Implications of pesticide residues in integrated ditch-dyke farming systems, Central Thailand

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Introduction

Ditch dyke systems developed from rice farming systems in many parts of Central Thailand around 20-30 years ago and facilitated the integration of land for growing vegetables / fruit, and water for irrigation and aquaculture.
In these systems the cropping cycles are as low as 50 days which provides high productivity but an increased demand for external inputs. Due to the diversity of crops grown, issues of food security and intensity of production, large quantities of pesticides are used to protect crops. Work within the MAMAS and MAPET projects has explored the issues relating to pesticide use, and misuse, within these systems and monitoring work has been carried out to assess the effects on the environment.
My research has focused on modelling and measuring the movement of pesticide residues into different parts of the ecosystem and relating the concentrations of these residues to the potential risks to the environment, human health and the marketability and safety of the crops sold.

Figure 1. A typical ditch-dyke system

The ecological risks

Constant use of pesticides within these systems has lead to decreased biodiversity. A decrease in biodiversity inevitably leads to the formation of new niches in the food chain which have the capacity to support large numbers of a certain pest. A pest infestation ensues and the requirement for pesticides is self perpetuating.
The primary reason seems to be that pesticide specificity is limited, and often beneficial insects (predators of the pests) are killed or displaced by the application. The function of the ecosystem in terms of self regulating pest numbers is therefore undermined.

Residues are present in all compartments of this agro-ecosystem, but perhaps the most real risk to humans, is through consumption of residues in food.

Figure 2. Farmers use no protection when applying pesticides

Implications for aquatic systems

With the close proximity of aquatic and terrestrial compartments, interactions are inevitable. In these truly "multi use aquatic systems", water is also utilised for domestic purposes as well as for agriculture and aquaculture. The network of irrigation canals within the farm (ditches), receive pesticide inputs, primarily from spray drifting from the target area, but also through leaching into the surface water.
The farm's irrigation/aquaculture system is linked to other farms via a series of sub and main canals, and water is pumped to and from farms, when required.
Due to the widespread, inappropriate use of pesticides in these farming systems, the potential for bio-concentration of residues in the aquatic food chain is high and my current results are showing pronounced increases (over 10x background level) in surface water residues for up to 3-5 days after application and with different crops at different growth levels on adjacent dykes, the pesticides applications often overlap and negative impacts are magnified.

The future

At present we are just touching the surface, there are hundreds of pesticides in use, containing a bewildering array of active ingredient combinations. The toxicity of these mixtures relates to the synergistic effects they have on one another, and is not only limited to the parent compounds but with the metabolites as well.

Much more research is required to fully understand the implications of these residues, especially in areas of the world where legislation is ineffective in controlling the misuse of these chemicals and where issues of food security have lead to conflicts of interest.

I am currently looking for potential research collaborations for a project planned to explore the overall sustainability of these systems in terms of residue monitoring and modelling, occupational health issues, current risks through consumption and to propose mitigation strategies to minimise residues within the systems. Please email charlie.price@stir.ac.uk for more information.

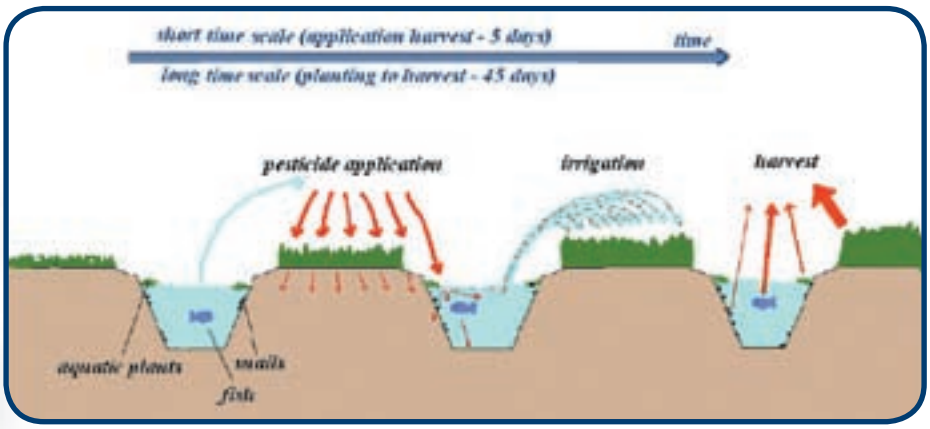

Figure 3. The cycling of pesticides into fish and plant harvests