9. Wissenschaftstagung Ökologischer Landbau.
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# Analysis of Soil Nutrients and Organic Matter in organic and conventional Marine Shrimp ponds at Guaraíra Lagoon, Rio Grande do Norte State, Brazil

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**Keywords:** marine shrimp farm, nutrient management

**Abstract:**
*This study compares the soil nutrients from an intensive and semi-intensive and an organic marine shrimp farm located in Guaraíra Lagoon, Rio Grande do Norte State, Brazil. The organic system showed significant lower levels of organic matter and phosphorus when compared to the two conventional systems. The results indicate that the conventional systems release large amount of nutrients into the environment and the organic system is a sink of nutrients from the Guaraira Lagoon ecosystem.*

## Introduction and Objectives:

Shrimp marine farming is a growing industry in Brazil. Most of the farms are located in Rio Grande do Norte State, which produces 40.6% of the total national production. Guaraíra Lagoon is located at Rio Grande do Norte State and is surrounded by a large number of conventional marine shrimp farms. More recently a former local conventional farm was converted into an organic marine shrimp farm. The local conventional marine shrimp farms use compound feed in order to enhance shrimp growth while in the local organic farm only the natural food is used. Several authors (AVNIMELECH & RITVO 2003, AVNIMELECH & LACHER 1979) state that there is an association between the input of feed in aquaculture ponds and the accumulation of organic matter, phosphorus, and nitrogen in the soil of the pond bottom.
This study aims to compare soil characteristics from intensive, semi-intensive, and organic marine shrimp ponds located at Guaraira Lagoon.

## Methods:

### Area description:

The farms studied were situated at Guaraira Lagoon. The lagoon is located in the South of the eastern coast of Rio Grande do Norte State and has a volume of $2.4*10^6$ $m^3$ and covers approximately 325 $km^2$ (IDEMA 2005).

Tab. 1: General characterization of the marine shrimp ponds studied at Guaraíra Lagoon.

| | **Intensive farm** | **Semi-intensive farm** | **Organic farm** |
|---|---|---|---|
| Cultured species | *Litopenaeus vannamei* | *L. vannamei* | *L. vannamei* *Crassostrea gigas* |
| Number of cycles/yr | 1 | 1 | 3.5 |
| Use of aerators | Yes | Yes | No |
| Use of nursery ponds | No | No | Yes |
| Stocking density/$m^2$ in the grow-out ponds | 65 PL10 | 30 PL10 | 2.6 shrimps* |
| Final weight (g) | 9.8 | 9.2 | 9.9 |
| Yield per pond (kg/ha/yr) | 2 510 | 2 060 | 650 |

Source: direct interview.
* Stocking density from the grow-out ponds. In the organic system, the post-larvae are stocked in nursery ponds prior to the transfer to the grow-out ponds with an average weight of 2.2 g.

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**Soil analysis:**
Samples of soil were collected from inside the organic, semi-intensive and intensive grow-out ponds during one rearing cycle at the intensive and semi-intensive pond and two consecutive rearing cycles in the organic pond. The samples were analysed for phosphorus, nitrogen, and organic matter according to the EMBRAPA (1997). The data was analysed in a two way ANOVA with repeated measures on one factor. Duncan´s multiple range test was used to compare the averages.

**Results and Discussion:**
Fig. 1 shows that the soil from the intensive farm has significantly higher average values of organic matter (87.8 g/kg). During the first rearing cycle the organic farm system had a higher organic matter content (73.1 g/kg) compared to the semi-intensive system (66.6 g/kg).
The organic system can be comparable to the extensive system, as it does not use artificial feed and large amount of fertilizer to improve the yields. The organic system is a sink of organic matter in the Guaraira Lagoon ecosystem and it uses organic matter from the environment to raise the shrimps. According to BOYD (1992), influent water poses a major source of sediment in extensive systems.

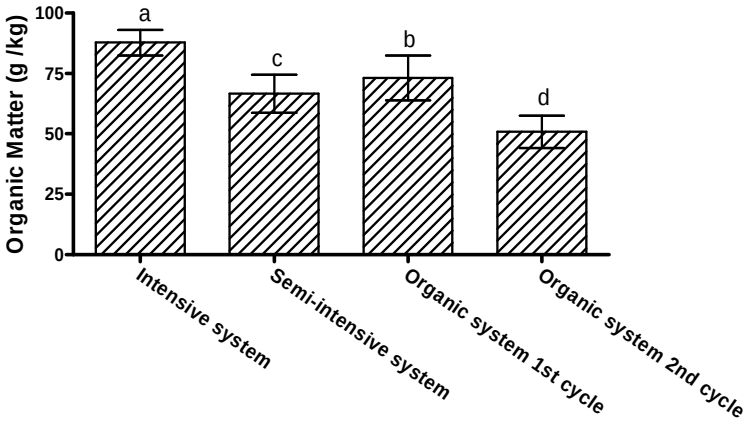


Fig. 1: Content of organic matter (g/kg) in the soil of the intensive, semi-intensive and organic marine shrimp pond. Average ±1 SD. Different letters above the columns indicate significant differences at $p<0.05$ according to Duncan´s test.

Fig. 2 shows significantly higher concentrations of phosphorus in the soil from the intensive system (282.7 mg/kg) followed by the semi-intensive system (103.9 mg/kg). The organic system showed the lowest concentrations with 33.7 (mg/kg) during the wet season and 25.5 (mg/kg) during the dry season. Fig. 3 shows a significant difference in nitrogen concentration in the soil from the intensive system (400 mg/kg) compared to the semi-intensive system (280 mg/kg) and the organic system in the first (240 mg/kg) and second (230 mg/kg) rearing cycle.

Tab.2. Estimated values for organic matter inputs and outputs from an intensive, semi-intensive and organic marine shrimp farm located at Guaraíra Lagoon.

| | **Intensive pond** | **Semi-intensive pond** | **Organic pond 1st cycle-rainy season** | **Organic pond 2nd cycle-dry season** |
|---|---|---|---|---|
| **Organic matter in the feed input (kg/ha)** | 5 400 | 3 632 | - | - |
| **Organic matter in the fertilization and other organic inputs (kg/ha)** | 30 | 19 | 4.8 | 1.9 |
| **Estimate total organic matter input (kg/ha)** | 5 430 | 3 651 | 4.8 | 1.9 |
| **Organic matter content in the harvest (kg/ha)** | 500 | 441 | 37.2 | 42.2 |
| **Estimated ratio organic matter input/organic matter output** | 10.8 | 8.3 | 0.12 | 0.04 |

Source: direct sampling and records from the studied farms.

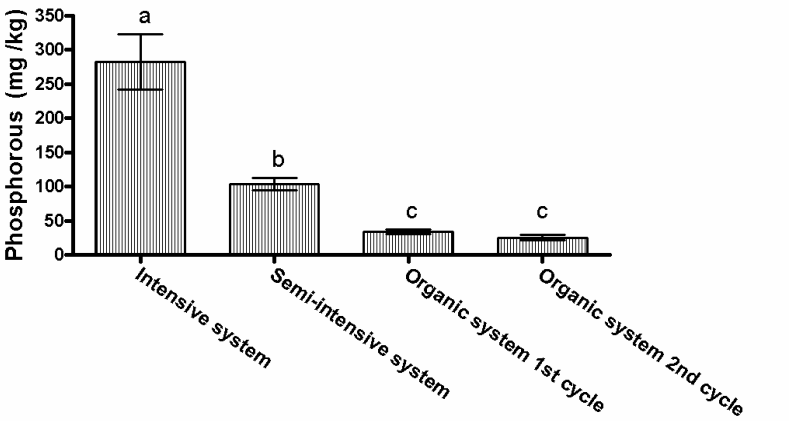


Fig. 2: Phosphorus content (mg/kg) in the soil of the intensive, semi-intensive and organic marine shrimp pond. Average ±1 SD. Different letters above the columns indicate significant differences at *p<0.05* according to Duncan´s test.

MARTIN et al (1998) showed that up to 38% of the total nitrogen input accumulates in the sediments of a shrimp pond. About 63% of the added phosphorus was reported to accumulate in the sediment of a semi-intensive shrimp farm (PAEZ-OSUNA et al. 1997).

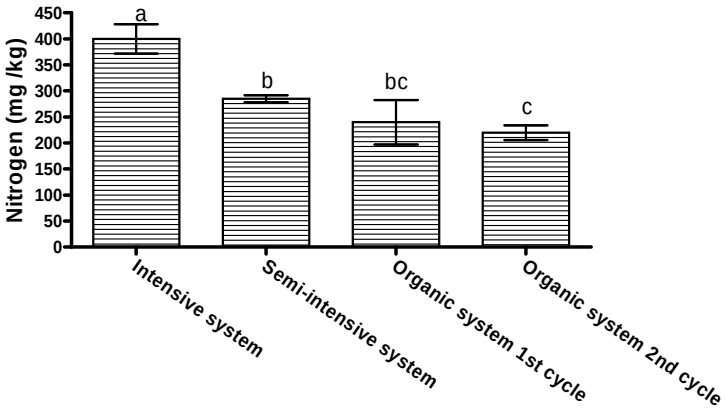


Fig. 3: Nitrogen content (mg/kg) in the soil of the intensive, semi-intensive and organic marine shrimp pond. Average ±1 SD. Different letters above the columns indicate significant differences at *p<0.05* according to Duncan´s test.

**Conclusions:**

The results of this study report lower concentrations of nutrients (N and P) and organic matter in the organic system. The environment is the main source of organic matter in the soil of the organic pond while in the conventional systems the feed is the main source of the organic matter content. The organic farming system is environmentally friendly but studies are required to evaluate the sustainability of the spread of the organic marine shrimp farms at Guaraira Lagoon.

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