



PERIPHYTON ENHANCED SYSTEM TO INCREASE YIELD IN POLYCULTURE PONDS WITH CARPS AND SMALL INDIGENOUS SPECIES

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Introduction

- **Carp-SIS (Small Indigenous Species) polyculture:** Has been promoted by AFU (before IAAS) since 2008 for the improvement of family nutrition and income generation among rural farmers in Terai, Nepal (Rai, 2012, 2013).
- However, feed accounts >53% of total operational costs (Gupta et al. 2014).
- Needs low cost feed sources such as periphyton enhancement (Azim et al. 2002, Rai et al. 2008).
- Since the combination of species and type of feed influence the yield and income in such a system, it is necessary to test the full combination of feed inputs, periphyton enhancement, and production to truly understand the best system for commercial production (Diana, 2012).

Objectives

- **To develop the low cost sustainable technology**
- **To transfer the technology to farmers**

On Station Trial

- Experimental site: AFU
- Average pond size: $150.9 \pm 4.1 \text{ m}^2$ (117.7- 168.5 m^2)
- Duration: 7 months (24 August 2014 to 28 March 2015)



Objectives

- To compare water quality among different polyculture systems
- To compare net yield of carps and SIS among different polyculture systems
- To compare the profit among different polyculture systems

Experimental Design: CRD

Treatment	Species combination	Feed	Substrate
T ₁	Carp	100% feed	No
T ₂	Carp+SIS	100% feed	No
T ₃	Carp+SIS	50% feed	Bamboo mat
T ₄	Carp+SIS	No feed	Bamboo mat

Stocking Combination

Species	T ₁	T ₂	T ₃	T ₄
	Carp	Carp+SIS	Carp+SIS	Carp+SIS
Carp				
Silver carp	3000	3000	3000	3000
Bighead carp	750	750	750	750
Grass carp	2250	2250	2250	2250
Common carp	3000	3000	3000	3000
Rohu	3750	3750	3750	3750
Mrigal	2250	2250	2250	2250
Sub-total	15000	15000	15000	15000
SIS				
Pothi		25000	25000	25000
Dedhuwa		25000	25000	25000
Sub-total		50000	50000	50000

Pond Preparation

- Fertilization: Urea - 470 g/100 m² and DAP- 350 g/100 m²
- Substrate preparation: Split bamboo mat (20-35 splits, split size 4 cm x 75 cm)
- Float: Styrofoam as float at top edges of mat
- Sinker: Brick as weight at bottom edges of the mat
- Two mats per pond
- Vertical positioning

Substrate Preparation and Installation



Stocking



Feed and Feeding

- Mustard oil cake and Rice bran (1:1) mixed in dough
- Fed once in the morning
- Feeding rate: 5% for initial two months and later 3% for rest experimental period
- Grass fed to Grass carp at 50% of body weight



- Partial harvesting of SIS:
during monthly fish
sampling



- Final harvesting:
complete draining of
the pond



Analytical Methods

- **Growth check:** Monthly, Sampling at least 20% of each carp species
- **Water quality analysis:** DO, pH, Temp., Transparency, Total alkalinity, TAN, SRP, Chlorophyll-a
- **Periphyton analysis:** Monthly, Dry matter, Ash, Ash free dry matter
- **Gross margin analysis:** Gross margin
- **One-way ANOVA:** Water quality, yield and gross margin, Student's t-test - Periphyton biomass

Net Fish Yield

NFY (t/ha/yr)	Carp	Carp + SIS	Carp + SIS + 50% Feed + Substrate	Carp + SIS + No Feed + Substrate
Carp	4.4±0.5 ^{ab}	3.5±0.4 ^b	5.5±0.5 ^a	4.2±0.4 ^{ab}
SIS	-	0.21±0.07 ^a	0.05±0.02 ^b	0.05±0.02 ^b
Combined NFY	4.4±0.5 ^{ab}	3.7±0.4 ^b	5.5±0.4 ^a	4.2±0.4 ^{ab}
AFCR	2.4±0.3 ^a	2.4±0.21 ^a	1.0±0.06 ^b	-

Gross Margin (NRs/100 m²) in 7 months

Particular	Carp	Carp + SIS	Carp + SIS +50% Feed + Substrate	Carp + SIS +No Feed + Substrate
Variable cost	3247.7±165.8 ^a	3056.0±9.9 ^a	2796.8±46.7 ^b	1850.6±3.2 ^c
Gross Return	6440.3±680.3 ^{ab}	5710.0±525.2 ^b	8354.7±612.9 ^a	6518.6±563.1 ^{ab}
Gross Margin	3192.6±622.4 ^{bc}	2654.0±519.9 ^c	5557.9±588.4 ^a	4618.5±566.0 ^{ab}
Gross Margin (NRs./ha/yr)	554.9±108.2 ^{bc}	461.3±90.4 ^c	966.0±102.3 ^a	802.7±98.4 ^{ab}

Carp+SIS + Bamboo substrate + 50% Supplemental feeding





Farm Trial

- Two best treatments were tested in farm in Tharu community
 - T₁ - Carp+100% feed
 - T₃ - Carp + SIS + 50% Feed + Substrate
- Trial period: 8 months (Apr. 2015-Dec. 2016)

Trial Sites



MAP OF NEPAL
 ADMINISTRATIVE DIVISION
 75 Districts, 14 Zones, 5 Regions

International Boundry 
 Regional Boundry 
 Zonal Boundry 
 District Boundry 

KTM - Kathmandu
 B - Bhaktapur

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Mishrit cooperative

Sundardeep women cooperative

Cooperative Participation

Cooperative	Carp + 100 % Feed	Carp + SIS + 50% Feed + Substrate	Total
Sundardeep women cooperative	7	8	15
Mishrit cooperative	12	10	22
Total	19	18	37

All farmers were women

Farmers prepared pond, stocked carp and SIS, and fed fish as per protocol of the on station trial



Record Keeping

- A note book was provided to each farmer to record fish consumed, sold and died.
- Partial harvesting of SIS from July



Final Harvesting



In December 2016

Fish production, consumption and profit earned by farmers in two systems in 8 months

	Carp	Carp + SIS + 50% Feed + Substrate
Production (kg/100 m ²)	46.5 _± 16.2 ^b	56.7 _± 17.8 ^a
Profit (NRs./100 m ²)	3586 _± 2984 ^b	6823 _± 3045 ^a
Consumption (kg/household)	14.7 _± 13.4 ^a	15.3 _± 12.7 ^a

T-test

84% of farmers (16 carp farmers and 15 carp+SIS+substrate farmers) consumed fish at home, and 41% of farmers(7 carp farmers and 8 carp+SIS+substrate farmers) sold carp

Fish production, consumption, sale and income per pond by farmers in two districts

District	Treatment	Carp sold (kg/pond)	Carp consumed (kg/pond)	SIS consumed (kg/pond)	Total production* (kg/pond)	Gross Income from fish sale (Rs./pond)
Chitwan (n=15)	Carp (n=7)	10.0	15.0	0.3	75.0	18761
	Carp + SIS +50% Feed + Substrate (n=8)	31.0	23.5	2.6	109.6	27411
Nawalparasi (n=22)	Carp (n=12)	44.4	15.7	0.5	128.8	34766
	Carp + SIS +50% Feed + Substrate (n=10)	25.8	8.7	2.2	164.0	44290

*Includes carp left in the pond and not consumed or sold at harvest.

Workshop to transfer technology



35 (7 men and 28 women) nonadopters participated

Conclusion

- The technology utilizes locally available bamboo which can be reused 3-5 years further.
- This technology is suitable to rural farmers as it is cost effective and supports family nutrition and income.
- The technology needs up scaling.

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