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Current Status of Pig-Fish Farming in Low Lands of Lao PDR

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Abstract: The survey was carried out in two districts (Saythani and Nasaythong), Vientiane Capital Lao PDR. The aim of the study was to understand existing currently integrated pig-fish farming systems. The method of the survey were collected a primary second data from DLF/PAFO and was selected list collaboration focus on the integrating of pig-fish farming system. A totally of fourty pig-fish farms were participated with interviews individually by using questionnaire structure, expressing mainly on the pig production and waste management, fish culture model and economic benefits.

The results of the survey found that characteristic of fish culture model in Monoculture 30% and polycultures 70% of areas on surveyed farms almost households 99% owned land mean income from pig-fish. The pig was rearing intensive system; fish culture in mono-polyculture, number of pig in monoculture averages 725 head/farm and polyculture 759 head/farm estimate feces produced in monoculture averages 206 kg/day or nitrogen 2.47 kg/day and polyculture was averages 190 kg/day or nitrogen 2.28 kg/day, the both of culture model were fertilized 1.5 times per week of nitrogen to fish pond between 11.6-12.6, Ng/m^2. Fish culture 6-8 months were stocking rate mono and poly-culture was significant difference ($P<0.05$). The yield production in monoculture were 2.90 tones/ha and was high than the polyculture 2.64 tones/ha respectively. The type of feed for fish are provides as rice barn, duckweed and vegetable. The profit monoculture was high income than polyculture

Keywords: *pig-fish farming, in lowland Lao PDR, survey*

I. INTRODUCTION

Integrated fish farming or agro-poly-culture aims at minimizing production costs and maximizing production by combining two or more normally separate systems. This leads to productive use of agricultural by-products and increases the returns per unit of land area giving a farmer a high disposable income. It also lowers the farmer's risk of production failure since he has diversified his production activities and increases the amount of animal proteins in the diet of the rural inhabitants thereby improving their nutrition (1; 20). Pig farming was integrated with fish culture, wastes from the pigsties act as feed and manure for the fish pond. This greatly reduced the cost of fish production in the pond thereby increasing the profitability of the integrated farming system (13). Integrated livestock-fish farming is defined as sequential linkages between two separate farming systems, whereby livestock and fish become sub-systems of a whole farming system generating synergistic effects on conservation of resources and profitability (2; 26). The principle of integrated fish farming is involves farming of fish along with livestock and agricultural crops offering efficiency in resource utilization, as by-products from one system is recycled effectively and enables effective utilization of available farming space for maximizing production (28). Integrated pig-cum-fish farming is considered better compared to other livestock integrated systems because of production of meat and fish at cheaper feeding cost. Pig dung can either be directly used or partially decomposed before application in fish pond as pig dung contains about 70% digestible matter for fishes besides certain digestive enzymes, and left-over pig feed serves as direct food for fish. Pig dung enhances nutrient for planktons which are used by the fishes as natural food (14; 15). This result in eliminating the cost of fish feed and manuring of the fish pond, thereby increasing the overall profitability of combined farming system (3). This is a type of animal-fish farming and the addition of pig manure into a fish pond increases fish production through direct consumption of the manure by fish and increase in natural fish feed via the release of nutrients from manure decomposition (25). The integration of aquaculture with livestock or crop farming provides quality protein food, resource utilization, recycling of farm waste, employment generation and economic development. Integrated fish farming is well developed culture practice in China followed by Hungary, Germany and Malaysia (23). System is recycled effectively and enables effective utilization of available farming space for maximizing production (Zira et al., 2015).

Objectives

- The aim of the survey was to understand existing currently integrated pig-fish farming systems in lowland areas, Vientiane Capital Lao PDR, and to evaluate the pig manure excretion and agri-byproducts for fish culture.

II. MATERIALS AND METHODS

Study area and farm selection

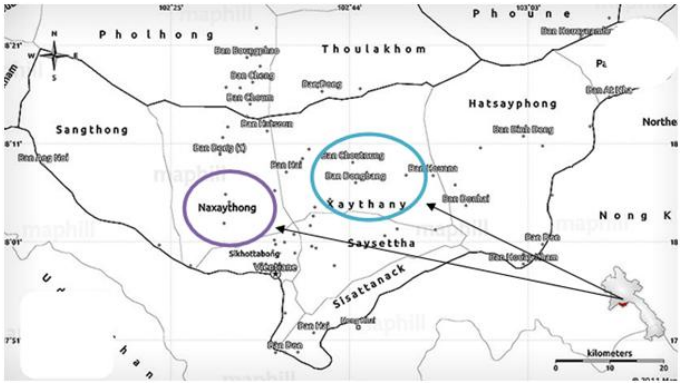

Figure 1: Location map was study on surveyed integrated of pig-fish farming system in Nasaythong and Saythani distracts

The survey was performed during September 2017 including 02 districts (Nasaythong and Saythani), Vientiane capital, Lao PDR, which around 30 km far from the city. The site of the study was selected focusing on the most integrate of pig-fish farming system. A totally of 40 integrated pig-fish farming

households were interviewed, with comprising of farms in Nasaythong and Saythany districts.

Data collection

The Data were collected initially second information from Department of Livestock and Fisheries (DLF) and the Provincial Agriculture and Forestry Office (PAFO), Vientiane Capital. The team of survey was preliminary discussed with District of Agriculture and Forestry Office (DAFO) to select the farms based on the integrate farming of pig-fish and designing contents of questionnaire to obtain the data and pilot test use of the questionnaire in the village prior to interviewing to farmers. The selected farmer was interviewed individually by use a question structure in more details on the issues of pig production, and productivity, waste management, problems and benefits of raising pigs. This information was gathered through face to face interviews to gain a deeper understanding of the issues.

The issues covered in the questionnaire is included an experience in pig-fish of farm, integrate pig-fish management systems such as the feed and feeding system for both of pig-fish production. The production and productive performance, any problem, benefits of pig-fish farming condition including their value chain were allocated on the questionnaire.

Data management and statistical analyses

The survey data was managed in worksheet of Microsoft Excel and all data were analyzed by using statistic program of SPSS software version 20.0. The source of statistical analysis was descripted for means value, frequency of distribution and variation of pig production system, pig manure management, fish farming and economic return of integrate farming system.

III. RESULTS

General information of the farms

Pig production systems in Lao PDR are mixed, multipurpose agricultural systems, which include pig production only as one of several livelihood options. Pigs, however, play an important role in income generation with relatively low input in traditional systems. If further intensified, they have potential to bring good revenues and help to secure income security for smallholders and food security for the region (19).

The table based on social economic characteristics integrated of pig-fish farming system was interview individle fourty farms and two districts were analyses in agricultural system of area, livestock and cultivation of crop and fruit, types of specializations (pig numbers on rearing and fish culture system) pond size, fish culture model on surveyed was clarify farms management on capacity of the area in livestock and cultivation unit per household activities were calcify pig-fish farms was extensive system. The fish culture in monoculture 30% and polyculture 70% of area on surveyed farms almost households 99% owned land. The number of farms in monoculture of the surveyed n= 12 and polyculture n= 28. Main income from the pig-fish, averages income from monoculture was 13.707USD/year, polycoulture 3.172 USD/year was significant difference (P<0.05), (Table 2).

Pig production system

The surveyed farms were located in lowland of Vientiane capital. The characteristic of farms was extensive system of pig rearing. The number of fattening and sow in monoculture and polyculture both of model were not significant (P>0.05) (Table 1).

Table 1: Pig production system

Components	Descriptions	Culture model		SEM	P value
		Monoculture Mean(n=12)	Polyculture Mean(n=28)		
Fattening farms	Percent (%)	30	70		
	Head of pig	725	759	82.04	0.675
Fattening and sow	Sow number	107	115	5.590	0.312
	Fattening number	700	747	86.63	0.587
Manure management	Percent (%)	100	100		
Estimates feces produced	Feces (kg/day)	206	190	66.69	0.655
	Nitrogen (kg/day)	2.47	2.28	62.92	0.804

Housing system and feeding practices

Types of floor, roof, ventilation and heating system; they were cleaned two times/day, consumption of water pumping from the well. A disinfectant was used for animal house cleaning (Lime for killing diseases around the housing) due to the weather in Vientiane capital. The temperature was averages 25- 32degree and mostly of the problems from disease was easily occurs to growing in the pig housing areas.

Feeding feed practical was 2times/day, types of feed on farms used commercial feed come from CP, Betagro, and other companies. But mostly depend on farmer's selection, for the feeding methods the farmers were followed catalogs standard in the bags.

Table 2: Social- Economic characteristics of surveyed farms

Components	Descriptions	Culture model		SEM	P value
		Monoculture Mean (n=12)	Polyculture Mean (n=28)		
Farms	Percent (%)	30	70		
	People in family	5	4	0.447	0.40
Area	Fish pond(ha)	0.795	1.1350	0.107	0.003
	Pig pen(ha)	0.070	0.054	0.012	0.195
	Other*(ha)	5.534	4.804	2.174	0.739
Experience	Fish culture(year)	5	7	1.160	1.160
	Pig rearing(year)	6	8	1.177	0.090
Income	Fish((USD/year)	2,894	3,822	1.561	0.556
	Pig(USD/year)	108,538	8,252	19.57	<0.001
	Other**(USD/year)	554	236		
	Total	13,707	3,172		

Remark: Other (areas for accommodations cultivation and free land); other** (Income from cultivation plant, vegetable, corp. fruits)*

Manure management was consequently; in extensive farms of the different culture categories had different patterns of manure disposal flow. Pig stocking density in farm 1 pig/m^2 in both mono and polyculture of fish in farms, and therefore have fewer problems with pig waste handling, the estimates feces produced (kg/day) in monoculture and polyculture not significant difference (P>0.05) (Table 2).

Control diseases on farms

The pig was injecting vaccines ready before carried piglets rearing on farm. The farmers has experienced for veterinarian on farm was done by them self if not serious situation disease, they were sometime inject vitamin or mineral, cleaned of the housing every day. The diseases were occurred and finding as species of swine fluenzea, colibacillosis. Injection and prevents diseases were used Anazine, Pendistrep (L.A), pensterp, Gentamicin SULPHATE, Genta-Tylosin, Gentalvet.

Fish culture systems

Fish stocking density

Farmers prefer to stock a larger, 5-10 g fish, although smaller fish are stocked in some cases due to their cheaper price. Stocking densities are typically low, reflecting the high price of fish fingerlings and the limited money farmers have to invest. Since most farmers do not generate cash, the purchase of fish fingerlings is frequently not possible (8).

On surveyed farms the farmers were preferred to Tilapia main species on fish culture and with other species, both of culture model fish were 07 months, and stocking rate monoculture 4fish/m^2 polyculture 07 fish/m^2 was high stocking density in polyculture (P<0.05), and the yield production of monoculture was high 2.90 tones/ha and polyculture were 2.64 tones/ha.

Table 3. Fish culture systems and management

Descriptions	Culture model		SEM	P value
	Monoculture Mean(n=12)	Polyculture Mean(n=28)		
Stocking density(fish/m^2)	4^a	7^b	1.485	0.037
Culture time (month)	7	7	0.358	0.238
Fish yield (ton/ha)	2.90	2.64	0.315	0.401

Table 4: Culture fish and management (% of fish culture in the pond on surveyed)

No	Culture model	Fish species			
		Tilapia	China Carp	Indian Carp	Indigenous
1	Tilapia ssp	100	-	-	-
2	Tilapia + Indigenous	75	-	-	25
3	Tilapia + China carp	73	27	-	-
4	Tilapia + China carp + Indigenous	78.5	9.4	-	12.1
5	Tilapia + China+ Indian	70	10	20	-
6	Tilapia + China carp + India+ Indigenous	74	10	8	8

There were two different molds of fish culture on farms such as monoculture and polyculture. The monoculture, the mostly of farmer was used culture of Tilapia only, and the polyculture as farmers' use of Tilapia, china carp, India carp and Indigenous, Tilapia culture in polyculture was more than 70% (table 2).

Culture species

Culture of Exotic Species present day aquaculture in Lao PDR is mostly dependent on exotic species (Common carp, Tilapia, Silver carp, Bighead carp, Grass carp, Rohu, Mrigal, African catfish, etc.) had introduced within country at various times (16). Economically, fish culture can be lucrative as well as nutritionally rewarding. There were 23 species of freshwater fish are cultured in the country, and most popularly was 10 cultured species (not by ranking) including Chinese carps: Silver carp (*Hypophthalmichthys molitrix*), Bighead carp (*Aristichthys nobilis*), Grass carp (*Ctenopharyngodon idella*); Indian carps: Rohu (*Labeo rohita*) and Mrigal (*Cirrhinus mrigala*); Common carp (*Cyprinus carpio*); Tilapias (*Oreochromis niloticus* and S. *mossambicus*); African catfish (*Clarias gariepinus*), Snake head (Channa micropeltis) and Silver barb (*Barbodes gonionotus*) (7). On the surveyed was found 10 species, which farmers were culture in the pond.

Table 5: Fingerling size (cm)

No	Fish species	Length (cm) $\bar{x}$ ± SD
1	Tilapia ssp	6.72±0.98
2	*Cyrinus carpio*	7.05±2.61
3	*Ctenopharyngodon idellas,*	8.65±1.73
4	*Cirrhiinus mrigala,*	8.00±1.16
5	*Aristichthys nobilis*	7.30±2.0
6	*Hypopthalmichthys mon*	9.54±1.36
7	*Labeo rohita*	10.25±2.60
8	*Probarbus jullieni*	8.01±1.78
9	*Barbodesgonionotus*	7.52±2.24
10	*Pangasianodon hypohthalmus*	15.20±2.58

Feeding feed

The ponds were fertilized pig manure and the types of feed was provided for fish as rice barn, duckweed, vegetable 87.5%, commercial with vegetable 10% and commercial 2.5% respectively.

Manure produced and management loading to fish pond

Those farms showed that the large scale farms, the pig manure was used for fertilizer in the ponds, and through away in water natural; the pigs were loading manure direct discharge of liquid manure into water ways, pig manure is not widely used for fertilization in the Southern of Vietnam in term of Mekong river delta, where pig manure is culturally considered to be 'hot', i.e. not suitable to fertilize all crops. Pig manure is considered suitable for rice production, but there is not useful for vegetables, coffee, and fruit-tree cash crops (5).

Manure collected a method was storage in the pond and separate from the fish pond. Pig wastes management storage types, covers and capacity of pond were treated by using lime with quantity 800-1000 kg/ha/year and they were also used the natural recycles with water hyacinth, duckweed and water spines (photo 1; 2). Manure compost in pond stored and treated by lime was additives used, composting procedures. Amount of manure in treated used for the fish ponds 60% estimate amount of manure loading into the pond/cropper at 1.43 and fresh manure 40% at 1.67. In otherwise the farmers can reduce pollution of manure proportion used for cultivation crops (photo 3), fruits, vegetable, grass for animal and other to neighbor who want to use. Both of fresh and treated manure into the pond was used fertilized by percent of nitrogen to fish pond at 11.6 to 12.6 (Table 6).

Table 6: The quantity of manure produced and management loading to the fish pond on surveyed farms

Descriptions	Manure management		SEM	P value
	Fresh	Treated		
Number of farms	16	24		
Percent	40	60		
Estimate amount of manure loading into the pond /crop.	1.67	1.43	0.234	0.316
Estimate nitrogen loading kg N /ha	11.67	12.68	1.471	0.496

Photo 1: Recycle by natural water hyacinth

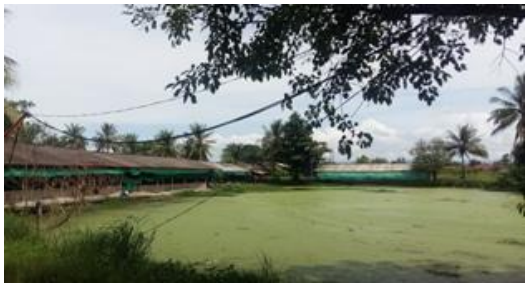

Photo 2: Recycle by natural duckweed)

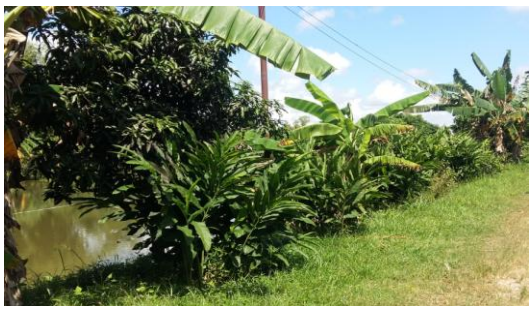

Photo 3: Crops and fruit cultivation on pig-fish farms (banana, mango, coconut, lemon *etc* ...)

Advantage and disadvantage on farms

Advantage

Pig manure was involved into aquaculture and reduce cost product get more income. The capacity of land use in agriculture get benefit from integrated farming system many produced in area.

In survey was found farmer's who has integrated farming systems between livestock and cultivation, (pig-fish) and corps (vegetable and fruit) in one area of land to increase volume income gets more benefit it is good way adaptation farming system when climate change.

Extension services on animal waste treatment were represent serious knowledge for farmers understanding farm managements pig production by commercial-scale more serious as pig production expands, if extension services was fail to catch up. Negative impact from disease prevents were directly to pig manure on health and environmentally is well understand all most farmers.

Disadvantage

Farmer's reported the prices of the pig on farms were received 22000Kip/kg or 2.7 USD in 2009-2013. DLF (2017) reported that the price was decreased 15000-16000 kip/kg or 1.8 USD in 2017.

The prices of pig productions were different counties including Lao PDR 1.8, Vietnam, and 1.38, Thailand 1.77, China 2.23, Cambodian 1.75, and Myanmar 2.41 USD. The marketing not sustainable of the price and the pig production was high cost to investment that the reason some farm stopped integrated pig-fish, but connects with chickens-fish farm.

The situation of pig production, almost systems were covered by companies especially marketing and the price of pig company controller such as the piglet and feed, import from neighbor countries as Thailand, Vietnam and China.

Discussion

Current status of pig-fish farming the quality of nitrogen in manure loading to fish pond 11.67-12.68 N g/m^2 /week in both of mono and polyculture were similar fertilized, if compares with other research was highly. According to reports the amount of fertilizer input to each pond was calculated based on a nitrogen input of 2kg N/ha/day (24). The effluent was applied in quantities equivalent to 160kg N/ha over the 120days, equivalent to 0.133g N/m^2/day (22). Among different pond fertilizing nutrients, high rates of N fertilizers are usually recommended, ranging from 200 to 400kg/ha (4). Pig dung is applied to the pond every morning. Each pig voids between 500-600Kg dung / year, which is equivalent to 250-300Kg/ pig /6 months (17). On surveyed farms fish yield production in monoculture 2.90 tones/ha was higher than the polyculture 2.64 tones/ha; due to the monoculture were found good managements for fish stocking density and lower than polyculture. According to reports in monoculture of Tilapia andersonii with pigs yielded 7 tones of whole fish ha^{-1} $year^{-1}$ in Zambia while monoculture of C. gariepinus with pigs yielded 7.5tones of whole fish ha^{-1} $year^{-1}$ in the Central Africa Republic with the growth rate of 2.9 g day1 for C. gariepinus (27). Even though excreta of three pigs may just be sufficient to fertilize a pond of 1,000 m² in one production cycle, more than 30 pigs ha^{-1} pond is recommended (12). To ensure sufficient supply of biofloc community for pond microbial synthesis and periphyton development (6). Fish stocking density between mono and polyculture was significant difference ($P<0.05$). Monoculture was stocking density lower than polyculture; fish stocking density 5-6fish/m^2 in natural pond in surveyed districts was high in particularly; and also the profit from mono was higher than polyculture. According to reports of CIFRI recommended stocking density of

8500fishes/ha for pig cum fish culture. ICAR Research Complex for NEH Region suggested stocking density to be 6000 fingerlings/ ha in pig cum fish culture integrated farming system (9). The stocking rates vary from 8,000 – 8,500 fingerlings/ha and a species ratio of 40% surface feeders, 20% of column feeders, 30% bottom feeders and 10-20% weedy feeders are preferred for high fish yields (17).

The findings of the present study, it may be concluded that integrated fish-pig farming is profitable for getting higher growth of fish, net income and optimum utilization of the given resources. The production yields from integrated fish farming vary depending on the livestock (either pig or poultry) and the management system practiced. Nevertheless, they were provided more profitable than unitary system of farming and ensures the spread of financial risk, reduced wastes and thus is ecologically more sustainable (21). Furthermore for sustainable aquaculture there should be, to a large extent dependency upon eco-friendly and economically and socially viable culture systems. Hence the recycling of organic wastes for fish culture comes in handy as it serves the dual purpose of cleaning the environment by avoiding the problem of waste disposal and providing economic benefits through reduced expenditure on costly feeds and inorganic fertilizers which form more than 50% of the total input cost in fish farming business (29).

CONCLUSION

- The survey was found that characteristic of fish culture model in monoculture 30% and polycultures 70%, Tilapia was main species culture; fish culture 6-8 months and fish yield production of monoculture 2.90 tones/ha and was higher than polyculture 2.64 tones/ha. Net income on monoculture was higher than polyculture
- The pig was rearing intensive system number of pig in monoculture averages 725 head/farm and poly-culture 759 head/farm, which estimates feces production in monoculture averages 206 kg/day or nitrogen 2.47 kg/day, the polyculture 190 kg/day or nitrogen 2.28 kg/day. Types of manure fresh and treated manure was fertilized to fish pond averages 11.6-12.6 N g/m^2

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