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**Utilization of by-catch and processing wastes from marine fishery
in feeds for the organic aquaculture of marine shrimp *Litopenaeus
vannamei* in Costa Rica**

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Abstract

In shrimp aquaculture one feasible way to reduce shrimp production costs and increase producers' profitability is the use of feeds with low fish meal levels or alternative protein sources with the aim of an organic certification. The main problem in conducting organic shrimp aquaculture is often the lack of suitable protein sources. Our protein source derives from a sustainable certified deep-sea shrimp fishery in Costa Rica, the Rainbow Export Processing S.A. Also important is the trading of the produced organic shrimps. A Public-Private-Partnership (PPP) was launched from the German Investment and Development Company (DEG), the Ristic AG (Prime Catch Seafood) and the University of Costa Rica in collaboration with the "Centrum für internationale Migration und Entwicklung" (CIM), the German "Gesellschaft für technische Zusammenarbeit" (GTZ) GmbH and the Costa Ricans Fishery and Aquaculture Institute (INCOPESCA). Aim of this project is the construction of sustainable infrastructures which make it possible to introduce an ecologically oriented and certifiable shrimp aquaculture in Costa Rica. Prime Catch Seafood supports this start-up phase with an extra payment for the cultured shrimps above the prices for conventional produced shrimps. After that, the certified products are gaining higher prices and therefore sustainability can be reached. In our case certifier for organic aquaculture of marine shrimp could be the German certifier "Naturland" that guarantees the selling of every organic produced shrimp. Regarding Naturland – guidelines, the fish meal content of the experimental diets is limited to a maximum of 20% of the total mass.

This study was carried out on a marine shrimp farm in Jicaral, Costa Rica which is related to the PPP and is certified from the British certifier "Friend of the Sea" for sustainable infrastructure. The study had the goal to test the possibility of using a locally available resource that is currently being wasted. A 48-day feeding trial was carried out to compare two test diets to one commercial control diet (Nicovita 35% protein). The two experimental feeds were prepared with fish meal of *Physiculus talarae*, *Pontinus cf sierra* and *Hippoglossina bollmani*, three common species that form part of the normal by-catch of the deepwater shrimp fishery in Costa Rica as well as shrimp head meal from *Heterocarpus vicarius*, integral wheat meal, sunflower oil and a vitamin & mineral premix. Pacific white shrimp, *Litopenaeus vannamei*, were used to test both diets in comparison to the above mentioned commercial feed.

Test diets were fed to shrimp with an initial weight of $10.8 \text{ g} \pm 0.56 \text{ g}$ to evaluate their growth and feed utilisation parameters: size and weight gain, feed consumption, Feed Conversion Ratio (FCR), survival, Protein Efficiency Ratio (PER), Body Weight Gain

(BWG) and Specific Growth Rate (SGR).

At the end of the experiment, average weight was $16.7 \text{ g} \pm 0.7$ in the control diet, $16.6 \text{ g} \pm 1.6$ and $16.7 \text{ g} \pm 0.4$ in the two experimental diets and no significant differences occurred between FCR, SGR and Survival for the three tested diets. The results of this study suggest that by-catch meals and processing wastes from certified deep-sea shrimp fishery can efficiently be used in feeds for the aquaculture of *Litopenaeus vannamei* in Costa Rica.