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# SPATIAL PATTERN OF STUNTING ON CHILDREN UNDER FIVE IN INDONESIA 2019

## *Pola Spasial Stunting Pada Balita Di Indonesia Tahun 2019*

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### *Abstract*

***Background:*** *The stunting countermeasures is one of the agendas in SDGs. The strategic and appropriate attempts could be planned based on the distribution of stunting and the influencing factors using a region-based data approach in accordance with the critical steps within the 2018 Global Nutrition Report.*
***Objective:*** *The purpose of this study was to determine the spatial autocorrelation of stunting on children under five between districts/cities in Indonesia 2019.*
***Method:*** *This research is an ecological study using a spatial approach. The data used was secondary data obtained from the study of Nutritional Status of children in 2019, with the unit of analysis for all districts/cities in Indonesia, totalling 416 districts and 98 cities. The study was tested using the analysis of Global Moran's I and Local Indicators of Spatial Association (LISA).*
***Result:*** *The result of the analysis showed that stunting on children under five between districts/cities in Indonesia has a spatial autocorrelation with a clustered pattern (I=0.347).*
***Conclusion:*** *Areas with high-high stunting patterns need to be set as priority areas for stunting reduction interventions. In addition, the formation of a Stunting Reduction Acceleration Team in these areas needs to be monitored thoroughly.*

***Keywords****: Priority areas, Spatial Autocorrelation, Stunting,*

### Abstrak

**Latar Belakang:** Penanggulangan *stunting* menjadi salah satu agenda dalam SDGs. Upaya strategis dan tepat sasaran dapat direncanakan berdasarkan sebaran kejadian *stunting* pada balita dan faktor-faktor yang mempengaruhinya dengan pendekatan data berbasis wilayah sesuai dengan langkah kritis dalam *Global Nutrition Report 2018.*
**Tujuan:** Tujuan penelitian ini adalah untuk mengetahui autokorelasi spasial *stunting* pada balita antar kabupaten/kota di Indonesia 2019.
**Metode:** Penelitian ini merupakan studi ekologi dengan pendekatan spasial. Data yang digunakan adalah data sekunder yang diperoleh dari Studi Status Gizi Balita 2019, dengan unit analisis seluruh kabupaten/kota di Indonesia yang berjumlah 416 kabupaten dan 98 kota. Penelitian ini diuji menggunakan analisis Global Moran's I dan Local Indicators of Spatial Association (LISA).
**Hasil:** Hasil analisis menunjukkan *stunting* pada balita antar kabupaten/kota di Indonesia memiliki autokorelasi spasial dengan pola yang mengelompok.
**Simpulan:** Wilayah dengan pola *high-high stunting* perlu ditetapkan sebagai wilayah prioritas intervensi penurunan *stunting*. Selain itu, pembentukan Tim Percepatan Penurunan *Stunting* di wilayah-wilayah tersebut perlu dipastikan telah terlaksana.

**Kata kunci**: autokorelasi spasial, *stunting*, wilayah prioritas

## INTRODUCTION

Stunting causes malnutrition and poverty across generations. Thus, the stunting countermeasures was included into one of the agendas on the second goal of the Sustainable Development Goals (SDGs)[1]. Besides, WHO has established the severity threshold of stunting. For instance, the low category is less than 20%, the normal category ranges from 20% - 29%, the high category ranges from 30%, and more than 40% is considered as very high[2]. The stunting prevalence of children under five in Indonesia has been decreasing from year to year until it reached 27,67% in 2019[3]. Nevertheless, this number is still considered moderate and it means that stunting is still a public health problem here. Thus, the stunting countermeasures need to be pushed and continually implemented in order to support the RPJMN target in 2024 that is reducing stunting percentage up to 14% and 40% stunting reduction from the baseline data of 2023 as the WHO target in 2025[4].

One of the critical steps found within the Global Nutrition Report of 2018 was increasing the use of the region-based data in order to tackle malnutrition problem[5]. The region-based data can be processed and analyzed through a spatial epidemiological approach, which is a study that describes and analyzes geographic variations of diseases related to demographic, environmental, behavioral, socioeconomic, genetics, and infection risk factors, which can also be called disease mapping [6,7]. The tool that can be used to analyze spatial epidemiological data is the Geographic Information System, hereinafter referred to as GIS.

GIS is useful for describing the geographical distribution of a disease and its relationship to various environmental, social, and economic factors[7]. GIS can provide integrated information and graphics. Policy makers can use GIS to visualize, analyze, and report risk factors and issues at multiple geographic levels[8]. One of the analyses that could be utilized is the spatial autocorrelation.

The spatial autocorrelation analysis provides estimation on the spatial similarity level of the attribute value in the neighborhood observation area[9,10]. Almasi et al. (2019) showed that the spatial autocorrelation was found on the stunting phenomenon in the world with a clustered pattern, which means that the level of stunting in an area has the same characteristics as the surrounding area[11]. Other studies with various levels of analysis unit also showed similar results[12–16]. Therefore, the study aims to to describe the spatial distribution and spatial autocorrelation of stunting among districts/cities in Indonesia.

## METHOD

This research was conducted from March - October in 2021 using an ecological study design and spatial approach. Ecological studies are studies that are conducted using data grouped by geographical area, or also called aggregate data[7]. The population and sample of this study were all districts/cities in Indonesia consisting of 416 districts and 98 cities. This study used secondary data obtained from the results of the Nutritional Status Survey on children under five (SSGBI) in 2019 published by BPS RI & Ministry of Health of the Republic of Indonesia[17].

SSGBI aims to describe the nutritional status of toddlers through indicators of weight/age, height/age, and weight/height by province to district/city. The 2019 SSGBI was carried out integrated with the National Socioeconomic Survey (SUSENAS) with a total sample of 84,792 toddlers [18]. SSGBI 2019 data collection was carried out in April-July 2019 by several teams by conducting interviews and anthropometric measurements using a questionnaire developed by the Health Research and Development Agency, Ministry of Health of the Republic of Indonesia[19].

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The hypothesis of this study stated that the spatial autocorrelation on stunting was found among districts/cities in Indonesia. The spatial distribution of stunting was obtained by combining the spatial data with the attribute data and providing color symbolism using Quantum GIS version 3.16. The color symbol for each category of stunting level refers to the threshold that was first set by WHO in 1993[20]. The attribute data here was the data of stunting prevalence on children under five obtained from SSGBI result in 2019.

Meanwhile, the spatial data was obtained from the map of Indonesia administrative boundaries per districts/cities that is compiled by BPS RI and published on the humanitarian data exchange website and it was developed by United Nations Office for the Coordination of Humanitarian Affairs (OCHA)[21]. The map is under license from the International Creative Commons Attribution for Intergovernmental Organizations (CC BY-IGO) 3.0[22]. Meanwhile, the hypothesis of the study was tested using the analysis of Global Moran's I and Local Indicators of Spatial Association (LISA) using GeoDa.

Data is processed using Microsoft Office Excel 2019 software and Quantum GIS version 3.12 software which can be downloaded freely on the internet. Microsoft Office Excel 2019 software is used to create a dummy table regarding the variables studied, namely stunting in toddlers, access to proper drinking water, access to proper sanitation, and poverty in Indonesia. The stages of data processing in this study include data replication and checking, coding, data merging, data cleaning, and data storage. The result of this study was delivered in table, scatterplot, and map.

## RESULT

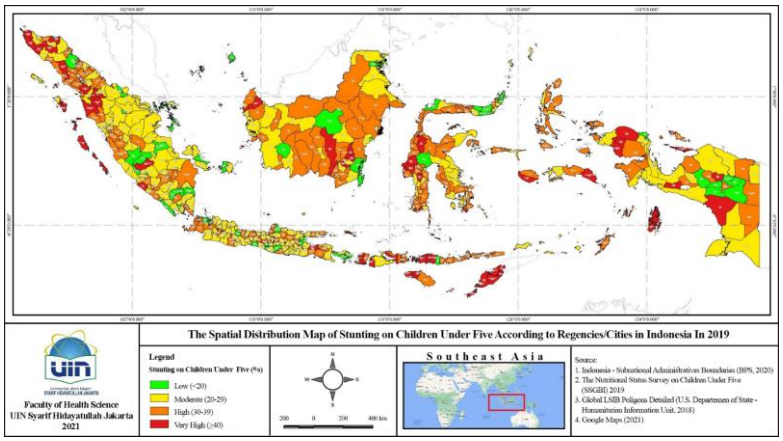


**Figure 1. The Spatial Distribution Map of Stunting on Children Under Five According to Regencies/Cities in Indonesia In 2019**

The spatial distribution map of stunting on children under five was displayed on the figure 1. The map showed that the stunting prevalence on children under five among districts/cities in Indonesia was various including low, moderate, and high until very high. There were 80 districts/cities with low stunting prevalence (15,56%), 219 regencies/ cities with moderate stunting prevalence (42,61%), 155 districts/cities with high stunting prevalence (30,16%) and 59 districts/cities with very high stunting prevalence (11,48%).

Most areas in East Nusa Tenggara had high and very high prevalence of stunting and one area was found with low prevalence of stunting. In addition, the figure showed that West Sulawesi only had high and very high prevalence of stunting. Meanwhile, districts/ cities in other provinces still showed lower and more moderate variations in stunting than the two provinces.

**Table 1. The analysis result of the Global Moran's I of Stunting on children under five in Indonesia 2019**

| *I* | *E(I)* | Zscore | *p-value* | Pattern |
|---|---|---|---|---|
| 0.347 | -0.0021 | 9.4991 | 0.001 | *Clustered* |

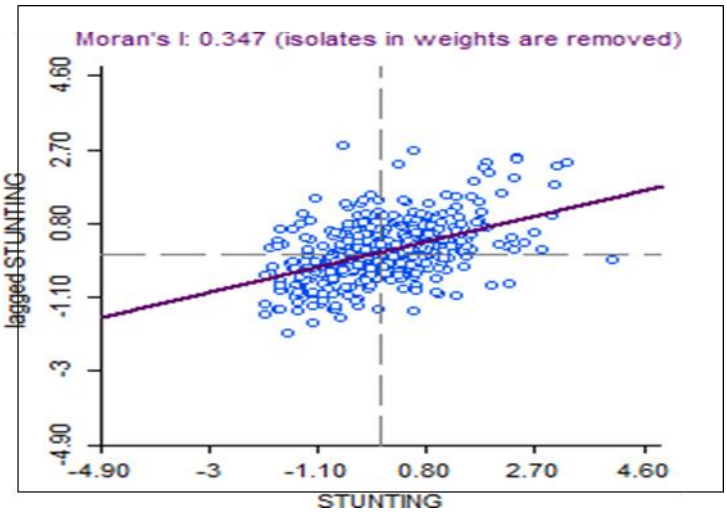


**Figure 2. Moran's I Scatter Plot**

The result of the Global Moran's I analysis on the stunting variable was presented in Table 1 and Figure 2. The table 1 showed that the Z-score was greater than Za/2 5%, that was 9.4991 (|Zcount|>Za/2), meaning that the research hypothesis was accepted. Thus, stunting on children under five of Indonesia in 2019 had a significant spatial autocorrelation.

Then, the Moran index value was obtained at 0.347 and it was greater than the expected Moran value (I > E(I)). This value showed that the spatial autocorrelation of stunting on children under five had a clustered pattern. Then, the figure 2 revealed the Moran Scatterplot for the spatial autocorrelation of stunting on children under five across districts/ cities in Indonesia. Meanwhile, districts/cities with this pattern could be identified through the LISA analysis.

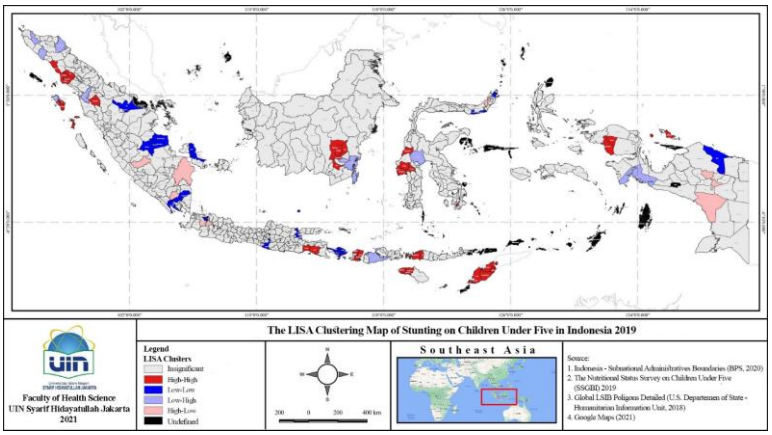


**Figure 3. The LISA Clustering Map of Stunting on Children Under Five in Indonesia 2019**

The analysis results of the LISA clustering map were shown in Figure 3. The areas with clustered patterns of stunting on children under five were shown by high-high and low-low areas in Figure 3. The High-high areas were districts/cities with high prevalence of stunting and they were surrounded by districts/cities with high prevalence of stunting, while the low-low areas were districts/cities with low prevalence of stunting and they were surrounded by districts/cities with low prevalence of stunting as

well. Thus, the areas with the high-high patterns were concentrated areas or stunting clusters.

**Table 2. The LISA Result Anlysis of Stunting on Children Under Five in Indonesia 20**

| *p-value* | Kuadran II (*Low-high*) (12) | *p-value* | Kuadran I (*High-high*) (39) |
|---|---|---|---|
| 0.05 (11) | **Aceh:** Aceh Timur, Pidie, Nagan Raya; **Sumatera Utara:** Nias Utara, Kota Gunungsitoli; **Jawa Timur:** Kota Probolinggo; **NTB:** Sumbawa; **Kalimantan Selatan:** Kota Baru, Hulu Sungai Tengah; **Sulawesi Selatan:** Luwu Utara; **Papua Barat:** Kaimana | 0.05 (30) | **Aceh:** Aceh Singkil, Aceh Selatan, Kota Subulussalam; **Sumatera Utara:** Nias, Dairi, Pakpak Bharat, Padang Lawas; **Jawa Timur:** Lumajang, Jember; **NTB:** Lombok Tengah, Lombok Timur, Lombok Utara; **NTT:** Sumba Barat, Manggarai Barat, Sumba Tengah, Sumba Barat Daya, Kota Kupang; **Kalimantan Tengah:** Barito Selatan, Barito Timur; **Kalimantan Selatan:** Tapin, Tabalong; **Sulawesi Selatan:** Tana Toraja; **Sulawesi Tenggara:** Kota Baubau; **Sulawesi Barat:** Majene, Polewali Mandar, Mamasa, Mamuju Tengah; **Papua Barat:** Sorong Selatan, Maybrat; **Papua:** Biak Numfor |
| 0.01 | - | 0.01 (6) | **Sumatera Utara:** Nias Selatan, Nias Barat; **NTT:** Kupang, Belu, Manggarai; **Kalimantan Selatan:** Hulu Sungai Utara |
| 0.001 (1) | **Sumatera Utara:** Tapanuli Salatan | 0.001 (3) | **NTT:** Timor Tengah Selatan, Timor Tengah Utara, Malaka |
| *p-value* | Kuadran III (*Low-low*) (35) | *p-value* | Kuadran IV (*High-low*) (8) |
| 0.05 (23) | **Riau:** Siak; **Jambi:** Batanghari, Muaro Jambi, Tanjung Jabung Timur, Kota Jambi; **Lampung:** Tanggamus, Lampung Tengah; **Kep. Bangka Belitung:** Bangka, Bangka Tengah, Kota Pangkal Pinang; **DKI Jakarta:** Jakarta Pusat; **Jawa Barat:** Kota Depok; **Jawa Tengah:** Sukoharjo; **DI Yogyakarta:** Gunung Kidul, Kota Yogyakarta; **Jawa Timur:** Sidoarjo; **Banten:** Kota Tangerang Selatan; **Bali:** Karangasem; **Sulawesi Utara:** Minahasa Utara, Bolaang Mongondow Selatan, Kota Manado; **Papua:** Sarmi | 0.05 (5) | **Sumatera Selatan:** Ogan Komering Ilir; **Lampung:** Lampung Utara; **Sulawesi Utara:** Minahasa selatan; **Papua:** Asmat, Tolikara |
| 0.01 (8) | **DKI Jakarta:** Kota Jakarta Barat, Kota Jakarta Timur, Kota Jakarta Utara; **Jawa Timur:** Gresik; **Banten:** Kota Tangerang; **Bali:** Tabanan, Badung, Klungkung | 0.01 (2) | **Sumatera Selatan:** Musi Rawas Utara; **Jawa Barat:** Bogor |
| 0.001 (5) | **DKI Jakarta:** Kota Jakarta Selatan; **Bali:** Gianyar, Bangli, Buleleng, Kota Denpasar | 0.001 (1) | **Papua:** Jayawijaya |

The information related to districts/cities on each quadrant was presented on the Table 2. The table showed that there were 39 districts/cities categorized as the high-high areas yang (quadrant I), 12 districts/cities categorized as low-high areas (quadrant II), 35 district/cities categorized as the low-low areas (quadrant III), and 8 districts/cities categorized as high-low areas (quadrant IV). The high-high areas were dispersed in several provinces such as Aceh, Sumatera Utara, Jawa Timur, NTB, NTT, Kalimantan Tengah, Kalimantan Selatan, Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Barat, Papua, and Papua Barat.

## DISCUSSION

This study showed that the stunting on children under five in districts/ cities in Indonesia varied from low to very high. Most districts/cities in Indonesia had the stunting prevalence on the moderate (20-30%) to high (30-40%) category. This study also showed a significant spatial autocorrelation with a clustered pattern for stunting cases. These are in line with the research of Sipahuntar & Eryando (2019) on the spatial analysis of province[16]. In addition, the spatial analysis of country conducted by Almasi et al. (2019) showed the similar result[11]. Other studies with different levels of analysis also showed similar results[12,13,15].

The result of the local spatial autocorrelation revealed that there were 39 districts/cities with the high-high pattern of stunting on children under five. These areas were dispersed across provinces such as Aceh, Sumatera Utara, Jawa Timur, NTB, NTT, Kalimantan Tengah, Kalimantan Selatan, Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Barat, Papua, dan Papua Barat. NTT had the most areas with the high-high pattern for example Sumba Barat, Manggarai Barat, Sumba Tengah, Sumba Barat Daya, Kota Kupang, Kupang, Belu, Manggarai, Timor Tengah Selatan, Timor Tengah Utara, dan Malaka.

The clustering of stunting might be formed as the neighboring areas tended to have similar characteristics. Almasi et al. (2019) stated that the clustering pattern of the malnutrition cases could be caused by lifestyle, beliefs and culture. Besides, another factor such as health access to health care facilities tends to be similar between neighboring areas[11]. Stunting in toddlers who are high and have a clustered pattern in NTT may be related to malaria endemicity in that province. NTT is the province with the highest malaria Annual Parasite Incidence (API) in Indonesia from 2015 to 2019[23,24]. The link between malaria and stunting in toddlers in NTT is supported by research by Wurisastuti & Suryaningtyas (2017) which was also conducted in the province[25]. In

addition, this is also exacerbated by the high poverty rate in NTT. All stunting cluster areas in NTT have poverty rates above 15%[26]. The clustering pattern of stunting causes the reduction interventions focus must be put on the cluster area.

The stunting prevalence on children under five in Indonesia increased for 3 consecutive years from 2016 to 2018. Then, it decreased in 2019. The stunting prevalence from 2016 to 2019 in a row was 27.6%, 29.6%, 30.8%, and 27.67%[17]. Although it decreased in 2019, it was still on the moderate category. In addition, the stunting on children under five was still the highest nutritional problem compared to underweight and wasting[28].

Various Ministries/Institutions (K/L) related to stunting reduction efforts have set priority areas in 2017. A total of 100 districts/cities have been set as the stunting reduction intervention priorities in 2017 and 2018. In addition, the Secretariat of the Vice President (Setwapres) RI together with Ministries/ Agencies related to the acceleration of stunting reduction issued the National Strategy (Stranas) on Accelerating the Stunting reduction for the 2018-2024 Period. Stranas has also developed a scheme to gradually expand the location of the stunting intervention focus until 2024.

The focus locations were then expanded to 60 districts/cities in 2019 and 100 districts/cities in 2020 according to the Nastra scheme. Thus, the total location that has been integrated from 2018-2020 was 260 districts/ cities[29–31]. In addition, the President through a limited cabinet meeting regarding the acceleration of stunting reduction held in 2020 stated that the stunting reduction should be focused on 10 provinces with high prevalence. For instance NTT, Sulawesi Barat, NTB, Gorontalo, Aceh, Kalimantan Tengah, Kalimantan Selatan, Kalimantan Barat, Sulawesi Tenggara, dan Sulawesi Tengah[32].

Most of the high-high stunting areas have become the focus of integrated stunting reduction interventions in 2018-2020. The areas that have not been included as focus locations during this period were Aceh Singkil and Aceh Selatan, Aceh; Lumajang, Jawa Timur; Kota Kupang, NTT; and Kota Baubau, Sulawesi Tenggara. Nevertheless, Lumajang was included as the focus location of stunting interventions in 2021. Then, the following year some areas such as Aceh Singkil, Aceh Selatan, Kota Kupang, and Kota Baubau got their turn as the focus location along with the area expansion until reached all regencies/ cities in Indonesia[33,34].

The area expansion of the stunting reduction intervention focus was originally planned gradually to cover all districts/ cities by 2024[35]. However, the expansion to all districts/cities will be accelerated in 2022 with the issuance of Decree of the Minister of National Development Planning/Head of Bappenas Decree Kep.10/M.PPN/HK/02/2021 concerning the Determination of the Expansion of Districts/Cities Focusing in Integrated Stunting Reduction Intervention in 2022[33]. This is done in order to have a longer time to reach the 2024 target, thereby easing the burden on local government budgets, as well as increasing stunting reduction convergence efforts[33]. These efforts need to be followed by improvements from the evaluation of the National Strategy that has been implemented previously.

The Report on the Achievement of the Implementation of the National Strategy for the Acceleration of Stunting Prevention for the 2018-2020 period stated that the formation of the Team for the Acceleration of Stunting Reduction (TPPS) and the implementation of convergence actions have not been held in all districts/cities. This could happen since there were still many regions that do not have a legal umbrella and the regent/mayor regulations are considered not strong enough[36].

Hence, the President issued presidential decree number 72, 2021 on the acceleration for stunting reduction as the legal instrument to strengthen the national strategy. The strategy and instruction on the acceleration for stunting reduction to the priority areas have not reached the cluster area of stunting (the high-high pattern areas). On the other hand, these areas have higher risk to produce other stunting children. This was supported by the research of Gebreyesus et al. (2016) which showed that children in the stunting cluster are at risk of experiencing stunting by 1.48 times and severe stunting by 1.69 times than children outside the cluster[27]. Besides, there were only 3 provinces whose Index on stunting treatment (IKPS) were above the national level until 2020 such as Jawa Timur, NTB, and Kalimantan Selatan[37]. Despite the government effort, the cluster areas of

stunting still need to be monitored thoroughly both by the national and regional government.
Efforts to accelerate stunting reduction in cluster areas need to be prioritized and also supported by a strong legal umbrella. For example, the determination of stunting clusters areas and the establishment of TPPS immediately on the province that owns stunting cluster area and its IKPS is below the national level. The relevant governors need to immediately issue regulations on the formation of TPPS and instructions for the establishment of TPPS in stunting cluster districts/cities as a priority.

Governors that own stunting cluster areas must immediately build TPPS and instruct the establishment of TPPS immediately in stunting cluster districts/cities. For instance Governors of Aceh, Sumatra Utara, NTT, Kalimantan Tengah, Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Barat, Papua, and Papua Barat. Apart from the TPPS formation, each stunting cluster must have a special coordinator who is responsible for the implementation of the program.

The coordinator establishment could be useful in the case that there is collaboration among districts/ cities within the cluster to run the program together. The cluster coordinator can map the problems and potential of districts/cities in one cluster, so that they can provide recommendations for cooperation programs between local governments in an effort to accelerate the stunting reduction. It is expected to prevent the expansion and increase of stunting in cluster areas.

## CONCLUSION

The conclusion that can be drawn from this study is that most of the districts/cities in Indonesia have high stunting prevalence that range from moderate (20-29%) to high (30-39%) category in 2019. Furthermore, the stunting cases among districts/cities in 2019 have the spatial autocorrelation with clustered pattern, which means that areas with a high prevalence of stunting are surrounded by areas with a high prevalence of stunting as well, and vice versa. It indicates that stunting condition in one area can affect the stunting condition in neighboring areas. The high-high patterns are frequently found in some areas, particularly in NTT.

## RECOMMENDATION

There are some recommendations proposed by the author such as giving a priority to the stunting cluster area, specifically areas with high-high pattern. Some efforts that might be useful for example the establishment of TPPS immediately in provinces that have stunting cluster areas, especially to those whose IKPS below the national one. In addition, stunting cluster areas also need to be determined by the TPPS at the central level in order to encourage and facilitate coordination, collaboration, and program synergy between neighboring stunting areas. The provincial government also needs to give instructions on the formation of TPPS in districts/cities that are in the stunting cluster, as well as form a coordinating team in the stunting cluster area.
Further more, decision-making to determine priority areas for stunting prevention until the smallest units such as sub-districs can also prioritize areas with high stunting cluster. Besides that, the allocation of budgets, resources, and other assistance efforts can also be prioritized in the stunting cluster area. This is expected to prevent the stunting cluster from expanding or getting worse.

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