

## STOCK ENHANCEMENT IN RESERVOIR FISHERIES

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### **Abstract**

Reservoir fisheries are one of the water resource ecosystems, which contribute to inland fish catch for family consumption and income for the poor people. To support government policy to regenerate fish species that have been lost and to increase the fish catch in the reservoir, stocking fish in the reservoir are option for consideration. A research activity on stocking of native species in Thmorda reservoir was conducted. The objective of the research was to evaluate if stocking in the reservoir could enhance the fish catch to increase food and income for the people living in the area.

Twenty one thousand and five hundred fingerlings of native fish; 10,000 *Barbonymus gonionotus*, 10,000 *Barbonymus altus*, 500 *Pangasianodon hypophthalmus* and 1000 *Trichogaster pectoralis*; were stocked in Thmorda reservoir on 5 November 2002. Monthly monitoring, informal discussions and catch assessment activities with fishers were conducted to collect information on captured stocked fish. According to the survey and discussions with fishers, stocked fishes grew 5 to 6 times faster than pond based aquaculture system. Up to 30-50% of stocked *Barbonymus gonionotus* and *Barbonymus altus* were recaptured, reaching a total weight of about 1,000kg, with an estimated value of about US\$1,400.

Stocking fish in reservoir is widely accepted by fishers as one of the most practical option to improve the livelihood of the people living in the reservoir. However, the ecological status and constraints after stocking should be studied and research conducted on how stocking native fish in the reservoir fisheries may affect the ecology of the reservoir or the socio economic conditions of the people living in the reservoir area.

### **1.0 Introduction**

Literature on Cambodia's inland fisheries makes frequent reference to the abundance of fish in the Tonle Sap and Mekong ecosystem and the expertise of the fishers who exploit this boundary. Together with rice, without a doubt, inland fisheries form the backbone of Cambodia's food security accounting for 3/4 of animal protein consumption and provide invaluable revenue and full or part time employment to around 2 million people, especially among rural households that still comprise almost 90% of the country's poor. Inland fisheries produce an estimated 290,000-430,000 tones of fish each year with an estimated value at landing of around US\$ 150m to US\$ 200m (DoF, 2002). In fact, the contribution of freshwater capture fisheries' to national food security and the Cambodian economy is deemed higher than in any other country in the Southeast Asian region.

The natural resource is rich in the 1.8 million-hectare freshwater system composed of rivers and lakes, reservoir, flooded forests, grasslands, rice fields, and swamps. Reservoir fisheries are one of the water resource ecosystems, which supply a lot of inland fish for family consumption and income for the poor people. There are approximately more than 600 reservoirs throughout the country. While reservoir fisheries may have adverse effects on existing fish habitats and stocks, they can also serve as new environments in which fisheries and fish culture can be developed. This is recognized by the government of Cambodia, who emphasize the need for adequate reservoir fisheries management in order to sustainably utilize their existing potential.

Yet, attention is increasingly being drawn to the impacts of over fishing and destructive practices. Illegal fishing with homemade bombs or dynamite, electro fishing or fishing with fine mesh nets are prohibited but are still being used by a number of fishers and have destroyed many fishes and other organisms. However, due to effective management, blast with bombs or dynamite fishing has decreased throughout the country.

Two rehabilitation options for natural aquatic resources are improved management through community involvement and stock enhancement. The objective of the study is to evaluate if stocking in reservoir could enhance the fish catch to increase food and income for the people living around the reservoir.

## **2.0 Characteristics of Thmorda Reservoir Fisheries and its Ecology**

Thmorda reservoir is located in Kampong Cham province to the north of the country and this reservoir is 135km from the capital city of Phnom Penh and 17km from Kampong Cham town. Thmorda reservoir was built during the Pol Pot regime (1976 to 1977) by human labor and it was renovated from November 1994 to May 1996 under a Royal Government Loan from the ADB (Asian Development Bank) for US\$1,543,000.

Figure 1 shows the location of Thmorda reservoir in Kampong Cham Province. The Thmorda reservoir covers 200 hectares in size but its water surface is approximately 70m<sup>2</sup> with a maximum dept of 4 meters. The reservoir has a capacity of 2,300,000 cubic meters of water, which can irrigate 2,000 hectares of rice fields. During rainy season, the water from the reservoir is channeled out through the gate and flows along the canal to the Tonle Sap River. During dry season, the reservoir is disconnected from natural water body but its water is used for irrigation in the two communes.

There are 749 families in the four villages living around the Thmorda reservoir. The main occupation is rice cultivation, followed by fishing which accounts for 30% of the total livelihood sources of families. However, around 15 families keep fishing as their main source of livelihood because they have no paddy field and garden, so they are depend mostly on the natural production in the reservoir.

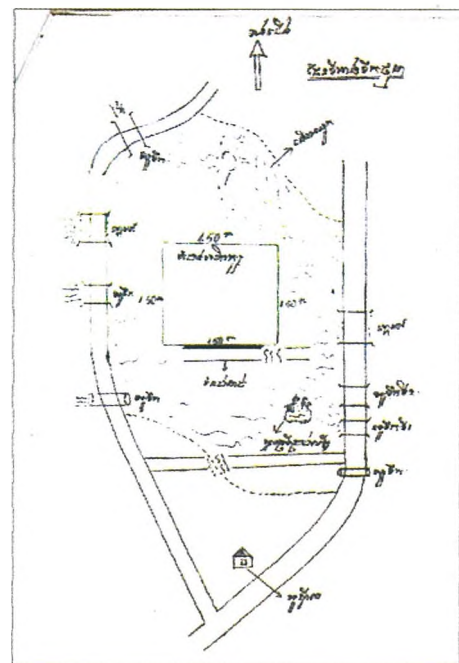
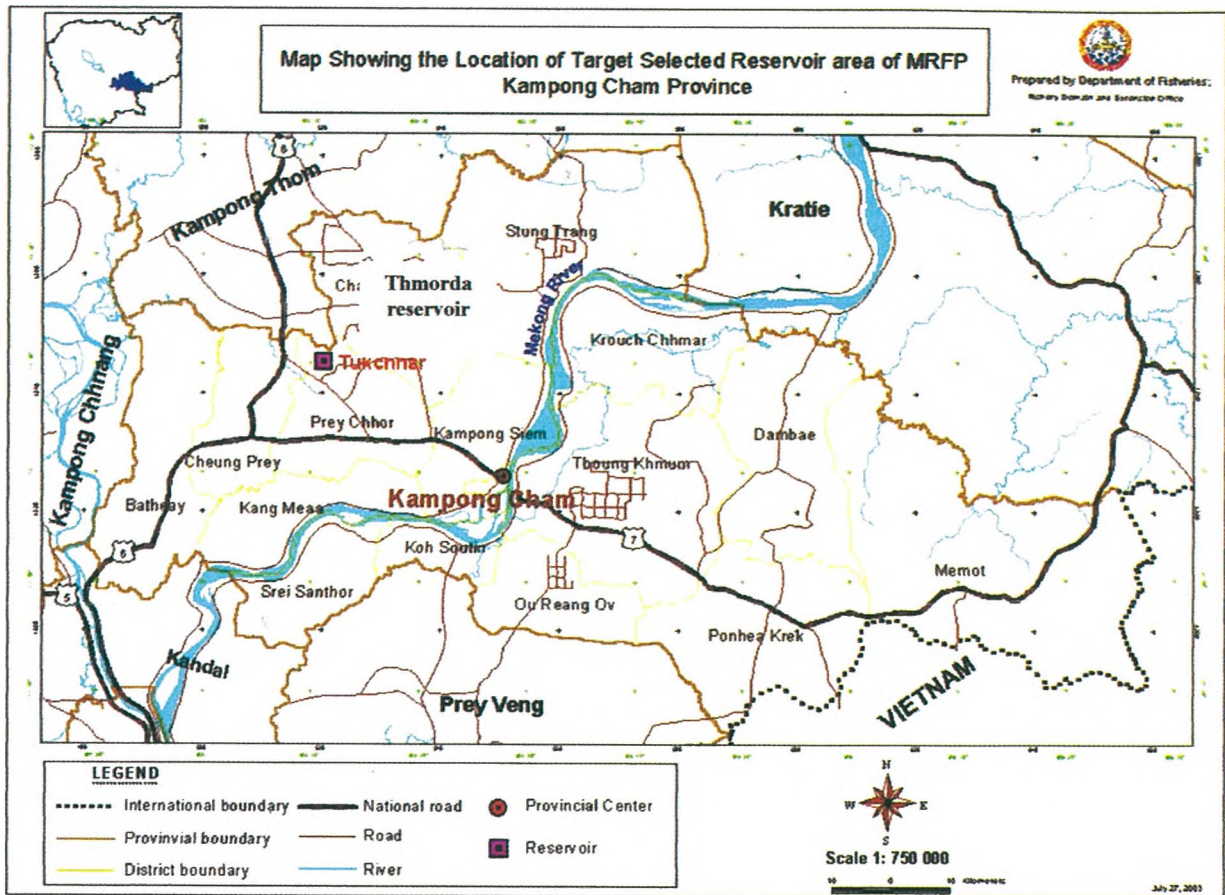


Figure 1: Map Showing Location of Thmorda Reservoir in Kampong Cham Province.

#### 4.0 Fishing Activities in Thmorda Reservoir

The Thmorda reservoir is rich in natural stock including many fish species and snails. Estimation from the catch assessment in the reservoir illustrated that in 2001 and 2002 the fish production was approximately between 13,000-15,000kg. Most fishers in the village use small-scale fishing gears to catch fish and some fishers collect snail manually. The common fishing gears used in the reservoir are cast net, gillnet, seine, hook, long line, spear gun etc. and with these types of fishing gear a fisher could catch fish amounting to about 8-10kg per day during rainy season and 2-3 kg during dry season. The major species found in the reservoir are *Hampala dispar*, *Pristolepis fasciata*, *Oxyeleotris marmorata*, *Channa striata*, *Clarias batrachus*, *Clarias macrocephalus*, *Notopterus notopterus*, *Henicorhynchus caudimaculatus*, *Anabas testudineus*, *Pseudabassis notatus*, *Mystus nemurus*, *Monopterus albus*, *Tilapia nilotica*, *Macragnathus siamensis*, *Macragnathus maculates*, etc. Some species that are lost in the last 5 years due to over and illegal fishing are *Barbonymus gonionotus*, *Cyclocheilichthys repasson*, *Cyclocheilichthys armatus*, *Osteochilus hasseltii* and *Wallago attu*.

Illegal fishing activities in the Thmorda reservoir have occurred during the last 5 years and these activities continue to date, even though community fisheries and local authority try to address them. Two types of illegal fishing gear used for fishing in the reservoir are electro fishing (Figure 2) and used of very fine mesh net (Figure 3). With these two prohibited fishing gears, fish stock in the reservoir decreased drastically from year to year, causing some species to disappear, especially *Barbonymus gonionotus*, *Barbonymus altus*, *Trichogaster pectoralis*, etc.



Figure 2: Electro Fishing



Figure 3: Used of Very Fine Mesh Net

#### 5.0 Community Fisheries Establishment in the Thmorda Reservoir

Because of their involvement in fishing activities, the people of the four villages surrounding the reservoir has organized community fisheries with technical support from the Department of Fisheries and financial support from the Component of Reservoir Fisheries Management of MRC. The main objective of the community fisheries management is the sustainable fisheries management and development of the reservoir region for food security and poverty alleviation.

With support from the Department of Fisheries and a component of the Reservoir Fisheries Management program, a reservoir committee was elected and formed. An internal fisheries regulation for the community fisheries of Thmorda reservoir has also been discussed among members of the committee and local authority under the technical supervision and support of the Department of Fisheries. The regulation was signed officially by the chief of committee and local authority and disseminated to the people living in and outside the reservoir region. Since the formation of the fisheries community in the reservoir, illegal fishing activities seem to have decreased and the fisheries resource in the reservoir seemed to have improved.

## 6.0 An Example of Stock Enhancement in Thmorda Reservoir Fisheries

### 6.1 Why do we Stock?

Stocking indigenous fish species in the reservoir might be an option to enhance reservoir fisheries in order to increase fish catch and improve the livelihood of the people living around it. In this connection, stocking of fish in the natural water body was considered as an effective measure to regenerate fish that has been lost and a sub-decree was officially signed by the Prime Minister of the Royal Government of Cambodia on 25 August 2002, effective immediately and also proclaiming July 1 of every year as the National Fish day.

To support this proclamation, the Thmorda reservoir was selected as a target place for fish stocking. Before stocking, a consultation with Thmorda reservoir community fisheries was conducted to identify which fish species will reintroduced and to discuss how to manage the stocked fishes. *Barbonymus gonionotus*, *Barbonymus altus* and *Trichogaster pectoralis* fish species have come under considerable pressure in the reservoir, and were under threat of disappearing in the past. On the other hand, according to the reservoir ecology, geographical feature and productivity, these three species were suitable for stocking. The fish species and number is shown in the Table 1 below:

Table 1: Fish Species and Number of Stocked Fish in Thmorda Reservoir

Stocked species	Number of Stocked Fish	Average weight (g)
<i>Barbonymus gonionotus</i>	10,000 seeds	2.60
<i>Barbonymus altus</i>	10,000 seeds	1.60
<i>Pangasianodon hypophthalmus</i>	1,000 seeds	1.30
<i>Trichogaster pectoralis</i>	500 seeds	2.50
<b>Total</b>	<b>21,500 seeds</b>	

The broodstocks were collected from the Tonle Sap River and bred at the Chrang Chamres station. The fish seeds from the station were transferred and stocked in the reservoir on November 6, 2002. The stocking ceremony was organized by the community fisheries and participated by local authorities, Department and provincial fisheries officers and local villagers. The ceremony was also used as an occasion to advice the people how to manage

stocked fishes and avoid using prohibited fishing gears. Figure 4 shows the participation of fishers in fish stocking activities.



Figure 4: Participation of Fishers in Fish Stocking Activities in Thmorda Reservoir.

## 6.2 Monitoring and Data Gathering

Every month, data such as number, species, fish weight, fishing gears and market price information were gathered from 40 fishers in the reservoir by district facilitator. In order to get accurate data, the record lists were distributed to fishers to record the information related to recapture stocked fishes. These activities were started since the end of the stocking month and now these activities are still on going. During monitoring, informal discussions with community fisheries and fishers have been conducted very often in order to get some feed back from fishers on fish stocking advantages and disadvantages and to share information among fishers. The discussion on yearly catch assessment with fishers has also been conducted in order to evaluate the catch after community fisheries formation and indigenous fish stocking.

## 6.3 Result of Stock Enhancement

The growth of stocked fish in the reservoir was significantly faster than in the pond. It must be due to low stocking density and high productivity in the reservoir than in the pond. The data from the survey showed that the growth rate per day of *Barbonymus gonionotus* and *Barbonymus altus* was 4.5g and 2.2g respectively, and they would be 5 to 6 times higher than in the pond base culture system. According to the survey, *Barbonymus*

*gonionotus* species reached 0.8 kg and *Barbonymus altus* reached 0.4 kg during 7 months period.

Only a small number of *Trichogaster pectoralis* and *Pangasianodon hypophthalmus* were recaptured from the reservoir. However, the growth of these species was found to be faster if compared to its growth in the pond base culture system.

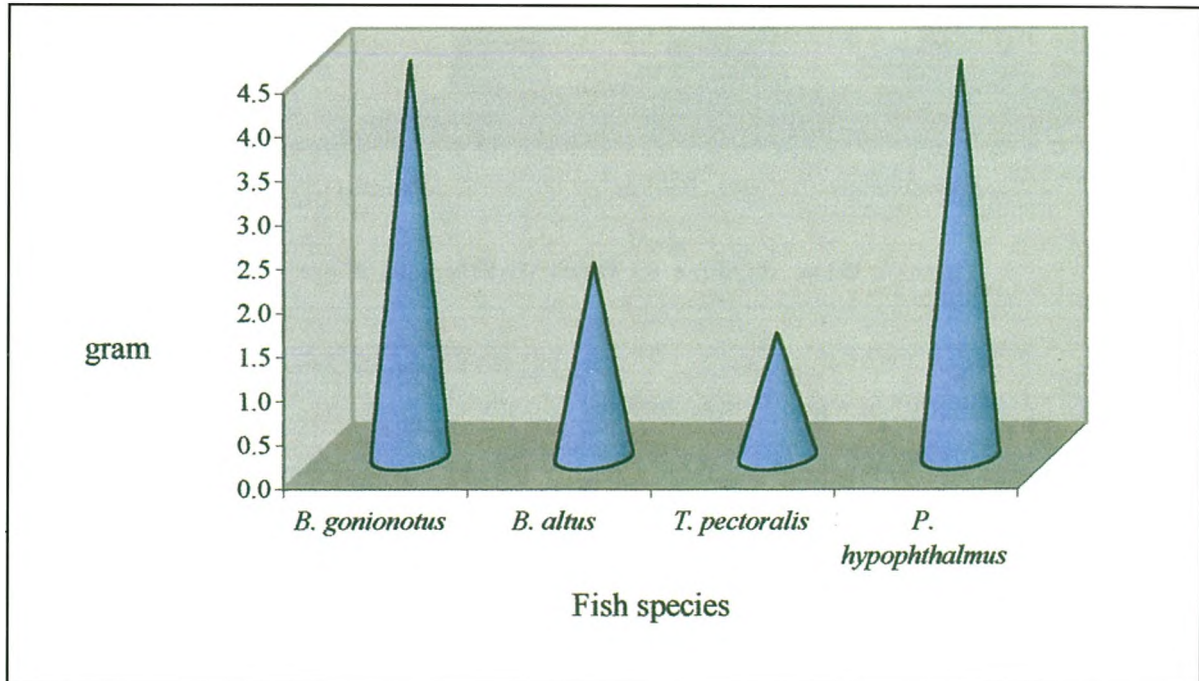


Figure 5: Average Growth of Stocked Fish

The stocked fishes have been caught since the end of November 2002 and the peak number of stocked fish was caught in December 2002 and then it decreased drastically from January to May 2003. . In Figure 6, around 1,000 *Barbonymus gonionotus* fishes were caught in December 2002 and from May 2003 only 30-50 fishes were caught. Among the stocked species, around 50% and 30% of *Barbonymus gonionotus* and *Barbonymus altus* were recaptured and only a small number of *Trichogaster pectoralis* (10%) and *Pangasianodon hypophthalmus* (2%) were recaptured respectively from the reservoir from November 2002 to May 2003.

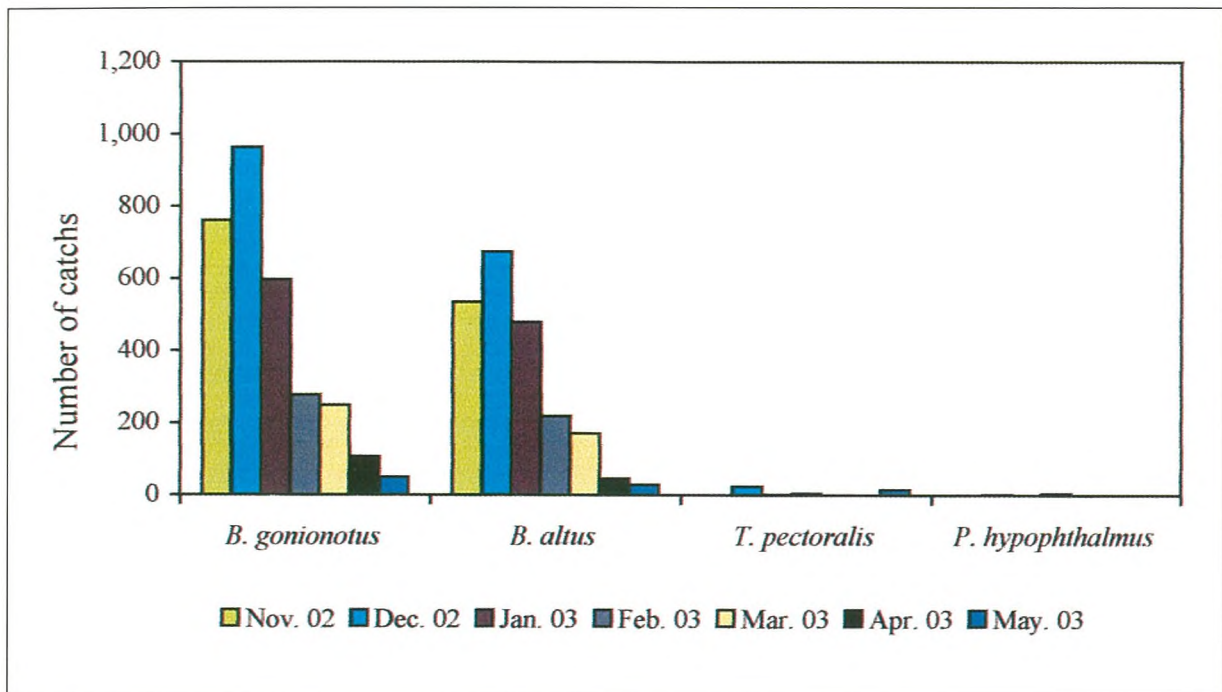


Figure 6: Number of Stocked Fish Caught by Month

Table 2 shows that from November 2002 to May 2003 the total weight of stocked fish catch was 972.7kg. Of this amount *Barbonymus gonionotus* contributed up to 705 kg (72%) and followed by *Barbonymus altus*, 258kg (26%). An even higher number of stocked fish was caught in December 2002 and January 2003 but the biggest weight of the stocked fishes caught extended from December 2002 to March 2003.

According to the catch assessment data, fish catch increased from 15,000 kg in 2002 to 18,720kg in 2003 (Figure 7). It means that after the fisheries community formation and stocking, fish catch increased by 20% wherein stocked fish contributed up to 26% of the increased catch and compared to the total catch in 2003 stocked fish contributed around 5.4%. When calculated in US Dollars the total income from stocked fish caught is about \$1,470.

Table 2: Total Weight of Stock Fishes Caught by Species and Month (kg)

Species	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Total Weight (kg)
<i>B. gonionotus</i>	65.0	150.0	155.0	95.0	120.0	70.0	50.0	705.0
<i>B. altus</i>	25.0	50.0	55.0	40.0	50.0	20.0	18.0	258.0
<i>T. pectoralis</i>		1.8	0.5	0.3			4.5	7.1
<i>P. hypophthalmus</i>		0.6		2.0				2.6
<b>Total Weight</b>	<b>90.0</b>	<b>202.4</b>	<b>210.5</b>	<b>137.3</b>	<b>170.0</b>	<b>90.0</b>	<b>72.5</b>	<b>972.7</b>



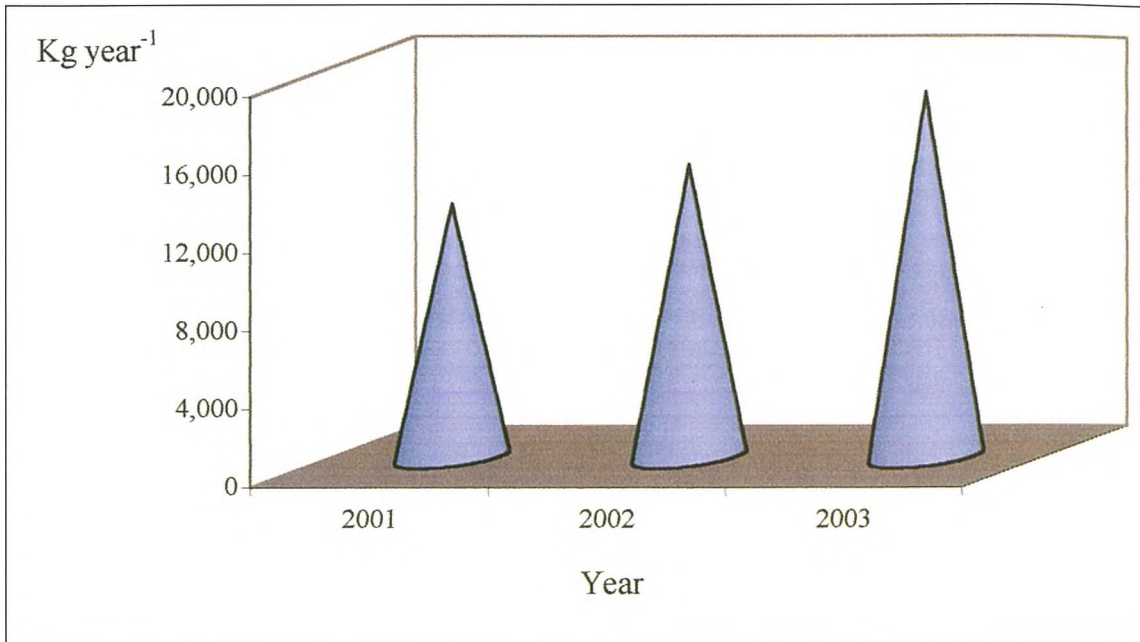


Figure 7: Total Fish Catch by Year (kg year<sup>-1</sup>)

The fishers in the reservoir area usually used gillnet, cast net, seine, hook line and knife to catch fishes. Gillnet is one of the most effective fishing gear that fishers used to capture the stocked fish. Around 80% of stocked fish was caught by gillnet and 15% by cast net. The mesh size of gillnet was increased every month in order to hunt *Barbonymus gonionotus*. In Figure 8, when the *Barbonymus gonionotus* grew from 0.0026kg at stocking month to 800g in May 2003 the mesh size of gillnet was changed from 4-5cm to 9-10cm.

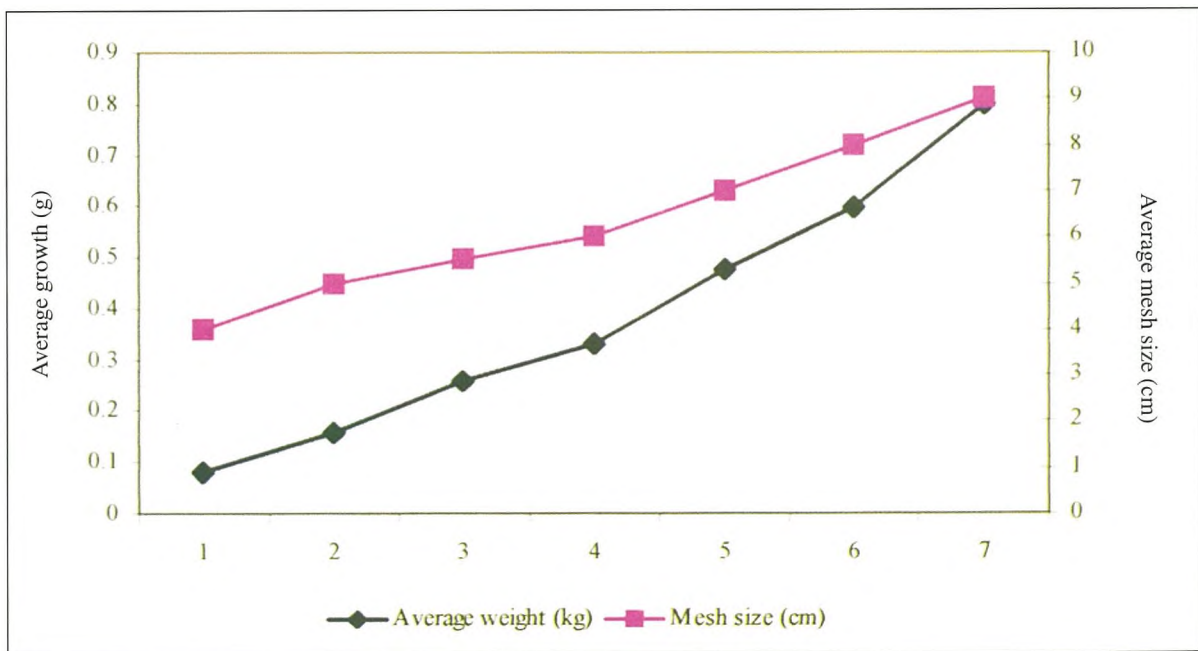


Figure 8: Relationship between Growth of *Barbonymus gonionotus* and Mesh Size.

#### **6.4 Attitude of Fishers Towards Fish Stocking Programmes**

The people in the reservoir fisheries of Thmorda are very happy with this activity because of increased food and income, especially since they were able to catch fish species that have already disappeared. According to the survey, around 60% of fish catch was sold in the village and 40% was kept for household consumption. Some fishers recommended that after stocking, the community fisheries should set up a fishing regulation, for instance, restriction of mesh size of gillnet used and time for fishing. However, some people complained that poor fishers could not catch the stocked fish because they were not able to buy fishing gear for target these fishes.

#### **7.0 Lessons Learned from Fish Stocking Programmes**

Fish stocking in reservoirs is widely accepted as one of the most practical and effective method to enhance fish catch and preserve aquatic resources in the reservoir fisheries.

As a result of the practical work on releasing native fish in the Thmorda reservoir, fishes grew very fast and recapture was also very high (up to 50%), especially *Barbonymus gonionotus* and *Barbonymus altus* because these species could adopt well to the reservoir ecology, natural productivity and physical feature. Therefore, before stocking native fish species in the reservoir, selection of fish species must be done based on their adaptability and suitability to the reservoir environment.

Fishers were very happy with the fish stocking because they gained some benefit such as more fish for consumption and more income through increased catch, which helped to improve the livelihood of the fisher families. As a result, after fisheries community formation and stocking the total catch per year increased up to 20%, 26% of which valued at US\$ 1,470 came from stocking.

Stocking in close reservoir is more profitable than in open reservoir because stocked fish will not migrate to other places and lead to higher recapture rate (50%).

What is the next step with the stocking in the reservoir; should continue or stop. Two options might be consider as recommendation for community fisheries to manage the fish recruitment and fish catch. First option is that the community fisheries should intervene by preparing some regulation on fishing activities such as restriction of mesh size and time for fishing. If it's effective, fish catch will increase and stocked fish can be recruited by natural reproduction without needing manual stock. But sometime this option is not effective to implement because fishers in the reservoir may be difficult to be changed their habitude. However, the secondary option might be more effective. The community fisheries should promote one fisher to become the fish seed producer. This seed producer should be responsible for producing and stocking fingerling in the reservoir. But to keep sustainability operation of seed production, all fishers in the Thmorda reservoir must pay a small amount of money to the fish seed producer.

Therefore, this practice is being recommended to be continued and applied to other reservoirs throughout the country but selection of stocked fish must be consider depending on ecology, productivity and physiology of the reservoir.

## **8.0 Recommendations for Further Study**

The following are some recommendations for further study:

- Social impact of fish stocking
- Constraints of fish stocking faced by fishers
- Ecological change in reservoir after stocking

## **9.0 Reference**

**DoF (2002).** Catch assessment report. Department of Fisheries Cambodia.