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Research Article

FARMING RICE WITH DUCKS: THRUST ON RICE PRODUCTION AND WEED COMMUNITIES

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Abstract: Field investigations were carried out in Annamalai University experimental farm for two consecutive years to trace the impact of duck integration in transplanted rice crop. The experiment was aimed at comparing the performance of duck integration in different modes viz duck herding in puddled fields, duck herding in transplanted fields, duck herding in transplanted and puddled fields. The field experiment was laid out in split plot design consisting of thrice sub treatments and replicated thrice. All the treatments involving various modes of duck integration resulted significantly in increased grain yield and straw yield and simultaneously decreased weed parameters. The interaction effects of duck herding. The interaction effects of duck herding in cropped and puddled condition coupled with conoweeding + one hand weeding suppressed total weed population recorded 5.77 per m^2 and 5.67 per m^2 during I and II season. Similarly duck integration had a positive impact recording 15.03 t ha-1 4.34 t ha^{-1} and 7.29 t ha^{-1} of crop DMP, grain yield and straw yield respectively during I season and crop DMP of 15.3 t ha^{-1}, grain yield of 4.88 t ha^{-1} and straw yield of 7.58 t ha^{-1} during II season (duck integration, rice production, weed management).

Keywords: Conoweeding, Rice production, Weed management

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Introduction

Environmental concern is unique and is being realized in all contexts due to its multifaceted dynamism in sustainable production, soil health, biodiversity conservation, natural resource management, leading to social, economic and environmental benefits. By far, integrated farming system is a concept of approach designed with a prime objective of addressing vertical expansion of land use in agriculture augmenting self sustainability, ecological soundness and enhanced farm productivity. During the last few decades progress in the economy, health and education of humans have changed values and demographic profile in countries, and invariably India too. The most important staple food crop rice secures the livelihood of half of the world's population and 130 million tonnes of rice production is the expected target at 2030AD as against the present production of 102.75milllon tonnes. In Tamilnadu rice crop occupies an area of 44.6 m.ha with a production of 90 mt [8] but the productivity level is very low. As the production of food evolves towards greater sustainability, a systematic programme for the entire farming period through a series is required in order to improve the efficiency of the farming system as a whole, involving rice-duck integration need to be explored. The appropriate way to produce rice with organic cultivation approach is combined rice cultivation and duck breeding [4, 6, 11]. In general ducks are quite hardy more easily brooded, resistant to common avian diseases, requiring less attention thriving well in scavenging conditions and deliberately occupies an important position next to chicken farming. Duck herding in paddy fields for scavenging on weeds, crop residues, snails, fresh water crustaceans was introduced in North Vietnam in 1994 by a Japanese scientist. The ducks are likely to be a powerful tool in integrated pest management and weed control in the rice fields [6,5]. Ducks improve ecological conditions of rice growth, increase biodiversity, activity of soil organisms, energy efficiency the growth of rice and ultimately the paddy field [7,8]. The work of rice-duck integration is quite simple but the compliment duck provides is tremendous and the process is termed as duck effect. Duck effect includes weed control effect, pest control effect, full time ploughing and muddying effect, bird tillage effect, rice stimulation effect, methane suppressive effect *etc.* The traditional practice followed with the ducks in rice fields is it could be kept in fields either before planting or after the harvest and in Tamil Nadu *i.e.*, South India duck herds are allowed in the harvested rice fields, enabling them to pick the fallen rice grains. But In Japan, the mutual effect of rice with duck and vice versa, is explored. Therefore, as a complementary farming element duck rearing is practiced as free-ranging-scavenging-duck husbandry system in small rural farms. Although the performance under these conditions favours in enhancing soil-health the more active foraging capacity of water fowls supplements weed control. Ducks are relished by the South East Asians, and hence simultaneous production of rice and ducks might be ventured into the new arena of rice -duck farming in South India. In this regard, according to the importance of producing healthy output in ecological farming systems, this experiment with integration of ducks and rice was taken in order to study the effect of duck integration in rice fields and its impact on weeds, growth and yield parameters with economics eventually.

Materials and Methods

The field experiments were conducted in the wetland block of Annamalai University Experimental farm, Annamalainagar. The experimental farm is located at 11°24'N latitude and 79°44' E longitude and altitude of 5.79m above mean sea level. The experimental field was irrigated with good quality of irrigation water from deep bore well of the experimental farm. The mean annual rainfall received at Annamalainagar is 1500mm with a distribution of 1000 mm during North east monsoon, 400mm during south east monsoon and 100 mm during hot weather period which is spread over 60 rainy days. The maximum temperature range from 27°C to 38.9°C with a mean of 32.7°C while the minimum temperature range from 24.4°C to 25.6°C with a mean of 24.6°C. The highest relative humidity of 85% was observed during April to May and lowest of 80% during November with a mean of 83.5%. The soil of the experimental field was clay loam in texture with a pH of 7.3, the soil was low in available N (239kg per ha) medium in available P_2O_5 (20.3 $kgha^{-1}$) and available K_2O.

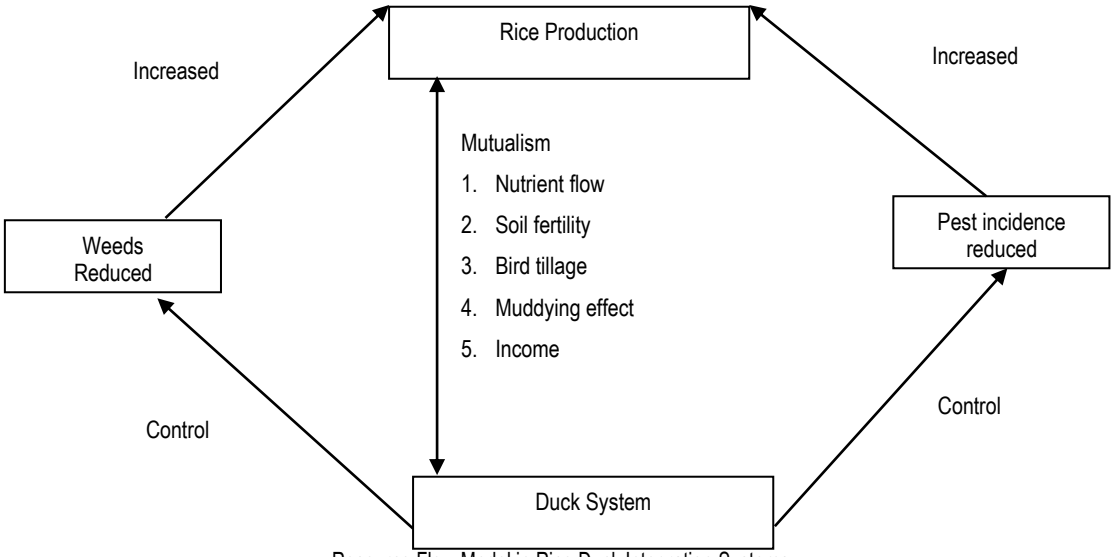
Table-1 *Effect of duck integration and weed control options on weed observations*

Main treatment	Weed count / m²		Weed dry matter production kg/ ha		Weed control index (%)	
	I	II	I	II	I	II
Control	9.27 (96.67)	9.04 (82.90)	1113.14	1031.49		
Duck herding in puddled field	6.17 (39.68)	6.92 (50.17)	472.52	471.52	44.88 (69.65)	40.00 (4.00)
Duck herding in cropped field	7.53 (58.79)	7.65 (59.74)	532.76	546.57	40.92 (43.11)	35.99 (35.06)
Duck herding in puddled and cropped field	6.08 (32.71)	5.58 (32.71)	399.15	404.05	49.88	46.76 (49.02)
SEd	0.26	0.20	22.33	21.16	0.70	10.52
CD(p=0.05)	0.52	0.40	44.65	42.34	-	2.33
Sub treatments						
Unweeded control	10.08 (102.81)	9.38 (88.79)	834.76	796.86		
Twice hand weeding	7.67 (59.80)	7.29 (85.32)	657.22	641.51	37.36 (37.03)	36.46 (35.64)
Inter culturing with cono weeder	8.79 (78.07)	8.14 (66.97)	729.37	673.34	32.57 (29.31)^	32.50 (29.05)
Cono weeding + one hand weeding	5.77 (42.02)	5.67 (33.78)	503.60	449.81	46.5 r (52.21)	45.00 (50.11)
SEd	0.30	0.32	19.12	15.62	0.64	0.7
CD	0.61	0.64	38.24	31.26	1.27	1.50

Table-2 *Effect of duck integration and weed control Grain and Straw yield tha^{-1}*

Main Treatments	Grain yield tha^{-1}		Straw Yield tha^{-1}	
	I	II	I	II
Unweeded Control	2.37	3.03	4.90	5.31
Duck herding in puddled field	3.97	4.23	7.29	5.999
Duck herding in cropped field	3.43	4.63	6.37	7.60
Duck herding in puddled and cropped field	4.03	4.90	6.37	7.60
SED	0.11	0.15	0.16	0.19
CD P = 0.05	0.22	0.29	0.35	0.39
Unweeded Control	2.31	2.96	5.03	5.30
Twice Hand Weeding	3.23	3.93	6.11	6.29
Inter culturing with cono weeder	3.01	3.52	5.74	5.98
Conoweeding + Handweeding	3.87	4.70	6.80	7.45
SED	0.07	0.12	0.10	0.17
CD p = 0.05	0.13	0.24	0.20	0.33

I-Mean of sornarvari (Season-1), II-Mean of samba (Season-II)



Resource Flow Model in Rice Duck Integration Systems

The main treatment comprises of control (conventional method of rice cultivation), duck herding in puddled fields, duck herding in cropped fields, ducks herding in puddled and cropped field. The subtreatments include, unweeded control, twice hand weeding @ 20 and 40 DAT, intercultivation with conoweeding and conoweeder plus hand weeding. The fields were laid out into four main plots of dimension 16m x 15m, with each subplot dimension of 5m x 4m. In the main plots, the treatments were taken up with off-season management practices. In the one unit of the four partitions, the ducks were allowed for herding in rice field for 10-15 days in puddled field to trace the impact on weed population and rice crop performance trace the impact on weed population and rice crop performance during cropped period. In the second partition of the experimental unit the ducks were allowed for herding in the cropped fields into which the duck entry was ensured at 5-7 DAT and extended up to panicle initiation. In the third unit earmarked in the experimental area, the duck herding was ensured during puddled and cropped fields. The ducks in the paddy fields was withdrawn at the time of panicle initiation. In the control plots deep ploughing with disc plough during the summer was taken, and allowed for exposure to sunlight for one month, before land preparation. The mainfield was puddled three times to bring the soil to a satisfactory colloidal condition and later, the field was levelled perfectly. The bunds of the plots were strengthened as and when required in order to prevent seepage of water into neighbouring plots. In treatment plots involving duck integration the nutrients added through duck manure was worked out and deducted while scheduling fertilizer application. The observations taken were weed count, weed DMP, weed control index, crop DMP, grain yield, straw yield and economics.

Results and Discussion

During the first season the impact of duck foraging in puddled and cropped field was best registering the least weed count of 6.08 per m^2 followed by duck foraging in puddled field registering 60.17 per m2. Subsequently during second season the total weed count was reduced to 5.58 per m^2 in plots where ducks foraged in puddled and cropped fields. Among the main treatments involved, duck scavenging in puddled and transplanted field excelled, all others, in reducing the population of *Marselia quadrifoliata* and *Cyperus rotundus* that was contributing largely for the total weed count. This is because the ducks scavenging within the rows enabled the exposure of tubers and weeds seeds and in turn, were fed by them. Moreover the movement of these water fowls in the inter row spaces frequently disturbed the soil, thus deprived the germinated weed seeds to emerge and establish. This was earlier reported by [1]. Similarly, the interaction effect of ducks scavenging during puddled and cropped condition followed by conoweeder + one hand weeding showed remarkable suppression of total weed population recording 5.77 m^2 and 5.67 per m^2 during I and II season. This is because already the duck scavenging through weed control and bird tillage effect had suppressed the weed emergence up to flowering stage and further the subsequent hand weeding followed by conoweeder gave remarkable results on weed control that had further checked the weed sprouts [Table-1]. The synergistic effect of the treatments favoured crop performance as evidenced from the same main treatment supplemented with twice hand weeding proved the next best [8]. During the second magnificent weed control in rice with particular impact of *Marselia quadrifoliata* and *Cyperus rotundus*, the duck scavenging in puddled and cropped field was highly pronounced when coupled with conoweeder + one hand weeding. This might be due to soil disturbance offered by duck movement in the transplanted field, which suppressed the emerged weed seedlings and burying the exposed weed seeds. This was earlier reported by [2, 5, 11]. Similar impacts were observed in crop dry matter production, grain yield and straw yield as a result of duck herding in the rice fields. Ducks integration during the puddled and cropped stage in the first season performed the best recording 15.03t per ha, 4.34t per ha and 7.29t per ha of crop DMP, grain yield, and straw yield respectively. The second season results were comparatively the same with duck integration during puddled and cropped field registering the highest DMP of 15.3t per ha, grain yield of 4.88t per ha, and straw yield of 7.58t per ha [Fig-2]. The mere performance of ducks in the puddled and transplanted rice field apart from offering weed control is almost a closed nutrient cycle. Significantly the rationalized use of available resources and promotion of interaction among component enterprise is the potential contribution from integrated farming system. The ducks when herded, feed on young weed plants and weed seeds brought about the mechanism of weed control in the cropped fields. Further the trampling activity through their webbed feet oxygenated the water and encouraged the roots of rice plants to grow vigorously and prevented the harmful gas accumulation in the rhizosphere [3,9]. Except the trampling and grazing effect of ducks on weeds and weed seeds the disturbed water and muddy field created by full day walking and swimming ploughing activities of ducks may also inhibit the germination and growth of weeds by reducing light penetration in the water [10]. Consequently, the bird tillage effect and rice stimulation effect promoted through ducks integration, comparatively favoured crop performance and hence the yield parameters.

Conclusion

Organic rice farming though practiced from years together the, production and quality decreased due to pests, diseases and weeds. Wetland rice - duck farming system, a complex ecosystem has a long history and has been practiced in Asia to promote organic rice production to eliminate the use of fertilizers, herbicides, and pesticides from the present investigation, it can be concluded that pre-season management practices, such as duck scavenging in puddled and cropped field coupled with conoweeding plus one hand weeding played a very significant role in managing the weeds in wetland condition and making rice farming successful. Indeed, enhancing soil fertility led to ecological sustainability, environmental stability and economical feasibility is an assured contribution in rice-duck ecosystem. The results of the present study revealed the rice duck cultivation is highly profitable besides reducing the weed and pest infestation proving its fitness in complimenting the environment too.

Application of research: Rice-duck technology with is inherent potential of enhancing the livelihood status of the resource poor farmers stands firm in its feasibility for adoption of Tamil Nadu, farmers.

Research Category: Rice-duck technology

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