeted Forest in 2000–2001 was truly systematic.

(7) Cropland systematically avoided Forest in 2000–2001

Examining the transitions from Forest in 2000–2001, Cropland experienced a gain intensity of 1.72%, below the uniform of 7.06%, which meant that Forest loss was avoided by Cropland in 2000–2001. This was further supported by good evidence where an omission error of 77.0% (above the mean of 58.7% in this period) was required. This meant that 1329 pixels had to be erroneously omitted in this transition from Forest to Cropland to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Cropland in 2000–2001, Forest experienced a loss intensity of 0.120%, below the uniform of 0.132%, which meant that the gain of Cropland avoided Forest in 2000–2001. This was further supported by good evidence where an omission error of 9.47% (above the mean of 1.35% in this period) was required. This meant that 41.6 pixels had to be erroneously omitted in this transition from Forest to Cropland to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Cropland and (2) the gain of Cropland avoided Forest, this transition where Cropland avoided Forest in 2000–2001 was truly systematic.

(8) Other Vegetation systematically avoided Forest in 2000–2001

Examining the transitions from Forest in 2000–2001, Other Vegetation experienced a gain intensity of 0%, below the uniform of 7.06%, which meant that Forest loss was avoided by Other Vegetation in 2000–2001. This was further supported by good evidence where an omission error of 100% (above the mean of 85.4% in this period) was required. This meant that 81 pixels had to be erroneously omitted in this transition from Forest to Other Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Other Vegetation in 2000–2001, Forest experienced a loss intensity of 0%, below the uniform of 0.000635%, which meant that the gain of Other Vegetation avoided Forest in 2000–2001. This was further supported by good evidence where an omission error of 100% (above the mean of 14.3% in this period) was required. This meant that 3 pixels had to be erroneously omitted in this transition from Forest to Other Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Other Vegetation and (2) the gain of Other Vegetation avoided Forest, this transition where Other Vegetation avoided Forest in 2000–2001 was truly systematic.

(9) Shrubland systematically targeted Forest in 2001–2002

Examining the transitions from Forest in 2001–2002, Shrubland experienced a gain intensity of 11.9%, above the uniform of 9.15%, which meant that Forest loss was targeted by Shrubland in 2001–2002. This was further supported by good evidence where a commission error of 25.2% (above the mean of 19.9% in this period) was required in 11274 pixels lost from Forest to Shrubland to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Shrubland in 2001–2002, Forest experienced a loss intensity of 3.51%, above the uniform of 2.89%, which meant that the gain of Shrubland targeted Forest in 2001–2002. This was further supported by good evidence where a commission error of 18.1% (above the mean of 16.7% in this period) was required in these 11274 pixels gained by Shrubland from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Shrubland and (2) the gain of Shrubland targeted Forest, this transition where Shrubland targeted in 2001–2002 was truly systematic.

(10) Non-Vegetation systematically avoided Forest in 2001–2002

Examining the transitions from Forest in 2001–2002, Non-Vegetation experienced a gain intensity of 0%, below the uniform of 9.15%, which meant that Forest loss was avoided by Non-Vegetation in 2001–2002. This was further supported by good evidence where an omission error of 100% (above the mean of 99.6% in this period) was required. This meant that 980 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 2001–2002, Forest experienced a loss intensity of 0%, below the uniform of 0.000216%, which meant that the gain of Non-Vegetation avoided Forest in 2001–2002. This was further supported by good evidence where an omission error of 100% (above the mean of 30.9% in this period) was required. This meant that 1 pixel had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 2001–2002 was truly systematic.

(11) Non-Vegetation systematically avoided Forest in 2002–2003

Examining the transitions from Forest in 2002–2003, Non-Vegetation experienced a gain intensity of 0%, below the uniform of 0.878%, which meant that Forest loss was avoided by Non-Vegetation in 2002–2003. This was further supported by good evidence where an omission error of 100% (above the mean of 99.6% in this period) was required. This meant that 87 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 2002–2003, Forest experienced a loss intensity of 0%, below the uniform of 0.000431%, which meant that the gain of Non-Vegetation avoided Forest in 2002–2003. This was further supported by good evidence where an omission error of 100% (above the mean of 30.9% in this period) was required. This meant that 2 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 2002–2003 was truly systematic.

(12) Shrubland systematically targeted Forest in 2003–2004

Examining the transitions from Forest in 2003–2004, Shrubland experienced a gain intensity of 10.1%, above the uniform of 7.20%, which meant that Forest loss was targeted by Shrubland in 2003–2004. This was further supported by good evidence where a commission error of 31.1% (above the mean of 19.9% in this period) was required in 10781 pixels lost from Forest to Shrubland to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Shrubland in 2003–2004, Forest experienced a loss intensity of 3.54%, above the uniform of 2.86%, which meant that the gain of Shrubland targeted Forest in 2003–2004. This was further supported by good evidence where a commission error of 19.8% (above the mean of 16.7% in this period) was required in these 10781 pixels gained by Shrubland from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Shrubland and (2) the gain of Shrubland targeted Forest, this transition where Shrubland targeted in 2003–2004 was truly systematic.

5.2.3. Post-land-cover regime shift dynamics (2004–2015)

(13) Mosaic Vegetation systematically targeted Forest in 2004–2005

Examining the transitions from Forest in 2004–2005, Mosaic Vegetation experienced a gain intensity of 0.729%, above the uniform of 0.451%, which meant that Forest loss was targeted by Mosaic Vegetation in 2004–2005. This was further supported by good evidence where a commission error of 38.3% (above the mean of 11.6% in this period) was required in 297 pixels lost from Forest to Mosaic Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Mosaic Vegetation in 2004–2005, Forest experienced a loss intensity of 0.102%, above the uniform of 0.0707%, which meant that the gain of Mosaic Vegetation targeted Forest in 2004–2005. This was further supported by good evidence where a commission error of 30.6% (above the mean of 10.4% in this period) was required in these 297 pixels gained by Mosaic Vegetation from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Mosaic Vegetation and (2) the gain of Mosaic Vegetation targeted Forest, this transition where Mosaic Vegetation targeted in 2004–2005 was truly systematic.

(14) Non-Vegetation systematically avoided Forest in 2004–2005

Examining the transitions from Forest in 2004–2005, Non-Vegetation experienced a gain intensity of 0%, below the uniform of 0.451%, which meant that Forest loss was avoided by Non-Vegetation in 2004–2005. This was further supported by good evidence where an omission error of 100% (above the mean of 59.3% in this period) was required. This meant that 44.1 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 2004–2005, Forest experienced a loss intensity of 0%, below the uniform of 0.00108%, which meant that the gain of Non-Vegetation avoided Forest in 2004–2005. This was further supported by good evidence where an omission error of 100% (above the mean of 57.1% in this period) was required. This meant that 4 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 2004–2005 was truly systematic.

(15) Non-Vegetation systematically avoided Forest in 2005–2006

Examining the transitions from Forest in 2005–2006, Non-Vegetation experienced a gain intensity of 0%, below the uniform of 0.130%, which meant that Forest loss was avoided by Non-Vegetation in 2005–2006. This was further supported by good evidence where an omission error of 100% (above the mean of 90.3% in this period) was required. This meant that 13 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 2005–2006, Forest experienced a loss intensity of 0%, below the uniform of 0.000431%, which meant that the gain of Non-Vegetation avoided Forest in 2005–2006. This was further supported by good evidence where an omission error of 100% (above the mean of 98.5% in this period) was required. This meant that 2 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 2005–2006 was truly systematic.

(16) Shrubland systematically targeted Forest in 2006–2007

Examining the transitions from Forest in 2006–2007, Shrubland experienced a gain intensity of 0.422%, above the uniform of 0.413%, which meant that Forest loss was targeted by Shrubland in 2006–2007. This was further supported by good evidence where a commission error of 2.16% (above the mean of 0.894% in this period) was required in 451 pixels lost from Forest to Shrubland to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Shrubland in 2006–2007, Forest experienced a loss intensity of 0.155%, above the uniform of 0.126%, which meant that the gain of Shrubland targeted Forest in 2006–2007. This was further supported by good evidence where a commission error of 18.6% (above the mean of 17.8% in this period) was required in these 451 pixels gained by Shrubland from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Shrubland and (2) the gain of Shrubland targeted Forest, this transition where Shrubland targeted in 2006–2007 was truly systematic.

(17) Mosaic Vegetation systematically targeted Forest in 2006–2007

Examining the transitions from Forest in 2006–2007, Mosaic Vegetation experienced a gain intensity of 0.661%, above the uniform of 0.413%, which meant that Forest loss was targeted by Mosaic Vegetation in 2006–2007. This was further supported by good evidence where a commission error of 37.7% (above the mean of 35.5% in this period) was required in 272 pixels lost from Forest to Mosaic Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Mosaic Vegetation in 2006–2007, Forest experienced a loss intensity of 0.0936%, above the uniform of 0.0687%, which meant that the gain of Mosaic Vegetation targeted Forest in 2006–2007. This was further supported by good evidence where a commission error of 26.6% (above the mean of 21.0% in this period) was required in these 272 pixels gained by Mosaic Vegetation from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Mosaic Vegetation and (2) the gain of Mosaic Vegetation targeted Forest, this transition where Mosaic Vegetation targeted in 2006–2007 was truly systematic.

(18) Other Vegetation systematically targeted Forest in 2006–2007

Examining the transitions from Forest in 2006–2007, Other Vegetation experienced a gain intensity of 0.811%, above the uniform of 0.413%, which meant that Forest loss was targeted by Other Vegetation in 2006–2007. This was further supported by good evidence where a commission error of 49.3% (above the mean of 8.17% in this period) was required in 9 pixels lost from Forest to Other Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Other Vegetation in 2006–2007, Forest experienced a loss intensity of 0.00310%, above the uniform of 0.00191%, which meant that the gain of Other Vegetation targeted Forest in 2006–2007. This was further supported by good evidence where a commission error of 38.4% (above the mean of 14.2% in this period) was required in these 9 pixels gained by Other Vegetation from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Other Vegetation and (2) the gain of Other Vegetation targeted Forest, this transition where Other Vegetation targeted in 2006–2007 was truly systematic.

(19) Cropland systematically avoided Forest in 2006–2007

Examining the transitions from Forest in 2006–2007, Cropland experienced a gain intensity of 0.0988%, below the uniform of 0.413%, which meant that Forest loss was avoided by Cropland in 2006–2007. This was further supported by good evidence where an omission error of 76.1% (above the mean of 39.6% in this period) was required. This meant that 77 pixels had to be erroneously omitted in this transition from Forest to Cropland to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Cropland in 2006–2007, Forest experienced a loss intensity of 0.00826%, below the uniform of 0.0194%, which meant that the gain of Cropland avoided Forest in 2006–2007. This was further supported by good evidence where an omission error of 57.4% (above the mean of 24.6% in this period) was required. This meant that 33 pixels had to be erroneously omitted in this transition from Forest to Cropland to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Cropland and (2) the gain of Cropland avoided Forest, this transition where Cropland avoided Forest in 2006–2007 was truly systematic.

(20) Non-Vegetation systematically targeted Forest in 2006–2007

Examining the transitions from Forest in 2006–2007, Non-Vegetation experienced a gain intensity of 0%, below the uniform of 0.413%, which meant that Forest loss was avoided by Non-Vegetation in 2006–2007. This was further supported by good evidence where an omission error of 100% (above the mean of 90.3% in this period) was required. This meant that 40.2 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 2006–2007, Forest experienced a loss intensity of 0%, below the uniform of 0.000647%, which meant that the gain of Non-Vegetation avoided Forest in 2006–2007. This was further supported by good evidence where an omission error of 100% (above the mean of 98.5% in this period) was required. This meant that 2 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 2006–2007 was truly systematic.

(21) Cropland systematically avoided Forest in 2007–2008

Examining the transitions from Forest in 2007–2008, Cropland experienced a gain intensity of 0.0739%, below the uniform of 0.306%, which meant that Forest loss was avoided by Cropland in 2007–2008. This was further supported by good evidence where an omission error of 75.9% (above the mean of 39.6% in this period) was required. This meant that 57 pixels had to be erroneously omitted in this transition from Forest to Cropland to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Cropland in 2007–2008, Forest experienced a loss intensity of 0.00620%, below the uniform of 0.0209%, which meant that the gain of Cropland avoided Forest in 2007–2008. This was further supported by good evidence where an omission error of 70.4% (above the mean of 24.6% in this period) was required. This meant that 43 pixels had to be erroneously omitted in this transition from Forest to Cropland to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Cropland and (2) the gain of Cropland avoided Forest, this transition where Cropland avoided Forest in 2007–2008 was truly systematic.

(22) Other Vegetation systematically avoided Forest in 2007–2008

Examining the transitions from Forest in 2007–2008, Other Vegetation experienced a gain intensity of 0%, below the uniform of 0.306%, which meant that Forest loss was avoided by Other Vegetation in 2007–2008. This was further supported by good evidence where an omission error of 100% (above the mean of 68.8% in this period) was required. This meant that 4 pixels had to be erroneously omitted in this transition from Forest to Other Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Other Vegetation in 2007–2008, Forest experienced a loss intensity of 0%, below the uniform of 0.000212%, which meant that the gain of Other Vegetation avoided Forest in 2007–2008. This was further supported by good evidence where an omission error of 100% (above the mean of 9.09% in this period) was required. This meant that 1 pixel had to be erroneously omitted in this transition from Forest to Other Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Other Vegetation and (2) the gain of Other Vegetation avoided Forest, this transition where Other Vegetation avoided Forest in 2007–2008 was truly systematic.

(23) Non-Vegetation systematically avoided Forest in 2007–2008

Examining the transitions from Forest in 2007–2008, Non-Vegetation experienced a gain intensity of 0%, below the uniform of 0.306%, which meant that Forest loss was avoided by Non-Vegetation in 2007–2008. This was further supported by good evidence where an omission error of 100% (above the mean of 90.3% in this period) was required. This meant that 30 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 2007–2008, Forest experienced a loss intensity of 0%, below the uniform of 0.000216%, which meant that the gain of Non-Vegetation avoided Forest in 2007–2008. This was further supported by good evidence where an omission error of 100% (above the mean of 98.5% in this period) was required. This meant that 1 pixel had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 2007–2008 was truly systematic.

(24) Mosaic Vegetation systematically targeted Forest in 2008–2009

Examining the transitions from Forest in 2008–2009, Mosaic Vegetation experienced a gain intensity of 1.06%, above the uniform of 0.482%, which meant that Forest loss was targeted by Mosaic Vegetation in 2008–2009. This was further supported by good evidence where a commission error of 54.9% (above the mean of 35.5% in this period) was required in 446 pixels lost from Forest to Mosaic Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Mosaic Vegetation in 2008–2009, Forest experienced a loss intensity of 0.154%, above the uniform of 0.113%, which meant that the gain of Mosaic Vegetation targeted Forest in 2008–2009. This was further supported by good evidence where a commission error of 26.5% (above the mean of 21.0% in this period) was required in these 446 pixels gained by Mosaic Vegetation from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Mosaic Vegetation and (2) the gain of Mosaic Vegetation targeted Forest, this transition where Mosaic Vegetation targeted in 2008–2009 was truly systematic.

(25) Non-Vegetation systematically avoided Forest in 2008–2009

Examining the transitions from Forest in 2008–2009, Non-Vegetation experienced a gain intensity of 0%, below the uniform of 0.482%, which meant that Forest loss was avoided by Non-Vegetation in 2008–2009. This was further supported by good evidence where an omission error of 100% (above the mean of 90.3% in this period) was required. This meant that 46.9 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 2008–2009, Forest experienced a loss intensity of 0%, below the uniform of 0.000431%, which meant that the gain of Non-Vegetation avoided Forest in 2008–2009. This was further supported by good evidence where an omission error of 100% (above the mean of 98.5% in this period) was required. This meant that 2 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 2008–2009 was truly systematic.

(26) Mosaic Vegetation systematically targeted Forest in 2009–2010

Examining the transitions from Forest in 2009–2010, Mosaic Vegetation experienced a gain intensity of 1.18%, above the uniform of 0.758%, which meant that Forest loss was targeted by Mosaic Vegetation in 2009–2010. This was further supported by good evidence where a commission error of 35.9% (above the mean of 35.5% in this period) was required in 500 pixels lost from Forest to Mosaic Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Mosaic Vegetation in 2009–2010, Forest experienced a loss intensity of 0.173%, above the uniform of 0.130%, which meant that the gain of Mosaic Vegetation targeted Forest in 2009–2010. This was further supported by good evidence where a commission error of 25.0% (above the mean of 21.0% in this period) was required in these 500 pixels gained by Mosaic Vegetation from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Mosaic Vegetation and (2) the gain of Mosaic Vegetation targeted Forest, this transition where Mosaic Vegetation targeted in 2009–2010 was truly systematic.

(27) Non-Vegetation systematically avoided Forest in 2009–2010

Examining the transitions from Forest in 2009–2010, Non-Vegetation experienced a gain intensity of 0%, below the uniform of 0.758%, which meant that Forest loss was avoided by Non-Vegetation in 2009–2010. This was further supported by good evidence where an omission error of 100% (above the mean of 90.3% in this period) was required. This meant that 74 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 2009–2010, Forest experienced a loss intensity of 0%, below the uniform of 0.000647%, which meant that the gain of Non-Vegetation avoided Forest in 2009–2010. This was further supported by good evidence where an omission error of 100% (above the mean of 98.5% in this period) was required. This meant that 2 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 2009–2010 was truly systematic.

(28) Other Vegetation systematically targeted Forest in 2010–2011

Examining the transitions from Forest in 2010–2011, Other Vegetation experienced a gain intensity of 1.075%, above the uniform of 0.642%, which meant that Forest loss was targeted by Other Vegetation in 2010–2011. This was further supported by good evidence where a commission error of 40.6% (above the mean of 8.17% in this period) was required in 12 pixels lost from Forest to Other Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Other Vegetation in 2010–2011, Forest experienced a loss intensity of 0.00417%, above the uniform of 0.00254%, which meant that the gain of Other Vegetation targeted Forest in 2010–2011. This was further supported by good evidence where a commission error of 39.1% (above the mean of 14.1% in this period) was required in these 12 pixels gained by Other Vegetation from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Other Vegetation and (2) the gain of Other Vegetation targeted Forest, this transition where Other Vegetation targeted in 2010–2011 was truly systematic.

(29) Non-Vegetation systematically avoided Forest in 2010–2011

Examining the transitions from Forest in 2010–2011, Non-Vegetation experienced a gain intensity of 0%, below the uniform of 0.642%, which meant that Forest loss was avoided by Non-Vegetation in 2010–2011. This was further supported by good evidence where an omission error of 100% (above the mean of 90.3% in this period) was required. This meant that 63 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 2010–2011, Forest experienced a loss intensity of 0%, below the uniform of 0.000216%, which meant that the gain of Non-Vegetation avoided Forest in 2010–2011. This was further supported by good evidence where an omission error of 100% (above the mean of 98.5% in this period) was required. This meant that 1 pixel had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 2010–2011 was truly systematic.

(30) Mosaic Vegetation systematically targeted Forest in 2011–2012

Examining the transitions from Forest in 2011–2012, Mosaic Vegetation experienced a gain intensity of 0.196%, above the uniform of 0.0958%, which meant that Forest loss was targeted by Mosaic Vegetation in 2011–2012. This was further supported by good evidence where a commission error of 51. 2% (above the mean of 35.5% in this period) was required in 84 pixels lost from Forest to Mosaic Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Mosaic Vegetation in 2011–2012, Forest experienced a loss intensity of 0.0293%, above the uniform of 0.0223%, which meant that the gain of Mosaic Vegetation targeted Forest in 2011–2012. This was further supported by good evidence where a commission error of 23.9% (above the mean of 21.0% in this period) was required in these 84 pixels gained by Mosaic Vegetation from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Mosaic Vegetation and (2) the gain of Mosaic Vegetation targeted Forest, this transition where Mosaic Vegetation targeted in 2011–2012 was truly systematic.

(31) Cropland systematically avoided Forest in 2011–2012

Examining the transitions from Forest in 2011–2012, Cropland experienced a gain intensity of 0.0281%, below the uniform of 0.0958%, which meant that Forest loss was avoided by Cropland in

2011–2012. This was further supported by good evidence where an omission error of 70.7% (above the mean of 39.6% in this period) was required. This meant that 17 pixels had to be erroneously omitted in this transition from Forest to Cropland to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Cropland in 2011–2012, Forest experienced a loss intensity of 0.00244%, below the uniform of 0.0493%, which meant that the gain of Cropland avoided Forest in 2011–2012. This was further supported by good evidence where an omission error of 95.0% (above the mean of 24.6% in this period) was required. This meant that 134 pixels had to be erroneously omitted in this transition from Forest to Cropland to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Cropland and (2) the gain of Cropland avoided Forest, this transition where Cropland avoided Forest in 2011–2012 was truly systematic.

(32) Non-Vegetation systematically avoided Forest in 2011–2012

Examining the transitions from Forest in 2011–2012, Non-Vegetation experienced a gain intensity of 0%, below the uniform of 0.0958%, which meant that Forest loss was avoided by Non-Vegetation in 2011–2012. This was further supported by good evidence where an omission error of 100% (above the mean of 90.3% in this period) was required. This meant that 10 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Non-Vegetation in 2011–2012, Forest experienced a loss intensity of 0%, below the uniform of 0.00151%, which meant that the gain of Non-Vegetation avoided Forest in 2011–2012. This was further supported by good evidence where an omission error of 100% (above the mean of 98.5% in this period) was required. This meant that 5 pixels had to be erroneously omitted in this transition from Forest to Non-Vegetation to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was avoided by Non-Vegetation and (2) the gain of Non-Vegetation avoided Forest, this transition where Non-Vegetation avoided Forest in 2011–2012 was truly systematic.

(33) Shrubland systematically targeted Forest in 2013–2014

Examining the transitions from Forest in 2013–2014, Shrubland experienced a gain intensity of 0.618%, above the uniform of 0.571%, which meant that Forest loss was targeted by Shrubland in 2013–2014. This was further supported by good evidence where a commission error of 7.68% (above the mean of 0.894% in this period) was required in 675 pixels lost from Forest to Shrubland to account for its deviation past the uniform, which we deem as rather unlikely.

Examining the transitions to Shrubland in 2013–2014, Forest experienced a loss intensity of 0.236%, above the uniform of 0.185%, which meant that the gain of Shrubland targeted Forest in 2013–2014. This was further supported by good evidence where a commission error of 21.5% (above the mean of 17. 8% in this period) was required in these 675 pixels gained by Shrubland from Forest to account for its deviation past the uniform, which we deem as rather unlikely.

Therefore, since good evidence supported the reciprocal relationship that (1) Forest loss was targeted by Shrubland and (2) the gain of Shrubland targeted Forest, this transition where Shrubland targeted in 2013–2014 was truly systematic.

6. Timeline summary of relevant key events based on literature review

Table A4. Timeline summary of relevant key events based on literature review to complement the narratives (see Section 4.3, Results) that describe the preconditions, triggers, and self-reinforcing processes for understanding the land-cover regime shift in Tanintharyi Region, Myanmar.

Period	Year	Event
Pre-land cover regime shift	1980–1981	▪ When Deng Xiao Ping came to power, China gradually reduced aid to CPB, which contributed to the collapse of the CPB [2]
	1988	▪ SLORC comes to power after 8888 Uprisings [3]
		▪ A border agreement between China and Burma closed off parts of China that had previously provided safe harbour for ethnic rebels, precipitating the collapse of the CPB [4,5]
		▪ Nakhon Si Thammarat mudslide/floods in southern Thailand [6]
		▪ Thailand negotiated logging concessions in border areas with Myanmar [2]
	1989	▪ Fall of the CPB [4]
		▪ SLORC negotiates first round of ceasefire agreements [3]
		▪ Thai government imposed total logging ban and revoked all logging licenses in Thailand [6,7]
		▪ Tatmadaw was allowed by Thai government to cross over into Thai territory to attack Mon, Karen, and Karenni strongholds [2]
		▪ As a result of Tatmadaw suppression of 8888 Uprisings, US/EU imposed sanctions which prohibited direct exports of Myanmar timber to US and Europe [5]; hence, redirecting Myanmar to solely trade with China, Thailand [2,5]
	1989–1993	▪ SLORC grants logging concessions along Thai-Myanmar border (in ethnic-controlled territories) to Thailand [8]
	Early 1990s	▪ SLORC negotiates second round of ceasefire agreements as part of a more deliberate strategy [3]
	1991	▪ Through Wastelands Act, Myanmar government starts to reallocate land from smallholder farmers to military institutions and officials [9]
	1993	▪ Following the SLORC's Khin Nyunt public calls for peace talks, Thai authorities then pressured Mon, Karen, and Karenni forces to make ceasefires with SLORC [2]
	1994	▪ Thai military and their National Security Council threatened NMSP to force 10,000 refugees in Thailand back to Myanmar if the NMSP refused to enter into ceasefires with the Myanmar government [3]
	1995	▪ Fall of Manerplaw—headquarters of the KNU, which paved the way for further militarisation and pressure for ceasefire deals [10]
		▪ NMSP concluded a ceasefire agreement with SLORC following Thai pressure (economic reasons), Tatmadaw military pressure, and the fall of the KNU and NDF in Manerplaw [2]
Land-cover regime shift	1999	▪ Edible Oils Policy passed to make Myanmar self-sufficient in edible oils [11]
	1999–2012	▪ Private large-scale agribusiness concessions (oil palm, rubber) allocated in Tanintharyi resulting in deforestation and conversion timber [9]
	2005	▪ Tanintharyi Nature Reserve (420,000 acres) formally approved [9]

Period	Year	Event
Post-land cover regime shift	2007	▪ Civil protests (or the Saffron Revolution) ensued against sudden increases in the government-controlled prices of diesel fuel and compressed natural gas [12,13]
	2008	▪ Myanmar's Third Constitution enacted after a referendum [14], which then came into force in 2011 [15]
		▪ Thailand and Myanmar governments signed MoU to establish the Dawei Special Economic Zone [16]
	2009	▪ Strain in Myanmar-China relations triggered due to SPDC operations against certain ceasefire groups (such as Kokang, Wa and Kachin) with strong historical Chinese ties, which were part of the efforts by the Myanmar government to convert these ethnic militias into "border protection forces [17,18]
	2010	▪ First Myanmar national elections held after 22 years of direct military rule [14]
	2010-present	▪ Thailand-Myanmar relations further improved, which was influenced by Myanmar's political and economic reforms since 2010 and Thailand's economic interests [19]
	2011–2012	▪ EU/US/CA/AU suspend almost all sanctions apart from an arms embargo, removing obstacles for companies from these countries to invest in Myanmar [16]
	2012	▪ Farmland Law and the Vacant, Fallow, and Virgin Land Management Law were passed [20]
		▪ NLD triumphed in by-elections, bringing Daw Aung San Suu Kyi into parliament [14]
		▪ Foreign Investment Law passed [20]
	2013	▪ EU lifted sanctions [5]
		▪ Myanmar government and EU initiated formal 'Forest Law Enforcement, Governance, and Trade' bilateral process [21]
	2014	▪ Myanmar export log ban came into force [21]
	2015	▪ NLD won a landslide victory during the national elections [22,23]

Note: CPB – Communist Party of Burma; KNU – Karen National Union; NDF – National Democratic Force; NLD – National League for Democracy; NMSP – New Mon State Party; SLORC – State Law and Order Restoration Council; SPDC – State Peace and Development Council.

7. Land cover assessment using visual interpretation

We implemented a land cover assessment through visual interpretation of available high-resolution satellite imagery to validate the connection between the land cover change results, specifically the major forest transitions from Forest to Shrubland, Forest to Mosaic Vegetation, and Forest to Cropland, and the proximate causes of deforestation identified in the narratives during the regime shift (1997–2004), specifically timber extraction by logging concessions as well as the expansion of agro-industrial plantations during the early and latter stages of the regime shift, respectively. We assessed historical high-resolution imagery available between 2000–2017 using the Open Foris Collect Earth system (http://www.openforis.org/tools/collect-earth.html), an integrated tool that enables systematic land cover data collection through augmented visual interpretation of historical time-series high-resolution satellite imagery.

We produced a land cover change map based on the annual time-series land cover maps (1992–2015) developed by European Space Agency Climate Change Initiative. We then extracted the change pixels representing the three major forest cover change transitions, opting to select the changes that occurred throughout the entire temporal domain of our study instead of only during the regime shift (1997–2004) since the land cover changes that occurred pre-1997 and post-2004 were relatively small compared to the extensive and rapid land cover change occurred during the regime shift.

The forest cover change transition raster map was vectorised to aggregate pixels of the same transition and to facilitate the random selection of sample polygons for the land cover assessment. A total of 150 sample polygons were randomly selected for each of the three forest transitions, from which the geographic coordinates of the polygon centroids were then obtained and exported as Keyhole Markup Language (KML) files that were used for the land cover assessment within the Open Foris Collect Earth system.

A survey form was designed using Collect Earth that streamlined the process of visual assessment of land cover from available high-resolution satellite imagery by facilitating the efficient in-survey data collection and post-hoc extraction of survey results. The visual assessment involved the identification of land cover categories within the polygon, including an indicative estimation of its areal extent percentage within that polygon. The survey results were then continuously archived within the Collect Earth system as an exportable Comma Separated Value (CSV) file as the user progressed through the assessment of sampled regions.

We applied a standardised interpretation criteria in the assessment of each polygon. Where imagery was available, polygons were assessed on whether they contained any of the eight following land cover categories; Oil Palm, Rubber, Rice Paddy, Logging, Built-Up Area, Forest, Mixed Vegetation, and Bare Ground, closely following the land cover categories mapped by De Alban et al. [24] within Tanintharyi Region, Myanmar. Data regarding the size of Oil Palm, Rubber, Rice Paddy, Logging and Built-Up Area were also collected by broadly categorizing them as either small, medium, or large (Table A5). We did not assess the relative sizes for Forest, Mixed Vegetation, and Bare Ground as we were not interested in knowing their proportion within the polygon. Note that Logging refers to areas where logging was observed, but it was challenging to discern the vegetation/crop type being extracted. Mixed Vegetation refers to areas where there was a heterogenous landscape consisting of different areal compositions of multiple natural vegetation categories such as Forest, Shrubland, Grassland, Bare Ground, Water Bodies, among others.

Table A5. Criteria for estimation of the size of a land cover category in a polygon.

Size	Description
Small	Land cover category observed totals up to < 20 % of the polygon, made up of small patches that are sporadically distributed.
Medium	Land cover category observed totals up to 20–50 (%) of the polygon, made up of several, semi-contiguous patches.
Large	Land cover category observed totals up to > 50 % of the polygon, made up of large expanses of contiguous patches.

We developed an interpretation key to guide our visual assessment of land cover types for each polygon using snapshots from the imagery representing various land cover present for a 9-ha area (i.e., the size of a single 300 x 300 m pixel in the ESA CCI land cover maps). We visually assessed the land cover across entire polygons that varied widely in terms of their sizes (i.e., number of pixels). Polygons that were too expansive were discarded and not used for the analyses as it proved unnecessarily cumbersome to conclude for the presence of a land cover category in a large, heterogenous landscape.

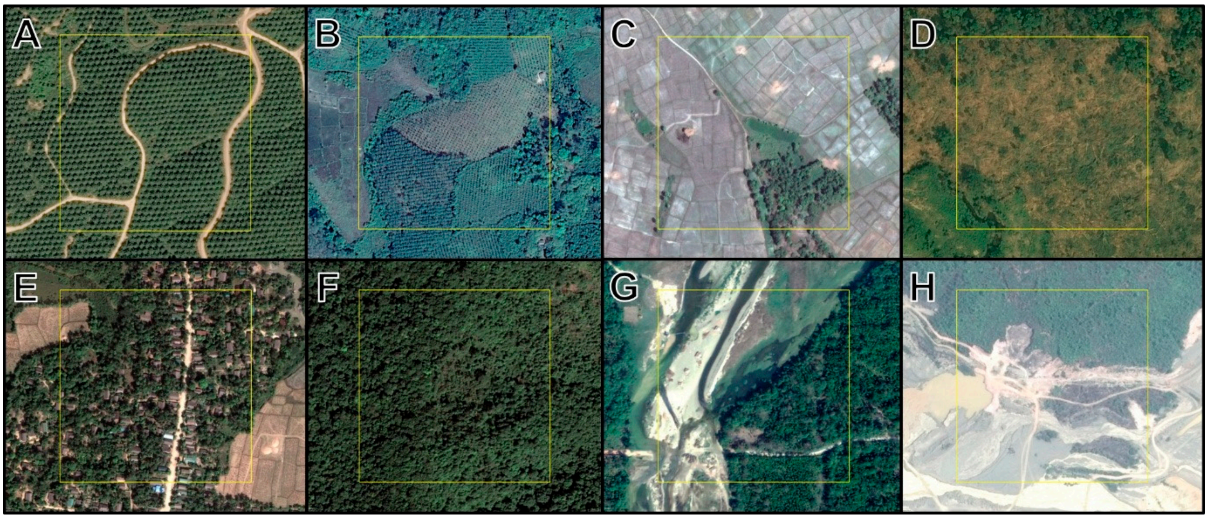

Figure A9. Sample interpretation key for a 9-ha plot as assessed through Collect Earth, representing the eight land cover categories assessed in this survey; (A) Oil Palm, (B) Rubber, (C) Rice Paddy, (D) Logging, (E) Built-Up Area, (F) Forest, (G) Mixed Vegetation, (H) Bare Ground.

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