OPTIMIZING INCOME FOR VEGETABLE FARMING IN PUUBUNGA VILLAGE BAULA DISTRICT KOLAKA REGENCY

Devita Pratiwi Hunowu1), Idrus Salam1), Hidrawati1)

1)Department of Agribusiness, Faculty of Agriculture, Halu Oleo University Kendari 93232

*Corresponding author : hidrawati@uh0.ac.id

To cite this article:

doi:http://dx.doi.org/10.37149/jimdp.v6i1.16178

Received: January 24, 2021; Accepted: February 27, 2021; Published: February 28, 2021

ABSTRACT

This study aims to determine whether the poly-culture of vegetables (mustard greens, spinach and kale) in Puubunga village has achieved optimal resource use and how much income the farmers use of the resources in optimal conditions. This research was conducted from July to August 2020. Analysis of the data used in this research is the analysis of optimality using the analysis tool Linear Programming POM for Windows 3. Sensitivity analysis is carried out to determine the sensitivity interval between changes in resources without changing the optimal income. The results of the optimization analysis show that resource use is not optimal. The use of land, mustard seeds, urea fertilizer, medicines (dursban and gramoxyone) and labor is not yet optimal or not fully utilized while their availability is excessive, so it needs to be added or subtracted from the existing supply. The use of spinach seed, kale seeds and manure are scarce resources because in optimal conditions all supplies are used up. The total income of vegetable farming (mustard greens, spinach and kale) obtained under optimal conditions is IDR 777.275 per growing season, which is greater than the actual total income of vegetable farming of IDR 672.814 per growing season.

Keywords: linear programming; optimal income; puubunga village; vegetable farming

INTRODUCTION

The agricultural sector still plays an important role in the national development of the Indonesian nation to improve the Indonesian economy. This can be seen from the large number of people who work in the agricultural sector as well as from the amount of national products originating from this sector (Gultom 2018). One of the mainstay agricultural sub-sectors is horticulture Horticulture is the study of cultivating vegetables, fruits, medicinal plants, ornamental plants including water plants, mosses and fungi (Nuriyani et al. 2018).

According to the Directorate General of Horticulture in The Annual Performance Plan (2016), Indonesian horticulture development in 2015-2019 is directed at developing national superior commodities in order to increase the scale of horticultural development business. Horticultural development has the aim of encouraging the development of horticultural agribusiness able to produce competitive products, increase the income of farmers and business actors, strengthen the regional economy to support national income growth by optimizing the management of available natural resources.

Baula District is the largest producer or supplier of vegetable needs in Kolaka Regency for spinach and beans, followed by Samaturu District. Meanwhile, for tomato production, the vegetables in the producing area are Samaturu District. The total production of horticultural crops for vegetables and fruit in Kolaka Regency in 2017 is 6,660.2 tons. One of the areas that does vegetable farming and is the main horticulture center in Baula District is Puubunga Village. Initially the farmers did rice farming but because they often experienced drought, some farmers switched to developing vegetable crops. Apart from seasonality, farmers assume that vegetable farming is more profitable. Based on data from the profile of Puubuga Village in 2019, it was recorded that the land area used
for the agricultural sector was 21,700 hectares, while the land area used for settlement was 15,600 hectares.

Farmers in Puubunga Village cultivate a mixed type of vegetable crop (polyculture). The purpose of planting various types of plants in one area of land is to streamline costs and increase income due to the production of more than one type of crop. For horticultural crops including mustard greens, spinach and kale have a high market demand because they are a daily food requirement. This is what motivates the people in Puubunga Village to plant the three types of plants. The current reality is that there are obstacles to planting more than one type of plant in one area of land. There are two obstacles faced by farmers in Puubunga Village, including the problem of land area which has the most important position so that it requires farmers to optimize land use (Budiyanto 2018), where the area of land owned by farmers in Puubunga Village is 0.316 hectares, while the area under cultivation is 0.158 hectares. The second constraint faced by farmers is the use of inputs including seeds, fertilizers and pest control drugs as well as the inefficient use of labor in vegetable farming. These constraints can affect the income that farmers earn. Farmers' income can be supported by the use of efficient inputs so as to reduce costs besides that it must be supported by high production and prices to increase income.

Facing this reality, the opportunity to increase income can be carried out by planning the right strategy by taking into account the existing constraints through optimizing the use of resources in the form of land, use of seeds, fertilizers and medicines for pest control (Plant Pest Organisms) and the use of labor. According to Djafri et al. (2016) the goal of farmers to maximizing income can be achieved through optimization planning. Optimization is an attempt to maximize income efficiently, from optimal use of resources.

The research that will be carried out is to analyze the optimal use of resources (land, seeds, fertilizers, medicines and labor) in increasing farmers' income in Puubunga Village, Baula District, Kolaka Regency.

**MATERIALS AND METHODS**

This research was conducted in Puubunga Village, Baula District, Kolaka Regency in July-August 2020. The location selection was determined intentionally (purposive) with the consideration that the location of Puubunga Village is one of the villages in Baula District where the community does vegetable farming, especially spinach, mustard greens and kale.

The population in this study were all heads of family (KK) farmers who do vegetable farming in Puubunga Village, Baula District, Kolaka Regency, especially spinach, mustard greens and kale as many as 40 people. Sampling in this study using the census method (Census Sampling) thus obtaining a sample of 40 people. The census is the taking of the entire population as the research sample. Sampling by census is when the population is less than 50 people (Rianse & Abdi. 2009).

Data collection was carried out by direct interview technique with sample farmers based on a list of questions that had been prepared. The data collected includes primary data and secondary data. Primary data is obtained from respondents directly covering the characteristics of farmers and vegetable farming, while secondary data is obtained through various relevant sources in the form of books, references, library sources or from the internet, scientific journals and information sourced from related agencies such as the Central Statistics Agency.

Data analysis in this study used assistance software POM for Windows 3. Data analysis can be described as follows:

1. Optimality analysis is the analysis used to determine the optimal use of resources and farm income. Similar to the research of Zenis et al. (2018), optimality analysis is expressed in the following formulations:

   Objective function:
   
   \[ Z = C_1X_1 + C_2X_2 + C_3X_3 \]

   Constraints:
   
   - Land Constraints: \[ \sum a_jX_j \leq b \]
   - Seed Constraints: \[ \sum d_jX_j \leq e \]
   - Fertilizer Constraints: \[ \sum f_jX_j \leq g \]
   - Medicine Constraints: \[ \sum h_jX_j \leq i \]
   - Labor Constraints: \[ \sum k_jX_j \leq l \]

Hunowu et al 8 eISSN: 2527-2748
\[ \text{X}_j > 0 \text{; for } j = \text{Mustard greens, Spinach dan Kale} \]

Where:

- \( Z \): Maximized total farm income (Rp)
- \( C_1 \): The income of cultivated mustard greens farming per growing season (IDR)
- \( C_2 \): The income of cultivated spinach farming per growing season (IDR)
- \( C_3 \): The income of cultivated kale farming per growing season (IDR)
- \( X_1 \): Mustard greens farming activities
- \( X_2 \): Spinach farming activities
- \( X_3 \): Kale farming activities
- \( b \): The available land area (ha)
- \( e \): The amount of seeds available for each commodity (kg)
- \( g \): The amount of fertilizers available for each commodity (kg)
- \( i \): The amount of medicines available for each commodity (ml)
- \( l \): The amount of labors available for each commodity (HOK)
- \( a_j \): Technical coefficient (land area) on farming \( j \)
- \( d_j \): Technical coefficient (seed) on farming \( j \)
- \( f_j \): Technical coefficient (fertilizer) on farming \( j \)
- \( h_j \): Technical coefficient (medicine) on farming \( j \)
- \( k_j \): Technical coefficient (labor) on farming \( j \)

2. Sensitivity analysis (sensitivity interval) is an analysis used to determine the effect of changes in income and resource availability on the optimal conditions of mustard, spinach, and kale farming.

RESULTS AND DISCUSSION

**Respondent Characteristics**

<table>
<thead>
<tr>
<th>No</th>
<th>Respondent Characteristics</th>
<th>Amount (Person)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Age</td>
<td>18</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>46 – 55 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>37</td>
<td>92,5</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>33</td>
<td>7,5</td>
</tr>
<tr>
<td>3.</td>
<td>Level of Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Primary School</td>
<td>20</td>
<td>50,0</td>
</tr>
<tr>
<td>4.</td>
<td>Number of Family Dependents</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 – 4 people</td>
<td>19</td>
<td>46,3</td>
</tr>
<tr>
<td>5.</td>
<td>Farming Experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>06 – 10 years</td>
<td>15</td>
<td>37,5</td>
</tr>
</tbody>
</table>

Source: Primary data processed, 2020

Age is one of the factors that can affect a person's abilities, both physically and mentally. The age range of Puubunga Village farmers in the age range of 46 - 55 years with a percentage of 45%. This explains that most of the farmers in Puubunga Village are of productive age. A farming activity carried out by farmers who are relatively younger or productive (15 - 54 years) will have an effect on the achievement of increasing their farm production.

The concept of gender in this study is not only interpreted as a physical difference between the two, but also socially. Based on the results of the study, it can be seen that the largest percentage is 92.5% for male respondents. The implication of the dominance of male respondents in horticultural farming in Puubunga Village will have an impact on the intensity of farming land management. The Table shows that there are 3 female farmers. This phenomenon occurs due to economic conditions that require a woman to become the head of the family. However, the involvement of women to work in the agricultural sector is now considered normal, so this involvement results in women having a dual role, namely the role of being housewives and earning a living for their daily needs.

The level of education is an important element related to the ability of farmers to absorb new information about agricultural activities and determine one's mindset and actions. The results showed that the respondents' formal education in Puubunga Village varied, ranging from 0-16 years with an average of 7.5 years. Most farmers have a relatively limited formal education level, the management of vegetable farming is carried out simply with information from among farmers. Farmers also receive...
informal education in the form of counseling held by the Baula District Regional Extension Officers or the Department of Agriculture as well as programs held by farmer groups.

The average dependents of the respondent's family in Puubunga Village can be categorized into the low group, namely 3-4 people. The greater the number of dependents, will require a family head to work harder to make ends meet. If the family is of a productive age, then at times it can help the head of the family in carrying out farming activities as a workforce in the family.

Based on Table 1 it shows that the largest percentage of respondents who were sampled in Puubunga village by farming experience was in the range of 6 - 10 years. This condition can be said to be quite experienced in managing vegetable farming. Thus, it can be expected that farmers are able to be more skilled in managing their farming so that the production obtained can increase and the income obtained by farmers can also increase from their farming.

Optimal Solutions

Optimal Income

The results of linear programming data processing indicate that the use of resources in vegetable farming cultivated by residents is not optimal so that the income earned by farmers is not optimal. Determination of optimal conditions by looking at the value of the basic variable and non-basic variable. According to Hidrawati (2007) the value of the basic variable that describes the type of plant and the number of constraints that are cultivated, including the base variable is a variable that has a value that is not equal to zero or is positive. There are also non-basic variables that describe the types of plants or constraints that are not exploited, namely variables that have a value equal to zero. The result analysis of basic variable consist of value and reduced cost. Value is number of variable value that describes the amount of constraint that must be worked out. Reduced cost, which shows how much the coefficient of the objective function of each variable must be added so that the decision variable is positive in the optimal solution. Optimality analysis shows that the value of reduced cost is 0, then the function coefficient value is positive and no additional costs are required.

Table 2. Value and reduced cost on each basic variable

<table>
<thead>
<tr>
<th>No</th>
<th>Decision Variable</th>
<th>Value</th>
<th>Reduced Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mustard greens ($X_1$)</td>
<td>0.2349</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>Spinach ($X_2$)</td>
<td>1.0517</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>Kale ($X_3$)</td>
<td>1.8318</td>
<td>0</td>
</tr>
</tbody>
</table>

Objective Function 777.275,2

Table 6 shows that in the linear program data processing, the coefficient values for each variable are 0.2349 for mustard greens ($X_1$), 1.0517 for spinach ($X_2$) and 1.8318 for kale ($X_3$), so that it can achieve the objective function by optimizing existing constraints or resources. The optimal condition shows the value of the objective function or the average total income of vegetable farming of IDR 777.275 per growing season, while the actual average total income of vegetable farming is Rp 672.814 per growing season. so that there is an increase before and after the optimization analysis is carried out.

Land Use

The condition of the mustard, spinach and kale farming carried out by farmers in Puubunga village after processing data shows conditions that are not optimal there is a slack/surplus of 0.157 hectares, while the land area is minimal which is in optimal condition is 0.159 hectares. Not optimal utilization this land is because part of the land is not cultivated, because of the limited capital owned by the respondent farmers so that a lot of land was not cultivated at the time of this research.

Use of Seeds for Each Plant

The condition of using the seeds after analyzing the linear program was that the use of mustard seeds showed a suboptimal condition because 0.0621 kg remained or had not been fully utilized. Spinach seeds and kale seeds are able to meet the needs in optimal conditions. Spinach seeds have a dual value of 65.503,62 and kale seeds have a dual value of 185.647,4. This shows that these two resources have opportunity costs so that if the cost of seeds is added by one unit (one kilogram), the income will increase by IDR 65.503 for spinach seeds and IDR 185.647 for kale seeds without changing the use of other resources. Kale seeds have the highest dual value compared to the others, this means that kale seeds have an important role to play in obtaining optimal income so that their use may be added not to exceed 1,4044 kg and not less than 1,1578 kg. Similar to research of
Puspitasari et al. (2013) stated the use of seeds in rice and vegetable farming has opportunity costs of increasing income.

**Use of Manures**

The organic fertilizer used by the respondent farmers is manure from livestock (goat) manure. Dirt goats can be used as organic material in making manure because of the content, the nutrient elements are relatively high where goat manure is mixed with the urine as well contains nutrients, this usually does not occur in other types of manure such as cow dung (Linda et al. 2017). The optimization results show the use of manure for mustard green farming as much as 239 kg, for spinach farming as much as 195 kg and for kale farming 209 kg with the availability of manure as a whole amounting to 644 kg indicating that its availability can be fully utilized to obtain optimal income. Manure has a dual value of 842,6904 so the addition of one kilogram of manure will increase income by IDR 843 provided that other resources are constant.

**Use of Urea Fertilizer**

One source of nitrogen that is widely used is urea which contains 45 - 46% N, so it is good for plant growth processes, especially for plants with harvested leaves such as vegetables (Kogoya et al. 2018). Based on the results of data analysis, the available urea fertilizer as much as 31,7 kg is not in optimal condition because there is still a slack/surplus of 0,046 kg. The status of urea fertilizer resources is included in excess resources and the value of the dual value is equal to 0, meaning that if its availability is added it will not affect the optimal income.

**Use of Medicines**

Generally, there are two types of medicines used by farmers in Puubunga Village, namely dursban and gramoxone, where dursban is used to eradicate pests in the form of leafworms while gramoxone is used to eradicate weeds. Optimality results show that conditions that are not yet optimal also occur in the availability of dursban and gramoxone drugs, where 444,2218 ml and 463,3998 ml respectively remain. This happened because the respondent farmers bought the two pest control medicines in bottles with 500 ml contents. According to respondent farmers, the dosage used to control plant pests is a low dose of 56 ml for dursban and 36 ml for gramoxone so that one bottle of the medicine can be used for more than one growing season.

**Use of Labor**

The entire labor used by the respondent farmers comes from within the family consisting of 1-2 people. Optimization Results The use of labor in vegetable farming shows a slack / surplus value of 272.5879 HOK, this means that labor resources at the respondent farmer level have an excess status. The use of labor in vegetable farming has a bulk time of about 3-4 hours on land, if it is compared with the HOK stipulation, which is 8 hours per day, the labor is less than the stipulated time so that there is still a lot of time that is not used. This is what causes labor resources including excess resources. Labor resources do not have a dual value value, this means that labor resources do not have opportunity costs so that additional capacity or labor supply will not result in an increase in optimal income.

**Sensitivity Analysis**

Sensitivity analysis provides sensitivity for the optimal solution indicated by the range that is limited by the upper bound and the lower bound value. The optimal solution will not change as long as the change in the destination function falls within the sensitivity interval. (Ansor 2016). Similar to the research of Puspitasari et al. (2013) stated that the optimal condition will not change if it does not exceed the recommended upper and lower bound.

The results of the sensitivity analysis of the objective function show that if there is a change in the income of the mustard farm with a lower limit of IDR 0 and an upper limit of IDR 209.753 it will not change the optimal condition. The income of spinach and water spinach farming has a lower limit of IDR 164,325 and IDR 176,122, while the upper limit or upper limit of the income of spinach and kale farming has an infinite or unlimited value. According to Utami et al. (2020) infinity means having unlimited limits. The results of this analysis show that the infinity value is the upper limit value for spinach and kale farming, which means that the two plants have the opportunity to provide the largest farming income because they have an infinity upper bound value. Spinach and kale farming can change the value of the income as high as possible and this value will not change the coefficient value of the basic variable under optimal conditions.
The values of the right hand side (RHS) can range variably without changing the value and interpretation of the dual prices. This means that dual prices are still valid even if the values of the RHS increases or decreases in an allowable manner (Steffany. et al. 2017). The sensitivity analysis of the value of the right-hand side of the constraint shows that mustard greens seeds, kale seeds and manure are resources that have an influence on income changes so that their use needs to be maintained. Generally in the use of seeds, there are always problems such as the quality of the seeds to be used and environmental factors such as weather and pest attacks during the nursery but the use of seeds needs to be controlled at 0 to 0,1341 kg for spinach seeds and 1,1578 kg to 1,4044 kg for kale seeds. Similarly, the supply of manure at the farmer level has been used all for the three vegetable farms, although the use of 1 kg of manure can increase farmer income by IDR 843 but it is very necessary to control its use not less than 587,92 kg or more than 644,99 kg in order to obtain optimal income amount is IDR 777.275 per growing season. Land, mustard seeds, urea fertilizer, medicines and labor use in the mustard, spinach and kale farming are included in the inactive constraint function or their addition will not affect optimal income, this happens because these resources are excessive and their use is still under optimal conditions. It is recommended for farmers to increase or decrease according to the minimum value recommended in the analysis results, namely 0,1592 hectares for land, 0,0148 kg for mustard seeds, 31,65 kg for urea fertilizer, 55,78 ml for dursban medicine, 36,6 ml for gramoxone and 15,4 HOK for labor.

CONCLUSIONS AND SUGGESTIONS

The use of land, mustard greens seeds, urea fertilizers, medicines (dursban and gramoxone) and labor resources is a function of inactive constraints where the availability is excessive at the farmer level, to achieve optimal income it is necessary to increase its use (reduce availability) according to the minimum amount shown in lower bound which is 0.1592 ha for land; 0.0148 kg for mustard greens seeds; 31.65 kg for urea fertilizer; 55.78 ml for dursban; 36.6 ml for gramoxone and 15.4 HOK for labor. The use of spinach seeds, kale seeds and manure are scarce resources under optimal conditions. Each use in optimal conditions, namely 0 kg to 0,1341 kg for spinach seeds. Likewise, with as much as 1,1578 kg to 1,4044 kg of kale seeds and 587,92 kg of manure to 644,99 kg. Optimal income that uses resources optimally in vegetable farming (mustard greens, spinach and kale) is IDR 777.275 per growing season. This value is greater than the actual total income of IDR 672.814 per growing season. The use of kale seeds ranging from 1,1578 kg to 1,4044 kg is recommended to farmers because it has a higher dual value than other resources, namely 185,647 so that optimal income can be received at this dual value. If farmers do not want to increase the availability of limited resources, it is better if the availability of excess resources should be reduced to save on production costs incurred so as to increase the total income of farmers. And Then, agricultural counseling related to vegetable cultivation such as the use of seeds, fertilizers and medicines needs to be carried out by parties or agencies in Puubunga Village so that the success of farming in the next planting season can be achieved by efficient use of resources.

REFERENCES


