Effluent Treatment Alternatives

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Outline of Presentation

- Brief history of the issue
- Characteristics of effluents
- Specific challenges
- Treatment alternatives
- Economic evaluation

Brief History of the Issue

Focused on effluents from ponds
(green water leaving ponds attracts attention from public)

HSB producers historically manage yellow grub infestations by drying ponds between cycles (creates effluent)

Effluent Challenges

- Flat topography of coastal area means low flow conditions for receiving streams
- Producers encouraged by NCDWQ to meet limits of 5 mg/L BOD and 40 ug/L Chlorophyll-a

Characteristics of pond effluents and inflow water

Variable	Castle Hayne well water	Phase II (3 -100 g)	Phase III (100 - 681g)	EPA Effluent Standards for wastewater treatment [1]
BOD (mg/L)	------	19.20	13.70	30.00
TSS (mg/L)	------	51.05	82.00	30.00
TP (mg/L as P)	0.68[2]	0.38	0.85	0.17
TN (mg/L as N)	2.30[2]	2.85	5.45	1.77
Chlorophyll-a (ug/L)	------	112.0	300.0	------

[1] Schwarz and Boyd 1994

[2] NCDA&CS Solution Analysis Lab. Sampled from Aurora area.

Characteristics of Effluents

Variable	Fish Pond Effluent	Hog Lagoon Effluent
Total Nitrogen (mg/L)	5.45	899
Total Phosphorus (mg/L)	0.85	163

Hydraulic limitation (fish effluents) instead of nutrient limitation (lagoon effluents)

Not necessarily what is in the water, but the overall amount of water that will drive choice of treatments (water budget).

Annual Farm Water Balance (Specific Challenge)

Month	Rainfall	Pump	Gain	Evap.	Seep.	Loss	Discharge	% Total
JAN	4.3	2.9	7.2	1.9	1.6	3.5	0.0	0%
FEB	3.1	1.2	4.3	2.3	1.6	3.8	2.2	6%
MAR	4.1	1.8	5.9	3.6	1.6	5.1	1.2	4%
APR	3.3	7.7	11.1	4.1	1.6	5.7	3.6	11%
MAY	4.3	7.5	11.8	5.2	1.6	6.7	4.4	13%
JUN	4.6	6.8	11.5	4.2	1.6	5.7	3.6	11%
JUL	5.9	5.3	11.1	5.9	1.6	7.5	6.7	20%
AUG	6.4	4.8	11.1	4.3	1.6	5.9	4.6	14%
SEP	4.6	1.6	6.1	3.7	1.6	5.3	2.2	7%
OCT	3.3	3.9	7.2	1.8	1.6	3.3	2.8	8%
NOV	2.9	5.8	8.7	2.5	1.6	4.0	1.8	5%
DEC	3.4	5.8	9.1	2.1	1.6	3.6	0.6	2%
	50.0	55.1	105.1	41.5	18.6	60.1	33.7	100%

Treatment Alternatives

Treatment Alternative	Description
Retain in the same pond	Water is retained on farm post-harvest for subsequent production in the same pond
Retain in different pond	Water is retained on farm post-harvest for subsequent production by pumping to another production pond
Retain/treat in holding basin	Water is pumped post-harvest to specially constructed holding basin and later returned to one of the production ponds for subsequent cycle or discharged once it reaches the standards
Retain/treat in converted pond	Water is pumped post-harvest to specially designated converted pond and later returned to one of the production ponds for subsequent cycle or discharged once it reaches the standards

Chemical treatment	**Water is treated in production pond post-harvest with chemicals to meet quality standards prior to discharge**
Passive treatment	**Water is retained in production pond post-harvest to allow natural processes to bring it to standards prior to discharge**
Artificial wetlands (100%)	**Water is pumped to specially constructed wetlands where aquatic plants remove nutrients prior to eventual discharge**
Artificial wetlands (20%)	**Some water (80%) is retained on farm post-harvest by pumping to another production pond. The last 20% of water is pumped to specially constructed wetlands where aquatic plants remove nutrients prior to eventual discharge**
Land application	**Terrestrial plants (trees, grasses, etc.) are employed to utilize water and nutrients (conversion of point-source to non-point source)**

Treatment Alternative	Total Added Costs ($)	Total Reduced Returns ($)	Net Impact ($)
1. Retain in the same pond	0.00	0.00	3,284.60
2. Retain in different pond	2,594.40	0.00	361.74
3. Retain in holding basin	6,526.30	0.00	-3,570.16
4. Retain in converted pond	5,238.80	60,720.20	-36,862.58
5. Treat in holding basin	3,931.90	0.00	-3,931.90
6. Treat in converted pond	2,644.40	60,720.20	-37,224.32
7. Chemical treatment	31,200.00	0.00	-31,200.00
8. Passive treatment	0.00	213,682.02	-121,691.07
9. Artificial wetlands (100%)	18,078.90	0.00	-18,078.90
10. Artificial wetlands (20%)	5,691.30	0.00	-3,326.39
11. Land application (planted trees)	4,794.40	0.00	-4,794.40
12. Land application (existing trees)	4,694.40	0.00	-4,694.40

*Estimates based on partial-budget analysis of 72-acre commercial HSB farm

Conservation of Water via Water Retention

Treatment	Net Yield (kg/ha)	Harvest Wt. (kg)	Survival %	FCR
Drained	2,490±495	0.35±0.03	84.5±9.0	1.95±0.27
Undrained	2,476±204	0.36±0.03	85.3±6.2	1.80±0.11

* Three successive production cycles

There were no significant differences between treatments (P>0.05).

Land Application onto Terrestrial Plants

La Paz sturgeon project Lenoir Co., NC

Land Application onto Trees

City of Garner, NC wastewater treatment plant

Summary

- Water retention in the same production pond and land application are promising treatment alternatives to traditional practice of releasing water post-harvest
- These alternatives are not yet practiced on commercial farms and need further evaluation (yellow grubs, growth and survival of plants).
- Use of cost-share funds (NRCS) to offset installation of water conservation methods (including land application) not factored into this analysis but would reduce negative impact of alternatives (horizontal pumping and land application.