Evaluating the pressure of agrochemicals on the health and safety of polder-based aquaculture in Kuttanad, Southwest coast of India

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Kuttanad is an agriculturally unique ecosystem that is composed of the southern part of internationally important Ramsar site-Vembanad wetland ecosystem (location no. 1214) in Kerala, lying 0.6 to 2.2 m beneath the mean sea level in the South-west India. It is one of the three Globally Important Agricultural Heritage Systems (GIAHS) in India. More than two-third of the total land area of Kuttanad is used for paddy cultivation (Swaminathan, 2007). However, the high cost of production and low profit severely diminished thepaddy cultivation in Kuttanad leaving the polders fallow (Thomas, 2002).

One paddy–one prawn farming system (Fig. 1) turned out to bea feasible solution to support the heavily indebted farmers. The culture of scampi (*Macrobrachiumr osenbergii*) alternating with rice came out with an economically appealing production of 70 to 500 kg/ha of scampi with aprofit of Rs. 5,000 to 20,000/ha (Kurup & Ranjeet, 2002). However, the scampi population in the Vembanad lake and its confluent rivers (Kerala, India), have abated drastically in recent years due to human interventions in the ecosystem. Toxicity induced by pesticides used in the paddy fields is one of the major factors contributing to the threats posed against scampi.

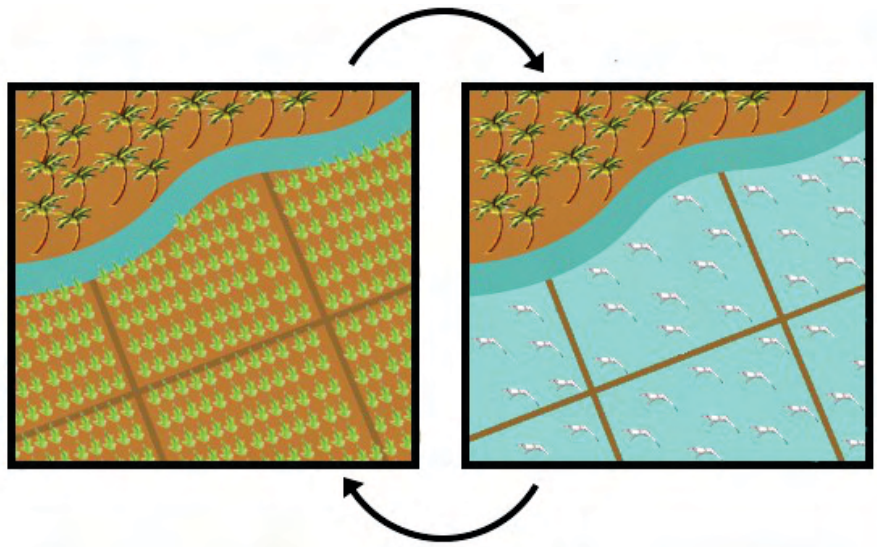

Fig.1 *One paddy–one prawn farming system*

The closure of Thanneermukkam bund has permanently obstructed the natural flow of water that washed off the pesticides used in the paddy fields, resulting in its accumulation and increased acidity of the soil, contrarily influencing rotational farming practices of paddy and prawn in Kuttanad (Lakshmi, 2018). Chlorpyrifos, hexaconazole and imidacloprid are pesticides commonly used in the paddy fields of Kuttanad. The leaching potential and persistence of pesticides, viz. chlorpyrifos, hexaconazole and imidacloprid were evaluated by the method of Aslam *et al.*(2015). The results revealed that imidacloprid has the highest leaching potential and persistence followed by Hexa conazole and Chlorpyrifos (Fig. 2).

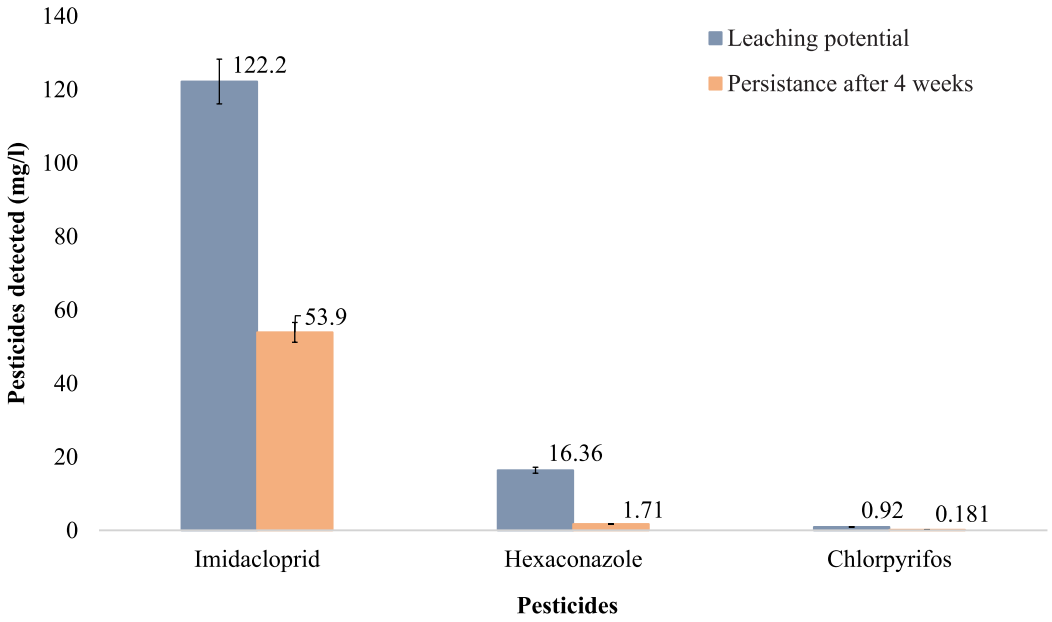

Fig.2 *Leaching potential and persistence of pesticides in water 4 weeks after application.*

Imidacloprid (Fig. 3) is one of the potentneo-nicotinoid insecticides used against sucking pests in the paddy fields of Kuttanad. It is found to cause adverse effects in a wide range of non-targeted organisms, especially *M.rosenbergii* once the most valuable export species of Kerala. Hence, it is important to investigate the toxicity of imidacloprid in *M.rosenbergii.* Acute toxicity study of imidacloprid in postlarvae of *M.rosenbergii* was carried out based on the manual of the Environmental Protection Agency USA (Peltier and Weber, 1985). The24, 48, 72 and 96 h LC_{50} values were determined using SPSS version 16.0 (Finney, 1952 which ranged between 0.009 – 0.046 mg/l (Fig. 4).

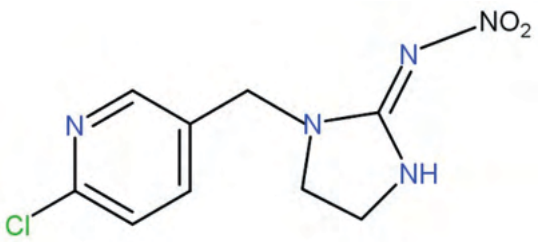

Fig.3 *Structure of imidacloprid*

Lake reclamation, over fishing, migratory barriers and habitat destruction are the other factors contributing to the alarming stock reduction of this species. These ecological alterations also resulted in diminished freshwater prawn culture in this area. As a solution to this problem, the Department of Fisheries, Government of Kerala has implemented a scheme 'Social Fishery' by which reared hatchery-reared seeds (post larvae) of *M.rosenbergii* are ranched in the lakes and confluent rivers ata large scale for stock replenishment. Still, this scheme becomes less effective as the field application concentration of imidacloprid (0.003mg/l) is higher than the safe concentration (0.002mg/l) determined for post larvae of *M.rosenbergii*. Hence, the investigators of the present study suggest to reduce the use of imidacloprid in the paddy fields of Kuttanad, promote bio safe pest management practices and to restrict the fishery of *M.rosenbergii* until its revival to avoid complete devastation of the species in its homeland.

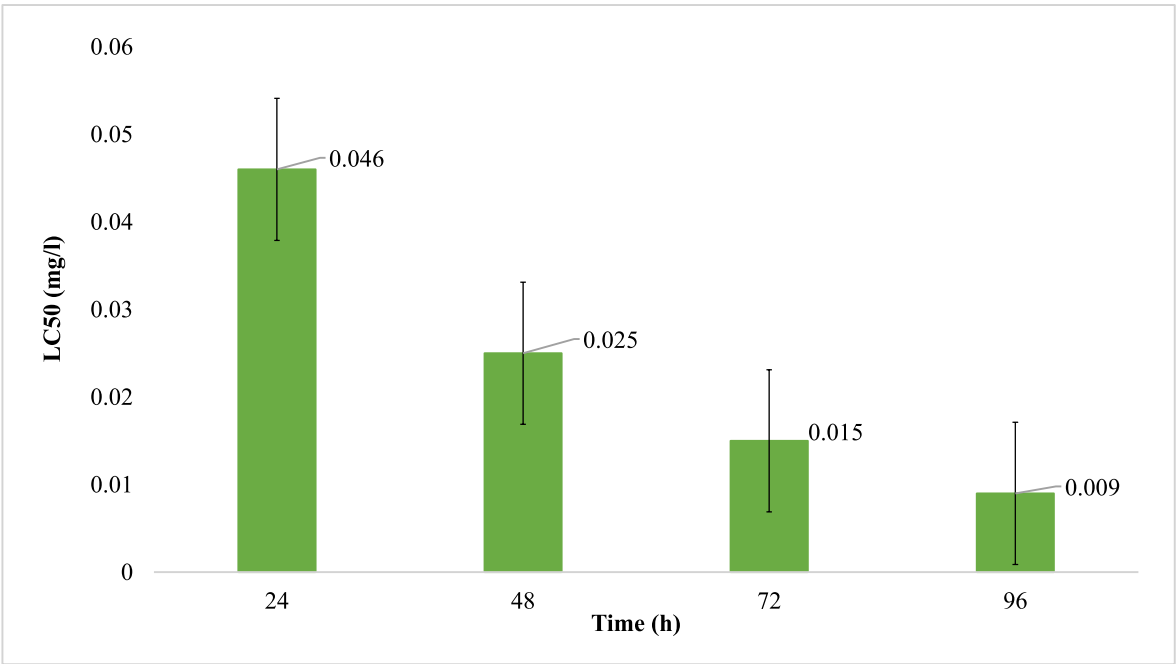

Fig.4 *Acute toxicity (24, 48, 72, 96 h LC_{50} values) of imidacloprid in postlarvae of M. rosenbergii.*

References:

Aslam, S., Iqbal, A., Deschamps, M., Recous, S., Garnier, P., & Benoit, P. (2015). Effect of rainfall regimes and mulch decomposition on the dissipation and leaching of Smetolachlor and glyphosate: a soil column experiment. Pest management science, 71(2), 278-291.

Finney, D.J. (1952). Statistical method in biological assay. Statistical method in biological assay. https://www.cabdirect.org/cabdirect/abstract/19542203721

Kurup, B. M.andRanjeet, K. (2002). Integration of freshwater prawn culture with rice farming in Kuttanad, India.

Lakshmi, G. (2018). Agricultural Development and Ecological Imbalance in Kuttanad. International Journal of Social Science and Economic Research, 3(12), 6946-6957.

Peltier, W.Hand Weber, C.I. (1985). Methods for measuring the acute toxicity of effluents to freshwater and marine organisms.

Swaminathan, M. S. (2007). Measures to mitigate agrarian distress in Alappuzha and Kuttanad wetland ecosystem. Chennai, India: Swaminathan Research Foundation, Union Ministry of Agriculture.

Thomas, P. M. (2002). Problems and prospects of paddy cultivation in Kuttanad region. Thiruvananthapuram: Kerala Research Programme on Local Level Development, Draft report.