

The Progress of Indonesia's Administrative Boundaries Mapping after 72 years of Independence

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Abstract—Administrative boundaries are belong to the fundamental dataset of national base map. These information have an affect to the management of home affairs such as natural resources, tax, land administration, natural disasters. Indonesia proclaimed its independence in 1945. It means, Indonesia is 72 years old in 2017. Now, One Map Policy becomes one of hot issues in Indonesia especially for geospatial society. Every region needs definitive administrative boundaries for their activity but not available yet for all region. This paper aim is to explain the development or trend of Indonesia's administrative boundaries mapping after 1945 in order to get the information of Indonesian government performance in the "national boundary making". The method of this research is comparing the spatial and numerical data of Indonesia's administrative boundaries which are limited to the province and regency/city boundaries. The result of this research shows that there are 3 significant periods which are affect Indonesia's administrative boundary mapping i.e. 1998-2005, 2006-2012, and 2013 to this day. The conclusion of this study is the definitive boundaries of The Republic of Indonesia in 72 years after independence reached 472 segments or 48.31% of total 977 segments.

Keywords—administrative boundaries, segment, trend.

I. INTRODUCTION

Administrative boundaries are belong to the fundamental geospatial datasets to support development agenda for each countries in the world e.g. Ukraine, US, Colombia, Mexico, Nigeria, Western Australia, South Africa, Bostwana, etc [1]. United Nation (UN) through UN-GGIM (Global Geospatial Information Management) leads the standardization process of fundamental geospatial datasets among countries in order to can support Sustainable Development Goals (SDGs)[2]. Administrative boundaries are important and have an affect to the management of home affairs such as natural resources, tax, land administration, natural disasters[3].Indonesia's independence has been proclaimed by Soekarno with Hatta standing by his side on 17 August 1945 [5]. Proclamation is the historical milestone of Indonesia's independence. A day after proclamation, the committee of Indonesia's independence declared the 1945 Constitution of the Republic of Indonesia [6].

The Republic of Indonesia is one of archipelagic country in the world[4].The territory of Indonesia was divided into provinces, regencies and city. Both regencies and city were technically the same level of government. In 2017, the Republic of Indonesia is 72 years after independence and it has 34province which are widely distributed from 6°N – 11°S to 95°E – 141°E. The province number rose significantly from 8 in 1945[7] to 34 in 2018[8] (see Table 1 for the details).

Table.1: The province number in 1945 – 2017 [9]

Year	Number of Province	Remark
1945	8	Sumatera, Jawa Barat, Jawa Tengah, Jawa Timur, Nusa Tenggara (Sunda Kecil), Maluku, Sulawesi, and Kalimantan
1950	11	- Sumatera was divided into: Sumatera Utara, Sumatera Tengah, and Sumatera Selatan - Jawa Tengah was divided into: Jawa Tengah and Daerah Istimewa Yogyakarta

Year	Number of Province	Remark
1956	15	- Sumatera Utara was divided into: Sumatera Utara and Daerah Isimewa Aceh - Jawa Barat was divided into: Jawa Barat and Daerah Khusus Ibukota Jakarta - Kalimantan was divided into: Kalimantan Barat, Kalimantan Timur, and Kalimantan Selatan
1957	17	- Sumatera Tengah was divided into: Sumatera Barat, Riau, and Jambi - Kalimantan Selatan was divided into: Kalimantan Selatan and Kalimantan Tengah
1958	20	- Nusa Tenggara was divided into: Bali, Nusa Tenggara Barat, and Nusa Tenggara Timur - Riau was divided into: Riau and Jambi
1959	21	- Sumatera Selatan was divided into: Sumatera Selatan and Lampung
1960	22	- Sulawesi was divided into: Sulawesi Utara & Tengah and Sulawesi Selatan & Tenggara
1964	24	- Sulawesi Utara & Tengah was divided into: Sulawesi Utara and Sulawesi Tengah - Sulawesi Selatan & Tenggara was divided into: Sulawesi Selatan and Sulawesi Tenggara
1967	25	- Sumatera Selatan was divided into: Sumatera Selatan and Bengkulu
1969	26	- Irian Jaya was formally incorporated into Indonesia
1976	27	- Nusa Tenggara Timur was divided into: Nusa Tenggara Timur and Timor-timor
1999	26	- Referendum made Timor-timor as a new country called Timor Leste - Maluku was divided into: Maluku and Maluku Utara
2000	32	- Irian Jaya was divided into: Irian Jaya Timur, Irian Jaya Tengah, and Irian Jaya Barat - Sumatera Selatan was divided into: Sumatera Selatan and Bangka Belitung - Jawa Barat was divided into: Jawa Barat and Banten - Sulawesi Utara was divided into: Sulawesi Utara and Gorontalo
2001	31	- Irian Jaya Timur and Irian Jaya Tengah have been merged into Papua
2002	32	- Riau was divided into: Riau and Kepulauan Riau
2004	33	- Sulawesi Selatan was divided into: Sulawesi Selatan and Sulawesi Barat
2012	34	- Kalimantan Timur was divided into: Kalimantan Timur and Kalimantan Utara
2018	34	There is no change in number of province

The province number rose in 1945 – 1998 period was caused by the geographic reason such as too large area of each existed province. Different reason caused the growth of the number of province in 1999 – 2018. The regional autonomy/decentralization age was one of the reason why much more province were established in recent years. Each region (province and city/regency) has authorities to manage their own region i.e. government affairs, public interest, natural resources, etc. Some of new region establishment were bottom-up process through community aspirations [10].

Different maps covering the same thing i.e. Indonesia's forest cover became one of the reason why "One Map" has been mandated as a national target on mapping sector by president of the Republic of Indonesia in 2010[11]. Then, it was followed by Presidential Instruction No 10 year 2011 and Geospatial Information Agency establishment by the Law of Geospatial Information No 11 year 2011[12]. Then, 5 years after the ratification of the Law of Geospatial Information, the Presidential Regulation No 9 year 2016 has been legalized as the implementation of One Map Policy although only cover 1:50,000 of scale. The target of "One Map Policy" based on Presidential Regulation No 9 year

2016 must be finished at 2019. It shows the positive action in reducing the spatial conflict problems [11]. The target of that policy was to reintegrate all map themes in Indonesia into one map (single reference, single standard, single database, and single geoportal). Boundary dataset was the one of these themes. The One Map Policy is a catalyst for speeding up administrative boundaries. Regional boundary disputes are generally caused by the quality of the map which is an attachment to the new regional expansion law (such as the attachment of the New Region Establishment Law)[13].

Definition of boundaries as imaginary lines that represent natural and man-made features based on aspects of culture such as language, religion or etymology, known as anthropomorphic[14]. Boundary making in the implementation of regional boundary mapping has been implemented in the international boundary mapping. There were three significant contributors on the development of international boundary making theory i.e. Lapradelle (1928), Jones (1945), and Nichols (1983)[15]. Based on the analysis result of Donaldson, the boundary making theory of Stephen B. Jones (1945) is the most comprehensive and still relevant for 21 century [16][13]. The Jones's boundary making has four main

stages namely: 1) allocation; 2) delimitation; 3) the demarcation of boundaries in the field; and 4) boundary administration. Sumaryo used that theory as the base theory for his dissertation. His dissertation focused on regional context (province and regency/city in Indonesia) of boundary making and boundary dispute [15].

Sumaryo argued that the regulation of regional boundary making must refer to the present theory i.e. Jones's theory. That regulation is related to "the Law of Local Government". Before independence, Indonesia has three dominant regulation about home affairs i.e. *Decentralisatiewet* 1930, *Wet op de Bestuurshervorming* (Stb 1922/216) and *Osamuseirei* No. 27 year 1942. Then, after independence, Indonesia has eight regulation about "Local Government" namely: 1) Law No 1 year 1945; 2) Law No 22 year 1948; 3) Law No 1 year 1957; 4) Law No 18 year 1965; 5) Law No 5 year 1974; 6) Law No 22 year 1999; 7) Law No 32 year 2004; and 8) Law No 23 year 2014 [17]. The regulation for regional boundary making in Indonesia has been three times changed/revised i.e. Ministerial Regulation of Home Affairs No 1 year 2006, Ministerial Regulation of Home Affairs No 76 year 2012, and recent valid regulation called Ministerial Regulation of Home Affairs No 141 year 2017 on

Guidelines for Affirmation of Regional Boundaries. There were 4 general steps of Indonesia's regional boundary making namely: 1) document preparation; 2) boundary tracking; 3) the demarcation of boundaries in the field; and 4) boundary map creation.

Each province and regency/city has different characteristic of boundary making process. Some case need more than 20 years but the other case just need 2-5 years of boundary making process. It depends on the factors that caused the boundary dispute such as interest (natural resource, finance), structural (unequal power/authority), data (different interpretation), values (belief systems), and relationships (negative experience in the past) [13].

This paper aim is to explain the development or trend of Indonesia's administrative boundaries mapping after 1945 in order to get the information of Indonesian government performance in the "national boundary making".

II. MATERIAL AND METHODS

The study was conducted in The Republic of Indonesia, located in between from 6°N – 11°S to 95°E – 141°E. Location of the study is shown in Figure 1.

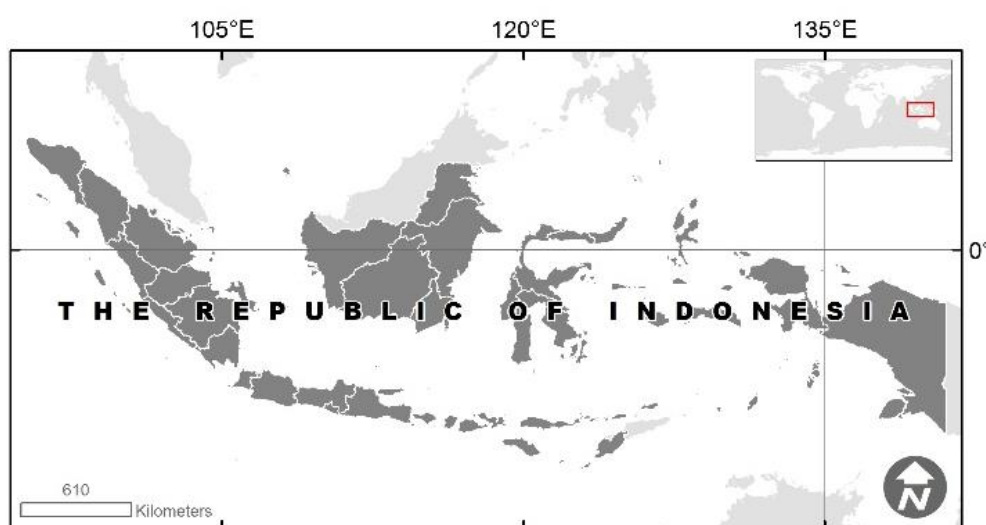


Fig.1: Research location map

This research used various data such as updated Indonesia's regional boundary datasets, Indonesia's regional segments database, and legal documents. This research used the latest spatial boundary datasets which were updated on December 2017 due to the limitation of updated data. Using vary data sources such as Geospatial Information Agency, Ministry of Home Affairs, and Ministry of Law and Human Right. These data were analyzed by using statistic methods i.e. time-series analysis. Literally, time-series term is "a series of a

quantity obtained at successive times, often with equal intervals between them" based on oxford dict. Time-series is time-ordered sequence of observations. The examples of such data which is categorized as time-series data are quarterly crime rates, annual birth rates, monthly unemployment figures, etc. Time-series may be quantified discretely or continuously [18]. Statistical method for analyzing time series is called time-series analysis [19]. That method is usually used to investigate the phenomena which dealing with time-ordered data.

Matalas argued that time-series analysis may also be used to investigate the phenomena that vary in space especially in hydrologic study [20].

This research used three general steps. Figure 2 shows the research stages. Firstly, spatial and non-spatial boundary datasets were extracted as numerical data. Secondly, these

data were clustered by use the periods based on the regulation of boundary affirmation i.e. 1945 – 2005, 2006 – 2012, and 2013 – 2017. Thirdly, all data were analyzed using time-series analysis method (ARIMA model) through SPSS software (trial version).

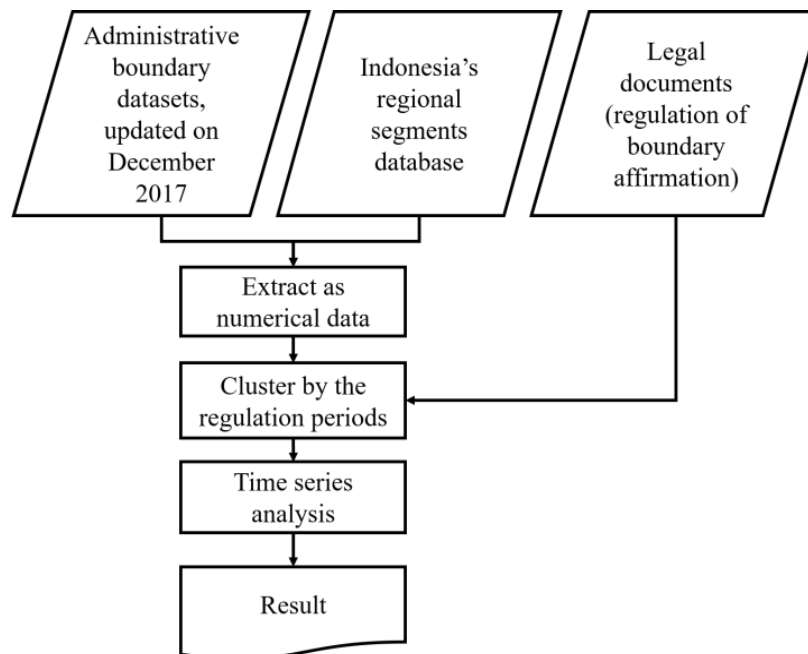


Fig.2: Research stages

III. RESULT AND DISCUSSION

Administrative Boundaries Affirmation in 1945 – 2005

In the period 1945 - 2005, there were several regulations relating to regional government. At that time, there were no specific guidelines regarding the confirmation of regional boundaries. In 1945-2003 there was absolutely no affirmation of regional boundaries for both regency / city and provincial segments. Basically, regional boundaries are an important component of the development law for the regions and several laws state that definite boundaries are made by the Minister in this case the Minister of Home Affairs. Then, the numbers differed in 2004 and 2005. There were affirmations of 5 regional boundary segments in 2004 and 12 regional boundary segments in 2005. In 2004, two Ministerial Decrees were made by the Minister of Home Affairs on regency boundaries: namely: 1) Minister of Home Affairs Decree No 163 of 2004 on Determination of the Boundary of the Mimika and Paniai Regency and Puncak Jaya Regency on Mount Grasberg and its surroundings (consist of 2 segments); and Minister of Home Affairs Decree No. 246 of 2004 on the Boundary of the Cirebon Regency Region of West Java Province (consist of 3 segments). Therefore a total of 5 segments were obtained in 2004. The number of segments

can be seen in Table 2 and spatially are presented in Figure 3.

In 2003, precisely on December 22, Minister of Home Affairs Decree No 130 of 2003 on the Organization and Work Procedure of the Ministry of Home Affairs was officially issued with one of the objectives to support the implementation of orderly government administration. The Ministry of Home Affairs is a government implementing element in the field of domestic governance including one of them is related to the formulation and implementation of technical policies in the field of general government. The author identifies that with the existence of the Minister of Home Affairs Regulation, implications for confirming boundaries in several regions. This is evidenced by several considerations of the issuance of the Minister of Home Affairs Decree concerning the boundaries of an area that is related to orderly administration and the resolution of problems of natural resources. Both Minister of Home Affairs Decree No 163 of 2004 and Minister of Home Affairs Decree No 246 of 2004 used several legal bases, such as Minister of Home Affairs Decree No 130 of 2003 concerning the Organization and Work Procedure of the Ministry of Home Affairs.

Table.2: Definitive boundaries in 1945-2005

Year	Definitive boundaries per year (segments)	Aggregate of the definitive boundaries (segments)
1945 - 2003	0	0
2004	5	5
2005	12	17

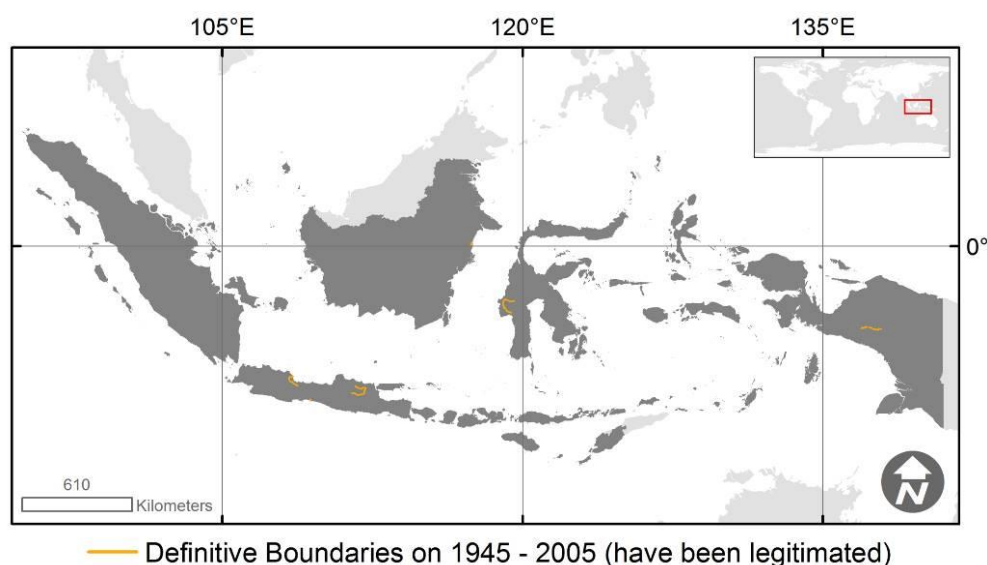


Fig.3: Definitive boundaries in 1945 – 2005

Administrative Boundaries Affirmation in 2006 – 2012

In contrast to the previous period, in the period of 2006-2012 there was only one regulation concerning regional governance, namely Law No. 32 of 2004. Article 152 of Law No. 32 of 2004 explained that in regional development planning it was based on accurate and reliable data and information. One of the data and information is basic territorial information including regional boundaries. Then, in 2006, on January 12, the Minister of Home Affairs Regulation No. 1 of 2006 was issued on Guidelines for Affirmation of Regional Boundaries. The Minister of Home Affairs emphasizes efforts to realize clear and definite regional boundaries both from juridical and physical aspects in the field. The affirmation of regional boundaries refers to regional boundaries that have been stipulated in the law on regional establishment. Stages of affirmation of land regional boundaries, namely: 1) document review; 2) border tracking; 3) installation of boundary pillars; 4) measurement and positioning of boundary pillars; and 5) making boundary maps. The affirmation of regional boundaries in accordance with Minister of Home Affairs Regulation No. 1 of 2006 is carried out by Regional Boundary Affirmation Teams consisting of successive central, provincial and regency / city which were

determined respectively by the Minister of Home Affairs, Governors and Regents / Mayors. Decisions on regional boundaries affirmation are determined by the Minister of Home Affairs based on the results of verification of the central Regional Boundary Affirmation Team and includes maps of regional boundaries. In addition, in 2007 a Government Regulation No. 78 of 2007 was issued on the Procedures for Establishment, Elimination and Merger of Regions. The Government Regulation also stipulates that the regency / city and province boundaries must be resolved / affirmed no later than 5 (five) years after the establishment of the relevant provinces and regencies / cities. That affirmation of boundaries was carried out in the field and should determined / legalized by the Minister of Home Affairs. If it is not fulfilled according to the 5 (five) year deadline, then the affirmation of regional boundaries is carried out by the Minister of Home Affairs.

With the existence of written rules as a guideline, it turns out that it can increase the quantity of affirmation of regional boundaries from the previous 17 segments in the period 1945 - 2005 to 144 segments in 2012. There was an addition of around 747% in 2012 from the achievement in 2005 despite volatile realization. The overall trend from 2006 to 2012 can be seen in Table 3.

Table.3: Definitive boundaries in 2006-2012

Year	Definitive boundaries per year (segments)	Aggregate of the definitive boundaries (segments)
2006	11	28
2007	25	53
2008	15	68
2009	24	92
2010	13	105
2011	7	112
2012	32	144

One of the factors that influenced this was related to financing because in accordance with Minister of Home Affairs Regulation No. 1 of 2006, the implementation of regional boundary enforcement activities was financed through the National Income and Expenditure Budget and supported through the Regional Revenue and Expenditure Budget. The affirmation of regional boundaries in the period 2006 - 2012 is still concentrated in Java, although there are several segments in Sumatra, Kalimantan and Sulawesi (distribution can be seen in Figure 4).

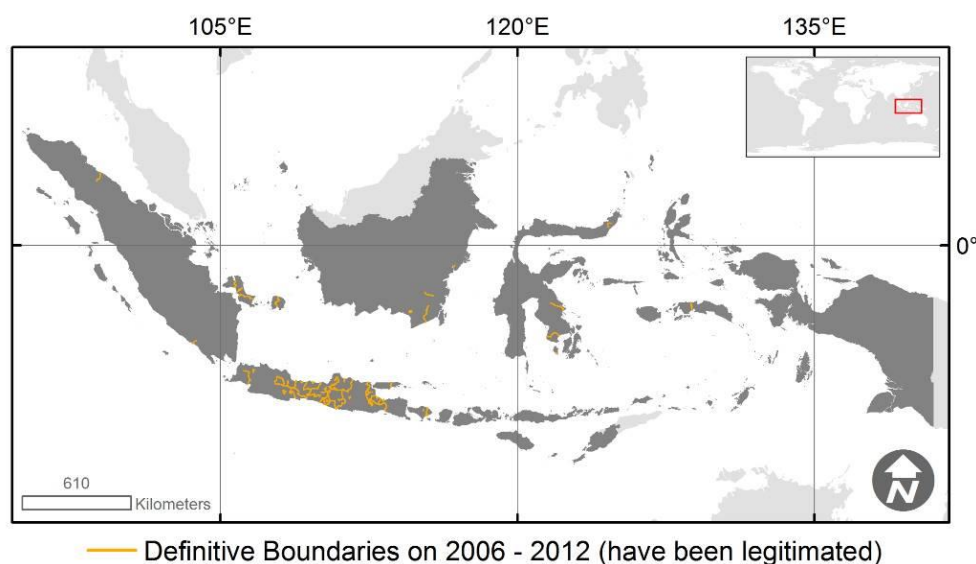


Fig.4: Definitive boundaries in 2006 – 2012

Administrative Boundaries Affirmation in 2013 – 2017

During this period, there were 2 (two) laws concerning regional government which were made as a basis. The first is Law No. 32 of 2004 up to September 29/2014 because of September 30/2015, Law No. 23 of 2014 began to take effect on Regional Government. The fundamental difference regarding the regional boundaries of the two laws is that Law No. 23 of 2014 clearly states that regional boundaries become one of the basic requirements of the territoriality that must be proven by coordinate points on a base map before an area can be divided. One of the reasons for using the basic map is that the boundary mapping uses one version of data that can be accounted for. If in the future there are boundary

problems, for example due to natural disasters, it can be reconstructed with the basic map. The Geospatial Information Agency of Indonesia as an institution authorized to organize base maps has provided a base map of a scale of 1: 50,000 for the entire territory of Indonesia and a scale of $\geq 1: 25,000$ in some region of Indonesia.

On December 12/2012, Minister of Home Affairs Regulation No. 1 of 2006 was replaced by Minister of Home Affairs Regulation No 76 of 2012 on Guidelines for Affirmation of Regional Boundaries. Stages of confirming regional boundaries on land, namely: 1) document preparation; 2) border tracking; 3) measurement and positioning of boundaries; and 4)

making boundary maps. The basic issue is that Minister of Home Affairs Regulation No. 76 of 2012 allows the implementation of the cartometric method for border tracking and measurement and determination of boundaries. The cartometric method according to Minister of Home Affairs Regulation No. 76 of 2012 is the search / withdrawal of boundaries on work maps and measurement / calculation of point position, distance and area coverage by using basic maps and other maps as a complement. According to Maling, the cartometric method is a method of measuring and calculating the numerical value of a map [21]. The stipulation of the

cartometric method as one method in tracking regional boundaries was followed by the addition of realization of affirmation of regional boundaries. It was recorded that until 2017, the definitive regional boundary was 472 segments or around 227% from 144 in 2012. As in the previous period, the realization of the regional boundary affirmation in the period 2013-2017 experienced fluctuations. The overall trend for 2013 - 2017 can be seen in Table 4. In this period, the distribution of the definitive boundary has been fairly evenly distributed on the islands of Sumatra, Kalimantan and Sulawesi (can be seen in Figure 5).

Table.4: Definitive boundaries in 2013-2017

Year	Definitive boundaries per year (segments)	Aggregate of the definitive boundaries (segments)
2013	74	218
2014	70	288
2015	49	337
2016	55	392
2017	80	472

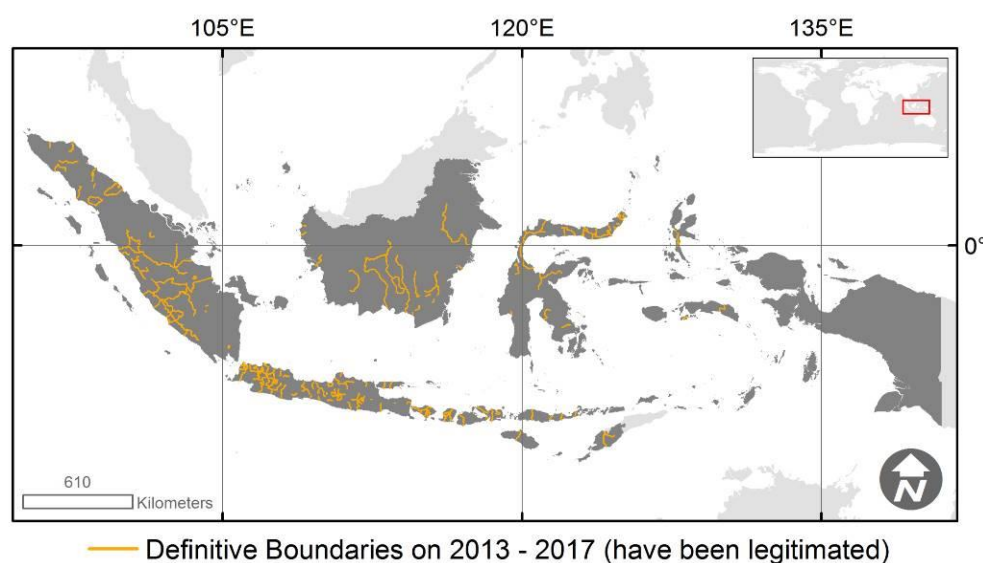


Fig.5: Definitive boundaries in 2013 – 2017

The cartometric method can be said to accelerate the realization of boundary affirmation. In addition, indirectly the One Map Policy is also indicated to be one that contributes in accelerating the realization of boundary affirmation. The Presidential Regulation concerning the Acceleration of the One Map Policy was promulgated in 2016. According to the data in 2016 - 2017, the number of definitive segments significantly increased by 45.45%.

Administrative Boundaries Affirmation in 1945 – 2017

The period of 1945 – 2017 showed some extreme points of realization of boundary affirmation. The highest

number of affirmations is in 2017, namely 80 segments, while the lowest number is in 1945-2003, namely 0 segments. During this period, regional boundaries were not a priority because there had not been a regional boundary dispute. Disputes began to occur because of the factors of decentralization where there were conflicts of interest between regions. Significant increase in realization of boundary reinforcement was in 2012 towards 2013, from 32 segments to 74 segments. The trend of realization of boundary assertions in the period 1945 - 2017 has fluctuated according to Figure 6. The definitive regional boundary distribution based on

aggregate per 2017 can be seen in Figure 7. Based on the distribution map in Figure 7, the most definitive regional boundary segments are still concentrated on Java. In aggregate, every year the definitive limit in Indonesia always experiences an increase or an increase (see Figure

8). For 72 years after independence, the definitive segments of Indonesia are still low i.e. 48.31% of all administrative boundary segments.

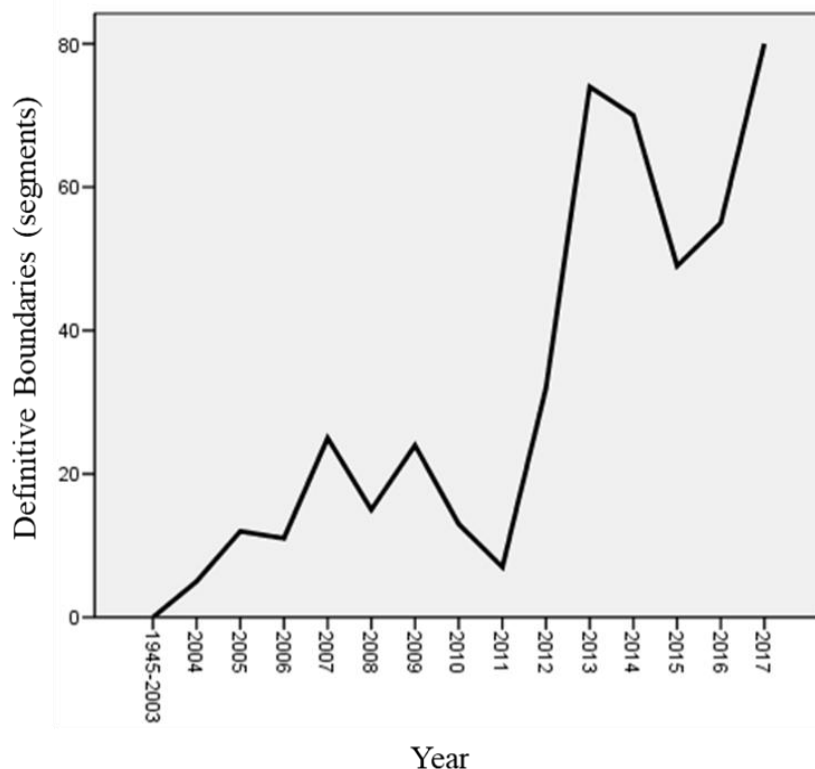


Fig.6: The realization of administrative boundaries affirmation per year in 1945 – 2017

Then time-series analysis was carried out on the definitive aggregate value from 1945 to 2017. Model statistics and Model parameters which were resulted by time-series analysis can be seen respectively in Figure 9 and Figure 10. Based on Ljung-Box result, ARIMA model (1,0,1) is

suitable to be used as a short-time forecast in the future because all coefficients are significant (<0.05) except intercept (constant) and Error White Noise by using (1):

$$Y_t = 249.236 + 1.978Y_{t-1} - 0.978Y_{t-2} + 0.832e_{t-1} \cdot (1)$$

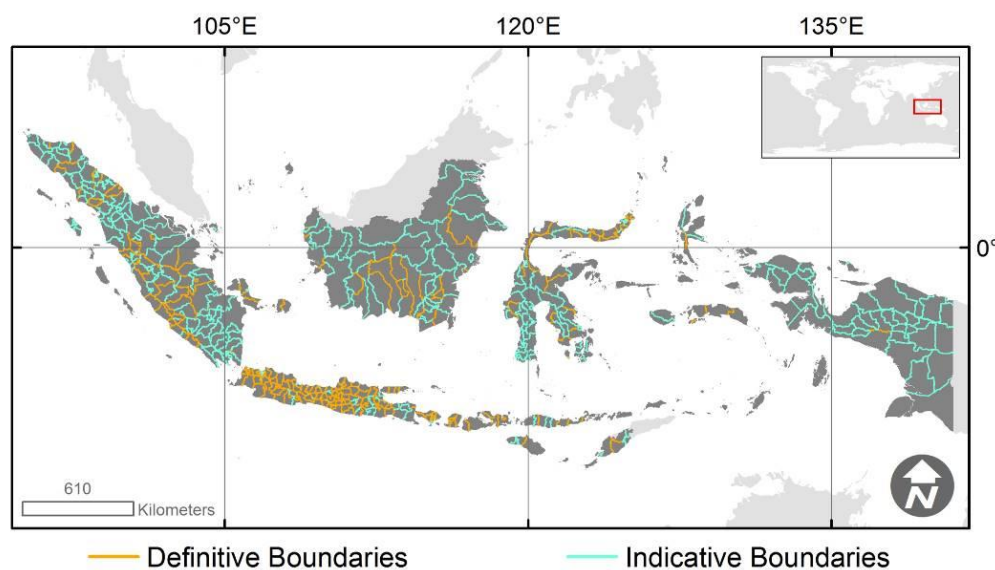


Fig.7: All boundaries status based on December 2017 datasets

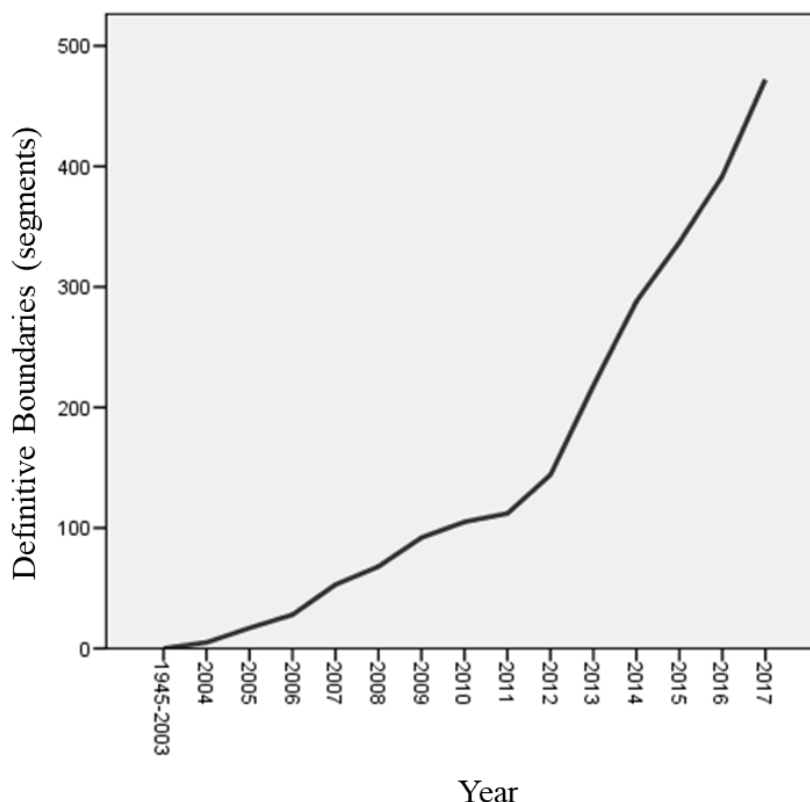


Fig.8: The aggregate of the definitive boundaries in 1945 – 2017

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)			Number of Outliers
		Stationary R-squared	Statistics	DF	Sig.	
Accum_ Definitif-Model_1	0	.774	.	0	.	0

Fig.9: Model statistics

				Estimate	SE	t	Sig.
Accum_ Definitif-Model_1	Accum_ Definitif	No Transfor mation	Constant	249.236	796.833	.313	.760
			AR Lag 1	.978	.139	7.056	.000
			MA Lag 1	-.832	.359	-2.316	.039

Fig.10: ARIMA Model parameters

IV. CONCLUSION

In the period of 1945-2003 the affirmation of territorial boundaries had not yet received priority. Changes in a centralized government system to decentralization of boundary determination and confirmation activities began to get priority. Regional boundary disputes due to economic potential and inter-regional interests. In 2004

there were 5 (five) boundary setting and confirmation segments and in 2005 12 regional boundary segments were completed. Issued a boundary regulation in 2006 increasing the quantity of affirmation of regional boundaries, the period of 2006-2012 has been resolved 127 segments of regional boundaries. In 2017, the definitive boundaries of The Republic of Indonesia in 72

years after independence reached 472 segments or 48.31% of total 977 segments.

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