Journal of Animal Environment

(E-ISSN 2717-1396, ISSN 2717-1388)

Original Research Paper

IMPACT OF INTEGRATED RICE-DUCK FARMING ON RICE GROWTH, YIELD, AND DUCK EGG PRODUCTION

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ABSTRACT

The rice-duck farming system benefits both components. The duck is a natural grazer and scavenger, able to consume a wide range of developing weeds, insects, and snails, and the rice field offers natural habitat and feed that can replace the duck's basic needs, reducing the need for costly commercial feeds, which account for 80% of duck raising costs. The study was conducted to evaluate the growth and yield performance of rice and, the laying performance of duck under the rice-duck farming system. The result of the study, based on the data gathered for the growth performance, shows no significant difference from each treatment. The growth performance of rice is suspected that the activity of ducks can maintain the elements needed by plants resulting in the activity of nutrient absorption being maximized the T2 even without fertilization. For the yield performance, T3 is higher than T2 because of the effect of commercial synthetic fertilizers and pesticides given to the rice for the whole period of production increases the yield performance of rice. For the laying performance, T1 had higher egg production than T2, because the duck in T1 received full commercial feeds and was not allowed to graze outside which lessened their usage of energy that could be converted to eggs this made the duck in T1 perform more in terms of laying performance into the optimal level. Even though the T1 and T3 have higher in yield and laying performance respectively. T2 is more profitable than T1 and T3 because of the lower capital expenses in the production by lowering the volume of agricultural inputs needed. This shows that the T2 rice duck farming system is competitive or greater in terms of profit than the conventional method of farming which could increase the income of farmers who will adopt this technology.

Keywords: Average Daily Gain, Growth performance, Yield performance

I. INTRODUCTION

Many Filipino farmers are simply unable to take their production further due to the high expense of many critical inputs. Compounding this is the low palay prices that could be expected after harvesting, which keeps many farmers in a perpetual state of struggle and often in serious debt.

Partly due to market forces and exploitative practices, basics such as fertilizers, high-yield seed grains, and mechanized farm equipment are prohibitively priced for many farmers, who must then struggle harder to produce a profitable crop through more labor-intensive methods. Agricultural drones, AI, and data-driven farming, which would save labor and waste, are much more expensive.

Agricultural inputs are necessary to address the different problems encountered on the farm, this input will be for the following purpose in rice production: Fertilizer is the main nutrient requirement of the plant to increase growth and yield, and Herbicide is used to control the growth of weeds that compete with rice in the absorption of nutrients, pesticides are also used to control the bad insect that destroys the rice.

Despite the increase in agricultural inputs the price of rice remains below the expected market price because of the increasing supply of rice that is imported from other countries. The increasing price of agricultural inputs and the lack of changes in the price of rice caused the farmers to bankrupt and fall into debt which left them no choice but to stop farming and look for another job.

To maintain positive income farmers must have an alternative way to substitute the agricultural inputs to decrease the expenses needed in the establishment of rice farms the rice duck integration is an old technology used by farmers in other countries the conduct of this study will help to convince rice farmers in reducing the usage of rice inputs by adopting this technology.

Significance of the Study

This study aims to find alternative methods to increase the income in rice and duck production by reducing the usage of other agricultural inputs like pesticides, molluscicide, weeding, and fertilizer through the rice duck farming system.

II. OBJECTIVE

Generally, the study aims to evaluate the growth, and yield performance, of rice and the egg performance of duck.

Specifically, the Study aims to:

1. Evaluate the growth and yield performance of rice
2. Evaluate the laying performance of ducks
3. Cost and return analysis of integrated rice-duck farming system

III. REVIEW OF LITERATURE

The Philippine Rice Industry, called kanin in the Philippines, is a cereal crop that is related to other cereals like corn and wheat. It is the greatest source of energy and is high in vitamins and minerals (Geonka Foods, n.d.). It is included in every Filipino's meal and is regarded as the country's staple cuisine. Additionally, this is primarily consumed in Asian nations. Rice is essential to the nation's economy and food supply. In the Philippines, hectares of land are used to plant rice seeds in order to grow rice by the method of plowing usually during the start of the rainy season. Rice usually matures approximately after three to four months and can be harvested after five months from being planted (Heirloom Organics, 2014).

While they may complain about the price of rice in supermarkets or enjoy so-called unli-rice meals at their favorite fast-food chains, urban Filipinos don't always appreciate just how crucial rice is to our culture and way of life. And it's not just because we're among the world's biggest consumers of rice per capita. More than a tenth of

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Received: 25th May, 2026; Revised: 6th June, 2026; Accepted: 8th June, 2026; Available Online: 29rd July, 2026
(DOI): 10.70102/AEJ.2026.18.2s.14

Filipinos rely on rice as a source of income as well as sustenance.

By some estimates, there are 10 million rice farmers in the Philippines, a country of just over 100 million. When you include people in rice trade and processing, as well it can observe how big of a social and economic influence rice has in the Philippines by looking at the dependents of everyone involved in the rice industry. Unfortunately, among the most disadvantaged individuals in the Philippines are rice farmers, who provide the majority of our calories. Farmers are finding it increasingly difficult to make a living as a result of decades of systemic issues.

High input costs make it impossible for Filipino farmers to increase their output because many essential inputs are so expensive. This is made worse by the low palay prices that are anticipated following harvest, which leave many farmers in a never-ending state of hardship and frequently in significant debt.

Basics like fertilizers, high-yield seed grains, and mechanized farm equipment are too expensive for many farmers, in part because of market forces and exploitative behaviors. As a result, they must work harder to produce a viable crop using more labor-intensive techniques. Even more unattainable are cutting-edge agricultural inputs that would reduce waste and save labor, such data-driven farming, AI, and agricultural drones.

The Philippines' second-largest poultry industry is the production of ducks. The Philippine Statistics Authority reports that the total amount of duck eggs produced from January to March 2022 was 12.88 thousand metric tons, which represents an increase of 11.8 percent over the 11.52 thousand metric tons produced during the same period in 2021.

https://pinoynegosyo.net/business/duck-raising-business-1840.html

Plants make up the majority of the mallard's diet. It consumes the leaves, stems, and seeds of aquatic plants as well as the seeds of grasses and sedges. Sometimes, especially when it is young, it consumes insects, crabs, and mollusks. Because it can lower its head and reach plants at the bottom, it prefers to forage in water that is no deeper than 16 inches. On farmland, the mallard occasionally forages for grains such as barley, wheat, corn, oats, and rice.

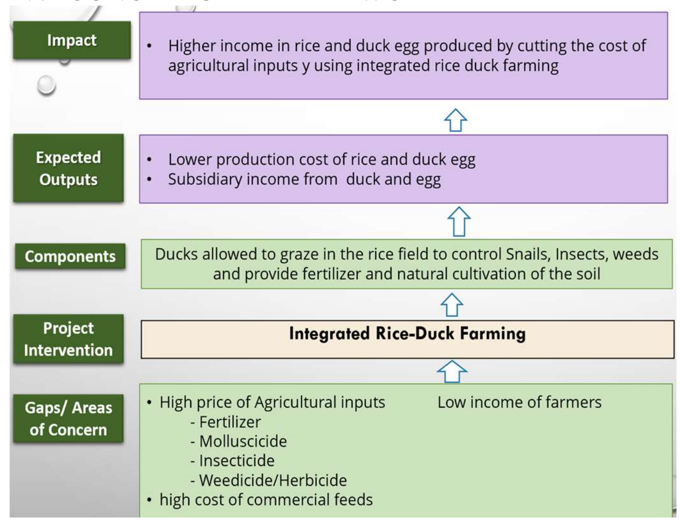
https://ducksmudge.org/RationForDucks/mallard-duck-eating-habits

In China, Japan, and Korea, ducks and rice have long been raised together in irrigated areas. Before the ground is prepared, mallard ducks, or "itik," are typically released into rice fields in the Philippines to feed on snails like the "golden apple snail," which is a rice pest. Ducks are thought to be able to harm rice plants, yet this is actually a popular myth.

https://www.agriculture.com.ph/2018/10/22/rice-duck-farming-is-profitable-and-good-for-the-environment/

A modern multispecies integrated agricultural method with historic origins is rice and duck farming, or "aigamo" as it is known in Japan. Pacific Rim rice producers have been using flocks of ducks to help manage pests and weeds in their rice fields for thousands of years. However, the ancient method has been substantially improved with the introduction of contemporary enclosure systems and the capacity to artificially hatch big flocks of ducklings on a specific day. These improvements boost plant health and soil fertility while lowering labor costs and improving the advantages of weed and insect management.

IV. CONCEPTUAL FRAMEWORK



V. MATERIALS AND METHODS

A. Research Design

T-test, a test of significant difference for 2 independent samples

B. Locale of the Study- Cagayan State University-Gonzaga

C. Duck production

C.1.Housing for duck

Housing was established in a quiet, cool place and near to a Rice paddy area. Local materials like bamboo, nipa and cogon were used for the establishment which can provide a shelter and protection of the ducks against extreme weather condition.

Duck houses is separated from one another using chicken net which is low enough to go over them from one pen/replication to another. Fence is extended down to the rice field where the animals can move freely and access the housing and feeding area for the whole period of the study.

C.2. Procurement of Mallard duck

The ready to lay five months and two weeks of age mallard duck used in the study was procured to the local duck raisers in the locality. Local produce mallard duck was chosen to lessen the level of stress of the animal from transportation and adaptation to new environment climatic condition.

C.3. Feeding of ducks

The two groups of ducks in this study were given with layer commercial feeds this is to give the consistent nutrition requirement of the ducks in order to attain their optimum laying performance and also to lessen the labor in finding and processing of raw materials.

C.4.Sampling Technique

a total of sixty (60) heads five months and 2 weeks old mallard duck was distributed into Two (2) treatments and replicated three (3) times per treatment with a total of 10 ducks per replication at the rate of 200 birds per hectare. Each have a different method of management for the ducks in treatment 1 they are provided with housing and perimeter fence with an area of 14.5m x5 m but they are not allowed to range in the rice field (intensive method of production) while for treatment 2 each replication is allowed to range in the rice field 30 days after transplanting of rice for the whole period of the study with an area of 500 sq.m. per replication. Both treatments are given with fresh water and commercial feeds daily and any left-over of the feeds given is measured to know the total daily feed consumption of ducks. The statistical design used in this study is a t-test, a test of significant difference for 2 independent samples.

D. Rice production

D.1.Selection of seeds

The promising hybrid rice cultivar, cv. Pioneer US 78 (21 days old seedlings) was transplanted during the last week of May. Hybrid rice is selected because the rice duck farming method requires bigger planting distance to allow the duck to walk in between hills of rice and to prevent damage of rice during growing.

D.2. Seed Sprouting

For a whole day, seeds chosen using the specific gravity method were submerged in water in a bucket. After that, these were removed from the water and securely stored in gunny bags. After 48 hours, the seeds began to sprout and could be sown within 72 hours.

D.3. Land preparation

Land preparation and crop establishment require water to saturate the soil, which cuts down on the amount of time that can be spent on these activities. Harrowing will be done after watering till the soil is fully cultivated. After harrowing, the soil is leveled to reduce the occurrence of weeds, improve snail control, maximize fertilizer use, ensure consistent crop growth and maturity, harvest crops on time, use water and irrigation techniques efficiently, and make effective use of farm equipment.

D.4. Preparation of seedling

Sprouted seeds were sown as broadcast in a total of 4 seed bed with a total dimension of seedbed 1x5m fertilizer application is given 10 days after sowing complete (14-14-14) fertilizer is applied as basal dose. Urea (46-0-0) was top-dressed after 17 days of sowing.

D.5. Uprooting and transplanting of seedlings

21 days old seedlings were uprooted from the seedbed and transplanted in the prepared rice production area with a planting distance of 25cm x 20cm. molluscicide is applied to prevent the golden apple snail from eating the newly transplanted rice plant.

Application of irrigation water

Water is drained in the rice field before transplanting and water is given after transplanting at the dept of 2 to 3 cm and maintain for 14 days after transplanting. From tillering to ripening water level is maintained at the dept of 5cm until the beginning of ripening. Water was drained from the plots during ripening stage to harden the soil for harvesting.

D.6.Fertilization on the main field

10 days after transplanting complete fertilizer is applied as basal and application of urea will be conducted every 14 days till the flowering stage of the rice. For rice duck integrated farming fertilizer and pesticide application is halted 30 days after transplanting or when the duck is already integrated to rice production area

D.7. Weeding and insecticide application

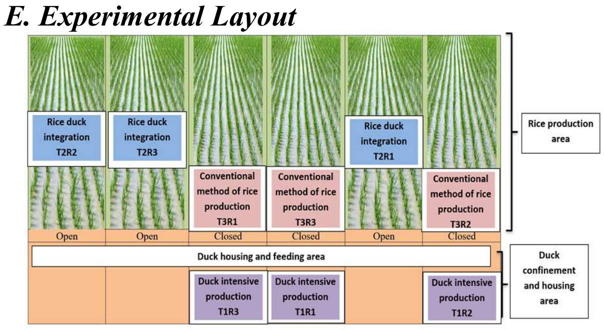
In subplots designated for the traditional mode of production, weeding is done twice and insecticide are applied once. In rice-duck integrated farming, no pesticides, herbicides, or weeding are applied.

D.8. Sampling Technique

For rice production, two treatments were conducted Treatment 2 rice duck integration and T3 conventional method of rice production. Each treatment is replicated into three (3) blocks 500 sq. m. (14.5 m x 35.5 m) per block, in each block, ten (10) sample plants were randomly selected which will be the representative for data gathering for the growth and yield performance. Each block was separated from the others with raised dykes and surrounded with green plastic chicken net with the height of six feet to prevent duck to escape in treated block with rice duck integration as well as to prevent entry of other predators from outside the rice fields. each treatment of rice from seed sowing to 30 days after transplanting have receive the same management like the fertilizer, pesticide and herbicide application. After 30 days of transplanting the treatment 2 is integrated with ducks and all of the intervention for fertilizer, pesticide and weed management is totally eliminated until harvesting. The ducks in the treatment 2 is allowed to range for the whole period of the study because they have the unlimited access to the rice field because their housing provided is connected to the rice field. The duck rice integration is only allowed for the period of forty-six (46) days when the rice is already flowering this is to prevent the rice to be disturb during pollination and from feeding of the rice brains. while for treatment 3 the conventional management of rice production is applied for the whole period of the study until harvesting. The statistical design used in this study is a t-test, a test of significant difference for 2 independent samples.

TREATMENT		
Duck	Rice	**The intervention used in the Study**
T1		Intensive method of production of ducks
T2		Rice duck integration farming system
	T3	Conventional method of rice production

E. Experimental Layout



F. Data Collection Instruments and Procedures

Evaluated the growth performance of rice plant height, the number of leaves and tillers from one selected hill of each plot was measured, and then the average of ten hills from the three replicates for each treatment was calculated. The height of each plant was measured before heading, from the soil surface to the top of the highest leaf tip of each hill, and after heading, from the soil surface to the top of the highest panicle. After the crop was harvested, grains and a few rice plant hills were collected, and the root, stem, leaf, and panicle of the rice plants were separated. Fifteen plant hills were randomly selected for each treatment in order to measure the yield components.

Yield components, including effective panicle number per plot, spikelet number per panicle, grain filling percentage, and grain weight, were computed from the fifteen selected rice plant hills for each treatment. Data were averaged across all subsamples for each treatment.

1. evaluate the growth and yield performance of rice in terms of:

a. To evaluate the growth performance of rice

a.1. Plant height

a.1. Number of tillers

a.1. Average number of leaves

b. Yield performance

b.1.Number of panicles
b.2. Number of spikelets
b.3. Height of panicle
b.4. Filed grains
b.5. Unfiled grain
b.6. Total harvest yield using crop cut
b.6.1. un cleaned
b.6.2. cleaned
b.6.3. Dry
b.6.4. Weed density
2. To evaluate the laying performance of ducks in terms of
a. Average Daily Gain (ADG)
b. Feed consumption
c. Total egg produced.
3. Profitability analysis
4. Weed density
Weed density was conducted using abundant, frequent, and rare methods of observation
Abundant – When the field is almost covered with weeds
Frequent - When weeds occur on the spot
Rare - When weeds are almost absent

VI. RESULT AND DISCUSSION

Table 1: Growth performance of rice

Treatment	Plant Height	No. of Tillers	No. Leaves
T3	117.98	26.33	3.67
T2	118.6	25.7	3.9

Figure 1. Growth performance of rice

Independent Samples Test

		Equality of Variances		t-test for Equality of Means					of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
height	Equal variances assumed	1.320	.315	.119	4	.911	.66667	5.60793	-14.90345	16.23678
	Equal variances not assumed			.119	2.877	.913	.66667	5.60793	-17.62135	18.95468
Tiller	Equal variances assumed	.235	.653	-.603	4	.579	-.66667	1.10554	-3.73614	2.40281
	Equal variances not assumed			-.603	3.723	.581	-.66667	1.10554	-3.82831	2.49498
Leaves	Equal variances assumed	7.193	.055	.670	4	.539	.23333	.34801	-.73290	1.19956
	Equal variances not assumed			.670	2.357	.562	.23333	.34801	-1.06633	1.53300

Table 1 shows the plant height and number of leaves T2 is higher than T1 for the number of tillers, T3 was higher than T2 but based on the statistical result using the T-Test all of the parameters shown in Table 1 for growth performance there is no significant difference from each other.

A. Yield performance

Table 2. Crop-cut

Treatment	Fresh weight(kg)	Uncleaned (kg)	Cleaned (kg)	Dry weight (kg)
T3	3.49	2.75	2.47	2.25
T2	3.27	2.73	2.25	1.98

Figure 2. Yield performance of rice using crop cut

Independent Samples Test

		Equality of Variances		t-test for Equality of Means					of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
FW	Equal variances assumed	2.732	.174	-1.523	4	.202	-.22667	.14885	-.63993	.18660
	Equal variances not assumed			-1.523	2.481	.243	-.22667	.14885	-.76163	.30829
Uncleaned	Equal variances assumed	1.565	.279	-1.455	4	.219	-.02000	.01374	-.05816	.01816
	Equal variances not assumed			-1.455	3.124	.238	-.02000	.01374	-.06277	.02277
Cleaned	Equal variances assumed	4.378	.105	-3.916	4	.017	-.22000	.05617	-.37596	-.06404
	Equal variances not assumed			-3.916	2.692	.036	-.22000	.05617	-.41093	-.02907
DW	Equal variances assumed	.932	.389	-3.671	4	.021	-.27333	.07446	-.48007	-.06660
	Equal variances not assumed			-3.671	3.223	.031	-.27333	.07446	-.50129	-.04538

Based on the figure shown in **Table 2** for fresh weight, Uncleaned, weight shows no significant difference from each other while for Cleaned, and Dry weight T3 is higher than T2.

Table 3. per rice sample

Treatment	No. of Panicle	No. of Spiklet	Filled Grains	Unfilled grains	Weight (g)
T3	16.13	160.23	995.27	528.10	30.27
T2	15.87	144.20	804.77	546.80	28.27

Figure 3. Yield performance of rice using sample plant

Independent Samples Test

		Equality of Variances		t-test for Equality of Means					of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
height	Equal variances assumed	8.255	.045	.373	4	.728	2.46667	6.61480	-15.89896	20.83229
	Equal variances not assumed			.373	2.213	.742	2.46667	6.61480	-23.52774	28.46107
panicles	Equal variances assumed	2.306	.203	-.238	4	.824	-.26667	1.12200	-3.38184	2.84851
	Equal variances not assumed			-.238	3.021	.827	-.26667	1.12200	-3.82341	3.29008
spikelets	Equal variances assumed	1.428	.298	-.960	4	.391	-16.03333	16.69704	-62.39175	30.32508
	Equal variances not assumed			-.960	2.965	.409	-16.03333	16.69704	-69.53052	37.46386
f_grains	Equal variances assumed	2.743	.173	-4.555	4	.010	-190.50000	41.82032	-306.61181	-74.38819
	Equal variances not assumed			-4.555	2.525	.028	-190.50000	41.82032	-338.92091	-42.07909
uf_grains	Equal variances assumed	2.200	.212	.343	4	.749	18.70000	54.59826	-132.88907	170.28907
	Equal variances not assumed			.343	2.606	.758	18.70000	54.59826	-170.91900	208.31900
weight	Equal variances assumed	1.446	.296	-1.511	4	.205	-2.00000	1.32372	-5.67522	1.67522
	Equal variances not assumed			-1.511	3.334	.219	-2.00000	1.32372	-5.98384	1.98384

Table 3 shows that T3 is higher than T2 for the number of panicles, spikelets, filled grains, and unfilled grains. Statistically, using the T-test only the filled grains show that T3 is significantly higher than the T2.

For the weed density, T3 has an abundant number of different weeds present in the rice field while T2 shows frequent weeds present in the field.

Table 4. Production performance of Duck

Treatment	Average Daily Gain	Laying Performance	Feed consumption
T1	0.01	6.68	106.64
T2	0.01	7.3	89.62

Figure 4. Average Daily Gain in Weight of Duck

Independent Samples Test

		Equality of Variances		t-test for Equality of Means					Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Avg.gain	Equal variances assumed	5.000	.089	-.535	4	.621	-.000666667	.001247219	-.004129502	.002796169
	Equal variances not assumed			-.535	2.306	.640	-.000666667	.001247219	-.005405385	.004072052

Figure 5. Egg-laying performance of duck

Independent Samples Test

		Equality of Variances		t-test for Equality of Means					Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
EF	Equal variances assumed	9.949	.034	-2.912	4	.044	-.62333333	.21403530	-1.21759060	-.02907606
	Equal variances not assumed			-2.912	2.078	.096	-.62333333	.21403530	-1.51186425	.26519758

Figure 6. Average Feed consumption of Duck

Independent Samples Test

		Equality of Variances		t-test for Equality of Means					Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Feed_Con	Equal variances assumed	.252	.642	9.514	4	.001	17.02333	1.78938	12.05521	21.99145
	Equal variances not assumed			9.514	3.786	.001	17.02333	1.78938	11.94273	22.10393

Table 4 shows the comparative study between the two treatments for average daily gain of duck this shows no significant difference between the two treatments. In the laying performance, shows no difference for T1 and T2, and for feed consumption T1 is higher than T2 statistically has a significant difference from each other using the T-test, test of significant difference for 2 independent samples.

Table 5. Cost and return analysis

	Duck alone (T1)	Rice Duck (T2)	Rice Alone (T3)
Duck	10,500.00	10,500.00	
feeds	1,971.80	1,178.23	
Perimeter fence and labor	1,500.00	1,500.00	

Duck housing	350.00	350.00	
Seeds		650.00	650.00
Fertilizer		900.00	7,200.00
Pesticide		150.00	700.00
Molucicide		150.00	700.00
Fuel and Oil		1,500.00	1,500.00
Labor fertilizer and pesticide application		100.00	550.00
labor on land preparation		1,500.00	1,500.00
labor on transplanting		1,125.00	1,125.00
Labor on harvest		1,000.00	1,000.00
Total	**14,321.80**	**20,603.23**	**14,925.00**
Income			
Rice Paddy		22,200.00	20,220.00
Duck egg	6,738.00	7,360.00	
Duck	10,500.00	10,500.00	
Gross income	17,238.00	40,060.00	20,220.00
Net Income	**2,916.20**	**19,456.77**	**5,295.00**

The result of the cost and return analysis in Table 5 shows that the rice duck farming method has the highest expenses in the establishment but has the highest net income and it was followed by T3 (Rice alone) and T1 (Duck alone).

VII. DISCUSSION

A. Growth performance of rice

Based on the result of the **Figure 1.** The plant height, Number of tillers, and a number of leaves show statistically no significant differences between treatments, which makes the rice duck farming system and the conventional method of farming rice have the same result in terms of growth performance. It is suspected that the activity of ducks can preserve the components that plants require, which maximizes the activity of nutrient absorption. This supports the findings of Liu, X., Xu, et al., who claim that by improving the physical characteristics of the soil, the duck-rice farming system—and particularly duck activities—also enhances nutrient transfer and accumulation. As stated by Gao, H., et al. This could increase the amount of nitrogen in the soil and the microbial activity surrounding the roots while inhibiting nitrification. Enhancing plants' capacity to absorb nitrogen can have a direct impact on their development and yield since optimal vegetative phase growth also benefits the generative phase of plants, Alavan, A., et al. this proves that rice duck farming have comparable growth performance to conventional method of rice farming even it only received fertilizer, and pesticide application at thirty days after transplanting and the rest of the production period is being take charged by the duck integration.

B. Yield Performance

Based on the result of the study in **Figure 2.** using **crop cut** statistically shows no significant difference in parameters for fresh weight, and uncleaned, but for cleaned and dry weight of rice has a significant difference in each other, T3 is higher than the T2. for the sample plant Figure 2. Shows that the number of panicles, unfilled grains, and weights of rice T3 and T2 show no significant difference from each other while field grains show that T3 is significantly higher than T2. This means that T3 has a higher yield because it was given a recommended volume of synthetic fertilizer and pesticide to make the productive performance of rice at the optimal level while for T2 rice duck farming system only received fertilizer and pesticide application for one month after transplanting before the duck allowed to range in the rice field and for the rest of production of rice there is no fertilizer and pesticide given. According to M Azizi et al 2023 given that treating ducklings on rice plants satisfies the need for grain development in rice plants, it is hypothesized that treating ducklings can preserve nitrogen availability and improve plant absorption. Zhang, Li M. et al. Al. went on to say that the ducks released on rice fields can reduce nitrogen loss and increase grain nitrogen consumption. As stated by Ghoneim, A. M., et al. Al. The availability of nitrogen can enhance a plant's capacity to absorb nitrogen based on its growth phases and requirements. The role of nitrogen is to improve internode prolongation, photosynthesis, rice development, metabolism, and output of plant assimilation. Teng, Q., et al. claim that rearing ducks in paddy fields has the ability to promote soil fertility, enhance soil biodiversity, and efficiently boost grain yield in addition to reducing rice pests and diseases and controlling weed risks. This is consistent with findings by Choi Song Yoel et al. (1996) and Ahmed et al. (2004). According to Kang Yang Soon et al. (1995), plots containing ducks had a 3% greater grain yield (t/ha) than plots with only rice.

C. Production performance of Duck

For the Average Daily Gain (ADG), the two treatments have no significant difference because the duck used in the study is ready to lay (5 months and 2 weeks old) where its growth performance is already attained, making its average daily weight gain insignificant. In terms of the Laying performance of the duck, it shows no significant difference because both of the treatments are given with commercial feeds which makes them receive the recommended nutrition for laying but in terms of feed consumption, T1 has higher feed consumption than T2 because T1 is fully dependent on commercial feeds while T2 ducks were reared under the scavenging condition which has access to the rice field and can eat a variety of feed sources (weeds, insects, and snails) this makes the duck in T2 to eat lesser commercial feeds given to them. The findings in the study show that the rice duck farming system consumes a lesser volume of commercial feeds with comparable laying performance to the duck eating pure commercial feeds. This will make the rice duck farming system cheaper to maintain because of the lesser dependence on the duck in commercial feeds.

According to Adzitey & Adzitey (2011), ducks may scavenge on their own to gain the nutrients they require for growth under traditional systems, but their egg output is still low if they do not receive additional nutrients. When given proper care and nutrition, ducks can produce up to 80% of their eggs. According to Wibowo et al. (2007), the semi-intensive system maintenance produced more eggs and generated more profit (revenue over feed cost) than the extensive system. The majority of small and marginal farmers were found to rearing the ducks and being poor, no supplemental feed was provided to the ducks. Natural feeds were also not available ad-libitum as per requirement for ducks throughout the year. Some of the farmers were supplied supplemental feed to the ducks in the form of rice polish, broken rice, whole paddy, maize, etc., but the feed was not balanced with nutrients, and hence the ducks remained underfed and the observed growth and egg production always remained sub-optimal Kabir F. et. al. (2020). This proved that the rice duck farming system alone or even in combination with supplemental feeds using locally available raw materials is not enough to attain the optimal laying performance of the duck. The use of commercial feeds in this study fulfills the basic nutrient requirement of the duck to produce eggs at optimal levels this makes the rice duck farming system comparable to the duck feeding with commercial feeds without grazing.

D. Profitability analysis

The profitability analysis of the study shows that the rice duck farming system requires the highest capital to establish because of the combination of two commodities and in terms of gross and net income, the rice duck farming system is the most profitable among the rest of the treatments this makes the integration of these two (2) commodities advantageous to rice farmers. It has been demonstrated that adding ducks to rice farms increases yield by 20% while increasing net return by almost 50%. In addition to rice, other items like meat and eggs can be produced on the same growing area.

In addition, it lowers labor inputs by using ducks to control insects and weeds. United Nations Food and Agriculture Organization.

VIII. SUMMARY AND CONCLUSION

Based on the result of the study, tables and figures show that the T2 integrated rice-duck farming system is statistically lower than the T3 conventional farming method of rice in terms of yield of rice and also lower than T1 in terms of egg-laying performance respectively. For the yield performance, T3 is higher because the effect of commercial synthetic fertilizers and pesticides given to the rice for the whole period of production increases the yield performance of rice. For the laying performance, T1 had higher egg production than T2, because the duck in T1 received full commercial feeds and was not allowed to graze outside which lessened their usage of energy that could be converted to eggs this made the duck in T1 perform in terms of laying performance into the optimal level. Even the T1 and T3 are higher in yield and laying performance respectively. T2 is more profitable than T1 and T3 because of the lower capital expenses in the production of rice and egg production by lowering the volume of synthetic fertilizer, pesticides, and consumption of commercial feeds. This shows that the T2 rice duck farming system is competitive or greater in terms of profit which could increase the income for farmers who will adopt this technology.

IX. IMPLICATION AND RECOMMENDATIONS

The rice duck farming system is highly recommended because it lowers the cost of production by reducing the usage of fertilizer, pesticide, and labor in rice production and for duck by reducing the volume of feed consumed with the competitive performance of rice and duck in comparison to conventional methods of farming.

X. ACKNOWLEDGEMENTS:

The authors thank Froilan A. Pacris, jr., Ph. D. (Campus Executive Officer of Cagayan State University-Gonzaga Campus) for his valuable support of this study. This work was financially supported by the Technical Vocational Education and Training of CSU-Gonzaga. To Christian jay Arellano, Jenny Palor, TVET Staff and Students who assist in the implementation and gathering of data of the study.