UNIVERSITÀ DEGLI STUDI DI PADOVA
DAFNAE
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PRORMAS

Producing valuable proteins and organic fertilizers from saline water sources using a recirculating multitrophic aquaponic system

Climate change-driven loss of arable land and degradation of water resources affect food production and weaken food security globally. This is particularly true in Europe where food production systems are excessively dependent on external inputs and increasingly scarce water supplies. European protein self-sufficiency for food and feed purposes remains extremely low. Therefore, innovative food production systems based on the principles of the “Green Deal” are imperative. Seafood currently supplies approximately 17% of animal protein and about 7% of total protein. Global fishery yield has not increased in 3 decades, thus aquaculture continues to fill the gap - ensuring food security. Aquaculture will supply 60% of global seafood by 2030. Euryhaline aquatic species, including shrimps, are the most economically important species in worldwide aquaculture. Despite strong market demand, European shrimp production is approximately 500 tons/p.a and in many Countries, such as Italy, shrimp supply is completely dependent on imports. In Germany and Lithuania, the aquaculture of shrimps (L. vannamei) in Recirculating Aquaculture Systems is a growing industry. However, "waste" dissolved and solid nutrients have so far remained unused, representing inefficiency and cost for the system. In Italy, especially in the Po Valley (the most important productive area of the country for the primary sector), the effects of climate change have greatly impacted the entire agricultural sector in recent years. In particular, the water level of the main rivers has fallen significantly and the saline wedge limits water use for agronomic and industrial purposes. A possible solution is to exploit brackish water to produce protein for feed and food. This demands the development of recirculating multitrophic aquaponic systems (RMAS) where aquatic species (eg. shrimps), filter feeders (e.g.

polychaetes) and plants (e.g. halophytes) are grown in a fully curcular system in, otherwise unused, saline water. The overarching objective of ProRMAS is to develop RMAS as an innovative food production system that will close the circle, produce highest quality protein, and maximize water and nutrient use efficiency. Shrimps will be produced as high-value food; polychaetes will be produced while recovering nutrients and reducing organic wastes via remineralization; Plants will absorb dissolved nutrients and produce food and feed. Polychaetes have high market value as live food for

aquaculture species and as an alternative to fish meal and fish oils in aquafeeds. In terms of plants, there is a growing interest in the cultivation of wild edibles in consideration of their organoleptic, nutritional, and nutraceutical properties. ProRMAS will use algae (Ulva spp) and innovative halophytes species (eg. Sea fennel, salicornia, sea rocket) to exploit dissolved nutrients from shrimp waste as fertilizers. Algae will function as feeds and halophytes, containing, essential amino acids, essential fatty acids, antioxidants and bioactive compounds will be used for direct human consumption. In RMAS plant production, the need for fertilizer is minimized and the plant growth optimized. Finally, any organic solid residue remaining in the system will be valorized as bio-fertilizers in testing on soil and soilless vegetables species reducing waste and nutrient loss to zero. ProRMAS is structured in 6 interlinked WP developed over a period of 3 years by AWI (DE), UNIPD (IT), KMTP (LT).

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