Chemicals in Asian Aquaculture: Need, Usage, Issues and Challenges

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ABSTRACT

This paper outlines the opening introductory presentation made at the "Expert Meeting on the Use of Chemicals in Aquaculture in Asia," which was held 20-22 May 1996 at the SEAFDEC facilities in Tigbauan, Iloilo, the Philippines. Its purpose is to provide a balanced and realistic perspective on the needs, issues and challenges with respect to the use of chemicals in Asian aquaculture. We hope to assist participants in identifying development opportunities and in differentiating real hazards from hypothetical threats to cultured organisms, end-users and the environment as a consequence of chemical use. We do not attempt to provide answers to issues related to chemicals in Asian aquaculture, but rather offer some basic directives and opportunities to the workshop participants to assist them in their discussions and in the compilation of realistic recommendations.

INTRODUCTION

During the past decade, world aquaculture production has grown tremendously, averaging and annual growth rate of 9.4% during the period 1984-1994. Total world aquaculture production is now on the order of 25.5 million mt, valued at $US 39.8 billion, and accounts for some 21.7% of the total world fishery landings. China remains the largest producer, accounting for 60.4% of total world production.

Although the culture of high-priced species such as shrimp and salmon often receives the lion's share of attention, it is important to note that low-value inland finfish (e.g., Indian major and Chinese carps, tilapia, etc.) produced in extensive or semi-intensive culture systems comprise the bulk of world aquaculture production. Crustaceans, by comparison, represent only 4.2% of total aquaculture production by weight, and only 18.1% by value. Developing countries contribute more than 86% of total world production, with LIFDCs (Low Income Food Deficient Countries) accounting for more than 75% of the total. The LIFDCs contribute more than 80% of the world finfish production, of which more than 95% is derived from inland freshwater fish culture. Production from the LIFDCs continues to grow at an above average rate of some 13% annually, indicating aquaculture's real and potential contribution to providing low cost protein to those among the world's most impoverished sectors.

In aquaculture, as in all food production sectors, one of the external inputs required for successful crop production is chemicals. In the most simple, extensive systems, this may be limited to fertilizers (most often manure), while in more complex semi-intensive and intensive systems a wide range of natural and synthetic compounds may be used. It is safe to say that, as in agriculture, chemicals

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are an essential "ingredient" to successful aquaculture, one which has been used in various forms for centuries.

The purpose of this introductory presentation is to provide a balanced and realistic perspective on the needs, issues and challenges with respect to the use of chemicals in Asian aquaculture. We hope to assist in identifying development opportunities and in differentiating real hazards from hypothetical threats to cultured organisms, end-users and the environment as a consequence of chemical use. We will not attempt to provide answers to issues related to chemicals in Asian aquaculture, but intend to offer some basic directives and opportunities to the workshop participants to assist them in their discussions and in the compilation of realistic recommendations.

CHEMICALS IN AQUACULTURE

What are Chemicals?

There are many different classifications and working definitions of "chemicals" (see Van Houtte, this volume). These include classification of "drug groups" (see Alderman and Michel 1992), the classification provided by the International Council for the Exploration of the Sea (ICES 1994), a classification developed specifically for prawn culture (see Primavera *et al.* 1993), as well as various working definitions for scientific and legal purposes. In aquaculture, chemicals can be classified by the purpose of use, the type of organisms under culture, the life cycle stage for which they are used, the culture system and intensity of culture, and by the type of people who use them.

Why are Chemicals Used in Aquaculture?

Chemicals have many uses in aquaculture, the types of chemicals used depending of the nature of the culture system and the species being cultured. They are essential components in:

- pond and tank construction,
- soil and water management,
- enhancement of natural aquatic productivity,
- transportation of live organisms,
- feed formulation,
- manipulation and enhancement of reproduction,
- growth promotion,
- health management, and
- processing and value enhancement of the final product.

The benefits of chemical usage are many. Chemicals increase production efficiency and reduce the waste of other resources. They assist in increasing hatchery production and feeding efficiency, and improve survival of fry and fingerlings to marketable size. They are used to reduce transport stress and to control pathogens, among many other applications.

Concerns Regarding Chemical Usage

There are several important concerns with regard to the use of chemicals in aquaculture. These include:

- Human health concerns related to the use of feed additives, therapeutants, hormones, disinfectants and vaccines.

- Product quality concerns related to such issues as the occurrence of chemical residues in

aquaculture products, their use in the enhancement of product quality and in the preparation of value-added products, the need for consumer protection from hazardous usage, and issues surrounding consumer acceptance of the use of chemicals in the production of fish and shellfish destined for human consumption.

- Environmental concerns, such as the effects of aquaculture chemicals on water and sediment quality (nutrient enrichment, loading with organic matter, etc.), natural aquatic communities (toxicity, disturbance of community structure and resultant impacts on biodiversity), and effects on microorganisms (alteration of microbial communities and the generation of drug-resistant strains of bacteria).

- The general lack of knowledge concerning the effects and fates of chemicals and their residues in cultured organisms and within the aquaculture system itself. Similarly, information is lacking on the actions and fate of chemicals used in aquaculture in the aquatic environment in general (impacts on non-cultured organisms, sediments and the water column).

- The lack of alternative means for chemical application. Development of highly specific targeted chemicals that have reduced side effects and environmental implicates is needed. The availability of affordable treatments suitable for aquaculture systems raising low-value species needs to be improved.

Human health and environmental concerns regarding the use of chemicals in aquaculture are reflected in the FAO Code of Conduct for Responsible Fisheries (FAO 1995). In fact, the Code calls upon States to:

- Promote effective farm and fish health management practices favouring hygienic measures and vaccines. Safe, effective and minimal use of therapeutants, hormones and drugs, antibiotics and other disease control chemicals should be ensured. (Article 9.4.4).

- Regulate the use of chemical inputs in aquaculture which are hazardous to human health and the environment. (Article 9.4.5)

ISSUES AND OPPORTUNITIES

Future Issues

There a number of currents trends in global aquaculture which will continue to make the use of chemicals a subject for future discussion and debate.

Increased market demands which create pressure for the production of high-value species such as shrimp and salmon may, in turn, lead to increased intensification, more highly sophisticated culture systems, and a corresponding increase in both responsible and irresponsible chemical usage.

Recent measures such as the Agreement on the Application of Sanitary and Phytosanitary Measures (GATT 1994) have a major impact on the conditions of international trade in aquaculture products, both increasing the freedom of movement of products and requiring that exporting countries meet uniform standards with regard to quality, production procedures, etc. Various organizations have put forth real and suggested standards (via legislation, agreements, codes of conduct, guidelines, etc.) in such areas as production procedures and ethics, minimal residue levels (MRLs), allowable daily intakes (ADIs), withdrawal periods for chemicals used in treatment and prophylaxis, and for standards for aquatic animal health.

For many of these issues, policy and legislation is rapidly advancing, outstripping the advances in

technical knowledge through applied research which are necessary to make informed decisions and to support implementation of policy and law. This is particularly true when standards are set for chemical usage in aquaculture. An example is the need for research data related to chemical residues in aquaculture products, where information is needed on MRLs and withdrawl periods, and for chemical registration and approval.

It is clear that chemicals are an important component in aquaculture systems, and that further advancement of the aquaculture industry, particularly in systems undergoing intensification, may, in some cases, continue to be tied to increased chemical usage. However, development of vaccines, for example, may also lead to reduction in the use of therapeutants, and the use of synthetic chemicals is not required in all systems.

Major Challenges and Opportunities

There are three broad groups of people who deal directly with aquaculture chemicals: manufacturers and traders, farmers, and consumers.

Manufacturers and traders should work towards manufacturing and supplying "appropriate" species- and systems-specific chemicals. They should facilitate availability through ensuring an adequate supply of such chemicals; should provide accurate and adequate information to farmers, and avoid illegal trade. The private sector should also conduct more research and development towards reducing the harmful impacts of chemicals in aquaculture systems, and should work to improve public awareness of the pros and cons of chemical use.

Farmers should work to understand the on-farm management of chemical use in order to increase effectiveness and minimize adverse impacts. They should also inform themselves of the advantages and disadvantages of chemical use in each specific situation. Aquaculturists need to increase their awareness of the short-, medium- and long-term implications of the use of a chosen chemical.

Consumers should be aware of the health consequences of chemical misuse. They should inform themselves of the benefits, as well of the hazards, arising from chemical use, and should guard against undue influence by criticisms against aquaculture based mainly on emotional arguments that have little basis in scientific fact. However, where evidence strongly indicates the need for constructive change within the aquaculture industry, consumers should support advocacy groups working towards this goal.

Policy makers, researchers, and scientists should work together in addressing the issues of chemical use, with the view to reduce the adverse impacts. More research is needed, and they should focus on providing answers to the problems related to the use of chemicals. More research efforts should be made towards finding non-chemotherapeutic solutions to health management and disease control. There is a need to distinguish between perceived problems (i.e., subjective views) and potential hazards (which can be pre-determined and evaluated scientifically).

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