
**Peri-Urban Aquatic Production Systems
In Ho Chi Minh City, Vietnam**

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ABSTRACT

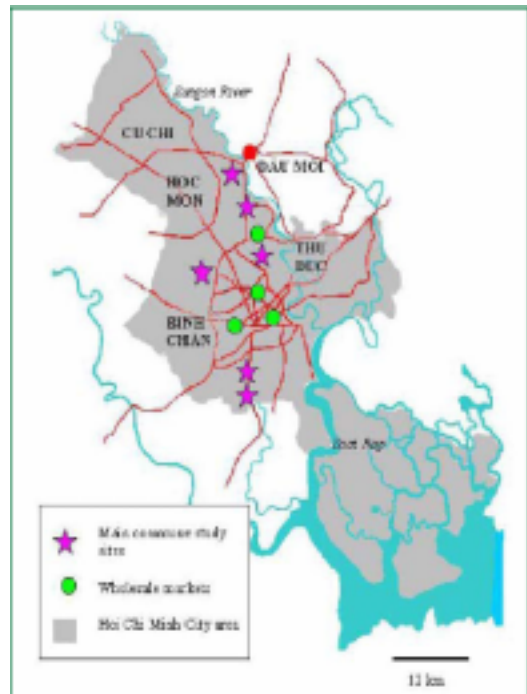
Aquatic production systems are very popular in peri-urban area of Ho Chi Minh city (HCMC), which have been developed in the lowland areas (South and South-West) of the City. Peri-urban aquaculture in HCMC can be classified in to 2 major types including wastewater-fed and non-wastewater systems. Wastewater-fed aquaculture systems can be considered the more popular, which are usually located in lowland areas of the city where all wastewater from the city is discharged to. Tilapia seed production, fish polyculture, morning glory, water mimosa, fish – water lotus combination are the typical wastewater-fed systems. The other type of aquaculture in HCMC peri-urban areas is non-wastewater systems which are located mainly in more elevated land areas of the city. Fish monoculture and polyculture are the common non-wastewater systems. Species cultured in these peri-urban aquaculture systems can also be categorized into 2 groups including fish and aquatic plants. In general, these systems are playing important roles in job provision as well as food supply, which ensure a relative good living conditions to the producers. However, these aquatic production systems are facing some serious problems which might lead to their extinction. Peri-urban aquaculture is very little within the concerns of the City's Authority. Land use priority is never specifically given to aquaculture when the city planners are setting target areas for urbanization. This leads to more uncertainty regarding the future of urban aquaculture development. Industrial waste contamination of wastewater is another big constraint for aquatic production systems in peri-urban areas. The situation gives more cause for concern as the involved population, with low labour mobility, might enlarge the battalion of the City jobseekers; while their actual situation, not being exceptional, allows them a correct livelihood. The need for more concerns from the Government to take urgent measures to solve these problems are clearly exposed.

Key words: Ho Chi Minh City, Peri-urban aquaculture, urbanization, wastewater aquaculture

INTRODUCTION

Ho Chi Minh City (HCMC) is one of the two biggest cities of Vietnam located in the South-Eastern part of the country. With an area of 209,370 ha, HCMC is currently inhabited by almost 6 million permanent residents (Statistical data from Ho Chi Minh City's website). About 83.3% of population is living within the urban area creating a very high population density with a diverse and dynamic economic environment.

Aquaculture is one of, but not the most important component of the City's economy. Indeed, the contribution of the agriculture-aquaculture sector in GDP of the city's economy has been continuously decreasing from 2.2% in 2000 to 1.4% in 2005 and is predicted to be only 0.8% in 2010 (HCMC website) whilst the contribution of other sectors, especially the industrial and service sectors have been increasing and will increase further according to the city's development plans. Moreover, the area for agriculture, aquaculture sector will be reduced as well, from 128,760ha in 2000 down to 121,235ha in 2005 and more to 107,465ha in 2010. All these figures indicate that more and more pressure will be placed on urban agriculture as well as aquaculture activities in HCMC in the near future. Nevertheless, the decline of agriculture and aquaculture within the city boundaries – urban areas – is inevitable but there is also a corresponding increase in aquatic production in further out “peri-urban” areas on the outskirts of the city. This is really a case for the peri-urban agriculture and aquaculture to develop further against the pressure of urbanization of the city. However, this requires farmers to be active in their own plans of cultivation and reallocation since they are very limited in their support in this



area from the government and receive very little support from the City Authority.

Peri-urban aquaculture in HCMC can be classified into 2 major types including wastewater-fed and non-wastewater systems. Wastewater-fed aquaculture systems can be considered the more popular because most wastewater from the city goes directly to the Saigon River which is the main water source for aquaculture. The nature of the wastewater drainage system has created a wide, diffuse dispersal system of wastewater and therefore a less well defined area of wastewater-fed aquaculture. These aquaculture systems are usually located in lowland areas of the city where all wastewater from the city is discharged to. The other type of aquaculture in HCMC peri-urban areas is non-wastewater systems which are located mainly in more elevated land areas of the city. In these higher areas, the water source can be either another source independent of a wastewater drainage river/channel or far less polluted distributaries of a drainage channel or river. Species cultured in these peri-urban aquaculture systems can also be categorized into 2 groups including fish and aquatic plants which will be described further in following sessions.

GENERAL SITUATION

Peri-urban aquaculture

Water, as the most important factor of aquaculture, plays significant roles in aquaculture. In a big and rapidly developing city like HCMC, water pollution is increasingly disturbing aquaculture activities at higher and higher levels over time. In fact, besides more wastewater from domestic discharge, many other sources of pollution are added to the water supply system in the city, especially minimally regulated industrial waste from small-scale industries located within domestic areas. Attempts have been done by the City's Authority for reallocation of these industries. The government has been trying to move all these household industries into industrial parks/industrial zones located outside the city where there are properly designed and functioning wastewater treatment systems. With all these attempts, the situation has been improved in some peri-urban areas. Da Phuoc commune, a study site of the EC funded PAPUSSA (Production in Aquatic Peri-urban Systems in SE Asia) project can be taken as a very good example. In this commune wild fish which disappeared due to pollution and over fishing a long time ago are now starting to come back to farmers' fields. According to farmers' knowledge, fish are coming back to their fields because of water quality improvements resulting in the reallocation of these household industries.

Flooding is another constraint that farmers are annually facing. As mentioned previously, aquaculture activities of HCMC, especially wastewater-fed aquaculture are commonly practiced in lowland areas of the city where water levels change with the daily tidal regime. In the rainy season, the impact of this tidal regime is exacerbated by considerable volumes of rain water causing flooding largely in many places of Binh Chanh districts. Phong Phu and Da Phuoc communes – also study sites of the PAPUSSA project - are also good examples of this deleterious effect flooding can have. Flooding doesn't only cause production losses for peri-urban fish farmers, it can also lead to

unmanageable pollution of pond water which has in the past caused significant fish kills within farmers stocks. Indeed farmers in areas which flood cannot afford to have major preventive measures against flooding other than nets surrounding their ponds. With this method, they can only prevent fish loss from overflows but wastewater, which they have to supply to fish ponds only at certain period to avoid water pollution, can become uncontrollable flowing into their ponds with flooding and result in fish kills. This is really a problem that cannot be overcome by farmers themselves; they need support from government.

Although the city's Authority has assigned some regions of the city to be reserved for agriculture/aquaculture development, aquaculture areas in many other places within the city are being developed into residential zones and for public construction projects. Land use priority is rarely given for aquaculture purposes when it needs to be considered. Therefore area depletion is another pressure on aquaculture activities and thus to fish and aquatic plants growers of the city.



Figure 1. People are involved intensively in morning glory pre-processing

Hired labour scarcity is a constraint in many places (e.g Da Phuoc, Phong Phu, Dong Thanh communes), where there is a common trend that only older household members are involved directly in aquaculture activities whilst the young generations are going to work in other non-agricultural jobs. This does not necessarily indicate that aquaculture is less attractive to young people, but it also creates a problem of labour scarcity, especially during harvesting periods. Fish farmers in Da Phuoc commune have got to hire labour from other outside districts (e.g. Nha Be district) at higher rates. However this

becomes more difficult when people in those districts are able to find other alternative jobs and not willing to work with fish farmers. This is really a constraint for fish farmers not only from an economic point of view but also from a developmental point of view. Conversely hired labour for morning glory (aquatic plant) production is highly available in Thu Duc district. Morning glory growers can very easily find labourers for their harvesting and preliminary processing before sale. Though this is actually relatively low paid labour, people in the surrounding area of morning glory farms are very interested in this kind of job. This can be seen as a relative advantage for morning glory farming and very important to the existence and development of morning glory farming in the district.

Wastewater-fed aquaculture systems

There have been many studies in the literature of wastewater-fed aquaculture systems around the world. Calcutta and Hanoi can be described as examples of sewage-fed aquaculture. However it is still worth mentioning about HCMC's wastewater-fed

aquaculture systems as they may be quite different from both the Calcutta and Ha Noi systems in terms of their sewage delivery and treatment systems, the pattern of wastewater-fed aquaculture, the role of sewage fed aquaculture in city waste treatment, and the nature of the drainage channel system. In fact the clear differences between the Ha Noi and HCMC systems are the sources of wastewater and the types of farming systems. Traditionally people in HCMC have been using untreated wastewater mainly for tilapia seed production whilst the Ha Noi systems use sewage for fish culture in a number and range of different aquaculture systems. Further more, Ha Noi sewage-fed aquaculture is concentrated mainly in one lowland district where sewage is transferred into, whilst the wastewater of Ho Chi Minh City is discharged into many lowland districts around the city through the complicated river channels system. These distinctions between two cities imply that HCMC may need greater effort for good management and planning of wastewater aquaculture. These differences between wastewater sources and the methods of delivery are really evidence for the relatively higher risk of HCMC's systems.

♦ *Seed production system*

Originally tilapia seed production in HCMC started up very early in the 1960s in District 6. But it had disappeared from this District by 1985 due to urbanization. Since tilapia seed production has moved to District 8 and has been practiced there for a very long time. It has been developing there year after year until its peak in 1998 when the total area of tilapia seed production in the district was nearly 200 ha, with a total of more than 100 households involved in the activity. Since then the total area and number of farmers involved has been reducing due to many problems caused by urbanization and industrialization of the city. These problems include wastewater pollution, farmers' aspirations (farmers want to improve their living conditions and sell their land for money instead of keeping for aquaculture), attractiveness of the land price, and the pressure of Government's urbanization projects. With all these problems the area and number of fish farmers involved in producing tilapia seed in District 8 has been subsequently reduced and now become a more minor income earning activity. In more recent years the further out Binh Chanh district is now the main place for wastewater-fed aquaculture systems, not just for tilapia seed production but also for many other aquaculture production systems using the city's wastewater as a water supply and source of nutrients.

Since seed production has almost collapsed in District 8, Binh Chanh district is currently the main place for Tilapia seed production in Ho Chi Minh City. The total area used for this activity is not known clearly, however total production is quite significant. Indeed estimated total production of Tilapia seed in the area is about 600 tons of fingerlings which is equivalent to 150 – 200 millions tilapia seed which can meet 90% of the demand for tilapia seed in south Vietnam (Hung, 2000). They are not only the Tilapia seed suppliers for the south of Vietnam but also for the entire country. The "black" strain of tilapia is traditionally and commonly produced. Though other strains have been introduced to peri-urban farmers including GIFT and hybrid red tilapia strains, farmers still like their original strain..

Wastewater is utilized very efficiently in this type of production system. Tilapia fry are nursed in plankton rich pond water developed by nutrients from wastewater. Wastewater is usually stored in the pond for 2 – 3 weeks until the water colour turns green indicating it is rich in phytoplankton before stocking fish. Taking the advantage of short breeding cycles of tilapia, farmers annually produce 4 cycles of seed and one crop of table fish per year. Brood fish are renewed by selection from newly produced seed. Using this technique the total number of ponds for individual farmers practicing seed production is 4 ponds and thus it requires more land than other systems. The products from this type of systems are not only tilapia seed but also tilapia table fish. With high productivity and diversity of products, this system gives farmers opportunities to improve their living conditions and to stabilize their livelihoods. However as wastewater is more polluted day by day, seed producers have to manipulate the water supply to avoid production losses due to fish kills.

Other common systems

Peri-urban aquaculture in HCMC can be classified into different systems based on species cultured and level of intensity. Fish is commonly raised in mono-culture or polyculture pond systems. Aquatic plants including morning glory (*Ipomea aquatica*) and water mimosa (*Neptunia oleracea*) are also grown in pond systems. Both fish and aquatic plant systems can be either wastewater or non-wastewater fed.

Fish polyculture system

Many fish species with different feeding behaviour are stocked in a pond to feed on natural foods at all different layers of the pond water column. This system maximizes the natural food utilization in the culture system and therefore supplemental feeds are used very sparingly. The most commonly cultured fish species in this system are tilapia, common carp, grass carp, silver carp, pangasius, and catfish, in which tilapia is the most preferred species. This fish poly-culture system can be seen and is very popular in either wastewater-fed areas (Da Phuoc, Phong Phu commune, Binh Chanh district) or non-wastewater areas (Long Thanh My ward, District 9; Dong Thanh commune, Hoc Mon district). While wastewater is used as nutrient source for natural foods development in wastewater-fed ponds, the main nutrient input for fish polyculture pond are animal manures which originate from household integrated livestock systems eg pigs, ducks, or from collection. Farmers carry out different species composition and stocking density within their ponds based on their own knowledge and experience. Therefore the utilization efficiency of natural foods is varied amongst different farmers' ponds. As a result profit from fish culture varies between the different households involved depending on their level of experience and expertise.

Figure 2. Fish culture pond in Da Phuoc commune - Binh Chanh district



Fish monoculture system



Figure 3. Fish culture pond in Dong Thanh commune – Hoc Mon district

With a higher stocking density, this model can be considered as a more intensive system, in which supplemental feed is required as natural foods are not able to supply the total nutrient requirement of the fish. High value fish species such as red tilapia, hybrid catfish, giant gourami, etc. are cultured in these systems using manufactured pelleted feeds. Tilapia and red tilapia are the most commonly cultured species in Phong Phu, DA Phuoc commune, Binh Chanh district; Long Thanh and My ward, District 9. Catfish are also used for mono-culture systems in some households in Da Phuoc commune, Binh

Chanh district in which catfish mono-culture ponds are fed with raw feed materials such as trash fish and slaughter house waste. Giant gourami is another preferred species for monoculture systems in Dong Thanh commune, Hoc Mon district. However, because feeding behaviour of this species is different, nutrient sources for giant gourami mono-culture ponds are mainly plant based materials including duckweed, grass (in Dong Thanh commune) or morning glory leaves (in Tam Phu commune, Thu Duc district).

Water mimosa cultivation



Figure 4. Water mimosa system in Binh Chanh district

This type of system is usually found in two main areas in HCMC, Binh Chanh district and District 12 where the water quality is found suitable for water mimosa to grow well.

Low investment capital and simple cultivation techniques help farmers to generate high levels of income from growing water mimosa. Water mimosa needs duckweed (*Limnna sp.*) in the pond to shade the water in order to prevent

phytoplankton growth so that water mimosa can grow well. Therefore many farmers in Binh Chanh district (Phong Phu commune) are combining water mimosa with fish culture

but in separate ponds. Fish culture can utilize better the duckweed and improve the profit of combined systems. For farmers, water mimosa is a daily income source and fish is a long-term income source. Fish species are similar to other polyculture systems but more

kissing gourami are cultured to maximize the potential for duckweed consumption of the fish. Tilapia is also the dominant species as in other systems in Binh Chanh district.

This type of system can also be seen concentrated in one place in Thanh Xuan ward, District 12. The distinctions between water mimosa in this place and in Binh Chanh district are many but can be generalized as two main points 1/ water quality in Thanh Xuan commune is better than in Binh Chanh district 2/ most farmers here are not local villagers, they have recently migrated from other provinces, especially from the North. Migration of people into the area for water mimosa culture indicates that this is an attractive and lucrative source of income, at least for people who face livelihood difficulties and have to leave their original homes.



Figure 5. Water mimosa system in District 12

Though water mimosa is produced widely within the peri-urban areas of HCMC, almost no technical research has been done and therefore farmers are really lacking in technical knowledge especially on water mimosa diseases which are currently causing difficulties for those growing it. Furthermore this species of aquatic plant cannot live in heavily polluted water whilst the inflowing water is gradually becoming more and more polluted. This type of aquaculture practice is in danger of collapse if water quality continues to decline through industrial pollution.

Morning glory cultivation



Figure 6. Morning glory system in Tam Phu commune, Thu Duc district

Morning glory is found to be another suitable species for the wastewater environment which also provides a good income source for farmers. Tam Phu commune in Thu Duc district is the most common and concentrated place for this production. In this commune there are many lowland fields which experience high acidity and polluted wastewater, which cannot be used either for rice or fish culture. Morning glory is therefore cultivated as the only appropriate crop. Therefore

these fields have developed into a large area for morning glory culture, supplying a considerable amount of production to the city's markets. In such a situation, surrounding rice fields have been

gradually converted into morning glory fields by the farmers themselves over time. With this ongoing process of rice fields being converted for the more profitable morning glory cultivation, the production of the remaining rice fields has declined due to a corresponding increase in rice field predators. When fewer fields are used for rice culture, the remaining rice fields are the concentrated places for rodent pests, rats, birds, and snakes. Therefore the remaining rice farmers suffered from further loss of their rice production due to predators and other associated technical and economic problems. Therefore morning culture has become very popular and is the occupation of choice of many farmers in Tam Phu commune of the district.



Although farmers here are not equivocal about the benefits of wastewater they do use it to fertilize their morning glory ponds since it is the only source of water supply available. This wastewater-fed aquatic production system plays a considerable role in the livelihoods of many people living in these peri-urban areas.

Figure 7. Giant gourami pond combined with morning glory system in Thu Duc

Fish culture is also combined and integrated with morning glory cultivation within some household farming systems, but in different ponds and perhaps also different places. The morning glory system is similar to the system described above but the by-products from morning glory processing i.e. the leaves, are used as a nutrient input for nearby fish ponds. Because morning glory leaves are used as the main food source for fish culture, the fish species cultured are quite different to other systems in Binh Chanh district. The main species are giant gourami (*Osphronemus gouramy*) and kissing gourami (*Helostoma temmincki*), which can digest and utilize aquatic plants most effectively. Because it takes a relatively longer time for giant gourami to reach marketable size (18 – 24 months), farmers are usually adding some other species such as tilapia, grass carp and pangasius into their ponds in order to have partial harvests which supplement their household income and food supply.

INSTITUTIONAL CONSTRAINTS FOR PERI-URBAN AQUACULTURE IN HCMC

It is also worth mentioning the institutional issues related to peri-urban aquaculture as they have certain effects on aquaculture activities and its development. Firstly, as peri-urban aquaculture is very little within the concerns of the City's Authority, it is rarely taken into consideration in the city's development planning process. Secondly, as a result of the above, land use priority is never specifically given to aquaculture when the city planners are setting target areas for urban development. This

leads to more uncertainty regarding the future of urban aquaculture development. Furthermore there is almost no clear plan for aquaculture development for the city though it might be included as a minimal component within the city’s agriculture development plans. Thirdly, farmers are provided very limited information about the city’s development plans thus they always feel high risk in investing further in their aquaculture activities, this lack of investment in inputs and infrastructure very definitely holding back aquaculture in the urban development process.

SWOT analysis for the development of peri-urban aquaculture in Ho Chi Minh City

<p>Strengths</p> <ul style="list-style-type: none"> -Strong interest from most of the farmers involved -Technically simple and easy to practice -Low inputs required -Good way of natural resource utilization -Good way of wastewater processing, environmentally friendly activity -Farmers’ main occupation -Farmers involved have strong capability 	<p>Threats</p> <ul style="list-style-type: none"> -Pressure from urbanization and industrialization on land use -Industrial waste contamination -Untreated wastewater usage -Presently unknown and unquantified risks for human health -Increased threat of production losses caused by industrial wastewater contamination -Competition and attraction of high price of land -Availability of other food sources for the city -Availability of alternative jobs for the young generation will reduce importance of WFA?? -The development of sewerage system may stop WFA in some locations whilst also introducing it to other peri-urban areas in and around HCMC.
<p>Opportunities</p> <ul style="list-style-type: none"> -High demand in aquatic food products from the city -Large potential future markets for aquaculture products -Ornamental fish culture – new aquaculture practice encouraged by local government to resolve the land use constraint in peri-urban area -Development of proper sewerage system may reduce industrial wastewater contamination and create new places for sewage-fed aquaculture 	<ul style="list-style-type: none"> -High level of vulnerability from production losses -Limited choice for water supply and uncontrollable water quality -High uncertainty limiting the investment willingness
<p>Weaknesses</p> <ul style="list-style-type: none"> -Industrial contamination of wastewater sources -Little concern by government -Low contribution in the City’s economy 	

CONCLUSION

Aquaculture activities in peri-urban areas of HCMC are still widely and actively being practiced and important in a number of peri-urban communities with a variety of different aquatic production systems. However they are increasingly facing constraints as the city develops. Under pressure from urbanization, aquaculture will have to move further out from the urban areas which will require more active and constructive efforts from both the government/city authorities and also from the farmer themselves. In the near future, the term “peri-urban” has to be understood in a wider context – not just limited within the city’s demarcated area but perhaps further out to parts of the neighbouring provinces.

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REFERENCES

Hung, L.T, Tu, N.V, T.T. Giang, 2000. Sewage reuse and food security in Ho Chi Minh City. Impress presentation in the seminar on Feeding Asian Cities, Prince Palace Hotel, Bangkok, Thailand. November 27-30, 2000.

Hoan, V.Q., 2001. Wastewater Reuse through Aquaculture in Hanoi: Status and Prospects. In L. Raschid-Sally, W. Hoek, and M. Ranawaka (Eds.), Wastewater Reuse in Aquaculture in Vietnam: Water Management, Environment and Human Health Aspects. Proceedings of a Workshop held in Hanoi, Vietnam on 14th March 2001. Available online: <http://www.cgiar.org/iwmi/pubs/working/WOR30.pdf> [Downloaded: 11st November 2002]

Huy, H.P.V., 2003. Potentials and Constraints in The Development of Wastewater-Fed Aquaculture Systems in The Peri-Urban area Of Ho Chi Minh City, Viet Nam. M.Sc thesis of Asian Institute of Technology, Bangkok, Thailand.

Institutional Analysis for Aquaculture in HCMC done by PAPUSSA project, 2003

Market Analysis Report done by PAPUSSA project, 2003

Participatory Community Appraisal Reports done by PAPUSSA project, 2003

Website of Ho Chi Minh City: www.hochiminhcity.gov.vn