Correspondence Process for Submitting International Publications

Date and Activity of Publication Correspondence to JITAA

Article Title : The Optimation of Cow-Calf Beef Cattle and Paddy Farm Integration on Farmer Household in Grobogan Regency

No	Process	Date	Attachment
1.	Submission Acknowledgment	February 4, 2020	Attachment 1
2.	Author declaration	February 11, 2020	Attachment 2
3.	Review Manuscript	May 10, 2020	Attachment 3
4.	Revision submit	May 15, 2020	Attachment 4
5.	Check Author Correspondency	May17, 2020	Attachment 5
6.	Check of Proof Sheet	May 28, 2020	Attachment 6
7.	Revision of Proof Sheet	May 30, 2020	Attachment 7
8.	Publication Information	June 9, 2020	Attachment 8

1. Attachment 1 : Submission Acknowledgment Fabruary 4, 2020

[ITAA] Submission Admowledgement.

toogtaalat_ &

10 V Edy Garelands - Constraintly Publications Lagrantic DV VIA Denset Dr Trik Butwatt

There you to substitute the menuality of TOE OPTIMALIEN OF CAN CALF BEEF CATED AND PACKY CANNING CONTRACTOR ON CAMPACTION OF CAMPACTURE CONCY to contrast of the independent Topical Canning Agriculture With the other prover consignment system. There is a new power you will be able to that the program through the address process for logging is to the owned water and

Vienaciot URL Interferenti advi antidodes der Manustern der einer Stillet Vienaren Internet

Froutieve any spectrum, presses contact no. Thank you for considering this process in presses for your work

Toly Kentanto Journal of the Indonesian Trapical Aprilal Agriculture

accident of the indonesian Trippical Anniel Agriculture the resource Lendre of chickes who have

HE OPTIMATION OF COW-CALF BEEF CATTLE AND PADDY FARMING INTEGRATION ON FARMER HOUSEHOLD IN GROBOGAN REGENCY

By:

Titik Ekowati, Edy Prasetyo, Migie Handayani Faculty of Animal and Agriculture Diponegoro University

ABSTRAK

Rumahtangga petani umumnya berusahatani pada sub-sektor pertanian tanaman pangan dan sub-sektor peternakan yang belum dilaksanakan dengan baik, sehingga kondisi optimal usahatani belum dicapai. Penelitian bertujuan untuk menganalisis optimasi integrasi sapi potong dan padi, simulasi perubahan harga input dan penggunaan sumberdaya terhadap model optimal. Metode survey digunakan dalam penelitian di Kabupaten Grobogan, dengan menentukan Kecamatan Wirosari dan Kecamatan Purwodadi. Ouota sampling method digunakan untuk menentukan jumlah sampel peternak sapi potong induk-anak dan petani padi tanpa menghitung jumlah populasi sebagai sampling frame. Jumlah responden setiap kecamatan adalah 40 petani sehingga total responden 80 petani. Data dianalisis dengan linear programming. Hasil penelitian menunjukkan bahwa kondisi optimum skala usaha integrasi sapi potong dan padi dicapai pada luas lahan 0,45 ha, pemeliharaan induk sapi potong 2.75 UT dengan maksimum pendapatan Rp 52.112.440/tahun. Hasil simulasi perubahan penggunaan input menunjukkan bahwa penambahan luas lahan 0,25% memberikan peningkatan skala usaha sapi potong 0,018% dan pendapatan 14,78%, Kesimpulan optimasi integrasi sapi potong dan padi dicapai pada luas lahan 0,45ha dan induk sapi potong 2.75 UT dan simulasi solusi optimal menunjukkan bahwa petani mempunyai kemampuan untuk mengembangkan usahataninya.

Kata kunci : integrasi, optimasi, padi, pendapatan, sapi potong

ABSTRACT

Farmer households generally operate food crops and livestock subsectors that have not fully implemented well, so an optimal farming has not been achieved. This study aimed to analyze optimation of cow-calf beef cattle and paddy farming integration and simulation changing in input prices and the usage of resources to the optimal model. Survey method was used in the research in Grobogan District by determining Wirosari District and Purwodadi District. Quota sampling method is used to determine the number of samples of farmers without counting the population as a sampling frame. The number of respondents in each district was 40 farmers so the total respondent was 80 farmers. Data were analyzed using linear programing. Results showed that optimum conditions of integration were achieved in 0.45ha land, 2.75 AU of cow-calf beef cattle with maximum income of IDR 52,112,440/year. The simulation results regarding in changing in input usege indicated that the addition of 0.25% land area gives a change in scale of cow-calf beef cattle to 0.018% and income of 14.78%. In conclusion, integration optimation was achieved on 0.45ha land, 2.75 UT beef cattle and optimal solution simulations indicated that farmers have the ability to develop their farming.

Keywords: cow-calf beef cattle, integration, income, optimation, paddy

INTRODUCTION

Beef cattle and paddy farmings are forms of farm activity pursued by many people in Central Java. The meaning contained in these farm activities is how beef cattle and paddy farming are run by farm households to get better results, both in terms of farm scale and income. The policy regarding beef cattle and paddy farming development is basically has a correlative and synergistic relationship, considering that agricultural waste is substantially raw material (feed) for livestock farm. Farmer households use integrated farming system in developing agriculture, considering that besides providing economic benefits, this pattern also provides benefits in land conservation and land productivity. This is in line with Soedjana (2007) and Hutasoit, D.D.P.I. (2008) that the reason why farmers choose mixed farming or integration is because of habits (tradition), to maximize revenue from limited resources, and increase benefits of correlation between integrated farming patterns in the food crop sub-sector and livestock sub-sector, which will encourage the development of food crops especially paddy and livestock and create investment opportunities. This is also supported by Basuni et al. (2010), Mukhlis et al. (2015) and Ponnusamy and Devi, 2017 that the integration of farming systems can provide both ecological and economic benefits because the waste from each commodity can be used as an input factor, so that it can save the use of cost and can increase income. Another research by Darith et al. (2016) indicated that activities carried out by farmers in the integration model can increase farmer income which in turn can increase investment in farming

Farmer households can be seen as a unit of farm activity consisting of production, activities and labor services activities. All of these activities are a unity, so that farmer's household cannot be seen as a pure consumer because there is a portion of the production that is consumed and partly sold as capital. Likewise in the labor use, farmers-breeders, labor can come from within the family or outside the family. Thus, farmer households can be said to be producers and consumers (Priyanti, 2007).

Integration of beef cattle and paddy based on the scale of farm that the number of livestock and land area can provide some form of integration (Matin *et al*, 2016). Integration can take the form of an exchange relationship between livestock and paddy which can be in the form of fertilizer and forage (Regan *et al.*, 2017)

Integrated farming systems, in Grobogan, which is managed by farmer's household generally consist of beef cattle, especially cow-calf rearing, and paddy farm. Farm households

usually face constraints on land and cow-calf resource constraints. These constraints are in accordance with by Basuni *et al.* (2010) statement that in West Java, the integration of beef cattle and paddy is contained in land boundaries and livestock numbers. Therefore, the optimal allocation of resource use in the integration of cow-calf and pady needs to be assessed.

Allocation of resource use controlled by farmers is very important, because non-optimal resource use means a cost for farming management. As a result, the profits generated for farmer as farming manager becomes are optimal (A. Masayasu *et al.*, 2018). Allocation of the use of production factors that provide optimal results can be analyzed by linear programming.

Analysis using linear programing can provide information for agricultural policy makers regarding: (a) the structure of related relationships and the costs of comparative advantage in agricultural sector; (b) production potential; (c) job opportunities; (d) consistency of every alternative agricultural policy. (Minh *et al.*, 2007)

Linear programing is a method that is more systematic and mathematically rigorous for determining the optimum combination of farm sectors or contributions such as revenue maximization or cost minimization with limited available resources (Darith *et al.* (2016). From the study results, it is expected that an allocation model for an optimal use of production factors can be created, so that it can benefits for farmers. Based on the bacground, the objective of the study were to develop an optimation for beef cattle and paddy farm integration and simulate changes in input prices and resources use to optimal model.

MATERIAL AND METHODS

The study was conducted by using a survey method to determine the condition of farmer households, especially cow-calf cattle farming and paddy farming in managing their farm integration. Survey method is a method of taking respondents by determining a sample of the existing population. (Singarimbun dan Effendi, 1995)

Purposive method was used to determine the study location based on potential of the most populated area by beef cattle and paddy production in Central Java. Based on data on Agricultural and Animal Husbandry Statistics in 2017, it is known that Grobogan is regency with a potential combination of beef cattle and paddy and farming from the planting area and paddy production aspects as well as the raising of beef cattle in Central Java. Based on regency location, there were 2 districts selected where two villages were taken in each district based on several indicators such as the highest number of beef cattle population, paddy production and farmer group activities. Based on the purposive results, districts selected for the study were Wirosari District, consist of Karangasem Village and Sambirejo Village, and Purwodadi District with Nambuhan Village and Genuksuran Village.

Quota sampling method was conducted to determine the sample number of cow-calf cattle and paddy farmers without counting the population as a sample frame. The sample number of cowcalf beef cattle and paddy farmers from each village were 20 farmers, so the total number of respondents was 80 farmers households.

The method used to analyze the objectives was linear programming and descriptive analysis. From this model, cow-calf beef cattle and paddy farmers can be considered as cow-calf beef cattle and paddy producers that produce livestock and paddy supply continuously from optimal allocation of resources. Thus, the objective function in this linear programming research model was to maximize household income in term of integration cow-calf beef cattle and paddy farming.

The mathematical form of the Linear Programing model that maximizes the objective function in general is:

Maximum Z = C₁X₁ + C₂X₂ +C₃X₃ ... + C_jX_j - + C_nX_n or Z = $\sum_{j=1}^{n} C_j X_j$... (1)

With constraint:

 $\begin{array}{l} a_{11}x_1 + a_{12}x_2 + \ldots a_{1j}x_j + \ldots a_{1n}x_n \leq b_1 \\ a_{21}x_1 + a_{22}x_2 + \ldots a_{2j}x_j + \ldots a_{2n}x_n \leq b_2 \\ a_{31}x_1 + a_{32}x_2 + \ldots a_{3j}x_j + \ldots a_{3n}x_n \leq b_3 \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1}x_1 + a_{m2}x_2 + \ldots a_{mj}x_j + \ldots a_{mn}x_n \leq b_m \text{ or } \sum_{\substack{j=1 \\ j=1}}^{n} a_{ij}X_j \leq b_i \quad \dots \dots \dots \\ j=1 \end{array}$ (2)Explanation:

 $i = 1, 2, 3 \dots$ m is the number of limitation factors

 $j = 1, 2, 3 \dots$ n is the number of production activity

Activity was not negative: $xj \ge 0$ for all j

Z = objective function which is the income of maximized cow-calf beef cattle

Farmers and paddy

C = production prices (C) and input prices (-C)

xj = production and consumption activities carried out by households of cow-calf beef cattle and paddy farmers

aij = input coefficient of each production and consumption activity

bij = value of constraints or the available resource limits

Referring to the research objectives the are basic components can be formulated as follows:

1. Objective function

The objective function (Z) in this study is to maximize the income of cow-calf beef cattle and paddy farmers from various alternative activities with existing resource constraints.

2. Alternative Activity Model

Some of activities carried out in this study include: (1) farming - livestock production activities; (2) purchasing production facilities; (3) hiring of workers; (4) sales of products; (5) consumption expenditure (food and non-food)

RESULTS AND DISCUSSION

Overview of Grobogan Regency

The livelihood of Grobogan residents are generally dominant in agriculture. This is due to the potential of Grobogan Regency which mostly dominated by agricultural land. Based on the results of population in 2017, it was noted that the population working in the agricultural sector amounted to 52.5%. One of the main capital in the development is labor. In line with the ongoing demographic process, the number and composition of the labor will continue to change. (BPS, 2018)

In Grobogan Regency, land conversion from agricultural to non-agricultural land is increasing, but the potential of agricultural sector until now is still dominant in supporting the economic sector of Grobogan Regency. In 2017, about 84.91% of the total area in Grobogan Regency was used for agricultural activities. The production of lowland paddy of Grobogan Regency in 2017 experienced a significant increase compared to the previous year. This year, the production of lowland paddy reached 786,040 tons with a harvested area of 123,446 ha. While for upland paddy, the production reached 13,267 tons with a harvested area of 3,489 hectares. On the other hand, corn production reached 700,941 tons with a harvest area of 112,700 ha. The

population of livestock in Grobogan Regency in 2017 generally increased compared to the previous year. The population of livestock consisted of 365 dairy cows, 178,555 beef cattle, 2,457 buffaloes, and 494 horses. Many livestock in Grobogan Regency are sent out of the area to meet the demand of other regions. In 2017, the number of livestock sent out from Grobogan Regency reached 30,108 cattle and 3,634 buffaloes. (Table 1)

Respondents were majority consisted of farmers in their productive age (85%) with 100% working as farmers and 57.50% of them were primary school with the farm experience was 34% around 20 years; while the average land tenure was 0.45 ha and averagedly the livestock ownership was 1.54 animal unit (AU). This condition can affect production, both in cow-calf and paddy farming. (Table 2)

Increasing education is the most important factor in Indonesian development, if it seen from the population perspective, both as the object of development as well as the subject of development. The success of the development in an area can be indicated by the high level of education of its population. This is surely correlated to the educational facilities available in the area. The livelihoods of residents in Grobogan Regency are still dominant in agriculture. This is due to the potential area of Grobogan Regency which still dominated by agricultural land. Based on the results of population projection in 2015, it was noted that the population working in the agricultural sector amounted to 56.0 percent, trade 17.5 percent, transportation 8.6 percent, and the rest worked in the services, plantation, industry, fisheries, and other sectors (BPS, 2018)

Analysis of Costs and Income of Cow-Cal Beef Cattle and Paddy Farming

The use of production factors on farming will cause a cost, both variable costs and fixed costs. Costs for variable input expenditures include seeds, fertilizers, pesticides, non-family labor, and other costs such as irrigation costs, farmer group fees and loan interest. In addition, farmers also pay fixed costs such as land rent, tractor rent, depreciation of capital goods (hoe, hand sprayer, sickle, and *sosrok*), and land tax. All costs are stated in rupiah, the amount of which is based on the price at the time the transaction takes place. (Table 3)

Farmers with 1.54 AU of cow-calf beef cattle operations require a production cost of IDR. 8,095,927.19 per year with the highest cost of IDR. 3,760,560 (46.45%) allocated for forage cost. Labor cost is also incurred by many farmers, considering the scarcity of family labor, so it is necessary to allocate this cost, which amounted to IDR. 3,274,875.00 (40.45%). The highest cost

in paddy farming was the labor cost. Today, agricultural labor is an important asset, given the number is increasingly scarce in the countryside. This is what makes the high wages of labor so that farmers have to pay more for labor costs (Maryanto *et al.*, 2015). The production cost of paddy farming per hectare was IDR. 15,584,121.5, - per year where farmers cultivated paddy crops two times in one year.

Revenue for cow-calf beef cattle was IDR. 6,680,937.5 and livestock value added was IDR. 2,436,037.5. Thus, the income of cow-cal was IDR. 9,116,975,-/year with the cost incurred of IDR. 8,095,927.19 and income of IDR. 1,041,860.32/year/1.54 AU or IDR. 86,821.69/month/1.54 AU. It's a very small value to support the farmer's daily life. Whereas, revenue of paddy farming in the form of harvested dried rice for a year with 2 planting seasons was 6,187.5 tons/ha harvest. the price of paddy was IDR. 4.000,-/kg then farmer's revenue was IDR. 24,750,000/0.45ha/season, or IDR. 49,500,000/ha/year, with an income of IDR. 33,915,878/ha/year or IDR 2,826,323.2/ha/month. Based on the farm income, the profitability of cow-cal beef cattle and paddy farm were 1.2% and 217.63%, respectively. This showed that the farmer's household is more supported by the results of paddy farming, as Mukhlis *et al.* (2018) said that integrated of livestcok and farming system can increase income and profitability of farmer's household which paddy farm is dominant for household income.

Optimation Analysis

The results of optimization analysis will illustrate the results of optimal solutions by using resources describing the optimal solution of linear programming analysis which incude: (1) validation of optimal solution values, 2) farm household income from optimal solutions, (3) optimal allocation of farmer's household resources and beef cattle farm activities as well as the level of constraints and shadow prices of resources. (Nasendi and Anwar, 1985 and Ryschawy *et al.*, 2017)

Optimation of cow-calf beef cattle farming and paddy describes the farm system with the farm household approach. The farm household approach is implemented because the farmerbreeder's livelihood is not independent as farmers or breeders alone, but both activities are integrated in one household. On one hand, farmers can be seen as producers and on the other hand as consumers. Farmers-breeders as producer means that farmers-breeders will maximize income from a number of activities, while as consumer, farmers-breeders will consume goods either from their own production or purchased for family consumption. Results of research showed that optimal condition of cow-calf beef cattle and paddy integrated farming system were 2.75 AU of local cow s of the year 1, 1.483 AU of non local livestock raising pattern and 0.45 ha land harvested of paddy. In maximizing income was IDR 52,122,440 in 3 years. In this term, farmers are faced with challenges on land, labor, and capital. This is consistent with Rohaeni *et al.* (2014) and Tawaf *et al.* (2017) that the farmer's problems in the application of optimation of agricultural patterns are capital, land, labor, and price fluctuation.

Validation the Value of The Optimal Solution

Model validation is the first step that needs to be done in the analysis of optimization of household resource allocation. The results of the validation of linear programming models are conducted to determine whether the model used in the analysis is valid. The results of model validation showed the optimal conditions of the state of the resource or household activities of farmers. The optimal analysis model is valid if the optimal value is at the confidence interval. The results of the validation of the model of household resources of farmers are presented in Table 4.

The results of the validation of the optimization model it was known that the resources and activities carried out by the household are in a confidence interval, namely the optimal conditions for cow-claf beef cattle was 2.75 located between 2.612 - 2.887 at the confidence interval, while the land optimal condition was achieved at 0.45 with the confidence interval was 0.428 - 0.473. It mean that the model used is valid. If there is a change in resources or activities outside the confidence interval, it will cause changes in optimal conditions. Conversely, if the change is still at a confidence interval, it certainly will not change the optimal conditions. Based on the results of the linear program, it was known that rearing of local cow-calf beef cattle and non-local cow-calf cattle and also paddy farming obtained optimal values and are in confidence intervals. The optimum capital use was achieved in year 1, which is IDR 4,500,000. While the use of agricultural land for paddy commodities is known to be optimal conditions in year 1, 2 and 3. The use of family labor labor showed optimal use and results are within the confidence interval. The use of an optimal workforce showed that if farmer households need labor, the workforce must be met from outside the family. Food and non-food consumption has also shown optimal conditions and is at the dividend interval. It met with Maryanto et al., 2015 that there was relationship between production decisions, allocation of labor farming and consumption decisions in households of integrated farming systems of beef cattle and paddy. After the optimation analysis is carried out, the answer to the hypothesis is that the main source of livestock, land and labor has been allocated optimally. Therefore, these resources can be said to be a limiting factor/farm constraints because the resources used are used up. (Table 4)

The Validation results of optimal analysis model on farmers household activities in Grobogan Regency showed that the optimal condition for cow-calf beef cattle of 2.75 AU and agricultural land use was 0.45ha. From cow-calf beef cattle and paddy farming activities, the optimal labor was achieved at 80.415 work day and capital for each period of IDR. 4,500,000,-The results of income maximization obtained by farmers-breeders households amounted to IDR. 52,122,440,00 per year.

Simulation of Optimal Conditions

Optimation analysis model of resource allocation for farmers household showed valid results and optimal conditions are achieved. Therefore, a simulation is carried out to find out whether there is a change in the objective function or constraints. This was taken to find out how much there has been a change in farming-cow-calf beef cattle and income of farmers households in order to keep in optimal condition, if there are changes in land resource constraints and input prices.

Livestock resources are not simulated for changes in increase because the limit value of the cattle resources has reached its optimum condition at 2.75 AU. Thus, if there is any addition made, then other resources will not support it, especially labor. This is because the existing labor has another activity, i.e. paddy farming. Therefore, simulations are carried out on the rising of input prices both for cow-calf beef cattle and paddy farming, with a change of 10% without an increase in output prices. While the increase of input prices was based on field conditions, where the price of animal feed was tend to rise with variation in increase around 10%. Changes occured from the simulation results are presented in Table 5

The simulation results showed that 0.25% addition in land area, namely from 0.45 ha to 0.6 ha gave a change in the scale of livestock farm of 0.018% and income of 14.78%, i.e. from IDR 52,112,440,- to Rp 61,152,910,-. Changes in the optimal solution results of the simulation indicated that farmers have the ability to develop their farms. (Table 6). This is in accordance with Maryanto *et al.* (2015) that if optimal conditions are reached and simulations are carried out with

changes in the use of land and price limiting factors then the optimal conditions are reached and farmers are still able to do the integration farming system.

It also can be seen that there is an increase in the area of labor resources needed, meaning that the addition of land area is still possible to be managed by farmers. The increase of input prices with fixed output prices that are counter balanced by an increase in land area results in an optimal change in income solutions, i.e. an increase in income. An increase in income resulting from the optimal solution is possible because an increase in input prices of 10% can still be counter balanced by the results of farming sales; given the addition of farm scale will result in production as the source of revenue. It can be noted from the simulation results that the optimal solution showed the ability of the farmers in managing their farming and livestock. The simulation showed the farmers ability to manage their farm if there is an increase in the land area scale, but input and output prices are fixed. This is consistent with Karmini and Syarifah (2008) and Howara (2011) that land area will affect farming production and profits. Determining the right amount of optimal land is one way to increase production with the aim of achieving maximum profits. An increase in the amount of farmers' income is also still possible by making changes to the use of land inputs, so that productivity increases and ultimately increases the income. In addition, the ability to manage land for farming is generally also influenced by the availability of labor and capital, as stated by Khalik et al. (2013). As in optimal conditions, labor in the farmer's household is used up to manage his farm.

CONCLUSION

Based on the study results, it can be concluded that:

- The optimal condition is obtained on cow-calf beef cattle of 2.75 AU and a land area of 0.45 ha.
- 2. The maximum income of farmer households was IDR. 52,112,440/year.
- 3. The simulation results of changes in input use indicated that the addition of land area of 0.25%, i.e. from 0.45 ha to 0.6ha results in a change of 0.018% in the scale of cow-calf farm and income of 14.78%, i.e. from IDR. 52,112,440,- to IDR. 61,152,910,-. Changes in the results of the optimal solution in the simulation indicated that farmers have the ability to develop their farms.

REFERENCES

- Basuni, R., Muladno, C. Kusmana and Suryahadi. 2010. Model sistem integrasi padi-sapi potong di lahan sawah. Forum Pascasarjana. 33(3):177-190
- BPS. 2018. Grobogan Dalam Angka 2018.
- Darith, S., S. Xu, W. Yu and A. A. Gafar. 2016. Optimization model of cattle Husbandry for rural household in Cambodia. Journal of Agricultural Chemistry and Environment.5:6-11
- Howara, D. 2011. Optimalisasi pengembangan usahatani tanaman padi dan ternak sapi secara terpadu di Kabupaten Majalengka. J. Agroland 18 (1) : 43 49.
- Hutasoit, D.D.P.I. 2008. Pengaruh kegiatan optimasi lahan terhadap Pengembangan wilayah di Kabupaten Simalungun (Studi Kasus Nagori/Desa Naga Saribu, Kecamatan Pamatang Silima Huta). Wahana Hijau. Jurnal Perencanaan & Pengembangan Wilayah. 4(2):51-58.
- Karmini and A.A. Syarifah. 2008. Optimalisasi lahan usahatani tomat dan mentimun dengan kendala tenaga kerja (pendekatan program linier). EPP.5(2):44-50.
- Khalik R, Safrida, and A.H. Hamid. 2013. Optimasi pola tanam usahatani sayuran selada dan sawi di daerah produksi padi (Studi Kasus di Desa Lam Seunong, Kecamatan Kota Baro, Kabupaten Aceh Bes.,
- Martin, G., M. Moraine, J. Ryschawy, M. A. Magne, M. Asai, J. P. Sarthou, M. Duru and O. Therond. 2016. Crop–livestock integration beyond the farm level: a review. Agron. Sustain. Dev. 36:53.
- Masayasu, A., M. Moraine, J. Ryschawy, J. de Witd, A.K. Hoshidee and G. Martinc. 2018. Critical factors for crop-livestock integration beyond the farm level: A crossanalysis of worldwide case studies. Land Use Policy 73:184-194
- Mariyanto, J.,R. Dwiastuti and N. Hanani. 2015. Model ekonomi rumahtangga pertanian lahan kering di Kabupaten Karanganyar Provinsi Jawa Tengah. Habitat, 26 (2):108-118
- Minh, Th., S. Ranamukhaarachchi and H. Jayasuriya. 2007. Linear Programming-based optimization of the productivity and sustainability of crop-livestock-compost manure integrated farming systems in Midlands of Vietnam. ScienceAsia 33:187-195
- Mukhlish, M. Noer, Nofialdi and Mahdi. 2015. Analisis usahatani integrasi padi sapi potong. Jurnal Penelitian Lumbung, 14(1):1-10
- Mukhlis, M. Noer, Nofialdi and Mahdi. 2018. The integrated farming system of crop andlLivestock: A Review of Rice and Cattle Integration Farming. International Journal of Sciences: Basic and Applied Research (IJSBAR). 42(3): 68-82

Nasendi, B. D. and A. Anwar. 1985. Program Linear dan Variasinya. PT. Gramedia.

- Ponnusamy, K. and M.K. Devi. 2017. Impact of integrated farming system approach on doubling farmer's income. Agricultural Economics Research Review. 30:233-240
- Priyanti, A., B.M. Sinaga, Y. Syaukat and S.U. Kuntjoro. 2007. Model ekonomi rumahtangga petani pada sistem integrasi tanaman-ternak: Konsepsi dan studi empiris. WARTAZOA 17(2):61-70
- Regan, J. T., S. Martonc, O. Barrantes, E. Ruanef, M. Hanegraaf, J. Berland, H. Korevaar, S. Pellerina and T. Nesme. 2017. Does the recoupling of dairy and crop production via cooperation between farms generate environmental benefits? A case-study approach in Europe. Europ. J. Agronomy. 2016:15
- Rohaeni, E. S., B. Hartono, Z. Fanani and B. A. Nugroho. 2014. Sistem usaha tani terintegrasi tanaman-ternak sebagai respons petani terhadap faktor risiko. Journal of Economics and Sustainable Development. 5(1):159-168.
- Ryschawy, J., G. Martin, M. Moraine, M. Duru and O. Therond. 2017. Designing crop–livestock integration at different levels: Toward new agroecological models? Nutrient Cycling in Agroecosystems. 108(1):5-20.
- Soedjana, T.D. 2007. Sistem usaha tani terintegrasi Tanaman-ternak sebagai respons petani terhadap faktor risiko. Jurnal Litbang Pertanian, 26(2):82-87.
- Tawaf, R., M. Paturochman, L. Herlina, M. Sulistyati and A. Fitriani. 2017. The optimation of farmers families' revenue the integration of Pasundan cattle and paddy farming in West Java. J. Indonesian Trop. Anim. Agric. 42(4):270-278.

Commodity	Harvested area	Production
	ha	tons
Paddy		
- Lowland	123,446	786,040
- Upland	3,489	13,267
Corn	112,700	700,941
	Population	
	head	
Beef cattle	178,555	
Dairy cows	365	
Buffaloes	2,457	
Horses	494	

Table 1. The Agriculture Potential Commodities in Grobogan

Source : BPS Central Java, 2018

Table 2. 1	Number and	Percentage	of Farmer	's Household	l Profile
------------	------------	------------	-----------	--------------	-----------

No.	Profile	Number	Percentage (%)
			%
1.	Age (year)		
	■ ≤17	0	0.00
	■ 18-60	68	85.00
	■ ≥ 61	12	15.00
2.	Main livelihood		
	 Farmer 	80	100.00
	 Village Officials 	0	0.00
	 Entrepreneur 	0	0.00
3.	Education		
	Primary School	46	57.50
	 Junior High School 	22	27.50
	 Senior High School 	12	15.00
4	Farming Experience (year)		
	■ 6-10	12	15.00
	■ 11 – 20	32	40.00
	■ > 20	36	45.00
5	Land tenure (ha)		
5.	■ < 0.25	5	6.25
	• 0.25 – 0.5	48	60.00
	 > 0.5 	27	33.75
6.	Number of Cattle (head)		
	■ <3	10	12.5
	3 -4	55	68.75
	■ > = 5	15	18.75

Table 3. Income of Cow-Calf Beef Cattle and Paddy Farming

Components	Beef Cattle Farming Income	Rice Farming Income
	IDR/1.54 AU/year	IDR/ha/year
Revenue	9,116,975.00	49,500,000.00
Cost	8,095,927.19	15,584,121.50
Income	1,041,860.32	33,915,878.50

Source: Primary Data Analysis

	Validation Model		
Activities	Optimal	Confidence Interval	
	Condition	(α=95%)	
Local livestock raising pattern (AU)		\$ *	
 Local cows of the year 1 	2.750	2.612 - 2.887	
 Non Local livestock raising pattern (AU 	1.483	1.408 - 1.557	
Sale of local female calves			
 Sales of local calves in year 1 	5.500	5.225 - 5.775	
 Sales of local calves in year 2 	2.750	2.612 - 2.887	
 Sales of local calves in year 3 	2.750	2.612 - 2.887	
Sale of local male calves			
 Sales of local male calves in year 1 	1.483	1.409 - 1.557	
 Sales of local male calves in year 2 	1.483	1.409 - 1.557	
 Sales of local male calves in year 3 	1.483	1.409 - 1.557	
Use of agricultural land (ha)			
 Paddy in year 1 	0.45	0.428 - 0.473	
 Paddy in year 2 	0.45	0.428 - 0.473	
 Paddy in year 3 	0.45	0.428 - 0.473	
Capital Requirements in year 1	4,500,000		
Paddy sales (kw)			
 Paddy sales in year 1 	28.435	27.013 - 29.857	
 Paddy sales in year 2 	28.408	26.987 - 29.828	
 Paddy sales in year 3 	28.435	27.013 - 29.857	
Family labor (working day)			
 Family workforce in year 1 (working day) 	80.415	76 394 - 84 436	
 Family workforce in year? (working day) 	80.415	76.394 - 84.436	
 Family workforce in year 3 (working day) 	80.415	76 394 84 436	
Consumption expenditure	00.115	70.391 01.130	
 Food consumption in year 1 	4 070 545 00	3 867 017 75 - 4 274 072 25	
 Food consumption in year 2 	4.153.825.00	3.946.133.75 - 4.361.516.25	
 Food consumption in year 3 	4.886.500.00	4.642.175.00 - 5.130.825.00	
 Non-food consumption Year 1 	3.516.549.30	3.340.721.55 - 3.692.376.45	
 Non-food consumption Year 2 	3.588.315.60	3.408.899.82 - 3.767.731.38	
 Non-food consumption Year 3 	3,642,960.00	3,460,812.00 - 3,825,108.00	
Income in year of 1-3 (IDR)	52,122,440.0	,	

Table 4. The Results of The Optimal Validation Model of Household Resources

Note : confidence interval at $\alpha = 5\%$

Table 5.	Simulation of Optimal Condit	ions on Farmers	' Households in the
	Research Area		

Types of Scenario		Expected Results
Changes in farming land resources	 The greatest increase in the paddy farming scale managed by farmers from 0.45 ha to 0.6 ha Other resource constraints are considered unchanged / fixed Inputs and output prices are considered unchanged / fixed 	 Farm scale increases due to land expansion Increase in farmers' income Changes in optimal farm patterns
Increases in Input prices	 Increase in input prices based on the highest price change, which is around 10% Other resource constraints are considered unchanged / fixed 	 Changes of income in farmers - breeders household Changes in optimal conditions
	 Output prices are unchanged / fixed 	

Table 6. Simulation Results 1 Regarding Changes in Animal Resource Constraints on Farmers' Households in the Research Area

Resources	Optimal Condition	Simulation Results	Percentage of
	-	1	Change (%)
Land	0.48	0.6	0.25
Local cattle	2.75	2.80	0.018
Labor	80.415	80.415	No change
Income	52,112,440.00	61,152,910.00	14.78

2.Attachment 2. Author Declaration, February 11, 2020





AUTHOR DECLARATION FORM (Journal of the Indonesian Tropical Animal Agriculture)

We, the undersigned authors of the manuscript entitled:

"The Optimation Of Cow-Calf Beef Cattle And Paddy Farm Integration On Farmer Household In Grobogan Regency"

hereby declare the authors responsibility, source of funding and copy right statement in order to publish the article in Journal of the Indonesian Tropical Animal Agriculture (JITAA).

- 1. Authors Responsibility
 - The manuscript is not previously published or is not being considered for publication elsewhere.
 - We have approved the content of the manuscript.
 - We follow the format of JITAA (see Guide for Authors and Template for Manuscript)
 - The corresponding author is responsible for publication fee.
- 2. Source of Funding

The source of funding for study (contract number and year of funding): Surat Penugasan Pelaksanaan Penelitian No. 275-048/UN7.5.1/PG/2017 Tanggal 23 Maret 2017 Penelitian Riset Pengembangan dan Penerapan Tahun Anggaran 2017.

3. Copyright Statement Agreement

The copyright of an article is transferred to the Journal of the Indonesian Tropical Animal Agriculture (JITAA), when the article is accepted for publication.



3.Attachment 3 . Manuscript Review, May 10, 2020



Thank You.



28408-8176 ... doc.

Manuscript Review

Optimation of cow-calf beef cattle and paddy farming integration (Ekowati et al.)

The optimation of cow-calf beef cattle and paddy farming integration on farmer household In Grobogan Regency

ABSTRAK

Rumahtangga petani umumnya berusahatani pada sub-sektor pertanian tanaman pangan dan sub-sektor peternakan yang belum dilaksanakan dengan baik, sehingga kondisi optimal usahatani belum dicapai. Penelitian bertujuan untuk menganalisis optimasi integrasi sapi potong dan padi, simulasi perubahan harga input dan penggunaan sumberdaya terhadap model optimal. Metode survey digunakan dalam penelitian di Kabupaten Grobogan, dengan menentukan Kecamatan Wirosari dan Kecamatan Purwodadi. Quota sampling method digunakan untuk menentukan jumlah sampel peternak sapi potong induk-anak dan petani padi tanpa menghitung jumlah populasi sebagai sampling frame. Jumlah responden setiap kecamatan adalah 40 petani sehingga total responden 80 petani. Data dianalisis dengan linear programming. Hasil penelitian menunjukkan bahwa kondisi optimum skala usaha integrasi sapi potong dan padi dicapai pada luas lahan 0,45 ha, pemeliharaan induk sapi potong 2.75 UT dengan maksimum pendapatan Rp 52.112.440/tahun. Hasil simulasi perubahan penggunaan input menunjukkan bahwa penambahan luas lahan 0,25% memberikan peningkatan skala usaha sapi potong 0,018% dan pendapatan 14,78%, Kesimpulan optimasi integrasi sapi potong dan padi dicapai pada luas lahan 0,45ha dan induk sapi potong 2.75 UT dan simulasi solusi optimal menunjukkan bahwa petani mempunyai kemampuan untuk mengembangkan usahataninya.

Kata kunci : integrasi, optimasi, padi, pendapatan, sapi potong

ABSTRACT

Farmer households generally operate food crops and livestock subsectors that have not fully implemented well, so an optimal farming has not been achieved. This study aimed to analyze optimation of beef cattle and paddy farming integration and simulation changing in input prices and the usage of resources to the optimal model. Survey method was used in the research in Grobogan District by determining Wirosari District and Purwodadi District. Quota sampling method is used to determine the number of samples of farmers without counting the population as a sampling frame. The number of respondents in each district was 40 farmers so the total respondent was 80 farmers. Data were analyzed using linear programing. Results showed that optimum conditions of integration were achieved in 0.45ha land, 2.75 AU of beef cattle with maximum income of IDR 52,112,440/year. The simulation results regarding in changing in input usege indicated that the addition of 0.25% land area gives a change in scale of beef cattle to 0.018% and income of 14.78%. In conclusion, integration optimation was achieved on 0.45ha land, 2.75 UT beef cattle and optimal solution simulations indicated that farmers have the ability to develop their farming.

Keywords: beef cattle, integration, income, optimation, paddy

INTRODUCTION

Beef cattle and paddy farmings are forms of farm activity pursued by many people in Central Java. The meaning contained in these farm activities is how beef cattle and paddy farming are run by farm households to get better results, both in terms of farm scale and income. The policy regarding beef cattle and paddy farming development is basically has a correlative and synergistic Commented [MS1]: Regency?

Commented [MS2]: Respondents

Commented [MS3]: by

relationship, considering that agricultural waste is substantially raw material (feed) for livestock farm. Farmer households use integrated farming system in developing agriculture, considering that besides providing economic benefits, this pattern also provides benefits in land conservation and land productivity. This is in line with Soedjana (2007) and Hutasoit, D.D.P.I. (2008) that the reason why farmers choose mixed farming or integration is because of habits (tradition), to maximize revenue from limited resources, and increase benefits of correlation between integrated farming patterns in the food crop sub-sector and livestock sub-sector, which will encourage the development of food crops especially paddy and livestock and create investment opportunities. This is also supported by Basuni *et al.* (2010), Mukhlis *et al.* (2015) and Ponnusamy and Devi, 2017 that the integration of farming systems can provide both ecological and economic benefits because the waste from each commodity can be used as an input factor, so that it can save the use of cost and can increase income. Another research by Darith *et al.* (2016) indicated that activities carried out by farmers in the integration model can increase farmer income which in turn can increase investment in farming

Farmer households can be seen as a unit of farm activity consisting of production, activities and labor services activities. All of these activities are a unity, so that farmer's household cannot be seen as a pure consumer because there is a portion of the production that is consumed and partly sold as capital. Likewise in the labor use, farmers-breeders, labor can come from within the family or outside the family. Thus, farmer households can be said to be producers and consumers (Priyanti, 2007).

Integration of beef cattle and paddy based on the scale of farm that the number of livestock and land area can provide some form of integration (Matin *et al*, 2016). Integration can

Commented [MS4]: Hutasoit

take the form of an exchange relationship between livestock and paddy which can be in the form of fertilizer and forage (Regan *et al.*, 2017)

Integrated farming systems, in Grobogan, which is managed by farmer's household generally consist of beef cattle, especially cow-calf rearing, and paddy farm. Farm households usually face constraints on land and cow-calf resource constraints. These constraints are in accordance with by Basuni *et al.* (2010) statement that in West Java, the integration of beef cattle and paddy is contained in land boundaries and livestock numbers. Therefore, the optimal allocation of resource use in the integration of cow-calf and pady needs to be assessed.

Allocation of resource use controlled by farmers is very important, because non-optimal resource use means a cost for farming management. As a result, the profits generated for farmer as farming manager becomes are optimal (A. Masayasu *et al.*, 2018). Allocation of the use of production factors that provide optimal results can be analyzed by linear programming.

Analysis using linear programing can provide information for agricultural policy makers regarding: (a) the structure of related relationships and the costs of comparative advantage in agricultural sector; (b) production potential; (c) job opportunities; (d) consistency of every alternative agricultural policy. (Minh *et al.*, 2007)

Linear programing is a method that is more systematic and mathematically rigorous for determining the optimum combination of farm sectors or contributions such as revenue maximization or cost minimization with limited available resources (Darith *et al.* (2016). From the study results, it is expected that an allocation model for an optimal use of production factors can be created, so that it can benefits for farmers. Based on the bacground, the objective of the study were to develop an optimation for beef cattle and paddy farm integration and simulate changes in input prices and resources use to optimal model.

Commented [MS5]: programming

Commented [MS6]: font 11?

MATERIAL AND METHODS

The study was conducted by using a survey method to determine the condition of farmer households, especially cow-calf cattle farming and paddy farming in managing their farm integration. Survey method is a method of taking respondents by determining a sample of the existing population. (Singarimbun dan Effendi, 1995)

Purposive method was used to determine the study location based on potential of the most populated area by beef cattle and paddy production in Central Java. Based on data on Agricultural and Animal Husbandry Statistics in 2017, it is known that Grobogan is regency with a potential combination of beef cattle and paddy and farming from the planting area and paddy production aspects as well as the raising of beef cattle in Central Java. Based on regency location, there were 2 districts selected where two villages were taken in each district based on several indicators such as the highest number of beef cattle population, paddy production and farmer group activities. Based on the purposive results, districts selected for the study were Wirosari District, consist of Karangasem Village and Sambirejo Village, and Purwodadi District with Nambuhan Village and Genuksuran Village.

Quota sampling method was conducted to determine the sample number of cow-calf cattle and paddy farmers without counting the population as a sample frame. The sample number of cowcalf beef cattle and paddy farmers from each village were 20 farmers, so the total number of respondents was 80 farmers households.

The method used to analyze the objectives was linear programming and descriptive analysis. From this model, cow-calf beef cattle and paddy farmers can be considered as cow-calf beef cattle and paddy producers that produce livestock and paddy supply continuously from optimal allocation of resources. Thus, the objective function in this linear programming research Commented [MS7]: It is better to get the latest one

Commented [MS8]: Why don't the researchers get the latest data

Commented [MS9]: Too much "and"

village

Commented [MS10]: Why did the researchers select only two districts and two villages??what sampling method did you use? Commented [MS11]: The highest usually pointed only one

Commented [MS12]: May explain, why did researcher choose 20 farmers from each village

model was to maximize household income in term of integration cow-calf beef cattle and paddy

farming.

The mathematical form of the Linear Programing model that maximizes the objective

function in general is:	 Commented [MS13]: Any reference for this formula?

n

Maximum $Z = C_1X_1 + C_2X_2 + C_3X_3 \dots + C_jX_j - \dots + C_nX_n$ or $Z = \sum_{j=1}^{n} C_jX_j \dots$ (1)

With constraint:

 $\begin{aligned} a_{11}x_1 + a_{12}x_2 + \dots & a_{1j}x_j + \dots & a_{1n}x_n \le b_1 \\ a_{21}x_1 + a_{22}x_2 + \dots & a_{2j}x_j + \dots & a_{2n}x_n \le b_2 \end{aligned}$

 $a_{31}x_1 + a_{32}x_2 + \dots a_{3j}x_j + \dots a_{3n}x_n \le b_3$

Explanation:

 $i = 1, 2, 3 \dots$ m is the number of limitation factors

 $j = 1, 2, 3 \dots$ n is the number of production activity

Activity was not negative: $xj \ge 0$ for all j

Z = objective function which is the income of maximized cow-calf beef cattle

Farmers and paddy

- C = production prices (C) and input prices (-C)
- xj = production and consumption activities carried out by households of cow-calf beef cattle and paddy farmers
- aij = input coefficient of each production and consumption activity
- bij = value of constraints or the available resource limits

Referring to the research objectives the are basic components can be formulated as follows:

3. Objective function

The objective function (Z) in this study is to maximize the income of cow-calf beef cattle

and paddy farmers from various alternative activities with existing resource constraints.

4. Alternative Activity Model

Some of activities carried out in this study include: (1) farming - livestock production activities; (2) purchasing production facilities; (3) hiring of workers; (4) sales of products; (5) consumption expenditure (food and non-food)

RESULTS AND DISCUSSION

Overview of Grobogan Regency

The livelihood of Grobogan residents are generally dominant in agriculture. This is due to the potential of Grobogan Regency which mostly dominated by agricultural land. Based on the results of population in 2017, it was noted that the population working in the agricultural sector amounted to 52.5%. One of the main capital in the development is labor. In line with the ongoing demographic process, the number and composition of the labor will continue to change. (BPS, 2018)

In Grobogan Regency, land conversion from agricultural to non-agricultural land is increasing, but the potential of agricultural sector until now is still dominant in supporting the economic sector of Grobogan Regency. In 2017, about 84.91% of the total area in Grobogan Regency was used for agricultural activities. The production of lowland paddy of Grobogan Regency in 2017 experienced a significant increase compared to the previous year. This year, the production of lowland paddy reached 786,040 tons with a harvested area of 123,446 ha. While for upland paddy, the production reached 13,267 tons with a harvested area of 3,489 hectares. On the other hand, corn production reached 700,941 tons with a harvest area of 112,700 ha. The population of livestock in Grobogan Regency in 2017 generally increased compared to the previous year. The population of livestock consisted of 365 dairy cows, 178,555 beef cattle, 2,457 buffaloes, and 494 horses. Many livestock in Grobogan Regency are sent out of the area to meet

Commented [MS14]: It is better to be consistent, regency/district

the demand of other regions. In 2017, the number of livestock sent out from Grobogan Regency reached 30,108 cattle and 3,634 buffaloes. (Table 1)

Respondents were majority consisted of farmers in their productive age (85%) with 100% working as farmers and 57.50% of them were primary school with the farm experience was 34% around 20 years; while the average land tenure was 0.45 ha and averagedly the livestock ownership was 1.54 animal unit (AU). This condition can affect production, both in cow-calf and paddy farming. (Table 2)

Increasing education is the most important factor in Indonesian development, if it seen from the population perspective, both as the object of development as well as the subject of development. The success of the development in an area can be indicated by the high level of education of its population. This is surely correlated to the educational facilities available in the area. The livelihoods of residents in Grobogan Regency are still dominant in agriculture. This is due to the potential area of Grobogan Regency which still dominated by agricultural land. Based on the results of population projection in 2015, it was noted that the population working in the agricultural sector amounted to 56.0 percent, trade 17.5 percent, transportation 8.6 percent, and the rest worked in the services, plantation, industry, fisheries, and other sectors (BPS, 2018)

Analysis of Costs and Income of Cow-Cal Beef Cattle and Paddy Farming

The use of production factors on farming will cause a cost, both variable costs and fixed costs. Costs for variable input expenditures include seeds, fertilizers, pesticides, non-family labor, and other costs such as irrigation costs, farmer group fees and loan interest. In addition, farmers also pay fixed costs such as land rent, tractor rent, depreciation of capital goods (hoe, hand sprayer,

Commented [MS15]: Is taken from central bureau statistics of Indonesia?

Commented [MS16]: Cow calf?

sickle, and *sosrok*), and land tax. All costs are stated in rupiah, the amount of which is based on the price at the time the transaction takes place. (Table 3)

Farmers with 1.54 AU of cow-calf beef cattle operations require a production cost of IDR. 8,095,927.19 per year with the highest cost of IDR. 3,760,560 (46.45%) allocated for forage cost. Labor cost is also incurred by many farmers, considering the scarcity of family labor, so it is necessary to allocate this cost, which amounted to IDR. 3,274,875.00 (40.45%). The highest cost in paddy farming was the labor cost. Today, agricultural labor is an important asset, given the number is increasingly scarce in the countryside. This is what makes the high wages of labor so that farmers have to pay more for labor costs (Maryanto *et al.*, 2015). The production cost of paddy farming per hectare was IDR. 15,584,121.5, - per year where farmers cultivated paddy crops two times in one year.

Revenue for cow-calf beef cattle was IDR. 6,680,937.5 and livestock value added was IDR. 2,436,037.5. Thus, the income of cow-cal was IDR. 9,116,975,-/year with the cost incurred of IDR. 8,095,927.19 and income of IDR. 1,041,860.32/year/1.54 AU or IDR. 86,821.69/month/1.54 AU. It's a very small value to support the farmer's daily life. Whereas, revenue of paddy farming in the form of harvested dried rice for a year with 2 planting seasons was 6,187.5 tons/ha harvest. the price of paddy was IDR. 4.000,-/kg then farmer's revenue was IDR. 24,750,000/0.45ha/season, or IDR. 49,500,000/ha/year, with an income of IDR. 33,915,878/ha/year or IDR 2,826,323.2/ha/month. Based on the farm income, the profitability of cow-cal beef cattle and paddy farm were 1.2% and 217.63%, respectively. This showed that the farmer's household is more supported by the results of paddy farming, as Mukhlis *et al.* (2018) said that integrated of livestcok and farming system can increase income and profitability of farmer's household which paddy farm is dominant for household income.

Commented [MS17]: 4,000

Optimation Analysis

The results of optimization analysis will illustrate the results of optimal solutions by using resources describing the optimal solution of linear programming analysis which incude: (1) validation of optimal solution values, 2) farm household income from optimal solutions, (3) optimal allocation of farmer's household resources and beef cattle farm activities as wel as the level of constraints and shadow prices of resources. (Nasendi and Anwar, 1985 and Ryschawy *et al.*, 2017)

Optimation of cow-calf beef cattle farming and paddy describes the farm system with the farm household approach. The farm household approach is implemented because the farmerbreeder's livelihood is not independent as farmers or breeders alone, but both activities are integrated in one household. On one hand, farmers can be seen as producers and on the other hand as consumers. Farmers-breeders as producer means that farmers-breeders will maximize income from a number of activities, while as consumer, farmers-breeders will consume goods either from their own production or purchased for family consumption. Results of research showed that optimal condition of cow-calf beef cattle and paddy integrated farming system were 2.75 AU of local cow s of the year 1, 1.483 AU of non local livestock raising pattern and 0.45 ha land harvested of paddy. In maximizing income was IDR 52,122,440 in 3 years. In this term, farmers are faced with challenges on land, labor, and capital. This is consistent with Rohaeni *et al.* (2014) and Tawaf *et al.* (2017) that the farmer's problems in the application of optimation of agricultural patterns are capital, land, labor, and price fluctuation.

Validation the Value of The Optimal Solution

Model validation is the first step that needs to be done in the analysis of optimization of household resource allocation. The results of the validation of linear programming models

Commented [MS18]: Get the newer reference

Commented [MS19]: 1.48 AU

are conducted to determine whether the model used in the analysis is valid. The results of model validation showed the optimal conditions of the state of the resource or household activities of farmers. The optimal analysis model is valid if the optimal value is at the confidence interval. The results of the validation of the model of household resources of farmers are presented in Table 4.

The results of the validation of the optimization model it was known that the resources and activities carried out by the household are in a confidence interval, namely the optimal conditions for cow-claf beef cattle was 2.75 located between 2.612 - 2.887 at the confidence interval, while the land optimal condition was achieved at 0.45 with the confidence interval was 0.428 - 0.473. It mean that the model used is valid. If there is a change in resources or activities outside the confidence interval, it will cause changes in optimal conditions. Conversely, if the change is still at a confidence interval, it certainly will not change the optimal conditions. Based on the results of the linear program, it was known that rearing of local cow-calf beef cattle and non-local cow-calf cattle and also paddy farming obtained optimal values and are in confidence intervals. The optimum capital use was achieved in year 1, which is IDR 4,500,000. While the use of agricultural land for paddy commodities is known to be optimal conditions in year 1, 2 and 3. The use of family labor labor showed optimal use and results are within the confidence interval. The use of an optimal workforce showed that if farmer households need labor, the workforce must be met from outside the family. Food and non-food consumption has also shown optimal conditions and is at the dividend interval. It met with Maryanto et al., 2015 that there was relationship between production decisions, allocation of labor farming and consumption decisions in households of integrated farming systems of beef cattle and paddy. After the optimation analysis is carried out, the answer to the hypothesis is that the main source of livestock, land and labor has

Commented [MS20]: means

been allocated optimally. Therefore, these resources can be said to be a limiting factor/farm constraints because the resources used are used up. (Table 4)

The validation results of optimal analysis model on farmers household activities in Grobogan Regency showed that the optimal condition for cow-calf beef cattle of 2.75 AU and agricultural land use was 0.45ha. From cow-calf beef cattle and paddy farming activities, the optimal labor was achieved at 80.415 work day and capital for each period of IDR. [4,500,000,-] The results of income maximization obtained by farmers-breeders households amounted to IDR. 52,122,440,00 per year.

Simulation of Optimal Conditions

Optimation analysis model of resource allocation for farmers household showed valid results and optimal conditions are achieved. Therefore, a simulation is carried out to find out whether there is a change in the objective function or constraints. This was taken to find out how much there has been a change in farming-cow-calf beef cattle and income of farmers households in order to keep in optimal condition, if there are changes in land resource constraints and input prices.

Livestock resources are not simulated for changes in increase because the limit value of the cattle resources has reached its optimum condition at 2.75 AU. Thus, if there is any addition made, then other resources will not support it, especially labor. This is because the existing labor has another activity, i.e. paddy farming. Therefore, simulations are carried out on the rising of input prices both for cow-calf beef cattle and paddy farming, with a change of 10% without an increase in output prices. While the increase of input prices was based on field conditions, where the price of animal feed - tend to rise with variation in increase around 10%. Changes occured from the simulation results are presented in Table 5

Commented [MS21]: 4,500,000,00??look the number below using .00

The simulation results showed that 0.25% addition in land area, namely from 0.45 ha to 0.6 ha gave a change in the scale of livestock farm of 0.018% and income of 14.78%, i.e. from IDR 52,112,440,- to Rp 61,152,910,-. Changes in the optimal solution results of the simulation indicated that farmers have the ability to develop their farms. (Table 6). This is in accordance with Maryanto *et al.* (2015) that if optimal conditions are reached and simulations are carried out with changes in the use of land and price limiting factors then the optimal conditions are reached and farmers are still able to do the integration farming system.

It also can be seen that there is an increase in the area of labor resources needed, meaning that the addition of land area is still possible to be managed by farmers. The increase of input prices with fixed output prices that are counter balanced by an increase in land area results in an optimal change in income solutions, i.e. an increase in income. An increase in income resulting from the optimal solution is possible because an increase in input prices of 10% can still be counter balanced by the results of farming sales; given the addition of farm scale will result in production as the source of revenue. It can be noted from the simulation results that the optimal solution showed the farmers in managing their farming and livestock. The simulation showed the farmers ability to manage their farm if there is an increase in the land area scale, but input and output prices are fixed. This is consistent with Karmini and Syarifah (2008) and Howara (2011) that land area will affect farming production and profits. Determining the right amount of optimal land is one way to increase production with the aim of achieving maximum profits. An increase in the amount of farmers' income is also still possible by making changes to the use of land inputs, so that productivity increases and ultimately increases the income. In addition, the ability to manage land for farming is generally also influenced by the availability of labor and capital, as stated by Khalik

et al. (2013). As in optimal conditions, labor in the farmer's household is used up to manage his farm.

CONCLUSION

Based on the study results, it can be concluded that:

- The optimal condition is obtained on cow-calf beef cattle of 2.75 AU and a land area of 0.45 ha.
- 2. The maximum income of farmer households was IDR. 52,112,440/year.
- 3. The simulation results of changes in input use indicated that the addition of land area of 0.25%, i.e. from 0.45 ha to 0.6ha results in a change of 0.018% in the scale of cow-calf farm and income of 14.78%, i.e. from IDR. 52,112,440,- to IDR. 61,152,910,-. Changes in the results of the optimal solution in the simulation indicated that farmers have the ability to develop their farms.

REFERENCES

Basuni, R., Muladno, C. Kusmana and Suryahadi. 2010. Model sistem integrasi padi-sapi potong di lahan sawah. Forum Pascasarjana. 33(3):177-190

BPS. 2018. Grobogan Dalam Angka 2018.

- Darith, S., S. Xu, W. Yu and A. A. Gafar. 2016. Optimization model of cattle Husbandry for rural household in Cambodia. Journal of Agricultural Chemistry and Environment.5:6-11
- Howara, D. 2011. Optimalisasi pengembangan usahatani tanaman padi dan ternak sapi secara terpadu di Kabupaten Majalengka. J. Agroland 18 (1) : 43 49.

Commented [MS22]: BPS Kabupaten Grobogan?

- Hutasoit, D.D.P.I. 2008. Pengaruh kegiatan optimasi lahan terhadap Pengembangan wilayah di Kabupaten Simalungun (Studi Kasus Nagori/Desa Naga Saribu, Kecamatan Pamatang Silima Huta). Wahana Hijau. Jurnal Perencanaan & Pengembangan Wilayah. 4(2):51-58.
- Karmini and A.A. Syarifah. 2008. Optimalisasi lahan usahatani tomat dan mentimun dengan kendala tenaga kerja (pendekatan program linier). EPP.5(2):44-50.
- Khalik R, Safrida, and A.H. Hamid. 2013. Optimasi pola tanam usahatani sayuran selada dan sawi di daerah produksi padi (Studi Kasus di Desa Lam Seunong, Kecamatan Kota Baro, Kabupaten Aceh Bes.,
- Martin, G., M. Moraine, J. Ryschawy, M. A. Magne, M. Asai, J. P. Sarthou, M. Duru and O. Therond. 2016. Crop–livestock integration beyond the farm level: a review. Agron. Sustain. Dev. 36:53.
- Masayasu, A., M. Moraine, J. Ryschawy, J. de Witd, A.K. Hoshidee and G. Martinc. 2018. Critical factors for crop-livestock integration beyond the farm level: A crossanalysis of worldwide case studies. Land Use Policy 73:184-194
- Mariyanto, J.,R. Dwiastuti and N. Hanani. 2015. Model ekonomi rumahtangga pertanian lahan kering di Kabupaten Karanganyar Provinsi Jawa Tengah. Habitat, 26 (2):108-118
- Minh, Th., S. Ranamukhaarachchi and H. Jayasuriya. 2007. Linear Programming-based optimization of the productivity and sustainability of crop-livestock-compost manure integrated farming systems in Midlands of Vietnam. ScienceAsia 33:187-195
- Mukhlish, M. Noer, Nofialdi and Mahdi. 2015. Analisis usahatani integrasi padi sapi potong. Jurnal Penelitian Lumbung, 14(1):1-10
- Mukhlis, M. Noer, Nofialdi and Mahdi. 2018. The integrated farming system of crop andlLivestock: A Review of Rice and Cattle Integration Farming. International Journal of Sciences: Basic and Applied Research (IJSBAR). 42(3): 68-82

Nasendi, B. D. and A. Anwar. 1985. Program Linear dan Variasinya. PT. Gramedia.

- Ponnusamy, K. and M.K. Devi. 2017. Impact of integrated farming system approach on doubling farmer's income. Agricultural Economics Research Review. 30:233-240
- Priyanti, A., B.M. Sinaga, Y. Syaukat and S.U. Kuntjoro. 2007. Model ekonomi rumahtangga petani pada sistem integrasi tanaman-ternak: Konsepsi dan studi empiris. WARTAZOA 17(2):61-70
- Regan, J. T., S. Martonc, O. Barrantes, E. Ruanef, M. Hanegraaf, J. Berland, H. Korevaar, S. Pellerina and T. Nesme. 2017. Does the recoupling of dairy and crop production via cooperation between farms generate environmental benefits? A case-study approach in Europe. Europ. J. Agronomy. 2016:15
- Rohaeni, E. S., B. Hartono, Z. Fanani and B. A. Nugroho. 2014. Sistem usaha tani terintegrasi tanaman-ternak sebagai respons petani terhadap faktor risiko. Journal of Economics and Sustainable Development. 5(1):159-168.
- Ryschawy, J., G. Martin, M. Moraine, M. Duru and O. Therond. 2017. Designing crop–livestock integration at different levels: Toward new agroecological models? Nutrient Cycling in Agroecosystems. 108(1):5-20.
- Soedjana, T.D. 2007. Sistem usaha tani terintegrasi Tanaman-ternak sebagai respons petani terhadap faktor risiko. Jurnal Litbang Pertanian, 26(2):82-87.
- Tawaf, R., M. Paturochman, L. Herlina, M. Sulistyati and A. Fitriani. 2017. The optimation of farmers families' revenue the integration of Pasundan cattle and paddy farming in West Java. J. Indonesian Trop. Anim. Agric. 42(4):270-278.

Table 1. The Agriculture Potenti	al Commodities in G	irobogan
----------------------------------	---------------------	----------

-		
Commodity	Harvested area	Production
	ha	tons
Paddy		
- Lowland	123,446	786,040
- Upland	3,489	13,267
Corn	112,700	700,941
	Population	
	head	
Beef cattle	178,555	
Dairy cows	365	
Buffaloes	2,457	
Horses	494	
rce : BPS Central J	ava, 2018	

Commented [MS23]: Not available in references

Table 2. Number and Percentage of Farmer's Household Profile

No.	Profile	Number	Percentage (%)			
			%			
1.	Age (year)					
	■ ≤17	0	0.00			
	■ 18 – 60	68	85.00			
	■ ≥61	12	15.00			
2.	Main livelihood					
	 Farmer 	80	100.00			
	 Village Officials 	0	0.00			
	 Entrepreneur 	0	0.00			
3.	Education					
	 Primary School 	46	57.50			
	 Junior High School 	22	27.50			
	 Senior High School 	12	15.00			
4.	Farming Experience (year)					
	• 6 – 10	12	15.00			
	■ 11 – 20	32	40.00			
	■ > 20	36	45.00			
5.	5. Land tenure (ha)					
	< 0.25	5	6.25			
	■ 0.25 – 0.5	48	60.00			
	■ > 0.5	27	33.75			
6.	Number of Cattle (head)					
	• < 3	10	12.5			
	 3-4 	55	68.75			
	■ > = 5	15	18.75			

Table 3. Income of Cow-Calf Beef Cattle and Paddy Farming

Components	Beef Cattle Farming Income	Rice Farming Income
	IDR/1.54 AU/year	IDR/ha/year
Revenue	9,116,975.00	49,500,000.00
Cost	8,095,927.19	15,584,121.50
Income	1,041,860.32	33,915,878.50

Source: Primary Data Analysis

Table 4. The Results of The Optimal Validation Model of Household Resources

	Validation Model			
Activities	Optimal	Confidence Interval		
	Condition	(α=95%)		
Local livestock raising pattern (AU)				
 Local cows of the year 1 	2.750	2.612 - 2.887		
 Non Local livestock raising pattern (AU 	1.483	1.408 - 1.557		
Sale of local female calves				
 Sales of local calves in year 1 	5.500	5.225 - 5.775		
 Sales of local calves in year 2 	2.750	2.612 - 2.887		
 Sales of local calves in year 3 	2.750	2.612 - 2.887		
Sale of local male calves				
 Sales of local male calves in year 1 	1.483	1.409 - 1.557		
 Sales of local male calves in year 2 	1.483	1.409 - 1.557		
 Sales of local male calves in year 3 	1.483	1.409 - 1.557		
Use of agricultural land (ha)				
 Paddy in year 1 	0.45	0.428 - 0.473		
 Paddy in year 2 	0.45	0.428 - 0.473		
 Paddy in year 3 	0.45	0.428 - 0.473		
Capital Requirements in year 1	4,500,000			
Paddy sales (kw)				
 Paddy sales in year 1 	28.435	27.013 - 29.857		
 Paddy sales in year 2 	28.408	26.987 - 29.828		
 Paddy sales in year 3 	28.435	27.013 - 29.857		
Family labor (working day)				
• Family workforce in year 1 (working day)	80.415	76.394 - 84.436		
 Family workforce in year2 (working day) 	80.415	76.394 - 84.436		
• Family workforce in year 3 (working day)	80.415	76.395-84.436		
Consumption expenditure				
 Food consumption in year 1 	4,070,545.00	3,867.017.75 - 4.274.072,25		
 Food consumption in year 2 	4,153,825.00	3.946.133,75 - 4.361.516,25		
 Food consumption in year 3 	4,886,500.00	4,642,175.00 - 5,130,825.00		
 Non-food consumption Year 1 	3,516,549.30	3,340,721.55 - 3,692,376.45		
 Non-food consumption Year 2 	3,588,315.60	3,408,899.82 - 3,767,731.38		
 Non-food consumption Year 3 	3,642,960.00	3,460,812.00 - 3,825,108.00		
Income in year of 1-3 (IDR)	52,122,440.0			
Note : confidence interval at α =5%

Table 5. Simulation of Optimal Conditions on Farmers' Households in the Research Area

Types of Simulation	Scenario	Expected Results
Changes in farming land resources	 The greatest increase in the paddy farming scale managed by farmers from 0.45 ha to 0.6 ha Other resource constraints are considered unchanged / fixed Inputs and output prices are considered unchanged / fixed 	 Farm scale increases due to land expansion Increase in farmers' income Changes in optimal farm patterns
Increases in Input prices	 Increase in input prices based on the highest price change, which is around 10% Other resource constraints are considered unchanged / fixed 	 Changes of income in farmers - breeders household Changes in optimal conditions
	 Output prices are unchanged / fixed 	

Table 6. Simulation Results 1 Regarding Changes in Animal Resource Constraints on Farmers' Households in the Research Area

Resources	Optimal Condition	Simulation Results	Percentage of
	_	1	Change (%)
Land	0.48	0.6	0.25
Local cattle	2.75	2.80	0.018
Labor	80.415	80.415	No change
Income	52,112,440.00	61,152,910.00	14.78

4.Attachment 4 : Submission of Manuscript Revision, May 15, 2020



PAPER REVISION

Optimation of cow-calf beef cattle and paddy farming integration (Ekowati et al.)

The optimation of cow-calf beef cattle and paddy farming integration

on farmer household In Grobogan Regency

ABSTRAK

Rumahtangga petani umumnya berusahatani pada sub-sektor pertanian tanaman pangan dan sub-sektor peternakan yang belum dilaksanakan dengan baik, sehingga kondisi optimal usahatani belum dicapai. Penelitian bertujuan untuk menganalisis optimasi integrasi sapi potong dan padi, simulasi perubahan harga input dan penggunaan sumberdaya terhadap model optimal. Metode survey digunakan dalam penelitian di Kabupaten Grobogan, dengan menentukan Kecamatan Wirosari dan Kecamatan Purwodadi. *Quota sampling method* digunakan untuk menentukan jumlah sampel peternak sapi potong induk-anak dan petani padi tanpa menghitung jumlah populasi sebagai *sampling frame*. Jumlah responden setiap kecamatan adalah 40 petani sehingga total responden 80 petani. Data dianalisis dengan linear programming. Hasil penelitian menunjukkan bahwa kondisi optimum skala usaha integrasi sapi potong dan padi dicapai pada luas lahan 0,45 ha, pemeliharaan induk sapi potong 2.75 UT dengan maksimum pendapatan Rp 52.112.440/tahun. Hasil simulasi perubahan penggunaan input menunjukkan bahwa penambahan luas lahan 0,25% memberikan peningkatan skala usaha sapi potong 0,018% dan pendapatan 14,78%, Kesimpulan optimasi integrasi sapi potong dan padi dicapai pada luas lahan 0,45ha dan induk sapi potong 2.75 UT dan simulasi solusi optimal menunjukkan bahwa petani mempunyai kemampuan untuk mengembangkan usahataninya.

Kata kunci : integrasi, optimasi, padi, pendapatan, sapi potong

ABSTRACT

Farmer households generally operate food crops and livestock subsectors that have not fully implemented well, so an optimal farming has not been achieved. This study aimed to analyze optimation of beef cattle and paddy farming integration and simulation changing in input prices and the usage of resources to the optimal model. Survey method was used in the research in Grobogan Regency by determining Wirosari District and Purwodadi District. Quota sampling method is used to determine the number of respondents without counting the population as a sampling frame. The number of respondents in each district was 40 farmers so the total respondent was 80 farmers. Data were analyzed using linear programing. Results showed that optimum conditions of integration were achieved in 0.45ha land, 2.75 AU of beef cattle with maximum income of IDR 52,112,440/year. The simulation results regarding in changing in input usege indicated that the addition of 0.25% land area gives a change in scale of beef cattle by 0.018% and

income of 14.78%. In conclusion, integration optimation was achieved on 0.45ha land, 2.75 UT beef cattle and optimal solution simulations indicated that farmers have the ability to develop their farming.

Keywords: beef cattle, integration, income, optimation, paddy

INTRODUCTION

Beef cattle and paddy farmings are forms of farm activity pursued by many people in Central Java. The meaning contained in these farm activities is how beef cattle and paddy farming are run by farm households to get better results, both in terms of farm scale and income. The policy regarding beef cattle and paddy farming development is basically has a correlative and synergistic relationship, considering that agricultural waste is substantially raw material (feed) for livestock farm. Farmer households use integrated farming system in developing agriculture, considering that besides providing economic benefits, this pattern also provides benefits in land conservation and land productivity. This is in line with Soedjana (2007) and Hutasoit (2008) that the reason why farmers choose mixed farming or integration is because of habits (tradition), to maximize revenue from limited resources, and increase benefits of correlation between integrated farming patterns in the food crop sub-sector and livestock sub-sector, which will encourage the development of food crops especially paddy and livestock and create investment opportunities. This is also supported by Basuni et al. (2010), Mukhlis et al. (2015) and Ponnusamy and Devi, 2017 that the integration of farming systems can provide both ecological and economic benefits because the waste from each commodity can be used as an input factor, so that it can save the use of cost and can increase income. Another research by Darith et al. (2016) indicated that activities carried out by farmers in the integration model can increase farmer income which in turn can increase investment in farming

Farmer households can be seen as a unit of farm activity consisting of production, activities and labor services activities. All of these activities are a unity, so that farmer's household cannot be seen as a pure consumer because there is a portion of the production that is consumed and partly sold as capital. Likewise in the labor use, farmers-breeders, labor can come from within the family or outside the family. Thus, farmer households can be said to be producers and consumers (Priyanti, 2007).

Integration of beef cattle and paddy based on the scale of farm that the number of livestock and land area can provide some form of integration (Matin *et al*, 2016). Integration can take the form of an exchange relationship between livestock and paddy which can be in the form of fertilizer and forage (Regan *et al.*, 2017)

Integrated farming systems, in Grobogan, which is managed by farmer's household generally consist of beef cattle, especially cow-calf rearing, and paddy farm. Farm households usually face constraints on land and cow-calf resource constraints. These constraints are in accordance with by Basuni *et al.* (2010) statement that in West Java, the integration of beef cattle and paddy is contained in land boundaries and livestock numbers. Therefore, the optimal allocation of resource use in the integration of cow-calf and pady needs to be assessed.

Allocation of resource use controlled by farmers is very important, because non-optimal resource use means a cost for farming management. As a result, the profits generated for farmer as farming manager becomes are optimal (Masayasu *et al.*, 2018). Allocation of the use of production factors that provide optimal results can be analyzed by linear programming.

Analysis using linear programming can provide information for agricultural policy makers regarding: (a) the structure of related relationships and the costs of comparative advantage in agricultural sector; (b) production potential; (c) job opportunities; (d) consistency of every alternative agricultural policy. (Minh *et al.*, 2007)

Linear programming is a method that is more systematic and mathematically rigorous for determining the optimum combination of farm sectors or contributions such as revenue maximization or cost minimization with limited available resources (Darith *et al.* (2016). From the study results, it is expected that an allocation model for an optimal use of production factors can be created, so that it can benefits for farmers. Based on the bacground, the objective of the study were to develop an optimation for beef cattle and paddy farm integration and simulate changes in input prices and resources use to optimal model.

MATERIAL AND METHODS

The study was conducted by using a survey method to determine the condition of farmer households, especially cow-calf cattle farming and paddy farming in managing their farm integration. Survey method is a method of taking respondents by determining a sample of the existing population. (Morissan, 2012)

Purposive method was used to determine the study location based on potential of the most populated area by beef cattle and paddy production in Central Java. Based on data on Agricultural and Animal Husbandry Statistics in 2018, it is known that Grobogan is regency with a potential combination of beef cattle, paddy farming from the planting area and paddy production aspects as well as the raising of beef cattle in Central Java. Based on regency location, there were 2 districts purposively selected where two villages were taken in each district based on several indicators such as number of beef cattle population, paddy production and farmer group activities. Based on the purposive results, districts selected for the study were Wirosari District, consist of Karangasem Village and Sambirejo Village, and Purwodadi District with Nambuhan Village and Genuksuran Village.

Quota sampling method was conducted to determine the sample number of cow-calf cattle and paddy farmers without counting the population as a sample frame. The sample number of cowcalf beef cattle and paddy farmers from each village were 20 farmers, so the total number of respondents was 80 farmers households. The reason for determining the number of respondents is 20 farmers per village because the characteristics of farmers are relatively homogeneous in the context of farm scale and rearing management

The method used to analyze the objectives was linear programming and descriptive analysis. From this model, cow-calf beef cattle and paddy farmers can be considered as cow-calf beef cattle and paddy producers that produce livestock and paddy supply continuously from optimal allocation of resources. Thus, the objective function in this linear programming research model was to maximize household income in term of integration cow-calf beef cattle and paddy farming.

The mathematical form of the Linear Programing model that maximizes the objective function in general is: (Minh *et al.*, 2007)

n

Maximum $Z = C_1 X_1 + C_2 X_2 + C_3 X_3 \dots + C_j X_j - \dots + C_n X_n$ or $Z = \sum_{i=1}^{n} C_i X_j \dots$ (1)

..

With constraint:

..

••

$$\begin{split} a_{11}x_1 + a_{12}x_2 + \ldots & a_{1j}x_j + \ldots & a_{1n}x_n \leq b_1 \\ a_{21}x_1 + a_{22}x_2 + \ldots & a_{2j}x_j + \ldots & a_{2n}x_n \leq b_2 \\ a_{31}x_1 + a_{32}x_2 + \ldots & a_{3j}x_j + \ldots & a_{3n}x_n \leq b_3 \end{split}$$

..

 $a_{m1}x_1+a_{m2}x_2+\ldots\,a_{mj}x_j+\ldots\,a_{mn}x_n\leq b_m \mbox{ or } \sum_{i=1}a_{ij}X_i\leq b_i \quad \ldots\ldots$

Explanation:

 $i = 1, 2, 3 \dots$ m is the number of limitation factors

 $j = 1, 2, 3 \dots$ n is the number of production activity

Activity was not negative: $xj \ge 0$ for all j

Z = objective function which is the income of maximized cow-calf beef cattle Farmers and paddy

C = production prices (C) and input prices (-C)

- xj = production and consumption activities carried out by households of cow-calf beef cattle and paddy farmers
- aij = input coefficient of each production and consumption activity

bij = value of constraints or the available resource limits

Referring to the research objectives the are basic components can be formulated as follows: Objective function

The objective function (Z) in this study is to maximize the income of cow-calf beef cattle

and paddy farmers from various alternative activities with existing resource constraints.

Alternative Activity Model

Some of activities carried out in this study include: (1) farming - livestock production

activities; (2) purchasing production facilities; (3) hiring of workers; (4) sales of products;

(5) consumption expenditure (food and non-food)

RESULTS AND DISCUSSION

Overview of Grobogan Regency

The livelihood of Grobogan residents are generally dominant in agriculture. This is due to the potential of Grobogan Regency which mostly dominated by agricultural land. Based on the results of population in 2017, it was noted that the population working in the agricultural sector amounted to 52.5%. One of the main capital in the development is labor. In line with the ongoing demographic process, the number and composition of the labor will continue to change. (BPS, 2018)

In Grobogan Regency, land conversion from agricultural to non-agricultural land is increasing, but the potential of agricultural sector until now is still dominant in supporting the economic sector of Grobogan Regency. In 2018, about 84.91% of the total area in Grobogan Regency was used for agricultural activities. The production of lowland paddy of Grobogan Regency in 2017 experienced a significant increase compared to the previous year. This year, the production of lowland paddy reached 786,040 tons with a harvested area of 123,446 ha. While for upland paddy, the production reached 13,267 tons with a harvested area of 3,489 hectares. On the other hand, corn production reached 700,941 tons with a harvest area of 112,700 ha. The population of livestock in Grobogan Regency in 2017 generally increased compared to the previous year. The population of livestock consisted of 365 dairy cows, 178,555 beef cattle, 2,457 buffaloes, and 494 horses. Many livestock in Grobogan Regency are sent out of the area to meet the demand of other regions. In 2018, the number of livestock sent out from Grobogan Regency reached 30,108 cattle and 3,634 buffaloes. (Table 1)

Respondents were majority consisted of farmers in their productive age (85%) with 100% working as farmers and 57.50% of them were primary school with the farm experience was 34% around 20 years; while the average land tenure was 0.45 ha and averagedly the livestock ownership was 1.54 animal unit (AU). This condition can affect production, both in cow-calf and paddy farming. (Table 2)

Increasing education is the most important factor in Indonesian development, if it seen from the population perspective, both as the object of development as well as the subject of development. The success of the development in an area can be indicated by the high level of education of its population. This is surely correlated to the educational facilities available in the area. The livelihoods of residents in Grobogan Regency are still dominant in agriculture. This is due to the potential area of Grobogan Regency which still dominated by agricultural land. Based on the results of population projection in 2015, it was noted that the population working in the agricultural sector amounted to 56.0 percent, trade 17.5 percent, transportation 8.6 percent, and the rest worked in the services, plantation, industry, fisheries, and other sectors (BPS, 2018)

Analysis of Costs and Income of Cow-Cal Beef Cattle and Paddy Farming

The use of production factors on farming will cause a cost, both variable costs and fixed costs. Costs for variable input expenditures include seeds, fertilizers, pesticides, non-family labor, and other costs such as irrigation costs, farmer group fees and loan interest. In addition, farmers also pay fixed costs such as land rent, tractor rent, depreciation of capital goods (hoe, hand sprayer, sickle, and *sosrok*), and land tax. All costs are stated in rupiah, the amount of which is based on the price at the time the transaction takes place. (Table 3)

Farmers with 1.54 AU of cow-calf beef cattle operations require a production cost of IDR. 8,095,927.19 per year with the highest cost of IDR. 3,760,560 (46.45%) allocated for forage cost. Labor cost is also incurred by many farmers, considering the scarcity of family labor, so it is necessary to allocate this cost, which amounted to IDR. 3,274,875.00 (40.45%). The highest cost in paddy farming was the labor cost. Today, agricultural labor is an important asset, given the number is increasingly scarce in the countryside. This is what makes the high wages of labor so that farmers have to pay more for labor costs (Maryanto *et al.*, 2015). The production cost of paddy farming per hectare was IDR. 15,584,121.5, - per year where farmers cultivated paddy crops two times in one year.

Revenue for cow-calf beef cattle was IDR. 6,680,937.5 and livestock value added was IDR. 2,436,037.5. Thus, the income of cow-calf was IDR. 9,116,975,-/year with the cost incurred of IDR. 8,095,927.19 and income of IDR. 1,041,860.32/year/1.54 AU or IDR. 86,821.69/month/1.54 AU. It's a very small value to support the farmer's daily life. Whereas, revenue of paddy farming in the form of harvested dried rice for a year with 2 planting seasons was 6,187.5 tons/ha harvest. the price of paddy was IDR. 4,000,-/kg then farmer's revenue was IDR. 24,750,000/0.45ha/season, or IDR. 49,500,000/ha/year, with an income of IDR. 33,915,878/ha/year or IDR 2,826,323.2/ha/month. Based on the farm income, the profitability of cow-calf beef cattle and paddy farm were 1.2% and 217.63%, respectively. This showed that the farmer's household is more supported by the results of paddy farming, as Mukhlis *et al.* (2018) said that integrated of beef cattle and farming system can increase income and profitability of farmer's household which paddy farm is dominant for household income.

Optimation Analysis

The results of optimization analysis will illustrate the results of optimal solutions by using resources describing the optimal solution of linear programming analysis which incude: (1) validation of optimal solution values, 2) farm household income from optimal solutions, (3) optimal allocation of farmer's household resources and beef cattle farm activities as wel as the level of constraints and shadow prices of resources. (Mukhlis *et al.*, 2018 and Ryschawy *et al.*, 2017)

Optimation of cow-calf beef cattle farming and paddy describes the farm system with the farm household approach. The farm household approach is implemented because the farmerbreeder's livelihood is not independent as farmers or breeders alone, but both activities are integrated in one household. On one hand, farmers can be seen as producers and on the other hand as consumers. Farmers-breeders as producer means that farmers-breeders will maximize income from a number of activities, while as consumer, farmers-breeders will consume goods either from their own production or purchased for family consumption. Results of research showed that optimal condition of cow-calf beef cattle and paddy integrated farming system were 2.75 AU of local cow s of the year 1, 1.48 AU of non local livestock raising pattern and 0.45 ha land harvested of paddy. In maximizing income was IDR 52,122,440 in 3 years. In this term, farmers are faced with challenges on land, labor, and capital. This is consistent with Rohaeni *et al.* (2014) and Tawaf *et al.* (2017) that the farmer's problems in the application of optimation of agricultural patterns are capital, land, labor, and price fluctuation.

Validation the Value of The Optimal Solution

Model validation is the first step that needs to be done in the analysis of optimization of household resource allocation. The results of the validation of linear programming models are conducted to determine whether the model used in the analysis is valid. The results of model validation showed the optimal conditions of the state of the resource or household activities of farmers. The optimal analysis model is valid if the optimal value is at the confidence interval. The results of the validation of the model of household resources of farmers are presented in Table 4.

The results of the validation of the optimization model it was known that the resources and activities carried out by the household are in a confidence interval, namely the optimal conditions for cow-calf beef cattle was 2.75 located between 2.612 - 2.887 at the confidence interval, while the land optimal condition was achieved at 0.45 with the confidence interval was 0.428 - 0.473. It means that the model used is valid. If there is a change in resources or activities outside the confidence interval, it will cause changes in optimal conditions. Conversely, if the change is still at a confidence interval, it certainly will not change the optimal conditions. Based

on the results of the linear program, it was known that rearing of local cow-calf beef cattle and non-local cow-calf cattle and also paddy farming obtained optimal values and are in confidence intervals. The optimum capital use was achieved in year 1, which is IDR 4,500,000. While the use of agricultural land for paddy commodities is known to be optimal conditions in year 1, 2 and 3. The use of family labor labor showed optimal use and results are within the confidence interval. The use of an optimal workforce showed that if farmer households need labor, the workforce must be met from outside the family. Food and non-food consumption has also shown optimal conditions and is at the dividend interval. It met with Maryanto *et al.*, 2015 that there was relationship between production decisions, allocation of labor farming and consumption decisions in households of integrated farming systems of beef cattle and paddy. After the optimation analysis is carried out, the answer to the hypothesis is that the main source of livestock, land and labor has been allocated optimally. Therefore, these resources can be said to be a limiting factor/farm constraints because the resources used are used up. (Table 4)

The validation results of optimal analysis model on farmers household activities in Grobogan Regency showed that the optimal condition for cow-calf beef cattle of 2.75 AU and agricultural land use was 0.45ha. From cow-calf beef cattle and paddy farming activities, the optimal labor was achieved at 80.415 work day and capital for each period of IDR. 4,500,000,-The results of income maximization obtained by farmers-breeders households amounted to IDR. 52,122,440,- per year.

Simulation of Optimal Conditions

Optimation analysis model of resource allocation for farmers household showed valid results and optimal conditions are achieved. Therefore, a simulation is carried out to find out whether there is a change in the objective function or constraints. This was taken to find out how much there has been a change in farming-cow-calf beef cattle and income of farmers households in order to keep in optimal condition, if there are changes in land resource constraints and input prices.

Cow-calf beef cattle resources are not simulated for changes in increase because the limit value of the cattle resources has reached its optimum condition at 2.75 AU. Thus, if there is any addition made, then other resources will not support it, especially labor. This is because the existing labor has another activity, i.e. paddy farming. Therefore, simulations are carried out on the rising of input prices both for cow-calf beef cattle and paddy farming, with a change of 10% without an increase in output prices. While the increase of input prices was based on field conditions, where the price of animal feed tend to rise with variation in increase around 10%. Changes occured from the simulation results are presented in Table 5

The simulation results showed that 0.25% addition in land area, namely from 0.45 ha to 0.6 ha gave a change in the scale of livestock farm of 0.018% and income of 14.78%, i.e. from IDR 52,112,440,- to Rp 61,152,910,-. Changes in the optimal solution results of the simulation indicated that farmers have the ability to develop their farms. (Table 6). This is in accordance with Maryanto *et al.* (2015) that if optimal conditions are reached and simulations are carried out with changes in the use of land and price limiting factors then the optimal conditions are reached and farmers are still able to do the integration farming system.

It also can be seen that there is an increase in the area of labor resources needed, meaning that the addition of land area is still possible to be managed by farmers. The increase of input prices with fixed output prices that are counter balanced by an increase in land area results in an optimal change in income solutions, i.e. an increase in income. An increase in income resulting from the optimal solution is possible because an increase in input prices of 10% can still be counter balanced

by the results of farming sales; given the addition of farm scale will result in production as the source of revenue. It can be noted from the simulation results that the optimal solution showed the ability of the farmers in managing their farming and cow-calf beef cattle. The simulation showed the farmers ability to manage their farm if there is an increase in the land area scale, but input and output prices are fixed. This is consistent with Karmini and Syarifah (2008) and Howara (2011) that land area will affect farming production and profits. Determining the right amount of optimal land is one way to increase production with the aim of achieving maximum profits. An increase in the amount of farmers' income is also still possible by making changes to the use of land inputs, so that productivity increases and ultimately increases the income. In addition, the ability to manage land for farming is generally also influenced by the availability of labor and capital, as stated by Khalik *et al.* (2013). As in optimal conditions, labor in the farmer's household is used up to manage his farm.

CONCLUSION

Based on the study results, it can be concluded that:

- The optimal condition is obtained on cow-calf beef cattle of 2.75 AU and a land area of 0.45 ha.
- 2. The maximum income of farmer households was IDR. 52,112,440/year.
- 3. The simulation results of changes in input use indicated that the addition of land area of 0.25%, i.e. from 0.45 ha to 0.6ha results in a change of 0.018% in the scale of cow-calf farm and income of 14.78%, i.e. from IDR. 52,112,440,- to IDR. 61,152,910,-. Changes in the results of the optimal solution in the simulation indicated that farmers have the ability to develop their farms.

REFERENCES

- Basuni, R., Muladno, C. Kusmana and Suryahadi. 2010. Model sistem integrasi padi-sapi potong di lahan sawah. Forum Pascasarjana. 33(3):177-190
- BPS Kabupaten Grobogan. 2018. Grobogan Dalam Angka 2018.
- BPS Jawa Tengah. 2018. Jawa Tengah Dalam Angka 2018.
- Darith, S., S. Xu, W. Yu and A. A. Gafar. 2016. Optimization model of cattle Husbandry for rural household in Cambodia. Journal of Agricultural Chemistry and Environment.5:6-11
- Howara, D. 2011. Optimalisasi pengembangan usahatani tanaman padi dan ternak sapi secara terpadu di Kabupaten Majalengka. J. Agroland 18 (1) : 43 49.
- Hutasoit, D.D.P.I. 2008. Pengaruh kegiatan optimasi lahan terhadap Pengembangan wilayah di Kabupaten Simalungun (Studi Kasus Nagori/Desa Naga Saribu, Kecamatan Pamatang Silima Huta). Wahana Hijau. Jurnal Perencanaan & Pengembangan Wilayah. 4(2):51-58.
- Karmini and A.A. Syarifah. 2008. Optimalisasi lahan usahatani tomat dan mentimun dengan kendala tenaga kerja (pendekatan program linier). EPP.5(2):44-50.
- Khalik R, Safrida, and A.H. Hamid. 2013. Optimasi pola tanam usahatani sayuran selada dan sawi di daerah produksi padi (Studi Kasus di Desa Lam Seunong, Kecamatan Kota Baro, Kabupaten Aceh Bes.,
- Martin, G., M. Moraine, J. Ryschawy, M. A. Magne, M. Asai, J. P. Sarthou, M. Duru and O. Therond. 2016. Crop–livestock integration beyond the farm level: a review. Agron. Sustain. Dev. 36:53.
- Masayasu, A., M. Moraine, J. Ryschawy, J. de Witd, A.K. Hoshidee and G. Martinc. 2018. Critical factors for crop-livestock integration beyond the farm level: A crossanalysis of worldwide case studies. Land Use Policy 73:184-194

- Mariyanto, J., R. Dwiastuti and N. Hanani. 2015. Model ekonomi rumahtangga pertanian lahan kering di Kabupaten Karanganyar Provinsi Jawa Tengah. Habitat, 26 (2):108-118
- Minh, Th., S. Ranamukhaarachchi and H. Jayasuriya. 2007. Linear Programming-based optimization of the productivity and sustainability of crop-livestock-compost manure integrated farming systems in Midlands of Vietnam. ScienceAsia 33:187-195
- Morissan, M. A. 2012. Metode Penelitian Survei. Kencana. Jakarta
- Mukhlish, M. Noer, Nofialdi and Mahdi. 2015. Analisis usahatani integrasi padi sapi potong. Jurnal Penelitian Lumbung, 14(1):1-10
- Mukhlis, M. Noer, Nofialdi and Mahdi. 2018. The integrated farming system of crop andlLivestock: A Review of Rice and Cattle Integration Farming. International Journal of Sciences: Basic and Applied Research (IJSBAR). 42(3): 68-82
- Ponnusamy, K. and M.K. Devi. 2017. Impact of integrated farming system approach on doubling farmer's income. Agricultural Economics Research Review. 30:233-240
- Priyanti, A., B.M. Sinaga, Y. Syaukat and S.U. Kuntjoro. 2007. Model ekonomi rumahtangga petani pada sistem integrasi tanaman-ternak: Konsepsi dan studi empiris. WARTAZOA 17(2):61-70
- Regan, J. T., S. Martonc, O. Barrantes, E. Ruanef, M. Hanegraaf, J. Berland, H. Korevaar, S. Pellerina and T. Nesme. 2017. Does the recoupling of dairy and crop production via cooperation between farms generate environmental benefits? A case-study approach in Europe. Europ. J. Agronomy. 2016:15
- Rohaeni, E. S., B. Hartono, Z. Fanani and B. A. Nugroho. 2014. Sistem usaha tani terintegrasi tanaman-ternak sebagai respons petani terhadap faktor risiko. Journal of Economics and Sustainable Development. 5(1):159-168.

- Ryschawy, J., G. Martin, M. Moraine, M. Duru and O. Therond. 2017. Designing crop-livestock integration at different levels: Toward new agroecological models? Nutrient Cycling in Agroecosystems. 108(1):5-20.
- Soedjana, T.D. 2007. Sistem usaha tani terintegrasi Tanaman-ternak sebagai respons petani terhadap faktor risiko. Jurnal Litbang Pertanian, 26(2):82-87.
- Tawaf, R., M. Paturochman, L. Herlina, M. Sulistyati and A. Fitriani. 2017. The optimation of farmers families' revenue the integration of Pasundan cattle and paddy farming in West Java. J. Indonesian Trop. Anim. Agric. 42(4):270-278.

Table 1. The Agriculture Potential Commodities in Grobogan

Commodity	Harvested area	Production
	ha	tons
Paddy		
- Lowland	123,446	786,040
- Upland	3,489	13,267
Corn	112,700	700,941
	Population	
	head	
Beef cattle	178,555	
Dairy cows	365	
Buffaloes	2,457	
Horses	494	

Source : BPS. 2018. Jawa Tengah Dalam Angka

Table 2. Number and Percentage of Farmer's Household Profi	ile
--	-----

No.	Profile	Number	Percentage (%)
			%
1.	Age (year)		
	■ ≤17	0	0.00
	■ 18-60	68	85.00
	• ≥ 61	12	15.00
2.	Main livelihood		
	 Farmer 	80	100.00
	 Village Officials 	0	0.00
	 Entrepreneur 	0	0.00
3.	Education		
	 Primary School 	46	57.50
	 Junior High School 	22	27.50
	 Senior High School 	12	15.00
4.	Farming Experience (year)		
	• 6 – 10	12	15.00
	■ 11-20	32	40.00
	• > 20	36	45.00
5.	Land tenure (ha)		
	< 0.25	5	6.25
	■ 0.25 – 0.5	48	60.00
	■ > 0.5	27	33.75
6.	Number of Cattle (head)		
	• < 3	10	12.5
	• 3-4	55	68.75
	• > = 5	15	18.75

Table 3. Income of Cow-Calf Beef Cattle and Paddy Farming

Components	Beef Cattle Farming Income	Rice Farming Income
	IDR/1.54 AU/year	IDR/ha/year
Revenue	9,116,975.00	49,500,000.00
Cost	8,095,927.19	15,584,121.50
Income	1,041,860.32	33,915,878.50

Source: Primary Data Analysis

Table 4. The Results of The Optimal Validation Model of Household Resources

	Validation Model		
Activities	Optimal	Confidence Interval	
	Condition	(a=95%)	
Local livestock raising pattern (AU)		· · · · ·	
 Local cows of the year 1 	2.750	2.612 - 2.887	
 Non Local livestock raising pattern (AU 	1.483	1.408 - 1.557	
Sale of local female calves			
 Sales of local calves in year 1 	5.500	5.225 - 5.775	
 Sales of local calves in year 2 	2.750	2.612 - 2.887	
 Sales of local calves in year 3 	2.750	2.612 - 2.887	
Sale of local male calves			
 Sales of local male calves in year 1 	1.483	1.409 - 1.557	
 Sales of local male calves in year 2 	1.483	1.409 - 1.557	
 Sales of local male calves in year 3 	1.483	1.409 - 1.557	
Use of agricultural land (ha)			
 Paddy in year 1 	0.45	0.428 - 0.473	
 Paddy in year 2 	0.45	0.428 - 0.473	
 Paddy in year 3 	0.45	0.428 - 0.473	
Capital Requirements in year 1	4,500,000		
Paddy sales (kw)			
 Paddy sales in year 1 	28.435	27.013 - 29.857	
 Paddy sales in year 2 	28.408	26.987 - 29.828	
 Paddy sales in year 3 	28.435	27.013 - 29.857	
Family labor (working day)			
• Family workforce in year 1 (working day)	80.415	76.394 - 84.436	
 Family workforce in year2 (working day) 	80.415	76.394 - 84.436	
 Family workforce in year 3 (working day) 	80.415	76.396-84.436	
Consumption expenditure			
 Food consumption in year 1 	4,070,545.00	3,867.017.75 - 4.274.072,25	
 Food consumption in year 2 	4,153,825.00	3.946.133,75 - 4.361.516,25	
 Food consumption in year 3 	4,886,500.00	4,642,175.00 - 5,130,825.00	
 Non-food consumption Year 1 	3,516,549.30	3,340,721.55 - 3,692,376.45	
 Non-food consumption Year 2 	3,588,315.60	3,408,899.82 - 3,767,731.38	
 Non-food consumption Year 3 	3,642,960.00	3,460,812.00 - 3,825,108.00	
Income in year of 1-3 (IDR)	52,122,440.0		

Note : confidence interval at $\alpha = 5\%$

Table 5.	Simulation of Optimal Conditions on Farmers' Households in the
	Research Area

Types of Simulation	Scenario	Expected Results
Changes in farming land resources	 The greatest increase in the paddy farming scale managed by farmers from 0.45 ha to 0.6 ha Other resource constraints are considered unchanged / fixed Inputs and output prices are considered unchanged / fixed 	 Farm scale increases due to land expansion Increase in farmers' income Changes in optimal farm patterns
Increases in Input prices	 Increase in input prices based on the highest price change, which is around 10% Other resource constraints are considered unchanged / fixed 	 Changes of income in farmers - breeders household Changes in optimal conditions
	- Output prices are unchanged / fixed	

Table 6. Simulation Results 1 Regarding Changes in Animal Resource Constraints on Farmers' Households in the Research Area

Resources	Optimal Condition	Simulation Results	Percentage of
	_	1	Change (%)
Land	0.48	0.6	0.25
Local cattle	2.75	2.80	0.018
Labor	80.415	80.415	No change
Income	52,112,440.00	61,152,910.00	14.78

LIST OF REVISION

List of Manuscript Revision

The optimation of cow-calf beef cattle and paddy farming integration on farmer household In Grobogan Regency

Line number	Written	Comment - correction	Revision or justification
33	District	Regency	Regency
35	samples of farmers	Respondents	Respondents
41	То	by	By
55	Hutasoit D.D.P.I	Hutasoit	Hutasoit

89	Programing	programming	Programming
93	Programing	programming	Programming
98	Font 11	Font 12	Font 12
106	Singarimbun dan Effendi, 1995)	It is better to get the latest one	Morissan, M. A. 2012
108 - 109	Statistics in 2017		2018
110-111	beef cattle and paddy and farming from the planting area and paddy	Too much "and"	beef cattle, paddy farming from the planting area and paddy
112	were 2 districts	Why did the researchers select only two districts and two villages??what sampling method did you use?	Were 2 districts purposively selected
113	The highest	The highest usually pointed only one village	The highest word is omitted and directly refers to the reason for choosing the research location
121	were 20 farmers	May explain, why did researcher choose 20 farmers from each village	The reason for determining the number of respondents is 20 farmers per village because the characteristics of farmers are relatively homogeneous in the context of farm scale and rearing management.
132		Any reference for this formula?	Minh et al., 2007
168	Regency	It is better to be consistent, regency/district	Regency
177		Is taken from central bureau statistics of Indonesia?	No, the data taken from BPS, Grobogan Dalam Angka 2018
205		Cow calf?	Yes, this research focuses on cow-calf beef cattle
229	4.000	4,000	4,000
243	Nasendi and Anwar, 1985	Get the newer reference	Mukhlis et al., 2018
253	1.483	1.48	1.48
271	Mean	means	Means
294	4,500,000,-	4,500,000,00??look the number below using ,00	4,500,000,- Line 294 is adjusted to 52,122,000,-

355	BPS	BPS Kabupaten	BPS Kabupaten Grobogan
		Grobogan?	
413		BPS Jawa Tengah, 2018	It has been added in line 356
		Not available in	
		references	

5.Attachment 5 : Corresponding Authors, May 17, 2020



E JITAA JPPT sportpancip Ognaticum) 👘 Kapadai Titik Ekowati Ekowati

📇 - Mei, 17 Mei 2020 jam 1417. 🕸

Dear Author,

Please write the names of the authors, complete addresses and corresponding authors in the manuscript

Thank You



Optimation of cow-calf beef cattle and paddy farming integration (Ekowati et al.)

The optimation of cow-calf beef cattle and paddy farming integration on farmer household In Grobogan Regency

T. Ekowati*, E. Prasetyo and M. Handayani Faculty of Animal and Agricultural Sciences, Diponegoro University Tembalang Campus, Semarang 50275 – Indonesia *Correspondence E-mail : tiekowati@yahoo.co.id

ABSTRAK

Rumahtangga petani umumnya berusahatani pada sub-sektor pertanian tanaman pangan dan sub-sektor peternakan yang belum dilaksanakan dengan baik, sehingga kondisi optimal usahatani belum dicapai. Penelitian bertujuan untuk menganalisis optimasi integrasi sapi potong dan padi, simulasi perubahan harga input dan penggunaan sumberdaya terhadap model optimal. Metode survey digunakan dalam penelitian di Kabupaten Grobogan, dengan menentukan Kecamatan Wirosari dan Kecamatan Purwodadi. Quota sampling method digunakan untuk menentukan jumlah sampel peternak sapi potong induk-anak dan petani padi tanpa menghitung jumlah populasi sebagai sampling frame. Jumlah responden setiap kecamatan adalah 40 petani sehingga total responden 80 petani. Data dianalisis dengan linear programming. Hasil penelitian menunjukkan bahwa kondisi optimum skala usaha integrasi sapi potong dan padi dicapai pada luas lahan 0,45 ha, pemeliharaan induk sapi potong 2.75 UT dengan maksimum pendapatan Rp 52.112.440/tahun. Hasil simulasi perubahan penggunaan input menunjukkan bahwa penambahan luas lahan 0,25% memberikan peningkatan skala usaha sapi potong 0,018% dan pendapatan 14,78%, Kesimpulan optimasi integrasi sapi potong dan padi dicapai pada luas lahan 0,45ha dan induk sapi potong 2.75 UT dan simulasi solusi optimal menunjukkan bahwa petani mempunyai kemampuan untuk mengembangkan usahataninya.

Kata kunci : integrasi, optimasi, padi, pendapatan, sapi potong

ABSTRACT

Farmer households generally operate food crops and livestock subsectors that have not fully implemented well, so an optimal farming has not been achieved. This study aimed to analyze optimation of beef cattle and paddy farming integration and simulation changing in input prices and the usage of resources to the optimal model. Survey method was used in the research in Grobogan Regency by determining Wirosari District and Purwodadi District. Quota sampling method is used to determine the number of respondents without counting the population as a sampling frame. The number of respondents in each district was 40 farmers so the total respondent was 80 farmers. Data were analyzed using linear programing. Results showed that optimum conditions of integration were achieved in 0.45ha land, 2.75 AU of beef cattle with maximum income of IDR 52,112,440/year. The simulation results regarding in changing in input usege indicated that the addition of 0.25% land area gives a change in scale of beef cattle by 0.018% and income of 14.78%. In conclusion, integration optimation was achieved on 0.45ha land, 2.75 UT beef cattle and optimal solution simulations indicated that farmers have the ability to develop their farming.

Keywords: beef cattle, integration, income, optimation, paddy

INTRODUCTION

Beef cattle and paddy farmings are forms of farm activity pursued by many people in Central Java. The meaning contained in these farm activities is how beef cattle and paddy farming are run by farm households to get better results, both in terms of farm scale and income. The policy regarding beef cattle and paddy farming development is basically has a correlative and synergistic relationship, considering that agricultural waste is substantially raw material (feed) for livestock farm. Farmer households use integrated farming system in developing agriculture, considering that besides providing economic benefits, this pattern also provides benefits in land conservation and land productivity. This is in line with Soedjana (2007) and Hutasoit (2008) that the reason why farmers choose mixed farming or integration is because of habits (tradition), to maximize revenue from limited resources, and increase benefits of correlation between integrated farming patterns in the food crop sub-sector and livestock sub-sector, which will encourage the development of food crops especially paddy and livestock and create investment opportunities. This is also supported by Basuni *et al.* (2010), Mukhlis *et al.* (2015) and Ponnusamy and Devi, 2017 that the integration of farming systems can provide both ecological and economic benefits because the waste from each commodity can be used as an input factor, so that it can save the use of cost and can increase income. Another research by Darith *et al.* (2016) indicated that activities carried out by farmers in the integration model can increase farmer income which in turn can increase investment in farming

Farmer households can be seen as a unit of farm activity consisting of production, activities and labor services activities. All of these activities are a unity, so that farmer's household cannot be seen as a pure consumer because there is a portion of the production that is consumed and partly sold as capital. Likewise in the labor use, farmers-breeders, labor can come from within the family or outside the family. Thus, farmer households can be said to be producers and consumers (Priyanti, 2007).

Integration of beef cattle and paddy based on the scale of farm that the number of livestock and land area can provide some form of integration (Matin *et al*, 2016). Integration can

take the form of an exchange relationship between livestock and paddy which can be in the form of fertilizer and forage (Regan *et al.*, 2017)

Integrated farming systems, in Grobogan, which is managed by farmer's household generally consist of beef cattle, especially cow-calf rearing, and paddy farm. Farm households usually face constraints on land and cow-calf resource constraints. These constraints are in accordance with by Basuni *et al.* (2010) statement that in West Java, the integration of beef cattle and paddy is contained in land boundaries and livestock numbers. Therefore, the optimal allocation of resource use in the integration of cow-calf and pady needs to be assessed.

Allocation of resource use controlled by farmers is very important, because non-optimal resource use means a cost for farming management. As a result, the profits generated for farmer as farming manager becomes are optimal (Masayasu *et al.*, 2018). Allocation of the use of production factors that provide optimal results can be analyzed by linear programming.

Analysis using linear programming can provide information for agricultural policy makers regarding: (a) the structure of related relationships and the costs of comparative advantage in agricultural sector; (b) production potential; (c) job opportunities; (d) consistency of every alternative agricultural policy. (Minh *et al.*, 2007)

Linear programming is a method that is more systematic and mathematically rigorous for determining the optimum combination of farm sectors or contributions such as revenue maximization or cost minimization with limited available resources (Darith *et al.* (2016). From the study results, it is expected that an allocation model for an optimal use of production factors can be created, so that it can benefits for farmers. Based on the bacground, the objective of the study were to develop an optimation for beef cattle and paddy farm integration and simulate changes in input prices and resources use to optimal model.

MATERIAL AND METHODS

The study was conducted by using a survey method to determine the condition of farmer households, especially cow-calf cattle farming and paddy farming in managing their farm integration. Survey method is a method of taking respondents by determining a sample of the existing population. (Morissan, 2012)

Purposive method was used to determine the study location based on potential of the most populated area by beef cattle and paddy production in Central Java. Based on data on Agricultural and Animal Husbandry Statistics in 2018, it is known that Grobogan is regency with a potential combination of beef cattle, paddy farming from the planting area and paddy production aspects as well as the raising of beef cattle in Central Java. Based on regency location, there were 2 districts purposively selected where two villages were taken in each district based on several indicators such as number of beef cattle population, paddy production and farmer group activities. Based on the purposive results, districts selected for the study were Wirosari District, consist of Karangasem Village and Sambirejo Village, and Purwodadi District with Nambuhan Village and Genuksuran Village.

Quota sampling method was conducted to determine the sample number of cow-calf cattle and paddy farmers without counting the population as a sample frame. The sample number of cowcalf beef cattle and paddy farmers from each village were 20 farmers, so the total number of respondents was 80 farmers households. The reason for determining the number of respondents is 20 farmers per village because the characteristics of farmers are relatively homogeneous in the context of farm scale and rearing management

The method used to analyze the objectives was linear programming and descriptive analysis. From this model, cow-calf beef cattle and paddy farmers can be considered as cow-calf beef cattle and paddy producers that produce livestock and paddy supply continuously from optimal allocation of resources. Thus, the objective function in this linear programming research model was to maximize household income in term of integration cow-calf beef cattle and paddy farming.

The mathematical form of the Linear Programing model that maximizes the objective function in general is: (Minh *et al.*, 2007)

n

Maximum $Z = C_1 X_1 + C_2 X_2 + C_3 X_3 \dots + C_j X_j - \dots + C_n X_n$ or $Z = \sum_{j=1}^{n} C_j X_j \dots$ (1)

With constraint:

 $\begin{array}{l} a_{11}x_1 + a_{12}x_2 + \ldots a_{1j}x_j + \ldots a_{1n}x_n \leq b_1 \\ a_{21}x_1 + a_{22}x_2 + \ldots a_{2j}x_j + \ldots a_{2n}x_n \leq b_2 \\ a_{31}x_1 + a_{32}x_2 + \ldots a_{3j}x_j + \ldots a_{3n}x_n \leq b_3 \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1}x_1 + a_{m2}x_2 + \ldots a_{mj}x_j + \ldots a_{mn}x_n \leq b_m \text{ or } \sum_{j=1}^n a_{ij}X_j \leq b_i \quad \dots \dots \dots \\ j = 1 \end{array}$ (2)
Explanation:

 $i = 1, 2, 3 \dots m$ is the number of limitation factors

 $j = 1, 2, 3 \dots n$ is the number of production activity

Activity was not negative: $xj \ge 0$ for all j

Z = objective function which is the income of maximized cow-calf beef cattle Farmers and paddy

- C = production prices (C) and input prices (-C)
- xj = production and consumption activities carried out by households of cow-calf beef cattle and paddy farmers
- aij = input coefficient of each production and consumption activity

bij = value of constraints or the available resource limits

Referring to the research objectives the are basic components can be formulated as follows: Objective function The objective function (Z) in this study is to maximize the income of cow-calf beef cattle and paddy farmers from various alternative activities with existing resource constraints.

Alternative Activity Model

Some of activities carried out in this study include: (1) farming - livestock production activities; (2) purchasing production facilities; (3) hiring of workers; (4) sales of products; (5) consumption expenditure (food and non-food)

RESULTS AND DISCUSSION

Overview of Grobogan Regency

The livelihood of Grobogan residents are generally dominant in agriculture. This is due to the potential of Grobogan Regency which mostly dominated by agricultural land. Based on the results of population in 2017, it was noted that the population working in the agricultural sector amounted to 52.5%. One of the main capital in the development is labor. In line with the ongoing demographic process, the number and composition of the labor will continue to change. (BPS Kabupaten Grobogan, 2018)

In Grobogan Regency, land conversion from agricultural to non-agricultural land is increasing, but the potential of agricultural sector until now is still dominant in supporting the economic sector of Grobogan Regency. In 2018, about 84.91% of the total area in Grobogan Regency was used for agricultural activities. The production of lowland paddy of Grobogan Regency in 2017 experienced a significant increase compared to the previous year. This year, the production of lowland paddy reached 786,040 tons with a harvested area of 123,446 ha. While for upland paddy, the production reached 13,267 tons with a harvested area of 3,489 hectares. On the other hand, corn production reached 700,941 tons with a harvest area of 112,700 ha. The population of livestock in Grobogan Regency in 2017 generally increased compared to the

previous year. The population of livestock consisted of 365 dairy cows, 178,555 beef cattle, 2,457 buffaloes, and 494 horses. Many livestock in Grobogan Regency are sent out of the area to meet the demand of other regions. In 2018, the number of livestock sent out from Grobogan Regency reached 30,108 cattle and 3,634 buffaloes. (Table 1)

Respondents were majority consisted of farmers in their productive age (85%) with 100% working as farmers and 57.50% of them were primary school with the farm experience was 34% around 20 years; while the average land tenure was 0.45 ha and averagedly the livestock ownership was 1.54 animal unit (AU). This condition can affect production, both in cow-calf and paddy farming. (Table 2)

Increasing education is the most important factor in Indonesian development, if it seen from the population perspective, both as the object of development as well as the subject of development. The success of the development in an area can be indicated by the high level of education of its population. This is surely correlated to the educational facilities available in the area. The livelihoods of residents in Grobogan Regency are still dominant in agriculture. This is due to the potential area of Grobogan Regency which still dominated by agricultural land. Based on the results of population projection in 2015, it was noted that the population working in the agricultural sector amounted to 56.0 percent, trade 17.5 percent, transportation 8.6 percent, and the rest worked in the services, plantation, industry, fisheries, and other sectors (BPS Kabupaten Grobogan, 2018)

Analysis of Costs and Income of Cow-Cal Beef Cattle and Paddy Farming

The use of production factors on farming will cause a cost, both variable costs and fixed costs. Costs for variable input expenditures include seeds, fertilizers, pesticides, non-family labor, and other costs such as irrigation costs, farmer group fees and loan interest. In addition, farmers

also pay fixed costs such as land rent, tractor rent, depreciation of capital goods (hoe, hand sprayer, sickle, and *sosrok*), and land tax. All costs are stated in rupiah, the amount of which is based on the price at the time the transaction takes place. (Table 3)

Farmers with 1.54 AU of cow-calf beef cattle operations require a production cost of IDR. 8,095,927.19 per year with the highest cost of IDR. 3,760,560 (46.45%) allocated for forage cost. Labor cost is also incurred by many farmers, considering the scarcity of family labor, so it is necessary to allocate this cost, which amounted to IDR. 3,274,875.00 (40.45%). The highest cost in paddy farming was the labor cost. Today, agricultural labor is an important asset, given the number is increasingly scarce in the countryside. This is what makes the high wages of labor so that farmers have to pay more for labor costs (Maryanto *et al.*, 2015). The production cost of paddy farming per hectare was IDR. 15,584,121.5, - per year where farmers cultivated paddy crops two times in one year.

Revenue for cow-calf beef cattle was IDR. 6,680,937.5 and livestock value added was IDR. 2,436,037.5. Thus, the income of cow-calf was IDR. 9,116,975,-/year with the cost incurred of IDR. 8,095,927.19 and income of IDR. 1,041,860.32/year/1.54 AU or IDR. 86,821.69/month/1.54 AU. It's a very small value to support the farmer's daily life. Whereas, revenue of paddy farming in the form of harvested dried rice for a year with 2 planting seasons was 6,187.5 tons/ha harvest. the price of paddy was IDR. 4,000,-/kg then farmer's revenue was IDR. 24,750,000/0.45ha/season, or IDR. 49,500,000/ha/year, with an income of IDR. 33,915,878/ha/year or IDR 2,826,323.2/ha/month. Based on the farm income, the profitability of cow-calf beef cattle and paddy farm were 1.2% and 217.63%, respectively. This showed that the farmer's household is more supported by the results of paddy farming, as Mukhlis *et al.* (2018) said that integrated of

beef cattle and farming system can increase income and profitability of farmer's household which paddy farm is dominant for household income.

Optimation Analysis

The results of optimization analysis will illustrate the results of optimal solutions by using resources describing the optimal solution of linear programming analysis which incude: (1) validation of optimal solution values, 2) farm household income from optimal solutions, (3) optimal allocation of farmer's household resources and beef cattle farm activities as wel as the level of constraints and shadow prices of resources. (Mukhlis *et al.*, 2018 and Ryschawy *et al.*, 2017)

Optimation of cow-calf beef cattle farming and paddy describes the farm system with the farm household approach. The farm household approach is implemented because the farmerbreeder's livelihood is not independent as farmers or breeders alone, but both activities are integrated in one household. On one hand, farmers can be seen as producers and on the other hand as consumers. Farmers-breeders as producer means that farmers-breeders will maximize income from a number of activities, while as consumer, farmers-breeders will consume goods either from their own production or purchased for family consumption. Results of research showed that optimal condition of cow-calf beef cattle and paddy integrated farming system were 2.75 AU of local cow s of the year 1, 1.48 AU of non local livestock raising pattern and 0.45 ha land harvested of paddy. In maximizing income was IDR 52,122,440 in 3 years. In this term, farmers are faced with challenges on land, labor, and capital. This is consistent with Rohaeni *et al.* (2014) and Tawaf *et al.* (2017) that the farmer's problems in the application of optimation of agricultural patterns are capital, land, labor, and price fluctuation.

Validation the Value of The Optimal Solution

Model validation is the first step that needs to be done in the analysis of optimization of household resource allocation. The results of the validation of linear programming models are conducted to determine whether the model used in the analysis is valid. The results of model validation showed the optimal conditions of the state of the resource or household activities of farmers. The optimal analysis model is valid if the optimal value is at the confidence interval. The results of the validation of the model of household resources of farmers are presented in Table 4.

The results of the validation of the optimization model it was known that the resources and activities carried out by the household are in a confidence interval, namely the optimal conditions for cow-calf beef cattle was 2.75 located between 2.612 - 2.887 at the confidence interval, while the land optimal condition was achieved at 0.45 with the confidence interval was 0.428 - 0.473. It means that the model used is valid. If there is a change in resources or activities outside the confidence interval, it will cause changes in optimal conditions. Conversely, if the change is still at a confidence interval, it certainly will not change the optimal conditions. Based on the results of the linear program, it was known that rearing of local cow-calf beef cattle and non-local cow-calf cattle and also paddy farming obtained optimal values and are in confidence intervals. The optimum capital use was achieved in year 1, which is IDR 4,500,000. While the use of agricultural land for paddy commodities is known to be optimal conditions in year 1, 2 and 3. The use of family labor labor showed optimal use and results are within the confidence interval. The use of an optimal workforce showed that if farmer households need labor, the workforce must be met from outside the family. Food and non-food consumption has also shown optimal conditions and is at the dividend interval. It met with Maryanto et al., 2015 that there was relationship between production decisions, allocation of labor farming and consumption decisions in households of integrated farming systems of beef cattle and paddy. After the optimation analysis is carried out, the answer to the hypothesis is that the main source of livestock, land and labor has been allocated optimally. Therefore, these resources can be said to be a limiting factor/farm constraints because the resources used are used up. (Table 4)

The validation results of optimal analysis model on farmers household activities in Grobogan Regency showed that the optimal condition for cow-calf beef cattle of 2.75 AU and agricultural land use was 0.45ha. From cow-calf beef cattle and paddy farming activities, the optimal labor was achieved at 80.415 work day and capital for each period of IDR. 4,500,000,-The results of income maximization obtained by farmers-breeders households amounted to IDR. 52,122,440,- per year.

Simulation of Optimal Conditions

Optimation analysis model of resource allocation for farmers household showed valid results and optimal conditions are achieved. Therefore, a simulation is carried out to find out whether there is a change in the objective function or constraints. This was taken to find out how much there has been a change in farming-cow-calf beef cattle and income of farmers households in order to keep in optimal condition, if there are changes in land resource constraints and input prices.

Cow-calf beef cattle resources are not simulated for changes in increase because the limit value of the cattle resources has reached its optimum condition at 2.75 AU. Thus, if there is any addition made, then other resources will not support it, especially labor. This is because the existing labor has another activity, i.e. paddy farming. Therefore, simulations are carried out on the rising of input prices both for cow-calf beef cattle and paddy farming, with a change of 10% without an

increase in output prices. While the increase of input prices was based on field conditions, where the price of animal feed tend to rise with variation in increase around 10%. Changes occured from the simulation results are presented in Table 5

The simulation results showed that 0.25% addition in land area, namely from 0.45 ha to 0.6 ha gave a change in the scale of livestock farm of 0.018% and income of 14.78%, i.e. from IDR 52,112,440,- to Rp 61,152,910,-. Changes in the optimal solution results of the simulation indicated that farmers have the ability to develop their farms. (Table 6). This is in accordance with Maryanto *et al.* (2015) that if optimal conditions are reached and simulations are carried out with changes in the use of land and price limiting factors then the optimal conditions are reached and farmers are still able to do the integration farming system.

It also can be seen that there is an increase in the area of labor resources needed, meaning that the addition of land area is still possible to be managed by farmers. The increase of input prices with fixed output prices that are counter balanced by an increase in land area results in an optimal change in income solutions, i.e. an increase in income. An increase in income resulting from the optimal solution is possible because an increase in input prices of 10% can still be counter balanced by the results of farming sales; given the addition of farm scale will result in production as the source of revenue. It can be noted from the simulation results that the optimal solution showed the ability of the farmers in managing their farming and cow-calf beef cattle. The simulation showed the farmers ability to manage their farm if there is an increase in the land area scale, but input and output prices are fixed. This is consistent with Karmini and Syarifah (2008) and Howara (2011) that land area will affect farming production and profits. Determining the right amount of optimal land is one way to increase production with the aim of achieving maximum profits. An increase in the amount of farmers' income is also still possible by making changes to the use of land inputs,
so that productivity increases and ultimately increases the income. In addition, the ability to manage land for farming is generally also influenced by the availability of labor and capital, as stated by Khalik *et al.* (2013). As in optimal conditions, labor in the farmer's household is used up to manage his farm.

CONCLUSION

Based on the study results, it can be concluded that:

- The optimal condition is obtained on cow-calf beef cattle of 2.75 AU and a land area of 0.45 ha.
- 2. The maximum income of farmer households was IDR. 52,112,440/year.
- 3. The simulation results of changes in input use indicated that the addition of land area of 0.25%, i.e. from 0.45 ha to 0.6ha results in a change of 0.018% in the scale of cow-calf farm and income of 14.78%, i.e. from IDR. 52,112,440,- to IDR. 61,152,910,-. Changes in the results of the optimal solution in the simulation indicated that farmers have the ability to develop their farms.

REFERENCES

Basuni, R., Muladno, C. Kusmana and Suryahadi. 2010. Model sistem integrasi padi-sapi potong di lahan sawah. Forum Pascasarjana. 33(3):177-190

BPS Kabupaten Grobogan. 2018. Grobogan Dalam Angka 2018.

- Darith, S., S. Xu, W. Yu and A. A. Gafar. 2016. Optimization model of cattle Husbandry for rural household in Cambodia. Journal of Agricultural Chemistry and Environment.5:6-11
- Howara, D. 2011. Optimalisasi pengembangan usahatani tanaman padi dan ternak sapi secara terpadu di Kabupaten Majalengka. J. Agroland 18 (1) : 43 49.

- Hutasoit, D.D.P.I. 2008. Pengaruh kegiatan optimasi lahan terhadap Pengembangan wilayah di Kabupaten Simalungun (Studi Kasus Nagori/Desa Naga Saribu, Kecamatan Pamatang Silima Huta). Wahana Hijau. Jurnal Perencanaan & Pengembangan Wilayah. 4(2):51-58.
- Karmini and A.A. Syarifah. 2008. Optimalisasi lahan usahatani tomat dan mentimun dengan kendala tenaga kerja (pendekatan program linier). EPP.5(2):44-50.
- Khalik R, Safrida, and A.H. Hamid. 2013. Optimasi pola tanam usahatani sayuran selada dan sawi di daerah produksi padi (Studi Kasus di Desa Lam Seunong, Kecamatan Kota Baro, Kabupaten Aceh Bes.,
- Martin, G., M. Moraine, J. Ryschawy, M. A. Magne, M. Asai, J. P. Sarthou, M. Duru and O. Therond. 2016. Crop–livestock integration beyond the farm level: a review. Agron. Sustain. Dev. 36:53.
- Masayasu, A., M. Moraine, J. Ryschawy, J. de Witd, A.K. Hoshidee and G. Martinc. 2018. Critical factors for crop-livestock integration beyond the farm level: A crossanalysis of worldwide case studies. Land Use Policy 73:184-194
- Mariyanto, J., R. Dwiastuti and N. Hanani. 2015. Model ekonomi rumahtangga pertanian lahan kering di Kabupaten Karanganyar Provinsi Jawa Tengah. Habitat, 26 (2):108-118
- Minh, Th., S. Ranamukhaarachchi and H. Jayasuriya. 2007. Linear Programming-based optimization of the productivity and sustainability of crop-livestock-compost manure integrated farming systems in Midlands of Vietnam. ScienceAsia 33:187-195
- Morissan, M. A. 2012. Metode Penelitian Survei. Kencana. Jakarta
- Mukhlish, M. Noer, Nofialdi and Mahdi. 2015. Analisis usahatani integrasi padi sapi potong. Jurnal Penelitian Lumbung, 14(1):1-10

- Mukhlis, M. Noer, Nofialdi and Mahdi. 2018. The integrated farming system of crop andlLivestock: A Review of Rice and Cattle Integration Farming. International Journal of Sciences: Basic and Applied Research (IJSBAR). 42(3): 68-82
- Ponnusamy, K. and M.K. Devi. 2017. Impact of integrated farming system approach on doubling farmer's income. Agricultural Economics Research Review. 30:233-240
- Priyanti, A., B.M. Sinaga, Y. Syaukat and S.U. Kuntjoro. 2007. Model ekonomi rumahtangga petani pada sistem integrasi tanaman-ternak: Konsepsi dan studi empiris. WARTAZOA 17(2):61-70
- Regan, J. T., S. Martonc, O. Barrantes, E. Ruanef, M. Hanegraaf, J. Berland, H. Korevaar, S. Pellerina and T. Nesme. 2017. Does the recoupling of dairy and crop production via cooperation between farms generate environmental benefits? A case-study approach in Europe. Europ. J. Agronomy. 2016:15
- Rohaeni, E. S., B. Hartono, Z. Fanani and B. A. Nugroho. 2014. Sistem usaha tani terintegrasi tanaman-ternak sebagai respons petani terhadap faktor risiko. Journal of Economics and Sustainable Development. 5(1):159-168.
- Ryschawy, J., G. Martin, M. Moraine, M. Duru and O. Therond. 2017. Designing crop–livestock integration at different levels: Toward new agroecological models? Nutrient Cycling in Agroecosystems. 108(1):5-20.
- Soedjana, T.D. 2007. Sistem usaha tani terintegrasi Tanaman-ternak sebagai respons petani terhadap faktor risiko. Jurnal Litbang Pertanian, 26(2):82-87.
- Tawaf, R., M. Paturochman, L. Herlina, M. Sulistyati and A. Fitriani. 2017. The optimation of farmers families' revenue the integration of Pasundan cattle and paddy farming in West Java. J. Indonesian Trop. Anim. Agric. 42(4):270-278.

Commodity	Harvested area	Production
	ha	tons
Paddy		
- Lowland	123,446	786,040
- Upland	3,489	13,267
Corn	112,700	700,941
	Population	
	head	
Beef cattle	178,555	
Dairy cows	365	
Buffaloes	2,457	
Horses	494	

Table 1. The Agriculture Potential Commodities in Grobogan

Source : BPS Kabupaten Grobogan, 2018.

Table 2. Number and Percentage of Farmer's Household Profile

No.	Profile	Number	Percentage (%)
			%
1.	Age (year)		
	■ ≤17	0	0.00
	■ 18-60	68	85.00
	• ≥ 61	12	15.00
2.	Main livelihood		
	 Farmer 	80	100.00
	 Village Officials 	0	0.00
	 Entrepreneur 	0	0.00
3.	Education		
	Primary School	46	57.50
	 Junior High School 	22	27.50
	 Senior High School 	12	15.00
4.	Farming Experience (year)		
	• 6-10	12	15.00
	■ 11 – 20	32	40.00
	• > 20	36	45.00
5	Land tenure (ha)		
с.	• < 0.25	5	6.25
	■ 0.25 – 0.5	48	60.00
	► > 0.5	27	33.75
6.	Number of Cattle (head)		
	• < 3	10	12.5
	• 3-4	55	68.75
	■ > = 5	15	18.75

Table 3. Income of Cow-Calf Beef Cattle and Paddy Farming

Components	Beef Cattle Farming Income	Rice Farming Income
	IDR/1.54 AU/year	IDR/ha/year
Revenue	9,116,975.00	49,500,000.00
Cost	8,095,927.19	15,584,121.50
Income	1,041,860.32	33,915,878.50

Source: Primary Data Analysis

Table 4. The Results of The Optimal Validation Model of Household Resources

	V	Validation Model
Activities	Optimal	Confidence Interval
	Condition	(α=95%)
Local livestock raising pattern (AU)		· · ·
 Local cows of the year 1 	2.750	2.612 - 2.887
 Non Local livestock raising pattern (AU 	1.483	1.408 - 1.557
Sale of local female calves		
 Sales of local calves in year 1 	5.500	5.225 - 5.775
 Sales of local calves in year 2 	2.750	2.612 - 2.887
 Sales of local calves in year 3 	2.750	2.612 - 2.887
Sale of local male calves		
 Sales of local male calves in year 1 	1.483	1.409 - 1.557
 Sales of local male calves in year 2 	1.483	1.409 - 1.557
 Sales of local male calves in year 3 	1.483	1.409 - 1.557
Use of agricultural land (ha)		
 Paddy in year 1 	0.45	0.428 - 0.473
 Paddy in year 2 	0.45	0.428 - 0.473
 Paddy in year 3 	0.45	0.428 - 0.473
Capital Requirements in year 1	4,500,000	
Paddy sales (kw)		
 Paddy sales in year 1 	28.435	27.013 - 29.857
 Paddy sales in year 2 	28.408	26.987 - 29.828
 Paddy sales in year 3 	28.435	27.013 - 29.857
Family labor (working day)		
 Family workforce in year 1 (working day) 	80.415	76.394 - 84.436
 Family workforce in year2 (working day) 	80.415	76.394 - 84.436
 Family workforce in year 3 (working day) 	80.415	76.397-84.436
Consumption expenditure		
 Food consumption in year 1 	4,070,545.00	3,867.017.75 - 4.274.072,25
 Food consumption in year 2 	4,153,825.00	3.946.133,75 - 4.361.516,25
 Food consumption in year 3 	4,886,500.00	4,642,175.00 - 5,130,825.00
 Non-food consumption Year 1 	3,516,549.30	3,340,721.55 - 3,692,376.45
 Non-food consumption Year 2 	3,588,315.60	3,408,899.82 - 3,767,731.38
 Non-food consumption Year 3 	3,642,960.00	3,460,812.00 - 3,825,108.00
Income in year of 1-3 (IDR)	52,122,440.0	

Note : confidence interval at $\alpha = 5\%$

Table 5.	Simulation of Optimal	Conditions	on Farmers'	Households in	n the
	Research Area				

Types of Simulation	Scenario	Expected Results
Changes in farming land resources	 The greatest increase in the paddy farming scale managed by farmers from 0.45 ha to 0.6 ha Other resource constraints are considered unchanged / fixed Inputs and output prices are considered unchanged / fixed 	 Farm scale increases due to land expansion Increase in farmers' income Changes in optimal farm patterns
Increases in Input prices	 Increase in input prices based on the highest price change, which is around 10% Other resource constraints are considered unchanged / fixed Output prices are unchanged / fixed 	 Changes of income in farmers - breeders household Changes in optimal conditions

Table 6. Simulation Results 1 Regarding Changes in Animal Resource Constraints on Farmers' Households in the Research Area

Resources	Optimal Condition	Simulation Results	Percentage of
		1	Change (%)
Land	0.48	0.6	0.25
Local cattle	2.75	2.80	0.018
Labor	80.415	80.415	No change
Income	52,112,440.00	61,152,910.00	14.78

Note : List of Revision is the same as before

6.Attachment 6. Proof Sheet, May 28, 2020



JITAA	PROOF SHEET - 1	L Indensian Trop. Anim. Agea SN 2007 A277 a255N 2466-6276 ported andp as id totocylepijea
Average of the Indonesian Tropical Aver	nő Agnicóltora	45(3):, fore 1020
Averaging by Drive Perspecta Robins	g Nes Mr.E.KPT-2018	DOI: 10.14710/jmit.45.2

The optimation of cow-calf beef cattle and paddy farming integration on farmer household

T. Ekowati*, E. Prasetyo and M. Hamlayani

Focalty of Animal and Agravatural Sciences, Diplonegoon University, Tembulary Comput. Semarang 30273 - Indonesia *Corresponding E-mail . tielewalt@yahos co.id Received February 54 3920: Antepted May 17, 2020

ABSTRAK

Romahtangga petani umamnya berusahatani pada sub-sektor pertanian tanaman pangan dan subsektor paternakan yang belum dilaksanakan dengan bark, sehingga kondus optimul usuhatara belum dicspai. Penelitian bertajuan untuk menganalasa optimusi intograsi sopi potong dan padi, simulasi peruhahan harga orput dan pengganaan sumberdaya terhadap model optimal. Metoda survey digonakan dalam penelitian di Kabupaten Grobogan, dengan meneruhkan Kecamatan Waroseri dan Kecamatan Parwodadi. Quoto sampling method digarakan tantuk menentukan jumlah sampid peternak saju potong induk-anak dan petani judi tanjai menghitang jumlah pepulasi sebagai sampling Jeane. Jumlah responden setup kecamatan adalah 40 petani sehingga sotal responden 80 petani. Data dianalisis dengan linear programmeng. Hand penelitian esemunjukkan bahwa kondisi optimaan skala usoba integrasi sapi potong dan padi dicapai pada luas lalun 0,45 lm, peneliharaan mduk sapi potong 2.75 UT dengan maksomim pendapatan Rp 52/112/440/tahun. Hanil senselasi perubahan penggunaan input menungukkan bahwa perumbahan kute lahar 0,25% memberikan peningkatan skala utaha sapi potong 0,018% dan pendapatan 14,78%, Kesimpulan optimasi integrasi sapi petong dan pada dicapat pada tuar lohan 0.45ha dan induk sapi potong 2.75 UE dan simulasi soliasi optimul mensinjukkan bahwa petani mempunyai kemampuan temik mengembangkan usahatanmya

Kata kunci - integrasi, optimati, pudi, pendapotan, sapi potong-

ABSTRACT

Farmer households generally operate feed crops and locestock subsectors that have not fully emplemented well, so an optimal farming has not been achieved. This study aimed to analyze optimation of beef cattle and paddy farming integration and simulation changing in input prices and the usage of resources to the optimal model. Survey method was used in the research in Grobogan Regency by determining Winson District and Purwodade District. Quita sampling method is used to determine the number of respondents without counting the population as a sampling frame. The number of respondents in each district was 40 farmers ac the total sespondent was 80 farmers. Data were analyzed using linear programing. Results showed that optimizen conditions of integration were achieved in 0.45ha land, 2.75 AU of beef cattle with maximum income of IDR 52.112,440/year. The innulation results regarding in changing in upper usage indicated that the addition of 0.23% land area govers a change in scale of beef eatile by 0.018% and means of 14.78%. In conclusion, integration optimistion was achieved on 0.45% land. 75 UT beef cattle and optimal solution simulations indicated that farmers have the ability to develop their faming

Keywords: Neef cattle, integration, income, optimation, paddy

Optimation of Conversity Reef Cattle and Parkly Farming Integration (2) (Reputtionally to: 45(2). have 2020 .

INTRODUCTION

Boef cattle and puddy farmings are forms of fam activity pursued by many people in Central lava. The meaning contained in these farm activities is how beef cattle and paddy farming are run by farm households to got better results, both in terms of farm scale and income. The policy regarding beef cattle and packly farming development is basically has a correlative and synergotic relationship, considering shar agricultural waste is substantially raw material (feed) for levestock farm. Farmer households use integrated farming system in developing agriculture, considering that besides providing economic benefits, this pattern also provides benefits in land conservation and land productivity. This is in line with Soedjana (2007) and Histosoit (2009) that the reason why farmers chause intered forming or integration is because of habits (tradition), to maximize revenue from limited resources, and increase benefits of correlation between integrated farming patients in the food crop sub-sector and livestock sub-sector, which will encourage the development of food crops especially puddy and livestock and create investment opportunities. This is also supported by Basimi et al. (2010), Mukhlis et al. (2015) and Ponnusamy and Devi, 2017 that the integration of farming systems can provide both ecological and economic henefits because the wester from each commodity can be used as an input factor, so that it can save the use of onet and can increase income. Another research by Dirtith et al. (2016) indicated that activities carried out by farmers in the integration model can incruise farmer income which in tim can incruase investment in farming Farmer households can be seen as a unit of farm activity consisting of production, activities and labor services activities. All of these activities are a unity, so that farmer's household cannot be seen as a pure consumer because there is a portion of the production that is consumed and parily sold as capital. Likewise in the labor use, farmerabreeders, labor can come from within the family or outside the family. This, famor households can be said to be producers and consumers (Priyanti, 2007).

Integration of beel cattle and paddy based on the scale of farm that the number of hyestock and land area can provide some form of integration (Matin et al. 2016). Integration can take the form of an ecologing relationship between lovestock and paddy which can be in the form of fertilizer and

firrage (Regan et al., 2017)

Integrated farming systems, in Grobogat, which is numiged by farmer's household generally consist of beel cattle, expectably concalf norming, and paddy farm. Farm households usually face constraints on land and cow-calf resource constraints. These constraints are in accordance with by Bouni *et al.* (2010) statement that in West Java, the integration of beef cattle and paddy is contained in land boundaries and livertock numbers. Therefore, the optimal allocation of resource use in the integration of cow-calf and pady needs to be assessed.

Allocation of resource use controlled by farmers is very important, because non-optimal resource use means a cost for farming management. As a result, the profits generated for farmer as farming manager becomes are optimal (Masayasu et al., 2018). Allocation of the use of production factors that provide optimal results can be analyzed by linear programming.

Analysis using linear programming can provide information for agricultural policy makers regarding: (a) the structure of related relationships and the costs of comparative advantage in agricultural sector. (b) production potential: (c) job opportunities: (d) consistency of every alternative agricultural policy. (Minh et al., 2007) Linear programming is a method that is more systematic and mathematically reporters for determining the optimum combination of farm sectors or contributions such as revenue maximization or cost minimization with limited available resources (Darith et al. (2016). From the study results, it is expected that an allocation model for an optimal use of production factors can be crusted, so that it can benefits for famsers. Based on the hacground, the objective of the study were to develop an optimation for beef cittle and paddy farm integration and simulate changes in input prices and resonances use to optimal model.

MATERIALS AND METHODS

The study was conducted by using a survey method to determine the condition of farmer boundwhile, especially cow-call cathle farming and paddy farming in managing their farm integration forvey method is a method of taking respondents by determining a sample of the existing population, (Morissan, 2012)

Purposive method was used to determine the study location based on petential of the most

Optimation of Conversit Reaf Cattle and Paddy Forming Integladionskiel Engediatelity (2), 25(2). . . . Anno 2020

populated area by boef cattle and paddy production in Central Java. Based on data un Agricultural and Anemal Hudoandry Statistics in 2018, et is known that Geologgan in regency with a potential combination of beef cattle, paddy production aspects as well as the taising of beef cattle in Central Java. Based on regency location, there were 2 districts purposively selected where two villages were taken in each district based on several inductions such as number of bod cattle population, paddy production and farmer group activities. Based on the purposive results, districts selected for the study were Witnaari District, consist of Karangasem Village and Sambingio Village, and Purwodadi Detrict with Nambuhan Village and Genukstern Village.

Quota sampling method was conducted to determine the mergle number of cow-call cattle and paddy farmers without counting the population as a sample frame. The analyle samber of cow-calf beel cattle and paddy farmers from meth village were 20 farmers, so the total number of respondents was 80 farmers beaucholds. The reason for determining the number of respondents is 20 farmers are relatively homogeneous in the context of farm scale and rearing management.

The method used to analyze the objectives was linear programming and descriptive analysis. From this model, cow-call beef cattle and paddy fammers can be considered as cow-call beef cattle and paddy producers that produce Xvestock and paddy supply continuously from optimal allocation of resources. Thus, the objective function on this linear programming research model was to maximize bousehold income in term of integration cow-call beef cattle and paddy faming.

The mathematical form of the Liscar Programing model that maximizes the objective function in general (Minh et al., 2007) is

Maximum $Z = C_1 X_1 + C_2 X_2 + C_3 X_3 + C_j X_j$

$$\cdots$$
 + \cdots + $C_n X_n$ or $Z = \sum_{i=1}^{n} C_j X_j$ (1)

With constraint:

$$\begin{array}{l} a_{1j}x_{j}+a_{1j}x_{j}+\dots-a_{1j}x_{j}+\dots-a_{1j}x_{k}\geq b_{j}\\ a_{2j}x_{j}+a_{2j}x_{j}+\dots-a_{2j}x_{k}\geq b_{j}\\ a_{3j}x_{j}+a_{3j}x_{j}+\dots-a_{3j}x_{j}+\dots-a_{3k}x_{k}\geq b_{j} \end{array}$$

$$a_{m1}a_1 + a_{m2}a_2 + \cdots + a_{m3}a_1 + \cdots + a_{m6}a_n \le b_m$$

or $\sum_{i=1}^{n} a_{ij}a_j \le b_i$ (2)

Explanation

 $i = 1, 2, 3 \dots$ m is the number of limitation factors; $j = 1, 2, 3 \dots$ n is the number of production activity. Activity was not negative: $x_j \ge 0$ for all j

- Z = objective limition which is the income of maximized cow-call beef cattle farmers and paddy
- C production prices (C) and input prices (-C)
- xj production and consumption activities carried out by homeholds of cow-call beef cattle and paddy farmers
- aij = input coefficient of each production and constamption activity
- big value of constraints or the available resource limits

Referring to the research objectives the are basic components can be formulated as follows:

- Objective function
 The objective function (Z) in this study is to maximize the income of cowcall' beef cattle and paddy farmers from various alternative activities with existing resource constraints.
- Alternative Activity Model Some of activities carried out in this study include (1) farming - levestock production activities; (2) purchasing production facilities; (3) hiring of workers; (4) sales of products; (5) communities expenditure (food and nonfood)

RESULTS AND DISCUSSION

Overview of Grobogan Regency

The livelihood of Grobugan residents are generally dominant in agricultane. This is due to the potential of Grobugan Regency which mostly dominated by agricultanal land. Broad on the results of population in 2017, it was noted that the population working in the agricultanal sector amounted to 52,5%. One of the main capital in the development is labor. In lise with the ongoing demographic process, the number and computation of the labor will continue to charge

Optimation of Convexily Boot Cartle and Pathly Forming Integlation (Bell Togethemellovic, 15(2)) ..., Jone 2020

(BPS Grobsgan Regency, 2018)

in Grobogan Regency, land conversion from agricultural to non-agricultural land is increasing, but the potential of agricultural sector until now is still dominant in supporting the economic sector of Geobogan Regency. In 2018, about 84.91% of the total area in Grobogan Regency was used for agricultural activities. The production of lowland paddy of Geobogan Regency in 2017 experienced a significant increase compared to the previous year. This year, the production of lowland paddy reached 786,040 tons with a harvested area of 123,446 hn. While for upland paddy, the production reached 13,267 tons with a harvested area of 3,489 hectarus. On the other hand, com production reached 700,941 tons with a harvest area of 112,700 ha. The population of fivestock in Gnibogan Regency in 2017 generally increased compared to the previous year. The population of livestock consisted of 365 dairy cows, 178,555 heef ratifie. 2,457 buffaloes, and 494 horses. Many livestock in Grobogan Regency are sent out of the area to meet the demand of other regions. In 2018, the number of Investock sent out from Grobogan Regency reached 30,108 cattle and 3,634 buffaloes. (Table ъ

Respondents were majority consisted of formers in their productive age (85%) with 100% working as farmers and 57.50% of them were primary school with the form experience was 34% around 20 years; while the average land tenure was 0.45 ha and averagedly the investock ownership was 1.54 animal unit (AU). This condition can affect production, both in cow-scall and paddy farming, (Table2)

increasing education is the most important factor in Indonesian development, if it seen from the population perspective, both as the object of development as well as the subject of development. The success of the development in an area can be indicated by the high level of education of its population. This is surely correlated to the educational facilities available in the area. The livelihoods of residents in Grobogan Regency are still dominant in agriculture This is due to the potential area of Grobogan Regimes which still dominated by agricultural land. Based on the results of population projection in 2015, it was noted that the population working in the agricultural sector amounted to 56.0 percent, trade 17.5 percent, transportation K-6 percent, and the rest worked in the services, plantation, industry, fisheries, and other sectors (BPS Grobogan Regency, 2018)

Analysis of Costs and Income of Cow-Cal Beef Cattle and Paddy Farming

The use of production factors on farming will cause a cost, both variable costs and fored costs. Costs for variable input expenditures include sends, fertilizers, pesticules, non-family labor, and other costs such as imigation costs, farmer group fees and loan enterest. In addition, farmers also pay fixed costs such as land rent, tractor rent, depreciation of capital goods (bee, hand sprayer, sickle, and souroit), and land tax. All costs are stated in rupult, the amount of which is based in the price at the time the transaction takes place. (Table3)

Parmers with 1.54 AU of cow-calf boof cattle operations require a production cost of IDR. 8,095,927.19 per year with the highest cost of IDR: 3,760,560 (46.45%) allocated for forage cost. Labor cost is also incurred by many farmers, considering the scarcity of family labor, so it is necessary to allocate this cest, which amounted to IDR. 3,274,875.00 (40,45%) The highest cost in paddy farming was the labor cost. Today, agricultural labor is an important asset, given the number is increasingly scarce in the countryside. This is what makes the high wages of labor so that farmers have to pay more for labor costs (Maryanto et al., 2015). The production cost of puddy farming per bectate was IDR. 15,584,121.5, - per year where farmers cultivated paddy crops two times in one year.

Revenue for cow-call heef cattle was IDR. 6,680,937.5 and livestock value added was IDR. 2,436,037.5. Thus, the income of cow-call was IDR: 9,116,975, year with the cost incurred of and monme of LEVE: 8,095,927.19 HTHR. 1.041.860.32/year/1.54 AU or IDR. 86,821,69/month/1.54 ALI. It's a very small value to support the farmer's daily life. Whereas, revenue of paddy farming in the farm of harvested dried tice for a year with 2 planting seasons was 6,187,5 tons ha harvest, the price of paddy was IDR, 4,000, kg then farmer's revenue was IDR. 24,750,000/0.45ha/season, or IDR: 49,590,000/ Baa watter with 0.0 income 148 - 111R 33,915;878 ha/year or IDR 2,826,325.2/ha/month threed on the farm income, the profitability of cow-calf beef cattle and puddy farm were 1.2% and 217.63%, respectively. This showed that the farmer's household is more supported by the results. of paddy farming, as Multible er al. (2018) and that integrated of beef cattle and forming system can increase zecome and profitability of family's hnuschold which paddy firm is dominant

Optimization of Convolution Processing and Product Forming Institution of International Systems 25(2) - June 2020

Table 1. The Agriculture Potential Commodities in Grobogan Regency*

Commodity	Harvested area (ha)	Production (tons)
Paddy.		
 Lowland Upland 	123,446 1,489	786.040 13.267
Cum	112,700	700.941
	Population	
	(head)	
Heef cattle	17K,555	
Dairy cowa		
- Sala	565	
Baffaloes	2,457	
Horses	494	

for household iscons.

Optimation Analysis

 The results of optimization analysis will illustrate the results of optimal solutions by using resources describing the optimal solution of linear programming analysis which incude: (1)

validation of optimal solution values, 2) farm household income from optimal solutions, (3) optimal allocation of farmer's household resources and beef cattle farm activities as wel as the level of constraints and shadow process of resources. (Mukhlis et al., 2018 and Ryschawy et al., 2017) Optimation of cow-call beef cattle farming and paddy describes the farm system with the farm household approach. The farm household approach is implemented biccuise the farmerbreeder's livelihood is not independent as families are integrated in one household. On one hand, farmers can be seen as producers and on the other hand as consumers. Farmers-breeders as producer means that farmers-breeders will mucinizat income from a number of activities, while as consume, farmers-breeders will convine goods either from their own production or parchased for

*BPS-Central Barran of Statistics of Grobogan Regency (2018)

Table 2. Number and Percentage of Farmer's Housebold Profile

No.	Profile	Number	Percentage (%)
1.	Age (year)		
	★ ≤17	0	0.00
	1 K ~ 60	68	35:00
	·秦 三01	12	15.00
2	Main livelihood		
	5 Farmer	80.	1000.000
	§ Village Officials	0	0.00
	Entropreneur	0	0.00
1	Education		
	Primary School	40	57.50
	1 Junior High School	22	27.30
	Senior High School	.12	15.00
4	Farming Experience (year)		
	1 6-10	12	15:00
	8 11-20	32	40.00
	1 > 20	36	45.00
4	Land tenare (ha)		
्यत	8 < 0.25	5	6.25
	4 0.25 0.5	48	60.00
	1 -0.5	27	33.75
6.0	Number of Cattle (head)		Column -
100	1 < 0.3	10	12.5
	3 34	66	68.75
	1 2+5	15	18.75

1 6/18 18(1)\$ 18 19 10 8(6)

Table 3. Income of Cou-Call Beef Calde and Paddy Farming

Beef Cattle Farming Income (IDBUL54 AU/year)	Rice Farming Iscome (IDR/ha/year)
9,116,975,00	49,500,000.00
8.6945.927.19	15,584,121.50
1,041,860.32	33,915,878.50
	Beef Cattle Farming Income (IDBU1.54 AU/year) 9,116,975.00 8,895,927.19 1,041,860.32

family consumption. Results of research showed that optimal condition of cow-call beef cattle and paddy integrated farming cystem were 2.75 AU of local cow s of the year 1, 1.48 AU of non-local livestock raising pattern and 0.45 ha land harvested of paddy to maximizing meone was 1DB 52,122,440 in 3 years. In this term, farmers are faced with challenges on land, labor, and capital. This is consistent with Roberni et al. (2014) and Tawaf et al. (2017) that the largest's problems in the application of optimation of agricultural patterns are capital, land, labor, and price flocing.

Validation the Value of The Optional Solution

Model validation in the first step that needs to be done in the analysis of optimization of locus/hold resonance differentiation. The results of the validation of locast programming models are conducted to determine whether the model used in the analysis is valid. The results of model validation showed the optimal conditions of the state of the resource or household activities of farmers. The optimal analysis model is valid if the episite of the validation of the model of household resources of farmers are presented in Table-1.

The results of the validation of the optimization model it was known that the traveration and activities carried out by the branchold are in a confidence interval, namely the optimal conditions for core-calf hoef cattle was 2.75 focated between 2.612 - 2.887 at the confidence interval was 0.428 - 0.475. It means that the model and is valid, if there is a charge in measures, or activities outside the confidence interval was 0.428 - 0.475. It means that the model and is valid. If there is a charge in measures, or activities outside the confidence interval, was 0.428 - 0.475. It means that the model and is valid. If there is a charge in measures or activities outside the confidence interval, it will cause charge is off at a confidence interval, it certainly will not charge the optimal conditions. Based on the results of the

linear program, it was known that rearing of local cow-call borf entile and non-local cow-call entile and also paddy farming obtained aptional values and use in confidence intervals. The entireum capital use was achieved in year 1, which is IDM. 4,500,000. While the use of agricultural land for paddy commodities is known to be optimal conditions in year 1, 2 and 3. The use of family labor labor showed optimal use and results are within the confidence interval. The use of an optimal workforce showed that if farmer boaseholds need labor, the workforce must be eset from outside the family. Food and non-food committion has also always uptimal conditions and is at the dividend interval. It met with Maryanto et al., 2015 that there was relationship between production decisions, allocation of labor farming and communication decisions in households of integrated farming systems of birel cattle and paddy. After the optimation analysis is carried out. the answer to the hypothesis is that the main source of investock, hand and labor has been allocated optimally. Therefore, these resources can be said to be a limiting factor farm constraints because the resources used are used up. (Table ii) The validation results of optimal analysis model on farmers hossehold activities in Grobogon Rearncy showed that the optimal condition for cow-call beef cattle of 2.75 AU and agricultural tand use was 0.45ha. From cow-calf beef canleand paddy farming activities, the optimal labor was achieved at 80.415 week day and capital for each period of IDR. 4,500,000,- The results of income maximization obtained by farmers-breaders laugeholds amounted to ESR. 52.122.440,- per year.

Simulation of Optimal Conditions

Optimation analysis spodel of resource allocations for farmers household showed valid results and optimal conditions are achieved. Therefore, a simulation is carried out to find out

Optimation of Con-call Bird Carls and Publy Farming ImgEnlanetExtEmpathebulgers: 35(2). - Jone 2020

Table 4. The Illevults of The Optimal Validation Model of Household Resources

		Validation Model
Activities	Optimal Condition	Confidence Interval (u=95%)
Locid livestock raising pattern (AU)		
Local costs of the year i	2,790	2.612-2.887
§ Non-Local livestock raising pattern (AU	1.483	1.408-1.557
Sale of local female calves § Sales of local unives in year 1 § Sales of local enives in year 2 § Sales of local calves in year 3	5,500 2,750 2,750	5.225 - 5.775 2.612 - 2.887 2.612 - 2.887
Sales of local male calves § Sales of local male calves in year 1 § Sales of local male calves in year 2 § Sales of local male calves in year 3	1.483 1.483 1.483	1.409 - 1.357 1.409 - 1.557 1.409 - 1.557
Use of agricultural land (ha) § Paddy in your 1 § Paddy in your 2 § Paddy in your 2	0.45 0.45 0.45	$\begin{array}{c} 0.428 - 0.473 \\ 0.428 - 0.473 \\ 0.428 - 0.473 \\ 0.428 - 0.473 \end{array}$
Capital Requirements in year 1	4,509,000	
Paddy sales (kw.) 8 Paddy sales in yuar 1 8 Paddy sales in yuar 2 8 Paddy sales in yuar 3	28.435 28.408 28.435	27:013 - 29:857 26:987 - 29:828 27:013 - 29:887
Family labor: (working day) 8 Family workforce in year 1 (working day) 8 Family workforce in year2 (working day) 9 Family workforce in year 3 (working day)	80.415 80.415 80.415	76,394 - 84,436 76,394 - 84,436 76,394 - 84,436
Consumption expenditure		
§ Food consumption in year 1	4,070,545.00	3,867.017.75 - 4.274.072.25
§ Food consumption in year 2	4,153,825.00	3.946.133,75 - 4.361,516,25
§ Food consumption in year 3	4,886,500.00	4,642,175.00 - 5,130,825.00
§ Non-food consumption Year 1	3,516,549.30	3,340,721,55 - 3,692,376,45
§ Non-food consumption Year 2	3.588,315.60	3,408,899,82 - 3,767,731,38
§ Non-food concomption Your 3	3,642,960.00	3,460,812.00 - 3,825,108.00
Income in year of 1-3 (IDR)	52,122,440,0	

Note : confidence interval at sr-5%

whether there is a change in the objective function or constraints. This was taken to find out how much there has been a change in farming-cow-call beef cattle and income of farmers households in order to keep in optimal condition, if there are changes in land resource constraints and input prices.

Cow-calf beef cattle resources are not simulated for changes in increase because the instit value of the cattle resources has machaol in optimum condition at 2.75 AU. Thus, if there is any addition made, then other resources will not support it, especially labor. This is because the existing labor has another activity, i.e. paddy

Openation of Con-call Bod Cattle and Paddy Farming Interdident/Rol Departmention: 45(2) - . June 2020

farming. Therefore, somulations are carried out on the tising of input prices both for cow-call beef cattle and pashly farming, with a change of 10% without an uscease in output prices. While the increase of input prices was based on field conditions, where the price of animal feed tend to rise with surranse in increase around 10%. Changes occurred from the simulation results are proceeded in Table5.

The simulation results showed that 0.25% addition in land area, namely from 0.45 ha to 0.6 ha gave a charge in the scale of levestock form of 0.018% and meters of 14.28%, i.e. from IDR 52,112,440,- to Rp 61,152,910,- Changes in the optimal solution results of the simulation indicated that farmers have the ability to develop

their farms. (Tablety), This is in accordance with Maryaoto avaid (2015) that if optimul conditions are reached and simulations are carried out with changes in the use of lard and price limiting factors then the optimal conditions are reached and farmers are still aftic to do the integration farming system.

It also can be seen that there is an increase in the area of labor resources meeded, meaning that the addition of land area is still possible to be managed by farmers. The increase of sipil proces with faced output prices that are counter balanced by an increase in land area results in an optimal change in increase in land area results in an optimal change in increase in oncore resulting from the optimal solution is possible because an increase in

Table 5. Income of Cow-Culf Beel Cattle and Paddy Farming

Types of Simulation	Scenario	Expected Results
Changes in farming land resources	 The greatest increase in the paddy farming scale managed by farmers from 0.45 ha to 0.6 ha Other sesource constraints are considered unchanged / fixed Inputs and output prices are considered unchanged / fixed 	 Farm scale increases due to land expansion Increase in farmers' income Changes in optimal farm partonia
Increases in Input prices	 Increase in input prices based on the highest price change, which is around 10% Other resource constraints are considered unchanged / fixed Output prices are unchanged / fixed 	 Changes of income in farmers breeders household Changes in optimal conditions

Table 6. Simulation Results 1 Regarding Changes in Animal Resource Construiets on Farmers' Households in the Research Area

Resinances	Optimal Condition	Simulation Results 1	Percentage of Change (%)
Land	0.48	0.6	0.25
Local cattle	2.75	2.80	0.018
Labor	80,415	80.415	No change
Income	\$2,112,440.09	\$1,132,910.00	14.78

input prices of 10% can shill be counter balanced by the results of farming sales; given the addition of farm scale will result in production as the source of revenue. It can be noted from the simulation results that the optimal solution showed the ability of the farmers in managing their farming and cow-calf beef cattle. The simulation showed the farmers ability to manage their farm if there is an increase in the land area scale, but input and output prices are fixed. This is consistent with Karmani and Syarifah (2008) and Howara (2011) that land area will affect farming production and peofits. Determining the right amount of optimal land is one way to increase production with the simof achieving maximum profits. An increase in the uncust of farmers' income is also still possible by making changes to the use of land inputs, so that productivity increases and ultimately increases the meome. In addition, the ability to manage land for farming is generally also influenced by the availability of labor and capital, as stated by Khalik et al. (2013). As in optimal conditions, labor in the farmer's household is used up to manage his farm.

CONCLESION

Based on the study remits, it can be concluded that:

- The optimal condition is obtained on cowcall beef cattle of 2.75 AU and a land area of 0.45 ha.
- The maximum income of farmer households was IDB: 52,112,440/year.
- 3. The simulation results of changes in input use indicated that the addition of fand area of 0.25%, i.e. from 0.45% in to 0.6he results in a change of 0.018% in the scale of cow-call farm and recome of 14.78%, i.e. from IDR 52,112,440.- to IDR: 61.152,910.- Changes in the results of the optimal solution in the similation indicated that farmers have the ability to develop their farms. (Incose wintrates there are two i.e., the wintrates needs to be corrected. Then the coordisation by giving strain many farmers for sum order. Phase make one paragraph []

REFERENCES

Basuni, R., Maladoo, C. Kusmana and Suryahadi. 2010. Model sistem integrasi piali-sapi potong di lahan sawah. Forum Pascasarjana, 33(3):177-190.

- BPS-Central Burna of Statistics of Grobogan Reprocy. 2018. Grobogan Dalare Angka 2018.
- Danth, S., S. Xu, W. Yu and A. A. Gafar. 2016. Optimization model of cattle Hashandry for rund household in Cambodia. J. Agric. Chem. Env. 5 6-11
- Howara, D. 2011. Optimalisasis pengembangan usahatani tamanan padi dan tarnak sapi secara terpadu di Kabupaten Majalengka. J. Agroland. 18 (1): 43 – 49.
- Hutassot, D.D.P.I. 2008. Pengarah keguntaroptimizu lahan terlaidap. Pengembangan wilayah iti Kabupaten Simalungun (Studi Kasas Nagory/Desa Naga Saribu, Kecomatan Pamatang Silima Huta). Wahana Hijau, Jurnal Perencanaan & Pengembangan Wilayah 4(2):51-58.
- Karmini and A.A. Syarifah. 2008. Optionaloani Idam osahatani komat dan mentimun dengan kendala uranga kerja (pendekatan program Imier). EPP:5(2):44–50.
- Martin, G., M.Mornane, J. Ryschowy, M. A. Magne, M. Asai, J. P. Sarthisa, M. Duru and O. Theronal. 2016. Crop lavenock integration beyond the farm level: a review Agron. Sestain. Dev. 36:53.
- Masayinii, A., M. Mornene, J. Ryschawy, J. de Wild, A.K. Bashidee and G. Martine. 2018. Critical factors for crop-livestock integration beyond the farm level: A crossanalysis of worldwide case studies. Land Use Policy 73:184-194
- Mariyanto, J., R. Dwigstuti and N. Hanani. 2015. Model ekonomi rumahitogga pertanaan lahan karing di Kabupaten Karanganyar Provinsi Jawa Tengah. Habitat, 26 (2):108-118
- Minh, Th., S. Ramanakhaarachchi and H. Jayasuriya. 2007. Linear Programmingbased optimization of the productivity and sostainability of crop-livestock composimanete integrated farming systems in Madiands of Victuans. Sci. Asia 33:187-198 Moreasen, M. A. 2012. Metede Penelitian Sarvai.
- Kencana Jakarta Makhlish, M. Noer, Notialdi and Mahili 2015.
 - Analosis usahatani integrasi padi sapi

Optimation of Cow-call Bool Cattle and Publy Farming brickindonestickTropatisticality in: 41(2)..., June 2020

potong, Jurnal Penelitian Lumbung, 14(1):1-10

- Mukhlis, M. Noer, Nofialdi and Mahdi. 2018. The integrated farming system of crop andILivestock: A Review of rice and cattle integration farming. Int. J. Sci.: Basic and App. Res. (IJSBAR). 42(3):68-82
- Ponnusany, K. and M.K. Devi. 2017. Impact of integrated farming system approach on doubling farmer's income. Agricultural Economics Research Review, 30:233-240
- Priyanti, A., B.M. Sinaga, Y. Syaukat and S.U. Kuntjoro. 2007. Model ekonomi rumahtangga petani pada sistem integrasi tanaman-ternak: Konsepsi dan studi empiris. Wartazoa. 17(2):61-70
- Regan, J. T., S. Martonc, O. Barrantes, F. Ruanef, M. Hanegraaf, J. Berland, H. Korevaar, S. Pellerina and T. Nesme. 2017. Does the recoupling of dairy and crop production via cooperation between farms generate environmental benefits? A case-study approach in Europe, Europ. J. Agronomy.

2016:15

- Rohaeni, E. S., B. Hartono, Z. Fanani and B. A. Nugroho. 2014. Sistem usaha tani terintograsi tanaman-ternak sebagai respons. petani terhadap faktor risiko. J. Econ. Sust. Dev. 5(1):159-168.
- Ryschawy, J., G. Martin, M. Moraine, M. Duru and O. Therond. 2017. Designing croplivestock integration at different levels: Toward new agroecological models? Natrient Cycling in Agroecosystems. 108(1):5-20.
- Soedjana, T.D. 2007. Sistem usaha tani terintograsi Tanaman-ternak sebagai respons petani terhadap faktor risiko. J. Litbang Pertanian, 26(2):82-87.
- Tawaf, R., M. Paturochman, L. Herlina, M. Sulistyati and A. Fitriani. 2017. The optimation of farmers families' revenue the integration of Pasundan cattle and paddy farming in West Java, J. Indonesian Trop. Anim. Agric, 42(4):270-278.

Revision of Proof Sheet

The optimation of cow-calf beef cattle and paddy farming integration on farmer household

By : T. Ekowati*, E. Prasetyo and M. Handayani

List Revisi Proof sheet :

Page	Line	Written	Revision
1	Abstrak, 14, 22, 26, 29	sapi potong	sapi potong induk anak
2	Abstract, 34, 41, 45, 47	beef cattle	cow-calf beef cattle
5	101	beef cattle	cow-calf beef cattle
15	Conclusion : 345	 Based on the study results, it can be concluded that: 4. The optimal condition is obtained on cow-calf beef cattle of 2.75 AU and a land area of 0.45 ha. 5. The maximum income of farmer households was IDR. 52,112,440/year. 6. The simulation results of changes in input use indicated that the addition of land area of 0.25%, i.e. from 0.45 ha to 0.6ha results in a change of 0.018% in the scale of cow-calf farm and income of 14.78%, i.e. from IDR. 52,112,440,- to IDR. 61,152,910, Changes in the results of the optimal solution in the simulation indicated that farmers have the ability to develop their farms. 	Based on the study results, it can be concluded that the optimal condition is obtained on cow-calf beef cattle of 2.75 AU and a land area of 0.45 ha. The maximum income of farmer households was IDR. 52,112,440/year. The simulation results of changes in input use indicated that the addition of land area of 0.25%, from 0.45 ha to 0.6ha results in a change of 0.018% in the scale of cow-calf farm and increasing income of 14.78%, from IDR. 52,112,440,- to IDR. 61,152,910, Changes in the results of the optimal solution in the simulation indicated that farmers have the ability to davalon their farms.
20	Title of Table 5,	Income of Cow-Calf Beef Cattle and Paddy Farming	Simulation of Optimal Conditions on Farmers' Households in the Research Area
21	Title of Table 6	Simulation Results 1 Regarding Changes in Animal Resource Constraints on Farmers' Households in the Research Area	Simulation Results Regarding Changes in Animal Resource Constraints on Farmers' Households in the Research Area
<i>L</i> 1		Simulation Results 1	Simulation Results

Optimation of cow-calf beef cattle and paddy farming integration (Ekowati et al.)

The optimation of cow-calf beef cattle and paddy farming integration

on farmer household

T. Ekowati*, E. Prasetyo and M. Handayani Faculty of Animal and Agricultural Sciences, Diponegoro University Tembalang Campus, Semarang 50275 – Indonesia *Correspondence E-mail : tiekowati@yahoo.co.id

ABSTRAK

Rumahtangga petani umumnya berusahatani pada sub-sektor pertanian tanaman pangan dan sub-sektor peternakan yang belum dilaksanakan dengan baik, sehingga kondisi optimal usahatani belum dicapai. Penelitian bertujuan untuk menganalisis optimasi integrasi sapi potong induk anak dan padi, simulasi perubahan harga input dan penggunaan sumberdaya terhadap model optimal. Metode survey digunakan dalam penelitian di Kabupaten Grobogan, dengan menentukan Kecamatan Wirosari dan Kecamatan Purwodadi. *Quota sampling method* digunakan untuk menentukan jumlah sampel peternak sapi potong induk-anak dan petani padi tanpa menghitung jumlah populasi sebagai *sampling frame*. Jumlah responden setiap kecamatan adalah 40 petani sehingga total responden 80 petani. Data dianalisis dengan linear programming. Hasil penelitian menunjukkan bahwa kondisi optimum skala usaha integrasi sapi potong dan padi dicapai pada luas lahan 0,45 ha, pemeliharaan induk sapi potong induk anak 2.75 UT dengan maksimum pendapatan Rp 52.112.440/tahun. Hasil simulasi perubahan penggunaan input menunjukkan bahwa penambahan luas lahan 0,25% memberikan peningkatan skala usaha sapi potong 0,018% dan pendapatan 14,78%, Kesimpulan optimasi integrasi sapi potong induk anak dan padi dicapai pada luas lahan 0,45ha dan induk sapi potong 2.75 UT dan simulasi solusi optimal menunjukkan bahwa petani mempunyai kemampuan untuk mengembangkan usahataninya.

Kata kunci : integrasi, optimasi, padi, pendapatan, sapi potong induk anak

ABSTRACT

Farmer households generally operate food crops and livestock subsectors that have not fully implemented well, so an optimal farming has not been achieved. This study aimed to analyze optimation of cow-calf beef cattle and paddy farming integration and simulation changing in input prices and the usage of resources to the optimal model. Survey method was used in the research in Grobogan Regency by determining Wirosari District and Purwodadi District. Quota sampling method is used to determine the number of respondents without counting the population as a sampling frame. The number of respondents in each district was 40 farmers so the total respondent was 80 farmers. Data were analyzed using linear programing. Results showed that optimum conditions of integration were achieved in 0.45ha land, 2.75 AU of cow-calf beef cattle with maximum income of IDR 52,112,440/year. The simulation results regarding in changing in input usege indicated that the addition of 0.25% land area gives a change in scale of beef cattle by 0.018% and income of 14.78%. In conclusion, integration optimation was achieved on 0.45ha land, 2.75 UT cow-calf beef cattle and optimal solution simulations indicated that farmers have the ability to develop their farming.

Keywords: cow-calf beef cattle, integration, income, optimation, paddy

INTRODUCTION

Beef cattle and paddy farmings are forms of farm activity pursued by many people in Central Java. The meaning contained in these farm activities is how beef cattle and paddy farming are run by farm households to get better results, both in terms of farm scale and income. The policy regarding beef cattle and paddy farming development is basically has a correlative and synergistic relationship, considering that agricultural waste is substantially raw material (feed) for livestock farm. Farmer households use integrated farming system in developing agriculture, considering that besides providing economic benefits, this pattern also provides benefits in land conservation and land productivity. This is in line with Soedjana (2007) and Hutasoit (2008) that the reason why farmers choose mixed farming or integration is because of habits (tradition), to maximize revenue from limited resources, and increase benefits of correlation between integrated farming patterns in the food crop sub-sector and livestock sub-sector, which will encourage the development of food crops especially paddy and livestock and create investment opportunities. This is also supported by Basuni et al. (2010), Mukhlis et al. (2015) and Ponnusamy and Devi, 2017 that the integration of farming systems can provide both ecological and economic benefits because the waste from each commodity can be used as an input factor, so that it can save the use of cost and can increase income. Another research by Darith et al. (2016) indicated that activities carried out by farmers in the integration model can increase farmer income which in turn can increase investment in farming

Farmer households can be seen as a unit of farm activity consisting of production, activities and labor services activities. All of these activities are a unity, so that farmer's household cannot be seen as a pure consumer because there is a portion of the production that is consumed and partly sold as capital. Likewise in the labor use, farmers-breeders, labor can come from within the family or outside the family. Thus, farmer households can be said to be producers and consumers (Priyanti, 2007).

Integration of beef cattle and paddy based on the scale of farm that the number of livestock and land area can provide some form of integration (Matin *et al*, 2016). Integration can take the form of an exchange relationship between livestock and paddy which can be in the form of fertilizer and forage (Regan *et al.*, 2017)

Integrated farming systems, in Grobogan, which is managed by farmer's household generally consist of beef cattle, especially cow-calf rearing, and paddy farm. Farm households usually face constraints on land and cow-calf resource constraints. These constraints are in accordance with by Basuni *et al.* (2010) statement that in West Java, the integration of beef cattle and paddy is contained in land boundaries and livestock numbers. Therefore, the optimal allocation of resource use in the integration of cow-calf and pady needs to be assessed.

Allocation of resource use controlled by farmers is very important, because non-optimal resource use means a cost for farming management. As a result, the profits generated for farmer as farming manager becomes are optimal (Masayasu *et al.*, 2018). Allocation of the use of production factors that provide optimal results can be analyzed by linear programming.

Analysis using linear programming can provide information for agricultural policy makers regarding: (a) the structure of related relationships and the costs of comparative advantage in agricultural sector; (b) production potential; (c) job opportunities; (d) consistency of every alternative agricultural policy. (Minh *et al.*, 2007)

Linear programming is a method that is more systematic and mathematically rigorous for determining the optimum combination of farm sectors or contributions such as revenue maximization or cost minimization with limited available resources (Darith *et al.* (2016). From the

study results, it is expected that an allocation model for an optimal use of production factors can be created, so that it can benefits for farmers. Based on the bacground, the objective of the study were to develop an optimation for cow-calf beef cattle and paddy farm integration and simulate changes in input prices and resources use to optimal model.

MATERIAL AND METHODS

The study was conducted by using a survey method to determine the condition of farmer households, especially cow-calf cattle farming and paddy farming in managing their farm integration. Survey method is a method of taking respondents by determining a sample of the existing population. (Morissan, 2012)

Purposive method was used to determine the study location based on potential of the most populated area by beef cattle and paddy production in Central Java. Based on data on Agricultural and Animal Husbandry Statistics in 2018, it is known that Grobogan is regency with a potential combination of beef cattle, paddy farming from the planting area and paddy production aspects as well as the raising of beef cattle in Central Java. Based on regency location, there were 2 districts purposively selected where two villages were taken in each district based on several indicators such as number of beef cattle population, paddy production and farmer group activities. Based on the purposive results, districts selected for the study were Wirosari District, consist of Karangasem Village and Sambirejo Village, and Purwodadi District with Nambuhan Village and Genuksuran Village.

Quota sampling method was conducted to determine the sample number of cow-calf cattle and paddy farmers without counting the population as a sample frame. The sample number of cowcalf beef cattle and paddy farmers from each village were 20 farmers, so the total number of respondents was 80 farmers households. The reason for determining the number of respondents is 20 farmers per village because the characteristics of farmers are relatively homogeneous in the context of farm scale and rearing management

The method used to analyze the objectives was linear programming and descriptive analysis. From this model, cow-calf beef cattle and paddy farmers can be considered as cow-calf beef cattle and paddy producers that produce livestock and paddy supply continuously from optimal allocation of resources. Thus, the objective function in this linear programming research model was to maximize household income in term of integration cow-calf beef cattle and paddy farming.

The mathematical form of the Linear Programing model that maximizes the objective function in general is: (Minh *et al.*, 2007)

n

Maximum Z = $C_1X_1 + C_2X_2 + C_3X_3 \dots + C_jX_j - \dots + C_nX_n$ or Z = $\sum_{j=1}^{n} C_jX_j \dots j = 1$ (1)With constraint: $a_{11}x_1 + a_{12}x_2 + \dots a_{1j}x_j + \dots a_{1n}x_n \le b_1$ $a_{21}x_1 + a_{22}x_2 + \dots + a_{2j}x_j + \dots + a_{2n}x_n \le b_2$ $a_{31}x_1 + a_{32}x_2 + \dots a_{3j}x_j + \dots a_{3n}x_n \le b_3$ n $a_{m1}x_1 + a_{m2}x_2 + \ldots a_{mj}x_j + \ldots a_{mn}x_n \leq b_m \ \text{or} \sum aijXj \leq bi \quad \ldots \ldots \ldots$ (2)i=1Explanation: $i = 1, 2, 3 \dots$ m is the number of limitation factors $j = 1, 2, 3 \dots$ n is the number of production activity Activity was not negative: $xj \ge 0$ for all j

Z = objective function which is the income of maximized cow-calf beef cattle Farmers and paddy

C = production prices (C) and input prices (-C)

xj = production and consumption activities carried out by households of cow-calf beef cattle and paddy farmers

aij = input coefficient of each production and consumption activity

bij = value of constraints or the available resource limits

Referring to the research objectives the are basic components can be formulated as follows: 5. Objective function

The objective function (Z) in this study is to maximize the income of cow-calf beef cattle and paddy farmers from various alternative activities with existing resource constraints.

6. Alternative Activity Model

Some of activities carried out in this study include: (1) farming - livestock production activities; (2) purchasing production facilities; (3) hiring of workers; (4) sales of products; (5) consumption expenditure (food and non-food)

RESULTS AND DISCUSSION

Overview of Grobogan Regency

The livelihood of Grobogan residents are generally dominant in agriculture. This is due to the potential of Grobogan Regency which mostly dominated by agricultural land. Based on the results of population in 2017, it was noted that the population working in the agricultural sector amounted to 52.5%. One of the main capital in the development is labor. In line with the ongoing demographic process, the number and composition of the labor will continue to change. (BPS Kabupaten Grobogan, 2018)

In Grobogan Regency, land conversion from agricultural to non-agricultural land is increasing, but the potential of agricultural sector until now is still dominant in supporting the economic sector of Grobogan Regency. In 2018, about 84.91% of the total area in Grobogan Regency was used for agricultural activities. The production of lowland paddy of Grobogan

Regency in 2017 experienced a significant increase compared to the previous year. This year, the production of lowland paddy reached 786,040 tons with a harvested area of 123,446 ha. While for upland paddy, the production reached 13,267 tons with a harvested area of 3,489 hectares. On the other hand, corn production reached 700,941 tons with a harvest area of 112,700 ha. The population of livestock in Grobogan Regency in 2017 generally increased compared to the previous year. The population of livestock consisted of 365 dairy cows, 178,555 beef cattle, 2,457 buffaloes, and 494 horses. Many livestock in Grobogan Regency are sent out of the area to meet the demand of other regions. In 2018, the number of livestock sent out from Grobogan Regency reached 30,108 cattle and 3,634 buffaloes. (Table 1)

Respondents were majority consisted of farmers in their productive age (85%) with 100% working as farmers and 57.50% of them were primary school with the farm experience was 34% around 20 years; while the average land tenure was 0.45 ha and averagedly the livestock ownership was 1.54 animal unit (AU). This condition can affect production, both in cow-calf and paddy farming. (Table 2)

Increasing education is the most important factor in Indonesian development, if it seen from the population perspective, both as the object of development as well as the subject of development. The success of the development in an area can be indicated by the high level of education of its population. This is surely correlated to the educational facilities available in the area. The livelihoods of residents in Grobogan Regency are still dominant in agriculture. This is due to the potential area of Grobogan Regency which still dominated by agricultural land. Based on the results of population projection in 2015, it was noted that the population working in the agricultural sector amounted to 56.0 percent, trade 17.5 percent, transportation 8.6 percent, and the rest worked in the services, plantation, industry, fisheries, and other sectors (BPS Kabupaten Grobogan, 2018)

Analysis of Costs and Income of Cow-Cal Beef Cattle and Paddy Farming

The use of production factors on farming will cause a cost, both variable costs and fixed costs. Costs for variable input expenditures include seeds, fertilizers, pesticides, non-family labor, and other costs such as irrigation costs, farmer group fees and loan interest. In addition, farmers also pay fixed costs such as land rent, tractor rent, depreciation of capital goods (hoe, hand sprayer, sickle, and *sosrok*), and land tax. All costs are stated in rupiah, the amount of which is based on the price at the time the transaction takes place. (Table 3)

Farmers with 1.54 AU of cow-calf beef cattle operations require a production cost of IDR. 8,095,927.19 per year with the highest cost of IDR. 3,760,560 (46.45%) allocated for forage cost. Labor cost is also incurred by many farmers, considering the scarcity of family labor, so it is necessary to allocate this cost, which amounted to IDR. 3,274,875.00 (40.45%). The highest cost in paddy farming was the labor cost. Today, agricultural labor is an important asset, given the number is increasingly scarce in the countryside. This is what makes the high wages of labor so that farmers have to pay more for labor costs (Maryanto *et al.*, 2015). The production cost of paddy farming per hectare was IDR. 15,584,121.5, - per year where farmers cultivated paddy crops two times in one year.

Revenue for cow-calf beef cattle was IDR. 6,680,937.5 and livestock value added was IDR. 2,436,037.5. Thus, the income of cow-calf was IDR. 9,116,975,-/year with the cost incurred of IDR. 8,095,927.19 and income of IDR. 1,041,860.32/year/1.54 AU or IDR. 86,821.69/month/1.54 AU. It's a very small value to support the farmer's daily life. Whereas, revenue of paddy farming

in the form of harvested dried rice for a year with 2 planting seasons was 6,187.5 tons/ha harvest. the price of paddy was IDR. 4,000,-/kg then farmer's revenue was IDR. 24,750,000/0.45ha/season, or IDR. 49,500,000/ha/year, with an income of IDR. 33,915,878/ha/year or IDR 2,826,323.2/ha/month. Based on the farm income, the profitability of cow-calf beef cattle and paddy farm were 1.2% and 217.63%, respectively. This showed that the farmer's household is more supported by the results of paddy farming, as Mukhlis *et al.* (2018) said that integrated of beef cattle and farming system can increase income and profitability of farmer's household which paddy farm is dominant for household income.

Optimation Analysis

The results of optimization analysis will illustrate the results of optimal solutions by using resources describing the optimal solution of linear programming analysis which incude: (1) validation of optimal solution values, 2) farm household income from optimal solutions, (3) optimal allocation of farmer's household resources and beef cattle farm activities as wel as the level of constraints and shadow prices of resources. (Mukhlis *et al.*, 2018 and Ryschawy *et al.*, 2017)

Optimation of cow-calf beef cattle farming and paddy describes the farm system with the farm household approach. The farm household approach is implemented because the farmerbreeder's livelihood is not independent as farmers or breeders alone, but both activities are integrated in one household. On one hand, farmers can be seen as producers and on the other hand as consumers. Farmers-breeders as producer means that farmers-breeders will maximize income from a number of activities, while as consumer, farmers-breeders will consume goods either from their own production or purchased for family consumption. Results of research showed that optimal condition of cow-calf beef cattle and paddy integrated farming system were 2.75 AU of local cow s of the year 1, 1.48 AU of non local livestock raising pattern and 0.45 ha land harvested of paddy. In maximizing income was IDR 52,122,440 in 3 years. In this term, farmers are faced with challenges on land, labor, and capital. This is consistent with Rohaeni *et al.* (2014) and Tawaf *et al.* (2017) that the farmer's problems in the application of optimation of agricultural patterns are capital, land, labor, and price fluctuation.

Validation the Value of The Optimal Solution

Model validation is the first step that needs to be done in the analysis of optimization of household resource allocation. The results of the validation of linear programming models are conducted to determine whether the model used in the analysis is valid. The results of model validation showed the optimal conditions of the state of the resource or household activities of farmers. The optimal analysis model is valid if the optimal value is at the confidence interval. The results of the validation of the model of household resources of farmers are presented in Table 4.

The results of the validation of the optimization model it was known that the resources and activities carried out by the household are in a confidence interval, namely the optimal conditions for cow-calf beef cattle was 2.75 located between 2.612 - 2.887 at the confidence interval, while the land optimal condition was achieved at 0.45 with the confidence interval was 0.428 - 0.473. It means that the model used is valid. If there is a change in resources or activities outside the confidence interval, it will cause changes in optimal conditions. Conversely, if the change is still at a confidence interval, it certainly will not change the optimal conditions. Based on the results of the linear program, it was known that rearing of local cow-calf beef cattle and non-local cow-calf cattle and also paddy farming obtained optimal values and are in confidence intervals. The optimum capital use was achieved in year 1, which is IDR 4,500,000. While the use

of agricultural land for paddy commodities is known to be optimal conditions in year 1, 2 and 3. The use of family labor labor showed optimal use and results are within the confidence interval. The use of an optimal workforce showed that if farmer households need labor, the workforce must be met from outside the family. Food and non-food consumption has also shown optimal conditions and is at the dividend interval. It met with Maryanto *et al.*, 2015 that there was relationship between production decisions, allocation of labor farming and consumption decisions in households of integrated farming systems of beef cattle and paddy. After the optimation analysis is carried out, the answer to the hypothesis is that the main source of livestock, land and labor has been allocated optimally. Therefore, these resources can be said to be a limiting factor/farm constraints because the resources used are used up. (Table 4)

The validation results of optimal analysis model on farmers household activities in Grobogan Regency showed that the optimal condition for cow-calf beef cattle of 2.75 AU and agricultural land use was 0.45ha. From cow-calf beef cattle and paddy farming activities, the optimal labor was achieved at 80.415 work day and capital for each period of IDR. 4,500,000,-The results of income maximization obtained by farmers-breeders households amounted to IDR. 52,122,440,- per year.

Simulation of Optimal Conditions

Optimation analysis model of resource allocation for farmers household showed valid results and optimal conditions are achieved. Therefore, a simulation is carried out to find out whether there is a change in the objective function or constraints. This was taken to find out how much there has been a change in farming-cow-calf beef cattle and income of farmers households in order to keep in optimal condition, if there are changes in land resource constraints and input prices. Cow-calf beef cattle resources are not simulated for changes in increase because the limit value of the cattle resources has reached its optimum condition at 2.75 AU. Thus, if there is any addition made, then other resources will not support it, especially labor. This is because the existing labor has another activity, i.e. paddy farming. Therefore, simulations are carried out on the rising of input prices both for cow-calf beef cattle and paddy farming, with a change of 10% without an increase in output prices. While the increase of input prices was based on field conditions, where the price of animal feed tend to rise with variation in increase around 10%. Changes occured from the simulation results are presented in Table 5

The simulation results showed that 0.25% addition in land area, namely from 0.45 ha to 0.6 ha gave a change in the scale of livestock farm of 0.018% and income of 14.78%, i.e. from IDR 52,112,440,- to Rp 61,152,910,-. Changes in the optimal solution results of the simulation indicated that farmers have the ability to develop their farms. (Table 6). This is in accordance with Maryanto *et al.* (2015) that if optimal conditions are reached and simulations are carried out with changes in the use of land and price limiting factors then the optimal conditions are reached and farmers are still able to do the integration farming system.

It also can be seen that there is an increase in the area of labor resources needed, meaning that the addition of land area is still possible to be managed by farmers. The increase of input prices with fixed output prices that are counter balanced by an increase in land area results in an optimal change in income solutions, i.e. an increase in income. An increase in income resulting from the optimal solution is possible because an increase in input prices of 10% can still be counter balanced by the results of farming sales; given the addition of farm scale will result in production as the source of revenue. It can be noted from the simulation results that the optimal solution showed the ability of the farmers in managing their farming and cow-calf beef cattle. The simulation showed

the farmers ability to manage their farm if there is an increase in the land area scale, but input and output prices are fixed. This is consistent with Karmini and Syarifah (2008) and Howara (2011) that land area will affect farming production and profits. Determining the right amount of optimal land is one way to increase production with the aim of achieving maximum profits. An increase in the amount of farmers' income is also still possible by making changes to the use of land inputs, so that productivity increases and ultimately increases the income. In addition, the ability to manage land for farming is generally also influenced by the availability of labor and capital, as stated by Khalik *et al.* (2013). As in optimal conditions, labor in the farmer's household is used up to manage his farm.

CONCLUSION

Based on the study results, it can be concluded that: The optimal condition is obtained on cow-calf beef cattle of 2.75 AU and a land area of 0.45 ha. The maximum income of farmer households was IDR. 52,112,440/year. The simulation results of changes in input use indicated that the addition of land area of 0.25%, from 0.45 ha to 0.6ha results in a change of 0.018% in the scale of cow-calf farm and increasing income of 14.78%, from IDR. 52,112,440,- to IDR. 61,152,910,-. Changes in the results of the optimal solution in the simulation indicated that farmers have the ability to develop their farms.

REFERENCES

Basuni, R., Muladno, C. Kusmana and Suryahadi. 2010. Model sistem integrasi padi-sapi potong di lahan sawah. Forum Pascasarjana. 33(3):177-190

BPS Kabupaten Grobogan. 2018. Grobogan Dalam Angka 2018.

- Darith, S., S. Xu, W. Yu and A. A. Gafar. 2016. Optimization model of cattle Husbandry for rural household in Cambodia. Journal of Agricultural Chemistry and Environment.5:6-11
- Howara, D. 2011. Optimalisasi pengembangan usahatani tanaman padi dan ternak sapi secara terpadu di Kabupaten Majalengka. J. Agroland 18 (1) : 43 49.
- Hutasoit, D.D.P.I. 2008. Pengaruh kegiatan optimasi lahan terhadap Pengembangan wilayah di Kabupaten Simalungun (Studi Kasus Nagori/Desa Naga Saribu, Kecamatan Pamatang Silima Huta). Wahana Hijau. Jurnal Perencanaan & Pengembangan Wilayah. 4(2):51-58.
- Karmini and A.A. Syarifah. 2008. Optimalisasi lahan usahatani tomat dan mentimun dengan kendala tenaga kerja (pendekatan program linier). EPP.5(2):44-50.
- Khalik R, Safrida, and A.H. Hamid. 2013. Optimasi pola tanam usahatani sayuran selada dan sawi di daerah produksi padi (Studi Kasus di Desa Lam Seunong, Kecamatan Kota Baro, Kabupaten Aceh Bes.,
- Martin, G., M. Moraine, J. Ryschawy, M. A. Magne, M. Asai, J. P. Sarthou, M. Duru and O. Therond. 2016. Crop–livestock integration beyond the farm level: a review. Agron. Sustain. Dev. 36:53.
- Masayasu, A., M. Moraine, J. Ryschawy, J. de Witd, A.K. Hoshidee and G. Martinc. 2018. Critical factors for crop-livestock integration beyond the farm level: A crossanalysis of worldwide case studies. Land Use Policy 73:184-194
- Mariyanto, J., R. Dwiastuti and N. Hanani. 2015. Model ekonomi rumahtangga pertanian lahan kering di Kabupaten Karanganyar Provinsi Jawa Tengah. Habitat, 26 (2):108-118
- Minh, Th., S. Ranamukhaarachchi and H. Jayasuriya. 2007. Linear Programming-based optimization of the productivity and sustainability of crop-livestock-compost manure integrated farming systems in Midlands of Vietnam. ScienceAsia 33:187-195

Morissan, M. A. 2012. Metode Penelitian Survei. Kencana. Jakarta

- Mukhlish, M. Noer, Nofialdi and Mahdi. 2015. Analisis usahatani integrasi padi sapi potong. Jurnal Penelitian Lumbung, 14(1):1-10
- Mukhlis, M. Noer, Nofialdi and Mahdi. 2018. The integrated farming system of crop andlLivestock: A Review of Rice and Cattle Integration Farming. International Journal of Sciences: Basic and Applied Research (IJSBAR). 42(3): 68-82
- Ponnusamy, K. and M.K. Devi. 2017. Impact of integrated farming system approach on doubling farmer's income. Agricultural Economics Research Review. 30:233-240
- Priyanti, A., B.M. Sinaga, Y. Syaukat and S.U. Kuntjoro. 2007. Model ekonomi rumahtangga petani pada sistem integrasi tanaman-ternak: Konsepsi dan studi empiris. WARTAZOA 17(2):61-70
- Regan, J. T., S. Martonc, O. Barrantes, E. Ruanef, M. Hanegraaf, J. Berland, H. Korevaar, S. Pellerina and T. Nesme. 2017. Does the recoupling of dairy and crop production via cooperation between farms generate environmental benefits? A case-study approach in Europe. Europ. J. Agronomy. 2016:15
- Rohaeni, E. S., B. Hartono, Z. Fanani and B. A. Nugroho. 2014. Sistem usaha tani terintegrasi tanaman-ternak sebagai respons petani terhadap faktor risiko. Journal of Economics and Sustainable Development. 5(1):159-168.
- Ryschawy, J., G. Martin, M. Moraine, M. Duru and O. Therond. 2017. Designing crop-livestock integration at different levels: Toward new agroecological models? Nutrient Cycling in Agroecosystems. 108(1):5-20.
- Soedjana, T.D. 2007. Sistem usaha tani terintegrasi Tanaman-ternak sebagai respons petani terhadap faktor risiko. Jurnal Litbang Pertanian, 26(2):82-87.

Tawaf, R., M. Paturochman, L. Herlina, M. Sulistyati and A. Fitriani. 2017. The optimation of farmers families' revenue the integration of Pasundan cattle and paddy farming in West Java. J. Indonesian Trop. Anim. Agric. 42(4):270-278.

Table 1. The Agriculture Potential Commodities in Grobogan

Co	ommodity	Harvested area	Production
		ha	tons
Padd	ly		
-	Lowland	123,446	786,040
-	Upland	3,489	13,267
Corr	1	112,700	700,941
		Population	
		head	
Beef	cattle	178,555	
Dair	y cows	365	
Buff	aloes	2,457	
Hors	es	494	
ource : E	BPS Kabupat	en Grobogan, 2018	

Table 2. Number and Percentage of Farmer's Household Profile

No.	Profile	Number	Percentage (%)
			%
1.	Age (year)		
	■ ≤17	0	0.00
	■ 18-60	68	85.00
	■ ≥ 61	12	15.00
2.	Main livelihood		
	 Farmer 	80	100.00
	 Village Officials 	0	0.00
	 Entrepreneur 	0	0.00
3.	Education		
	 Primary School 	46	57.50
	 Junior High School 	22	27.50
	 Senior High School 	12	15.00
4.	Farming Experience (year)		
	• 6-10	12	15.00
	■ 11 – 20	32	40.00
	■ > 20	36	45.00
5.	Land tenure (ha)		
	• < 0.25	5	6.25
	■ 0.25 – 0.5	48	60.00
	■ > 0.5	27	33.75

6.	Number	of Cattle	(head)
----	--------	-----------	--------

• < 3	10	12.5	
■ 3-4	55	68.75	
• > = 5	15	18.75	

Table 3. Income of Cow-Calf Beef Cattle and Paddy Farming

Components	Beef Cattle Farming Income	Rice Farming Income
	IDR/1.54 AU/year	IDR/ha/year
Revenue	9,116,975.00	49,500,000.00
Cost	8,095,927.19	15,584,121.50
Income	1,041,860.32	33,915,878.50

Table 4. The Results of The Optimal Validation Model of Household Resources

	Validation Model		
Activities	Optimal	Confidence Interval	
	Condition	(α=95%)	
Local livestock raising pattern (AU)			
 Local cows of the year 1 	2.750	2.612 - 2.887	
 Non Local livestock raising pattern (AU 	1.483	1.408 - 1.557	
Sale of local female calves			
 Sales of local calves in year 1 	5.500	5.225 - 5.775	
 Sales of local calves in year 2 	2.750	2.612 - 2.887	
 Sales of local calves in year 3 	2.750	2.612 - 2.887	
Sale of local male calves			
 Sales of local male calves in year 1 	1.483	1.409 - 1.557	
 Sales of local male calves in year 2 	1.483	1.409 - 1.557	
 Sales of local male calves in year 3 	1.483	1.409 - 1.557	
Use of agricultural land (ha)			
 Paddy in year 1 	0.45	0.428 - 0.473	
 Paddy in year 2 	0.45	0.428 - 0.473	
 Paddy in year 3 	0.45	0.428 - 0.473	
Capital Requirements in year 1	4,500,000		
Paddy sales (kw)			
 Paddy sales in year 1 	28.435	27.013 - 29.857	
 Paddy sales in year 2 	28.408	26.987 - 29.828	
 Paddy sales in year 3 	28.435	27.013 - 29.857	
Family labor (working day)			
• Family workforce in year 1 (working day)	80.415	76.394 - 84.436	
 Family workforce in year2 (working day) 	80.415	76.394 - 84.436	
• Family workforce in year 3 (working day)	80.415	76.398-84.436	
Consumption expenditure			
 Food consumption in year 1 	4,070,545.00	3,867.017.75 - 4.274.072,25	
 Food consumption in year 2 	4,153,825.00	3.946.133,75 - 4.361.516,25	
•	Food consumption in year 3	4,886,500.00	4,642,175.00 - 5,130,825.00
-----------------------------	-----------------------------	--------------	-----------------------------
•	Non-food consumption Year 1	3,516,549.30	3,340,721.55 - 3,692,376.45
•	Non-food consumption Year 2	3,588,315.60	3,408,899.82 - 3,767,731.38
•	Non-food consumption Year 3	3,642,960.00	3,460,812.00 - 3,825,108.00
Income in year of 1-3 (IDR)		52,122,440.0	
-			

Note : confidence interval at α =5%

Table 5. Simulation of Optimal Conditions on Farmers' Households in the Research Area

Types of Simulation	Scenario	Expected Results	
Changes in farming land resources	 The greatest increase in the paddy farming scale managed by farmers from 0.45 ha to 0.6 ha Other resource constraints are considered unchanged / fixed Inputs and output prices are considered unchanged / fixed 	 Farm scale increases due to land expansion Increase in farmers' income Changes in optimal farm patterns 	
Increases in Input prices	 Increase in input prices based on the highest price change, which is around 10% Other resource constraints are considered unchanged / fixed 	 Changes of income in farmers - breeders household Changes in optimal conditions 	
	 Output prices are unchanged / fixed 		

 Table 6. Simulation Results Regarding Changes in Animal Resource Constraints on Farmers' Households in the Research Area

Resources	Optimal Condition	Simulation Results	Percentage of
			Change (%)
Land	0.48	0.6	0.25
Local cattle	2.75	2.80	0.018
Labor	80.415	80.415	No change
Income	52,112,440.00	61,152,910.00	14.78

8.Attachment 8. Information of Publication, June 9, 2020

Re: Articles-June 2020	stratement of
Tirk Ekowet Dowest - Indowet Pyshologiski Kepediar (Tilek PPT)	高. 34, 11.5r 300, ar 14.8 文
Dear The JITAA Editor Thank you visu much the publishing information beet report	
12	
 Settinidation at 	
Pada Seans, D.Jam 2029 19.44 12 WED. JUTAA JPPT right bandp@gmail.com-menu	12
Dear Authors,	
The orbites in mass of June 2020 have been published unline. Please check to	
Trail you	

Optimation of Cow-calf Beef Cattle and Paddy Farming Integlatione (TarETcopaAirinalAgric. 45(2):..-.., June 2020