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# ALLOCATION OF LAND FOR PADDY FARM IN MATARAM MUNICIPAL - INDONESIA

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**ABSTRACT**

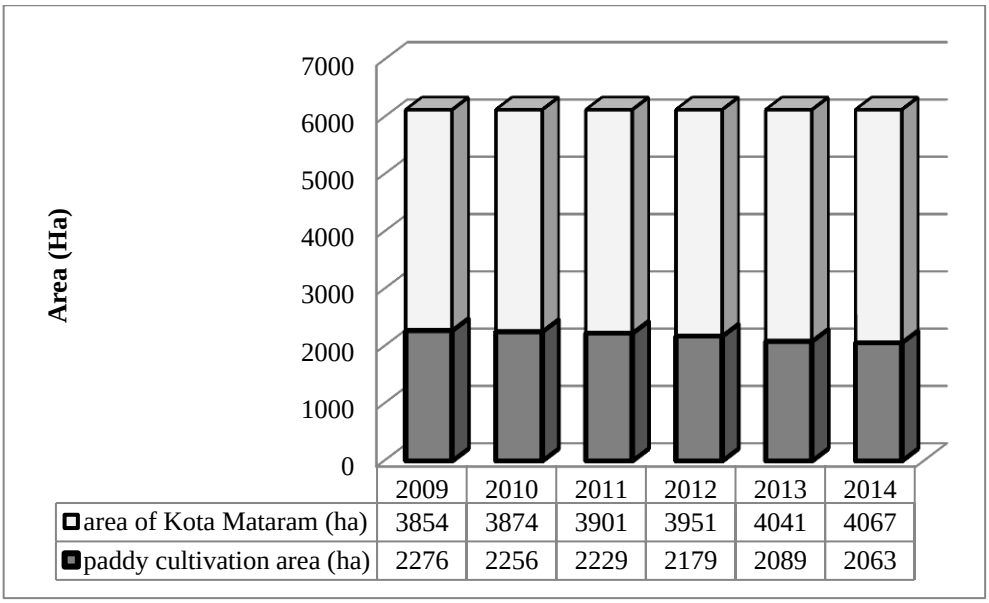
*The intended purposes are: 1) recognizing the decrease rate of land area devoted for paddy cultivation in Mataram Municipal, 2) recognizing the effects of the decrease of land area devoted for paddy cultivation towards the availability of local rice, and 3) formulating a solution to increase local rice production in Mataram Municipal. The research was conducted using descriptive method and secondary data. The data were analyzed by using trend ratio method. The conclusions obtained from research result are 1) the land area devoted for paddy cultivation in Mataram Municipal decreased with rate of 23.06 ha/year which can cause the reduction of agriculture product production, 2) the decrease of land area devoted for paddy cultivation from 2009 – 2014 does not have an impact yet on the decrease of rice production and the availability or local rice, the availability of local rice increased as the effect of the increase of cropping index and the increase of rice paddy farming; and 3) the production of local rice in Mataram Municipal still has a chance to be increased through the increase of farming index and the increase of rice paddy farming.*

**Keywords**: farming index, land area devoted, rice production, paddy farming, trend ratio methode.

## INTRODUCTION:

The problem faced by municipal government is a land use conflict – a conflict between the land use for agliculture for achieving regional food security and land use for non-agriculture in order to fulfill the need for settlement, trading, office complex, roads, and other public facilities. The conflict causes land use conversion process from agriculture to non-agriculture land occurrence which can threat regional food security (Iqbal & Sumaryanto, 2007)

Land use conversion from agriculture to non-agriculture is difficult to avoid (Santosa, Adnyana, & I Ketut Kartha Dinata, 2011) due to the increase demand of land request for non-agriculture purposes meningkat (Kubankova, M.Hajek, & A.Votavova, 2016). The increase causes land price become more expesinve and land rent price for farming increases as well (Kirchweger, J.Kantelhardt, & F.Leisch, 2015). Due to this situation, farmers who have land and cultivate it tend to sell their land instead of cultivating it (Buday & Tatiana, 2015). This cause the farming land which was owned by farmers becomes non-farmers property.




| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|
| area of Kota Mataram (ha) | 3854 | 3874 | 3901 | 3951 | 4041 | 4067 |
| paddy cultivation area (ha) | 2276 | 2256 | 2229 | 2179 | 2089 | 2063 |

**Figure 1.1: The development of land area devoted for paddy cultivation in Mataram Municipal in year 2009 - 2014**

**Sources:** Food Security Agency and Executive Agency for Agriculture and Fishery of Mataram Municipal *cit.* Usman, A., *et al.*, 2015.

Indonesia Republic policy which is written on laws no. 41 year 2009 pertaining Protection of Sustainable Food Crop Area has not been effective yet (Anita Widhy Handari, 2012) in many cities in Indonesia. One of the cities is Mataram Municipal. There is a massive land use conversion in Mataram Municipal because there is no Local Regulation following up the laws. In 2009, the land area devoted for paddy cultivation was 2,276.12 ha and it decreased into 2,063.36 ha in 2014. The decrease rate is 1.98%/year (Figure 1.1).

Mataram Municipal government faces difficult situation in which the government has to choose between keeping the land area devoted for paddy cultivation of 2,089.05 ha to support the availability of rice and granting the demand of land use conversion. This contradictary situation has hampered the ratification of Local Regulation Design of Mataram Municipal pertaining Sustainable Productive Agriculture Area. The reason is the absence of academic study that can be used as the base consideration in determining the land area devoted for paddy cultivation and recognizing its effects towards the availability of local rice.

The availability of local rice which was coming from rice field production is relatively small compared to the need of Mataram Municipal citizens. The local rice production contributed 46,25% (20,067 ton) out of the total need of 44,192 ton in 2013 and decreased into 43,45% in 2014 (Tajidan, Usman, GLP.Tanaya, & Wuryantoro, 2015). The decrease directly increases the import of rice, and weakens the position of Mataram Municipal as contributor of national rice reserve.

Because land use conversion from agriculture to non-agriculturen purposes is difficult to avoid, the ratio of land area devoted for paddy cultivation towards region area will have a dinamic change; meanwhile the need of rice keeps increasing year to year, thus there is a concern that the ratio of local rice production in fulfilling the rice

need of citizen will decrease. This concern still needs to be proven by reviewing the development of the land area devoted for paddy cultivation and estimating its effects towards the availability of local rice.
Mataram Municipal government through the chief of Agricultural Fishery and Livestock Office of Mataram Municipal wants an existence of optimal ratio between the land area devoted for paddy cultivation towards the municipal region area as the proportion of open green space of 35% from the area of municipal region. The agricultural economists are challenged to find a ratio formula of the land area devoted for paddy cultivation towards municipal region area that has not been available yet.
The alternative for solving the problem is by projecting the land area devoted for paddy cultivation and estimating its effects towards the availability of local rice. To date, the agricultural economists in trend linear projection analysis always use existing data, however in this research the ratio data was used.
Therefore, there is a need to project the land area devoted for paddy cultivation and its effects towards the availability of local rice, and formulate a solution to fulfill the rice need of citizen by paying attention on the case in Mataram Municipal. In the future, this model can be applied in other cities in Indonesia.

## PURPOSE OF THE STUDY:

The purposes of this study are:

a. Recognizing the decrease rate of land area devoted for paddy cultivation in Mataram Municipal
b. Recognizing the effect of the decrease of land area devoted for paddy cultivation towards the availability of local rice
c. Formulating a solution to increase local rice production in Mataram Municipal

## APPROACH FRAME WORK:

Projection is making approximation about number, condition in the future. One of the analysis tools used in the projection is trend analysis:

$$Yt = \alpha + \beta Xt \quad \text{..... (2.1)}$$

$$\alpha = \frac{\sum_{t=1}^{n} Yt}{n} \quad \text{..... (2.2)}$$

$$\beta = \frac{\sum_{t=1}^{n} Yt.Xt}{\sum_{t=1}^{n} Xt^2} \quad \text{..... (2.3)}$$

**Notes:**
Yt = data projected in year-t
Xt = time index in year- t
α = average Yt
β = trend coefficient
In deciding the need of rice, the researchers multiplied the need of rice per capita with citizen population. The need of rice per capita was standarized of 0,105 ton/capita/year, while the citizen population was projected using formula as follows:

$$Pt = Po\ (1+r)^{\wedge t} \quad \text{..... (2.4)}$$

**Notes:**
Pt = the citizen population in year-t
Po = the citizen population in initial year
t = time period
r = growth rate average.
Municipal region area is consisted of land area devoted for paddy cultivation and non-farming land area. Mathematically it is as follow:

$$LKo = LSt + LNt \quad \text{..... (2.5)}$$

**Notes:**
LKo = Municipal region area (ha)
LSt = the land area devoted for paddy cultivation (ha)
LNt = the land area for non-paddy cultivation (ha)
The projection of the land area devoted for paddy cultivation was done by using relative approach meaning using the ratio of the land area devoted for paddy cultivation towards the municipal region area (LSt/Lko). Equation (2.5) was changed into:

**LKo/LKo = LSt/LKo + LNt/LKo ..... (2.6)**

Trend linear equation of the land area devoted for paddy cultivation using ratio approach is as follow:

**LSt/LKo = a + bXt..... (2.7)**

**Notes:**

a = mean ration of local rice production towards municipal citizen rice need

b = trend coefficient.

The rice need of citizens is an accretion between local rice production and rice import. The calculation is as follow:

**KBt = BLt + BIt ..... (2.8)**

**Notes:**

KBt = number of municipal citizen rice need

BLt =number of local rice production

BIt = number of rice import

To project the number of local rice production, ratio approach was applied:

**KBt/KBt = BLt/KBt + BIt/KBt ..... (2.9)**

**BLt/KBt = c + dXt ..... (2.10)**

**Notes:**

c = mean ration of local rice production towards municipal citizen rice need

d = trend coefficient.

Equation (2.7) and (2.10) reaches equilibrium if:

LSt/LKo = BLt/KBt

a + bXt = c + dXt

(b-d)Xt = c – a, thus

**Xt = (c – a)/(b – d) ..... (2.11)**

If Xt is subtituted on equation (2.7), the result is the projection of land area devoted for paddy cultivation:

LSt/LKo = a + b Xt

**LSt = (a + b Xt) LKo ..... (2.12)**

The impact of projection result of land area devoted for paddy cultivation on equation (2.12) was used to estimate local rice production. The way is the projection of land area devoted for paddy cultivation (LSt) multiplied with rice cropping index (IPt) multiplied with rice paddy farming productivity (vt) and the conversion from rice to grain (0.65).

**BLt = LSt x IPt x vt x 0,65 ..... (2.13)**

## RESEACH METHODE:

### RESEARCH DESIGN:

This research was designed using time series data provided by Statistics Indonesia of Mataram Municipal, Executive Agency for Agriculture, Fishery and Forestry of Mataram Municipal, and Agriculture Offcie, Fishery Office and Livestock Office of Mataram Municipal. The data collected were the area of Mataram Municipal, the development of land area devoted for paddy cultivation, the area of rice harvest, the productivity of rice farming, rice production, the number of citizens, the conversion of rice plant to rice, the consumption of rice per capita, and relevant information to the purposes of the study.

### DATA ANALYSIS:

To achieve the first purpose of study, trend liniar analysis was used as formulated on equation (2.12); for the second purpose, equation (2.13); and for the third purpose, descriptive ananlysis of equation (2.12) and (2.13) was applied.

## RESULTS AND DISCUSSIONS:

### The Projection of Standard Farming Land:

The result of linear trend analysis with the land area devoted for paddy cultivation ratio approach towards the

municipal region area is shown in Table 4.1 below:

**Table 4.1 The development of land area devoted for paddy cultivation and its ratio in Mataram Municipal 2009 - 2014**

| No | Year | Land area devoted for paddy cultivation (LSt) | Area (LKo) | LSt/LKo | Xt | $Xt^2$ | LSt/LKo.Xt |
|---|---|---|---|---|---|---|---|
| 1 | 2009 | 2,276.12 | 6,130 | 0.37131 | -5 | 25 | -1.8565 |
| 2 | 2010 | 2,256.13 | 6,130 | 0.36805 | -3 | 9 | -1.1041 |
| 3 | 2011 | 2,229.21 | 6,130 | 0.36366 | -1 | 1 | -0.3637 |
| 4 | 2012 | 2,179.90 | 6,130 | 0.35561 | 1 | 1 | 0.3556 |
| 5 | 2013 | 2,089.05 | 6,130 | 0.34079 | 3 | 9 | 1.0224 |
| 6 | 2014 | 2,063.36 | 6,130 | 0.33660 | 5 | 25 | 1.6830 |
| | | | **Total** | **2.13602** | | **70** | **-0.26335** |

$a = \frac{\sum_{t=1}^{n} LSt/LKo}{n} = \frac{2.13602}{6} = 0.35600333$

$b = \frac{\sum_{t=1}^{n} LSt/LKo.Xt}{\sum_{t=1}^{n} Xt^2} = \frac{-0.26335}{70} = -0.00376214$

Linear trend equation of land area devoted for paddy cultivation is:

$$\underline{LSt}/LKo = 0{,}356 - 3{,}76^{-3}\ \underline{Xt} \quad \text{..... (3.1)}$$

Because the area of Mataram Municipal is = 6.130 ha, therefor Linear trend of land area devoted for paddy cultivation is:

$$\underline{LSt} = 2.182{,}3 - 23{,}06\ \underline{Xt} \quad \text{..... (3.2)}$$

By using equation (3.2), it can be projected that standard farming land area in Mataram Municipal is:

**Table 4.2: Projection result of land area devoted for paddy cultivation in Mataram Municipal 2009 – 2014**

| No | Year | Land area devoted for paddy cultivation (Ha)* | Area of Mataram Municipal (Ha)** | LSt/LKo | Xt | LSt/LKo | Projection LSt |
|---|---|---|---|---|---|---|---|
| 1 | 2009 | 2,276.12 | 6,130 | 0.37131 | -5 | 0.37481 | 2,297.61 |
| 2 | 2010 | 2,256.13 | 6,130 | 0.36805 | -3 | 0.36729 | 2,251.48 |
| 3 | 2011 | 2,229.21 | 6,130 | 0.36366 | -1 | 0.35976 | 2,205.36 |
| 4 | 2012 | 2,179.90 | 6,130 | 0.35561 | 1 | 0.35224 | 2,159.23 |
| 5 | 2013 | 2,089.05 | 6,130 | 0.34079 | 3 | 0.34472 | 2,113.11 |
| 6 | 2014 | 2,063.36 | 6,130 | 0.33660 | 5 | 0.33719 | 2,066.98 |

**Source:** * Executive Agency for Agriculture, Fishery and Forestry of Mataram Municipal
** Statistics Indonesia of Mataram Municipal

The projetion result of land area devoted for paddy cultivation (Projection LSt) in table 4.2 shows that a declining linear trend. The average decrease rate of land area devoted for paddy cultivation ratio towards area of Mataram Municipal is 23.06 ha/year from 2009 – 2014. The average ratio of land area devoted for paddy cultivation towards area of Mataram Municipal is 0.356 or land area devoted for paddy cultivation is 35.6 percent of Mataram Municipal area. Analysis results are 0.356 almost the same with the results of scaling up is 0.3503 or standard acreage of farmland paddy amounted 35.03 % ( 2,147.49 ha ) of the area of 6,130 ha Mataram ( Tajidan , et al. , 2015) .

## THE PROJECTION OF LOCAL RICE AVAILABILITY:

The availability of local rice is determined by rice harvest area and the productivity of rice plant, meanwhile harvest area is a total of land area devoted for paddy cultivation multiplied with rice cropping index. The data of rice harvest area, rice plant productivity and production in Mataram Municipal is shown in Table 4.3.

**Table 4.3: The development of Rice Production in Mataram Municipal 2009 - 2014**

| Year | land area devoted for paddy cultivation (Ha)* | Rice cropping index*** | Rice aarvest area (Ha)** | Productivity (Ton/Ha)** | Rice production (Ton)** |
|---|---|---|---|---|---|
| 2009 | 2,276.12 | 1.834 | 4175 | 5.475 | 22,859 |
| 2010 | 2,256.13 | 1.968 | 4440 | 5.459 | 24,236 |
| 2011 | 2,229.21 | 2.291 | 5107 | 5.329 | 27,217 |
| 2012 | 2,179.90 | 2.346 | 5115 | 5.343 | 27,328 |
| 2013 | 2,089.05 | 2.628 | 5489 | 5.625 | 30,873 |
| 2014 | 2,063.36 | 2.595 | 5355 | 5.782 | 30,960 |

**Source:** * Executive Agency for Agriculture, Fishery and Forestry of Mataram Municipal
** Mataram Municipal in Numbers 2013 and 2015
*** Division result of rice harvest area with land area devoted for paddy cultivation

The increasing of rice production is dominantly caused by the increasing of rice cropping index and productivity (Table 4.3). The highest rice cropping index was in 2013, meanwhile the highest rice plant productivity and production was in 2014.

In an effort to increase rice production , the strategy can be implemented is an increase in harvest area through increased indices of agriculture , and increase productivity through technological improvements , including through the use of improved seed hybrids , balanced fertilizer , control of plant pests , irrigation efficientcy, and utilization of agricultural machinery . The use of chemical fertilizers and excessive pesticide is a poison that is harmful to human health (Laary & Joseph, 2012) . Therefore the use of agrochemicals must be wise.

**Table 4.4: The ratio development of local rice production towards the rice need of citizens from 2009 - 2014**

| No | Year | Rice Production (Ton/Ha)* | The Availability of Local Rice (Ton)** | Population (person)* | The Rice Need of Citizens (Ton) | BLt/KBt |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4)=0.65*(3) | (5) | (6)=(5)*0.105 | (7)=(4):(6) |
| 1 | 2009 | 22,859 | 14,858.35 | 375506 | 39428.13 | 0.37685 |
| 2 | 2010 | 24,236 | 15,753.40 | 404502 | 42472.71 | 0.37091 |
| 3 | 2011 | 27,217 | 17,691.05 | 413622 | 43430.31 | 0.40734 |
| 4 | 2012 | 27,328 | 17,763.20 | 422673 | 44380.67 | 0.40025 |
| 5 | 2013 | 30,873 | 20,067.45 | 431876 | 45346.98 | 0.44253 |
| 6 | 2014 | 30,960 | 20,124.00 | 441064 | 46311.72 | 0.43453 |

**Source:** * Mataram Municipal in Numbers 2013 and 2015

The availability of local rice is increased and it is in line with the increasing of rice production. The need of rice is also increased along with the increase of citizen number. The growth rate of citizen number is higher than the increase of local rice availability; therefore there was an increase on the availability of local rice towards citizen rice need. The highest ratio was in 2013.

The result of linear trend analysis shows that the availability of local rice contributed 40.54 percent towards the citizen rice need with increase rate of 0.71 percent/year. Increasing food supply of local rice irrigation made possible by the availability of surface water and ground water through the utilization of irrigation wells pampa. Available surface water irrigation in rainy season and dry season-1 . Most standard acreage irrigated rice area planted with rice make possible three times a year . This opportunity has been exploited by the farmers, to cultivate rice crops throughout the year , but have a negative impact on the environment , because the life cycle of pests and diseases are not interrupted. The use of pesticides is a crucial production factor (Basorun, O., & Julius, 2012).

**Table 4.5 The projection of the availability of local rice in Mataram Municipal 2009 – 2014**

| No | Year | BLt/KBt | Xt | $Xt^2$ | BLt/KBt.Xt | BLt/KBt | Proyeksi BLt |
|---|---|---|---|---|---|---|---|
| 1 | 2009 | 0.37685 | -5 | 25 | -1.88423 | 0.36996 | 14586.73 |
| 2 | 2010 | 0.37091 | -3 | 9 | -1.11272 | 0.38413 | 16315.25 |
| 3 | 2011 | 0.40734 | -1 | 1 | -0.40734 | 0.39831 | 17298.83 |
| 4 | 2012 | 0.40025 | 1 | 1 | 0.40025 | 0.41249 | 18306.58 |
| 5 | 2013 | 0.44253 | 3 | 9 | 1.32759 | 0.42667 | 19348.08 |
| 6 | 2014 | 0.43453 | 5 | 25 | 2.17267 | 0.44085 | 20416.29 |
| | **Total** | **2.43241** | | **70** | **0.49621** | | |

$$c = \frac{\sum_{t=1}^{n} LSt/LKo}{n} = \frac{2.43241}{6} = 0.40540167$$

$$d = \frac{\sum_{t=1}^{n} LSt/LKo.Xt}{\sum_{t=1}^{n} Xt^2} = \frac{0.49621}{70} = 0.00708876$$

**Table 4.6: Estimation result of harvest area, rice production, and the availability of local rice in Mataram Municipal 2009 - 2014**

| Year | The projection of land area devoted for paddy cultivation (Ha) | Rice cropping index | Rice harvest area (Ha) | Rice productivity (Ton/Ha) | Estimation of rice production (Ton) | Estimation of local rice availability (Ton) |
|---|---|---|---|---|---|---|
| 2009 | 2,297.61 | 1.834 | 4,214.42 | 5.475 | 23,074.82 | 14,998.64 |
| 2010 | 2,251.48 | 1.968 | 4,430.85 | 5.459 | 24,186.05 | 15,720.93 |
| 2011 | 2,205.36 | 2.291 | 5,052.36 | 5.329 | 26,925.81 | 17,501.78 |
| 2012 | 2,159.23 | 2.346 | 5,066.50 | 5.343 | 27,068.87 | 17,594.77 |
| 2013 | 2,113.11 | 2.628 | 5,552.22 | 5.625 | 31,228.57 | 20,298.57 |
| 2014 | 2,066.98 | 2.595 | 5,364.39 | 5.782 | 31,014.32 | 20,159.31 |

The use of ratio data is an alternative that can be used in projection analysis, such as land area devoted for paddy cultivation towards municipal region area and the availability of local rice ratio towards citizen need of rice. Rice production or the availability of local rice is dominantly determined by the increase of farming area and productivity than the decrease of land area devoted for paddy cultivation. The decrease of land area devoted for paddy cultivation in 2009 – 2014 did not cause the decrease of rice production and the availability of local rice, because the decrease could still be handled by the increase of rice cropping index and productivity.

## THE SOLUTION OF THE INCREASE OF LOCAL RICE PRODUCTION IN MATARAM MUNICIPAL:

The decrease of land area devoted for paddy cultivation has been anticipated by the increase of cropping index (Nazam, Sabiham, Pramudya, Widiatmaka, & Rusastra, 2011). The increase of cropping index has been able to prevent the decrease of rice harvest area (table 4.6). The increase of cropping index and productivity altogether has been able to prevent the decrease of rice production and the decrease of grain production due to the decrease of land area devoted for paddy cultivation.

Therefore, the solution proposed to increase the rice production and raise the number of local rice availability is: increasing the cropping index and rice farming productivity. The increase of cropping still has a chance to be increased from 268% to almost 300%. The increase of cropping index can be done by using superior short-lived rice seed varieties, increasing the availability of water irrigation through irrigation system refinement (Mahananto, S.Sutrisno, & Candra, 2009) and utilizing boreholes and water pump engine so that rice field can be planted three times until four times a year.

The increase of rice farming productivity can be achieved through new technology application such as using balanced fertilizer, applying double row planting system, using agriculture tools and machines, controlling pests, preventing the yield lost on harvesting time and post-harvesting time. Meanwhile to optimize the use of farming land, it is suggested to allocate the utilization of optimal production factor by adding workers, reducting the use of seed, reductiong the use of SP-36 fertilizer (Asminah Herawaty Sinaga, 2012); (Idris, ?).

## CONCLUSIONS:

1. The land area devoted for paddy cultivation in Mataram Municipal encounters a decrease with a rate of 23.06 ha/year which can implicate on the shrinking of farming production potention.
2. The decrease of land area devoted for paddy cultivation from 2009 – 2014 has not affected the decrease of rice production and the availability of local rice. The availability of local rice increased as a resut of the increase of rice paddy cropping index and the increase of rice farming productivity.
3. The production of local rice in Mataram Municipal has a chance to be increased by increasing farming index and increasing rice farming productivity.

## SUGGESTIONS:

1. The increase of rice production in Mataram Municipal is suggested to be done by increasing cropping index until almost 300%, and increasing productivity through balanced fertilizer, applying double row planting system, using agriculture tools and machines, controlling pests, preventing the yield lost on harvesting time and post-harvesting time.
2. The use of ratio data on trend linear analysis gives more realistic result. Therefore, it is suggested that other researchers and practioners use ratio data when they conduct trend linear analysis.

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