Identification Of Driving Factors Causing Land Cover Change In Bandung Region Using Binary Logistic Regression Based On Geospatial Data

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Land cover is the description of the physical state of the earth's surface [4], [8] such as the type of vegetation, waters, deserts, forests, grounds, buildings, and so on.

Humans use the land as a facility to **supply the necessity of life** through the various forms of activity or interactions to the surrounding space.

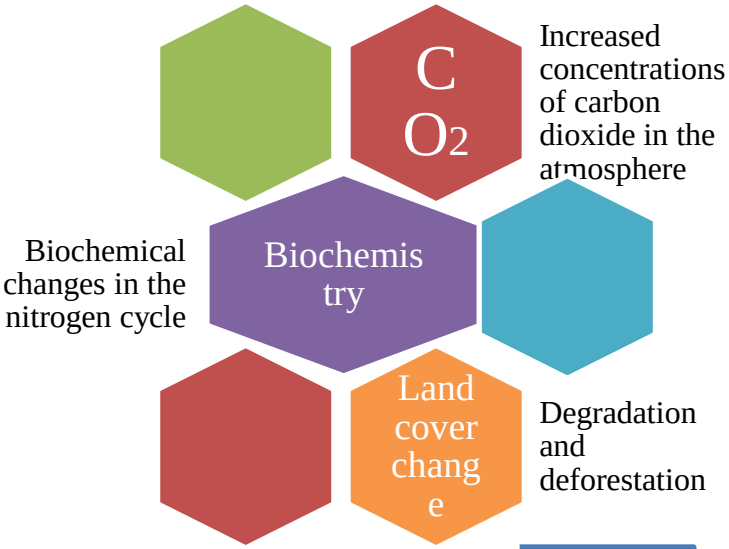
To cope with the complex conditions, it is necessary to simplify them in the form of **modeling**.

Therefore, a model has to consider the involved variables, such as the characteristic of the space where the human interaction is occurred.

[4] brissoulis, h.," *Analysis of land use change: theoritical and modeling approach"*, the web book of regional science, 2000. Http://www.Rri.Edu/webbook/brissoulis/

[8] jensen, J. R. .,"Remote sensing of the environment: an earth resource perspective", prentice-hall, inc, 544 p, 2000.

The cause of global environmental change (Agarwal et.al; Liu):



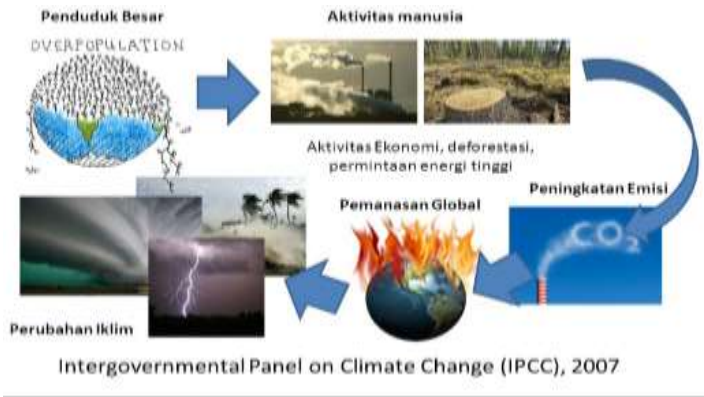


Figure 1. The cause of LULC

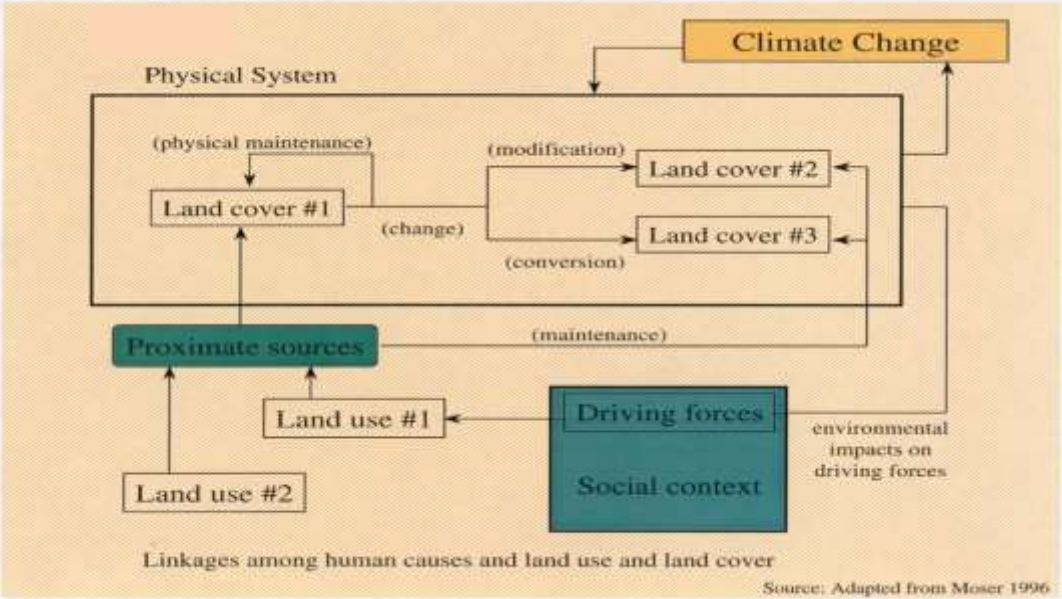


Figure 2. Linkages among human causes and LULC

- In many cases, human activities which are related to the land cover are often uncontrolled and give the negative impact to the environment.
- **Various negative impact** can occur indirectly as a result of land cover change, like the damage of the existing ecosystems, disruption of the biosphere-atmosphere interactions, and abnormal climate change.

The way to know and understand the land cover change phenomena can be approached through a form of modelling

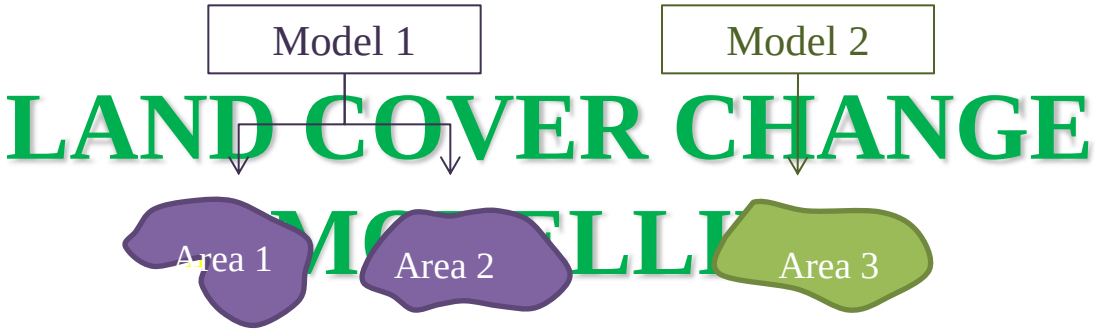


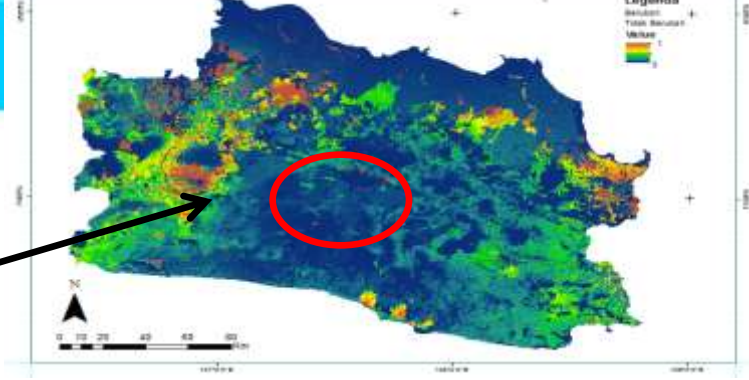
Figure 3. Land Cover Change Modelling

Although various modeling have the same purpose, but the location and method factors give more impact to the results. None of the model which can be applied to all locations.

Figure 4. Bandung Region

STUDY AREA

Bandung Region has an important role in the economy of West Java. The economic growth rate of Bandung is high, above the average economic growth of west Java, and also national. Bandung's economic growth rate from 2008-2012 averaged 8.62%, while the national economic growth of 5.8%. This year the economic growth rate of Bandung reaches more than 9%



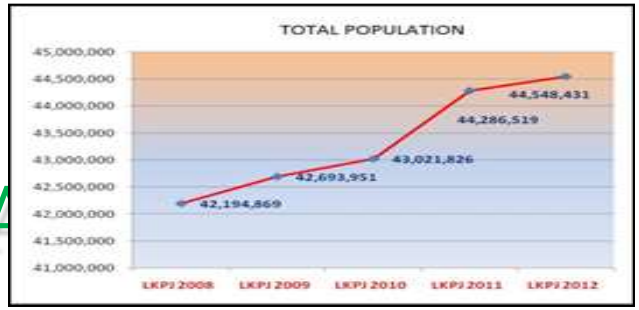


Figure 5. Total Population on West Java

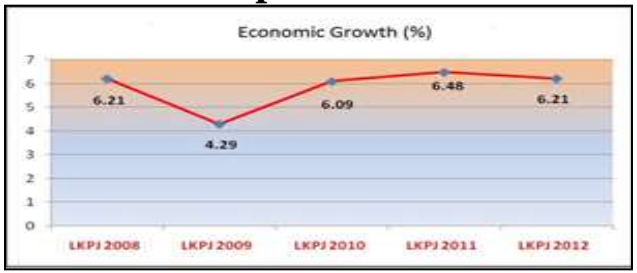
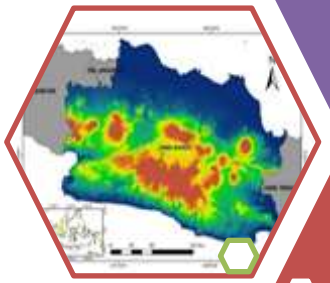


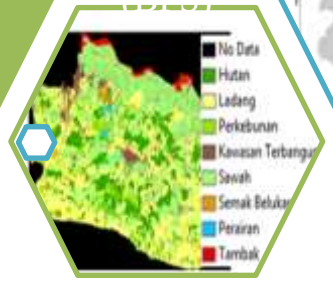
Figure 6. Economic Growth on West Java

Road Network Map derived from BIG



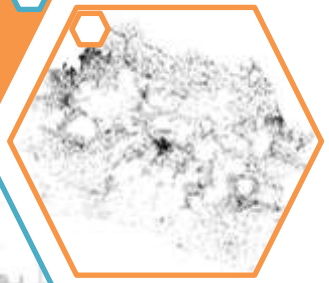
SRTM DEM with a resolution of 30 m (USGS 2010)

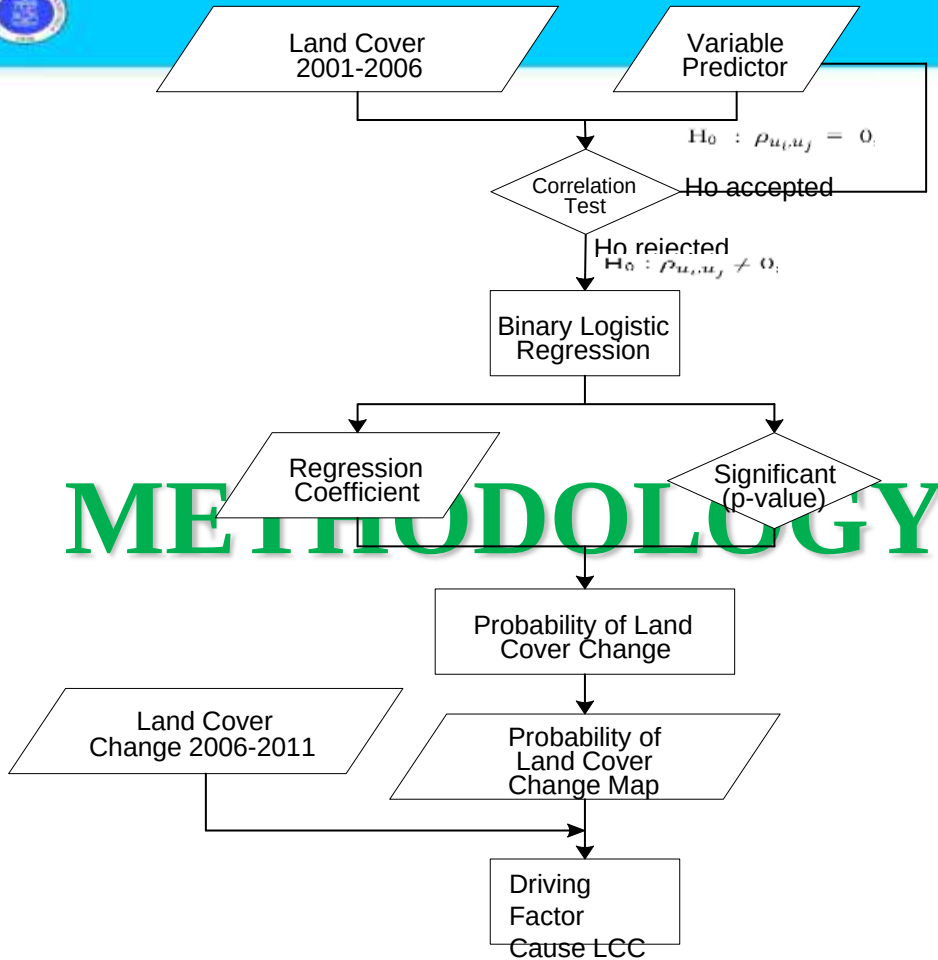
Map of Land Cover 2001, 2006 and 2011 derived from Geospatial Informatio



Population Data 2001 and 2006 derived from the Central Statistical Agency

Administrative Boundary Map derived from BIG





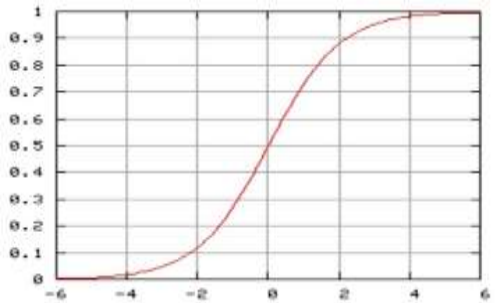
METHODOLOGY

What is Logistic Regression?

$$Logit\ (\pi) = ln\frac{\pi_i}{1-\pi_i} = \propto + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$$

$$\frac{\pi_i}{1-\pi_i} = \exp(\propto + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n)$$

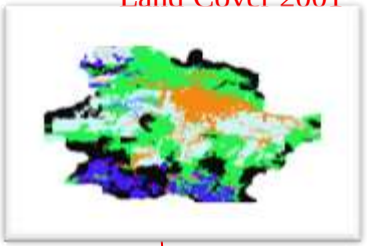
$$\pi(x) = \frac{exp\ (\alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n)}{1 + exp(\alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n)}$$



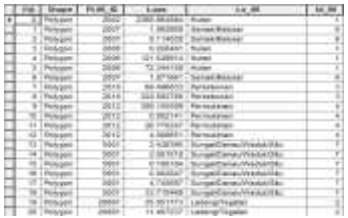
In statistics, **logistic regression**, or **logit regression**, or **logit** model is a **regression** model where the dependent variable (DV) is categorical. This article covers the case of **binary** dependent variables—that is, where it can take only two values, such as pass/fail, win/lose, change/not change, or healthy/sick.

Land Cover Change Using Binary Number

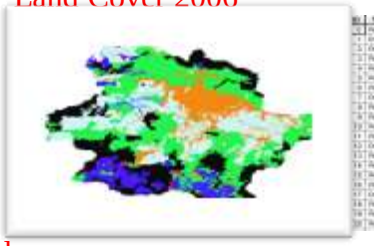
Land Cover 2001



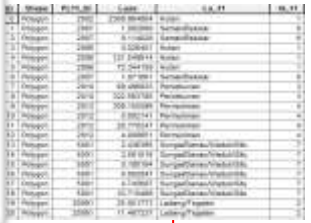
Atributte Data



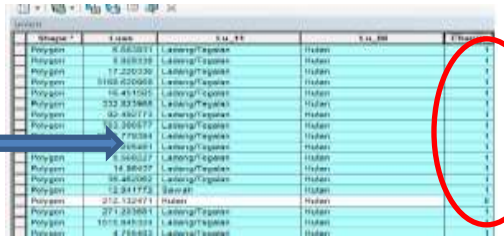
Land Cover 2006



Atributte Data

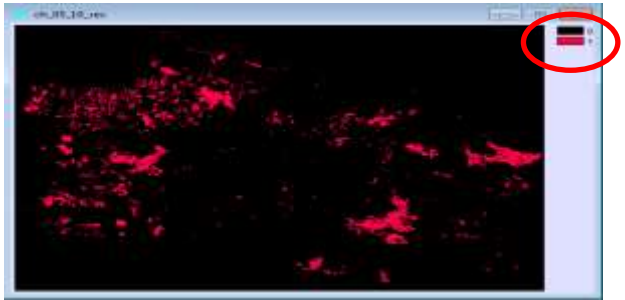


Overlay



"1"= change

"0"=not change



RESULT & DISCUSSION

Land cover / Driving Factors	Forest		Field/Moor		Plantations		Built Up Area		Shrubs		Paddy Field	
	B	p-value	B	p-value	B	p-value	B	p-value	B	p-value	B	p-value
Slope	-2,74E-03	0,00E+00	3,67E-04	0,00E+00	1,00E-03	0,00E+00	-1,23E-03	0,00E+00	-3,97E-05	6,50E-02	-1,92E-03	0,00E+00
Curvature	2,05E-02	8,55E-04	-1,42E-03	3,39E-02	-4,83E-03	2,68E-05	8,74E-03	1,31E-04	4,17E-03	2,84E-01	9,17E-03	6,81E-31
Elevation	-2,74E-03	0,00E+00	3,67E-04	0,00E+00	1,00E-03	0,00E+00	-1,23E-03	0,00E+00	-3,97E-05	6,50E-02	-1,92E-03	0,00E+00
Population	-4,44E+00	0,00E+00	-2,58E-02	0,00E+00	-8,36E-03	0,00E+00	6,98E-02	0,00E+00	1,06E-02	0,00E+00	-2,29E-02	0,00E+00
Distance To Road	-1,48E-01	1,05E-05	1,92E-05	3,67E-96	2,54E-04	0,00E+00	-1,00E-04	1,68E-208	-1,77E-04	1,37E-31	-1,49E-04	0,00E+00
Distance To Cimahi	-1,64E-04	8,72E-73	-7,94E-05	0,00E+00	2,90E-06	2,70E-01	-1,29E-04	1,75E-175	-2,55E-05	7,22E-05	-2,79E-04	0,00E+00
Distance To Soreang	-3,04E-05	1,91E-55	-7,96E-06	4,96E-152	1,54E-04	0,00E+00	-1,45E-05	5,28E-56	1,06E-04	0,00E+00	-3,74E-05	0,00E+00
Distance To Bandung	6,93E-05	2,16E-101	2,87E-05	0,00E+00	2,30E-05	3,88E-126	3,81E-05	2,07E-136	-1,80E-05	1,33E-13	8,33E-05	0,00E+00
Distance To Ngamprah	1,86E-04	2,93E-245	6,23E-05	0,00E+00	-1,27E-04	0,00E+00	1,13E-04	0,00E+00	-7,88E-05	7,60E-105	2,72E-04	0,00E+00

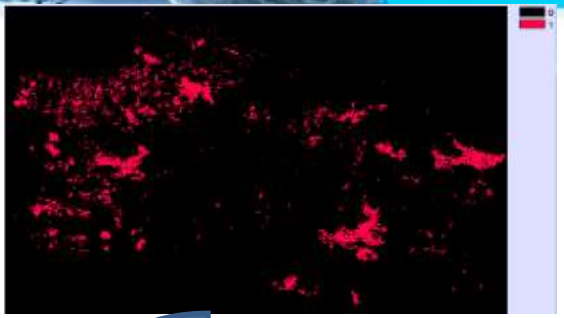
Table above interprets the influence of the driving factors of land cover changes on each land cover classes. Each driving factor has diverse influences for each class of land, which is characterized by positive or negative impacts. The whole predictor variables which are not proven to be correlated to land cover changes in Bandung Region are not included in the calculation of regression. Based on those result, all of the predictor variables proven give the impact that cause land cover change in Bandung Area with level of confident 95 % except for distance to Cimahi (plantation class) and curvature (shrubs class) has level of confident 70%

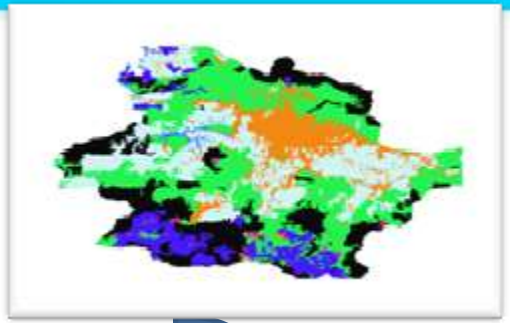
Land cover / Driving Factors	Forest	Field/Moor	Plantations	Built Up Area	Shrubs	Paddy Field
Slope						
Curvature						
Elevation						
Population						
Distance To Road						
Distance To Cimahi						
Distance To Soreang						
Distance To Bandung						
Distance To Ngamprah						

Factor cause land cover change

Factor did not caused Land cover change

Cut Off value for each land cover classes





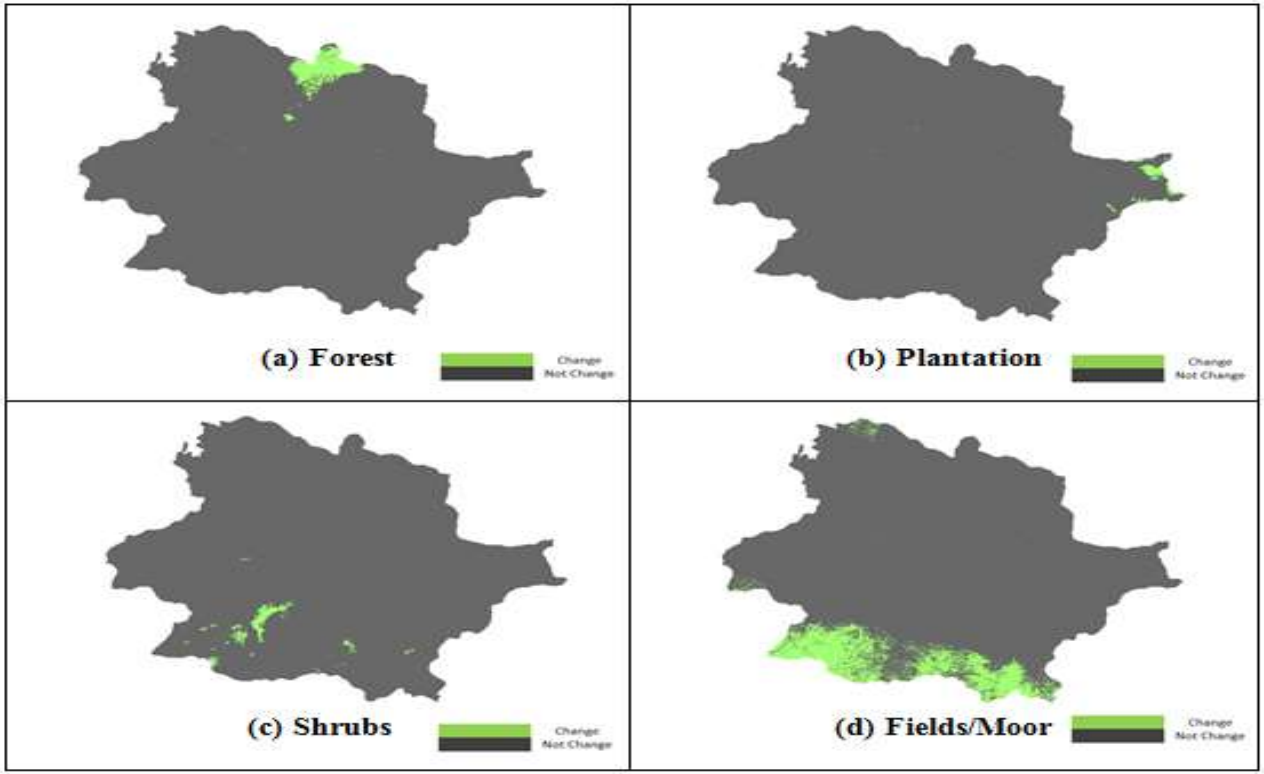
ID	Probabilitas	Aktual
1	0.64	1
2	0.58	1
3	0.25	0
4	0.26	0
5	0.60	0
6	0.63	1
7	0.32	0
8	0.33	0
9	0.55	1
10	0.55	1
11	0.32	1
12	0.33	1
.....	.....	.....
.....	.....	.....
4562528	0.08	0
4562529	0.09	0
4562530	0.18	0

Land Cover Classes	Cut off Value
Forest	0,1594
Field/Moor	0,2384
Plantation	0,2697
Built up Area	1,0000
Paddy Field	0,0888
Shrubs	0,6423

As discussed previously, the implementation of BLR method will generate a probability in the range of 0 to 1. Category 0 indicates no changes of land cover, while category 1 shows the changes of land cover.

RESULT & DISCUSSION

After the classification process is done for each class of land cover, then at this stage will be obtained maps of land cover change prediction in Bandung Region that already categorized in to changed and not changed.



FINAL REMARK

- RLB model shows that each land cover classes influenced by the driving factors that are not homogeneous. Thus the driving factors in land cover changes must be identified individually, not as a whole study area.

Land Cover / Driving Factors	Forest	Field/Moor	Plantation	Built Up Area	Shrubs	Paddy Field
Slope						
Curvature						
Elevation						
Population						
Distance To Road						

Figure 7. Driving Factors Cause LCC in Bandung Region

Land Cover / Driving Factors	Forest	Field/Moor	Plantation	Built Up Area	Shrubs	Paddy Field
Slope						
Curvature						
Elevation						
Population						
Distance To Road						

Figure 8. Driving Factors Cause LCC in West Java Province

- Overall, the drivers of both physical and socioeconomic aspects tend to have an equally influence as a factor that causes land cover changes in the Bandung Region.

ACKNOWLEDGMENT

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Thank You

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