CHAPTER ONE

Introduction

Farming systems, thinking about farming change continuously. These processes can be called the evolution of farming systems and system philosophy, if change is called evolution and if thinking about systems is called philosophy. Rapid change took place in the last two decades in both temperate and tropical regions in terms of yield per animal or plot, and in terms of input use.

All over the world the grain yields went up at spectacular rates during the green revolution and individual levels of production in animals followed a similar trend Alexandratos (2015). Ensuring food security for a fast-growing global population estimated at 9.1 billion in 2050 and over 10 billion by the end of the twenty first century is a mammoth challenge for the present agricultural production system Porcire (2007).

Shrinking average farm size in India and financial constraints for higher investment in agriculture due to 80% farm families belonging to small and marginal farmer categories further heighten the challenge. For securing food and nutrition security for sizable population, productivity enhancement may provide a vital solution.

This involves the adoption of scientific agronomic practices and technologies which promise an augmentation of the productive capacity of traditional agricultural systems. Agronomic practices such as the liberal use of inorganic pesticides and fertilizers during the twentieth century enhanced productivity significantly but undesirable environmental degradation accompanied by increased operational costs in agriculture raised concerns about economic feasibility and sustainability UNPFA 2011.

About 75% of the adversely affected households belong to rural communities of developing economies whose livelihood is directly or indirectly dependent on agriculture and allied activities IAASTD (2009). Unsustainable farming leads to environmental pollution and threatens the livelihood of millions of small farm holders. Strengthening agricultural production systems for greater sustainability and higher economic returns is a vital process for increasing income and food and nutrition security in developing countries FAO, (2010).

Therefore IFS is a multidisciplinary whole farm approach and very effective in solving the problems of small and marginal farmers. The approach aims at increasing income and employment from small-holding by integrating various farm enterprises and recycling crop residues and by products within the farm itself.

The farmers need to be assured of regular income for living at least above poverty line. The progress in production or steady growth in output is necessary to face the challenges posed by present economic, political and technological environment. In this context, farming system approach is one of the important solutions to face this peculiar situation as in this approach the different enterprises can be carefully undertaken and the location specific systems are developed based on available resources which will result into sustainable development Ravallion and Chen (2007).

Justification

The need to reduce the cost of production especially in feeding farm animals arises so that every Nigerian will be able to afford the purchase of these farm animals and their products for better standard of living is paramount especially as the population of human being keeps increasing. The need to produce animal protein to support the ever-increasing population of the people of country.

The need to research into livestock waste arises as alternative feed ingredients are sorted for, so as to reduce the rate at which farmers depended on the conventional feed in gradient that was meant for human consumption and not animals

Objectives of the study

i-Evaluate the effect of maggot from poultry feaces on performance characteristics of C. garipinus

ii-Determine the effect each of goat feaces, fish pond waste water and both on growth performance of Spinach.

iii-Evaluate the effect of fish pond water on performance characteristics of broiler chicken.

iv-Investigatethe effect of fish pond water on growth performance of West African Dwarf goat

CHAPTER TWO

LITERATURE REVIEW

Integrated farming system (IFS)

The global agricultural landscape continually faces challenges due to environmental changes, market fluctuations, and the pursuit of improved livelihoods (Saikanth et al., 2023). In response, integrated farming systems (IFS) have emerged as a promising strategy to address these multifaceted challenges in agriculture, particularly in regions vulnerable to environmental uncertainties. Smallholder farmers across South Asia, including Bangladesh, commonly adopt IFS models integrating agriculture, livestock, forestry, and fisheries (FAO, 2021). However, the specific components within IFS vary significantly based on agro-climatic conditions, land types, socioeconomic statuses of farmers, and market dynamics (Paramesh et al., 2022). While IFS shows potential for enhancing farmer well-being and global food production (Bashir et al., 2022; Saikanth et al., 2023), its implementation in Bangladesh's *haor* region reveals a complex blend of adaptation, innovation, and traditional practices. Understanding the interplay between global and local perspectives on IFS in Bangladesh's wetland ecosystem requires an exploration of both broader global contexts and localized intricacies (Kumar et al., 2022).

This context underscores the urgency of exploring alternative agricultural strategies such as IFS to improve employment, agricultural productivity, and income stability for farming communities in *haor* areas. IFS offers a viable solution by diversifying crop production, enhancing soil fertility, and improving climate resilience (Mishra et al., 2022), countering the negative impacts of conventional monocropping on farm output, biodiversity, soil health, and ecosystem functions (Clark et al., 2017; Pervaiz et al., 2020; Panklang et al., 2022). By integrating crop cultivation with agroforestry, livestock rearing, and fisheries, IFS not only optimizes resource utilization but also promotes sustainable practices tailored to the challenges of waterlogged landscapes (Al Mamun et al., 2012; Islam et al., 2015; Uddin et al., 2016).

By adopting IFS, farmers can address existing economic and environmental issues and gain access to additional household essentials like fuel, fertilizer, and feed, leading to a simultaneous boost in overall farm productivity (Islam et al., 2015; Al Mamun et al., 2012). Embracing IFS represents a modern and holistic approach, providing multiple benefits such as enhancing farm resilience, securing farmer incomes, ensuring food security, and fostering adaptability and resilience (Paramesh et al., 2022). By conducting various activities like crop cultivation, agroforestry, livestock rearing, and fishing on the same farm, IFS creates a harmonious blend of time and space, leading to increased productivity, lower environmental impact, and efficient resource recycling (Kumara et al., 2017; Paramesh et al., 2022). Moreover, IFS offers a tenfold increase in agricultural output, addressing global economic and environmental issues and meeting domestic consumption and export needs such as energy, fertilizer, and animal feed (Kumara et al., 2017). Overall, integrated farming is a key driver for sustainable and resilient agricultural practices, improving livelihoods and environmental stewardship.

Trend in IFS

In the past few years, researchers have actively pursued a practical understanding of integrated farming outcomes across various contexts. Much of the research on IFS has focused on adoption (Anowar et al., 2015; Jha et al., 2016; Aurangozeb, 2019), livelihood improvement (Sufian et al., 2017; Ali et al., 2018), adaptation to mitigate vulnerability (Begum et al., 2016a; Sarif et al., 2016), comparative economic analysis (Billah, 2012; Akter, 2014; Islam et al., 2015; Islam, 2018; Sharmin et al., 2018), and impact assessment on food and nutrition security (Akteruzzaman et al., 2012; Rahman et al., 2012; Bhuiya et al., 2014; Begum et al., 2016b; Ferdous et al., 2017; Uddin et al., 2016; Ponnusamy and Devi, 2017). The detailed literature reviews are shown in Table S1. However, existing literature reveals critical gaps and limitations necessitating more comprehensive research efforts. These gaps encompass a range of dimensions, including farmers' poor livelihood status, barriers faced by rural women in adopting integrated farming technologies, ambiguity in policy recommendations, and factors influencing the adoption of modern agricultural technologies related to IFSs. Moreover, the research has not adequately addressed these farming systems' long-term sustainability and environmental implications, underscoring the need to consider ecological and social dimensions.

Additionally, there is a lack of understanding regarding the profitability of various IFSs, warranting further investigation into the factors influencing economic outcomes. Static assessment methods have been employed, but dynamic matching techniques are advocated better to understand the real-time impact of IFSs on livelihood improvement. Gender-specific challenges, scalability, and adaptability of these models in diverse agro-ecological zones emphasize the necessity for tailored interventions. Addressing these gaps and limitations provides a compelling rationale for conducting additional research to enhance the resilience and well-being of farming communities in the *haor* region. While studies have examined the relative profitability of IFSs (Billah, 2012; Akter, 2014; Islam et al., 2015; Islam, 2018; Sharmin et al., 2018), limited focus has been placed on *haor* areas. Therefore, this study aims to fill this gap by identifying optimal IFS plans that contribute to sustainable production and livelihoods for *haor* farmers.

So, our study aims to investigate the role of IFSs in ensuring sustainable livelihood security for farmers in the *haor* region, with the following objectives: (a) to identify existing IFSs in the study area; (b) to evaluate the profitability of identified IFSs; and (c) to assess the impact of IFSs on farmers' income and livelihood status. To address these objectives, the study poses several research questions: (i) What are the different existing IFSs in the study area? (ii) Are the IFSs economically viable? (iii) How do IFSs affect integrated farmers' income generation and livelihood status? Our study encompasses three key novel contributions. Firstly, it advances the understanding of sustainable agricultural practices in a vulnerable and climate-sensitive region. Secondly, it provides valuable insights into how the integrated farming approach can bolster farmers' overall well-being (e.g., income and livelihood) and prosperity (e.g., income and livelihood) in *haor* areas. Thirdly, the research sheds light on how integrated farming can significantly improve the socio-economic conditions of the farming community. These innovative contributions make our study a valuable resource for policymakers, researchers, and agricultural practitioners seeking to enhance sustainable agricultural practices and livelihoods in vulnerable regions.

Constrains in IFS It is evident that the major technological constraints faced by the farmers in adoption of Integrated Farming System were poor knowledge on suitable cropping systems and their interaction (86.67%), lack of knowledge on usage of ICT tools in Integrated Farming System and difficult to get timely information from extension officials (80.00%), poor knowledge on resource recycling in Integrated Farming System (77.78%), poor knowledge on correct selection of poultry breeds (60.00%), poor knowledge on pest and disease management in various farm enterprises (56.67%), lack of knowledge on latest technologies in Integrated Farming System (53.33%) and inadequate knowledge on complementary combinations in Integrated Farming System (50.00%), non-availability of improved varieties of seed/breeds at farm site (48.88%) and lack of training on skilled work performance (47.22%). Poor knowledge on suitable cropping system in Integrated Farming System and their interaction was ranked first. The reasons might be respondents cultivate local varieties and they use their own seed materials for many years. Respondents were not aware of recent varieties released from ICAR / SAU in selection of location specific varieties of crops and livestock and other farm enterprises. Majority of the respondents have basic model of mobile and unable to avail the various mobile based agro advisory services. Hence, the lack of knowledge on usage of ICT tools in farming was ranked second. Difficult to get timely information from extension officials also ranked second. The reason might be that farmers practicing different enterprises in Integrated Farming System were ready to contact extension personnel of different departments for required information to their farm but, line departments were faced with less manpower and often assigned with other non-extension related tasks. This made difficult in disseminating agricultural information to the farming community. Poor knowledge on resource recycling in Integrated Farming System was ranked third. The reason might be respondents were unable to attend trainings, workshops and demonstrations on resource recycling and sometimes respondents were unwilling to attend the programmes conducted by the extension officials due to lack of sufficient time. Poor knowledge on correct selection of poultry breeds constraint was ranked fourth. The reason might be unawareness of suitable poultry breeds. Hence, it is suggested that by organizing suitable training programmes on selection of livestock breeds in Integrated Farming System and educating the farmers could be helpful to easily remove these constraints. These results are in conformity with the findings of Kerutagi et al. (2019).

CHAPTER THREE

MATERIALS AND METHODS

The experiment will be conducted in Kwara State Polytechnic, Ilorin, Nigeria. Two thousand (2000) day old chicks each of Broiler, Noiler, Cockreal, Quail and point of layer will be purchased from Affcom Nigeria Ltd with 500 from each set or types of birds to receive treatments from earthen and concreat pond of both clarias geriepinus and Tilapia. Five thousand (5000) pieces each of Juveniles of catfishes (Clarias gariepinus) with five hundrend each in earthen and concreate ponds of both Clarias geripinus and Tilapia fishes, one thousand (1000) weaner African dwarf goat of same age breed/species and close range of weight will be purchased from farms around Ilorin , two hundred each will receive treatment from each pond of each type of fishes while the last two hundred will be for control, half an hectare of vegetable (spinach) crop will be planted for used for this study, the half an hectare of vegetable farm land will be divided into five portion with each portion taken treatment from earthen and concreate pond of clarias and Tilapia though all of them will receive both goat and poultry manure except the fifth portion that will be left for control. All these farm animals will be located very close to each other for easy access and smooth running of the experiment that will last for twelve months, though each animal and farm produce will be harvested as at when due and while the African dwarf goat will be left alone remaining till end of the experiment. The experiment will be conducted in such a way that the weekly water that is removed from the fish ponds is left in the shade for 24hours to reduce the ordure and allowed to sediment and is shared into three part, one part is served to specific birds, second part is served to the goats for drink and the third part is used in watering the specific part of the vegetable farm leaving the control without any treatment, also the feaces from birds is also shared into three parts, one part will be dried and fed to the goats in the evening after feeding on grasses in the morning, second part was also used for growing maggots by keeping it in a shade and maggot is removed by washing for the consumption by fishes that receives treatments, fish feed is given in the morning and the maggot in the evening, the third part will be used on specific portion of vegetable farm leaving the last portion for control, the feaces from African dwarf goat will be only be used for same part that receives treatments for growing the vegetable farm, leaving the control experiment. Data will be taken as the experiment progresses, the height of the plant, broadness of the leaves and number of the leaves were taken from the vegetable farm, feed intake, weight gain and feed to weight gain was taken from broiler birds and African dwarf goat while feed intake, weight gain and fish length was also taken from fishes that is receiving treatment while laboratory analysis will also be carried out that includes blood characteristics, digestibility and immune level on sampled farm animals and compare the performance of animals fed water from fishes in earthen pond and that of concreate pond, measure the percent production and quality of egg qualities of birds in control and compare with that of birds that take treatments. All data collected was subjected to statistical analysis using Factorial experiment and complete randomized design (CRD) while means will be separated using Duncan multiple range between each set of particular animals that receives treatment and those that did not receive treatments.

Table 3.1: Composition of experimental Diets (%)

Ingredients(%)	
Maize	50.00
Soya bean meal	18.00
Groundnut cake	13.00
Fishmeal	3.00
Palm kernel cake	6.00
Wheat offal	7.00
Oyster shell	2.00
Salt	0.25
Broiler premix	0.25
Lysine	0.25
Methionine	0.25
Total	100
Calculated analysis	22.30
CP(%)	
M.E(kcal/kg) cal.	2920
Lysin (%)	1.10
Methionine	77

2.5 premix supplied per kilogram of diet; vit A12,000,000 i u vit D3 2,750,000 I vit E 20,000mg, vit k 3,2000mg. Thiamine B1 1,500mg,Riboflavin B2 4,000mg,Niacin 18,000mg,Panththenic Acid 7,000mg,vit B6 2,000mg vitB1212mcg,Folic Acid 1,000mg Biotin 15meg,Chline chloride 150,000mg,Cobalt 500mg,Copper 600mg,Iodine 1,100mg,Iron 20,000mg,Menganese 80,000mg,Selenium 200mg,Zinc 50,000mg and Antioxidand 125,000mg. CP = Crude protein; ME= Metabolic Energy.

Table 3.2 Composition of experimental diet fed to Clarias gariepinus

Ingredients	%
Cattle hoof meal	10.00
Fish meal	33.00
Soyabean meal	35.19
Yellow maize	19.62
Vitamin premix	2.89
Methionine	2.00
Lysin	3.00
Bone meal	1.00
Salt	0.30
Palm oil	3.00
Total	100

2.5 premix supplied per kilogram of diet; vit A12,000,000 i u vit D3 2,750,000 I vit E 20,000mg, vit k 3,2000mg. Thiamine B1 1,500mg,Riboflavin B2 4,000mg,Niacin 18,000mg,Panththenic Acid 7,000mg,vit B6 2,000mg vitB1212mcg,Folic Acid 1,000mg Biotin 15meg,Chline chloride 150,000mg,Cobalt 500mg,Copper 600mg,Iodine 1,100mg,Iron 20,000mg,Menganese 80,000mg,Selenium 200mg,Zinc 50,000mg and Antioxidand 125,000mg. CP = Crude protein; ME= Metabolic Energy.

Table 3.3 shows the Vaccination and medication Programme.

WEEK	DAYS	MEDICATION
1st	Day 1	Antistress, Glucose, Multivitamin
	2nd – 6th	Multivitamins
	7th	Gomboro vaccine
2nd	8th – 13th	Vitamins
	14th	Lazota
3rd	15 – 20th	Anticocci then vitamins
	21st	Vitamins
2ndGamboro		
	22nd – 27	Vitamins
4th	28th	2ndlazota
	29th – 34th	vitamins
5th	35th	Fowlpox vaccines
	36 – 41	Vitamin
6th	42	Decorim

CHAPTER FOUR

RESULT AND DISCUSSIONS

Result and Discussions

Table 1 shows the Performance characteristics of African Dwarf Goat (WAD) fed poultry feaces and fish pond waste water, is it was observed that significant difference occurred in all the parameters ($P<0.05$) those on T3 are those fed both grasses, fish pond water waste and poultry feaces performed better than others in T0 (control) and T1 (only fish pond waater) and T2 (those fed), there was no significant difference between T1 and T2 (those fed poultry feaces) and fish pond waste water respectively ($P>0.05$), while the control is the least in parameter when compared with other WAD on other treatment.

Table 2 shows the Performance characteristics of broiler chicken fed fish pond waste water, a significant difference occurred in all the parameters ($P<0.05$), The WAD fed both fish pond waste water T1 is better than those in control T0, however the feed intake of the control is higher than those that took ordinary water, this is because the fish pond waste water contain the dissolved fish feed that contain vitamins, minerals and nutrients that certifies certain percent of what the birds needs already, therefore the birds will only take feed a little to certifies its need hence the reduced feed intake is reduce the cost of feeding the birds

Table 3 shows the Performance characteristics of Clarias guripinus fed maggot from poultry feaces. The fish feed is both served to the two sets of fishes in the morning while in the evening around 4pm, the control is still fed the same fish feed while the pond with fishes that is taken treatment is served maggot made from poultry feaces, it was noticed that significant difference occurred (P<0.05) between the control and treatment fish, fish in the treatment pond performed better than those in the control and aside the cost of feeding the fishes is drastically reduced by 50% because instead of feeding them twice they are fed once and maggot from poultry feaces id fed in the evening, it cost no money to make the maggot they are made from the poultry birds.

Table 4 shows Performance of Spinach fertilized with fish pond waste water, African Dwarf goat feaces and those supplied with both the feaces and fish pond waste water. Significant difference occurred in all parameters (P>0.05), those spinach supplied with goat feaces and fish pond water are better in performance when compared with those that are supplied with either goat feaces or fish pond water separately. No significant difference occurred with those plants on T1 and T2 while the control plants with no any supply are least in performance.

Table 1: Performance characteristics of African Dwarf Goat (WAD) fed poultry feaces and fish pond waste water

Parameter	T_0	T_1	T_2	T_3	SEM
Initial live weight (kg)	7.70	7.77	7.79	7.71	
Final live weight (kg)	8.75^c	8.99^b	9.01^b	9.50^a	0.48
ADG(g/animal/day)	14.88^c	15.48^b	15.99^b	21.43^a	0.18
FCR	13.94^c	15.01^b	16.54^b	19.39^a	0.53
PER	1.88^c	2.09^b	2.15^b	2.57^a	0.10

abc Means in the same row with different superscripts differ significantly (P<0.05), TO= control experiment, T1= WAD fed only fish pond waste water, T2=WAD fed only poultry feaces, T3= WAD fed both fish pond waste water and poultry feaces, ADG = Average Daily Gain, FCR = Feed Conversion Ratio = Weight of feed/goat net-weight gain , PER = Protein Efficiency Ratio = Goat net-weight gain/crude protein intake.

Table 2: Performance characteristics of broiler chicken fed fish pond waste water

Parameter	T_0	T_1	SEM
Initial weight (g/bird)	40.08	40.00	
Final weight (kg/bird)	2.70^b	3.01^a	0.10
Total weight gain (kg/bird)	2.69^b	2.96^a	0.99
Total feed intake (kg/bird)	5.33^a	3.85^b	0.11
Daily wight gain (g/bird)	47.22^b	49.01^a	1.01
Daily feed intake (g/bird)	95.99^a	90.08^b	1.29
Feed conversion ratio	2.01^a	1.30^b	

a,b,c and d means within the same column with different superscripts are significantly different at ($P < 0.05$).

Table 3: Performance characteristics of Clarias guripinus fed maggot from poultry feaces

Parameters	T_0	T_1	SEM
Initial weight (g)	13.07+0.17	13.09+0.42	
Final weight (g)	193.90+.033	217.00+10.33[a]	0.89
weight gain	181.00+7.101	204.20+10.23[a]	1.01
% weight gain	1340+59.20	1562+68.7[a]	1.21
Initial total length (cm)	13.07+0.07	13.07+1.33	0.11
Final total length (cm)	28.13+0.09	33.01+0.29[a]	0.22
Total length gain (cm)	17.07+0.22	17.93+0.30[a]	0.12
% Total length gains	130.67+3.30	135.98+1.24[a]	1.90
Initial standard length (cm)	11.40+0.03	11.53+0.10	0.01
Final standard length (cm)	27.07+0.45	27.63+0.07[a]	0.51
Standard length gain (cm)	15.63+0.17	16.10+0.47[a]	0.16
% Standard length gain	137.47+2.69	139.47.4.40[a]	1.31
Condition factor	0.69+0.01	0.73+0.02	

a and b Means with same superscripts along row were not significantly different (P>0.05) maggot made from poultry feace

Table 4: Performance of Spinach fertilized with fish pond waste water and African Dwarf goat feaces

Parameter	T_0	T_1	T_2	T_3	SEM
Plant height	20.41^{c}	21.95^{b}	22.11^{b}	24.55^{a}	0.22
No of branches/plant	4.00^{c}	5.00^{b}	6.00^{b}	7.00^{a}	0.01
No of leaves/plant	12.00^{c}	14.00^{b}	15.00^{b}	17.00^{a}	0.10
Width of leaves	4.37^{c}	5.55^{b}	5.99^{b}	6.28^{a}	0.01
Length of leaves	7.69^{c}	8.61^{b}	9.22^{b}	10.47^{a}	0.13
Length of petiole	7.98^{c}	7.72^{b}	7.89^{b}	10.10^{a}	0.21
Leaf area	20.61^{c}	34.85^{b}	35.33^{b}	39.97^{a}	0.31
Leaf area index	0.41^{c}	0.50^{b}	0.55^{b}	0.70^{a}	0.04
Green leaf yield per plot	4.44^{c}	5.18^{b}	7.81^{b}	9.32^{a}	0.01
Green leaf yield/hectare	110.76^{c}	195.51^{b}	199.01^{b}	232.74^{a}	1.1
Leaf moisture content	94.32	95.44	96.99	96.44	0.91
Leaf chlorophyll	0.46^{c}	0.66^{b}	0.69^{b}	0.91^{a}	0.01

a,b,c and d means within the same column with different superscripts are sigificantly different at ($P < 0.05$). T_0 Is the control experiment without any special aid, T_2 are those supplied with goat feaces, T_3 are thos supplied with both fish pond water and goat feaces

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

Conclusions

i-Goat feaces is good and can improve the growth performance of the spinach vegetables

ii- Fish pond waste water is not poisonous to broiler chicken, it improvr their performance

iii-Maggot growth from broiler feaces can reduce cost of feeding C. garipinous and improve the growth of C. garipinoue without any harm to the fishes.

iv- Poultry feaces has no harm for WAD when fed to them.

Recommendations

i-Poultry feaces should also be tried on other ruminant animals

ii- Combinations of both fish pond water and goat feaces should be tried on other vegetable plants

iii-Fish pond water should be tried on Layers, Cockreal and Noilers

iv-Maggot should be tried on Layers, Cockreals and Noilers

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