# Economic Advantage Based on Productivity of Intercropped Indigofera and Brachiaria

Tilly Flora Desaly Lumy*, Janne Herly Willy Rembang**, Malcky Makanaung Telleng***

*)Laboratory of Socio-Economic, Faculty of Animal Science, Sam Ratulangi University, Manado Indonesia.
**)Assessment Institute of Agriculture Technology (AIAT) of North Sulawesi, Indonesia
***)Laboratory of Nutrition and Feed Technology, Faculty of Animal Science, Sam Ratulangi University, Manado Indonesia.

***Abstract-*** This decision was made for economic advantage of potential productivity in order to choose between the got crops leguminosae Indigofera (Li) and tropical grass Brachiaria (Gb). The purpose of this consideration was to investigate the apparent magnitude of this received change in light of bearing limit and abandonment. The plan for this test was completely random, and for combination planted (Cp), it used a combination of four drugs from the planted area, Cp1: Li with dimensions of 1.0 m x 1.0 m and Gb, with dimensions of 0.5 m x 0.25 m; Cp2: Li with dimensions of 1.0 m x 1.0 m and Gb, with dimensions of 0.5 m x 0.5 m; Cp3: Li, with dimensions of 1.0 m x 1.5 m and Gb, with dimensions of 0.5 m x 0.25 m; Cp4: Li, which had 1.0 m x 1.5 m, and Gb, which had 0.5 m x 0.5 m. Using the analysis of variance and the HSD test, the data were analyzed. Economic advantage based on potential carrying capacity were the variables that were measured (P<0.01). The outcomes appeared to be substantially different. The economic benefit are highest due to the improved grain yields of intercrop in Cp4. Li covered crops with established areas of 1.0 m x 1.5 m and Gb with established areas of 0.25 m x 0.5 m may be considered to have the best advantages in terms of yield for economic advantage.

**Key words :** carrying capacity, combination planted, economic advantage

## I. INTRODUCTION

Intercropping is one of the integrated soil fertility management practices in which two or more crops are grown simultaneously in the same area. Agriculture has benefited from this method, which has been used for decades. Intercropping systems are also advantageous to smallholder farmers in low-input and/or high-risk tropical regions, where smallholder farmers frequently intercrop cereals and legumes due to the legume's capacity to address the issue of declining soil fertility (Matusso et al 2012).

The essential target of intercropping is to increment land yield by improving assets that can't be used really in a monocropping framework (Moradi et al 2014). The primary advantage of intercropping is that it further develops crop efficiency and utilizes the current assets. By expanding invasion with mulch layers, giving shade, lessening wind speed, and further developing soil structure, intercropping can monitor soil water (Mobasser et al 2014). The accessibility of natural assets and the opposition between the parts for those assets decide fundamentally the presentation of part crops and the outcome of intercropping frameworks (Telleng et al 2016). Under the intercropping framework, be that as it may, a few blends adversely affect the parts' yield (Matusso et al 2012).

Any proportion of the yield advantage obtained by growing at least two harvests or assortments as an intercrop in comparison to developing similar yields or assortments as an assortment of monocultures is considered to be an important tool for studying and evaluating intercropping systems (Yancey and Cecil 1994).

## II. MATERIALS AND METHODS

### *A. Experimental Site*

The review was led in the trial station of Asasesement Institute of Agriculture Technology (AIAT) of North Sulawesi, located 12 km from Manado City. The trial site received 500 millimeters of precipitation on average and was truly dispersed throughout the area, with the exception of a month-to-month period with 50-100 millimeters of precipitation. The fertile, sandy loam soil had a pH of about 6. On a sunny morning at 10 a.m., light transmission was 73%, with PAR under mature tall coconuts. The soil was a dark clay color. January saw high rainfall intensities and precipitation peaks. This caused an 86% relative humidity level. Temperatures of the air ranged from 23.1 °C to 32.7 °C.

### *B. Experimental Design*

The Asassemen Institute of Agriculture Technology (AIAT) in North Sulawesi provided the grass Brachiaria (Gb). The Agrostology Laboratory of the Faculty of Animal Science at Bogor Agricultural University provided the legume seeds of leguminosae Indigofera (Li). Land-planted Indigofera seeds had been utilized as a nursery. After the plant seeds had laid down a good foundation for themselves, they were moved into the 2.5 kg plastic sack that was at that point loaded down with soil (one plant for each plastic pack). After growing for two months in a medium plastic sack, the plant was moved to the trial site in a 3 m x 4 m plot that had been treated with four medicines of establishing dispersing with 1 m column separation. The area for planting is Li: i) 1.0 m x 1.0 m and ii) 1.0 m x 1.5 m. Gb was planted after two months of growing Indigofera in experimental plots. Two planting areas in Gb: i) 0.5 m x 0.25 m, and ii) 0.5 m x 0.5 m. There were four combinations of intercropping, and each one was planted in five plots. The following were the plot points: Cp1: Li with dimensions of 1.0 m x 1.0 m and Gb, with dimensions of 0.5 m x 0.25 m; Cp2: Li with dimensions of 1.0 m x 1.0 m and Gb with dimensions of 0.5 m x 0.5 m; Cp3: Li with dimensions of 1.0 m x 1.5 m and Gb with dimensions of 0.5 m x 0.25 m; Cp4: Li which had a size of 1.0 m x 1.5 m, and Gb which had a size of 0.5 m x 0.5 m. MINITAB (Version 16) was used to conduct an analysis of variance (ANOVA) on the data. The difference between the treatments was determined using Honestly Significance Difference (HSD). At $p<0.05$, differences were taken into account.

### C. Economic Assumptions

We expect that one individual with an inspiration would be the best labor force for directing 1 ha of fields, 3,000,000 monthly rupiahs. Fee for renting land in Rp 4,000,000 annually per hectare. There are 10,000 Iz plants spaced 1.0 m x 1.0 m and 7,500 Iz plants spaced 1.0 m x 1.5 m in the mixed stand on that one hectare of land; Brachiaria with 38,330 plants spread out over a 0.5 m x 0.25 m; Brachiaria with 23,330 plants distributed 0.5 m x 0.5 m, taking into account the Rp cost of 2,500 per plant

## III. RESULTS AND DISCUSSION

### A. Results

*- Economic Analysis of monoculture*

In the monoculture editing framework, the expenses caused to do the littlest business are in mix Cp4, where the expenses brought about are just Rp. 190.4, followed by mix Cp2 with an expense of Rp. 190.80 and a blend of Cp3 at an expense of Rp. 236.5 and the greatest expense is in blend c1 with an expense of Rp. 246.0 for an area of 2 ha. While for the littlest pay got in mix Cp4 with a pay of Rp. 271.6 followed by blend Cp2 with a pay of Rp. 276.0 and mix Cp3 with a pay of Rp. 236.5 and the most elevated is in blend Cp1 with a pay of Rp. 400.5 for an area of 2 ha. yet, the greatest benefit is gotten in the Cp3 blend with a benefit of Rp. 159.57 for a 2 ha region, and that implies there will be a benefit of Rp. 79.69 for an area 1 ha.

Tabel 1. Economic Analysis of Intercropping *Indigofera* and *Brachiaria* .

| Combination | | | Economic Analysis (Rp. 000.000) Monoculture | | | Intercropping | | |
|---|---|---|---|---|---|---|---|---|
| ***code*** | ***Indigofera*** | ***Brachiaria*** | ***cost*** | ***income*** | **profit** | ***cost*** | ***income*** | **profit** |
| Cp1 | 1m x 1m | 0.5m x 0.25m | $246^{a}$ | $400.5^{a}$ | $154.54^{a}$ | $189^{a}$ | $345.9^{a}$ | $156.95^{a}$ |
| Cp2 | 1m x 1m | 0.5m x 0.5m | $199.80^{c}$ | $276^{b}$ | $76.17^{b}$ | $131.7^{d}$ | $176.8^{c}$ | $45.09^{c}$ |
| Cp3 | 1m x 1.5m | 0.5m x 0.25m | $236.5^{b}$ | $396.1^{a}$ | $159.57^{a}$ | $174.1^{b}$ | $316.4^{a}$ | $142.29^{a}$ |
| Cp4 | 1m x 1.5m | 0.5m x 0.5m | $190.4^{d}$ | $271.6^{b}$ | $81.21^{b}$ | $139.6^{c}$ | $238.4^{b}$ | $98.79^{b}$ |
| **P Value** | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **MSE** | | | 1.825 | 7.301 | 5.477 | 2.244 | 8.977 | 6.732 |

for indigofera seeds and the Rp cost of the seeds 500.-/clump.

### D. Variable Observations

The social affair of Indigofera was done 90 days after it was planted, and it was defoliated 100 cm over the ground level. Brachiaria lost their leaves at a level of 10 centimeters over the ground. To decide their dried weight, the tests were dried for around 48 hours at 60 °C. The potential dry matter abdicate and economic analysis are two of the factors (ton/ha/yr). The dry matter acquiescence of each plot was resolved utilizing the worth of the dry-weight rate. A monetary examination is utilized to decide the worth of the net benefit in the wake of deciding the limit with regards to every mix utilizing the information assembled from the creation of dry matter.The effectiveness assessment of each plot was utilized to change over the data assembled from the accumulate into the expected efficiency of one hectare.

*[a,b] Means in the same coloum with different letters show differences (p<0.05).*

Tabel 2. Economic Advantage of Intercropping *Indigofera* and *Brachiaria* .

| Combination | | | Economic Advantage (Rp. 000.000/ha) | | |
|---|---|---|---|---|---|
| ***code*** | ***Indigofera*** | ***Brachiaria*** | ***Profit monoculture*** | ***Profit intercropping*** | **Advantage intercropping** |
| Cp1 | 1m x 1m | 0.5m x 0.25m | $77.27^{a}$ | $156.95^{a}$ | $79.69^{a}$ |
| Cp2 | 1m x 1m | 0.5m x 0.5m | $38.08^{b}$ | $45.09^{c}$ | $7.01^{c}$ |
| Cp3 | 1m x 1.5m | 0.5m x 0.25m | $79.78^{a}$ | $142.29^{a}$ | $62.51^{ab}$ |
| Cp4 | 1m x 1.5m | 0.5m x 0.5m | $40.61^{b}$ | $98.79^{b}$ | $58.18^{b}$ |
| **P Value** | | | <0.001 | <0.001 | <0.001 |
| **MSE** | | | 2.738 | 6.732 | 5.755 |

*[a,b] Means in the same coloum with different letters show differences (p<0.05).*

*- Economic Analysis of Intercropping*

In the intercropping editing framework, the expenses caused to do the littlest business are in mix Cp2, where the expenses brought about are just Rp. 131.7, followed by mix Cp4 with an expense of Rp. 139.6 and a blend of Cp3 at an expense of Rp. 174.1 and the greatest expense is in blend Cp1 with an expense of Rp. 189.0 for an area of 1 ha. While for the littlest pay got in mix Cp2 with a pay of Rp. 176.8 followed by blend Cp4 with a pay of Rp. 238.4 and mix Cp3 with a pay of Rp. 316.4 and the most elevated is in blend Cp1 with a pay of Rp. 345.9 for an area of 1 ha. yet, the greatest benefit is gotten in the Cp1 blend with a benefit of Rp. 156.95 for an area of 1 ha.

- *Economic Advantage of Intercropping*

In all mixes of indigofera and brachiaria intercropping frameworks will get a higher benefit when contrasted with establishing in monoculture. Where the least benefit is acquired in blend Cp2 of Rp. 7.01 or approximately 18.40%, was followed by the Cp4 combination, which generated a profit of Rp. 58.18 or around 143.27% and Cp3 with a benefit of Rp. 62.51% or roughly 78.35 percent, while combination Cp1 yields the highest profit, Rp. 79.69 or around 103.13% higher than the monoculture editing framework.

## B. Discussion

The fundamental explanation that intercropping is utilized is to get a better return in a given time span than an unadulterated stand of a similar land region. intercropping as a way to produce more with fewer external inputs at a lower cost (Wiley 1991). This growing ability to use is important, especially for small-scale ranchers and in areas where the growing season is short (Altieri, 1995) and in rainfed areas (Maitra *et al.* 2001a; Maitra *et al.* 2001b). The expanded creation in intercropping can be ascribed to the expanded development rate, expanded creation of biomass, and viable usage of room and assets (Telleng 2017). Moreover, creation ascends in any intercropping framework where the part crops have correlative impacts since there is less contest between them (Willey 1991)

Expanding the utilization of leguminous yields and diminishing the utilization of mineral composts through intercropping can help differentiate agroecosystems (Neugschwandtner and Kaul, 2015). Crop efficiency and development could be supported through sensible intercropping (Cecilio et al., 2011), efficient use of water, nitrogen, and radiation as resources (Lithourgidis et al., 2011), macronutrients (Salehi et al., 2018) and micronutrients (Neugschwandtner and Kaul, 2015), yield quality (Klimek-Kopyra et al., 2017) and lower the damage caused by diseases and pests (Hauggaard-Nielsen et al., 2001). The benefits of intercropping legumes and non-legumes are explained by the complementary use of resources because legumes and non-legumes do not compete for the same resource niche (Bedoussac and Justes, 2010).

In intercropping frameworks, expanded supplement take-up can happen spatially and transiently. Crops in an intercropping system have temporal advantages in nutrient uptake when they have peak nutrient demands at different times, and root mass can increase spatial nutrient uptake (Anders *et al*., 1996). At the point when the tree vegetable leaves were remembered for the eating routine, feed consumption, live weight gain, and feed transformation all worked on because of the better edibility. Join minor elephant grass, Gliricidia sepium, Leucaena leucocephala and Indigofera zollingeriana, as far as principles, the goats dealt with the tree vegetable Indigofera zollingeriana recorded the best execution (Anis et al, 2020).

Intercropping has the advantage of making better use of limited resources like light, nutrients, and water (Musa et al 2010). The richness pace of the developing medium and a few biotic ecological elements impact plant supplement organization. Expanded thickness and supplement prerequisites and rivalry from daylight are exacerbated by brief distances. The rod's capacity to absorb nutrients increased as a result of the plant space's influence on the microenvironment (light, temperature, and humidity) (Telleng et al 2020). Because light comes from above the plants, people who place their leaves above the leaves of their neighbors benefit directly from increased photosynthetic rates and indirectly by reducing their neighbors' growth through shade (Craine and Dybzinski 2013). The number of branches decreased with a row spacing of 1.0 m x 0.5 m (Kumalasari et al 2017). The wide spacing between plants in rows probably made it easier for the plants to convert the intercepted solar radiation into leaf production (Telleng et al 2015). In a coconut ranch, Indigofera zollingeriana's establishing space affected the leaf protein content, stem unrefined fiber content, and leaf rough fiber content (Telleng et al 2020).

# IV. CONCLUSION

All blends of indigofera and brachiaria intercropping frameworks give higher benefits when contrasted with establishing in monoculture. Combination Cp4 has the highest profit percentage, with a profit of around 143.27 percent, and combination Cp1 has the highest financial profit, with a profit of Rp. 79.69.

## REFERENCES

[1] Altieri M A 1999 The ecological role of biodiversity in agroecosystems Agric Ecosyst Environ. 74:19–31.

[2] Anders M M, Potdar M V and Francis C A 1996 The significance of Intercropping in cropping systems. In: Ito, O., Johansen, C., Adu-Gyamfi, J.J., Katayama, K., Kumar, J.V.D., Rao, K. and Rego, T.J. (Eds.). Dynamics of roots and nitrogen in cropping systems of the semi-arid tropics. Japan International Research Center for Agricultural Sciences. International Agricultural Series No. 3 Ohwashi, Tsukuba, Ibavaki 305, Japan.

[3] Anis S D, Kaligis D A and Pangemanan S 2015 Integration of cattle and Koronivia grass pasture underneath mature coconuts in North Sulawesi, Indonesia. J. Livestock Research for Rural Development. 27(7):42-45.

[4] Anis S D, Kaligis D A, Tulung B and Aryoanto 2016 Leaf quality and yiels of *Gliricidia sepium*(Jacq) Steud under different population density and cutting interval in coconut plantation. J. of the Indonesian Tropical Animal Agriculture. 41(2):91-97.

[5] Anis S D, Kaunang Ch L, Telleng M M, Kaunang W B, Sumolang C I J and Paputungan U 2019 Preliminary Evaluation on Morphological Response of *Indigofera zollingeriana* Tree Legume Under Different Cropping Patterns Grown at 12 Weeks After Planting Underneath Mature Coconuts. Livestock Research for Rural Development 31(9)

[6] Anis S D, Kaunang Ch L, Telleng M M and Rumambi A 2020 Improving diets of fattening goats with leaves of fast-growing leguminous trees. J. Livestock Research for Rural Development. 32(8):132.

[7] Bedoussac L and Justes E 2010 The efficiency of a durum wheat-winter pea intercrop to improve yield and wheat grain protein concentration depends on N availability during early growth. Plant and Soil 330, 19–35.

[8] Brintha I and Seran T H 2009 Effect of Paired Row Planting of Radish (*Raphanus sativus* L.) Intercropped with Vegetable Amaranths (*Amaranths tricolor* L.) on Yield Components of Radish in Sandy Regosol. *J. Agric. Sci*. 4:19-28.

[9] Cecilio A B, Rezende B L A, Barbosa J C and Grangeiro L C 2011 Agronomic efficiency of intercroppingtomato and lettuce. Anais da Academia Brasileira de Ciencias 83, 1109–1119.

[10] Craine J M and Dybzinski R 2013 Mechanisms of plant competition for nutrients, water and light. Funct. Ecol. 27: 833-840.at: https://doi.org/10.1111/1365-2435.12081

[11] Dariush M, Ahad M and Meysam O 2006 Assessing the Land Equivalent Ratio (LER) of two corn [*Zea mays* L.] varieties intercropping at various nitrogen levels in Karaj, Iran. Journal of Central European Agriculture 7(2):359-364.

[12] Hauggaard-Nielsen H, Ambus P and Jensen E S 2001 Interspecific competition, N use and interference with weeds in pea-barley intercropping. Field Crops Research 70, 101–109.

[13] Ijoyah M O and Jimba J 2011 Effects of planting methods, planting dates and intercropping systems on sweet potato-okra yields in Makurdi, Nigeria. Agricultural Science Research Journal 1(8):184-190.

[14] Klimek-Kopyra A, Skowera B, Zając T and Kulig B 2017 Mixed cropping of linseed and legumes as a ecological way to effectively increase oil quality. Romanian Agricultural Research 34, 217–224.

[15] Kumalasari N R, Wicaksono G P and Abdullah L 2017 Plant Growth Pattern, Forage Yield, and Quality of *Indigofera zollingeriana* Influenced by Row Spacing. Media Peternakan 40(1) (2017) 14-19.

[16] Lithourgidis A S, Dordas C A, Damalas C and Vlachostergios D N 2011 Annual intercrops: an alternative pathway for sustainable agriculture. Australian Journal of Crop Science 5, 396–410.

[17] Matusso J M M, Mugwe J N and Mucheru-Muna M 2012 Potential role of cereal-legume intercropping systems in integrated soil fertility management in smallholder farming systems of subSaharan Africa Research Application Summary. Third RUFORUM Biennial Meeting 24-28 September 2012, Entebbe, Uganda.

[18] Maitra S, Ghosh D C, Sounda S and Jana P K 2001a Performance of inter-cropping legumes in finger millet (*Eleusine coracana*) at varying fertility levels. *Indian Journal of Agronomy*, 46(1): 38-44.

[19] Maitra S, Samui R C, Roy D K and Mondal A K 2001b Effect of cotton based intercropping system under rainfed conditions in Sundarban region of West Bengal. *Indian Agriculturist*, 45(3-4): 157-162 .

[20] Mead R and Willey R W 1980 The concept of a land equivalent ratio and advantages in yields for intercropping. Exp Agric. 16:217–228.

[21] Metwally A A, Shafik M M, Sherief M N and Abdel-Wahab T I 2012 Effect of intercropping corn on Egyptian cotton characters. J. Cotton Sci., 16 (4) (2012) 210–219, U.S.A.

[22] Mobasser H R, Vasirimehr M R and Rigi K 2014 Effect of intercropping on resources use, weed management and forage quality. IJPAES. 4:706-713.

[23] Mohammed S A A 2011 Assessing the Land Equivalent Ratio (LER) of Two Leguminous Pastures (CLITORIA and SIRATRO) Intercropping at VariousCultural Practices and Fencing at ZALINGEI–Western Darfur State-Sudan. ARPN Journal of Science and Technology 2(11), 1074-1080.

[24] Moradi H, Noori M, Sobhkhizi A, Fahramand M and Rigi K 2014 Effect of intercropping in agronomy. J. Nov. Appl. Sci. 3:315-320.

[25] Mosquera O, Buurman P, Ramirez B and Amezquita M C 2010 Soil carbon stocks under improved tropical pasture and silvopastoral systems in Colombian Amazonia. 19th World Congress of Soil Science, Soil Solutions for Changing World. 1-6 August 2010, Brisbane, Australia.

[26] Musa M, Leitch M H, Iqbal M and Sahi F U H 2010 Spatial arrangement affects growth characteristics of barley-pea intercrops. International Journal of Agriculture and Biology 12 (2010) 685–690.

[27] Neugschwandtner R W and Kaul H P 2015 Nitrogen uptake, use and utilization efficiency by oat-pea intercrops. Field Crops Research 179, 113–119.

[28] Salehi A, Mehdi B, Fallah S, Kaul H P and Neugschwandtner R W 2018 Integrated fertilization of buckwheat-fenugreek intercrops improves productivity and nutrient use efficiency. Nutrient Cycling in Agroecosystmes 110:407–425.

[29] Santalla M, Rodin˜o A P, Casquero P A and de Ron A M 2001 Interactions of bush bean intercropped with field and sweet maize.European Journal of Agronomy 15:185–196.

[30] Schaufele R and Schnyder H 2000 Cell growth analysis during steady and non-steady growth in leaves of perennial ryegrass (*Loliumperenne L*.) subject to defoliation. Plant Cell.Environ. 23:185-194.

[31] Suharlina and Abdullah L 2010 Productivity improvement of Indigofera sp. As high quality forage using organic fertilizer:The effect of nutritional content. Proceeding of Nasional Seminar of Tropical Forages. Denpasar, 5th November 2010.

[32] Telleng M M, Abdullah L, Permana I G, Karti P D M H and Wiryawan K G 2015 Growth and Productivity of Different Sorghum Varieties Cultivated with Indigofera in Intercropping System. Proceeding of the 3rd International Seminar on Animal Industry, Bogor 17-18 September 2015.

[33] Telleng M M, Wiryawan K G, Karti P D M H, Permana I G and Abdullah L 2016 Forages Production and Nutrient Composition of Different Sorghum Varieties Cultivated with *Indigofera* in Intercropping System. Media Peternakan 39(3):203-20.

[34] Telleng M M 2017 Penyediaan Pakan Berkualitas Berbasis Sorgum (*Sorghum bicolor*) dan Indigofera (*Indigofera zollingeriana*) dengan Pola Tanam Tumpangsari. Disertasi. Sekolah Pascasarjana IPB, Bogor.

[35] Telleng M M, Anis S D, Sumolang C I J, Kaunang W B and Dalie S 2020 The Effect of Planting Space on Nutrient Composition of *Indigofera zollingeriana* in Coconut Plantation. International Conference: Improving Tropical Animal Production for Food Security. IOP Conf. Series: Earth and Environmental Science 465:01201.

[36] Willey R W 1991 Evaluation and Presentation of Intercropping Advantages. Experimental Agriculture, 21:119-123

[37] Yancey and Cecil Jr 1994 Covers challenge cotton chemicals. The New Farm. February 1994:20–23.

## AUTHORS

**First Author** – Tilly Flora Desaly Lumy, Social-Economic for livestocks, Faculty of Animal Science, Sam Ratulangi University, Manado Indonesia.

**Second Author** – Janne Herly Willy Rembang, Plant breeding and development, Assessment Institute of Agriculture Technology (AIAT) of North Sulawesi, Indonesia.

**Third Author** – Malcky Makanaung Telleng, Forage Science and animal Nutrition, Faculty of Animal Science, Sam Ratulangi University, Manado Indonesia.

**Correspondence Author** – Tilly Flora Desaly Lumy,