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[Agrisocionomics] Submission Acknowledgement

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Ni Putu Sukanteri:

Thank you for submitting the manuscript, "OPTIMIZATION OF RESOURCE ALLOCATION IN THE TUMPANG SARI BUSINESS SYSTEM IN TABANAN REGENCY, BALI PROVINCE" to Agrisocionomics: Jurnal Sosial Ekonomi Pertanian. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

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If you have any questions, please contact me. Thank you for considering this journal as a venue for your work.

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2022-10-30

From: **Kadhung Prayoga** <kadhungprayoga@gmail.com>

To: "Ni Putu Sukanteri" <putusukanteri@unmas.ac.id>

Ni Putu Sukanteri:

We have reached a decision regarding your submission to to Agrisocionomics: Jurnal Sosial Ekonomi Pertanian, " OPTIMIZATION OF RESOURCE ALLOCATION IN THE TUMPANG SARI BUSINESS SYSTEM IN TABANAN REGENCY, BALI PROVINCE ".

Our decision is to: **Revisions required**, Please see the Reviewer/Editor note of revision. Revision should be submitted in two weeks through revision column in OJS

Regards,

Kadhung Prayoga

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- Authors:** Ni Putu Sukanteri, Putu Fajar Kartika Lestari, Ni Putu Angilia Anasari
- Title:** OPTIMIZING RESOURCES IN THE INTERCROPPING FARMING SYSTEM IN TABANAN REGENCY, BALI PROVINCE
- Section:** Articles
- Editor:** Tutik Dalemtyawan

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OPTIMIZATION OF RESOURCE ALLOCATION IN THE TUMPANG SARI BUSINESS SYSTEM IN TABANAN REGENCY, BALI PROVINCE

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Submitted ...; Approved ...

ABSTRACT

Land as a location for farming is the main asset managed by farmers. The area of land is directly proportional to the production of farming, the wider the area of land that is managed, the higher the products produced. The tumpang sari farming system shows that land is used for the production of several commodities such as cocoa, coconut, bananas, and cattle if the commodities being cultivated do not experience significant disturbances.

The research objectives are to analyze the gross income of smallholder plantation farming in Angkah Village and analyze the allocation of agricultural resources with the cocoa-coconut-banana crop intercropping system and cattle in Angkah Village.

The research was conducted in Akah Village, West Selemadeg Sub-district, Tabanan Regency, with an intercropping farming system. Research Optimization of resource allocation using *linear programming* is a formal mathematical technique that selects the combination and level of activity, from all feasible activities, to achieve the objective function without ignoring the availability of resources and other specified constraints.

The average gross income (gross margin) obtained by farmers in Akah Village is Rp. 45,728,824 a year. This income is obtained from the tumpang sari system of cocoa, coconut, banana, and cattle. Cultivated on an average of 0.53 ha of cocoa land. Coconut 0.071 ha, banana 0.061 and beef cattle 0.014 ha. With an optimal income of 69,800,035. The amount of agricultural resource allocation with the cocoa-coconut-banana intercropping system and cattle in Akah Village is 1,042 HOK. Changes in commodity prices cause changes in commodity prices in the intercropping system in Akah Village.

img] ANALISIS_PROGRAMING_KACOA_INTRODUCTION

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Background

Land as a location for farming is the main asset that is managed by farmers' farmer's land owned by the family or land leased by the farming family. The area of land is directly proportional to the production of farming, the wider the area of land that is managed, the higher the production produced if the commodity being cultivated does not experience significant disturbances. The area of plantation land in the province of Bali is 563,666 ha. The amount of land used as plantation land as non-rice field land is 122,127 ha in Bali. The land is 22,631 ha located in Tabanan Regency as the third largest land area after Buleleng 31,323 ha and Karangasem Regency 30,650 (BPS Bali 2017)

The land is also used for the production of a combination of plantation crops and crops and livestock raised by farmers. This combination allows farmers to do based on the commodities planted on each farmer's land. In general, the combination is carried out based on the farmer's desire for commodities that are considered profitable to the farmer.

Tabanan Regency as one of the largest land areas in Bali combines various plants in one area of land. The land area in Tabanan Regency is planted with cocoa, coffee, clove, and coconut plantations. The area of land planted with cocoa in Tabanan Regency reached 4,533.31 ha of 15 081.33 planted with deep coconut, 685.38 early coconuts, and 8.20 hybrid coconut (BPS Bali, 2017).

The combinations carried out by farmers are cocoa, coconut, banana, and cattle. Tabanan Regency is one of the farming-based villages, which combines cocoa-banana-coconut plantations on farming land. The purpose of this development is to increase land productivity through an intercropping system. Improving the welfare of farmers and encouraging the improvement of the rural economy.

One of the cocoa development centers in Tabanan Regency is Akah Village. Agribusiness commodities that aim to improve competitiveness, quality of output, and marketing. Akah Village is designated as one of the organizers of the P4s program, namely the Self-Help Agricultural and Rural Training Center, hereinafter referred to as P4S, which is a training institution with agricultural and rural apprenticeship methods. The purpose of establishing P4S is to accelerate access and application of information technology through the learning process of farmers and their families according to real conditions in the field.

To increase farmers in Akah Village, Selemadeg Barat District, and Tabanan Regency, they are faced with limited land, capital, labor, and others. Farmers' land ownership is on average 0.53 ha per household. Ownership of the land has not been fully able to improve the welfare of farmer families. Farmers have not been able to specify farming needs, and other necessities of life with certainty, and even the exact benefits obtained are not yet known for certain in the combination of intercropping farming integration. To increase the income of farmers who are faced with limited resources, it is necessary to research optimizing intercropping farming on plantation land in Akah Village through a linear programming approach.

The research objectives are to analyze the gross income of smallholder plantation farming in Angkah Village and analyze the allocation of agricultural resources with the cocoa-coconut-banana crop intercropping system and cattle in Angkah Village. Knowing the effect of changes in the prices of several commodities on the allocation of resources in the intercropping system in Akah Village. The benefits of the research include: so that farmers can utilize the available resources in limited quantities to maximize income. Optimal policy-making for agricultural development in plantations, and optimal use of resources at the research site.

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In addition, this section is very necessary to improve comparisons with previous studies.

The novelty of the study is very low. Authors need to directly state the novelty of their research.

RESEARCH METHODS**Research Locations The**

research was conducted in Angkah Village, Selemadeg Barat Subdistrict, Tabanan Regency, the research was conducted intentionally with the consideration that

1. Angkah Village is a training center for Agriculture and Rural Self-help on cocoa commodities
2. Village is the largest fermented cocoa producer in Tabanan Regency.
3. Angkahthe form of fermented cocoa beans Cocoa
4. the production uses the shoot grafting method

in Akah Village as a training center for rural agriculture, because it is supported by the widest cocoa development in Tabanan district, the form of a tumpeng sari farming system and research on optimization of resource allocation with the linear programming method has never been carried out.

Angkah village is a smallholder plantation farming system with an intercropping system, cocoa, coconut, banana, and cattle. The number of farmers in the adopted villages as P4S managers consists of 48 people. The entire population was used as the research sample.

The types of data collected in this study are quantitative data and qualitative data.

Quantitative data is data in the form of numbers that can be calculated, including: (1) The area of smallholder plantation land, both the area of land owned by the farmer and the area of land used as a place of farming; (2) Type and quantity of production facilities used and production (output) of each production activity; (3) the price of each means of production and each production; (4) The labor required for plant production activities per hectare, the labor required for each livestock production activity and the distribution of working days per type of activity for each production activity; and (5) The amount of costs incurred by farmers includes the cost of renting external workers, costs of production facilities and other costs for farming (variable costs) which are expressed in rupiah per hectare.

Qualitative data is data in the form of words, sentences, schemes, and pictures, or data that is not in the form of numbers, but in the form of qualitative information, including village map data, cropping pattern systems, and post-harvest activities in Angkah Village.

Sources of data are obtained from primary data and secondary data.

Primary data includes the number of farmers, the area of farmland, the number of cocoa plants, the number of coconut plants, the number of banana plants, and the number of cattle in Akah Village. Secondary data is data obtained from BPS data from Bali province covering the amount of land in Bali, cocoa production in Bali, and production area.

The variables observed in this study were

- a. income from each farm carried out by farmers.
- b. The area of arable land for each commodity of smallholder farming in a year
- c. The number of workers in the family and rental labor needed by farmers in farming activities for one year is calculated in HOK
- d. units
- e. . and harvesting bananas and raising cattle

. Data Analysis Methods

1. Linear Programming analysis model.

Research Optimization of resource allocation using *linear programming* is a formal mathematical technique that selects the combination and level of activity, from all feasible activities, to achieve the objective function without ignoring resource availability, and other

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specified constraints (Barlow *et al.* 1977) define linear programming. as a computer-based procedure that can direct the selection of activity combinations to achieve the objective function with existing constraints (Dengen *et al.*, 2019).

The specifications in this linear program are as follows.

1. Objective function: to maximize the income from intercropping farming, cocoa, coconut, banana, and cattle rearing
2. Constraints: land area, input stock, output stock, maximum hired labor, cash in, cash out.
3. To maximize farm income through the implementation of various farming activities, including crop production (forestry) and cattle in one year, purchase of inputs, labor rental, output sales, allocation, and transfer.

Mathematically, linear programming problems (Cohen and Cyert, 1976) are generally stated as follows.

a. The objective function $Z = C_1X_1 + C_2X_2 + \dots + C_nX_n$

b. Constraint function : $a_{11}X_1 + a_{12}X_2 + \dots + a_{1n}X_n \leq b_1$

$a_{21}X_1 + a_{22}X_2 + \dots + a_{2n}X_n \leq b_2$

$a_{m1}X_1 + a_{m2}X_2 + \dots + a_{mn}X_n \leq b_m$

c. Assumptions: $X_1, X_2, \dots, X_n > 0$

or in compact form, as follows:

$$\text{a. maximum output: } z = \sum_{j=1}^n c_j x_j \dots \dots \dots (1)$$

$$\text{with constraints: } \sum_{j=1}^n a_{ij} x_j \{ \leq, =, \geq \} b_i ; i = 1, 2, \dots, m \dots \dots \dots (2)$$

$$\text{assumptions } x_j \geq 0 ; j = 1, 2, \dots, n. \dots \dots \dots (3)$$

where

Z = Value of objective function

C = cost coefficient

X = activity / variable you want to find

A_{ij} = coefficient of output and input

B_i = available resources

Optimization analysis is constrained to farming systems in dry land with the Linnier Programing approach using BLPX 88 software (Eastern Software Product, Inc. 1984). Analysis using Method Simplex which is one of the Linear Programming aims to maximize profit in the form of a linear function (Sriwidadi & Agustina, 2013)

2) Farming activities

programming is a way to solve the problem of allocating

limited resources among activities in the best way (Sukanteri *et al.*, 2019). Farming activities in this model can be classified into three activities, namely crop and livestock production, hiring labor, and raising cattle. All activities and coefficients can be explained as follows.

a. Crop production

Positive values in the land availability column and row indicate a reduction in land available for producing the crop in question.

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Positive one in the crop production column and land availability row indicates that one hectare of land has been reduced to produce 1 hectare of cocoa, coconut, banana, and cattle production. The positive coefficient on the line of labor availability indicates the proportion of HOK of labor required to produce one hectare of crops and/or one head of cattle.

b. Hiring Workers

Hiring workers Negative one (-1) in the line of labor availability indicates the additional labor required in one HOK indicates that each activity of hiring one HOK will increase the stock of labor by one HOK.

c. Keeping Cattle.

The positive coefficients in the cattle production column and the land availability row indicate a reduction in the land to keep one cow and 1 cow kept by farmers.

2. Constraints

All types of constraints and their right-hand side (RHS) relationships and values. Each constraint is described in detail as follows.

- Land area: measured in hectares. Land ownership for crop production averages 0.53 ha, indicating that the constraint relationship with the land is less than or equal to the RHS value, meaning that the land used for production indicates that the land used in production can be smaller than the available land.
- Planted area: the area of land used to produce crops (cocoa, coconut, banana). The amount of land availability indicates the RHS value per growing season. The value indicates that it can be less than the available land.
- Availability of labor: measured by working days (HOK) of adult male workers. In contrast to female workers, which is calculated at 0.8 HOK from the value of the wages earned. The workforce is calculated based on real labor needs which shows a relationship smaller than or equal to the RHS meaning that the labor used is not more than the availability of family labor or hired labor.
- The stock of cattle: calculated from changes in the stock of cattle. The number of cattle owned by farmers is an average of 3 heads per year.

2. Gross Margin Analysis

Gross Margin (Jumaidi et al., 2018), is a comparison of operating profit that occurs after the selling price is reduced by the cost of goods purchased. Gross Margin (GM) or economic profit is the average amount of income minus the average total cost incurred on a certain area of land (eg per hectare) within a certain period (eg per year). This economic profit is agricultural income (production x price) minus costs (Saputro & Helbawanti, 2020).

RESULTS AND DISCUSSION

Farming income on smallholder plantation farming system

Gross margin (gross income received by farmers from cocoa sales is IDR 22,084,755, gross income for coconut farming is IDR 3,403,694, banana farming income is IDR 1,953,125, and livestock farming income cattle is 17,531,250. The income earned by farmers in Angkah Village from all commodities in one harvest period is Rp. 45,728,824. Farming incomes for smallholder plantation farmers in Angkah Village can be seen in Table 1

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below.

Table 1. Average gross margin of each farming system tumpang sari in Angkah Village

No	Type of Land area Farming (Ha)	revenue Farming (Rp)	Farming costs (Rp)	income Gross (Rp)	
1	Cocoa	0,53	27,141,315	4,300,560	22,840,755
2	Coconut	0,07	4,653,994	1,250,300	3,403,694
3	Bananas	0.06	2,183,125	230,000	1,953,125
4	Cattle	0.01	20,981,250	3,450,000	17,531,250
Total		54,959,684	9,230,860	45,728.824	

Source: processed from primary data, 2022

Research shows that smallholder cocoa plantations provide a large enough income for farmers in one harvest period with only an average land area of 0.53 ha. The cost of cacao farming is not too big, this is because cocoa requires rental labor costs at harvest time.

Based on the results of the study, it shows that cocoa, coconut, and banana farming is cattle farming carried out by farmers in Angkah Village for \pm 1 year obtaining an average gross margin of Rp. 17,531,250 with average maintenance of three cows. The average revenue is Rp. 20,981,250 and the average cost is Rp. 3,450,000. The revenue obtained shows a fairly high yield due to the sale of cattle after the cow is more than one year old and the average sex is male.

Likewise, the costs incurred are also calculated for cows since they were born in 2021. In line with research conducted by the Catur farmer group, it shows that the cattle sold are more than one year old and provide a fairly large income compared to calves that are still under one year old (Darmawi, 2011). Cattle that are managed on plantation land usually have more activities and look clean so that the performance of the cows is greater. Cattle reared in the wild in plantation areas give better weight than cows kept in cages continuously (Anindiyasari et al., 2015).

Optimal Resource Allocation for Smallholder Farming

Efforts to maximize profits or the objective function of cocoa, coconut, banana, and cattle farming in Akah Village are faced with various constraints or resource limitations.

a. Constraints

There are limited resources including land area constraints, labor availability constraints, and the number of cattle kept (Teguh Ujito & Marangka, 2018). The constraints can be explained below:

a. Constraints on the area of arable land:

The area of arable land is the area of land used for smallholder farming production activities. The results showed that the average area of arable land in Angkah Village showed a land area of 0.53 ha and was used for 4 smallholder farming activities with all commodities owned.

The area of land used in farming activities is carried out based on the characteristics of land use to maximize farmers' income (Maulida & Munir, 2022). Research on smallholder plantation farmers

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in Angkah Village shows that most land is used for cocoa farming, which is considered to provide the most maximum income when the research is carried out.

b. Constraints on the availability of labor in the household.

The number of workers in the household in question is productive workers aged between 15-65 years. Mastery of various ages will be able to take advantage of the power work evenly throughout the year (Maulida & Munir, 2022). The results showed that the number of productive workers involved in the production of each farmer household in the village of Akah in a work unit of 8 hours per day. The number of available workers per day is 48 HOK. Labor is calculated for 25 working days in a month. To meet the workforce needs during the cocoa harvest season, workers are hired only for certain months.

Activities Farming activities in an average land of 0.53 ha in Akah Village indicate various activities carried out on the land.

The results showed that the crops kept by farmers were an intercropping system between cocoa, coconut, banana, and cattle. The tumpang sari system is a farming system that provides the best alternative in the production process to increase farming profits through various farming activities. (Howara, 2011) states that farming activities combine crop farming and livestock business or known as the plant-livestock integration system. The choice of various activities is sought to optimize the utilization of various available resources owned by farmers.

There are various activities carried out by farmers, including:

1. Cocoa farming

activities Annual crop activities, namely cocoa, are cultivated by farmers in Akah Village. Farming activities are notated by PKO1. The income (gross margin) obtained from cocoa farming is Rp. 12,105,600 in one harvest period on an average land area of 0.53 ha for cocoa production. The income obtained is based on the expenditure of farm input costs in one cocoa harvest period. On one hectare of land, the income is Rp. 22,840,755. The results of the study (Naully et al., 2014) show the same thing that the cocoa income obtained is linearly related to the area of land used for production.

2. Coconut farming activities Coconut

farming is carried out throughout the year, farmers in Akah Village plant coconuts with a harvest duration of once every 6 months. Coconut is denoted by PK1. The average gross income per ha received by farmers is Rp. 3,404,694. Coconut is the main crop planted between cocoa as a shade plant and as an annual crop that acts as a farmer's income. Coconuts planted by farmers are harvested between cocoa harvests so that farmers can earn income outside the cocoa harvest from the number of coconuts produced. The need for labor both from within the family and outside the family in coconut farming is 18.45 HOK.

3. Banana farming activities Banana

production on farmers' land is one of the tumpang sari plants grown by farmers as a source of income. Banana production is denoted by PP1. Bananas are managed year-round but banana harvests are not the same as cocoa and coconut. The bananas that are cultivated at this time have given yields per harvest season which can be done every month with an average income of Rp. 1953.125 in one production period. Banana plants such as tumpang sari plants are planted only on the outskirts of the farmers' land. This is done to make it easier for farmers to harvest bananas and

make it easier for farmers to transport banana production. Harvesting bananas outside the cocoa plant will make harvesting easier because the banana trees that have been harvested will rot, and minimize bacterial or fungal attacks that can affect the cocoa plant.

4. Cattle farming activities

Farmers in Angkah Village carry out cattle activities in addition to producing cocoa, coconut, and banana plants. Cattle activities are carried out throughout the year. The activity of raising cattle is denoted by PSAPI. The average livestock cultivated by farmers is 3 heads. Cattle farming activities provide farmers with a gross income of IDR 17,531,250.

Table 2. Linear Matrix Programming Intercropping Farming System in Angkah Village

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NA2 : N21			X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	REL	RHS
NO	ITEM	UNIT	PKO1	PK1	PP1	PSAPI	STK03	STK04	STK05	STK08	STK09	STK12		
R1	EGM	Rp000	22,840,755	3,403,694	1,953,125	17,531,250	-50	-50	-50	-50	-50	-50		
R2	LAHAN	Ha	1	1	1	0.005							≤	4.7
R3	MLPKO1	Ha	1										≤	4.7
R4	MLPK1	Ha		1									≤	4.7
R5	MLP1	Ha			1								≤	2.1
R6	MLPSAPI	Ha				1							≤	5
R7	TKT01	HOK	11.8			3.75	-1						≤	48
R8	TKT02	HOK	10	0.92		7.5							≤	48
R9	TKT03	HOK	12.3	6.45		7.5							≤	48
R10	TKT04	HOK	11.52		24.1	9.375		-1					≤	48
R11	TKT05	HOK	8.3			7.5							≤	48
R12	TKT06	HOK				7.5							≤	48
R13	TKT07	HOK				7.5		-1					≤	48
R14	TKT08	HOK	49.8			7.5			-1				≤	48
R15	TKT09	HOK	15.1			7.5				-1			≤	48
R16	TKT10	HOK	5.84			4.125				-1			≤	48
R17	TKT11	HOK	14.4		23	7.5						-1	≤	48
R18	TKT12	HOK		69.3		7.5						-1	≤	48
R19	MTKS01	HOK											≤	23.4
R20	MTKS02	HOK		12									≤	34.4
R21	MTKS03	HOK	30.01				1						≤	35
R22	MTKS04	HOK	22					1					≤	60
R23	MTKS05	HOK	12						1				≤	27.2
R24	MTKS06	HOK											≤	35.6
R25	MTKS07	HOK											≤	35.6
R26	MTKS08	HOK	13.45								1		≤	50
R27	MTKS09	HOK	24.12									1	≤	55.01
R28	MTKS010	HOK											≤	55.01
R29	MTKS011	HOK											≤	55.01

c. Construction of the Linear Programming Model in the Intercropping Agricultural System

Based on the description above, a Linear Programming construction model can be made including resource constraints, farming activities, and resource availability, in the form of a matrix as in Table 1

Optimal Solutions in the Intercropping Farming System

Results of the analysis obtained the gross income value (gross margin) in optimal conditions of Rp 45,728,824 from all farming activities carried out by farmers using the tumpang sari system in Angkah Village in one production period. Farming activities can be seen in Table 1 which shows that all activities in the dry land farming system are profitable. Several labor hire activities carried out by farmers to cover labor needs in March, April, May, August, and September turned out to be unprofitable. This means that in these months there is no need to hire labor. Hiring labor in that month will increase costs, which should be utilized from the existing workforce. The hiring of labor will reduce the profits of farmers.

The results of the analysis show cocoa activity, indicating that the use of land resources in conditions that are not yet optimal is used up. In this condition, the farmer should use 0.52 ha of land from the available land of 0.53 ha so that the remaining 0.0010 ha of land can be used for other, more profitable farming. In coconut farming, farmers use 0.071 ha of land. In this condition, farmers should use 0.0764 ha of land so that there is a remaining 0.00036 ha of land that can be used for other farming. Banana farming uses 0.061 ha of land and cattle use 0.014 ha of land which should be utilized only 0.013 ha of the available land.

The use of available domestic labor is 48 HOK per month. Which is used in January, February, March, and April. May and August, September, October, and November. This means that this month farmers are allowed to hire workers because the availability of labor runs out so that the labor needs can be obtained from hiring workers. However, for June, July and December, farmers should not hire workers because there is enough labor from within the family. Manpower requirements can be seen in Table 2 below.

Commented [IYP15]: you need to add a discussion about the use of labor in each period.

Table 2. Linear Matrix Programming Intercropping Farming System in Akah Village.

Source: Primary Data

meaning of the linear programming code can be seen in Table 3

Table 3. The meaning of the linear programming code

MLPK1	Providing harvested cocoa production land 1
MLP1	Providing harvested coconut production land 1
MLPSAP	Providing cattle production land
I	
TKT01	January labor
TKT02	labor February
Monthly	
TKT03	Labor in March
TKT04 =	Labor in April
TKT05	Labor in May
TKT06	Labor in June

Commented [IYP16]: You need to explain not only labor constraint but also input, etc.

TKT07	Labor in July
TKT08	Labor in August
TKT09	Labor in September
TKT10	Labor in October
TKT11	Labor in November
TKT12	Labor December
MTKS01	Hiring labor in January
MTKS02	Hiring labor in February
MTKS03	Hiring labor in March
MTKS04	Hiring labor in April
MTKS05	Hiring labor in May
MTKS06	Hiring labor in June
MTKS07	Hiring labor in July
MTKS08	Hiring labor in August
MTKS09	Hire Monthly Labor September
MTKS01	Hiring Labor in October
0	
MTKS01	Hiring Labor in November
1	
MTKS01	Hiring Labor in December
2	

Simulation of the Effect of Changes in Agricultural Commodity Prices

Sensitivity analysis has the objective to determine changes in agricultural resource allocation and farm income caused by changes in commodity prices. The cocoa commodity at the research site fluctuates a lot. Changes in resource allocation can be seen in changes in cocoa commodity prices. If the price of cocoa increases to 3,000 packs of kg, the gross income earned by cocoa farmers will increase to Rp. 1,210,560 or 10% from 12,105,600 so that the gross income received by farmers becomes Rp. 13,316,160 per one cocoa harvest period.

The allocation of labor resources shows that the price of chili does not cause changes in the use of labor in farming. The labor used in all farms is 1,042 HOK.

Likewise with the price of cattle. Farmers receive an average price of cows per head of Rp 6,041,667. If the price of cattle increases from 6,041,667 by 7.5%, the gross income of petai from cattle will be 6,500,000 per head. The increase in cattle prices will cause an increase in the gross income received by farmers to Rp. 19,500,000 per year if farmers can produce an average of 3 cows per year. The income of cattle is one of the causes of an increase in farmers' income and its nature as a farmer's savings (Sukanteri, et. all, 2019)

Cows are one of the sources of farmers' income apart from cocoa yields. the number of cows kept by farmers is between 2 to 5 heads with an average number of cows being kept as much as 3 heads. increased to 37.9%.

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Conclusion

The average gross margin obtained by farmers in Akah Village is Rp. 45,728,824 a year. This income is obtained from the tumpang sari system of cocoa, coconut, banana, and cattle. Cultivated on an average of 0.53 ha of cocoa land. Coconut 0.071 ha, banana 0.061 and beef cattle 0.014 ha. With an optimal income of 69,800,035.

The amount of allocation of agricultural resources with the cocoa-coconut-banana intercropping system and cattle in Akah Village is 1,042 HOK

Changes in commodity prices cause changes in commodity prices in the tumpang sari system in Angkah Village.

SUGGESTIONS

Farmers need to apply a combination of optimal farming activities faced with limited resources, to obtain maximum income. 2) Farmers need to reduce hired labor in the months of not doing land cultivation so that the total cost decreases and income is maximized. 3) To obtain stable prices, it is necessary to guarantee prices for various commodities

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REFERENCES

- Anindyasari, Setiadi, & Ekowati. (2015). Income Analysis Of Dairy Farmers In Banyumanik District, Getasan District, And Cepogo District. *Journal Of Agricultural Sciences*, 11(2), 22–33.
- Darmawi, D. (2011). Income From Bali Cattle Raising Business In Muaro Jambi Regency. *Scientific Journal Of Animal Sciences, Jambi University*, Xiv(1), 14–22.
- Dengen, Cn, Nurcahyo, Ac, & Kusriani, K. (2019). Determination Of Plant Types Based On The Slope Of Agricultural Land Using The Adoption Of Linear Programming Based On Image Processing. *Journal Of Buana Informatics*, 10(2), 99. <https://doi.org/10.24002/jbi.V10i2.2253>
- Howara, D. (2011). *Optimalisasi Pengembangan Usahatani Tanaman Padi Majalengka Optimization Of The Rice And Cuttle Integrated Farming Development In Majalengka Regency*. 18(April), 43–49.
- Jumaidi, Lt, Bambang, B., & Hudaya, R. (2018). Analisis Pajak, Tunneling, Gross Margin, Dan Kap Spesialis Terhadap Keputusan Untuk Melakukan Transfer Pricing. *Jurnal Aplikasi Akuntansi*, 1(2), 1. <https://doi.org/10.29303/jaa.V1i2.1>
- Maulida, La, & Munir, M. (2022). Optimizing Land Use In Lumajang Regency. *Jurnal Tanah Dan Sumberdaya Lahan*, 9(1), 57–67. <https://doi.org/10.21776/Ub.Jtsl.2022.009.1.7>
- Nauliy, D., Daris, E., & Nuhung, Ia (2014). Daya Saing Ekspor Kakao Olahan Indonesia. *Agribusiness Journal*, 8(1), 15–28. <https://doi.org/10.15408/Aj.V8i1.5126>
- Saputro, Wa, & Helbawanti, Oh (2020). Produktivitas Tanaman Kakao Berdasarkan Umur Di Taman Teknologi Pertanian Nglanggeran. *Paradigma Agribisnis*, 3(1), 7. <https://doi.org/10.33603/Jpa.V3i1.3942>
- Sosial, J., Dan, E., Pertanian, K., Sukanteri, Np, Komang Suparyana, P., Made Suryana, I., Made, I., & Setyawan, D. (Nd). *Agrisocionomics Teknologi Pertanian Terpadu Berbasis Filosofi Tri Hita Karana Dalam Usahatani Menuju Pertanian Organik (Integrated Agriculture Technology Based On Tri Hita Karana Philoshopy Toward Organic Agriculture)*. <http://ejournal2.undip.ac.id/index.php/agrisocionomics>
- Sriwidadi, T., & Agustina, E. (2013). Analisis Optimalisasi Produksi Dengan Linear Programming

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Melalui Metode Simpleks. *Binus Business Review*, 4(2), 725–741.
<https://doi.org/10.21512/Bbr.V4i2.1386>

Sukanteri, Np, Kartika Lestari, Pf, & Suryana, Im (2019). Program Abdimas Kwt Kenanga Desa Gunung Salak, Kecamatan Selemadeg Timur Kabupaten Tabanan. *Caradde: Jurnal Pengabdian Kepada Masyarakat*, 2(2), 160–166. <https://doi.org/10.31960/Caradde.V2i2.256>

Teguh Ujianto, B., & Marinka, B. (2018). Optimasi Penjualan Rumah Dan Pemanfaatan Lahan Pada Perumahan Permata Jingga. *Pawon: Jurnal Arsitektur*, 2(01), 1–10.
<https://doi.org/10.36040/Pawon.V2i01.1061>

OPTIMIZATION OF RESOURCE ALLOCATION IN THE TUMPANG SARI BUSINESS SYSTEM IN TABANAN REGENCY, BALI PROVINCE

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ABSTRACT

Land as a location for farming is the main asset managed by farmers. The area of land is directly proportional to the production of farming, the wider the area of land that is managed, the higher the products produced. The tumpang sari farming system shows that land is used for the production of several commodities such as cocoa, coconut, bananas, and cattle if the commodities being cultivated do not experience significant disturbances.

The research objectives are to analyze the gross income of smallholder plantation farming in Angkah Village and analyze the allocation of agricultural resources with the cocoa-coconut-banana crop intercropping system and cattle in Angkah Village.

The research was conducted in Akah Village, West Selemadeg Sub-district, Tabanan Regency, with an intercropping farming system. Research Optimization of resource allocation using *linear programming* is a formal mathematical technique that selects the combination and level of activity, from all feasible activities, to achieve the objective function without ignoring the availability of resources and other specified constraints.

The average gross income (gross margin) obtained by farmers in Akah Village is Rp. 45,728,824 a year. This income is obtained from the tumpang sari system of cocoa, coconut, banana, and cattle. Cultivated on an average of 0.53 ha of cocoa land. Coconut 0.071 ha, banana 0.061 and beef cattle 0.014 ha. With an optimal income of 69,800,035. The amount of agricultural resource allocation with the cocoa-coconut-banana intercropping system and cattle in Akah Village is 1,042 HOK. Changes in commodity prices cause changes in commodity prices in the intercropping system in Akah Village.

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Background

Land as a location for farming is the main asset that is managed by farmers' farmer's land owned by the family or land leased by the farming family. The area of land is directly proportional to the production of farming, the wider the area of land that is managed, the higher the production produced if the commodity being cultivated does not experience significant disturbances. The area of plantation land in the province of Bali is 563,666 ha. The amount of land used as plantation land as non-rice field land is 122,127 ha in Bali. The land is 22,631 ha located in Tabanan Regency as the third largest land area after Buleleng 31,323 ha and Karangasem Regency 30,650 (BPS Bali 2017)

The land is also used for the production of a combination of plantation crops and crops and livestock raised by farmers. This combination allows farmers to do based on the commodities planted on each farmer's land. In general, the combination is carried out based on the farmer's desire for commodities that are considered profitable to the farmer.

Tabanan Regency as one of the largest land areas in Bali combines various plants in one area of land. The land area in Tabanan Regency is planted with cocoa, coffee, clove, and coconut plantations. The area of land planted with cocoa in Tabanan Regency reached 4,533.31 ha of 15 081.33 planted with deep coconut, 685.38 early coconuts, and 8.20 hybrid coconut (BPS Bali, 2017).

The combinations carried out by farmers are cocoa, coconut, banana, and cattle. Tabanan Regency is one of the farming-based villages, which combines cocoa-banana-coconut plantations on farming land. The purpose of this development is to increase land productivity through an intercropping system. Improving the welfare of farmers and encouraging the improvement of the rural economy.

One of the cocoa development centers in Tabanan Regency is Akah Village. Agribusiness commodities that aim to improve competitiveness, quality of output, and marketing. Akah Village is designated as one of the organizers of the P4s program, namely the Self-Help Agricultural and Rural Training Center, hereinafter referred to as P4S, which is a training institution with agricultural and rural apprenticeship methods. The purpose of establishing P4S is to accelerate access and application of information technology through the learning process of farmers and their families according to real conditions in the field.

To increase farmers in Akah Village, Selemadeg Barat District, and Tabanan Regency, they are faced with limited land, capital, labor, and others. Farmers' land ownership is on average 0.53 ha per household. Ownership of the land has not been fully able to improve the welfare of farmer families. Farmers have not been able to specify farming needs, and other necessities of life with certainty, and even the exact benefits obtained are not yet known for certain in the combination of intercropping farming integration. To increase the income of farmers who are faced with limited resources, it is necessary to research optimizing intercropping farming on plantation land in Akah Village through a linear programming approach.

The research objectives are to analyze the gross income of smallholder plantation farming in Angkah Village and analyze the allocation of agricultural resources with the cocoa-coconut-banana crop intercropping system and cattle in Angkah Village. Knowing the effect of changes in the prices of several commodities on the allocation of resources in the intercropping system in Akah Village. The benefits of the research include: so that farmers can utilize the available resources in limited quantities to maximize income. Optimal policy-making for agricultural development in plantations, and optimal use of resources at the research site.

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RESEARCH METHODS**Research Locations The**

research was conducted in Angkah Village, Selemadeg Barat Subdistrict, Tabanan Regency, the research was conducted intentionally with the consideration that

1. Angkah Village is a training center for Agriculture and Rural Self-help on cocoa commodities
2. Village is the largest fermented cocoa producer in Tabanan Regency.
3. Angkah the form of fermented cocoa beans Cocoa
4. The production uses the shoot grafting method

in Akah Village as a training center for rural agriculture, because it is supported by the widest cocoa development in Tabanan district, the form of a **tumpang sari** farming system and research on optimization of resource allocation with the linear programming method has never been carried out.

Angkah village is a smallholder plantation farming system with an intercropping system, cocoa, coconut, banana, and cattle. The number of farmers in the adopted villages as P4S managers consists of 48 people. The entire population was used as the research sample.

The types of data collected in this study are quantitative data and qualitative data.

Quantitative data is data in the form of numbers that can be calculated, including: (1) The area of smallholder plantation land, both the area of land owned by the farmer and the area of land used as a place of farming; (2) Type and quantity of production facilities used and production (output) of each production activity; (3) the price of each means of production and each production; (4) The labor required for plant production activities per hectare, the labor required for each livestock production activity and the distribution of working days per type of activity for each production activity; and (5) The amount of costs incurred by farmers includes the cost of renting external workers, costs of production facilities and other costs for farming (variable costs) which are expressed in rupiah per hectare.

Qualitative data is data in the form of words, sentences, schemes, and pictures, or data that is not in the form of numbers, but in the form of qualitative information, including village map data, cropping pattern systems, and post-harvest activities in Angkah Village.

Sources of data are obtained from primary data and secondary data.

Primary data includes the number of farmers, the area of farmland, the number of cocoa plants, the number of coconut plants, the number of banana plants, and the number of cattle in Akah Village. Secondary data is data obtained from BPS data from Bali province covering the amount of land in Bali, cocoa production in Bali, and production area.

The variables observed in this study were

- a. income from each farm carried out by farmers.
- b. The area of arable land for each commodity of smallholder farming in a year
- c. The number of workers in the family and rental labor needed by farmers in farming activities for one year is calculated in HOK
- d. units
- e. and harvesting bananas and raising cattle

. Data Analysis Methods

1. Linear Programming analysis model.

Research Optimization of resource allocation using *linear programming* is a formal mathematical technique that selects the combination and level of activity, from all feasible activities, to achieve the objective function without ignoring resource availability, and other

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1. Linear programming analysis model.
- 2) Farming activities
2. Constraints

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specified constraints (Barlow *et al.* 1977) define linear programming. as a computer-based procedure that can direct the selection of activity combinations to achieve the objective function with existing constraints (Dengen et al., 2019).

The specifications in this linear program are as follows.

1. Objective function: to maximize the income from intercropping farming, cocoa, coconut, banana, and cattle rearing
2. Constraints: land area, input stock, output stock, maximum hired labor, cash in, cash out.
3. To maximize farm income through the implementation of various farming activities, including crop production (forestry) and cattle in one year, purchase of inputs, labor rental, output sales, allocation, and transfer.

Mathematically, linear programming problems (Cohen and Cyert, 1976) are generally stated as follows.

a. The objective function $Z = C_1X_1 + C_2X_2 + \dots + C_nX_n$

b. Constraint function : $a_{11}X_1 + a_{12}X_2 + \dots + a_{1n}X_n \leq b_1$

$a_{21}X_1 + a_{22}X_2 + \dots + a_{2n}X_n \leq b_2$

$a_{m1}X_1 + a_{m2}X_2 + \dots + a_{mn}X_n \leq b_m$

c. Assumptions: $X_1, X_2, \dots, X_n \geq 0$

or in compact form, as follows:

$$\text{a. maximum output: } z = \sum_{j=1}^n c_j x_j \quad \dots \dots \dots (1)$$

$$\text{with constraints: } \sum_{j=1}^n a_{ij} x_j \leq b_i \quad ; \quad i = 1, 2, \dots, m \quad \dots \dots \dots (2)$$

$$\text{assumptions } x_j \geq 0 \quad ; \quad j = 1, 2, \dots, n. \quad \dots \dots \dots (3)$$

where

Z = Value of objective function

C = cost coefficient

X = activity / variable you want to find

A_{ij} = coefficient of output and input

B_i = available resources

Optimization analysis is constrained to farming systems in dry land with the Linnier Programing approach using BLPX 88 software (Eastern Software Product, Inc. 1984). Analysis using Method Simplex which is one of the Linear Programming aims to maximize profit in the form of a linear function (Sriwidadi & Agustina, 2013)

2) Farming activities

programming is a way to solve the problem of allocating limited resources among activities in the best way (Sukanteri et al., 2019). Farming activities in this model can be classified into three activities, namely crop and livestock production, hiring labor, and raising cattle. All activities and coefficients can be explained as follows.

a. Crop production

Positive values in the land availability column and row indicate a reduction in land available for producing the crop in question.

Positive one in the crop production column and land availability row indicates that one hectare of land has been reduced to produce 1 hectare of cocoa, coconut, banana, and cattle production. The positive coefficient on the line of labor availability indicates the proportion of HOK of labor required to produce one hectare of crops and/or one head of cattle.

b. Hiring Workers

Hiring workers Negative one (-1) in the line of labor availability indicates the additional labor required in one HOK indicates that each activity of hiring one HOK will increase the stock of labor by one HOK.

c. Keeping Cattle.

The positive coefficients in the cattle production column and the land availability row indicate a reduction in the land to keep one cow and 1 cow kept by farmers.

2. Constraints

All types of constraints and their right-hand side (RHS) relationships and values. Each constraint is described in detail as follows.

- Land area: measured in hectares. Land ownership for crop production averages 0.53 ha, indicating that the constraint relationship with the land is less than or equal to the RHS value, meaning that the land used for production indicates that the land used in production can be smaller than the available land.
- Planted area: the area of land used to produce crops (cocoa, coconut, banana). The amount of land availability indicates the RHS value per growing season. The value indicates that it can be less than the available land.
- Availability of labor: measured by working days (HOK) of adult male workers. In contrast to female workers, which is calculated at 0.8 HOK from the value of the wages earned. The workforce is calculated based on real labor needs which shows a relationship smaller than or equal to the RHS meaning that the labor used is not more than the availability of family labor or hired labor.
- The stock of cattle: calculated from changes in the stock of cattle. The number of cattle owned by farmers is an average of 3 heads per year.

2. Gross Margin Analysis

Gross Margin (Jumaidi et al., 2018), is a comparison of operating profit that occurs after the selling price is reduced by the cost of goods purchased. Gross Margin (GM) or economic profit is the average amount of income minus the average total cost incurred on a certain area of land (eg per hectare) within a certain period (eg per year). This economic profit is agricultural income (production x price) minus costs (Saputro & Helbawanti, 2020).

RESULTS AND DISCUSSION

Farming income on smallholder plantation farming system

Gross margin (gross income received by farmers from cocoa sales is IDR 22,084,755, gross income for coconut farming is IDR 3,403,694, banana farming income is IDR 1,953,125, and livestock farming income cattle is 17,531,250. The income earned by farmers in Angkah Village from all commodities in one harvest period is Rp. 45,728,824. Farming incomes for smallholder plantation farmers in Angkah Village can be seen in Table 1 below.

Table 1. Average gross margin of each farming system tumpang sari in Angkah Village

No	Type of Land area Farming (Ha)	revenue Farming (Rp)	Farming costs (Rp)	income Gross (Rp)	
1	Cocoa	0,53	27,141,315	4,300,560	22,840,755
2	Coconut	0,07	4,653,994	1,250,300	3,403,694
3	Bananas	0.06	2,183,125	230,000	1,953,125
4	Cattle	0.01	20,981,250	3,450,000	17,531,250
Total		54,959,684	9,230,860	45,728.824	

Source: processed from primary data, 2022

Research shows that smallholder cocoa plantations provide a large enough income for farmers in one harvest period with only an average land area of 0.53 ha. The cost of cacao farming is not too big, this is because cocoa requires rental labor costs at harvest time.

Based on the results of the study, it shows that cocoa, coconut, and banana farming is cattle farming carried out by farmers in Angkah Village for \pm 1 year obtaining an average gross margin of Rp. 17,531,250 with average maintenance of three cows. The average revenue is Rp. 20,981,250 and the average cost is Rp. 3,450,000. The revenue obtained shows a fairly high yield due to the sale of cattle after the cow is more than one year old and the average sex is male.

Likewise, the costs incurred are also calculated for cows since they were born in 2021. In line with research conducted by the Catur farmer group, it shows that the cattle sold are more than one year old and provide a fairly large income compared to calves that are still under one year old (Darmawi, 2011). Cattle that are managed on plantation land usually have more activities and look clean so that the performance of the cows is greater. Cattle reared in the wild in plantation areas give better weight than cows kept in cages continuously (Anindyasari et al., 2015).

Optimal Resource Allocation for Smallholder Farming

Efforts to maximize profits or the objective function of cocoa, coconut, banana, and cattle farming in Akah Village are faced with various constraints or resource limitations.

a. Constraints

There are limited resources including land area constraints, labor availability constraints, and the number of cattle kept (Teguh Ujito & Marangka, 2018). The constraints can be explained below:

a. Constraints on the area of arable land:

The area of arable land is the area of land used for smallholder farming production activities. The results showed that the average area of arable land in Angkah Village showed a land area of 0.53 ha and was used for 4 smallholder farming activities with all commodities owned.

The area of land used in farming activities is carried out based on the characteristics of land use to maximize farmers' income (Maulida & Munir, 2022). Research on smallholder plantation farmers

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in Angkah Village shows that most land is used for cocoa farming, which is considered to provide the most maximum income when the research is carried out.

b. Constraints on the availability of labor in the household.

The number of workers in the household in question is productive workers aged between 15-65 years. Mastery of various ages will be able to take advantage of the power work evenly throughout the year (Maulida & Munir, 2022). The results showed that the number of productive workers involved in the production of each farmer household in the village of Akah in a work unit of 8 hours per day. The number of available workers per day is 48 HOK. Labor is calculated for 25 working days in a month. To meet the workforce needs during the cocoa harvest season, workers are hired only for certain months.

Activities Farming activities in an average land of 0.53 ha in Akah Village indicate various activities carried out on the land.

The results showed that the crops kept by farmers were an intercropping system between cocoa, coconut, banana, and cattle. The **tumpeng sari system** is a farming system that provides the best alternative in the production process to increase farming profits through various farming activities. (Howara, 2011) states that farming activities combine crop farming and livestock business or known as the plant-livestock integration system. The choice of various activities is sought to optimize the utilization of various available resources owned by farmers.

There are various activities carried out by farmers, including:

1. Cocoa farming

activities Annual crop activities, namely cocoa, are cultivated by farmers in Akah Village. Farming activities are notated by PKO1. The income (gross margin) obtained from cocoa farming is Rp. 12,105,600 in one harvest period on an average land area of 0.53 ha for cocoa production. The income obtained is based on the expenditure of farm input costs in one cocoa harvest period. On one hectare of land, the income is Rp. 22,840,755. The results of the study (Naully et al., 2014) show the same thing that the cocoa income obtained is linearly related to the area of land used for production.

2. Coconut farming activities Coconut

Farming is carried out throughout the year, farmers in Akah Village plant coconuts with a harvest duration of once every 6 months. Coconut is denoted by PK1. The average gross income per ha received by farmers is Rp. 3,404,694. Coconut is the main crop planted between cocoa as a shade plant and as an annual crop that acts as a farmer's income. Coconuts planted by farmers are harvested between cocoa harvests so that farmers can earn income outside the cocoa harvest from the number of coconuts produced. The need for labor both from within the family and outside the family in coconut farming is 18.45 HOK.

3. Banana farming activities Banana

Production on farmers' land is one of the **tumpeng sari** plants grown by farmers as a source of income. Banana production is denoted by PP1. Bananas are managed year-round but banana harvests are not the same as cocoa and coconut. The bananas that are cultivated at this time have given yields per harvest season which can be done every month with an average income of Rp. 1,953,125 in one production period. Banana plants such as **tumpeng sari plants** are planted only on the outskirts of the farmers' land. This is done to make it easier for farmers to harvest bananas and

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make it easier for farmers to transport banana production. Harvesting bananas outside the cocoa plant will make harvesting easier because the banana trees that have been harvested will rot, and minimize bacterial or fungal attacks that can affect the cocoa plant.

4. Cattle farming activities

Farmers in Angkah Village carry out cattle activities in addition to producing cocoa, coconut, and banana plants. Cattle activities are carried out throughout the year. The activity of raising cattle is denoted by PSAPI. The average livestock cultivated by farmers is 3 heads. Cattle farming activities provide farmers with a gross income of IDR 17,531,250.

Table 2. Linear Matrix Programming Intercropping Farming System in Angkah Village

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NO	ITEM	UNIT	X1 PKO1	X2 PK1	X3 PP1	X4 PSAPI	X5 STK03	X6 STK04	X7 STK05	X8 STK08	X9 STK09	X10 STK12	REL	RHS
R1	EGM	Rp000	22,840,755	3,403,694	1,953,125	17,531,250	-50	-50	-50	-50	-50	-50		
R2	LAHAN	Ha	1	1	1	0.005							≤	4.7
R3	MLPKO1	Ha	1										≤	4.7
R4	MLPK1	Ha		1									≤	4.7
R5	MLP1	Ha			1								≤	2.1
R6	MLPSAPI	Ha				1							≤	5
R7	TKT01	HOK	11.8			3.75	-1						≤	48
R8	TKT02	HOK	10	0.92		7.5							≤	48
R9	TKT03	HOK	12.3	6.45		7.5							≤	48
R10	TKT04	HOK	11.52		24.1	9.375		-1					≤	48
R11	TKT05	HOK	8.3			7.5							≤	48
R12	TKT06	HOK				7.5							≤	48
R13	TKT07	HOK				7.5		-1					≤	48
R14	TKT08	HOK	49.8			7.5			-1				≤	48
R15	TKT09	HOK	15.1			7.5				-1			≤	48
R16	TKT10	HOK	5.84			4.125				-1			≤	48
R17	TKT11	HOK	14.4		23	7.5						-1	≤	48
R18	TKT12	HOK		69.3		7.5						-1	≤	48
R19	MTKS01	HOK											≤	23.4
R20	MTKS02	HOK		12									≤	34.4
R21	MTKS03	HOK	30.01				1						≤	35
R22	MTKS04	HOK	22					1					≤	60
R23	MTKS05	HOK	12						1				≤	27.2
R24	MTKS06	HOK											≤	35.6
R25	MTKS07	HOK											≤	35.6
R26	MTKS08	HOK	13.45								1		≤	50
R27	MTKS09	HOK	24.12									1	≤	55.01
R28	MTKS010	HOK											≤	55.01
R29	MTKS011	HOK											≤	55.01

c. Construction of the Linear Programming Model in the Intercropping Agricultural System

Based on the description above, a Linear Programming construction model can be made including resource constraints, farming activities, and resource availability, in the form of a matrix as in Table 1

Optimal Solutions in the Intercropping Farming System

Results of the analysis obtained the gross income value (gross margin) in optimal conditions of Rp 45,728,824 from all farming activities carried out by farmers using the tumpang sari system in Angkah Village in one production period. Farming activities can be seen in Table 1 which shows that all activities in the dry land farming system are profitable. Several labor hire activities carried out by farmers to cover labor needs in March, April, May, August, and September turned out to be unprofitable. This means that in these months there is no need to hire labor. Hiring labor in that month will increase costs, which should be utilized from the existing workforce. The hiring of labor will reduce the profits of farmers.

The results of the analysis show cocoa activity, indicating that the use of land resources in conditions that are not yet optimal is used up. In this condition, the farmer should use 0.52 ha of land from the available land of 0.53 ha so that the remaining 0.0010 ha of land can be used for other, more profitable farming. In coconut farming, farmers use 0.071 ha of land. In this condition, farmers should use 0.0764 ha of land so that there is a remaining 0.00036 ha of land that can be used for other farming. Banana farming uses 0.061 ha of land and cattle use 0.014 ha of land which should be utilized only 0.013 ha of the available land.

The use of available domestic labor is 48 HOK per month. Which is used in January, February, March, and April. May and August, September, October, and November. This means that this month farmers are allowed to hire workers because the availability of labor runs out so that the labor needs can be obtained from hiring workers. However, for June, July and December, farmers should not hire workers because there is enough labor from within the family. Manpower requirements can be seen in Table 2 below.

Table 2. Linear Matrix Programming Intercropping Farming System in Akah Village.

Source: Primary Data

meaning of the linear programming code can be seen in Table 3

Table 3. The meaning of the linear programming code

MLPK1	Providing harvested cocoa production land 1
MLP1	Providing harvested coconut production land 1
MLPSAP	Providing cattle production land
I	
TKT01	January labor
TKT02	labor February
Monthly	
TKT03	Labor in March
TKT04 =	Labor in April
TKT05	Labor in May
TKT06	Labor in June

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TKT07	Labor in July
TKT08	Labor in August
TKT09	Labor in September
TKT10	Labor in October
TKT11	Labor in November
TKT12	Labor December
MTKS01	Hiring labor in January
MTKS02	Hiring labor in February
MTKS03	Hiring labor in March
MTKS04	Hiring labor in April
MTKS05	Hiring labor in May
MTKS06	Hiring labor in June
MTKS07	Hiring labor in July
MTKS08	Hiring labor in August
MTKS09	Hire Monthly Labor September
MTKS01	Hiring Labor in October
0	
MTKS01	Hiring Labor in November
1	
MTKS01	Hiring Labor in December
2	

Simulation of the Effect of Changes in Agricultural Commodity Prices

Sensitivity analysis has the objective to determine changes in agricultural resource allocation and farm income caused by changes in commodity prices. The cocoa commodity at the research site fluctuates a lot. Changes in resource allocation can be seen in changes in cocoa commodity prices. If the price of cocoa increases to 3,000 packs of kg, the gross income earned by cocoa farmers will increase to Rp. 1,210,560 or 10% from 12,105,600 so that the gross income received by farmers becomes Rp. 13,316,160 per one cocoa harvest period.

The allocation of labor resources shows that the price of chili does not cause changes in the use of labor in farming. The labor used in all farms is 1,042 HOK.

Likewise with the price of cattle. Farmers receive an average price of cows per head of Rp 6,041,667. If the price of cattle increases from 6,041,667 by 7.5%, the gross income of petai from cattle will be 6,500,000 per head. The increase in cattle prices will cause an increase in the gross income received by farmers to Rp. 19,500,000 per year if farmers can produce an average of 3 cows per year. The income of cattle is one of the causes of an increase in farmers' income and its nature as a farmer's savings (Sukanteri, et. all, 2019). Cows are one of the sources of farmers' income apart from cocoa yields. the number of cows kept by farmers is between 2 to 5 heads with an average number of cows being kept as much as 3 heads increased to 37.9%.

Conclusion

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The average gross margin obtained by farmers in Akah Village is Rp. 45,728,824 a year. This income is obtained from the **tumpang sari system** of cocoa, coconut, banana, and cattle. Cultivated on an average of 0.53 ha of cocoa land. Coconut 0.071 ha, banana 0.061 and beef cattle 0.014 ha. With an optimal income of 69,800,035.

The amount of allocation of agricultural resources with the cocoa-coconut-banana intercropping system and cattle in Akah Village is 1,042 HOK

Changes in commodity prices cause changes in commodity prices in the tumpang sari system in Angkah Village.

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SUGGESTIONS

Farmers need to apply a combination of optimal farming activities faced with limited resources, to obtain maximum income. 2) Farmers need to reduce hired labor in the months of not doing land cultivation so that the total cost decreases and income is maximized. 3) To obtain stable prices, it is necessary to guarantee prices for various commodities

REFERENCES

- Anindyasari, Setiadi, & Ekowati. (2015). Income Analysis Of Dairy Farmers In Banyumanik District, Getasan District, And Cepogo District. *Journal Of Agricultural Sciences*, 11(2), 22–33.
- Darmawi, D. (2011). Income From Bali Cattle Raising Business In Muaro Jambi Regency. *Scientific Journal Of Animal Sciences, Jambi University*, Xiv(1), 14–22.
- Dengen, Cn, Nurcahyo, Ac, & Kusriani, K. (2019). Determination Of Plant Types Based On The Slope Of Agricultural Land Using The Adoption Of Linear Programming Based On Image Processing. *Journal Of Buana Informatics*, 10(2), 99. <https://doi.org/10.24002/jbi.V10i2.2253>
- Howara, D. (2011). *Optimalisasi Pengembangan Usahatani Tanaman Padi Majalengka Optimization Of The Rice And Cuttle Integrated Farming Development In Majalengka Regency*. 18(April), 43–49.
- Jumaidi, Lt, Bambang, B., & Hudaya, R. (2018). Analisis Pajak, Tunneling, Gross Margin, Dan Kap Spesialis Terhadap Keputusan Untuk Melakukan Transfer Pricing. *Jurnal Aplikasi Akuntansi*, 1(2), 1. <https://doi.org/10.29303/Jaa.V1i2.1>
- Maulida, La, & Munir, M. (2022). Optimizing Land Use In Lumajang Regency. *Jurnal Tanah Dan Sumberdaya Lahan*, 9(1), 57–67. <https://doi.org/10.21776/Uj.Jtsl.2022.009.1.7>
- Nauli, D., Daris, E., & Nuhung, Ia (2014). Daya Saing Ekspor Kakao Olahan Indonesia. *Agribusiness Journal*, 8(1), 15–28. <https://doi.org/10.15408/Aj.V8i1.5126>
- Saputro, Wa, & Helbawanti, Oh (2020). Produktivitas Tanaman Kakao Berdasarkan Umur Di Taman Teknologi Pertanian Nglanggeran. *Paradigma Agribisnis*, 3(1), 7. <https://doi.org/10.33603/Jpa.V3i1.3942>
- Sosial, J., Dan, E., Pertanian, K., Sukanteri, Np, Komang Suparyana, P., Made Suryana, I., Made, I., & Setyawan, D. (Nd). *Agrisocionomics Teknologi Pertanian Terpadu Berbasis Filosofi Tri Hita Karana Dalam Usahatani Menuju Pertanian Organik (Integrated Agriculture Technology Based On Tri Hita Karana Philoshopy Toward Organic Agriculture)*. <http://ejournal2.undip.ac.id/index.php/agrisocionomics>
- Sriwidadi, T., & Agustina, E. (2013). Analisis Optimalisasi Produksi Dengan Linear Programming Melalui Metode Simpleks. *Binus Business Review*, 4(2), 725–741. <https://doi.org/10.21512/Bbr.V4i2.1386>

- Sukanteri, Np, Kartika Lestari, Pf, & Suryana, Im (2019). Program Abdimas Kwt Kenanga Desa Gunung Salak, Kecamatan Selemadeg Timur Kabupaten Tabanan. *Caradde: Jurnal Pengabdian Kepada Masyarakat*, 2(2), 160–166. <https://doi.org/10.31960/Caradde.V2i2.256>
- Teguh Ujianto, B., & Marinka, B. (2018). Optimasi Penjualan Rumah Dan Pemanfaatan Lahan Pada Perumahan Permata Jingga. *Pawon: Jurnal Arsitektur*, 2(01), 1–10. <https://doi.org/10.36040/Pawon.V2i01.1061>



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Ni Putu Sukanteri, Putu Fajar Kartika Lestari, Ni Putu Anglila Amaral

On behalf of Agrisocionomics committee, we are pleased to inform you that your paper entitled

**OPTIMIZATION OF RESOURCE ALLOCATION IN THE TUMPANG SARI
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