Intensive Tank Culture of Tilapia with a Suspended, Bacterial-Based, Treatment Process

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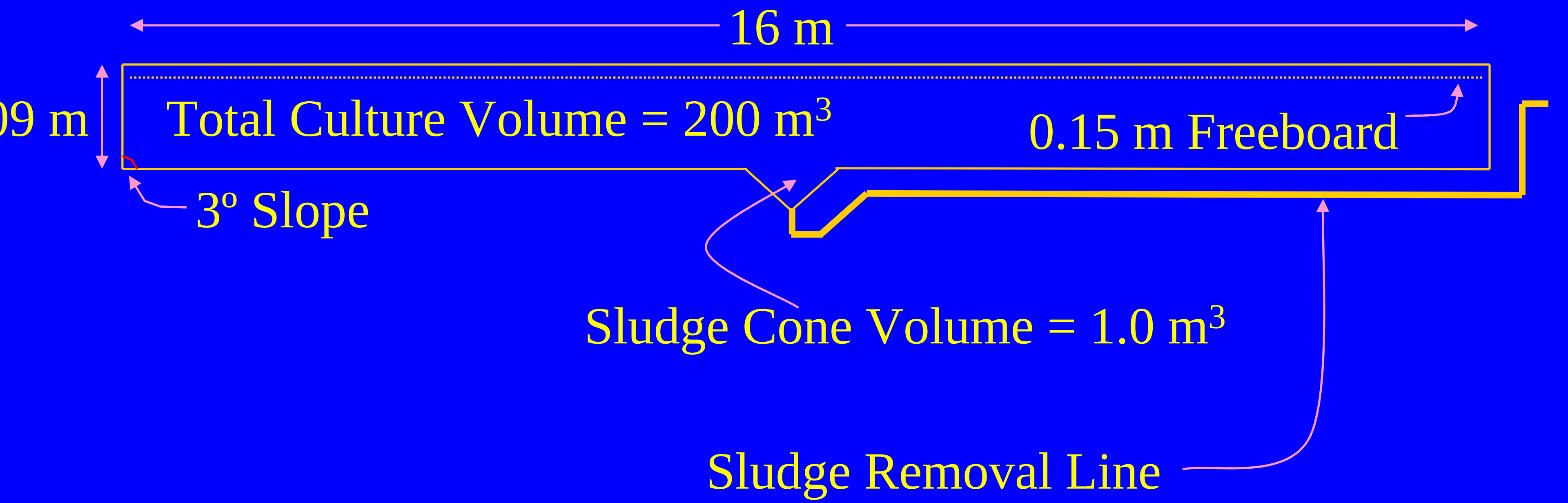
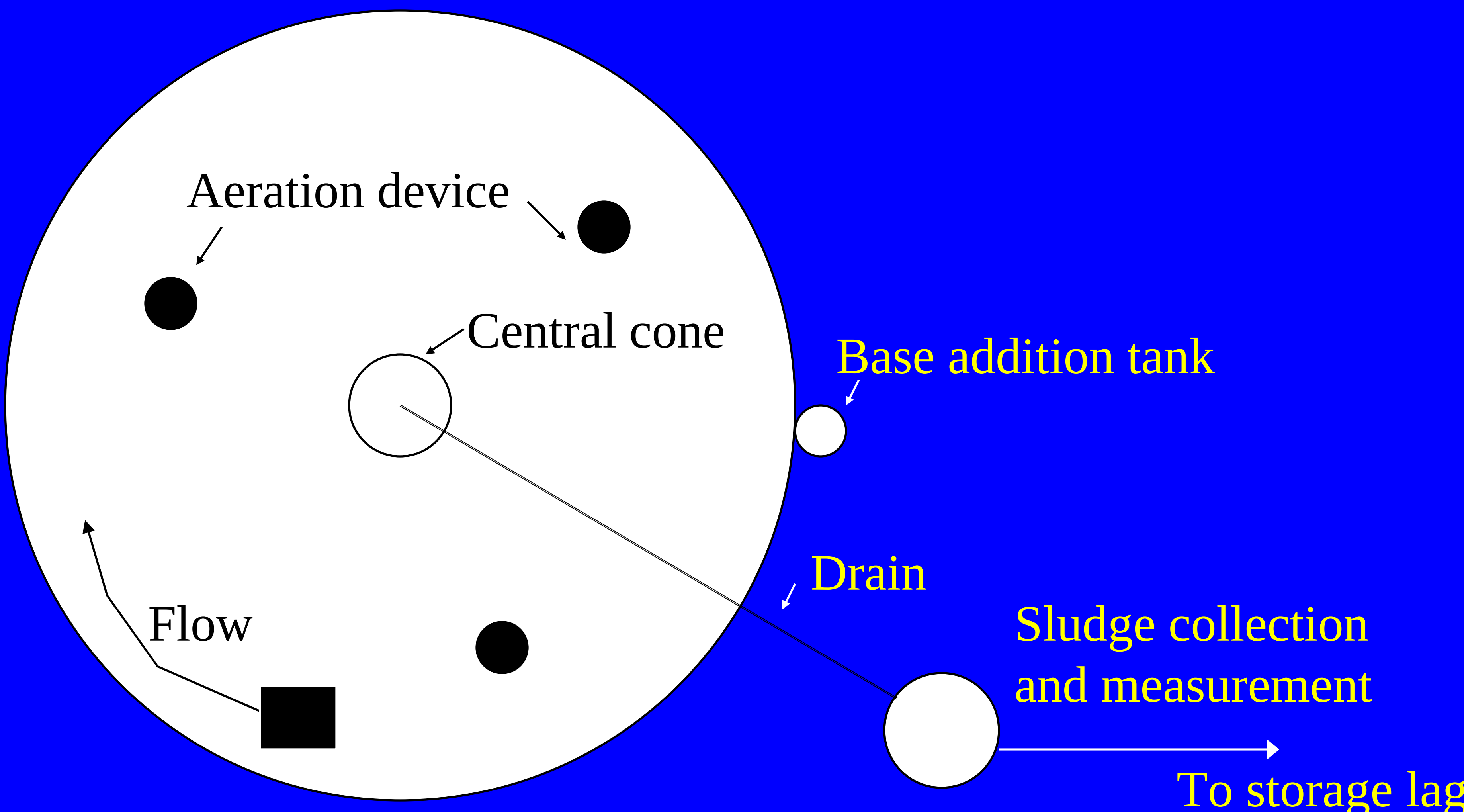
Tank Dimensions and Characteristics

- Size: 200 m^3, 16 m diameter, 1 m mean water depth
- Block wall and 30 mil HDPE liner
- Surface area: 200 m^2 (0.02 ha or 1/20 acre)
- Bottom: 3^o slope to center
- Center clarifier: 1 m^3, 45^o slope, fiberglass, 10-cm drain
- Outside standpipe for solids removal
- Aeration: three ¾-hp vertical-lift aerators
- Water movement: one ¾-hp vertical-lift aerator tilted horizontally

Tank Design


16 m
09 m
Total Culture Volume = 200 m³
0.15 m Freeboard
3° Slope
Sludge Cone Volume = 1.0 m³
Sludge Removal Line

Tank Plan View



Treatment Processes and Production Management

Continuous aeration

Mixing to maintain suspension of bacterial floc

Nitrification in water column

Settleable solid waste removal once daily

Feed twice daily with floating feed (32% protein)

Feed *ad libitum* for 30 – 60 minutes

Monitor pH daily, maintain pH 7.5 with $Ca(OH)_2$

Add $CaCl_2$ to prevent nitrite toxicity


kasco

Production

al	Stocking Rate (#/m^3)	Initial Size (g)	Final Size (g)	Culture Period (d)	Growth Rate (g/d)	Final Biomass (kg/m^3)	FCR	Surv (%
	20	214	912	175	4.0	14.4	2.2	78
	25	73.6	678	201	3.0	13.7	1.9	81

Major Inputs and Outputs

Trial	Initial Water (m^3)	Makeup Water (L/day)	Sludge (L/d)	Feed (kg/day)	Base Addition (kg/day)	Electrici (kWh/da
1	200	880	470	25.4	1.5	52.8
2	200	401	366	23.0	1.7	52.8

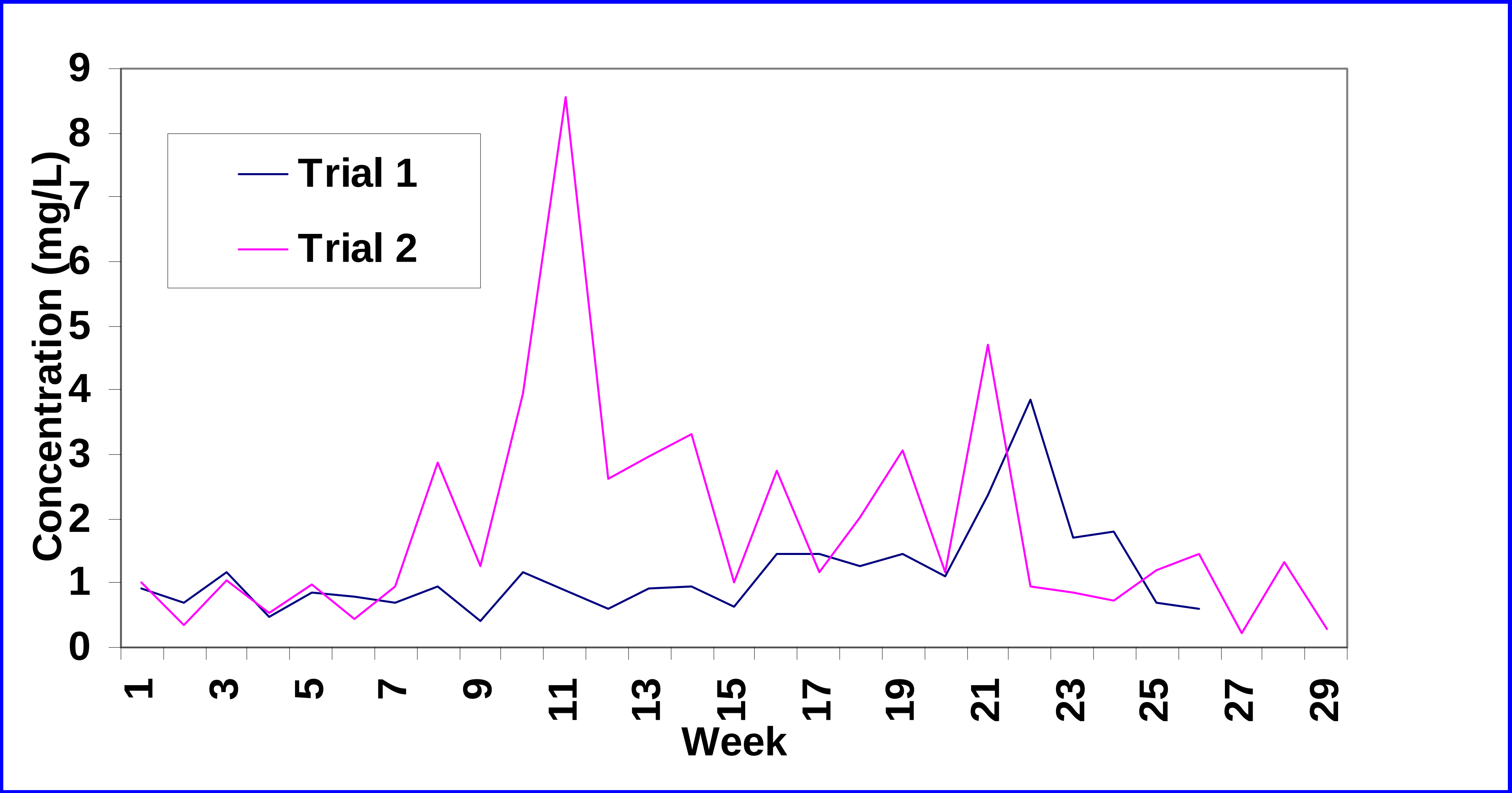
Water Quality

Parameter (mg/L)	Trial 1 Mean	Trial 2 Mean
DO	5.5	7.9
Water Temp (C)	26.8	28.5
NH_3-N	1.2	1.8
NO_2-N	1.5	2.7
pH	7.8	7.8
Total Alkalinity	224	204

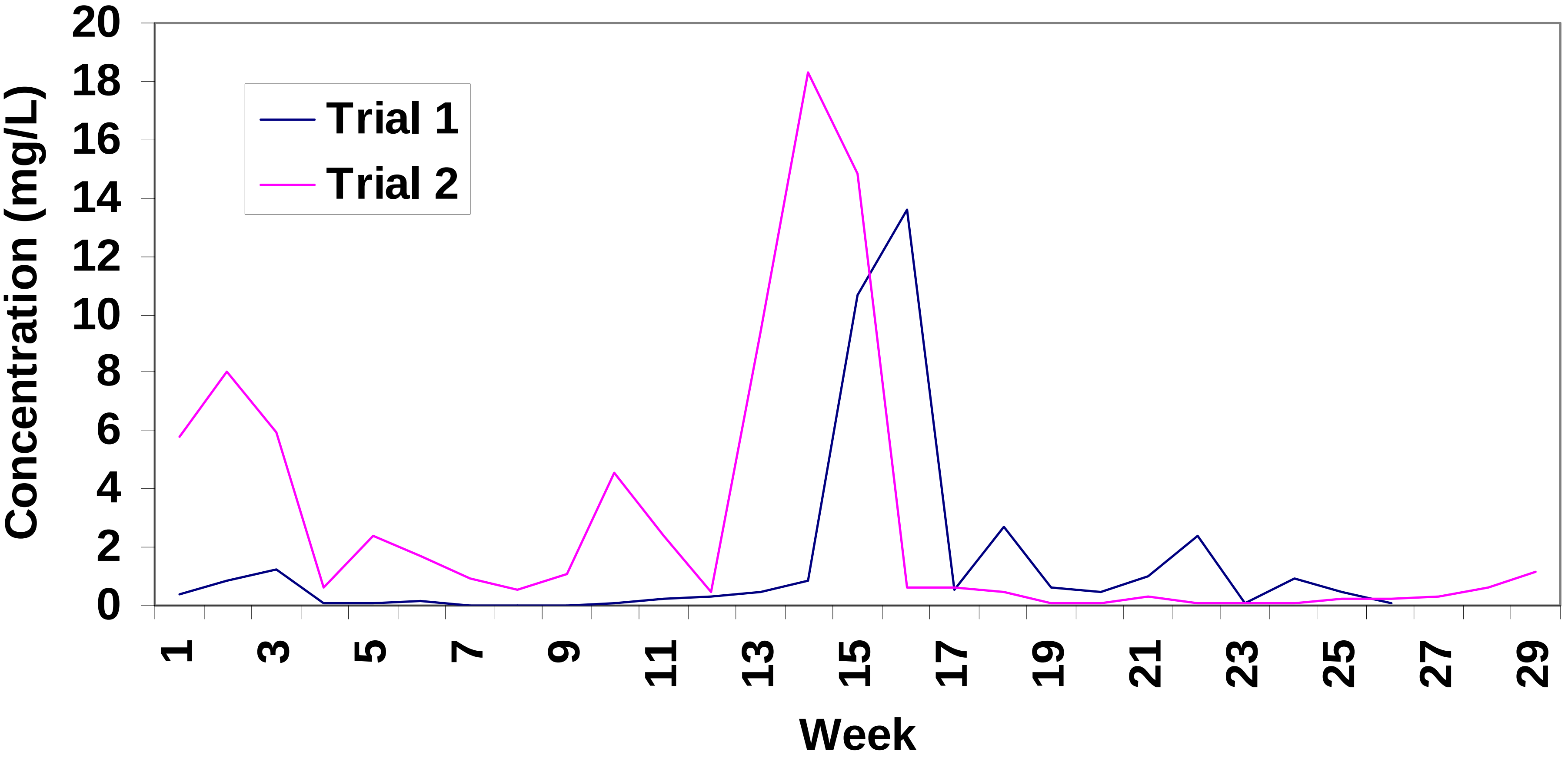
Water Quality

Parameter (mg/L)	Trial 1 Mean	Trial 2 Mean
Chlorophyll *a* (ug/L)	1895	924
COD	353	363
Settleable solids (ml/L)	29	48
TSS	476	855
Ortho-Phosphate	16.9	19.2
Cl	301	317

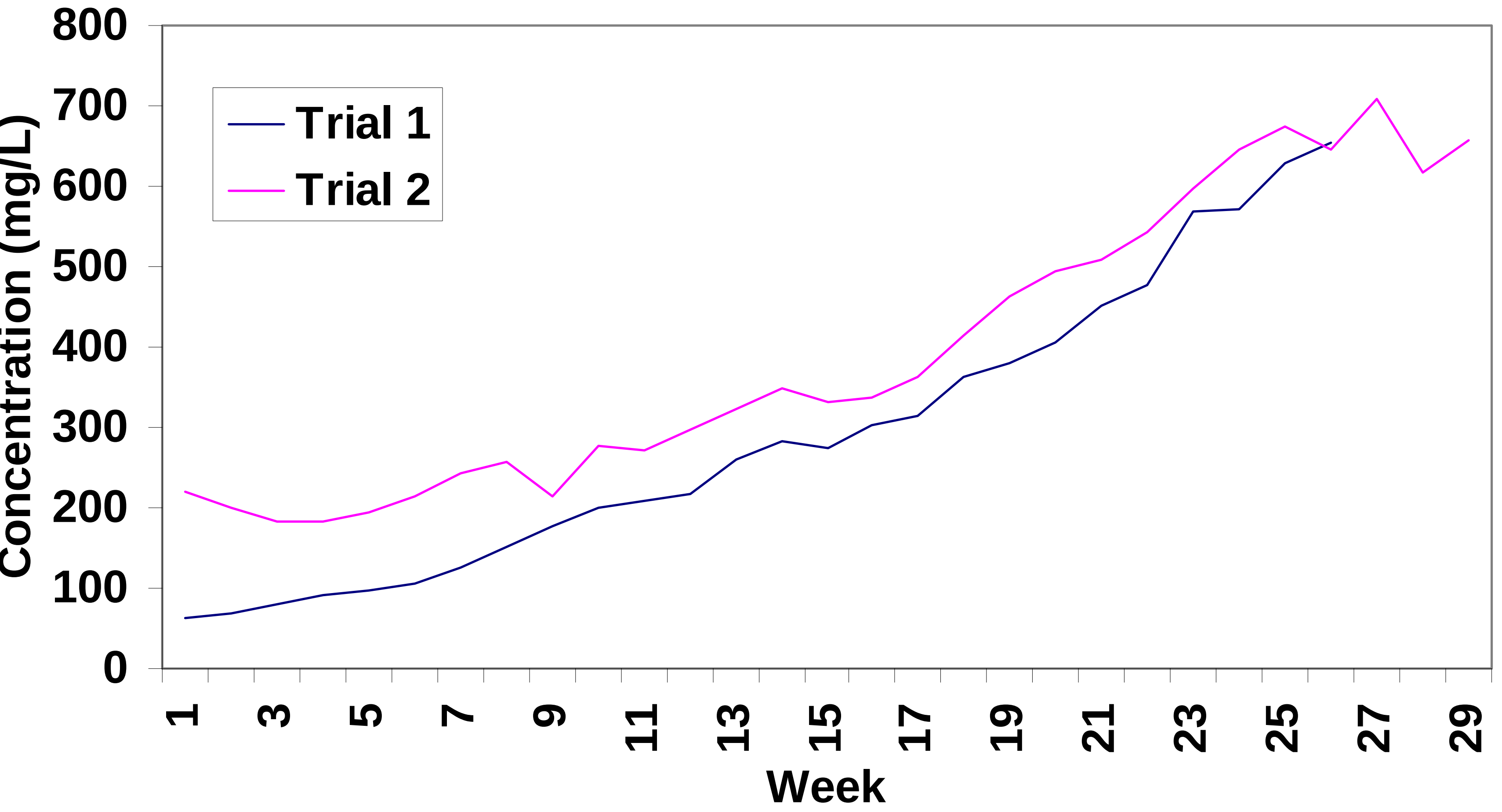
Total Ammonia Nitrogen – Trial 1 & 2



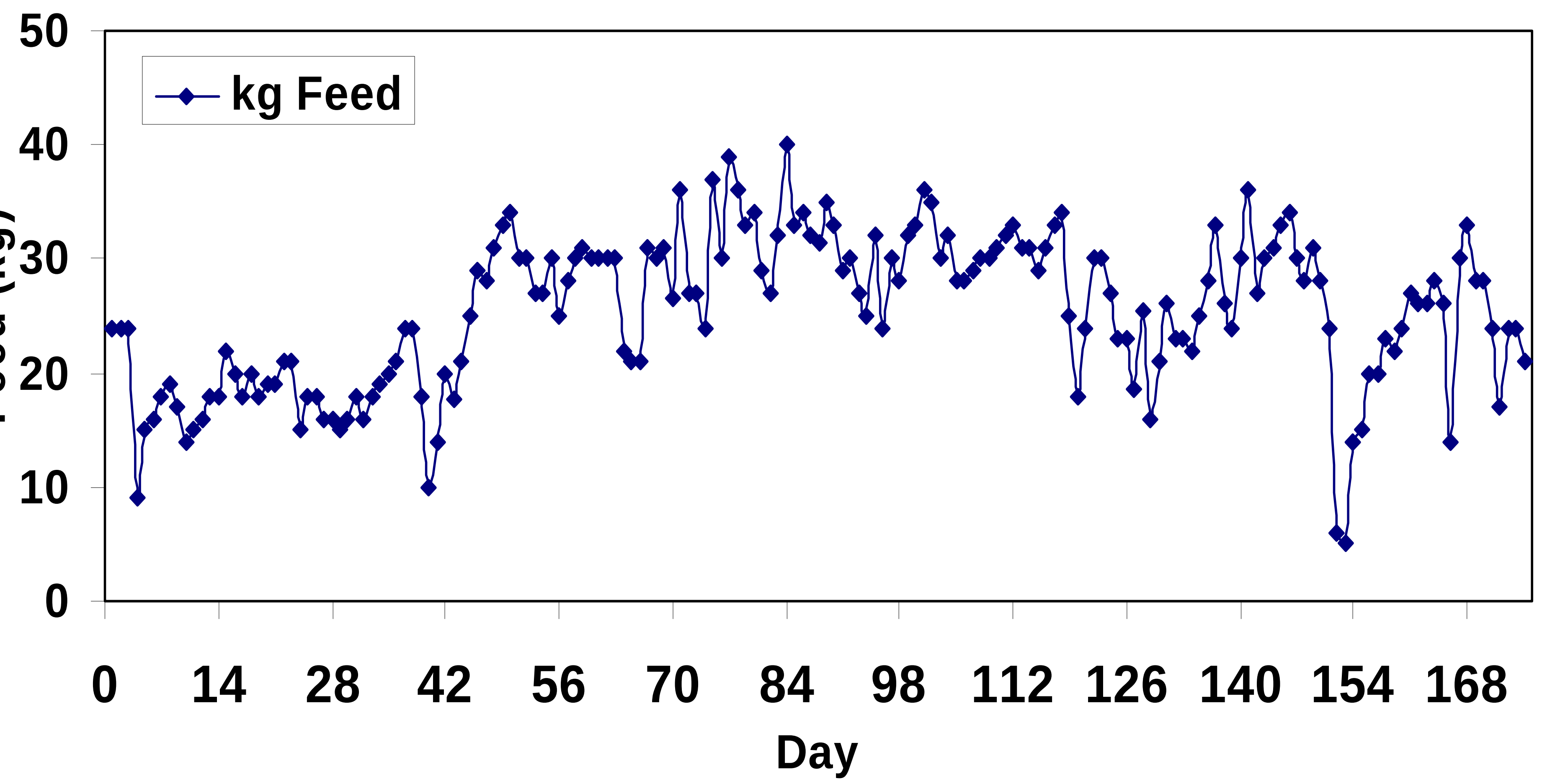
Nitrite Nitrogen – Trial 1 & 2



Nitrate Nitrogen – Trial 1 & 2

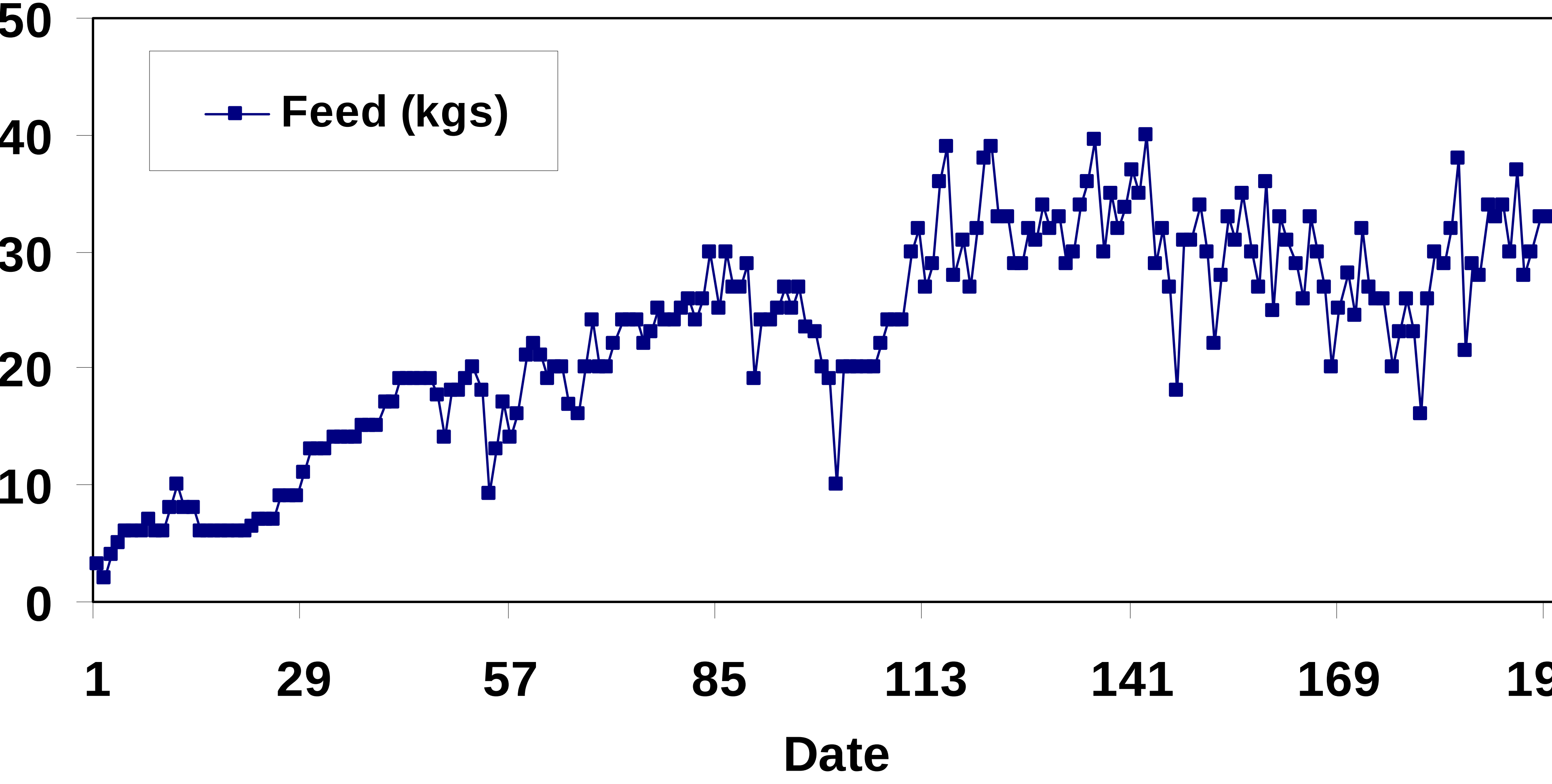


Feed – Trial 1

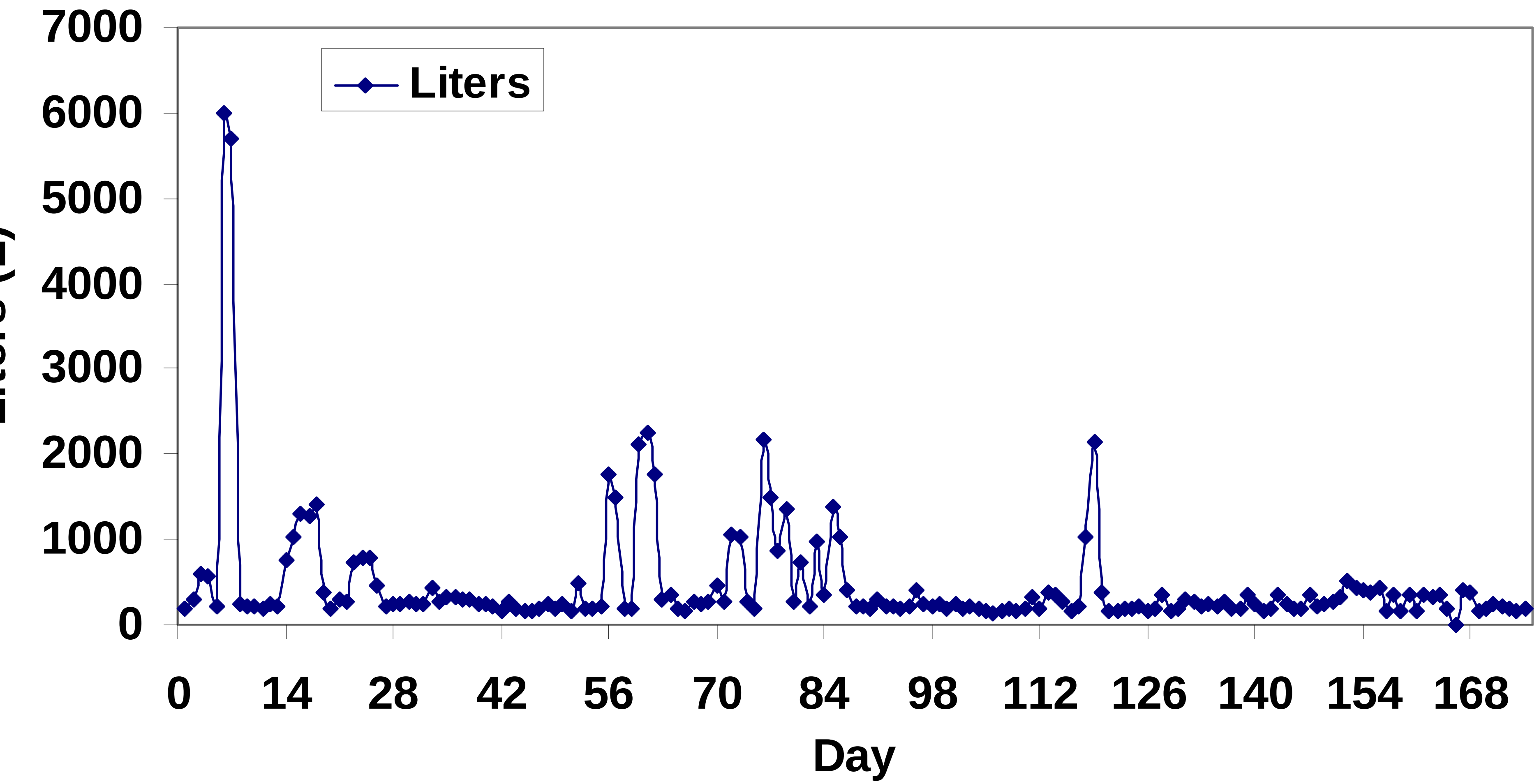


kg Feed
50
40
30
20
10
0
0
14
28
42
56
70
84
98
112
126
140
154
168
Day

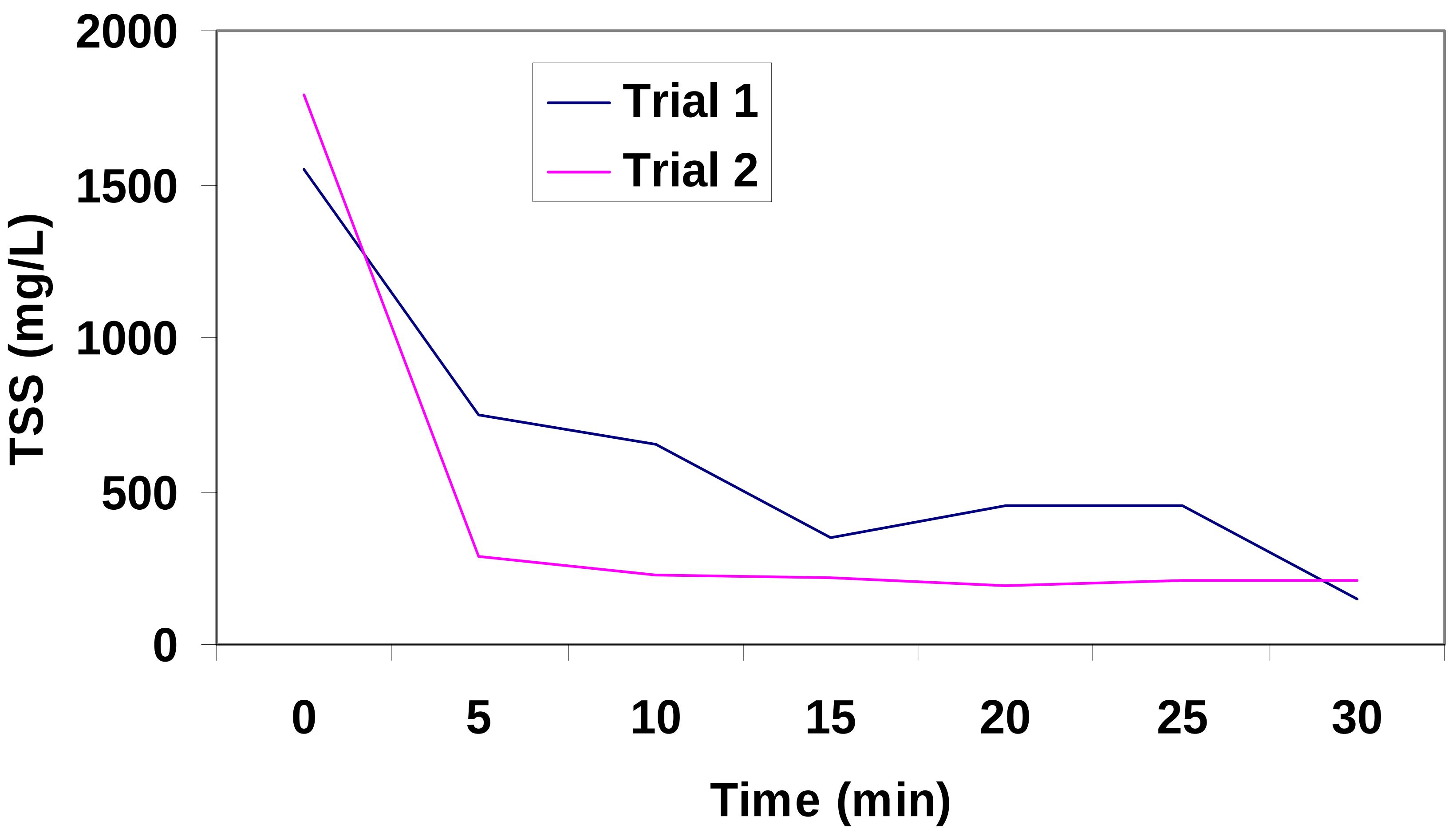
Feed – Trial 2



Sludge – Trial 1



Total Suspended Solids Settling Curve



Clarifier Efficiency

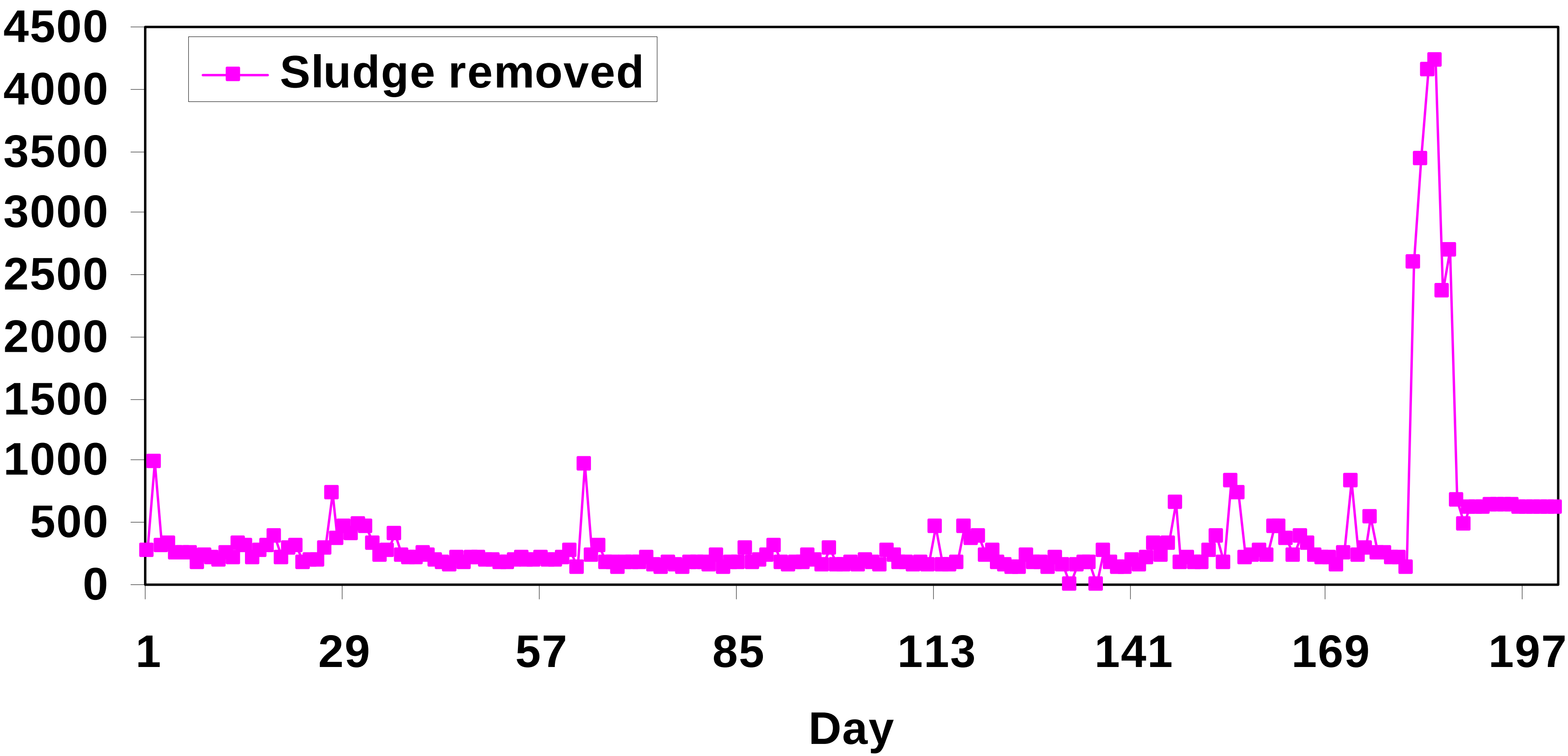
Clarifier effluent
Culture tank water
Sludge from clarifier

After 10 minutes of settling

External Clarifier Efficiency

Influent TSS (mg/L)	1178
Effluent TSS (mg/L)	136
Sludge TSS (mg/L)	26,230
Removal (%)	88.5

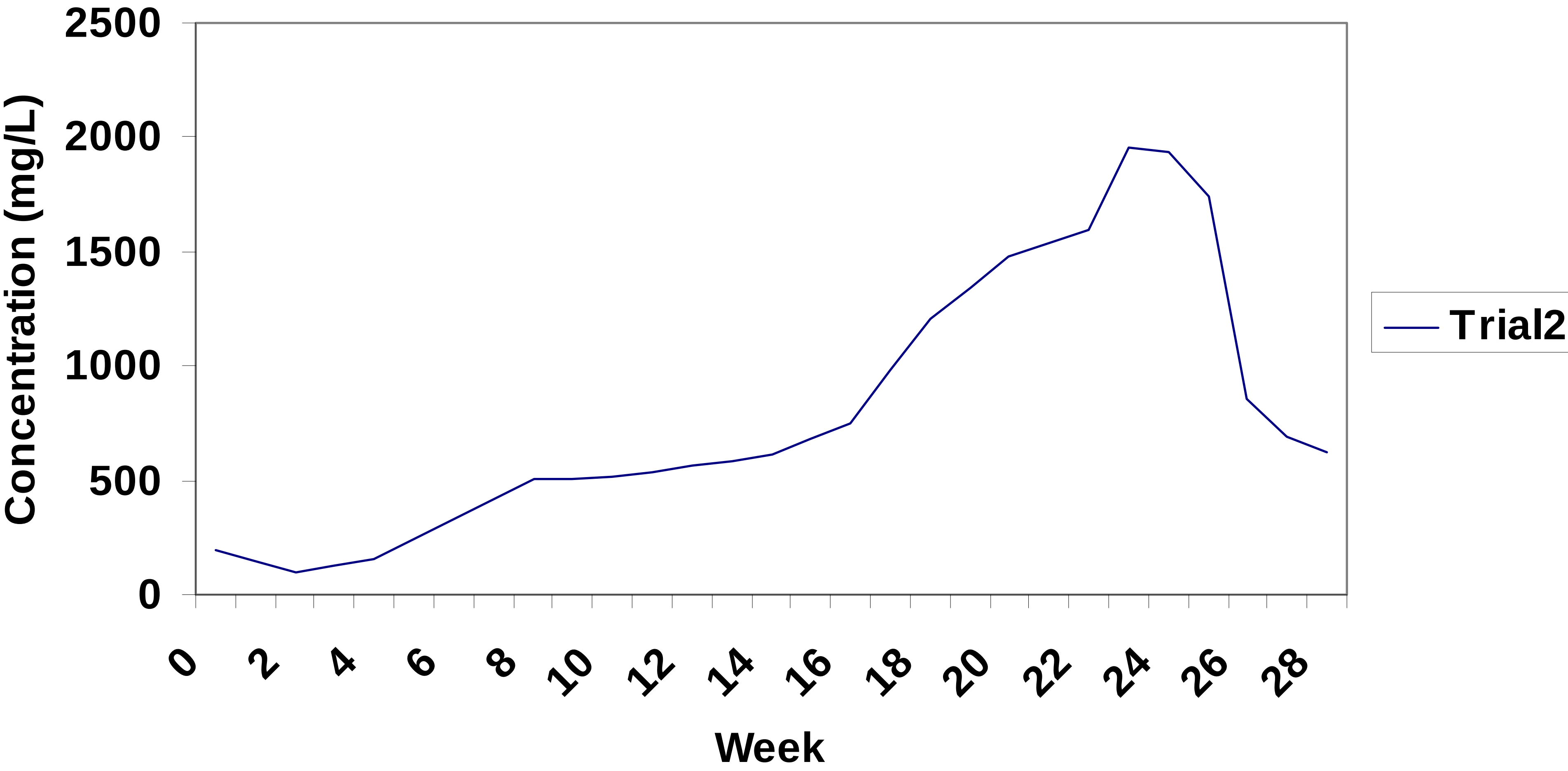
Sludge – Trial 2



Sludge Removal

	Day 1-6	Day 7-21
Clarifier		
Total (kg)	175.5	184.4
Mean (kg/d)	29.2	12.3
Cone		
Total (kg)	5.9	4.8
Mean (kg/d)	1.0	0.3
Percentage		
Clarifier (%)	96.7	97.5
Cone (%)	3.3	2.5

Total Suspended Solids



Advantages of Bacterial-Based Tank Culture

- Simple management
- Low water requirements
- Seepage problems avoided
- Not affected by algal die-offs
- Algae and bacteria supplement tilapia diet
- No off-flavor detected
- Production ~ 30 times higher than ponds
- No recruitment problem
- Wastewater used to irrigate and fertilize field crops

Disadvantages of Bacterial-Based Tank Culture

- Feeding response fluctuates
- Suspended solids nitrification less stable than fixed-film nitrification
- High energy input

Key Results

Total tilapia production:

2,740 – 2,880 kg in a 0.02-ha tank

Daily makeup water averaged 0.20 - 0.43% of total volume:

$0.40\text{-}0.86\ m^3$

Recovered approximately 0.38 m^3 of water daily for irrigation and fertilization of field crops.

Future Research

Scale-up (1,000 m^2?, 4,000 m^2?)

Aeration requirement

Size and number of clarifiers

Species

Economics

Conclusions

- A simple tank construction method was developed
- The tank was nearly 30 times more productive than a standard earthen pond (13.7 and 14.4 vs. 0.5 kg/m^3)
- External clarifier simplifies construction, improves solids removal and water quality and may increase production
- This production technology conserves water and recovers solids and nutrients