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# Stocking density, Survival rate and Growth performance feed utilization and economic evaluation of *Litopenaeus vannamei* , in different cultured shrimp farms in Suez Canal Region

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## ABSTRACT

Two studies were conducted to evaluate growth performance, feed utilization, survival rate and the economic cost of white shrimp (*P*. vannamei) in Suez Canal region. The first study was conducted in Eldebba farm in western region of Port Said Governorate in collaboration with a private fish farm. The second study was conducted in Suez Canal Fish Farm. The pond was stocked with white shrimp (*P*. *vannamei*) at the rate of 70000 PL 26 / feddan in eldebba Farm. In Suez Canal Farm the ponds stocked with 150000 PL 26 / feddan white shrimp (*P*. *vannamei*) with average initial 0.002 g in both Farms. A good quality (38 % protein) commercial feed was provided. Growth performance, feed utilization, survival rate and comical evaluation were the best in Eldebba farm than Suez Canal farm.

It could be concluded that stocking white shrimp at density 70000 / feddan was the best in terms of growth performance, feed utilization, survival and economic evaluation under this experimental conditions.

**Key word:** *Litopenaeus vannamei*- Stocking density - Water quality - Growth performance- Feed utilization- Survival rate- Economic evaluation.

## Introduction

In Egypt, shrimp culture has a fluctuated progression. Shrimp culture in Egypt dates back to the early 1980s, where the first shrimp farm was established near Alexandria (**Sadek *et al*., 2002**). Although shrimp culture is profitable, but shrimp diseases is still one of the major problems. Shrimp's origin is from the eastern Pacific waters. In practice of shrimp culture, shrimp farmers often use their habit and experience, including the harvest time (**Nour *et al*., 2004).** Shrimp farming is one of the majority gainful and fast-growing segments of the aquaculture industry (**Tacon, 2002**). Due to the economic importance of penaeid shrimp worldwide, particularly in aquaculture, a huge attempt to know the enlargement ecology of Penaeus spp. has been made in recent years. This includes studies on the influence of environmental factors such as temperature (**López- Martínez *et al*., 2003**)**,** salinity (**Lemos *et al*., 2001**) on shrimp growth**.**

*Litopenaeus vannamei* is the most important penaeid shrimp species farmed earth (**Alcivar Warren *et al.,* 2007**), which is considered the most widely cultured shrimp in the western hemisphere were the species contributes to regarding 90% of the total shrimp culture, as it represents the most commonly cultured shrimp in central and south American countries (**Wurmann *et al.,* 2004**).

Aquaculture can be performed within semi-intensive and intensive systems, which both cultivation systems depends on one characteristic which is the stocking density (**Neal *et al.,* 2010**). An increase in farmed shrimp production can be achieved by increasing stocking density but this requires an increase in feed input which may degrade water quality. The optimal stocking density varies depending on the farm system and management practices. Stocking densities range 1-3 shrimp / $m^2$ in extensive, 10-50 shrimp/$m^2$ in semi-intensive, and up to 160 shrimp/$m^2$ in intensive farming systems. Water exchange minimizes eutrophication without requiring additional aeration. Water exchange is required for intensive cultures to prevent phytoplankton blooms and agglomeration of toxic metabolites not assimilated by phytoplankton. Mechanical aeration (mainly at night) minimizes circadian changes of dissolved oxygen (**Mena-Herrera *et al.,* 2006)**. A balanced food supplement improves growth and together with aeration, is considered as the most commonly factors affected intensive culture. As shrimp aquaculture technology advances, greater efficiency with respect to water conditions, survival, growth, and yield is required. Farm yields have increased markedly due to technological advances. Density is a parameter that can affect the growth and survival rate of cultured species (**Gaber *et al.*, 2012)** stated that the density and performance of penaeid shrimp have positive correlation. The optimum density of the penaeid shrimp has been reported even though it varies greatly, such as 9-12 ind m-2 for *Penaeus semisulcatus* **(Zaki *et al*., 2004)**, 10 ind $m^{-2}$ for *P. indicus* (**Sivanandavel and Soundarapandian 2010**), 10 ind $m^{-2}$ for *Fenneropenaeus merguiensis* (**Anand *et al.*, 2014**), and 10-15 ind $m^{-2}$ for P. monodon (**Hossain *et al.*, 2013**). While *L. vannamei* has been widely reported although the density and culture systems used are very diverse **Gamal *et al.*, (2018).** When the post-larvae are grown in the hatchery till the juvenile stage and thereafter stocked in ponds, the survival rates could be expected to enhance compared to a system where the post-larvae are directly stocked in ponds (**Aquacop, 1984**). Several authors described concerning the growth in shrimp culture systems based on stocking density (**Maguire and Leedow 1983**) and some authors include reported an inverse relationship between growth and stocking density (**Daniels *et al.*, 1995**). The objective of this work was to evaluate the water quality parameters, survival, growth performance, feed utilization and economic production of *L. vannamei* cultures in the different aquaculture shrimp farms with different stocking densities and different hector levels.

## Materials and Methods

### Study Site and Experimental Units

Two studies were conducted to evaluate growth performance, feed utilization, survival and the economic production of white shrimp (*P. vannamei*) in Suez Canal region. The first study was conducted in Eldebba farm in western region of Port Said Governorate collaboration with a private fish farm, with a total pond area of one feddan / pond. The water depth of about 1.25 between May to august 2020. The water is a brackish due to the mixing of Mediterranean Sea water and water from Lake Manzala. Productivity was based on the natural productivity of the ponds hence the experimental ponds were kept free from any shading throughout the day.

### Pond preparation

Pond preparation procedures were briefly, which the ponds were dried for one month and the top soil was scraped and removed, ploughed and filled with pre-chlorinated (12 ppm available chlorine) water from a reservoir pond. Aerators were deployed in each pond according to the SD of the pond at the rate of one paddle wheel aerator (1 HP motor) for 1 lakh PL.

**Water quality**

In the first study water exchange rate was one third of pond's water every three days, while in the second study water exchange rate was half of the pond's water every four days. Sampling for physico-chemical parameters was done once a week between 09.00 and 12:00 h from specific points of the pond at a depth of 20-30 cm below the surface.

A mercury thermometer was used to measure water temperature (°C), while salinity (psu) was measured with a salinometer. Digital electronic meters (Model YSI-58, USA and Jenway Model-3020) were used to measure Dissolved Oxygen (DO) ($mg^{-1}$) and pH on site, respectively, according to the standard procedures and methods as defined in APHA (1998). Nitrite ($NO_2$) and ammonia nitrogen ($NH_3$ -N) levels were analyzed spectrophotometrically at 10 days intervals (Thermo Spectra, USA) following standard procedures (**APHA**, **1998**)

**White shrimp Stocking and Sampling**

The post larvae of white shrimp (*P. vannamei*) were obtained from private white shrimp hatchery in April. The pond was stocked with white shrimp (*P. vannamei*) at the rate of 70000 PL 26 / feddan in Eldebba Port-Saied Governorate, while In Suez Canal ponds stocked with 150000 PL 17 / feddan white shrimp (*P. vannamei*) with average initial 0.002 g in both farms.

In the first study four random samples of the shrimp were taken during the study period including the initial sample. Weight of the shrimps was measured using a top loading balance with an accuracy of 0.1 g. At the end of experiment, the pond was harvested and a complete census of all white shrimp (*P. vannamei*) was done, where all the harvested individuals were counted; weighed and all measurements was taken. To ensure complete harvest, the white shrimp (*P. vannamei*) were harvested initially by netting and any remaining individuals harvested by complete draining of the earthen ponds and hand picking any white shrimp (*P. vannamei*) in the ponds. Total production, survival rate and final harvest size in each pond were assessed at the time of harvest 0.1 g.

**Feeding white shrimp (*P. vannamei*)**

A good quality (38 % protein) commercial feed from Skretting Egypt Company (Table 1) was provided 3 times a day (06.00 hrs, 11.00 hrs, 17.00 hrs,) by broadcasting from a boat as per the feeding schedule given by the feed manufacturer. Check trays were used to monitor feed consumption after 2 h of feed application in Eldebba and Suez Canal farm. Supplied in feeding trays (36 cm in diameter) used for adjusting the daily food ration according to the apparent consumption observed on the feeding trays (**Clifford, 1997**).

**Table (1). Proximate composition (% dry matter)**

| Items | % |
|---|---|
| Moisture | 7.45 |
| Crude protein | 37.92 |
| Crude lipid | 6.5 |
| Ash | 9.7 |
| NFE | 45.88 |
| Gross energy | 440.65 |

Based on 5.1, 9.1 and 4.1 for protein, lipid and carbohydrate respectively **(NRC, 1993)**

**Growth Performance Parameters**

At the end of the experimental period , the following growth and feed utilization indices were calculate : weight gain (**WG)** , Average daily gain **(ADG)** specific growth rate **(SGR)** , feed conversion ratio **(FCR)** , feed efficiency ratio **(FER)** and protein efficiency ratio **(PER**) using the following formulas :

Weight gain **(WG)** = final average weight ($W_2$) g – initial average weight ($W_1$) g

Averag daily gain **(ADG)** = ($W_2$ –$W_1$) / T

Where $\mathbf{W_1}$ = the initial live body weight (g), & $\mathbf{W_2}$ = the final live body weight (g)

T = the time in days

Specific growth rate **(SGR)** = (ln $W_2$ – ln $W_1$) / T * 100

**ln** = natural logharetm & **T** = feeding period (days).

**Feed conversion ratio (FCR)** = Dry weight of feed intake (g) /wet weight gain of fish (g).

Protein efficiency ratio **(PER)** = weight gain by fish / protein intake .

Where protein intake = protein (%) in feed * total weight of diet consumed / 100

Total weight at stocking Kg / feddan = No. of shrimp stocked X Average weight at stocked

Total weight at Harvest Kg/feddan = No. of shrimp at harvest X Average weight at harvest

Net Production = Total weight at Harvest Kg/feddan - Total weight at stocking Kg/feddan

The feed conversion ratio (FCR) is expressed as the proportion of dry food fed required per unit live weight gain of fish

**Survival rates (%)**

Survival rates (%) were estimated as: No. of white shrimp harvested / No. of white shrimp stocked *100. Net production (kg feddan$^{-1}$) was calculated by deducting the biomass stocked from the biomass harvested.

The mean fish weight (g) was determined in terms of gain in weight:

GW = $(W_2-W_1)/W_1$x100

Where,

**Economic Analysis Methodology**

Fish production information

- White shrimp costs and quantities
- Feeding source, costs and quantities
- Pond aeration
- Labor
- Rent
- Shrimp production

PL cost = No. X price of each

Feed cost = amount of feed X price

Total production (kg /feddan) = weight of white shrimp No of at Harvest X average body weight

Total income LE feddan = Total production (kg /feddanX price of Kg

Net return LE feddan = Total income LE feddan- Total cost

A simple economic analysis was performed to estimate the profitability from this experiment. Total investment costs were calculated and the net revenue was determined by the difference between the gross revenue and the total investment costs. This analysis was based on farm gate prices of meager and current local market prices expressed in Egyptian LE.

### Statistical Analysis

Statistical analysis (paired t- test) was performed using the statistical software SPSS version 16. one-way ANOVA and any difference at 5 % level of significance. Kachigan (1991)

### Results and discussion

### Physico-chemical parameters of water

Many water quality parameters are interrelated and interact with each other (**Xu and Boyd, 2016**), and changes in one variable give insight about changes in a related variable. The physical parameters of water play vital role in the culture systems, maintenance of water quality was essential for optimum growth and survival of shrimp, which excess feeds, fecal matter and metabolites will exert a very influence on the water quality of shrimp farms (**Soundarapandian and Gunalan, 2008**). Physico-chemical parameters of water recorded in Eldebba and Suez Canal farm throughout the experimental period (120 days) are given in Table 2. All the parameters were within the favorable range required for white leg shrimp farming. Temperature fluctuated considerably in different seasons from 24ºC to 33ºC in Eldebba farm, while the range of temperature degrees in Suez canal farm was 24 - 32 ºC. (**Fast and Lannan 1992**) stated most excellent shrimp growth was experiential in a temperature ranged from 24-32ºC during the culture period the temperature was recorded between 25-30ºC. The pH of pond water is influenced by many factors, including pH of source water, acidity of bottom soil and shrimp culture inputs and biological activity. pH of the pond`s water was always within the acceptable range (8.4 – 9.00) for shrimp farming in Eldebba farm and (7.3 – 8.4) in Suez Canal farm, the results obtained from the present experiment was in consistent with **(Cohen *et al.*, 2005)**, who stated that, the proper value of pH for optimal performance in penaeids family is 7–9. (**Wang *et al.* 2004)** reported that, the pH 7.6 to 8.6 is favor for *L. vannamei* culture. The water quality measured throughout the experimental period 120 days was within the adequate range for the growth and survival of *Penaeus vannamei* (**Boyd, 2015**). The dissolved oxygen level in all treatments was above 5 mg $L^{-1}$, which is considered adequate for growth **(Garza de Yta *et al.*, 2004)**. Dissolved oxygen values were well above the minimum requirement (4.5 – 5.00 ppm) and 5-7 in Eldebbal and Suez Canal farm for shrimp farming (**Boyd and Arlow, 1992; Gicos, 1993**).

The salinity plays a major role in the water quality parameters. The *L. vannamei* though it is a uryhaline species it can tolerate the wide range of salinity between 2 and 45 ppt (**Samocha *et al*., 1999, Boyd *et al*.,**

**2015**).Table (2). Water parameters measured in experimental treatments for white shrimp *P. monodon* in Eldebba and Suez Canal farm throughout the experimental period (120 days).

| Prameters | Eldebba farm | Suez Canal farm |
|---|---|---|
| Temperature (°C) | 24 to 33 | 24-32 |
| Dissolved oxygen (mg/L) | 4.50-5.00 | 5-7 |
| pH | 8.4 to 9.0 | 7.3-8.4 |
| Salinity (ppt) | 36 to 44 ppt | 16-18 |
| Nitrite (mg/L) | 4.08 ± 1.6 | 3.2±4.10 |
| Nitrate (mg/L) | 4.77 ± 2.12 | 2.00±3.8 |
| $NH_3$ | 0.002 | 0.002 |
| Water productivity (Secchi disc) | 25 to 35 cm | 20-25 |

**V**ariation in salinity in the present study (36 - 44 ppt) and (16 – 18) for Eldebba and Suez Canal farms, respectively appears to play only minimal role in the growth and survival of *L. vannamei*, as (**Araneda *et al.*, 2008**) reported successful production of *L. vannamei* even in freshwater systems. **(Ponce-Palafox *et al.*, 1997)** reported the optimum salinity for *L. vannamei* cultivated in Mexico is 33-40‰. It is further explained that under certain conditions individual growth rates may be slowed down and also rapidly, depending on the area of culture such as aquaculture, brackish water and freshwater (low salinity). In addition, other factors such as water temperature, initial and final weight of individuals, and feed types also play an important role in the growth of organism. Nitrite–N level in water was well below the toxic limits reported for this species by **(Lin and Chen 2003)**. Ammonia-N was also within the tolerance limit reported by (**Lin and Chen 2001**). Altogether the water quality parameters were not varying substantially during the entire study period nullifying their influence on the performance of the species. Nitrite values (4.08 ± 1.6) and (3.2 ± 4.1) mg/L, Nitrate (4.77 ± 2.12) and (2 ± 3.8) mg / L and Secchi disc 25 to 35 cm and 25-30 for Eldebba and Suez Canal Farms in agreement with (**Boyd and Arlow, 1992)**.

**Growth Performances:**

Growth Performances parameters for both Eldebba and Suez Canal farms is shown in Table (3). The average initial body weight was 2.5 (g) for both farms. Generally the final body weight, weight gain, weight gain percentage, SGR and survival rate was significantly higher in Eldebba farm than Suez Canal farm. Similar results was obtained by (**Rosas *et al*., 2001**) who reported that, daily body increase of 0.04 and 0.13 g for 0.3 and 1.5 g sized groups of *L. vannamei*, respectively.(**Xia *et al*., 2010)** also reported a daily body increase of approximately 0.10 g in 6.2 g sized *L. vannamei*. Several authors have reported on the growth and survival of *L. vannamei* stocked in different salinity and densities in culture ponds (**Samocha, 1999**). As with survival rate, density also plays an important role in the growth of aquatic organisms (**Araneda *et al*., 2008**). While **(Gaber *et al*., 2012**) showed that, survival rate of 51.6 - 89 % with density of 5, 15 and 25 shrimp / $m^2$. **(Araneda *et al*., 2008**), reported a density of 90, 130 and 180 shrimp / $m^2$ with 76.1 %, 68.9 % and 65.9 % survival rate respectively, where the survival rate decreased with increasing of the density. (**Williams *et al*., 1996)** and **(Davis and Arnold 1998)** reported the growth rate of *L. vannamei* between 0.5 and 0.95 g $week^{-1}$ at high salinity at density of 107 and 100 $m^{-2}$. (**Samocha *et al*., 2004**) and (**Sowers and Tomasso, 2006)** get high growth rate of 1.17 and 1.23 g $week^{-1}$ in low salinity, (**Duy *et al*., 2012**) at a salinity of 20 - 23 ppt with a density of 10 shrimp $m^{-2}$ found in *Penaeus monodon* a lower growth rate than in 30 - 33 ppt salinity. The decreased of growth parameters and survival rates in shrimp farming and increased biomass production has also been reported (**Samocha *et al*., 2004**). This shows that interpersonal interactions have an effect on inhibiting growth and survival especially in increased density (**Arnold *et al*., 2006**). Although in the present study the cannibalism aspect has not been observed, often *L. vannamei* looks to prey on other shrimps that have died. When compared to the initial spread, the population density of shrimps decreased, greatly influencing the growth rate of the two density treatments by increasing the utilization of space (**Arnold *et al*., 2006**). More than a few authors have reported on the growth and survival of *L. vannamei* stock in different salinity and densities in culture ponds (**Samocha *et al*., 2004**). Finally our study revealed that the maximum production was obtained in pond with low stocking densities of high survival rates. An inverse relationship is known to exist between the stocking density and the survival and growth rates (**Emmerson and Andrews 1981**). Several authors described about the growth in shrimp culture systems based on stocking density (**Maguire and Leedow 1983**). In the present study was concluded that, good water quality parameter play a crucial role in shrimp culture ponds especially the low salinity (15 – 38 psu) which was optimum for shrimp. Significant ($P < 0.05$) differences were detected in the present study between the two nursery systems. In this connection, **Wyban *et al*. (1995)** found an increase in SGR values with smaller sizes of shrimp post-larvae, and a decrease from 4.5 - 5 % / day for small sizes (1.43 - 1.83 g / pce) to 0.62 - 1.1 % / day for bigger sizes (11.2 - 11.81 g / pce) with better results at 30 ºC compared with 27 and 23 ºC. **Ponce-Palafox *et al.* (1997)** found that, SGR % had ranged between 6 and 7.9 %. The average survival was 70 and 50 % for Eldebba and Suez Canal Farms. Similar results were obtained by (**Djumanto *et al.*, 2016**).

Table (3). Growth performance of white shrimp *P. monodon* in Eldebba and Suez Canal farm throughout the experimental period (120 days).

| Items | Eldebba farm | Suez Canal Farm |
|---|---|---|
| Initial weight g | 0.002 | 0.002 |
| Final weight gm | 40.0 | 35.20 |
| Wight gain gm | 39.99 | 35.19 |
| Wight gain gm/day | 0.33 | 0.29 |
| Wight gain % | 3999 | 1760 |
| SGR | 8.25 | 8.15 |
| Survival (%) | 70.00 | 50.00 |

**Feed utilization**

Table (4). Present Feed utilization of white shrimp *L. vannamei* in Eldebba and Suez Canal farms throughout the experimental period (120 days). FCR ( 1.7) was significantly (P<0.05) lower in white shrimp in Eldebba fish farm than in Suez Canal farm (1.89) while Feed efficiency was higher 0.59 in Eldebba fish farm than in Suez Canal farm 0.53 and PER value was higher (1.64) in Eldebba fish farm compared with the lower value (1.48) recorded in Suez Canal Fish Farm. **Gao *et al*. (2016)** reported that the optimum dietary protein level for *L. vannamei* (0.31 –6 g size) was 34 % when a semi-purified diet was used. (**Shahkar *et al.*, 2014)** reported that 33 % dietary protein level is optimum for an optimal growth of *L. vannamei* (approximately 1 – 11 g size) when fish meal was used as the main protein source. (**Apud *et al*. 1983**) reported FCR value of 1.5 and 2.5 for artificial feeds is acceptable. (**Wyban *et al*. 1995**) obtained that, FCR value of 1.8 when they nursed *L. vannamei* at a density of 50 pcs / $m^2$. However, all feed utilization data (FCR, FER and PER) in Eldebba farm was significantly higher than in Suez Canal Farm.

Table (4). Feed utilization of white shrimp *L. vannamei* in Eldebba and Suez Canal farm throughout the experimental period (120 days)

| Item | Elebba farm | Suez Canal farm |
|---|---|---|
| Feed intake gm | 67.93 | 66.41 |
| FCR (Feed conversion ratio) | 1.70 | 1.89 |
| FER (Feed Efficiency Ratio) | 0.59 | 0.53 |
| PER (Protein Efficiency Ratio) | 1.64 | 1.48 |
| Protein intake | 24.31 | 23.77 |

The optimum dietary protein level for maximum growth of *L. vannamei* can be affected by differences in shrimp size, stocking density, species of shrimp, culture system, and dietary protein sources. In the range of approximately 1 g sized shrimp, optimal growth was observed with 33 to 44 % crude protein in diets when krill meal was used as a main protein source, whereas (**Martinez-cordova *et al*. 2003)** found that, the optimal protein level was 25 % when *L. vannamei* (1 – 17 g size) was cultured in a pond system with three commercial diets containing 25, 35, and 40 % CP for 16 weeks. In a very high salinity condition (60 g / L), the optimum dietary protein level was estimated to 46.7 % when the *L. vannamei* (0.09 – 2.2 g size) was fed a semi-purified diet (**Sui *et al*., 2015**).

Generally, practical experimental diets have been used in this study covered most protein requirement for Penaeid shrimps. Most previous studies had used practical ingredients, i.e., fish meal and soybean meal as the main protein sources to increase or decrease the crude protein levels in the practical experimental diets. When fish meal is used as the main protein source to gradually increase the crude protein in diets for protein requirement study (**Xia *et al*. 2010 and Yun *et al*. 2016**), the result might be over-estimated because of unknown growth factors in fish meal.

**Economical evaluations**

Table (5). Present of the economical evaluation of white shrimp production in Eldebba and Suez Canal farm. The result reveald that the cost of feeds accounted for the largest proportion (52 and 41 %) of the total cost of fish production for Eldebba and Suez Canal farm. This is followed by cost of fixed input PL (26 and 43 %), rent (10 and 6 %), solar (5 and 3 %) and labor (5 and 5 %). This clearly shows that large fish farmers in the study area for purchase feeds spend amount of money. The fixed cost of production consists of cost of fixed assets such as feed, labour, rent and solar which accounted for 38000 and 58000 LE of total production cost for Eldebba and Suez Canal farms. This result is consistent with the finding of (**Mansaray *et al*., 2018**) from their studies on profitability on fish farming. Investments return LE / return LE cost 7.50 and 3.9 for Eldebba and Suez Canal Farms. White shrimp culture gives higher returns in money and food than rising of cattle, sheep and poultry (**Tammaroopa, *et al*., 2016**). In agreement with (**Olaoye, *et al*., 2016)**. The result of the present study has been shown the higher production of white shrimp and accordingly the higher income which means that investment in this field of production is profitable. Finally, the present study concluded that white shrimp are may be a promising candidate for the brackish and salt water pond aquaculture in Egypt as well as other parts of the world.

Table (5). Average cost and return of White shrimp production

| Items | Eldebba farm | | Suez Canal Farm | |
|---|---|---|---|---|
| | Rate | Percent | Rate | Percent |
| **Costs feddan** | | | | |
| PL costs LE | 10000 | 26.32 | 25000 | 43.10 |
| Feed cost LE | 20000 | 52.63 | 24000 | 41.37 |
| Labour and other costs LE | 2000 | 5.26 | 3000 | 5.17 |
| Rent | 4000 | 10.52 | 4000 | 6.89 |
| Solar | 2000 | 5.26 | 2000 | 3.45 |
| Total costs LE feddan | 38000 | | 58000 | |
| **Income feddan** LE | | | | |
| Total production (ton /feddan) | 1.900 | | 1.750 | |
| Price (LE) of one kg fish | 170 | | 165 | |
| Total income LE/ feddan | 323000 | | 288750 | |
| Net return LE/ feddan | 285000 | | 230750 | |
| Investmental return LE/ return LE cost | 7.50 | | 3.97 | |

This result is consistent with the finding of **Tammaroopa *et al*. (2016)** from their studies on profitability on fish farming. The rate of return per capital invested (RORCI) is the ratio of profit to total cost of production.

It indicates what is earned by the business by capital outlay (**Tammaroopa *et al*., 2016**).

## Conclusion

It could be concluded that stocking white shrimp at density 70000 / feddan was the best in terms of growth performance, feed utilization and economic evaluation under this experimental conditions.

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# كثافه التخزين، معدل البقاء، أداء النمو، الاستفاده من الأعلاف والتقييم الاقتصادى للجمبرى الفانمى المربى في مزارع مختلفة فى منطقة قناة السويس

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**الملخص العربى**

أجريت دراستان لتقييم أداء النمو، الاستفاده من الأعلاف، ومعدل البقاء والتكلفة الاقتصادية للجمبري الأبيض (P. vannamei) في منطقة قناة السويس. أجريت الدراسة الأولى في مزرعة الديبا بالمنطقة الغربية بمحافظة بورسعيد بالتعاون مع مزرعة أسماك خاصة. الدراسة الثانية أجريت بمزرعة قناة السويس السمكية. تم وضع الجمبري الأبيض (P. vannamei) في الحوض بمعدل ٧٠٠٠٠ ذريعة بحجم ٢٦/ فدان في مزرعة الديبا. في مزرعة قناة السويس تم تخزين الجمبري الأبيض بمعدل ١٥٠٠٠٠ ذريعة بحجم ٢٦/ فدان بمتوسط وزن ٠,٠٠٢ جم في كلا المزرعتين. تم توفير علف تجاري عالي الجودة (٣٨ ٪ بروتين). أداء النمو، الاستفاده من الأعلاف، معدل البقاء والتقييم الاقتصادي كانت الأفضل في مزرعة الديبا من مزرعة قناة السويس. ويمكن الاستنتاج أن مخزون الجمبري الأبيض بكثافة ٧٠٠٠٠ / فدان كان الأفضل من حيث أداء النمو واستخدام العلف والبقاء والتقييم الاقتصادي في ظل هذه الظروف التجريبية..