

Research article

# The Efficiency Analysis of Government Expenditure on Education and Health in Sumatra: The DEA Approach

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**Abstract:** The purposes of this study are to measure the level of the relative efficiency of educational spending and healthcare spending in achieving Mean Years of Schooling (MYS) and life expectancy at regency and city in Sumatera. Data Envelopment Analysis (DEA) were employed for a data set of the spending of 154 local governments in 2019 with an output-oriented model. The approach used is a variable return to scale. In measuring efficiency, two input were used are (i) Government spending of the educational function and (ii) Government spending of the healthcare function, while two output were used are (i) Mean Years of Schooling (MYS) and (ii) life expectancy. The results show that, of the 154 local governments, 6 across ten regency and city in Sumatera, were relatively efficient. There are Gunungsitoli, Bukit Tinggi, Padang Panjang, Solok, Banda Aceh and West Nias.

**Keywords:** educational spending, DEA, mean years of schooling, life expectancy, local government

**JEL Classification:** H61, H72, H76

**Abstrak:** Tujuan dari penelitian ini adalah untuk mengukur tingkat efisiensi relatif belanja pendidikan dan belanja kesehatan dalam pencapaian Mean Years of Schooling (MYS) dan angka harapan hidup di kabupaten dan kota di Sumatera. Data Envelopment Analysis (DEA) digunakan untuk menghitung data pengeluaran 154 pemerintah daerah pada tahun 2019 dengan berorientasi pada model output. Pendekatan yang digunakan adalah variabel return to scale. Dalam mengukur efisiensi, dua input yang digunakan adalah (i) pengeluaran pemerintah untuk fungsi pendidikan dan (ii) pengeluaran pemerintah untuk fungsi kesehatan, sedangkan dua output yang digunakan adalah (i) Mean Years of Schooling (MYS) dan (ii) harapan hidup. Hasil penelitian menunjukkan, dari 154 pemerintah daerah, 6 di sepuluh kabupaten dan kota di Sumatera, relatif efisien. Ada Gunungsitoli, Bukit Tinggi, Padang Panjang, Solok, Banda Aceh, dan Nias Barat.

**Kata Kunci:** belanja pendidikan, DEA, rata-rata tahun sekolah, harapan hidup, pemerintah daerah

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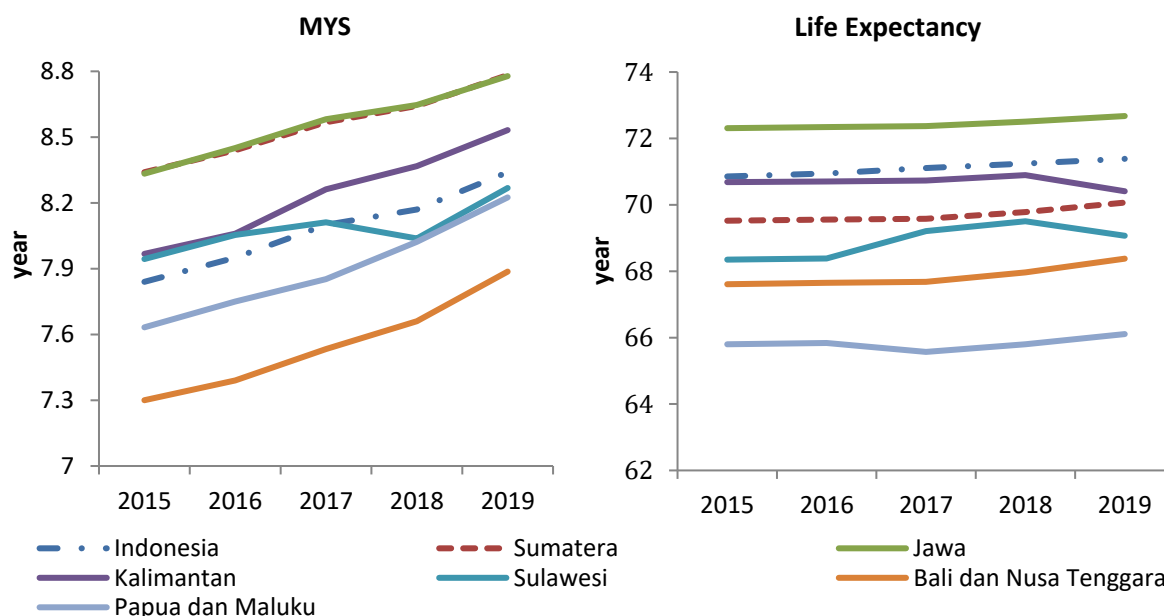
## 1. INTRODUCTION

Local government spending is the use of budget to carry out government duties and functions aimed at improving the welfare of local communities. The level of welfare of the people of a region today is not only seen from economic factors. It also focuses on education and health levels (Chan & Karim, 2012). Thus, economic development today is not only oriented to the economic sector but has changed towards the direction of human resource quality development. In the Regulation of the Minister of Internal Affairs Number 59 of 2007, the affairs of education and health are mandatory

affairs of local governments.

Indonesia is experiencing rapid expansion of the region, from 422 autonomous regions to 576 autonomous regions in 2019. Sumatra Island is the island that experienced the addition of the most autonomous regions, namely as many as 62 regencies and city, which initially there were 92 regencies and cities to 154 regencies and cities. While other islands only experience an increase of half of Sumatra (Rambe, 2020). Government spending in Sumatra is the second largest after Java, where Java is the center of development in Indonesia. The amount of government spending is not coupled with the level of quality of human life in Sumatra as seen from the number of life expectancy and average length of school as in the graph below (Brini & Jemmali, 2013). From Figure 1 can be known although the MYS on the island of Sumatra continues to increase and is above the national average, the Life Expectancy on the island of Sumatra is below the national average even below the island of Kalimantan which has a total expenditure smaller than the island of Sumatra. For that, it is interesting to learn how efficient the local government is in managing its spending. Then it is necessary to conduct an evaluation to find out which local government is relatively efficient in spending money to increase life expectancy and MYS in Sumatra.

Measuring efficiency itself is an important thing to do because efficiency is one of the principles of state financial management in Indonesia. The results of measuring the efficiency of an area will be useful to evaluate the area is good or not yet in managing its spending (Boetti et al., 2012). Therefore, it is interesting to take efficiency measurements in Sumatra to find out which local governments in Sumatra have spent money in a realistic efficient manner in the field of education and health (Kurnia, 2006; Pertiwi, 2007).



**Figure 1.** Average of Life Expectancy and MYS on Every Island in Indonesia from 2015 to 2019

Source: Indonesian Statistics

From Figure 1 can be known although the MYS on the island of Sumatra continues to increase and is above the national average, the Life Expectancy on the island of Sumatra is below the national average even below the island of Kalimantan which has a total expenditure smaller than the island of Sumatra. For that, it is interesting to learn how efficient the local government is in managing its spending. Then it is necessary to conduct an evaluation to find out which local government is relatively efficient in spending money to increase AHH and RLS in Sumatra.

Government spending classified into 10 functions should be allocated to achieve the goals of each function. To find out the achievement of community welfare, it is appropriate to evaluate how the relative efficiency level of spending functions. By knowing how the relative efficiency of local government spending functions, the central government can provide input so that in the future the

local government in each regency/city can increase the relative efficiency of spending. In previous research, quite a lot of research used Government spending of the educational function and Government spending of the healthcare function as input variables (Indriati, 2014). So, this research will also use education and health function spending as input variables. While the output variable that is usually used for education is the Life Expectancy (Adam et al., 2011; Olanubi & Osede, 2016; Fidalgo et al., 2010; Hsu, 2013), Infant Mortality (Adam et al., 2011) while the output variable in the field of education usually used Mean Years of Schooling (MYS) (Dufrechou, 2016). Because not all output variable data in previous research can be used in this study because of data limitations. So, for the output variable for the field of education that will be used in this study is the average length of school. Because there is a 12-year study in Indonesia. The implication is that local governments should be able to allocate money from their budgets to school fees, and the central government to help through its operational funds (Javarov & Gunnarsson, 2008). While the health field output variable will be used life expectancy because of the limited willingness of data.

The purpose of this study is to measure the relative efficiency level of government spending on education and health functions in each regency/city in Sumatra in 2019 using the Data Envelopment Analysis (DEA) approach. This research is also expected to be able to provide recommendations on the amount of life expectancy output and the average length of school that can be added so that regency/cities that are not relatively efficient can be relatively efficient. The empirical study used in this study is the concept of efficiency and government spending. Kawedar et al (2008) states that measuring efficiency can be seen from two sides, namely the cost incurred per unit of product (input to output) or the product produced per unit of resource (output to input). Efficiency is the ratio of output divided by inputs.

According to Mardiasmo et al. (2002), efficiency measurements are made using a comparison between the output produced against the input used. The greater the output than the input, the higher the level of efficiency. The process of operational activities can be said to be efficient if a particular product or work can be achieved with the use of resources and funds as low as possible (spending well). The efficiency ratio is not expressed in absolute form but in relative form. Bogetoft & Otto (2011) shows a mathematical relationship in explaining efficiency, where efficiency is the ratio of output per input. Efficiency measurement can be done with a ratio of 1 output to 1 input, or a multioutput to multi-input ratio. Government expenditure is the use of money in carrying out government functions to buy goods and services with the aim of fulfilling the welfare of the community. If the government has set a policy to buy goods and services, government spending reflects the costs that must be incurred to implement the policy (Mangkoesoebroto, 1999).

The constitution amends the 1945 Constitution article 31 paragraph 4 mandates the obligation of the government to allocate education costs of at least 20% of the state budget and APBD so that people can enjoy education services, developed countries can be seen from the high level of education of their people. The implication of development in the education sector is that human life will be more qualified". In relation to the economy, the higher the level of quality of life, the higher the growth rate and welfare of the nation. The higher the quality of life/investment of quality human resources will have implications also on the level of national economic growth (Afonso & Kazemi, 2016).

According to the Law of the Republic of Indonesia Number 36 of 2009 concerning Health, the government's health budget is allocated at least 5% (five percent) of the state budget beyond salary. As for the health budget of provincial and regency/city governments are allocated at least 10% (ten percent) of the regional revenue and spending budget beyond salary. Argues that health is the government's main concern as a public service organizer. Health sector spending is included in the classification of spending by function (Schultz, 1961). Health function spending is regional spending issued to improve the quality of health and services such as the purchase of drugs, health facilities, and health buildings.

This research is compiled from the background, the reasons why this research is important to do, a review of the relevant literature, the methods and data used, then the results of data processing and discussion of the results of the study, ending with the closing word. The most common method used to measure efficiency is Data Envelopment Analysis (DEA). DEA is the use of

linear programming methods to form the highest frontiers in a data set (Coelli et al., 2005). To estimate the best production limits and evaluate the relative efficiency of different units. There are several assumptions that must be met in using the DEA (Bogetoft & Otto, 2011). The assumption is as follows: first, no inputs or outputs are wasted. Second, convexity. Third, -Return to scale (where it is constant, decreases, or increases back to scale). Fourth, there is addition or replication. In the DEA, the units measured are called Decision-Making Units (DMU). The efficiency resulting from DEA for efficient DMU ranges from 0-100 percent or 0-1. A DMU that has a score of less than 1 (on a scale of 0-1) is considered a relatively inefficient unit compared to other units (Coelli et al., 2005).

## 2. RESEARCH METHODS

### 2.1. Data

This type of research is quantitative descriptive research. The data in this study is secondary data. The data used is input and output data in 154 regencies/cities in Sumatra in 2019 (BPS, 2020). The input data consists of 2 variables, namely Government spending of the educational function and Government spending of the healthcare function, both of data are accessed through the official website of the Ministry of Finance of the Republic of Indonesia (Porcelli, 2011). While the output data used is the Mean Years of Schooling (MYS) and life expectancy obtained from the Indonesian statistics publication book 2020 by the Indonesian Statistics.

### 2.2. Model

The analysis method used in this study is Data Envelopment Analysis (DEA) (Todaro, 2000). The selection of the use of DEA analysis is based on the consideration that DEA analysis is able to measure the relative efficiency of a Decision-Making Unit (DMU) under conditions of many inputs and outputs or so-called multi-input and multi-output (Bogetoft & Otto, 2011; Fidalgo et al., 2010). Relative efficiency measurement with DEA will use an output-oriented model based on Variable Return to Scale (VRS).

Model Objective Function:

$$\text{Max } E = \mu_1 Y_1 + \mu_2 Y_2 + \mu_0 \quad (1)$$

Subject to:

$$v_1 X_1 + v_2 X_2 = I \quad (2)$$

$$\mu_1 Y_1 + \mu_2 Y_2 - (v_1 X_1 + v_2 X_2) \leq 0 \quad (3)$$

$$\mu_1, 2; v_1, 2 \geq 0 \quad (4)$$

where:  $Y_1$  is life expectancy;  $Y_2$  is mean years of schooling;  $X_1$  is government spending of the educational function;  $X_2$  is government spending of the healthcare function;  $E$  is efficiency value of regency/city government;  $\mu_1, 2$  is weight for output  $Y$ ;  $v_1, 2$  is weight for output  $X$ ;  $v_0$  is beheadings that can be positive or negative.

The analytical tool that will be used to analyze relative efficiency with the DEA Method in this study is to use DEAP (Data Envelopment Analysis Program).

### 3. RESULTS AND DISCUSSION

#### 3.1. Efficiency of Local Government

Based on Table 1 of 154 regencies/cities in Sumatra shows the results of processing data on the relative efficiency of the cost of spending on regional education and health functions using the DEA in 2019 (Suparmoko, 2013). The relative efficiency score between 0 until 1, the score of 1 means relatively efficient.

**Table 1.** Regency/city Government Efficiency Statistics in Sumatra in 2019

Efficiency Score	Number of regions	%	Name of regencies/cities
0,832-0,888	16	10.39%	Lingga; Mandailing Natal; West Coast; South Aceh; Tanjung Balai; Lebong; South Tapanuli; Empat Lawang; Natuna; Southwest Aceh; Mentawai Islands; Subulussalam; Ogan Ilir; Simeulue; Lahat; North Musi Rawa.
0,889-0,945	105	54.55%	Gayo Lues; Sijunjung; East Tanjung Jabung; Mukomuko; Batu Bara; South OKU; Kaur; Pidie; Padang Lawas; Aceh Jaya; North Padang Lawas; Central Tapanuli; Anambas Islands; Pasaman; Aceh Singkil; Pagar Alam; West Lampung; Pakpak Bharat; Meranti Islands; Seluma; South Solok; Bungo; West Pasaman; Indragiri Hilir; South Bengkulu; Musi Rawas; West Aceh; South Bangka; Ogan Komering Ulu; Southeast Aceh; West Tanjung Jabung; Penukal Abab Lematang Ilir; North Bengkulu; Mesuji; Asahan; Central Bengkulu; Solok; Kepahiang; Rejang Lebong; Serdang Bedagai; North Tapanuli; Kuantan Singingi; Ogan Komering Ilir; Tanggamus; Musi Banyuasin; Langkat; South Nias; Padang Pariaman; South Labuhanbatu; Muara Enim; Banyuasin; Aceh Tengah; Aceh North; Dairi; East Aceh; East OKU; Pesawaran; Humbang Hasundutan; Lubuk Linggau; North Lampung; Sarolangun; Bener Meriah; Nagan Raya; South Lampung; Way Kanan; North Labuhanbatu; Padang Sidempuan; Aceh Tamiang; Limapuluh; Aceh Besar; Tanah Flat; Central Lampung; Labuhanbatu; Kerinci; Pringsewu; Toba Samosir; Rokan Hulu; Tebo; Tulang Bawang; Tulang Bawang Barat; West Bangka; Pidie Jaya; Prabumulih; and Rokan Hilir.
0,946-0,999	72	31.17%	Indragiri Hulu; Bintan; Nias; North Nias; Batanghari; Palembang; Sibolga; East Lampung; Langsa; Kampar; Tebing Tinggi; Pesisir Selatan; Karimun; Dumai; Bangka; Belitung; Pariaman; Pelalawan; Siak; Simalungun; Dharmasraya; Bengkalis; Bireuen ; Samosir; Merangin; Muaro Jambi; Central Bangka; Karo; Sawahlunto; Bandar Lampung; Lhokseumawe; Metro; Deli Serdang; Bengkulu; East Belitung; Tanjung Pinang; Agam; Binjai; Sungai Penuh; Jambi; Pekanbaru; Pangkal Pinang; Batam; Pematang Siantar; Medan; Payakumbuh; Padang; Sabang; Banda Aceh; West Nias; Gunungsitoli; Bukit Tinggi; Padang Panjang; Solok
1,000	6	3.90%	Indragiri Hulu; Bintan; Nias; North Nias; Batanghari; Palembang; Sibolga; East Lampung; Langsa; Kampar; Tebing Tinggi; Pesisir Selatan; Karimun; Dumai; Bangka; Belitung; Pariaman; Pelalawan; Siak; Simalungun; Dharmasraya; Bengkalis; Bireuen ; Samosir; Merangin; Muaro Jambi; Central Bangka; Karo; Sawahlunto; Bandar Lampung; Lhokseumawe; Metro; Deli Serdang; Bengkulu; East Belitung; Tanjung Pinang; Agam; Binjai; Sungai Penuh; Jambi; Pekanbaru; Pangkal Pinang; Batam; Pematang Siantar; Medan; Payakumbuh; Padang; Sabang; Banda Aceh; West Nias; Gunungsitoli; Bukit Tinggi; Padang Panjang; and Solok

Source: Authors' calculations

Table 1 shows that the condition of achieving the relative efficiency of education and health function spending there are 6 regencies/cities that reach relatively efficient from the total of 154 Sumatra (3.90% of the total). These 6 relatively efficient local governments are in 3 provinces namely Aceh, West Sumatra, and North Sumatra. The three provinces, most of the relatively efficient local governments are based in the province of West Sumatra (3 local governments are relatively efficient).

3.2. Increased Output for local government relative inefficiency in order to be relatively efficient

In firm-by-firm results in this study will be seen columns in original value, radial movement, and projected value. The following will be discussed further about the value of radial movement for each output, namely AHH and RLS, to be a recommendation for each regency/city that is inefficiency to increase the value of its output to achieve relative efficiency.

**Table 2.** Radial Movement Value at Output 1 (MYS) to Added on Maximize Efficiency Levels in Inefficiency regencies/Cities

Radial Movement value at output 1 (MYS) that must be added to be efficient	Regencies/Cities
0.028 - 0.541	Sabang City; Padang; Payakumbuh; Medan; Pematang Siantar; Pangkal Pinang; Batam; Pekanbaru; Jambi; Agam; East Belitung; Sungai Penuh; Nias; Binjai; Tanjung Pinang; Central Bangka; Merangin; North Nias; Muaro Jambi; Deli Serdang; Dharmasraya; Bangka; Pelalawan; East Lampung; Belitung; Bengkulu City;; Samosir; Karimun; Metro City; Karo; Bireuen; South Coast; Lhokseumawe City; Bengkalis; Simalungun; Sawahlunto City; Batanghari; Siak; West Bangka; Bandar Lampung City; Tulang Bawang Barat; Tulang Bawang; South Nias City; Pariaman; Bintan; Tebo; Indragiri Hulu; Kampar; Dumai City; Rokan Hilir; Central Lampung; Tebing Tinggi City; Pringsewu; Fifty Cities; Kerinci; Rokan Hulu; Sibolga City; Way Kanan; Pidie Jaya.
0.542 - 1.055	Tanah Datar; Palembang; South Lampung; Langsa; Banyuasin; Prabumulih; Labuhanbatu; Sarolangun; North Labuhanbatu; East OKU; Pesawaran; OKI; South Bangka; Mesuji; Aceh Tamiang; Penukal Abab Lematang Ilir; East Aceh; Tanggamus ; North Lampung; Nagan Raya; Musi Banyuasin; Muara Enim; Toba Samosir; Central Bengkulu; Padang Pariaman; Aceh Besar; North Aceh; Solok; Kepahiang; Indragiri Hilir; Tanjung Jabung Barat; Musi Rawas; Rejang Lebong; Langkat; Bener Meriah; South Labuhanbatu; Humbang Hasundutan; North Bengkulu; Serdang Bedagai; Kuantan Singingi; Lubuk Linggau City; Dairi; Anambas Islands; Padang Sidempuan City; Meranti Islands; Central Aceh; Asahan; West Pasaman; Seluma; East Tanjung Jabung; West Lampung; Ogan Komering Ulu; Bungo; South Solok; North Tapanuli; Pasaman; North Musi Rawas; West Aceh; South Bengkulu; Pakpak Bharat; Aceh Singkil; South OKU; Southeast Aceh; Coal; Central Tapanuli; Pagar Alam City; Aceh Jaya; Kaur; Mukomuko ; Padang Lawas; Pidie; North Padang Lawas; Gayo Lues; Sijunjung; Mentawai Islands.
1,056 - 1.569	Empat Lawang; Subulussalam City; Ogan Ilir; Lahat; Southwest Aceh; Lebong; Simeulue; Natuna; South Tapanuli; Lingga; South Aceh; West Coast; Tanjung Balai City; Mandailing Natal

Source: Authors calculations

The score in the Table 2 is obtained from the Radial Movement column in the firm-by-firm results of the DEA measurement results. Radial Movement was chosen because the value in Radial

Movement is the output value that can be added by each regency/city in the research year (Prasetyowati & Haryanto, 2018). While in the slack movement column is not used because the value in the column is a value that cannot be added in the research year or the need for further analysis and measurement in the year after. From the Table 2 we can analyze how for each relatively inefficiency DMU to increase its efficiency by adding MYS values in accordance with existing ranges (Prajanti, 2013). Mandailing Natal is the regency that must raise its RLS the most compared to other regencies/cities, which is 1.566 years so that the regency can increase its relative efficiency level.

**Table 3.** Radial Movement Value at Output 2 (Life Expectancy) to Added on Maximize Efficiency Levels in Inefficiency Regencies/Cities

Radial Movement value at output 1 (Life Expectancy) that must be added to be efficient	regencies/Cities
0.175 – 4.273	Kota Sabang, Kota Padang, Kota Payakumbuh, Kota Medan, Kota Pematang Siantar, Kota Batam, Kota Pangkal Pinang, Kota Pekanbaru, Kota Jambi, Kota Sungai Penuh, Kota Binjai, Agam, Kota Tanjung Pinang, Belitung Timur, Kota Bengkulu, Deli Serdang, Kota Metro, Kota Lhokseumawe, Kota Bandar Lampung, Kota Sawahlunto, Karo, Merangin, Muaro Jambi, Bireuen, Samosir, Bangka Tengah, Bengkalis, Dharmasraya, Kota Pariaman, Simalungun, Pelalawan, Siak, Bangka, Belitung, Kota Dumai, Kota Tebing Tinggi, Pesisir Selatan, Kota Langsa, Karimun, Kota Sibolga, Kampar, Lampung Timur, Kota Palembang, Nias Utara, Batanghari, Nias, Bintan, Indragiri Hulu, Rokan Hilir, Kota Prabumulih, Pidie Jaya, Bangka Barat,
4.274 - 8.372	Sabang City, Padang City, Payakumbuh City, Medan City, Pematang Siantar City, Batam City, Pangkal Pinang City, Pekanbaru City, Jambi City, Sungai Penuh City, Binjai City, Agam, Tanjung Pinang City, East Belitung, Bengkulu City, Deli Serdang , Metro City, Lhokseumawe City, Bandar Lampung City, Sawahlunto City, Karo, Merangin, Muaro Jambi, Bireuen, Samosir, Central Bangka, Bengkalis, Dharmasraya, Pariaman City, Simalungun, Pelalawan, Siak, Bangka, Belitung, Dumai City, Cliff City Tinggi, South Coast, Langsa City, Karimun, Sibolga City, Kampar, East Lampung, Palembang City, North Nias, Batanghari, Nias, Bintan, Indragiri Hulu, Rokan Hilir, Prabumulih City, Pidie Jaya, West Bangka,
8.373 – 12.471	Toba Samosir, Tebo, Rokan Hulu, Tulang Bawang, Tulang Bawang Barat, Labuhanbatu, Pringsewu, Kerinci, Aceh Besar, Central Lampung, Tanah Datar, Fifty Cities, Aceh Tamiang, Padang Sidempuan City, North Labuhanbatu, Way Kanan, South Lampung, Bener Meriah, Nagan Raya, Sarolangun, Humbang Hasundutan, North Lampung, Lubuk Linggau City, Pesawaran, East Aceh, East OKU, Central Aceh, North Aceh, Dairi, Banyuasin, South Labuhanbatu, Muara Enim, Langkat, South Nias, Padang Pariaman, Musi Banyuasin, Serdang Bedagai, North Tapanuli, Kuantan Singingi, Ogan Komering Ilir, Tanggamus, Kepahiang, Rejang Lebong, Solok, Central Bengkulu, Asahan, Penukal Abab Lematang Ilir, Southeast Aceh, North Bengkulu, Mesuji, Tanjung Jabung Barat, Ogan Komering Ulu, West Aceh, South Bangka, Musi Rawas, South Bengkulu, Pakpak Bharat, West Pasaman, Indragiri Hilir, Bungo, Pagar Alam City, South Solok, Seluma, Meranti Islands, West Lampung, Aceh Singkil, Pasaman, Aceh Jaya, Central Tapanuli, Padang Lawas U tara, Anambas Islands, Padang Lawas, Pidie, Kaur, South OKU, Batu Bara, Mukomuko, Tanjung Jabung Timur, Gayo Lues, Sijunjung, Musi Rawas Utara,

Source: Authors calculations

The score in the Table 3 also obtained from the Radial Movement column in firm-by-firm results from the results of DEA measurements. From the Table 3 we can know how for each relatively inefficiency DMU to increase its efficiency by adding life expectancy values in accordance with the existing range. Lingga is the regency that must raise its life expectancy the most compared to other regencies/cities, which is 12,471 years. While Sabang City is a regency/city that must increase its AHH at least 0.175 years.

#### 4. CONCLUSIONS

Based on the findings of research and discussion conducted on the analysis of relative efficiency of government spending in education and health in regencies and cities in Sumatra with inputs on Government spending of the educational function and Government spending of the healthcare function, as well as Life expectancy and Mean Years of Schooling (MYS) output in the Data Envelopment Analysis (DEA) method, there was a relative variation in the relative efficiency of health and education. Sumatra's average relative efficiency rate for health and education spending is 0.932. Banda Aceh City, West Nias City, Gunungsitoli City, Bukit Tinggi City, Padang Panjang City, and Solok City are six regencies/cities (4% of the total regencies/cities) with relatively efficient health and education spending.

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