

Current Status of Periurban Aquatic Production in Hanoi

With a total of 5100 ha of water surface area Hanoi has great potential for aquaculture development, not only of traditional aquaculture practiced in ponds, reservoirs, urban lakes, rice fields, and wastewater-fed areas, but also aquaculture integrated with tourism, leisure and entertainment facilities. Because of urbanisation, pond aquaculture in urban areas in Hanoi is decreasing, whilst in peri-urban areas lowland rice fields are being converted into areas for aquatic vegetable production, fish ponds and integrated farming systems.

Hanoi is the capital and the cultural and political centre of Vietnam, and has a total area of 920.97 km² and 3.08 million inhabitants (early 2005). There are increasing problems with road congestion, declining living environment, employment and especially in the provision of food for the growing population. The increasing population density produces a large amount of wastewater. Under the “Hanoi city drainage and environment improvement” project increasingly water will be treated, but currently wastewater from the city flows directly into the To Lich and Kim Nguu rivers mainly to the Thanh Tri area in the south of the city where it is being used as an input for aquaculture in cultivating aquatic vegetables and fish.

The cultivation of aquatic vegetables utilising the city’s wastewater has an important role in providing incomes and livelihoods for farmers in peri-urban Hanoi and is particularly prominent in Hoang Liet and Tran Phu communes. Market studies have shown considerable demand within the city for aquatic vegetables, particularly water spinach (*Ipomoea aquatica*) - commonly known as water morning glory. The agricultural systems in and around Hanoi are changing, with increasing use of wastewater for high-value crops such as mimosa, dropwort and cress rather than rice, giving peri-urban farmers increased yields and financial benefits. Recently aquatic production in peri-



Harvesting wastewater-fed fish

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urban Hanoi has been increasing in both overall area and yield. In the past 13 years, the land area used to produce fish increased from 2061 ha to 3348 ha, with the associated yield more than doubling, from 4207 to 8972 tons (Hanoi Agriculture and Rural Development Department, 2004). The majority of fish production occurs in Thanh Tri district (52%) whilst the remainder includes 15% from urban lakes, 12% in Tu Liem, 9% in Gia Lam, 7% in Dong Anh and 5% in Soc Son districts. The overall contribution of urban fish production depends on the different systems: fish ponds contributed 46%, wastewater-fed fish 31%, rice-cum-fish 13%, fish in urban lakes 7%, freshwater prawns 2% and fingerling fish nursing 1%.

AQUATIC VEGETABLES

Aquatic vegetables have a significant role in the balanced nutrition of Hanoi’s citizens. In terms of production levels, water spinach is the most important aquatic vegetable produced throughout the year. Water mimosa (*Neptunia oleracea*) is cultivated only in the summer months from April to August, whilst

others, primarily water dropwort (*Oenanthe stolonifera*) and water cress (*Rorippa nasturtium-aquaticum*), are cultivated in the winter months from September to March. Aquatic vegetable production in Hanoi is mainly concentrated in Thanh Tri and Gia Lam districts (including the villages/districts Bang B, Hoang Van Thu, Yen So, Vinh Quynh, Tam Hiep, Tu Hiep and Hoang Van Thu) where they are cultivated in enclosed fields using pumped wastewater from the city as the main nutritional input. Floating water spinach is also produced in wastewater canals, and is very attractive for consumers in the city’s markets. Rotation of the above crops is becoming more popular due to the benefits of increased and diversified incomes. To meet the urban consumers’ increasing demands for aquatic vegetables, the producers have excavated their fields deeper and constructed enclosed “ponds” into which they supply wastewater though the pumping service provided by the local agriculture cooperative. They have also increased the use of agro-chemicals in their production cycles in order to boost production levels

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further, however this has also resulted in increasing pollution of local rivers and water sources.

In Bang B village, Hoang Liet commune, cultivation of an annual rotation of water mimosa and water dropwort contributed 90% of the highest recorded household income of 40 million VND/year (2,547.70 USD/year; 1 USD = 15,700 VND). The production of water spinach contributed 100% of the lowest recorded household income of 21 million VND/year (1,337.5 USD/year). At present about 50% of households in this village cultivate aquatic vegetables. This is also illustrated by the fact that in 2004 14 ha of former rice fields in Bang A village were converted to produce water cress and water dropwort, reusing wastewater pumped from the To Lich river (Phuong, 2004)..

FISH CULTURE.

Most periurban farmers stock a polyculture of common carp, grass carp, silver carp, Indian major carps (mrigal, *Cirrhinus mrigala*; rohu, *Labeo rohita*), bighead carp (*Aristichthys nobilis*) and mud carp (*Cirrhinus molitorella*). A relatively small number of farmers stock the high-value carnivorous black carp (*Mylopharyngodon piceus*) because there were relatively few snails available for feed. The fish culture cycle usually runs for 10-11 months, from March/April to January/February. Ponds are drained after the final harvest in January/February, dried for 1-3 weeks and then are cleaned, limed and refilled with water. Three months after stocking fish, households begin to harvest fish for domestic consumption and/or sale. Some households have two production cycles per year. Stocking densities vary widely depending on the different types of aquaculture systems, with an average of 2-3 fish/ m² for fish pond culture and 1 fish/ 2m² for rice fish culture. Normally fairly large fingerlings are stocked into these systems, e.g. 500g/grass carp, 15-20g/tilapia, 150-250g/common carp, 200-300g/silver carp, 150-300g/Indian carps, 150-200g/ Colossoma. sp.

Wastewater has been used in Hanoi since the 1960s by farmers as a cheap and reliable source of water and nutrients for the culture of fish. Today's Hanoi fish farmers have thus gained considerable experience in wastewater-fed aquaculture. In recent years, however,

periurban areas are increasingly concerned about the contamination of domestic wastewater with industrial wastewater effluents due to the rapid development of industry in Hanoi. With a total of about 1,680 ha, most wastewater-fed fish culture areas are concentrated in the southern Thanh Tri district, such as Yen So, Tran Phu, Hoang Liet, and Tan Trieu communes, as well as producing fish in the inner urban lakes. The major fish species cultured using wastewater include silver carp (*Hypophthalmichthys molitrix*), mud carp (*Cirrhinus molitorella*) and Indian carp (Rohu, Mrigal), Tilapia (*Oreochromis niloticus*), common carp (*Cyprinus carpio*), grass carp (*Ctenopharyngodon idellus*) and Colosoma. The average productivity of wastewater-fed fish culture in Hanoi is increasing from 4 tons/ha/year in 2000 to 5.4 tons/ha/year in 2004 (Baseline survey, 2004).

Non-waste water culture of fish also occurs in the more peripheral periurban districts of Hanoi eg. Dong Anh where relatively clean water from the Ngu Huyen Khe river, a branch of the Red River, is used in pond based polyculture systems which are often integrated with fruit and livestock production. Fish culture started to increase in Dong Anh district in the mid 1990's as farmers began to convert rice fields into integrated fish pond systems realizing they could significantly increase and diversify their incomes by doing so. However more recently water pollution has been increasing due to effluents from the growing number of local backyard metal-working workshops which has resulted in problems for the fish farmers.

Hanoi has approximately 40 lakes covering small to large areas that total about 800 ha (1999). These **urban lakes** are important in climate control, local irrigation and other (cultural) uses. Currently, however, most of these urban lakes are faced with water pollution caused mainly by unregulated effluent from surrounding residential, industrial and hospital sources. A separate wastewater collection and disposal system in the future, will enable water use for leisure/entertainment, flood control, and aquatic food production systems.

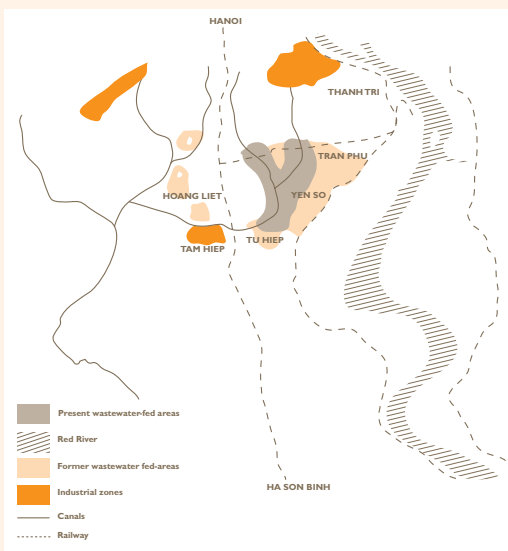
Previously, Hanoi had 10 government **hatcheries**, but there is now only one

government and several private hatcheries. 500 million hatchlings are produced annually from hatcheries in Hanoi and these supply 40% of the city's fish farmers' seed demand, 15% of which is produced by the Hanoi Fish Seed Center. The remainder is supplied from the Research Institute for Aquaculture No. 1 and other neighbouring provinces such as Bac Ninh, Hung Yen, Hai Duong. Fish farmers in Dong My, Tu Hiep, Yen So, Tam Hiep communes in Thanh Tri district, some households in Dong Anh, Gia Lam districts and also some urban lakes have become specialised in nursing and producing fingerlings to supply to individual households for on-growing into food fish.

Integrated aquaculture is practised in Hanoi at the household-level and is based on the concept of the **VAC** [an acronym from the Vietnamese words for garden (*vuon*), pond (*ao*) and livestock quarters (*chuong*)] system. Some better-off periurban farmers for example in Dong My Commune, who have had access to aquaculture training use improved techniques to raise chickens, pigs and ducks adjacent to or above fish ponds, feeding them with additional formulated feeds, with the ponds also benefiting from spilled feed and manure. The pond dikes are also used for growing fruit trees and vegetables with the nutrient rich mud from the drained pond bottoms being used to spread over the pond dikes to further recycle wastes, whilst at the same time increasing yields, diversifying production and thus raising and stabilising the farmers income.

Rice-cum-fish production is concentrated in Dong Anh, Thanh Tri and Gia Lam districts. It has developed from lowland areas where uncertain annual rice production has been changed into a rotation of one rice crop followed by one fish crop per year. Feed for fish is supplied by fallen rice grain, rice stubble and some other supplementary feeds. Species stocked into these systems include common carp, major carps, and tilapia. Grass carp is also stocked but only after a rice harvest, until which time they are held in canals or ponds. Productivity in this system is low at approximately 1 ton of fish / ha⁻¹ at present.

Fish and prawn culture started in Hanoi in the 1930s, but has developed since



2000 following conversion from periurban lowland rice fields into fish ponds. The water sources which supply aquaculture in Hanoi come from the wastewater-fed rivers (Thanh Tri) and irrigation systems from the Duong and the Red rivers (Dong Anh and Gia Lam). Supplementary food sources include maize, beer by-products, and rice bran; and a small proportion of households use formulated feed. Major species are Indian carps (Rohu, Mrigal), mud carp (*Cirrhinus molitorella*), grass carp (*Ctenopharyngodon idellus*), common carp (*Cyprinus carpio*), Nile tilapia (*Oreochromis niloticus*), silver carp (*Hypophthalmichthys molitrix*), Bighead carp (*Aristichthys nobilis*). Giant freshwater prawn (*M. rosenbergii*) culture started in the 1990s with more people engaging in this activity since 2000 following support from Hanoi's extension models in Thanh Tri, Gia Lam and Dong Anh districts.

MARKETS AND INSTITUTIONS INVOLVED

The study of marketing in fish and aquatic plants carried out in Hanoi from April to June 2003 showed that 90% of the freshwater fish sold in Hanoi's wholesale markets are cultured and transported in from outside provinces whilst the remaining 10% are actually produced in Hanoi. The more valuable fish from provinces around Hanoi, such as Bac Ninh, Hung Yen, Hai Duong, Ha Tay, etc., are sold in the city's markets mostly live. The smaller, cheaper fish typically produced using wastewater in Hanoi are transported out of the city to the provinces and mountainous regions.

From our markets survey it was found that Hanoi residents especially prefer to consume the aquatic vegetables water spinach, water mimosa, water dropwort

and water cress. Water spinach in particular is consumed everywhere, in canteens, restaurants and private homes, and is widely offered for sale in street markets.

Virtually 100% of aquatic vegetables grown in and around Hanoi are consumed in and meet the demand of the city itself. The main production areas which supply the city's markets are found in Hoang Liet, Tran Phu, Tu Hiep, Tam Hiep, Yen So, and Hoang Van Thu communes located in Thanh Tri & Gia Lam districts respectively. Urban consumers are mostly concerned with quality, freshness and price but seem unaware or not concerned that many aquatic vegetables are produced in wastewater often using chemicals. Periurban aquatic food production in Hanoi is regulated and affected by a combination of government and scientific research institutions at various levels: city, district, commune and household. At local level, the District Extension Unit coordinates other units within the district. The Commune People's Committee has responsibilities in administration and management of economic development. Households are more closely and directly related to the local units at commune level and also the District Extension Station, Research Institute for Aquaculture No.1 and some other universities through their training and research programmes in aquaculture as well as agriculture. Compared to fish farming, aquatic plant cultivation within periurban Hanoi is not well represented at any influential or management level within the institutions involved. Analyses of the future plans for the city and periurban districts show that land usages involving aquatic production systems will be restricted in areas near Hanoi city centre and will be encouraged and enlarged within the periurban areas further out from the city centre.

FUTURE TRENDS

Land use policy in Vietnam is changing; farmers are now allowed to convert low-lying rice fields into fish ponds, aquatic vegetable growing areas and orchards. Diversification of traditional farming activities can lead to increased farm household incomes. However, on the other hand investment in and development of small ponds near urban areas will be restricted under

PROBLEMS FACED

In a meeting held in Hanoi, December 2003 the following issues were identified:

- lack of water for production, polluted wastewater,
- diseases of fish and aquatic plants
- lack of technical training and literature/books
- scarcity and low quality of vegetable and fish seeds
- limited duration of land leases
- limited infrastructure
- lack of capital
- occupational health aspects: skin diseases, rheumatism, backaches, headaches, sore eyes.

urbanisation, whilst wastewater-fed aquatic plant and fish culture will be affected by conventional treatment of wastewater under the city's master plan. Aquatic vegetable cultivation and increasingly intensive fish culture will be developed in areas close to the city within range of urban markets to provide high-value products for the increasingly affluent urban consumer. The continuing high demand for aquatic vegetables amongst urban consumers as well as the relative lack of outside competition in producing them should ensure that they continue to be grown in considerable quantities in the expanding periurban areas of the city.

Hanoi's aquatic production systems are still very much in a state of evolution, with the importance and safety of using wastewater in producing food for the growing population very much within the realms of present and future urban development debates. Due to the high demand and potential for locally produced aquatic food products both in Hanoi and in a wider urban context, it is in the interests of urban planners and policy makers to broaden their understanding of both the benefits and constraints regarding future development of aquatic food production systems and general urban agriculture for Hanoi city.

This article is a summary of the first year of research in the PAPUSSA project and was funded by the European Commission.

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