Efficiency of Production Factors in The Farming of Bird’s Eye Chili in Lamoahi Village, North Buton Regency

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ABSTRACT

Chili is a commodity that often triggers inflation at certain times or periods due to sudden price increases. The reason is that the availability of chilies is not sufficient for market demand due to production inefficiencies. This research aims to determine the factors that influence cayenne pepper production and determine the efficiency of using production factors using the Cobb-Douglas production function. The results of the research show that seeds and labour have a significant effect on increasing cayenne pepper farming, while land area, fertilizers, and pesticides do not have a significant effect on production. The use of production factors has not yet reached the maximum level of efficiency. Production factors that are not yet efficient are land area and labour so their utilization needs to be increased. Meanwhile, inefficient production factors are seeds, fertilizers, and pesticides so their use does not need to be increased or reduced.

Keywords: Bird’s eye chili, Cobb-Douglas, Efficiency, Factors of production, Farming.

INTRODUCTION

Indonesia is an agricultural country where in the national agriculture plays an important role, in balancing the increasingly rapid rate of growth of Indonesia's population, so that advanced agricultural businesses need to be carried out in all agricultural areas of Indonesia (Watkaat, 2020). Horticultural commodities are one of the typical tropical agricultural commodities that have great potential to be developed in Indonesia and have bright prospects in the future as well as earning foreign exchange (Ummah, 2011).

Chili is one of the commodities that often triggers inflation at certain times or periods due to suddenly soaring prices. Although four areas have been designated as chili development centres, all areas in Southeast Sulawesi support the National Chili Planting Movement (Dinas Perkebunan dan Hortikultura Sultra, 2018).

Bird’s eye chili is a type of plant that is popular and widely grown by farmers in Indonesia. The adaptation of bird’s eye chili plants has a fairly good ability so that bird’s eye chili can grow well in various types of land, such as rice fields, plantations in the highlands, dry areas to coastal areas (Alif, 2017).

One of the bird’s eye chili-producing regions is Southeast Sulawesi Province. Statistical data on bird’s eye chili production in Southeast Sulawesi Province shows that in 2018 as much as 44,842 quintals and in 2019 the production produced was 36,686 quintals. Bird’s eye chili production data shows that the number of bird’s eye chili commodities produced is not evenly distributed in each region (BPS Sultra, 2021).
As many as four districts in Southeast Sulawesi Province have now been designated as the centre for the development of chili commodities, namely Konawe District, South Konawe, Kolaka, and North Kolaka. The soil conditions in these four areas are very suitable for chili development so they receive special attention as chili development areas. The total area of chili development in Southeast Sulawesi over the past few years is 541 hectares.

North Buton District is one of the bird’s eye chili-producing regions in Southeast Sulawesi Province. Statistical data shows that in 2019 the harvest area of bird’s eye chili was 6 Ha and its production was 76 Kw while the productivity produced was 12.67 Kw/ Ha. In 2020, the harvest area of bird’s eye chili was 9 Ha, while its production was 143 Kw and its productivity was 15.68 Kw/ Ha.

The use of production factors in Lamoahi Village is suspected to be still not optimal because when the harvest season is over, farmers in Lamoahi Village do not really calculate the use of production inputs and the efficiency level of the farming conducted, so farmers are less aware of what production factors greatly affect the production of bird’s eye chili and how efficient the use of production factors in bird’s eye chili farming in Lamoahi Village, North Kulimusu District, North Buton District.

It’s important for farmers to use inputs or production factors efficiently. Therefore, to support the success of achieving the goals of the agricultural development sector in an effort to increase bird’s eye chili production that will impact the amount of production and farmer welfare, the researcher is interested in conducting research to find out how the use of production factors and the efficiency of using production factors in bird’s eye chili farming in Lamoahi Village, North Kulimusu District, North Buton District.

METHODS

The research was conducted in Lamoahi Village, North Kulimusu District, North Buton District. The location was determined purposively, as the majority of the population in Lamoahi Village are bird’s eye chili farmers. Therefore, the researcher chose this place to conduct research from March 2022 to August 2022.

The population in this study were all 54 farmers cultivating cayenne pepper plants in Lamoahi Village, North Kulimusu District, North Buton Regency. The sample was determined using the simple random side method (simple random) with the Slovin formula (Rianse and Abdi, 2012). Based on the Slovin formula, a sample of 35 farmers was obtained. In accordance with the opinion of Rianse and Abdi (2009), statistically a sample size of 30 for each unit of analysis is the minimum requirement to be categorized as a "large sample". A large sample will be inadequate if the funds, energy and time available are limited with the consequence of reducing the level of precision of the analysis carried out and the expected results.

The data used in this study are primary and secondary data. The data collection techniques used are observation techniques, direct interview techniques, and library techniques. And for the variables in this study, the respondent characteristics consist of age, education level, experience in farming, and the number of dependents in the family as well as factors affecting production including land area, seeds, fertilizer, pesticides, and labor.
To answer the first objective, we use the Coob-Douglas production function analysis. This analysis is to determine the magnitude of the influence of the variables land area (X1), seeds (X2), fertilizer (X3), pesticides (X4), and labor (X5) on the production of bird’s eye chili (Y).

\[ Y = a \cdot X_1^{b_1} \cdot X_2^{b_2} \cdot X_3^{b_3} \cdot X_4^{b_4} \cdot X_5^{b_5} \cdot E \]  

(1)

To facilitate estimation, the equation above is transformed into a linear form of the natural logarithm function, i.e.:

\[ \ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + e \]

Explanation:

- \( Y \): Bird’s eye chili production (Kg)
- \( X_1 \): Land area (Ha)
- \( X_2 \): Seeds (Kg)
- \( X_3 \): Fertilizer (Kg)
- \( X_4 \): Pesticides (L)
- \( X_5 \): Labor (HOK)
- \( a \): Constant
- \( b_i \): Regression coefficient
- \( E \): Error term

Based on the use of the Cobb-Douglas production function technique. The formula to determine the efficiency of the use of production factors can be written as follows:

\( \frac{(b_i \cdot Y \cdot P_y)}{X_i} = P_x \) or \( \text{NPM}_i = P_x \) or \( \frac{\text{NPM}_i}{P_x} = 1 \)

(2)

Explanation:

- \( \text{NPM} \): Marginal Product Value
- \( b_i \): regression coefficient of production factor (input)
- \( Y \): production (output) (Kg)
- \( P_y \): unit price of output (Rp/Kg)
- \( X_i \): average use of production factor (input) (Kg)
- \( P_x \): unit price of input (Rp/Kg)

With the calculation criteria, if \( \frac{\text{NPM}_i}{P_x} < 1 \) then the use of production factors (input) is not efficient, meaning: that the use of production factors (input) needs to be reduced, and if \( \frac{\text{NPM}_i}{P_x} = 1 \) the use of production factors (input) is already efficient, that the use of production factors (input) has reached an optimal combination.

Efficiency is how someone maximizes output, by minimizing the input or resources expended in carrying out farming. (Prada, 2013). Farming science is usually a science that discusses how a person distributes existing resources effectively and efficiently with the aim of obtaining maximum profits at a certain time. It is said to be efficient when the resources used produce output that exceeds input (Soekartawi, 1995).

Hanafi (2017) states that production is an activity that produces or adds value to goods and services. The production process is the activity of combining and coordinating resources (input) in obtaining goods or services (output). The production function is the technical relationship between the factors of production and the inputs.
the relationship of input and output in a function. The production function is generally described as follows: \( y = f(x) \). Where \( y \) is output and \( x \) is production input, both \( x \) and \( y \) are positive numbers. Meanwhile, \( f(.) \) is a function that represents the relationship between input and output, has a positive value (output is always greater than or equal to zero) and is continuous (Suwarjo, 2019).

**RESULTS AND DISCUSSION**

**Respondent Characteristic**

Identity is an indicator to describe the diversity of human resources in agricultural activities. Farmer identity is the state of farmers that influences farmers’ decisions in conducting other business activities. Farmer identity includes: age, education, farming experience, and number of family dependents.

<table>
<thead>
<tr>
<th>Respondent Identity</th>
<th>Category</th>
<th>Number Of Souls</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>15-54 (Productive)</td>
<td>33</td>
<td>94.3</td>
</tr>
<tr>
<td></td>
<td>&gt;55 (Non-Productive)</td>
<td>2</td>
<td>5.7</td>
</tr>
<tr>
<td>Level Of Education</td>
<td>No School</td>
<td>2</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>27</td>
<td>77.2</td>
</tr>
<tr>
<td></td>
<td>Junior High School</td>
<td>2</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>Senior High School</td>
<td>4</td>
<td>11.4</td>
</tr>
<tr>
<td>Farming Experience</td>
<td>&lt;5 (Less)</td>
<td>35</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>5-10 (Enough)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>&gt;10 (Experienced)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Number Of Family Dependents</td>
<td>1-3 (Small)</td>
<td>18</td>
<td>51.4</td>
</tr>
<tr>
<td></td>
<td>4-6 (Medium)</td>
<td>17</td>
<td>48.6</td>
</tr>
<tr>
<td></td>
<td>&gt;7 (Big)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Primary Data, 2022.

The respondents who are of productive age are 33 and those who are not productive are 2 respondents. Based on the opinion put forward by Soeharjo and Patong (2012), age grouping is based on productive and non-productive criteria. The age range of 15-54 years is classified as productive age and 55 years and above are categorized as non-productive.

In terms of education level, it shows that 2 people (5.7%) did not pursue education or did not go to school, while 27 people (77.2%) pursued elementary school education, 2 people (5.7%) pursued junior high school education, and 4 people (11.4%) pursued high school education. These results indicate that some respondents did not pursue education or did not go to school, and most of the respondents in this study had attended formal education, thus representing a potential human resource that is expected to support in understanding information.

In terms of farming experience out of 35 respondents, the largest number of respondents with experience as bird’s eye chili farmers is in the range of <5 years, which is 19 respondents or 54.29%, while farming experience of 5-10 years is 16 respondents or 45.71% and farming experience >10 is 0% or none. Based on the conditions above, it can be concluded that the majority of respondents in Lamoahi Village are still inexperienced in managing their farming. Those with less and enough experience in managing farming will continue to seek information to improve their farming and compare what is obtained in extension activities.

According to Leibo (1995) who classified family dependents into three categories, namely family dependents in the category of 1-3 people (small family), the category of
4-6 people is included in the medium family category and family dependents more than 6 people are a large family. Respondents who have a family size of 1-3 (small) amount to 18 respondents (51.4%). The number of families 4-6 (medium) is 17 respondents (48.6%). While those who have family dependents >7 (large) are 0 (zero) or none. These results indicate that most respondents are categorized as having small family dependents.

**Use of Production Factors**

In line with the opinion of Manyamsari and Mujiburrahmad (2014) who suggested that the land area is categorized into three groups, namely narrow land area (< 1 hectare), medium land area (> 1-2 hectares), and large land area (> 2 hectares). The use of land area in Lamoahi Village, most respondents have a medium land area (1-2 hectares), which is 19 respondents. While a small portion of respondents have a narrow land area (<1 hectare), which is 16 respondents. The larger the land area planted with bird’s eye chili plants, the greater the amount of production that will be produced.

The highest use of seeds for one production is as much as 2,000 trees and the lowest is 500 trees with an average use of seeds by bird’s eye chili farmers in Lamoahi Village is 94 trees. The high and low use of seeds depends on the planting distance and the land area owned by farmers. For farmers who have a large land area, the number of seeds used is more than farmers who have narrow land.

The highest use of fertilizer for one production is as much as 5 Kg and the lowest is 0.45 Kg with an average of 1.91 Kg. Fertilization of bird’s eye chili plants in Lamoahi Village is done once a week. Fertilizer is very necessary for the growth of bird’s eye chili plants, fertilizing plants can increase and speed up plant production results. Boediono (2002) stated that the productivity level of farming is basically influenced by the level of technology application, and one of them is fertilization.

The highest use of pesticides is as much as 5 L and the lowest use of pesticides is as much as 0.1 L. This shows that the use of pesticides to prevent pest and disease attacks on bird’s eye chili plants in the research area with different amounts for each farmer in carrying out his farming. The common types of pesticides used are herbicides (for weeds), fungicides (copper/organomercury) and insecticides (for insect pests). The type of pesticide used by respondents in the research area is herbicide (for insect pests).

The use of labor by bird’s eye chili farmers in Lamoahi Village varies widely. The highest labor force is 8.75 HOK and the lowest is 0 HOK, in this case, the farmer does not use labor. From the table above, the average use of labor in one production is 2.5 HOK. The labor used is labor within the family and labor outside the family. Sardianti (2021), states that labor in production factors is the most important aspect to consider in the production process.

The highest bird’s eye chili production in the village is 100 Kg and the lowest is 10 Kg. With an average production result obtained as much as 43 Kg. The high and low production of bird’s eye chili obtained by farmers depends on the size of the land area used by farmers and the combination of the use of several inputs used by farmers, however not all land area produces high production because it is influenced by the planting distance used by farmers and also pest attacks that occur at any time, resulting in a lack of bird’s eye chili production obtained by farmers.

**Testing Production Factors Against the Influence Chili Production Levels**

The results of the analysis of production factors that affect productivity in bird’s eye chili farming can be known by using the Cobb-Douglas production function, where the independent variable (Y) is bird’s eye chili production and the independent variable (X), consists of land area (X1), seeds (X2), fertilizer (X3) pesticides (X4) and labor (X5).
Before performing data analysis, a classic assumption test must be conducted to ensure that there is no deviation from the classic assumption in this study. The steps that need to be done to determine the factors that affect the productivity of bird’s eye chili are the multicollinearity test, heteroscedasticity test, normality test and coefficient of determination analysis, simultaneous test (F), and partial test (t).

**Multicollinearity Test**

The multicollinearity test is conducted to test whether there is a correlation between independent variables in the regression model. The multicollinearity test can be seen by determining the Tolerance value and VIF in a regression model. Where if the Tolerance value is more than 0.1 and the VIF value is less than 10 then all variables are free from multicollinearity. In the research results, the Tolerance value in all variables is more than 0.1 and the VIF value in all variables is less than 10, so there are no symptoms of multicollinearity in this research result.

**Heteroscedasticity Test**

The Heteroscedasticity test aims to determine whether there is a variance inequality of residuals from one observation to another in a regression model. The results of the heteroscedasticity test with the Scatterplot method show that the points have spread, not forming a specific pattern that gathers. It can be concluded that the regression model in this study does not have a heteroscedasticity problem.

**Normality Test**

The normality test aims to test whether the residual values of each variable are normally distributed or not. One way to detect data normality is by analyzing the normal P-P Plot graph. The way to detect it is by looking at the data spread on the diagonal axis on the normal P-P plot of the regression standardized residual graph as the basis for decision making, if the points scatter around the diagonal line then the residual is normal, but if the spread of the points deviates from the line then it is not normally distributed. Based on the results of the normality test with the normal P-P Plot graph method in the study, the points are located around the line and follow the diagonal line. So, it is said that the residual data is normally distributed.

**F Test (Simultaneous)**

Looking at the joint effect of independent variables, namely from land area (X1), Seeds (X2), fertilizer (X3), pesticides (X4), and labor (X5) on the dependent variable (Y). The comparison between the significant value and the confidence level value of 95% or at the α5% level (0.05) proves to reject H0 and accept Ha, meaning that the independent variables of land area (X1), Seeds (X2), fertilizer (X3), pesticides (X4), and labor (X5) together significantly affect the dependent variable production (Y) with the criteria that if the significant value is smaller than the α5% value or 0.05 then with all independent variables will significantly affect the dependent variable and vice versa.

**Coefficient of Determination (R2)**

The research results obtained a coefficient of determination (R2) or R square of 0.945. The R square value of 0.945 comes from squaring the correlation coefficient or R value, which is 0.972 x 0.972. The R = 0.972 value states that the correlation or relationship between independent variables with the dependent variable is very strong. The magnitude of the coefficient of determination is 0.945 or equal to 94.5%. This figure implies that the independent variables of land area (X1), Seeds (X2), fertilizer (X3), pesticides (X4), and labor (X5) contribute to the influence on the production variable (Y). Meanwhile, the remaining 5.5% is influenced by variables outside the model.
**T Test (Partial)**

Partial testing is intended to see whether each independent variable of land area (X1), Seeds (X2), fertilizer (X3), pesticides (X4), and labor (X5) affects the dependent variable production (Y). Meanwhile, to see whether the X variable affects the Y variable can be seen in Table 16.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regression Coefficient</th>
<th>Partial Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>5.593</td>
<td>2.228</td>
</tr>
<tr>
<td>Land Area (X1)</td>
<td>.510</td>
<td>.340</td>
</tr>
<tr>
<td>Seed (X2)</td>
<td>.022</td>
<td>5.255</td>
</tr>
<tr>
<td>Fertilizer (X3)</td>
<td>.150</td>
<td>.113</td>
</tr>
<tr>
<td>Pesticide (X4)</td>
<td>-.219</td>
<td>-.162</td>
</tr>
<tr>
<td>Labor (X5)</td>
<td>6.462</td>
<td>6.499</td>
</tr>
</tbody>
</table>

The results of the regression t-test analysis in Table 2 show that the regression coefficient value is 0.510 with a significance level of 0.736 which is greater than the significance level used in this study, which is 5 percent or 0.05, so it can be interpreted that the land area variable does not significantly affect bird’s eye chili production. Land area is the area of land utilized for farming activities with the aim of obtaining output production from the farming conducted. This is in line with the research conducted by Bete and Taena (2018), which states that the land area variable does not significantly affect the production of bird’s eye chili.

In this research result that the number of seeds significantly affects. In line with the research results which show that the regression coefficient is 0.022 with a significance level of 0.000 smaller than the significance level used in this study, which is 5 percent or 0.05, so it is interpreted that seeds significantly affect the production of bird’s eye chili in Lamoahi Village. The regression estimation result is 0.022 which means that every 1 percent increase, the seeds will increase the production of bird’s eye chili by 0.022 percent. This research is in line with previous research conducted by Maemunah et al. (2019), in Grikulon Village, Secang District, Magelang Regency, found that seeds significantly affect bird’s eye chili production.

Based on the results of the regression t-test analysis, it was obtained that the regression coefficient is 0.150 with a significance level of 0.911 which indicates that the significance value is greater than 0.05, indicating that fertilizer does not significantly affect the production level of bird’s eye chili. The estimated value of the fertilizer regression coefficient is 0.150. This shows that if the use of fertilizer is increased by 1 percent, the amount of bird’s eye chili production will increase by 0.150 percent. This is in line with the research conducted by Eliyatiningsih and Mayasari (2019), who found that fertilizer does not affect the production of red chili in Wuluhan District, Jember Regency.

The results of the regression t-test analysis show that the regression coefficient is -0.219 with a significance level of 0.73. This indicates that the significance value is greater than 0.05, meaning that the pesticide variable does not significantly affect the production level of bird’s eye chili. The pesticide variable has a regression coefficient value of -0.219 which indicates that the correlation between the use of pesticides and the production of bird’s eye chili farming is negative. This means that if the pesticide variable increases by 1 percent, the amount of bird’s eye chili farming production will decrease by -0.219 percent. This is not in line with previous research conducted by
Saputra and Wanegama (2019) in Payangan District, Gianyar Regency, which shows that the pesticide variable affects the production of red chili.

Based on the research results, it shows that the labor variable significantly affects this can be seen in Table 2 which shows that the regression coefficient is 6.426 with a significance level of 0.000 smaller than the significance level used in this study, which is 5 percent or 0.05, so it is interpreted that labor significantly affects the production of bird’s eye chili in Lamoahi Village. The estimated result of 6.426 means that every 1 percent increase in labor will increase the production of bird’s eye chili by 6.426 percent. This is in line with previous research conducted by Sringin and Alam (2020), who said that labor significantly affects the production of bird’s eye chili in UPT Bulupountu Jaya, Sigi Biromaru District, Sigi Regency.

Efficiency of Production Factor Use
In their production process, farmers certainly aim to obtain maximum profit. Maximum profit is obtained if the level of efficiency in the use of production factors is achieved. Efficiency can be achieved when the marginal product value of an input or production factors (NPMXi) is equal to the price of the production factor or input (Pxi) or the ratio between NPMXi and Pxi is equal to one.

<table>
<thead>
<tr>
<th>Factors of production</th>
<th>NPMxi</th>
<th>pxi</th>
<th>NPMxi/Pxi</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land area</td>
<td>132,600</td>
<td>62,629</td>
<td>2.12</td>
<td>Not efficient yet</td>
</tr>
<tr>
<td>Seeds</td>
<td>19.96</td>
<td>121.571</td>
<td>0.000</td>
<td>Not efficient</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>65,151</td>
<td>108.428</td>
<td>0.60</td>
<td>Not efficient</td>
</tr>
<tr>
<td>Pesticide</td>
<td>-107,011</td>
<td>114,587</td>
<td>-0.93</td>
<td>Not efficient</td>
</tr>
<tr>
<td>Labor</td>
<td>2,222,982</td>
<td>128,228</td>
<td>17.33</td>
<td>Not efficient yet</td>
</tr>
</tbody>
</table>

Efficiency of Land Use
Based on Table 3, it shows that the value of NPMxi/Pxi = 2.12 > 1 which means that the use of land area in bird’s eye chili farming is not yet efficient or still less so it needs to be expanded, thus can increase the production of bird’s eye chili farming in Lamoahi Village, which will result in increased income and welfare of bird’s eye chili farmers in the village.

Efficiency of Seed Use
From the analysis of the use of production factors in bird’s eye chili farming in Lamoahi Village, North Kulisusu District, North Buton District, it is found that the ratio between the Marginal Product Value (NPM) of the seed production factor and the average seed price per tree is less than one (0.000). The NPMx/Pxi value of 0.000 indicates that the use of these seeds is not efficient. Thus, for the use of seeds in Lamoahi Village, North Kulisusu District, North Buton District, it does not need to be added or needs to be reduced.

Efficiency of Fertilizer Use
From the analysis of the use of fertilizer production factors in bird’s eye chili farming in Lamoahi Village, North Kulisusu District, North Buton District, the NPMx/Pxi value is 0.60 which indicates that the use of the fertilizer is not efficient because the NPMx/Pxi value is greater than one (0.60 < 1). This means that the use of fertilizer has not reached the optimal efficiency level, so the use of fertilizer in Lamoahi Village does not need to be increased or needs to be reduced.
Efficiency of Pesticide Use
From the analysis of the use of pesticide production factors in bird’s eye chili farming in Lamoahi Village, North Kulisu District, North Buton District, the NPMx/Pxi value is -0.93 which indicates that the use of the pesticide is not efficient because the NPMx/Pxi value is less than one (-0.93 < 1). Thus, the use of pesticides in Lamoahi Village, North Kulisu District, North Buton District needs to be reduced or does not need to be added.

Efficiency of Labor Use
Based on the analysis of the use of labor production factors in bird’s eye chili farming in Lamoahi Village, North Kulisu District, North Buton District, the NPMx/Pxi value is 17.33 which indicates that the use of pesticides is not yet efficient because the NPMx/Pxi value is greater than one (17.33 > 1). This means that there is a need to increase the use of labor if farmers want to make efficient use of the labor production factor, because adding labor will increase the production of bird’s eye chili.

CONCLUSION
The factors that significantly affect the production of bird’s eye chili in Lamoahi Village, North Kulisu District, North Buton District are seeds and labor, while factors that do not significantly affect are land area, fertilizer, and pesticides. The use of production factors in bird’s eye chili farming in Lamoahi Village, North Kulisu District, North Buton District has not yet reached the maximum efficiency level. The production factors that are not yet efficient are land area and labor, so their use needs to be increased. Meanwhile, the inefficient factors are seeds, fertilizer, and pesticides, so their use does not need to be increased or needs to be reduced.

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134