

Developing National Geospatial Thematic Information on Land Cover/Land Use: An Implementation of One Map Policy

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ABSTRACT

National Thematic Land Cover/Land Use Geospatial Information of Indonesia have been produced by several Ministries and Institutions more than decades. During the Cabinet Meeting on December 23 2010, the President of Indonesia showed the discrepancy of the land cover maps produced by the Ministry of Forestry and the Ministry of Environment. The finding of this map discrepancy gave the spirit to state the importance of One Map Policy. This policy is then strengthened by the Law No. 4/2011 on Geospatial Information. In this Law, BIG is given mandat to implement One Map Policy. As an initial step to implement One Map Policy, in 2013 BIG coordinated the related ministries/agencies to review the classification standard of land cover for land cover mapping with the scale of 1: 250.000. This effort resulted the new classification standard of land cover. Currently, BIG coopertaing with the related Ministries/Agencies are developing one map of national land cover, using the new classification standard of land cover concerned. The one map of National land cover developed will be used as baseline by stakeholders for any purposes, such as for biomass mapping, food security, national spatial planning, etc.

1. BACKGROUND

Currently, Indonesia has various types of land cover/land uses which are determined by the regional main lands. The numerous typical topographical and morphological features has influenced the land cover/land uses above them. In order to understanding the land cover it is crucial to have better understanding of the earth's fundamental characteristics and process (Giri, 2012). With this various information Indonesia has strategies to develop land cover information concerning the sectorals' purposes.

Land Cover and Land Use is very dynamic and essential for planning, but it is relies on its accuracy and reliable information given (Clawson and Stewart, 1965).

Indonesia has several ministries and institutions producing land cover maps based on their concern. Those are, Ministry of Forestry, Ministry of Environmental, Ministry of Agriculture, Ministry of Public Work, National Land Agency, and Geospatial Information Agency. They have been producing the land cover maps for several years. This map discrepancy makes users of land cover map confused.

The phenomena of the map discrepancy was identified by the Former President of the Republic Indonesia Susilo Bambang Yudoyono (SBY) during the Cabinet Meeting on 23 December 2010. In the Cabinet Meeting President SBY stated that there should be only one map as the national reference. The President statement was formulated as the Presidential Instruction (Inpres No 10/2011). To strengthen this presidential instruction, the Government of Indonesia has ratified the law of Geospatial Information on 21 April 2011.

According to the Law of Geospatial Information, there is a need to integrate thematic geospatial information including land cover maps produced by ministries and agencies, to create an accurate and accountable thematic geospatial information. The Integrating land cover/land use map is an implementation of One Map Policy as main goal of the Law of Geospatial Information.

2. OBJECTIVES

This paper has objectives to show the integration of land cover map as an implementation of one map policy. This presidential issue becomes a governmental policy to show the unity of Indonesian in management of national natural resources. The integration of land cover geospatial information is based on National Land Cover Classification.

3. 2014 NATIONAL LAND COVER CLASSIFICATION

Integrating one map is not an easy task to do. Sectoral concerns must be accounted, such as Ministry of forestry has concerned on the forestry livelihood, and ministry of environmental has a program to increase green environment on regency level. On another issue, National

| Indonesia National Standar Land Cover Classification | | | | | |
|--|--------------------------------|--------------------------------|--|--|-------------------------------|
| 2010 | | | 2014 | | |
| Vegetated | Cultivated | Dominant Vegetation | Natural/Semi-Natural Vegetation | Forest and Natural/Semi-Natural Vegetation | |
| | Non-Cultivated | | Cultivated Vegetation | Settled Cultivated Vegetation | Shifted Cultivated Vegetation |
| Non-Vegetated | Open Land | Non-Dominant Vegetation | Natural/Semi-Natural Non-Dominant Vegetation | Natural/Semi-natural Water Body | |
| | Settlement and non agriculture | | | Natural/Semi-natural Open Land | |
| | Water Body | | Cultivated Non Vegetation | Atrificial Water Body | |
| | | | | Cultivated Open Land and emplacement | |
| | | Built Area | | | |

Table 1. Revision of Indonesian Standard Land Cover Classification

Land Agency has a concerned on land status, even though has no relation with land cover, but mostly related to the land uses.

This showed the importance of land cover and land use classification. Governments had collected data especially about land independently and worked without coordination, this may cause duplication data and effort, Anderson (1975). The unparalleled working process showed the necessity for standardization.

To obtain Indonesian National Land Cover, remote sensing data and processing are commonly used by ministries and agencies. These are the outcome from the advance technology and efficient land cover mapping methodology. Landsat imagery has become the main satellite data to obtain land cover information. LAPAN (National Aeronautics and Space Institute) has a duty to serve a national satellite imagery distribution. The methodology and classification are different among the ministries and agencies; the similarity of the methodology is the visual interpretation for land cover classification. The dissimilarity of classifications on land cover has produced one national classification standardized by

Table 2. Matrix of Ministries and Agencies who conducted Land Cover Mapping

| Parameter | Ministry of Forestry | Ministry of Environment | National Land Agency | Ministry of Agriculture | BIG |
|-----------------|----------------------------|-----------------------------|----------------------------|----------------------------|----------------------------|
| Method | Remote Sensing Field Check | Remote Sensing Field Check | Remote Sensing Field Check | Remote Sensing Field Check | Remote Sensing Field Check |
| Periode | Yearly | Yearly | Yearly | Once (2010 and 2011) | Random |
| Lokasi | National | National | National | National | Priority Island |
| Focusing | All Classes | All Classes | All Classes | Rice Field | All Classes |
| Goal | Deforestation | Indonesian Vegetation Index | Land Status | Rice Field Mapping | Land Cover Mapping |
| Number of Class | 23 Classes | 15 Classes | 12 Classes | 4 Classes | 20 Classes |
| Scale | 1:250.000 | 1:100.000 | 1:250.000 | 1:5.000 and 1:10.000 | 1:250.000 |

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National Standardization Agency. The national classification for land cover had established on 2010. The classification referred to FAO Land Cover/Land Use Classification with ISO 19144-1 for Geographical Information – Classification System.

The new land cover classification has been established in 2014 and it is the abolishment of the late classification in 2010. The structures are still the same with more hierarchical land cover classes. The term of land cover is differ from land use, but it seldom land use classes are called as land covers, for example is paddy field (*sawah*) is a land use, but its nationally recognized as land cover.

The land cover classes are hierarchical according to the map scale, 1:1.000.000; 1:250.000; 1:50.000/1:25.000. These classes is defined by the minimum object recognition on those maps scale compared with satellite imagery spatial resolution with visual interpretation.

4. NATIONAL LAND COVER PRODUCERS

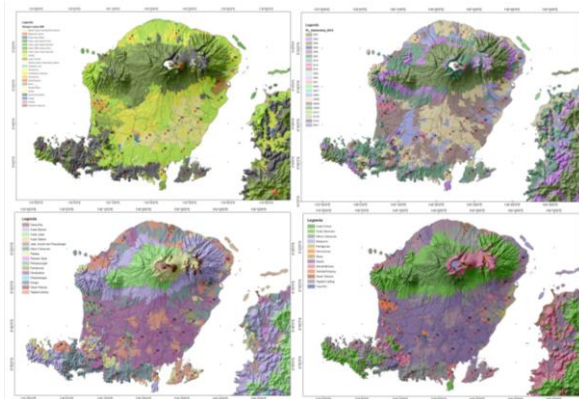


Figure 1. Land Cover Maps by Ministries

Indonesia has several ministries and agencies produce land cover maps. Although they originally named as different names, but they consist as land cover classes. Ministries and agencies who produce them are Geospatial Information Agency, Ministry of Forestry (2014), Ministry of Environment (2014), National Land Agency, and Ministry of Agriculture. These ministries and agencies have different concern on the land cover map, but generally have the same structure of classes.

Ministry of Forestry conducted land cover mapping for deforestation, where Ministry of Environment (before it merged with ministry of Forestry) had a task to improve the vegetation in spatial structure. Ministry of Agriculture have a duty to obtain rice field sustainability information, and National Land Agency is evaluating for land status.

Geospatial Information Agency have a great concept in fulfilling the mandate of one map policy. The sectoral land cover maps is harmonized in one national land cover which is

approved by the ministries and agencies. Geospatial Information Agency had managed the synchronizing of the land cover map, especially on the classes and topological features.

5. MAP DISCREPANCY AND ONE MAP POLICY

The Policy of one map as in The Presidential Instruction in 2011 was emerged because there were map discrepancies.

One of the map discrepancy was the land cover map. Because there was different standard lead to the miss count of the total area of forest in Indonesia. The sources of these maps were from Ministry of Environment and Ministry of Forestry.

While the map discrepancy emerged, the discussion was lead to find out the real

Forest maps, 2009

Forest in million hectares

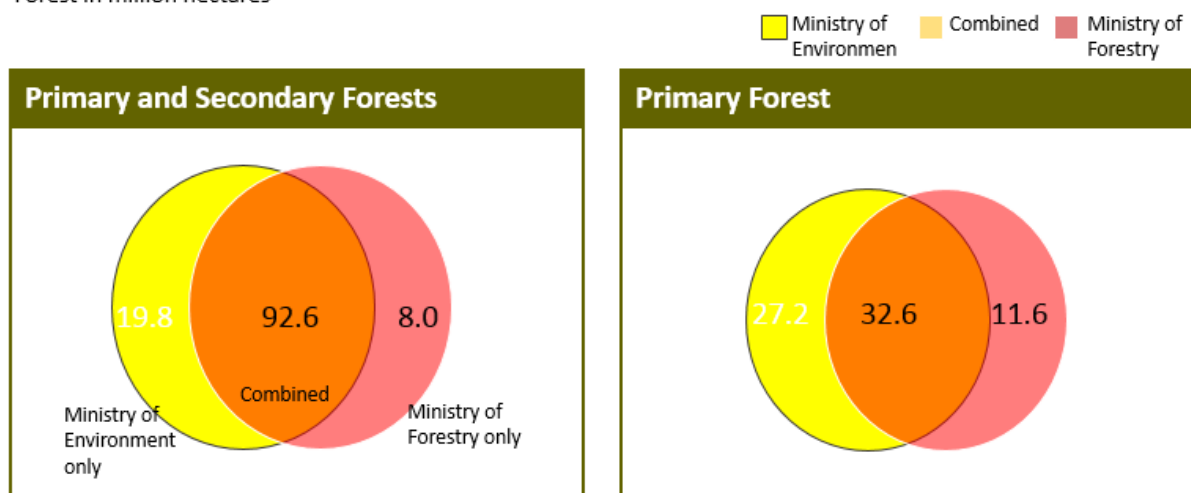


Figure 2. Map Discrepancy show the miscalculate of Forest Cover

issues. There was no similarity of one reference (base map), one standard, One Database, and One Geo-portal.

One reference means one base map. Topographic maps were produced by some ministries/agencies, which have different spatial references. This lead to misapprehend on the geometric accuracy of maps.

One standard in one map policy is included using the same definition, methodology and classification. This standard is to be regulated by Indonesia's National Standard Agency. BIG has one of the technical committee on the geospatial information standard.

One database has important part as one integrated database of spatial and non-spatial information – cross-sectors and cross-levels. The same database and single database can decrease the overlapping and missing information.

One Geo-Portal, one infrastructure of data sharing is the key to eliminate any misdoubt information which produce by stake holders. Any map produced by national and sub-national government institution has to be integrated on one geo-portal system for public transparency & participation: Indonesia National Spatial Data Infrastructure (Ina-SDI). The Indonesian Geo-portal: <http://tanahair.indonesia.go.id>, or <http://maps.ina-sdi.or.id>.

6. HARMONIZATION LAND COVER MAPS

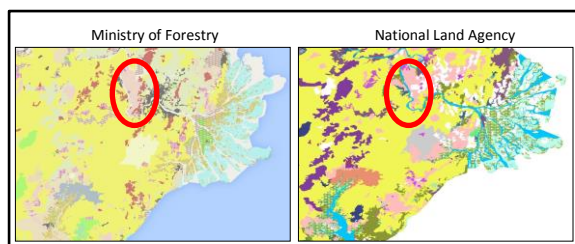


Figure 3. Differences of land cover classes

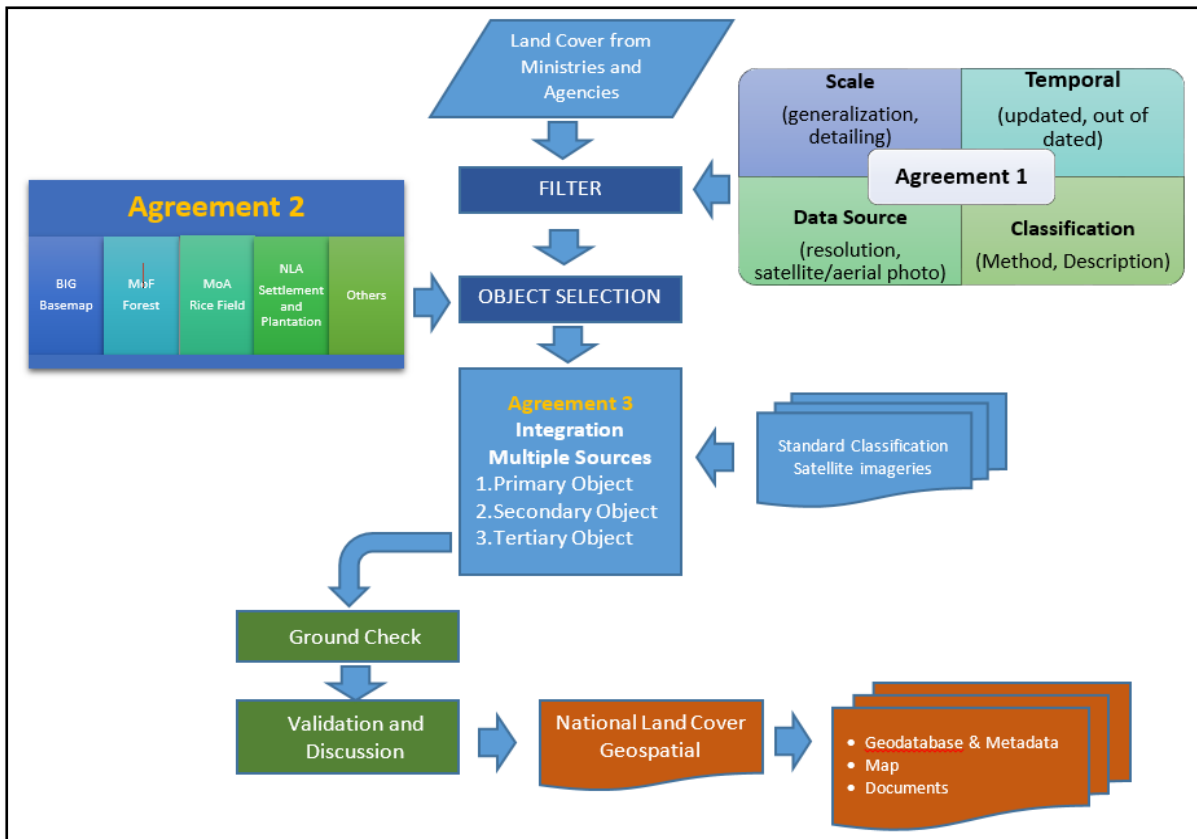


Figure 4. Flow Diagram Integration of National One Map Land Cover

The different concerns of land cover maps on each ministries and agencies has emerged when there was no a standard and regulation on land cover mapping. Otherwise the results of their land cover maps have great different on the national land cover map count on areas.

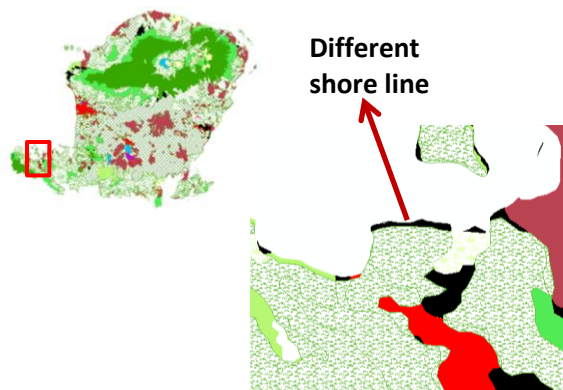


Figure 5. Editing topology for one base map



Figure 6. Discussion among ministries and agencies

The land cover maps show the different classes, undeniably it shows different pattern. They used almost the same sources as satellite imageries with the same recent year, but different technic and human resources creates different result.

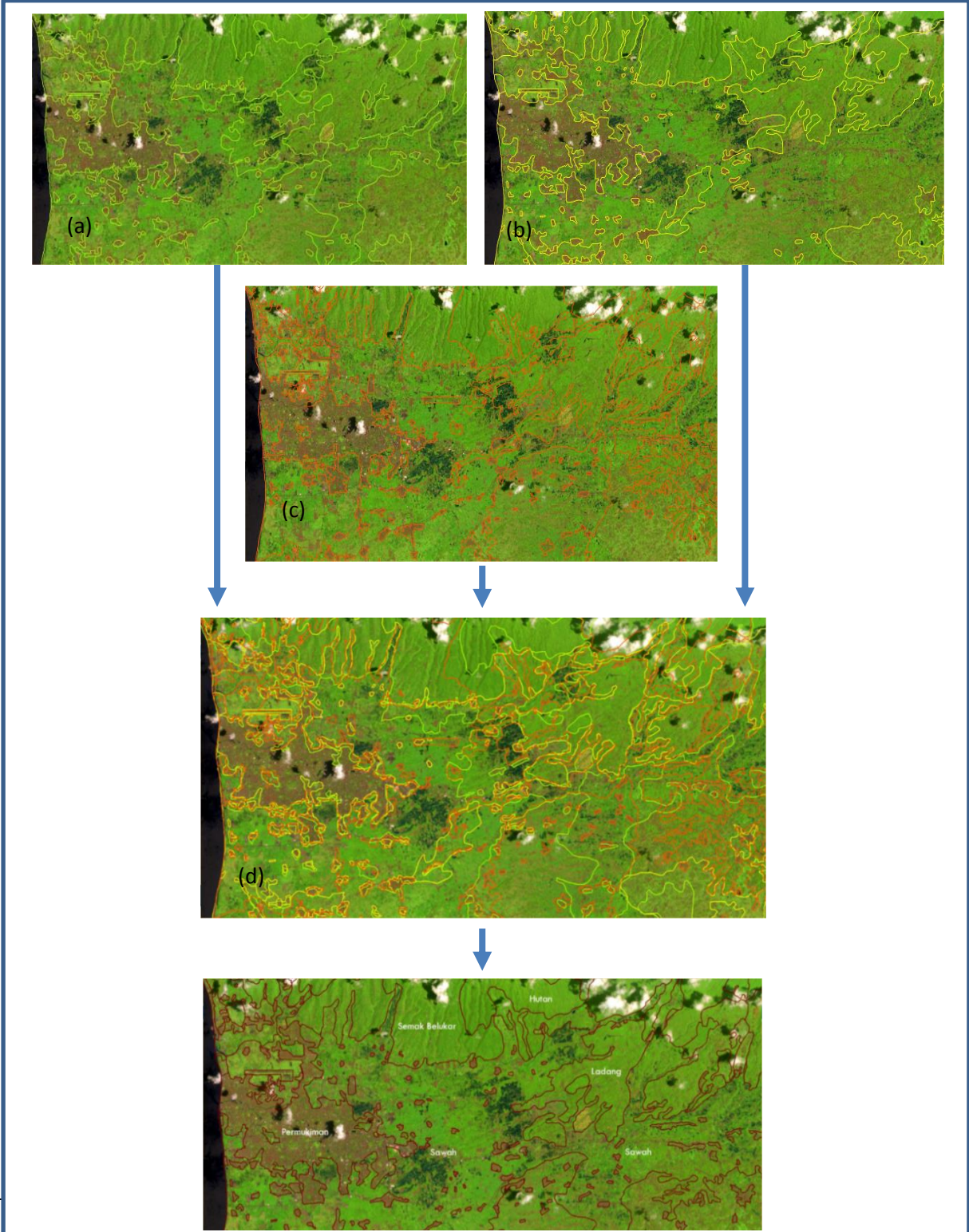


Figure 7. Integration and Synchronized Process of Land Cover Maps from Ministry of Forestry (a), Ministry of Environment (b), National Land Agency (c), thru the process (d) and synchronization (e)

Geospatial Information Agency had managed a program to synchronize and harmonized those maps into a single map that refer to one map policy

Several editing topologies performed to create one map with single reference of Indonesian Base Map. The numerous tasks and obstacles found in the process caused by different technic, map scale, and interpretation. These sectoral maps were visually interpreted which may cause the differences.

Table 3. One Map Land Cover Calculation
Data

| No | One Map Land Cover | Area (Ha) | % |
|----|------------------------------|--------------------|------------|
| 1 | Low Land Forest | 30,132,753 | 15.9 |
| 2 | High Land Forest | 48,310,933 | 25.6 |
| 3 | Mangrove Forest | 3,054,549 | 1.62 |
| 4 | Wetland and Peatland Forest | 12,605,493 | 6.67 |
| 5 | Plantation Forest | 11,500,656 | 6.08 |
| 6 | Food Estate | 5,038,945 | 2.66 |
| 7 | Mixed Food Farm | 15,426,784 | 8.16 |
| 8 | Bush and Shrubs | 20,557,503 | 10.9 |
| 9 | Seasonal Dryland Agriculture | 17,346,846 | 9.17 |
| 10 | Seasonal Wetland Agriculture | 8,132,642 | 4.3 |
| 11 | Mix Settlement | 3,990,688 | 2.11 |
| 12 | Built Area non-settlement | 13,045 | 0.01 |
| 13 | Open Land | 2,810,562 | 1.49 |
| 14 | Cultivated Open Land | 1,158,119 | 0.61 |
| 15 | Savana | 2,894,745 | 1.53 |
| 16 | Fishpond | 918,104 | 0.49 |
| 17 | Lake | 605,098 | 0.32 |
| 18 | Reservoir | 32,023 | 0.02 |
| 19 | River | 1,383,694 | 0.73 |
| 20 | Inland Swamp | 2,960,854 | 1.57 |
| 21 | Coastal Wetland | 204,753 | 0.11 |
| | | 189,078,789 | 100 |

The method used to generate the integration of land cover map is went thru discussions and iteration in harmonization on land cover classification. This hypothetic-inductive discussion method was led by BIG.

6. INDONESIAN NATIONAL LAND COVER MAP

As the result of the integration of land cover maps, the one map land cover was went thru many discussions and editing processions. The goal of one map land cover is the national count for natural resources and spatial planning in national and district level.

The national number for the calculation of area regarding the land cover was published and coincided with the launching of national one map on 22 December 2014. The launching was held by BIG, Ministry of Forestry and Environment, Ministry of Agriculture, Ministry of Agrarian, Ministry of Marine and Fishery, LAPAN, and other stake holders.

This calculation of land cover data was approved by ministries and Agencies, it was also validated by LANDSAT 8 as the verification data

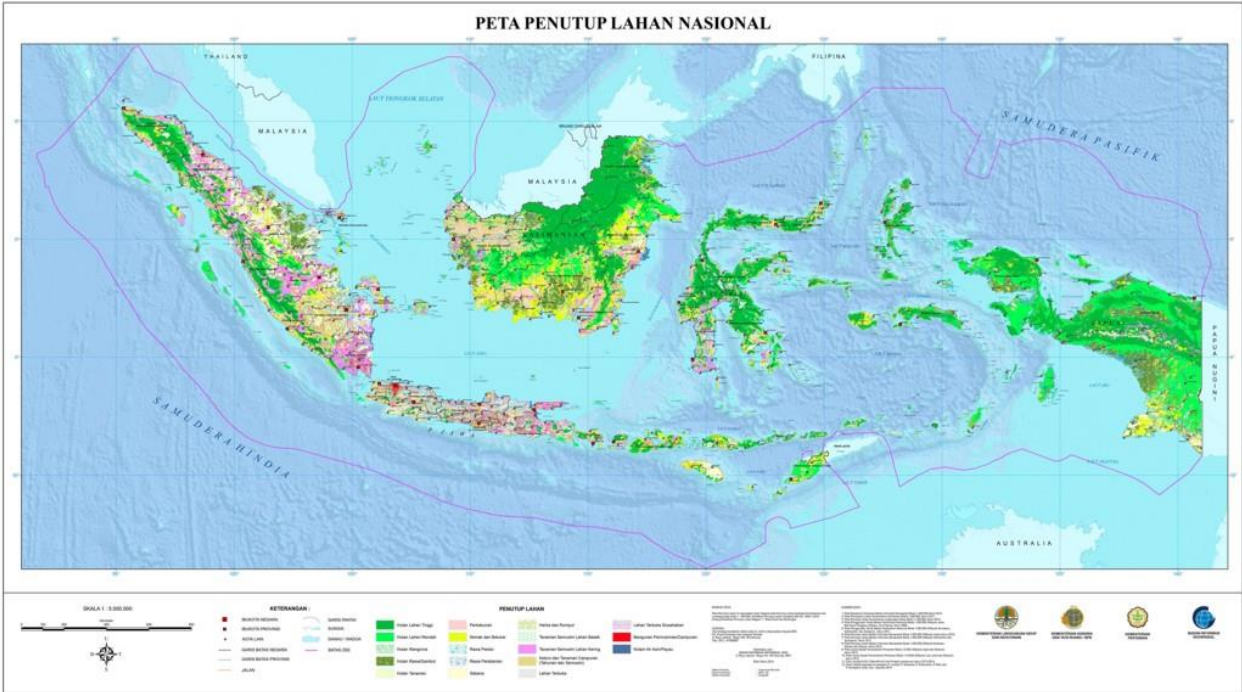


Figure 8. Indonesian National Land Cover Map, 2014

Table 4. One Map Land Cover Classification Compared to Indonesian Standard Classification, and Ministry and Agency's part of Duty

| MINISTRY OR AGENCY | ONE MAP LAND COVER CLASSIFICATION | INDONESIAN STANDARD LAND COVER CLASSIFICATION |
|--|-----------------------------------|---|
| Ministry of Forestry | Primary Dry Land Forest | High land or low land forest (cek elevation) |
| | Secondary Dry Land Forest | |
| | Primary Mangrove Forest | Mangrove Forest |
| | Secondary Mangrove Forest | |
| | Primary Wet Land Forest | Wetland and Peatland Forest |
| | Secondary Wet Land Forest | |
| | Plantation Forest | Plantation Forest |
| | Bush and shrubs | Bush and shrubs |
| | Dryland Agriculture | Seasonal dry land agriculture |
| | Mixed Food Farm | Mixed Food farm (seasonal or annual) |
| Ministry of Agriculture and National Land Agency | Rice Field | Seasonal wet land agriculture |
| National Land Agency | fishpond | brackish or salty water pond |
| National Land Agency and Ministry of Forestry | Food Estate | Food Estate |
| National Land Agency | Settlement/Built Area | Mixed Settlement |
| | | Built area non-settlement |
| BIG | Airport | Built area non-settlement |
| BIG | Sea Port | Built area non-settlement |
| Ministry of Forestry | Open Land | rock/sand landscape |
| | | beach sand |
| | | mud flats |
| | | other open land |
| National Land Agency and Ministry of Forestry | Mining Area | cultivated open land |
| Ministry of Forestry | Savana | savana |
| BIG | Lake | Lake |
| | River | River |
| | Reservoir | Reservoir |
| Ministry of Forestry | Swamp | Swamp |

7. FOLLOW-UP PROGRAM ONE MAP POLICY FOR INTEGRATING LAND COVER/LAND USE GEOSPATIAL DATA

One Map Policy as one reference, one standard, one database, and one portal, determined in Indonesian National Standard (SNI). Whereas, Ministries and Agencies have no intention to neglect the standard classification, but they also must fulfill the task given.

According to the new standard (2014), the obstacle on national land cover data integration is the mislead terminology of land cover itself, therefore the standard classification has minimize the aspect of classification to the most general aspect, ecology and geospatial aspects. It is not an easy task to minimize sectoral's frictions, especially when it came to their political concerns and projects. Regardless to the argument on them, an agreement had been reached on the approving the national land cover data in 2014.

An Integration of Land Cover/Land Use Map was working in 2014. The several ministries and institutions related to Land Cover/Land Use Map Productions are working together to elaborate an integration method and the data itself.

The point of integrating land cover/land use data is not a scientific technique only but government policies must be accounted. Therefore a harmonization of integration process is important to be remained in every step of this program. The main goal of integrating land cover/land use map is to show the most comprehensive information with the best accuracy to support the national development by creating National Thematic Land Cover/Land Use Geospatial Data.

BIG has task to launch one map land cover every year. It means that BIG must have produce regulation and methodology that are strengthen by regulation which be obeyed by ministries and agency. And for those users will have more accurate and agreement to use the national land cover Data.

In 2014, BIG has construct an agreement with ministries and agency in order to carry out this one map policy. Thing that must be agreed are:

- Project One Map Land Cover is initialized by BIG to synchronize the national land cover data
- Integration of national land cover data is referring to the Indonesian Standard of Land Cover Classification 2014
- One Map Land Cover is dynamic and update annually
- One Map Land Cover data which is approved by Ministries and Agency become Legal National land cover data use for spatial planning and other thematic analyses.
- Ministries and Agency who support this program become a validator.

With one map land cover the development of Republic Indonesia will be organized and the thematic analysis maps derived from can be accountable, such as biomass mapping, food security (food sovereignty), National Spatial Planning, and others.

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BIOGRAPHICAL NOTES

Nurwadjedi, born in Malang, 24 April 1959, graduated PhD Degree from Bogor Agricultural University, works as Deputy for Thematic Geospatial Information (Geospatial Information Agency), Indonesia. Expertise in Land Resource Survey

Suprajaka, born in Bantul, 29 September 1964, graduated bachelor in Geomorphology from Gadjah Mada University (1989), graduated master degree in urban and rural planning from Gadjah Mada University (1999), graduated Doctoral Degree in Geography from Gadjah Mada University, works in thematic geospatial information (Geospatial Information Agency) since 1991. Research interests are applied remote sensing and GIS for natural resource analysis, spatial fragmentation analysis, spatial stocktaking analysis. He is also on the editorial boards for Geomatic Journal (Geospatial Information Agency Journal).

Dheny Trie Wahyu Sampurno, M.Eng, born in Bandung, 15 October 1977, graduated double Degree Masters from Gadjah Mada University and Ritsumeikan University, work as mapping and survey analyst for thematic geospatial information (Geospatial Information Agency), active in remote sensing analysis and land cover specialist.

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