



Harnessing the Potential of the Economic and Nutritional Power of Integrated Farming

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Abstract. The agricultural system in Indonesia has changed to meet the needs. The green revolution farming system has begun to be abandoned and switched to integrated agriculture. Integrated agriculture, in principle, is to integrate several components that work together to produce products. Integrated agriculture has high economic and nutritional potential to be able to answer Indonesia's needs. Some of the profitable integration models are integrated farming rice-livestock, Integrated Farming rice – duck, Integrated Plantation – Livestock, and Vegetable – Fish Integrated system.

Keywords: Integrated farming · Potential of the economic and nutritional

1 Introduction

Several integration models that have been carried out based on the carrying capacity of the surrounding environment include integrated farming rice-livestock, integrated farming rice-duck, integrated plantation-livestock and vegetable, and integrated fish systems. The green revolution was introduced in the 1960s through Bimas, Inmas and (Insus) program, which has succeeded in overcoming the food crisis that is currently being faced [1]. Through the green revolution, Indonesian farmers' food production increased rapidly, with an average annual production increase of 4%, successfully making Indonesia a world food barn in 1984 [2].

The green revolution aims to increase production to meet domestic needs and national food reserves. Some of the activities carried out in this program include efforts to produce high-yielding varieties so that the plants mature early, are resistant to pests/diseases, have high productivity, and are responsive to external inputs. In addition, chemical fertilizers are introduced to meet plant nutrients, and anti-pest pesticides are applied at the farmer's level. Other forms of government intervention support for the high price of agricultural products [1], construction and repair of irrigation canals for irrigation [3]. Farmers being provided with capital through credit to provide plant production facilities [4]. Farmers are introduced to farming patterns that are different from those commonly applied, or in other words, the green revolution presents the modernization of agriculture. Through these efforts, the green process is able to increase crop production.

The green revolution succeeded in changing farmers' habits in farming but did not last long because there were negative impacts that emerged later According to Nugroho

[4]. The green revolution educates farmers not to be independent or dependent on other parties. It can be seen from the superior seeds that farmers must purchase every planting season, as well as fertilizers and pesticides; farmers depend on fertilizer and pesticide producers. Likewise, farmers hope for government subsidies; there is an increasingly clear gap between wealthy and small farmers. In 1986, there was a decline in crop production, and in 1988 Indonesia again had to import rice. Intensification through the use of superior seeds, monoculture cropping patterns, use of artificial chemical fertilizers, and pest and disease control using chemical pesticides impacts biodiversity and the environment. The unbalanced chemical fertilizers make agricultural soils saturated and unable to support crop production optimally [3], it has an impact on pest immunity [5], the emergence of new pests, pesticide residues in agricultural products [6], soil and water pollution, and can poison farmers [7]. Poisoning by farmers can be caused by insufficient knowledge, low awareness of the dangers of pesticides, inappropriate types, dosage, method of use, timing (frequency in a week, and duration of spraying per day), toxicity, and low use of personal protective equipment. The use of inappropriate pesticides can kill organisms other than pests and monoculture patterns, which will reduce biodiversity.

Dependence can be reduced by utilizing local resources as optimally as possible so that the independence of farmers can be regenerated. There are many local potentials that can be used as a means of production, one of which is by implementing integrated agriculture.

2 Integrated Farming

Integrated agriculture is one that integrates various existing resources to increase productivity, biodiversity, so that the economic value of farmers increases. In its application practical innovations in integrated production systems based on conservation that take advantage of synergies between crop production, agriculture and the agroforestry sector that ensure the economy and ecology while providing ecosystem services [8]. Integration in integrated agriculture is done intentionally and has a synergistic relationship between components. This synergy, if managed properly, will increase the social status, economy, food security, and environment improve the living standards of the farmers it manages. Integrated agriculture integrates various parts to meet needs. The waste from one part will be the raw material for the other part. Such integration of these various parts has proven to be profitable [9], productive and sustainable [10, 11]. This integrated agriculture is one of the resource management strategies that can increase production, be economical and sustainable [12, 13].

Through integrated agriculture will reduce input from outside so that the independence of farmers will increase. Business continuity is more guaranteed. One example is the integration between crops and livestock. Plant waste will be a source of food for livestock and vice versa livestock manure will become fertilizer for plants. Maximum compatibility will fulfill organic matter filling through effective recycling of organic waste. This will greatly reduce the dependence of farmers on inorganic fertilizers imported from outside.

3 Potential Economic and Nutritional Power of Integrated Agriculture

Integrated agriculture is one way that can solve various problems of farmers in Indonesia. Among them are expensive inputs so that production costs are high while the available capital is limited [14]. The implementation of integrated agriculture will train farmers to be independent because inputs are provided from other business waste. Intake from outside can be reduced or even eliminated so that production costs are cheaper. Integrated agriculture is one way to increase production [15].

Proper integration of integrated farming increases productivity vertically [16]. This business can also be said to be intensive farming. Commodity diversification will increase biodiversity, which will support each other. Combination of rice crops and cattle [17], duck fish, fish fowl, rice-fish and crop cultivation, technology, fish, and housing [12]. Commodity diversity can prevent crop failure. If one commodity fails, other entities are still available.

Integrated farming increases farmers' income compared to monoculture cultivation. Monoculture rice cultivate with a B/C ratio of 1.38 or an income of IDR. 9.213.550.00 per year. Meanwhile, integrated farming between rice and livestock can produce a B/C ratio value of 1.73 or IDR. Income. 17.981.726.95 per year [17].

IFS is reported to fetch higher farm income and profitability than conventional farming in smallholder systems of the developing world [18, 19]. By increasing the provision of animals and fish, IFS generate higher cash income. It is also reported to achieve a low cost of production and thus increase farmers' net income without disturbing the productivity concern. Since it adds to the system's sustainability (by ensuring local sourcing of agricultural inputs), the revenue from IFS is expected to be stable over the years. Crop-livestock-fish system or crop-livestock system is reported to give a higher net return than crop-based systems alone.

The concept of the integrated farming system is gaining momentum as a means to maximize food production and to elevate the economic status of the farmers by multifarious farm activities particularly by incorporating livestock enterprises. For human needs, the livestock provides food, fiber, skin, fertilizer, and fuel. Livestock also constitutes a "living bank" providing flexible financial reserves in times of emergency and serving as "insurance" against crop failure for survival. The results of the integrated farming system are daily products namely milk, eggs, and biogas; weekly results, namely compost, bio urine, animal feed; monthly yields of rice, meat; results annual is calves, goats, etc. The use of manure as organic fertilizer in the complement system crop-livestock has proven to have been able to increase the productivity and income of farmers and reduce production costs. The crop-livestock system model applied by farmers in Bali can save about 25.2% of fertilizer costs and increase revenue for farmers by 41.40% [20].

The Ministry of Agriculture initiated the optimization of the use of the yard through the concept of Sustainable Food Houses (SFH). SFH is a resident's house that cultivates the yard intensively to be used wisely with various local resources, ensuring the continuity of supply of quality and diverse household food. Suppose the SFH is developed wide, based on the hamlet (village), village, or other possible areas. In that case, the application of the Sustainable Food House (SFH) principle is called the Sustainable Food House Area (SFHA). In addition, SFHA also includes efforts to intensify the use

Table 1. Recommended dietary allowances

Age (years)	Weight (kg)	Height (cm)	Energy (ccal)	Protein (g)	Vit-A (RE)
10–12	30	135	2000	45	500
13–15	45	150	2400	64	600
16–19	56	160	2500	66	700
20–45	62	165	2800	55	700
46–59	62	165	2500	55	700
>60	62	165	2500	55	600

Source: Regulation of the Minister of Health of the Republic of Indonesia Number 28 of 2019 Concerning Recommended Nutrition Adequacy for the Community of Indonesia

of living fences, village roads, and other public facilities (schools, houses of worship, etc.), green open land, and developing processing and marketing of products.

Prevention of hunger and malnutrition has been carried out since the 1990s and has not been able to overcome the problem of food insecurity as a whole. There are still many malnourished mothers who give birth to premature babies with low weight, stunting. Progress in overcoming this problem is demonstrated by the success of the Sustainable Food House Program, which can address the issue of malnutrition and food insecurity at the household level. The availability and intake of food are increasing, including foods rich in micronutrients and varies throughout the year. This program has succeeded in overcoming food insecurity at the level of poor households.

Based on the Central Statistics Agency (CSA) report in the 2013 agricultural census, agricultural households in Indonesia reached 24.16 million, and some workers live below the poverty line. Several things cause condition farmers who tend to be below the poverty line. Such as the high capital required in the production process disproportionate to the income from the sale of agricultural products. That matters; this causes farmers to suffer losses in the production process. Price needs in the production process (seeds, fertilizers, pesticides, agricultural equipment, and so on) are expensive, weather changes that cause natural disasters, to pest attacks which are a factor in the low yield of agricultural production. It is a problem often faced by farmers. Especially farmers require capital to carry out the production process again, but it also fulfills daily basic needs, which are increasingly expensive.

One indicator of the poor is 1). It only consumes meat/milk/chicken once a week, 2). It only buys one new set of clothes a year, 3). It is only able to eat as much as one/two times a day, 4). It was unable to pay the cost of treatment at the polyclinic, 5). Sources of income for the head of household are farmers with a land area of 500 m², farm laborers, fishers, construction workers, plantation workers, and other jobs below IDR. 600.000,- per month, 6). The highest education of the head of the household: no school/not finished elementary school/graduated elementary school.

Table 1 explains the nutrition Sufficiency for the Community Indonesia, which indicates that the average need for a particular nutrient must be met every day for almost

Table 2. Nutritional content of food and its processed products (100 g)

No	Food	Calories (cal.)	Protein (mg)	Fat (mg)	Carbo (mg)	Ca (Mg)	P (mg)	Fe (g)	VITAMIN			Water (g)
									A (SI)	B1 (mg)	C (mg)	
1	Rice	178	2,1	0,1	40,6	5	22	0,5	0	0,02	0	57,0
2	Corn	361	8,7	4,5	72,4	9	380	4,6	350	0,27	0	13
3	Cassava	146	1,2	0,3	34,7	33	40	0,7	0	0,06	30	62,5
4	peanut	452	25,3	42,8	21,1	58	335	1,3	0	0,3	3	4
5	Chicken	302	18,2	25	0	14	200	1,5	810	0,08	0	55,9
6	Duck	326	16	28,6	0	15	188	1,8	900	0,1	0	54,3
7	Goat	154	16,6	9,2	0	11	124	1	0	0,09	0	70,3
8	Beef	207	18,8	14	0	11	170	2,8	30	0,08	0	66
9	Egg	162	12,8	11,5	0,7	54	180	2,7	900	0,1	0	74
10	Fish	129	20	4,8	0	20	150	2	150	0,05	0	74
11	Spinach	36	3,5	0,5	6,5	267	67	3,9	6,09	0,08	80	86,9
12	Mustard	22	2,3	0,3	4	220	38	2,9	6,46	0,09	102	92,2
13	Avocado		0,55	3,97	4,70							84,2
14	Mango		0,33	0,3	10,86							82,2
15	Papaya		0,38		9,15							86,7
16	Banana		0,90	0,15	19,35							72,0

Source: Agus S. Nutritional and Nutritional Content Data.

everyone with specific characteristics such as age, gender, levels of physical activity, and physiological conditions to live healthily.

According to law number 36 the Year 2009 on Health, health includes health physically, mentally, spiritually, or socially, allowing everyone to live productively [21].

The integrated farming system provides nutrition to the families. Corps delivers carbohydrates, vitamins, and minerals, while livestock provides essential nutrients, namely protein. Table 2 describes the nutritional content that a sustainable agricultural system can meet.

In general, the functions of food substances are:

- Source of energy or power. If this function is impaired, people become less active or less active and feel tired quickly.
- Supports body growth, namely the addition of new cells to existing cells.
- Maintain body tissue, replace damaged or worn out, such as replacing cells visible in body wounds, namely the harm covering tissue.
- Regulate metabolism and various balances in body fluids (balance of water, acid-base, and minerals)

- Play a role in the body's defense mechanism against various diseases as antioxidants and other antibodies.

According to Table 2 integrated farming system can supply the balanced nutrition of a community or smallholder.

4 Integrated Farming Model

4.1 Integrated Farming Rice-Livestock

The integrated rice - livestock program is an alternative in increasing the production of rice, meat, milk and at the same time increasing farmers' income. Integrated rice - livestock is implemented by applying processing technology by-products of rice plants such as rice straw, and cattle can use products such as rice bran as cattle feed. Meanwhile, cow dung is used as a source of raw material for organic fertilizers to improve soil fertility in paddy fields.

The by-products of rice plants are: Straw has considerable potential in supporting the availability of animal feed. Rice straw production can be available in large enough quantities, on average 4 tons/ha. After going through the fermentation process, it can provide feed ingredients for cows as much as 2/year [22].

Table 3 shows the implementation of integrated farming system of rice-cattle influenced by scale of land, the wider land leads to increased farmers' incomes.

Table 3. Income analysis of rice – cattle integrated system farming

Scale category	Analysis Component	Integrated (IDR)	Rice (IDR)	Cattle (IDR)
Small	Total cost	66.517.670	19.151.650	51.342.150
	Total revenue	84.149.730	22.981.340	61.168.390
	Income	17.632.030	3.829.690	9.896.240
	R/C Ratio	1.26	1.20	1.19
	Profitability	26.51	20.00	19.14
Medium	Total cost	226.794.630	49.557.610	189.827.550
	Total revenue	292.718.820	58.305.600	234.413.220
	Income	65.262.190	8.747.760	44.589.670
	R/C Ratio	1.29	1.18	1.23
	Profitability	28.69	17.65	22.49
Large	Total cost	906.854.270	310.729.950	681.928.450
	Total revenue	1.307.520.000	392.040.940	915.477.360
	Income	400.664.030	81.311.990	233.548.910
	R/C Ratio	1.44	1.26	1.34
	Profitability	44.18	26.17	34.25

Source: Mukhlis et al. [22]

4.2 Integrated Farming Rice–Duck

The rice and duck cultivation system is one of the integrated agricultural technologies in which rice and ducks/duck are cultivated on the same land. The benefits that could be obtained from the application of rice and duck cultivation are a. Benefits for weeding, b. Benefits of pest and disease control, c. Benefits of fertilization, d. Benefits of plowing and loosening the soil over time, e. Benefits of controlling golden snails, f. Benefits of stimulating rice growth [23].

Furthermore, reported that by implementing integrated agriculture of rice and ducks, there are several advantages, including direct benefits: a. Rice production with rice and duck systems did not decrease in yield compared to the rice farming system alone, b. Eggs and duck meat are added value for farmers’ income, c. The welfare and revenue of farmers increased. The treatment of an organic fertilizer dosage of 30 tons/ha significantly affected the number of tillers; dry grain weight, and milled dry grain weight. In contrast, the treatment of the duck population did not affect the number of tillers, harvested dry grain weight, and dry milled grain weight [24]. Investigated the revenue of integrated rice duck farming per year was IDR. 75.546.633 with the costs of IDR. 49.013.896 [25]. The R.C. value of the ratio was 1.54, which shows that integrated farming provides benefits for farmers. The results of the investment criteria analysis show that the integration of duck rice farming provides benefits to farmers.

Farmer’s income (Farmers Pattern) is IDR. 6.035.000, with the R/C value, is 2.4 and the B/C value is 1.4, while the income of the integration pattern is IDR. 11.625.000 for plants rice with an R/C ratio analysis value of 3.5 and B/C 2.5. Additional yields from ducks amounted to IDR. 5.375.000 with an R/C ratio of 1.6 and a B/C of 0.6. At the same time, the level of feasibility of introduction is classified as excellent and profitable for farmers. Meanwhile, the results of the calculation of farmers’ employee benefit reached IDR. 141.667 [26].

The average acceptance of the integration of broiler ducks in Pematang Johar village is IDR. 109.433.333,- and the average profit from the integration of broiler ducks in



Fig. 1. Effect of organic fertilizer dosage and ducks population on rice production in rice - duck integrated systems. (Source: Nizar A and Budianto) [24].



Fig. 2. Integrated palm oil–cattle. (Source: Nizar Achmad, 2018. *The Growth of Young Agricultural Entrepreneurs*. Polbangtan Malang. Kutai Kartanegara East Kalimantan).

Pematang Johar village is IDR. 63,395,829 The magnitude of the R/C ratio of the integration of broiler ducks in Pematang Johar Village, Labuhan Deli District, Deli Serdang Regency, is 2.37 [30]. In conclusion, the integration of ducks and farming has advantages for both ducks and rice farming, reducing production costs and feed costs with an R/C ratio greater than one. Suggestions submitted that livestock and agricultural activities should be carried out in an integrated manner (Fig. 1).

4.3 Integrated Plantation – Livestock

Integration of cattle in oil palm plantations is an effective way to increase food productivity in plants and animals (Fig. 2). The direct benefits obtained by farmers from integrating oil palm with cattle, namely oil palm plants, can increase the feed needs for cattle. The impact of implementing the integration of oil palm–cattle in the area of PT Sawit Sumbermas Sarana Tbk for oil palm plantations is an improvement in land fertility in the long term and a reduction in weed control costs [27]. Meanwhile, the impact of implementing oil palm–cattle for cattle farming is that it does not require the addition of new land for planting grass and reduces the cost of grazing labor.

The capacity of cattle in 15 ha from midrib, leaf, and grass is 23 units of adult cattle. The business scale of 1 parent without considering labor costs resulted in an R/C of 2.37; NPV IDR. 2.241.00; and 37.3% IRR. The business scale of 3 cows taking into account labor costs gives an R/C of 2.46; NPV IDR. 7.324.000 and IRR 39%; then on a business scale of 6 parents + 1 male indicates a commercial business with an R/C of 3.13; NPV IDR. 22.425.000 and IRR above 50% [28].

The results showed that plantations with SISKKA that use an organic fertilizer are 18.899.93 kg/ha/year, relatively higher than the productivity of plantations without SISKKA that do not use organic fertilizer 17.039.73/ha/year (significant at a 15%). The income of oil palm plantations using SISKKA IDR 22.906.136.7/ha/year is relatively higher than the income of the plantations without SISKKA IDR 21.294.583.00/ha/year;

Table 4. Analysis coffee-goat farming income per planting season (1ha)

Commodity	Quantity	Price (IDR)	Revenue (IDR)	Duration
Coffee bean	500 kg	35.000	17.500.000	6 month
Chili	65 kg	25.000	1.625.000	6 month
Banana	270 Branch	35.000	9.450.000	6 month
Goat	10	4.000.000	40.000.000	12 month
Manure	500 kg	3000	1.500.000	12 month
Total Revenue			70.075.000	

Source: Youth Entrepreneurship and Employment Support Services Polbangtan Malang 2021



Fig. 3. Integrated coffee-goat ampel gading Malang. (Source: Nizar Achmad [31] Youth Entrepreneurship and Employment Support Services Polbangtan Malang).

however, the difference is not statistically significant because using SISKA increase the production cost [30].

Based on Table 4 above, it can be explained that the farmer’s revenue from diversifying five commodities in 1 ha of integrated coffee – goat integrated system.

Cultivation of coffee and goats is the best and most profitable combination (Fig. 3). Goats are beneficial for coffee plants because they provide fertilizer. In addition, there are many advantages obtained with this system integration. Some of the benefits in terms of robusta coffee cultivation accepted include 1). Weed control, 2). Cheap organic fertilizer, 3). No need for transportation to transport fertilizer, 4). Increase income.

4.4 Vegetable – Fish Integrated System

The aquaponics system is a zero-waste cultivation system, so it is perfect to be applied in the yard. Many advantages are achieved through aquaponics technology, so this technology is very prospective to be involved and developed in supporting the development of Sustainable Food House Areas. The story of the SFHA is carried out by utilizing the



Fig. 4. Nizar Achmad, Sustainable food house.

Table 5. Production of vegetables and fish in integrated vegetables and fish sustainable food house areas urban farming model (40 M²)

Commodity	Duration (Month)	Production (kg)	Price (IDR)	Total Revenue (IDR)
Spinach	2,5	10	3.000	30.000
chilly	6	7	15.000	105.000
Tomato	6	15	10.000	150.000
Cucumber	2,5	20	5.000	100.000
Watermelon	3	50	7.000	350.000
Fish	4	5	45.000	225.000
Total revenue				960.000

Source: Nizar Achmad, Sustainable Food House

yards of the house so that it is more optimal in achieving family food self-sufficiency through fulfilling balanced nutrition and improving family menus. In the SFHA concept, the use of yards is managed through an integrated approach between various commodities, including food crops (vegetables, fruit, herbs, and medicines), livestock cultivation, and fish. Integrated vegetables and fish contribute to food and economical household (Fig. 4) [31].

Based on the table, 5 yards with an area of 40 m² can generate IDR. 960.000. If it is added to the income of poor farmers who receive IDR. 600.000 Per 1 month, the integrated farming system pattern significantly increases farmers' income.

The Integrated farming system can be concluded:

- Improves the soil fertility & Health
- Increasing economic yield per unit area
- Reduction in production costs — decreases farm input requirements
- Multiple income sources — family income support
- Efficient utilization of family labor — enhance employment generation

- Reduction in animal feeding requirements
- Minimize the use of chemical fertilizers — pollution-free environment
- Provides balanced nutritious food for the farmers
- Solves the energy problems with biogas — recycling of resources
- Avoids degradation of forests
- Improves the status & livelihood of the farmer (Table 5)

5 Conclusion

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