Integrating Landscape Change and Socio-economic Evaluation on Tropical Wetland Ecosystem Services System

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Abstract

The importance of peat swamp forest (PSF) is not only supporting the dynamic link of ecosystem services but also provides the beneficial influences of community livelihood. However, human activities are threatening the PSF causing the loss of this pristine forest. Klias Peninsula, Sabah, Malaysia was an extensive PSF ecosystem, which was unfortunately destroyed by fires especially in 1998 and 2003. In order to identify what lies behind these human activities we integrate remote sensing, GIS and socioeconomic survey to determine the driving forces of landscape change at household and village level. Multitemporal satellite remote sensing from mid 80s to mid 2000s was use to quantify the wetland vegetation change in Klias Peninsula. The PSF had plummeted almost about 70% from 1985 to 2003. GIS using buffering analysis was used in this study to generate 3 different distances (1000m, 2000m and 3000m) with 3 identified factors (settlement, agriculture and road). Then an intersect overlay of the identified factors with PSF change area (due to fire event in 1998 and 2003) was conducted. The intersect overlay analysis showed that agriculture was the main factor contributing to the fire ignition and deforestation in this area. Field interview also reached the same conclusion that slash and burn for plantation was the major cause of the fires in 1998 and 2003. This study reveal that most of local people are farmers and traditional land clearing by slash and burn practices contribute to the degradation of the PSF.

OBJECTIVES

We aimed at examining the anthropogenic influences on the forest fire using remote sensing, GIS and socio-economic survey techniques.
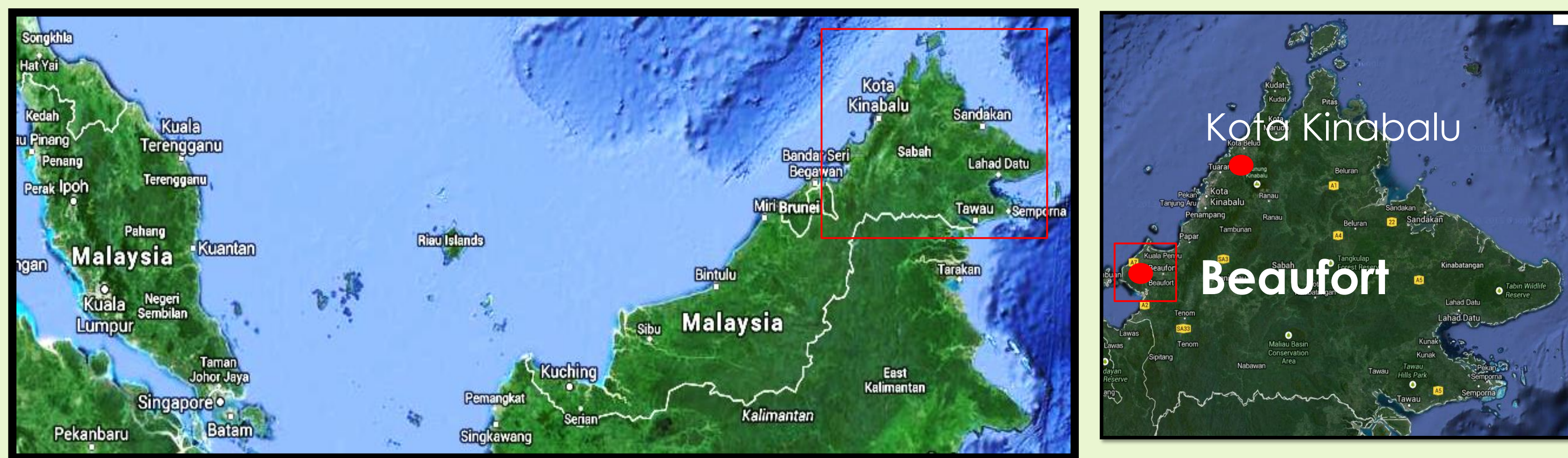
STUDY AREA

Figure 1: Location of Beaufort, Sabah, Malaysia

➢Beaufort area southwestern coast of Sabah (Figure 1).
➢Often referred as Klias Peninsula lies at the foothills of the Crocker Range.
➢ Rainfall with an annual average of 3500 mm.
➢The Klias Peninsula is an extensive wetland located in Beaufort area of approximately 130,000 ha.
➢ Fire brutally degraded the wetland especially peat swamp forest (PSF) vegetation type.
➢Adjacent area has been lost and become small patches because of fire during the El-Niño events in 1983, 1991, 1998 and 2003 (March-April).

METHODOLOGY

* Calculation use to identify the highest factor that was associated with the change area due to fire in 1998 and 2003 (Equation 1).

$$W_i = \cfrac{a_i}{\Sigma^I_{i=1} a_i} \quad \text{------------Equation 1}$$

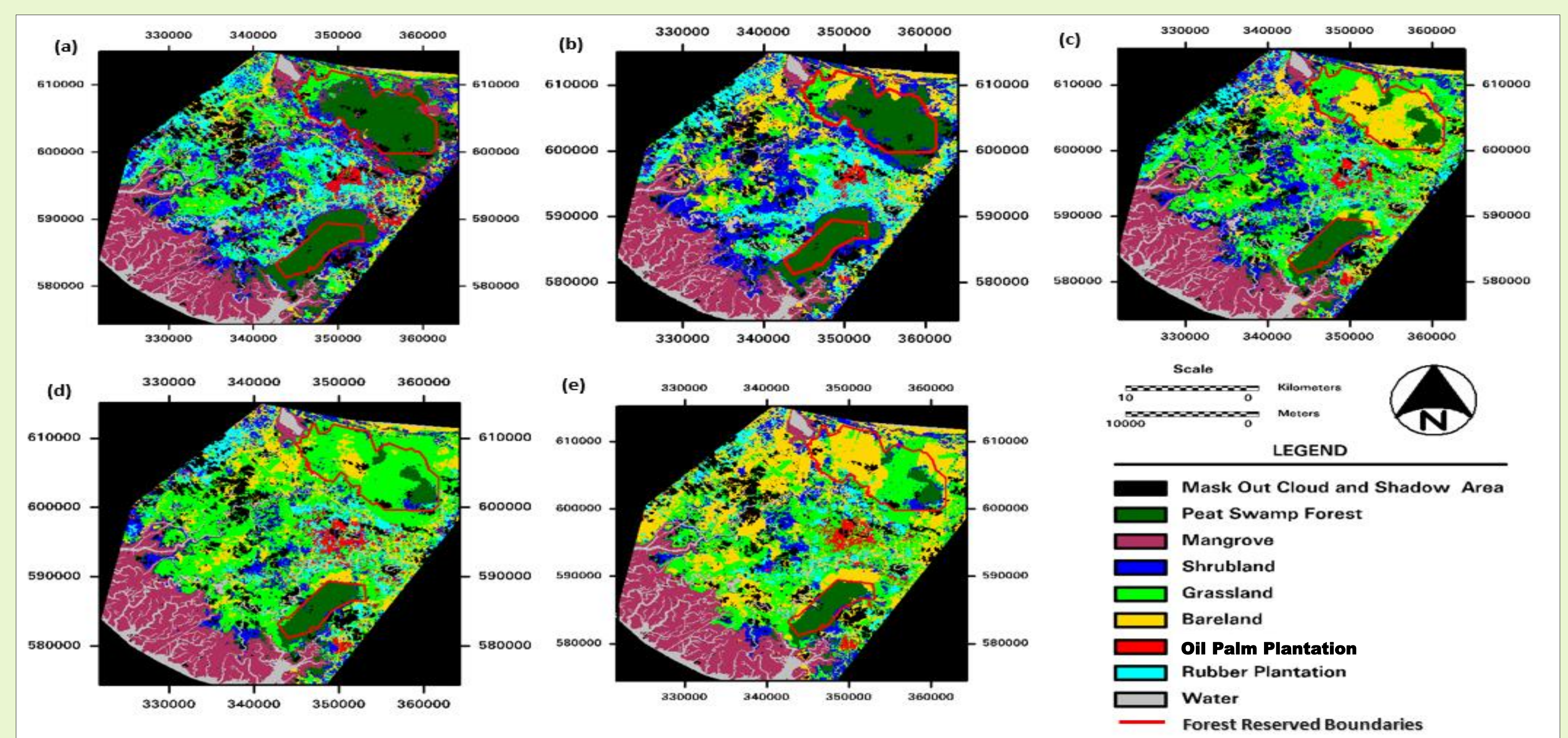Where; W_i = Weight , a_i = Anthropogenic activity factor

RESULT

Figure 2: Land Cover Classification Map Between 1985 to 2003 (Post-Fire) (a) 1985 (b) 1991 (c) 1998 (d) 2003 (Pre-fire) (e) 2003 (Post-fire)
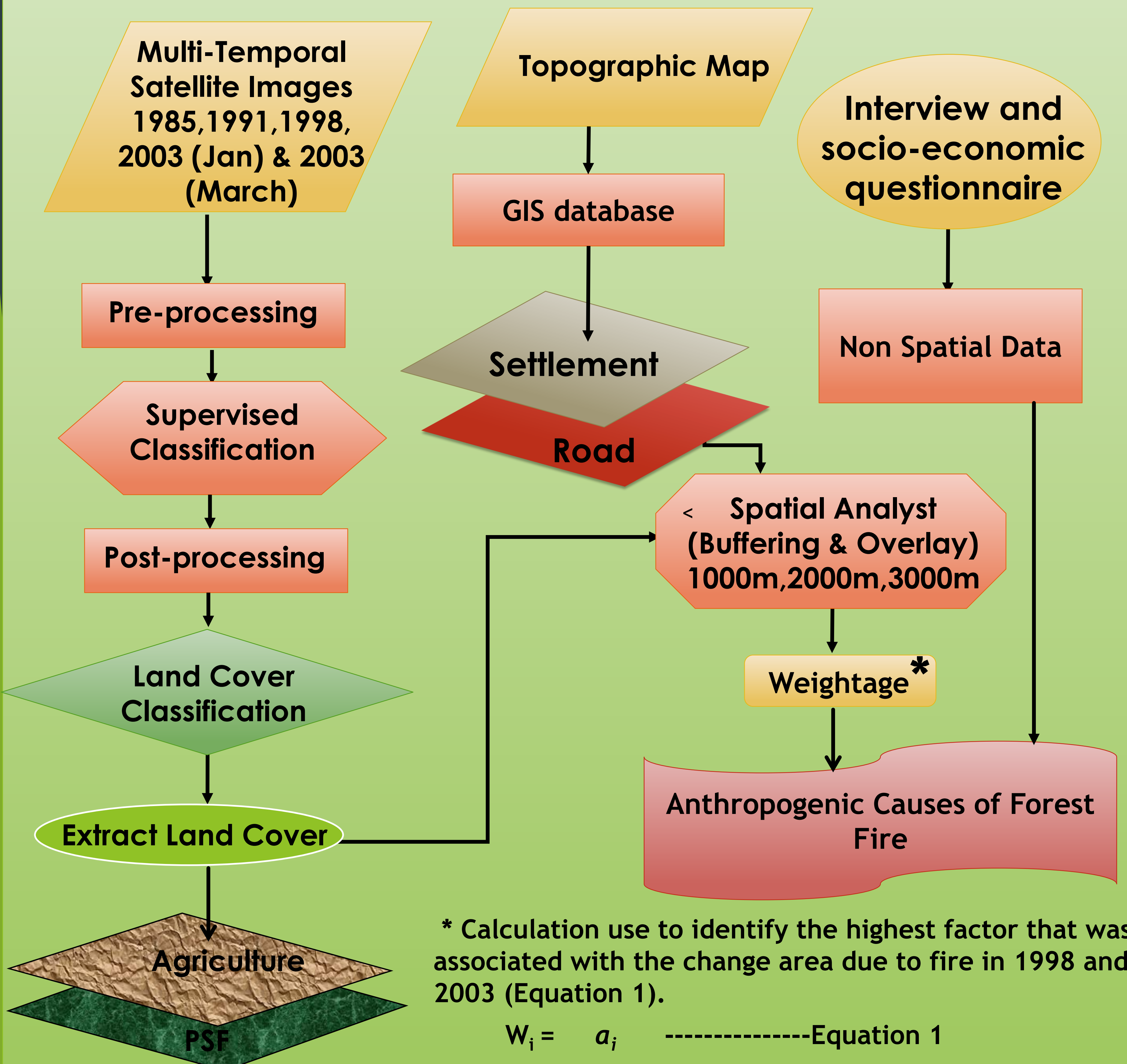
Table 1: Weightage for anthropogenic factor during 1998 El-Niño event; road, settlement and agriculture

Factor	a_i	W_i	(%)
Road	0.172	0.27	27%
Settlement	0.168	0.26	26%
Agriculture	0.295	0.47	47%
Total	0.635	1.00	100%

Table 2: Weightage for anthropogenic factor during 2003 El-Niño event; road, settlement and agriculture

Factor	a_i	W_i	(%)
Road	0.028	0.27	27%
Settlement	0.036	0.35	35%
Agriculture	0.040	0.38	38%
Total	0.104	1.00	100%

Table 3: Land clearing by respondents for plantation by distance

Land Clearing for Plantation	<1000m		2000m		>3000m		Total	
	n	%	n	%	n	%	n	%
No Answer	26	26.0	19	29.7	21	46.7	66	31.6
Slash and Burn	61	61.0	26	40.6	17	37.8	104	49.8
Machine	0	0	4	6.3	1	2.2	5	2.4
Machine and Herbicides Control	2	2.0	2	3.1	1	2.2	5	2.4
Chop and Herbicides Control	5	5.0	3	4.7	1	2.2	9	4.3
Chop	6	6	10	15.5	4	8.8	20	9.5
Total	100	100	64	100	45	100	209	100

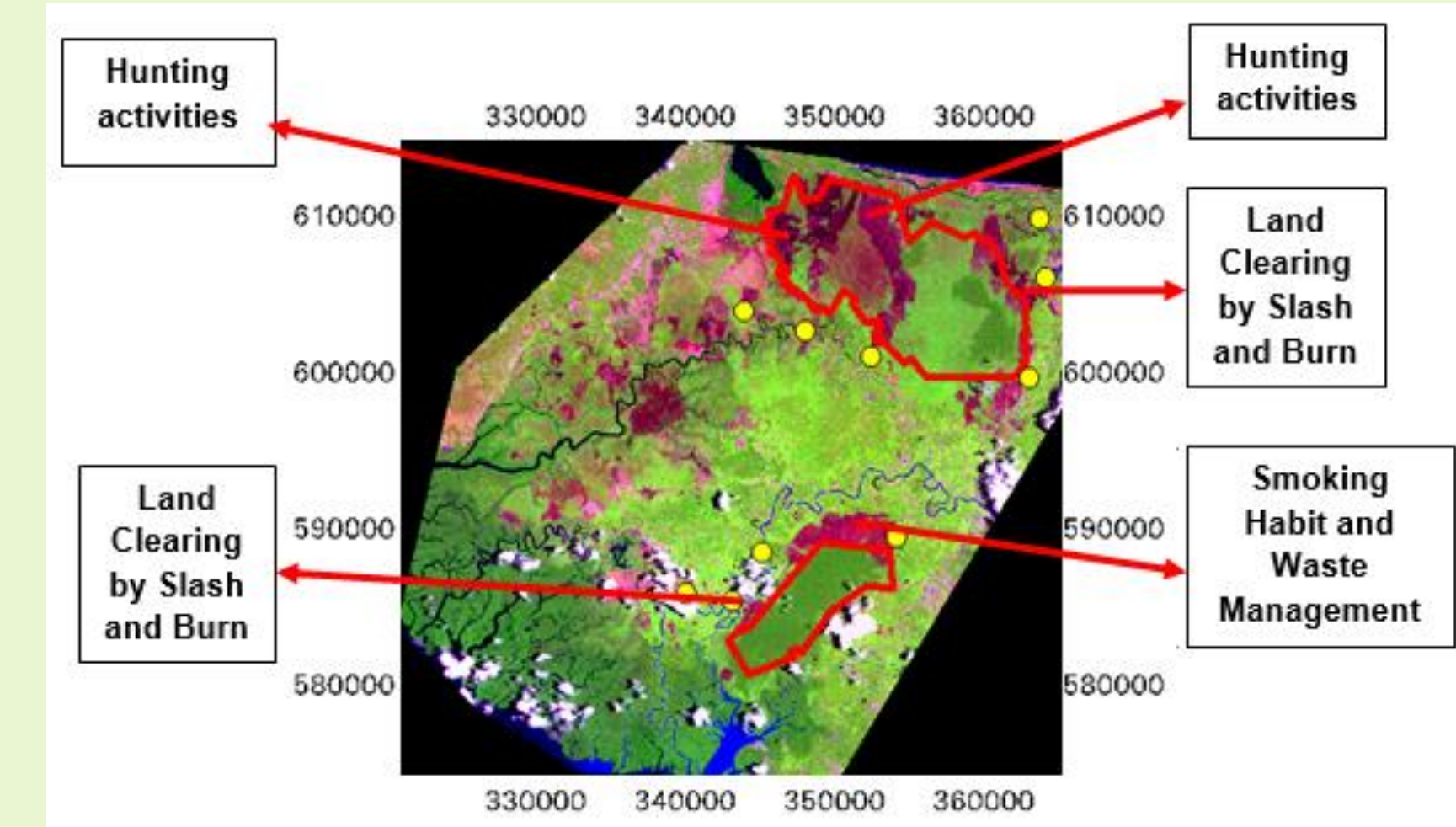n represent the number of respondent (n=209)

Figure 2: Respondents' personal information on the causes of forest fire in certain part of PSF reserves.

Table 4: Respondents reason of using slash and burn techniques by distance

Reason using slash and burn techniques	<1000m		2000m		>3000m		Total	
	n	%	n	%	n	%	n	%
No answer	36	36.0	34	53.1	29	64.4	99	47.4
Fertilizing soil	55	55.0	28	43.8	11	41753	94	45.0
Easiest way to clear land	8	8.0	2	3.1	5	11.1	15	7.2
Traditional method	1	1.0	0	0	0	0	1	0.5
Total	100	100	64	100	45	100	209	100

n represent the number of respondent (n=209)

CONCLUSION

➢Agriculture was the most influential contribution to the PSF vegetation change especially during El-Niño events.
➢Most farmers admitted that the techniques used for land clearing for plantation were by slash and burn (49.8%), the reason because it can fertilize the soil for cultivation.
➢Without proper control of unsustainable land use practices, deforestation leading to further fragmentation will destroy the remnants of the PSF in the Klias Peninsula of Beaufort area.

ACKNOWLEDGEMENT

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