Impacts of domestic goat *Capra hircus*, (Linnaeus, 1758) rice-fish co-culture system on rice paddy yield and fish diet.

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INTRODUCTION

Feeding the world in 2050 while ensuring food safety and environmental protection is one of the major challenges of sustainable development objectives. Traditional rice-fish co-culture systems, one of the Integrated Agri-Aquaculture Systems (IAAS), have increased the yield without using chemical fertilizer; the introduction of animal species in the rice fields is therefore an alternative to increase rice production and reduce environmental pollution caused by the monoculture of rice.

This work aims to assess how the introduction of domestic goats in the rice-fish co-culture system can affect the rice yield and the fish diets.

MATERIALS AND METHODS

Study area

The study was carried out at Chongming island in North-East of Shanghai, PR of China, 31.6773°N, 121.3258°E. It is the third largest island in China (Fig. 1).

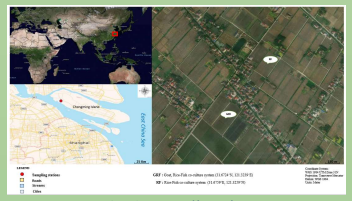

Fig. 1: Sampling site

Design

Rice yield and fish diet between the goat, rice-fish system (GRF) (Fig. 2) and the rice-fish system (RF) (Fig. 3) were compared

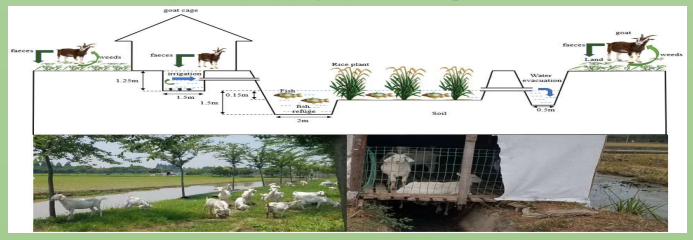

Fig. 2: goat, rice-fish co-culture system

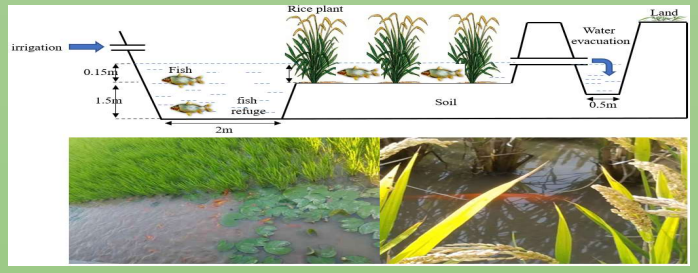

Fig. 3: rice-fish co-culture system

Sampling

The weight of Fresh Grain (FG) and Dry Grain (DG) in kgha^{-1} were collected by an investigation carried out on the campaigns of the years 2019 and 2020. *Cyprinus carpio* were caught from September to November 2020 using different Chinese traditional gears (Fig. 4).

Fig. 4: Experimental fishing

Analysis

The stomach contents of 14 specimens from each system were fixed at 4 % using formalin, and analysed by microscopy with a magnification of x40, then subjected to the frequency of occurrence (FOC) method (Hyslop, 1980). Students t-test were performed with a confidence interval of 95% using SPSS statistical package (IBM SPSS Statistics; version 24.0).

RESULTS

Rice yield

The FG yields were 7.10% lower in RF system (6014.1±96.29 kgha^{-1}) than GRF system (7302.0±212.06 kgha^{-1}), while DG yields were 4.40% lower in RF system (5749.275±161.09 kgha^{-1}) than GRF system (6783.375±424.29 kgha^{-1}) (Fig. 5). There is no significant difference between the rice yield from both system (p>0.05).

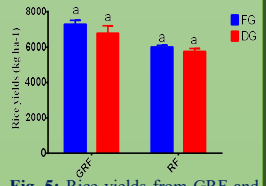

Fig. 5: Rice yields from GRF and RF; Same letters at the same stage indicate no significant differences, t-test (p>0.05).

Fish diet

The FOC of small fish (85.71%), macroinvertebrate parts (50%), plant parts (71.43%), and phytoplankton (46.38 %) were greater in the GRF system than RF system while the FOC of shrimp (50%), insect parts (42.86%) and zooplankton (42.56%) was greater in RF system than GRF system. There is no significant difference between the FOC of food items in the stomach of fish from both system, except the FOC of Chlorophyta (p=0.036) (Fig.6).

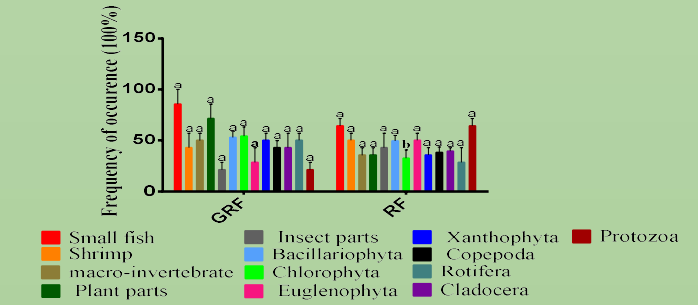

Fig. 6: Frequency of Occurrence of food items in stomach of *Cyprinus carpio* from GRF and RF systems. Different letters at the same stage indicate significant differences t-test (p<0.05).

DISCUSSION

The increase of rice yield in the goat rice-fish co-culture system may be due to the double fertilization from the goat and fish faeces. The frequency of occurrence of plant parts in the stomach contents of *Cyprinus carpio* from the goat rice-fish co-culture system (71%) is twice that of rice-fish system; this increase of plant parts in fish diet may be from the indigenous plant remains in the faeces of goats (Fig. 7).

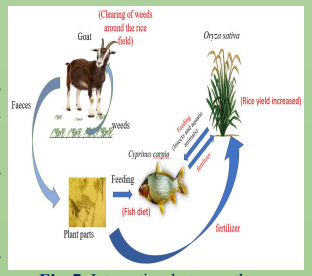

Fig. 7: Interaction between the components of goat, rice-fish co-culture system.

CONCLUSION

The use of domestic goats in rice-fish co-culture can increase rice yield; fish can also ingest plant parts from goat faeces, insects and aquatic animals in the rice field. The goat, rice-fish co-culture system produces fish, rice, and meat. We encourage farmers to practice this farming system for the diversity of agricultural production and the sustainability of Integrated Agri-Aquaculture Systems (IAAS).

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