

Status and Constrains of Carp Aquaculture
Industry Development in Indonesia

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ABSTRAK

Produksi perikanan di dunia sebesar 50% berasal dari perikanan budidaya dan kira-kira 98% diantaranya dihasilkan di Asia termasuk Indonesia. Tujuan penelitian ini adalah untuk melihat gambaran umum dari budidaya ikan mas dan pemmasalahannya di Indonesia. Metode penelitian yang digunakan adalah survey dan menggunakan data statistik tahunan dan data primer. Budidaya ikan mas di Indonesia biasanya dilakukan di kolam, keramba dan sawah. Jenis ikan mas lokal di Indonesia adalah *Sinyonya*, *Cumpai*, *Kancradomas*, *Punten*, dan *Majalaya*, sedangkan ikan mas yang berasal dari hasil silangan yaitu *Kuningan*, *Sutisna*, *Rajadanu*. Kedua jenis hasil silangan ini *diintroduksi* di Jawa Barat dan Nusa Tenggara Barat. Masalah utama yang dialami dalam budidaya ikan mas di Indonesia adalah tingkat produksi yang masih rendah, yang disebabkan oleh input teknologi pakan, dan kualitas yang rendah sebagai akibat penurunan kualitas lingkungan. Masalah yang lain adalah harga berfluktuasi, harga yang diterima oleh pembudidaya yang rendah, keterbatasan infrastruktur pasar dan kurangnya dukungan dari lembaga keuangan.

Introduction

Background

The supply difficulties experienced by capture fisheries in Asian developing countries are being partly counter-balanced by increased aquaculture production. Most aquaculture production in Asia is consumed locally, and local demand is predicted to keep expanding during the next decade. FAO (2000) has states that "As an inexpensive source of a highly nutritious animal protein, aquaculture has become an important factor for improving food security, raising nutritional standards, and alleviating poverty, particularly in the world's poorest countries".

Carps are the single most important group of fish contributing to world aquaculture production. They account to nearly 50 percent of world aquaculture production and about 98% of culture carp production is in Asia. Among people with low income, carps are favored because of their appealing taste and low price. In some Asian locations, carps are the main source of animal protein.

Carp aquaculture production has grown by 12 % per annum during the past decade, whereas production from capture fisheries has been declining at an average rate of one percent per year. About 13.5 million metric ton (T) of carp are produced annually in Asia by aquaculture and the average value per kg of the product is about USD 0,6 (Dey et al., 2002).

Carp Genetic Improvement Project Phase I, which was involved of six Asian countries have been succeeded to lay down the prospect of fish industries, particularly on finding the genetically improved carp, where in Indonesia this project has successfully conducted the Rajadanu strain (Atrmadja, 2004 p.c.). The efficacy of this project is believed that emerge from the good carp seeding, which is produced the high quality of carp seed with growth rate reach up to about 10% per year. Using the conservative assumption, carp genetic improvement is able to increase the carp production about 5% per year in the first year of its spreading, economic gain around of USD 40,5 millions. Add 5% for subsequent years will yield in fifth year the economic benefit equal to more or less US\$ 60 billion. This calculation indicates that adopted carp species very to improve food security and lessen poorness in Asia.

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By the way, efficiency exploiting of this carp strain need some important scientific information of social economics aspect yet. This aspect is related to improvement the capacities of fish seeding organizer and fish farmer, either by governmental side and or private sector. Information required in order to guarantying that carp strain population is looked after enough pre-eminent, can be multiplied and overspread to fish farmer and also used effectively in production system. In the end, the progress will affect to improvement the prosperity of small scale fish farmer.

Purpose

This study aimed to review the production, consumption and marketing of common carp aquaculture (including brood stock size) in Indonesia.

Study Method

This study was executed by desk study method. Data sources come from related institution, especially in various report form and annual aquaculture statistics and result of study especially from Marine Affairs and Fisheries Agency and Freshwater Aquaculture Research Institute.

Carp Aquaculture Status in Indonesia

Aquaculture Production in Indonesia

Table 1 shows the fish culture production in Indonesia by species. The table is indicates that common carp (hereinafter only stated as carp) culture production tend to be decrease in period of 1996 to 1999, showed by the production 69,091,000 kg in 1996 was step down to 57,278,000 kg in 1999. Table 1 also shows that the carp culture production from 2000 to 2001 has an increase tendency, when it notes by amount of the common carp culture production 75,322,000 kg in 2000 was step up to 76,475,000 kg in 2001. By percentage, production of carp culture during 1996 – 2001 was increase about 10.34%.

At the same period, the production of another species, e.g. Java barb, Mozambique tilapia, Nile carp and Snakeskin gouramy are decrease, but not for Nile tilapia and catfish,. The Nile tilapia production tends to be increase 51.77%, from 17,665,000 kg (1996) up to 34,122,000 kg (2001). In the mean time, the catfish production is also increase about 43.25%, from 14,765,000 kg (1996) up to 34,136,000 kg (2001). In general, Table 1 shows that carp is occupied about 34.45% of total aquaculture production in Indonesia. This condition gives an indication that common carp is the most favor species, both for cultured and consumed by Indonesia's societies.

Table 1. Aquaculture production by species in Indonesia, 1996–2001 (000 tones).

Species	1996	1997	1998	1999	2000	2001
- Total	182,918	171,768	168,478	177,622	214,393	222,790
- Common carp	69,091	63,864	56,546	57,278	75,322	76,475
- Java barb	19,753	15,327	14,043	15,633	15,542	13,250
- Mozambique tilapia	16,174	16,257	14,029	14,738	14,089	12,881
- Nile carp	17,226	9,934	10,245	10,850	12,057	12,554
- Nile tilapia	17,665	17,187	19,522	22,817	30,742	34,122
- Giant gouramy	7,453	7,975	9,004	9,327	13,339	17,865
- Snakeskin gouramy	2,614	2,736	2,799	2,795	3,099	2,586
- Kissing gouramy	6,635	5,603	5,321	5,693	4,718	4,512
- Catfishes	14,765	23,199	18,450	24,991	28,991	34,136
- River eels	71	1,703	1,560	194	195	841
- Others	11,471	7,983	16,959	13,306	16,299	13,176

Source: Annual book of Aquaculture Statistics, DGAF - MMAF, 2003.

Table 2 – 4, shows fish production by species which is resulting from three aquaculture systems in Indonesia (paddy field, cage and freshwater pond). Table 2 shows that common carp production

with paddy field system during 1996 – 2001 was decrease 9.31%, from 74,782,000 kgs (1996) down to 67,819,000 kgs (2001). On the other hand, the production of other species, i.e. Silver barb, Mozambique tilapia, Nile carp and Kissing gouramy, are also increase. However, based on all fish species production using paddy field system, the common carp is still the most favor species because of its production occupied about 69.07% of total production.

Table 2. Paddy field culture production by species in Indonesia, 1996–2001 (000 tones)

Species	1996	1997	1998	1999	2000	2001
- Total	101,214	94,334	89,930	94,634	93,063	98,190
- Common carp	74,782	71,234	48,281	61,647	65,924	67,819
- Java barb	13,212	8,337	7,661	11,391	9,788	12,012
- Mozambique tilapia	3,738	2,745	2,993	3,849	4,177	4,760
- Nile carp	381	695	414	347	579	2,702
- Nile tilapia	2,062	2,078	1,856	2,904	4,235	2,411
- Giant gouramy	145	133	560	253	272	826
- Snakeskin gouramy	499	391	400	967	352	214
- Kissing gouramy	26	19	49	127	95	91
- Cat fish	834	913	1,348	2,324	2,357	1,453
- River eels	-	29	404	2	127	8
- Freshwater prawn	-	-	-	-	-	34
- Others	5,535	7,760	25,964	10,823	5,157	5,860

Source: Annual book of Aquaculture Statistics, DGAF - MMAF, 2003.

Fish production by species was produced by cage system in Indonesia shows by Table 3. This table indicates that common carp production by cage system during 1996 to 2001 was decrease about 51.34%, from 34,489,000 kgs(1996) down to 16,783,000 kgs (2001). On the other hand, with the same culture systems, the production of other carp species, i.e. Silver barb, kissing gouramy, catfish, and tilapia, are decrease. However, based on all fish species production using cage system, the common carp is still the most favor species because of its production occupied about 42.66% of total production.

Table 3. Cage culture production by species in Indonesia, 1996 - 2001 (000 tonnes)

Species	1996	1997	1998	1999	2000	2001
- Total	44,631	26,186	17,639	32,323	25,773	39,339
- Common carp	34,489	11,574	5,082	20,445	7,901	16,783
- Java barb	221	249	1,420	1,782	6,710	857
- Mozambique tilapia	1,111	3,336	472	1,620	769	1,002
- Nile carp	969	199	130	98	185	63
- Nile tilapia	5,941	8,819	5,429	5,496	5,949	7,642
- Giant gouramy	138	566	101	240	454	336
- Snakeskin gouramy	2	50	12	-	35	8
- Kissing gouramy	13	38	14	32	71	24
- Cat fish	28	75	59	35	798	1,390
- River eels	-	90	382	-	4	39
- Cat fishes	-	-	-	-	-	807
- How's carp	-	-	-	-	-	41
- Indonesia snake head	-	-	-	-	-	66

Source: Annual book of Aquaculture Statistics, DGAF - MMAF, 2003.

Fish production by species was produced by freshwater pond system in Indonesia shows by Table 4. This table indicates that common carp production by freshwater pond system during 1996 to 2001 was increase about 9.66%, from 69,091,000 kgs (1996) up to 76,475,000 kgs (2001). The increase tendency is also depicted in the production of other carp species, i.e. Silver carp, Kissing gouramy, and Catfish. Additionally, based on all fish species production using freshwater pond system, the common carp is still the most favor species because of its production occupied almost about 34.33% of total production.

Table 4. Freshwater ponds culture production by species in Indonesia, 1996 – 2001 (000 tones).

Species	1996	1997	1998	1999	2000	2001
- Total	182.918	171.768	168.478	177.622	214.393	222.790
- Common carp	69.091	63.864	56.546	57.278	75.322	76.475
- Java barb	19.753	15.327	14.043	15.633	15.542	13.250
- Mozambique tilapia	16.174	16.257	14.029	14.738	14.089	12.881
- Nile carp	17.226	9.934	10.245	10.850	12.057	12.554
- Nile tilapia	17.665	17.187	19.522	22.817	30.742	34.122
- Giant gouramy	7.453	7.975	9.004	9.327	13.339	17.865
- Snakeskin gouramy	2.614	2.736	2.799	2.795	3.099	2.586
- Kissing gouramy	6.635	5.603	5.321	5.693	4.718	4.512
- Catfishes	14.765	23.199	18.450	24.991	28.991	34.136
- River eels	71	1.703	1.560	194	195	841
- Cat fish	-	-	-	-	-	306
- How's carp	-	-	-	-	-	43
-Indonesia snake head	-	-	-	-	-	-
- Sleeper gobies	-	-	-	-	-	-
- Freshwater prawn	-	-	-	-	-	43
- Others	11.471	7.983	16.959	13.306	16.299	13.176

Source: Annual book of Aquaculture Statistics, DGAF - MMAF, 2003.

Related to the study of socio-economics assessment of carp and genetic improve carp strain in Indonesia, then by using of the data shows on Table 2 to 4 and also Table 5 which is shown by assumption that carp is produced dominantly by pond, cage, and paddy field systems, it is considered that West Java Province being as one of study area because of this province has the biggest amount of fish culture production.

While, since the West Nusa Tenggara is not being a province which is has a big amount production of common carp as showed in Table 5 but was informed as one of the introduction or dissemination area for Rajadanu Strain, one of genetic improve common carp strain in Indonesia (p.c. Atmadja, 2004), then this province is also determine to be a study area.

Various Carp Species in Indonesia

Carp is included in Ostariopyschi ordo, sub-ordo Cyprinidea, family Cyprinidae, sub-family Cyprininae and genus Cyprinus. In Tropical region, it has known that optimal growth of carp in culture is at height between 150 - 700 m above of sea level, though this fish can live and cultured up to height 1000a.s.l. m. Water temperature for carp habitat is range from 18°C - 30°C (optimum between 20 - 28°C) with dissolved oxygen content in water more than 3ppm and acidity degree (water pH) range from 6.5 – 9.0. Carp is easily to culture. This fish has a wide niche range that makes carp known as a fish that has big environmental adaptation energy and easy feeds as an omnivore species, it able to eat various kinds of feeds, from artificial and natural feeds such as coconut oil cake, pellets, phytoplankton and zooplankton.

Table 5. Aquaculture production by aquaculture types and provinces in Indonesia, 2001 (000 tones).

Province	Total	Type of culture		
		Freshwater pond	Cage	Paddy field
TOTAL	360,322	222,792	39.34	98.19
SUMATERA	86,603	52,874	14.81	18,919
N.A. Darussalam	3,63	1,139	3	2,488
North Sumatera	15,175	8,598	203	6,374
West Sumatera	20,221	13,309	3,809	3,103
R i a u	13,49	11,167	2,24	83
J a m b i	2,834	2,065	754	15
South Sumatera	18,927	7,903	7,645	3,379
Bangka Belitung	104	104	-	-
Bengkulu	5,004	2,883	4	2,117
Lampung	7,218	5,706	152	1.36
J A V A	234,849	153,117	9,352	72.38
DKI Jakarta	1,601	1,601	-	-
Banten	4,887	4,887	-	-
West Java ¹	151,669	98,747	367	52,555
Center Java	33,408	25,062	6,657	1,689
D.I. Yogyakarta	4,318	3,907	143	268
East Java	38,966	18,913	2,185	17,868
BALI-NUSATENGARA	4,193	2,372.0	818	1,003
B a l i	916	490	35	391
West Nusa Tenggara ²	2,955	1,624	783	548
East Nusa Tenggara	322	258	-	64
KALIMANTAN	14,95	2,567	12,198	185
West Kalimantan	2,057	1,216	841	-
Center Kalimantan	1,792	322	1.47	-
South Kalimantan	3,801	797	2,819	185
East Kalimantan	7,3	232	7,068	-
SULAWESI	17,911	10,393	1,815	5,703
North Sulawesi	6,652	2,926	1,703	2,023
Gorontalo	382	233	100	49
Center Sulawesi	3,824	3,807	12	5
South Sulawesi	6,237	2,611	-	3,626
South East Sulawesi	816	816	-	-
MALUKU - PAPUA	1,816	1,469	347	-
Maluku	4	4	-	-
North Maluku	3	3	-	-
Papua	1,809	1,462	347	-

Source: Annual book of Aquaculture Statistics, DGAF - MMAF, 2003.

Morphologically, carp has a long and compressed body, "terminal and proctactil" mouth and part of its anterior has two complaint tides. In general, carp body almost covered by scales, which is relatively big and classified as sikiploid type. Carp body is also provided with fin. This morphological characteristic becomes a distinguished aspect for a various dominant local species of carp culture in Indonesia, which are:

- Carp "Sinyonya". This species has a relative lengthy body and its color turn yellow youngly. This species also identified by its slit eyes that almost closed with skin membrane;
- Carp "Kumpai". The special characteristic for this species is has a very long fin.
- Carp "Kancradomas". This species has a scaly body and colorful scales. The scale color of back area is dark and moving to stomach area the color is turn to silver bright.
- Carp "Punten". The body of this species relatively short or has "big belly" form. The back area is high and wide with dark green scales closing over the body. It is also has a rather uppermost eye and its movement and seems tammy.
- "Carp " Majalaya". This species relatively has a short body. High back is hunchbacked and slim. While, its part of body progressively fine-form toward back and snout form is flat.

Beside those species, carp also has improves or pre-eminent strain and recognized ones in Indonesia, which are:

- Carp Rajadanu
- Carp Sutasna Kuningan

Carp is one of few species that has successfully cultured in Indonesia. The domination of carp production because of some excellences from supply sides, which are a high growth level, high resistance to disease and parasite, only required a minimum environmental factors and slowly mature start. Carp also has excellences from demand side (market) when many consumers have opinions that common carp has soft flesh and delicious tastes.

Carp Culture Technologies

Hatchery

Seeding carp conduct in traditional and intensive ways. Both have some differentiation based on the operational technique. In Sukaluyu subdistrict, Cianjur District, West Java, carp fish farmer adopt traditional hatchery technique, in general. This technique is also recognized as a common technology used by carp fish farmer in another area in West Java. Traditional hatchery has been run for many generations, without mains election and lack of feed selection (usually from kitchen pickings and a little mixture of rice and bran). Fertilization treatment is giving patch of or worst there is no fertilization treatment, and the water quality is not paid attention yet (Suseno, 1994).

Initially, fish mains were obtained from Fish Seed Institute of Marine Affairs and Fisheries of Cianjur district, but here in after farmers tried to seed mains by themselves. Some phases performed within carp hatchery, which were obtained from some field observation in center of carp hatcehry spread along at Cianjur district, West Java, are:

1. *Brood Stock*

Brood stock pond utilized before spawning, owning 1 m² width with 0.75 m deepness. Meanwhile, feeds were given in the form of kitchen pickings and bran. Brood stock ponds of female and male mains are different in order to stimulated them when they met, hence spawning happened quickly.

2. *Holding pond*

After they were selected, fish mains are placed in holding pond without feeds during 48 hours before spawning. The purpose of this treatment is to make all energy of them are used only for spawning activity and not for digest food activity. Spawning pond is made narrow and separated between female and male mains, so that they are not able to move freely and do undesirable spawning.

3. *Spawning*

Spawning activity is required "kakaban" with 1.5m length and 0.4 m width which is attached in spawning ponds and the number of "kakaban" was required for one kilogram carp mains is about 5-7 "kakaban".

Before spawning conducted, spawning ponds were dried for three days. Hereinafter, pond is filled by clear water in the morning before attached "kakaban" in the evening. The pond base must be free from mud and stone and the water pond contain enough oxygen. After that, carp mains are released in the morning. At the early day, "kakaban" which egg result of spawning has stick on it was removed to hatch ponds. Every sheet of kakaban needs a 30-50 m² of hatch pond. Seed resulting from spawning can reach up to 15.000-30.000 female mains per kilogram after drying pond in three weeks.

Fry rearing

Fry rearing is conduct to enlarge fish seeds resulted by egg hatch until their size is quiet enough to disperse for rearing. Fry rearing pond is prepared by draining it for 2-3 days before having a fertilizing treatment. Usually, fish farmers, such as founded at Sukaluyu subdistrict, Cianjur district, West Java, were used organic fertilizer.

Stocking density is uncertain, and feeds are only from kitchen pickings or bran. Fry rearing phase 1 has duration about 12-15 days and feeding is in the form of egg yolk. While another phases, which is fry rearing phase 2nd to 6th, generally conduct in three weeks or harvested according to buyer or consumer request.

Fry rearing ponds is 10 times wider than hatch ponds. In Sukaluyu subdistrict, carp farmer is preferred to conduct fry rearing in paddy field. To obviating carp seeds from predator attack and to assist for looking for the natural feeds, every fry rearing ponds or paddy fields are given 1-2 couple of fish mains.

Fish seed that planted at fry rearing usually has size about 1 – 3 cm, stocking density around 70.000-100.000 fish with cultivating duration 30 day. The result is seeds with size 5-8 cm known locally as *putihan* with life ability rate is about 40-60% from stocking density.

Rearing

Carp rearing production which explained below is the common carp culture system that conducted by fish farmer society in West Java. It is consist of description of rearing unit growth and rearing technology, which are floating cage net (KJA) and freshwater pond.

1. Floating Cage Net (KJA)

Carp culture in floating cage net is common rearing technology that conducted by fish farmer society in West Java. Elaboration below is the description of this technology application in territorial waters of Jatiluhur Dam, Cianjur district. In this region, this carp culture system is conduct, either by monoculture (namely carp) or polyculture (carp and nile tilapia). Cultivating duration for carp generally about 3-3.5 months, while for nile tilapia is 5-6 months, then fish farmer in one year able to conduct three plant seasons for carp and two plant seasons plant for nile tilapia.

a. Floating Cage Net Preparation

The preparation of floating cage net is started by construct pocket net frame, that is has ability to be utilized as place gallows of pocket net. Usually, the net pocket frame is made from bamboo or iron. Fish farmer in Jatiluhur Dam makes a pocket net frame from iron materials, in general.

Materials and equipments for build pocket net frame are consists of iron, bamboo, drum, wood, mine and sinker of saw nail. The irons are jointed each other by using nut, nipper and bolt, so that those in formed as a square frame. Meanwhile, bamboos are bounded by using nipper and mine, each side stringed up by fastening back part of each side so that bamboos are also constructed in square form and their functioned as a footbridge for fish farmer when feeding the fish and for another activity.

Drums are attached at underside of cage net frame in order to keep the frame construction remained to floating in water, while wood drum frame was utilized as breach-block of drum in order to not appear. Frame, which is already tightened to drum, will be dipped in to the water to nailing at every back part of pocket net frame. In each frame side there are 4-5 drum. Frame which had attached by drum is ready for put down by boat in determine location.

b. Pocket Net

Pocket net utilized as cultivating place of enlarged fish. Pocket net, used by poly culture fish farmer, is consist of two shares, external and internal pocket. External pocket net use for Nile tilapia cultivation and internal one is for carp cultivation. Length and mesh size at every pocket is unequal, where the external pocket net has larger mesh size compare with internal pocket net. Net type utilized by fish farmer in Jatiluhur is polyethylene net with mesh size 1-1.5 inch for internal and 1.5 - 2 inch for external. First installation net process is installing external pocket net, than internal pocket net. After net installation, fish seeds to be enlarged ready for preserved.

c. Seed Preserve

Seeds size which preserved depends to the wanted rearing size. There are two ways of seed preserve which is usually conduct by fish farmer in one unit of KJA (49m²). First way is 100-150 fish in one kilogram seed or equal to 10 grams per fish for measure 100 fish per kg and the second one is 6.67 gram per fish for 150 seeds fish per kg. Those way are appropriate to carp or Nile tilapia, with seeds length range from 4-10 cm.

Monoculture fish farmer preserved carp seeds around 94 kg per season unit plant or 11.308 fish per unit per season plant. Stocking density for carp monoculture is 0.64 kg per m³ or 76.93 fish per m³ per unit per season plant. Poly culture fish farmer preserved carp seed around 84 kg per unit per season plant or around 11.207 fish per unit per season plant. Stocking density for carp poly culture is 0.68 kg per unit of m³ or 76.24 per unit per season plant. For Nile tilapia, fish farmer preserved seeds 53 kg per unit per season plant or around 82.88 fish per unit per season plant. Stocking density for Nile tilapia is 0.36 kg per m³ or 56.38 fish per m³.

Stocking density is conducted in evening day with new arrival seeds directly preserved into empty pocket net. Fish farmer of Jatiluhur Dam usually buy seeds both fish species not at the price of per fish or liter size but fish farmer buy seeds per kilogram. Seeds carp range from IDR 15.000,00 - 20.000,00 per kg depend on seed measure. Smaller asked seeds measure, costly price progressively. Payment of seeds is generally by cash.

d. Feeding

Seeds fish looked after by giving the goodness feeds and enough with high enough protein content. Generally feeds which use by farmer contain 25-30% protein in food composition. Feeding counted 3% from weight of fish body which we look after per one day. To minimize, feeding counted in three times per day, that is morning time, evening and noon. But outside the regular time, in fact many fish seems pop out to water level which is indicate the hungry fish. In that condition fish farmer have to give feeding, this matter is done by fish farmer in Jatiluhur Dam because farmer do not determine how much percent of feeding each day of total weight of rearing fish.

Feeding conducted by fish farmer by preserve in middle shares and feeds in disperse little by little, this matter is done with a purpose to not many feeds which is castaways. Nile tilapia, which is live under carp pocket, is only accepting the rest of feeds or feeding which is get away from pocket net carp. Besides Nile tilapia eat moss type patching at pocket net.

Fish farmer buy feeds in the feeds store that located around his culture location. Feeds price is IDR 2,100.00 /kg and the payment mechanism is not cash but with duration about one week later the feeds paid. Mains feeds of by monoculture fish farmer is 2.333 Kg per unit per season plant, while for type of poly culture equal to 2.383 Kg per unit per season plant.

e. Harvesting

Fish to be harvested had a relation with size fish seeds which was preserved when spreading, cultivating period and feeds given. Time period of cultivating influence amount of feeding and fish measure goals will reach. A period of carp cultivate in KJA of Jatiluhur Dam is three months, so that carp twice cropping compared Nile tilapia. While a cultivating period of Nile tilapia is two times from carp cultivating period is six months.

The average of harvesting result by fish farmer of Jatiluhur Dam for mono culture is equal to 1.836 kg per unit per season plant with carp amount between 2-12 fish or average for 1 kg about 5 fish consumption. For poly culture, fish farmer can harvest carp equal to 1.863 Kg per unit per season plant with carp amount from 2-12 fish or one kilogram of 5 fish consumption,

while for Nile tilapia, fish farmer can harvest equal to 1.296 Kg per unit per season plant with fish amount of Nile tilapia 3-6 fish per kilogram or one kilogram of 4-3 fish consumption.

Harvesting is usually conducted when temperature relative lower, that is starting 19:00 WIB till 05:00 WIB. Harvesting conducted totally for all fish types, because seeds measure was reserved in relative same in every unit of KJA.

Harvesting conducted by narrowing movement space in pocket net. This matter was conducted by unlacing net from both framework angle and constructively bamboo of net in furling from one side to other net side. To facilitate intake of fish, net pocket rather lift. Gathered fish had been taken by using frock and plastic drum, which had made hole to accommodate fish later in deliberating. Fish which have in deliberating input into double plastic sack which had filled water. After input fish to plastic, last in giving oxygen and tied with rope, this matter valid for carp and Nile tilapia. Then fish bringing to land by using boat to be sent into or out town.

f. Input-Output

Carp culture in KJA is influenced by some factors that are able to divide into two categories. First is control factor, for example wide of KJA, seed, labour and feeds. Second one is uncontrollable factor that is environmental factor such as weather, water current and temperature and also the condition of other territorial water.

Table 6. Production and production factors of carp culture in floating cage net, West Java, 2000.

Description	Amount	Minimum	Maximum	Average
Production (kg)	67.250	1.000	3.000	1.681,25
Width (m ²)	10.831	98	490	270,48
Seeds (kg)	6.045	100	500	151,13
Feeds (kg)	80.300	1.000	3.000	2.007,50
Employment(HKP)	1.860	22,50	90	46,50

Usage of production factors of carp culture in KJA will determine the level of fish farmer revenue. In this analysis, level of fish farmer revenue compare between actual condition with optimal condition. Level of revenue can be seen in following tables.

Table 7. Revenue analysis of carp culture in floating cage net, West Java, 2000.

Description	Actual Condition (IDR)	Optimal Condition (IDR)
Cost ($\sum X_i \cdot H_{xi}$)		
• Seeds (X ₂)	2.220.480	4.986.720
• Feeds (X ₃)	3.605.294	3.934.084
Revenue (Y. Hy)		
• Production (Y)	8.920.860	15.211.430
Benefit (π)	3.095.086	6.290.626
R/C Ratio	1,51	1,74

From the table, it shows that revenue level of fish farmer accepted is bigger at optimal condition compared to actual condition. It means that ratio between revenue and cost highly made the result efficiently and at the time maximum benefit level reached.

2. Rapid Basin (Freshwater Pond)

Fish culture at rapid basin (freshwater pond) is fish preserve using limited field, high stocking density, compulsion give artificial feeds and water abundant. In rapid basin not all fish species can be developed. Till now newly some species which was potential to develop are carp and Java barb yet, with the most giving results are coming from carp. In general, carp culture only used for rearing. There are few factors which is very determine carp culture in rapid basin conducting that is field preparation, seed selection, feeds and disease control.

a. Ponds Made and Prepare

Ponds can build in form of oval counted 20 ponds consist of 16 ponds. Ponds have 8 m length, 2.5 m width and 1.5 m deepness. Because of ponds debit water is very rapid wall and ponds build permanent. To get optimal water circulation and so that enough water productivity be

spread evenly so that oval form construction had to used reinforced concrete tying so that productive age of ponds become longer. The expectation of ponds made was there will be more muds, pickings and dirt of feeds which can be swept away out ponds. In each channel, go to limestone ponds to stabilized pH.

Ponds cultivating was conducted by cleansing three-day once and calcified one day. Ponds cleaned to be clear always because clear water is one factors to increasing fish appetite. Situation of enough water of cleanness because irrigate controlled with sweeping of connective moats of River of Cinagara with ponds. Water cultivating in the area conducted by recognized officer with the title " PARTNER of CAI", besides to take care of clear water always planted by eceng gondok for the filtering of dirt which enter into ponds.

Ponds dried one week, then elementary land processed and extracted, last filled with condensation and water of PK during 15 minute, salt added. This matter aim to increasing fish and avoid disease. Then ponds given water 80 cm later in letting during three-day, besides seed input of the size mean 100 gr per fish.

b. Seed Preserve

Under colour of debit irrigate 300 liters per second and preserve duration during 2 months so stocking density is 20-25 kg of m2 ponds where one seed has mean weight 100 gr per fish. So that when harvesting not exceed ability of ponds accommodation then used seeds have normal characteristic that is about 100 grs per fish, eat gluttonous, diametrical head form, if holded to felt smooth or soft / not stiff.

c. Feeding

Feeding was done in morning, noon, and evening. Feeding may not hurried because if the feeds do not provocation will sink to ponds base then contaminate water. Amount of feeds requirement for one season plant is about 720 kg to one ponds. Feeding not use selected dose, but with estimate. Usually dose of feeds depended of the cultivation of that 20 first day 3% from cultivations amount, 20 second day 4% from cultivations amount, and 20 third days 5 - 6% from cultivations amount. Convert feeds 2:1, with the meaning one kg of feeds fish can add fish weight 0.5 kg.

Feeds in the form of commercial palette with protein rate about 26%, neither mouldy nor dissolve easily to in water. Feeding at this rapid in place basin fish still use traditional way that is scattered as according to giving time which is ordinary to be conducted.

d. Disease Controlled

Disease is one of the problem, which was often faced by fish farmer after few weeks or 1 month, some fish in the reality suffer from disease. When the disease is not being handled well, fishes will die entirely. If the situation of water is normal, rapid water fish pond not many disease or pests, except when stocking the fish situation is chafed or brought long distance, before stocking it will be better if soaking first in PK or disinfectant, to prevent continuation infection (2,5 gram of PK per 1 M3). The procedure is fish soaking into PK 25 ppm during 30 minute. If in water tub counted 1 meter cubics, condensation of PK not more 25 kg fish during 30 minute. If fish stocking a lot pain then cured, or all together cured direct in ponds. Calculation of water volume in ponds soaking PK 5 ppm or 5 gr PK per 1 meter cubic for 2 hour. The medicines obtained from medicine store or shop.

e. Harvesting

Harvesting can be executed every 2 months, depend from utilized ponds amount or used to be productive and difference a period of planting to every ponds. Fish measure for stocking density equal to 300 gr per fish. During 2 months plant counted 300 kg and harvest 660 kg. Normally, in one year the farmer can harvest about 5 times. When harvesting time fish, feeding should not give for 1 day, to avoid dirt in tidiness to cause stres fish.

Afterwards ponds dried up to deepness 20 cm of ponds base, expected at the harvesting time the ponds condition is clean. Fish capture shall not use appliance to prevent fish damage. Harvest is usually conducted in the morning time. Before brought fish has to be fasting and to maintain fish in good condition using plastic sack with size 1.2 m which has filled water (10 liters and each plastic sack with filled by oxygen gas is not more than 10 kg in order to keep fish a life.

Carp Market and Marketing

Carp Market

Sufficient carp market for example is fish market of Cibaraja founded in the year 1950 broadly area 0.40 hectare. Constructor of this market is conducted by government for the agenda of assisting all fish farmers in course of marketing and also arranges all fish merchants. Before fish market of Cibaraja founded, activity of fish sales transaction done in roadway periphery so that traffic fluency annoyed.

Activity of fish marketing in Cibaraja fish Market is growth naturally from time to time. To support activity of marketing of fish in the year 1977 Local Government Of Sub-Province of Sukabumi complete market facilities and basic facilities for example making of basins and store relocation of fish. Source of defrayal rehabilitate the come from Sub-Province budget of Sukabumi, Province West Java and National.

Activity in fish market of Cibaraja take place almost every day, ad for red-letter days especially feast day of Idul Fitri and feast day of Idul Adha. Daily activity starting from 05.00 until 10.00 WIB (in the morning) and from 19.30 until 23.00 WIB (at night). Morning activity is sales various fish species and in so many fish measure which generally from Sub-Province region of Sukabumi while at night specific oversold fish that is carp and Nile tilapia consumption measure is from floating net cage of Jatiluhur, Saguling and of Jatiluhur.

Fish merchant of fish market Cibaraja was used assorted of appliance of storing for fish storage such as holding ponds, stocking ponds, bucket and cage. Special for the consumer of holding ponds and stocking ponds imposed by rent expenses equal to IDR 500,00 per day and IDR 15.000,00 per ponds for the duration of one months.

Fish merchant and fish farmer are having transaction in Cibaraja fish market imposed by retribution. Level of retribution which in going into effect in base Local Regulation (PERDA) Province of West Java No. 9 Year 1994 hitting market ticket. Merchant using cage imposed by retribution equal to IDR 300,00, merchant bringing fish isn't it motor vehicle imposed by retribution equal to IDR 750,00 while merchant of fish using truck imposed by retribution equal to IDR 1.500,00.

Size of Seed Fish and Fish Market

Fish which is trade in fish market of Cibaraja consist of various measure and species. Seed fish type which in marketing among others is carp (*Carpio cyprinus*) what was generally grouped in measure;

- a. Kebul is fish size 0-1 cm age 10-12 day after hatch.
- b. Burayak, is fish size 1-3 cm age 15-20 day after hatch.
- c. Belo, is fish size 3-5 cm age 30-50 day after hatch.
- d. Ngaramo, is fish size 5-8 cm age 40-60 day after hatch.

Sale of fish measured by using various measure type, that is dish, kilogram and tail (kg). Seed Fish measure of kebul, and the burayak of belo of him measured by using litre or dish. Fish measure seed of kebul, and burayak of belo sale measured by using litre or dish. Fish measure seed of nagaramo sold by per kilogram or tail, while consumption fish sold per kilogram. Fish or fish seed which have been sold tidy then by using double plastic of footage 1 m and wide 40 cm have capacities to more or less 15 kilogram following oxygen.

Merchant of fish follow price gyration applying market in determining price. Some of merchant give discounts equal to 5% from retail price if buyer buy in gross. Merchants of fish conduct direct payment system (cash), but if buyer forget customer given dispensation to pay by credit.

Constraints faced by all merchants of fish seed relate to facility are availability of water in dry season. At dry season, water current of Cibaraja River which supplied water demand of this market is very small and it caused the lack of water supply for this market. Further, the lack of water availability is make another negative condition for fish, which are the lack of oxygen for fish seed and poison generated by fish dirt sediment on water level that emerge caused by fish seed movement.

Marketing Distribution

Fishery result which come on the market fish of Cibaraja have enough area reach wide. Target area of marketing of fish is for example some district such as Sukabumi, Bogor, Bandung, Cianjur, Tanggerang, Karawang, Pandeglang, Bekasi, Jakarta, Lampung and also Palembang. Based on data of Market Fish at Cibaraja, Cianjur district, offer that happened earn in evaluation from two aspects that are fish type and measure.

Is evaluated from measure, is equal to 60% measure fish seed of kebul and of burayak which on the market needs fulfill effort fish aquaculture in rice field and ponds of fish farmer in Sub-Province of Sukabumi, while the rest (40%) fulfill request of fish seed from outside Sub-Province of Sukabumi. For the seed of measure fish of belo, equal to 60% from totalizing offer in fish market of cibaraja fulfill request of areas from outside Sub-Province of Sukabumi and the rest (40%) to fulfill local requirement. For the seed of fish of ngaramo, equal to 65% from totalizing bargaining in Market Fish of Cibaraja fulfill request of areas outside Sub-Province of Sukabumi.

Is evaluated from fish kind, equal to 75% carp type and Fish of Nile tilapia fulfill requirement of net conducting effort float, rapid basin, calm basin, and type of effort other fish farmer area of Cianjur, Pandeglang, Serang, Purwakarta and of Bogor, while the rest (25%) fulfilling requirement of farmer [in] Sub-Province region of Sukabumi.

Marketing of Carp Consumption

Mean carp weight result of production fish farmer use system of floating net cage in Accumulating basin of Jatiluhur is equal to 200 gram per tail and for the fish of nile tilapia is equal to 250 gram per tail of with long gyration of fish between 13-20 cm. total Cropping mechanism of fish Accumulating basin of Jatiluhur usually take place during 3 day, farmer usually give announcement 3 day before all to compiler if harvesting fish.

Carp price and fish of nile tilapia result of production fish farmer in Accumulating basin of Jatiluhur [in] determining by all middleman which also is seeds fish supplier in Accumulating basin of Jatiluhur. Gyration Price Carp mean consume for type of effort monoculture is IDR 4.800,00- 5.200,00 at the price of mean equal to IDR 4.900,00 per Kg while price gyration for the Fish of Nile tilapia is IDR 3.500,00 - 3.800,00 per Kg at the price of mean equal to IDR 3.553,00 per Kg.

Fish farmer in Accumulating basin of Jatiluhur most selling result of the crops of to all compilers because amount all compiler which many so that all farmer of difficulty fish not to find all compilers, but there is also selling direct to whole saler, consumer and dealer. Whole saler usually is all owners of ponds - fishing ponds or all restaurant and restaurateurs. Dealer are all ordinary merchants which selling in the market. Payment accepted by fish farmer selling the product of passing all non cash compilers generally but with maximum tempo one week after cropping hence just conducted payment by compiler.

Production of KJA in accumulating basin of Jatiluhur this in the marketing of besides for the consumption of society of Purwakarta, was also marketed to region of Jakarta, Cikampek, Bandung, Subang, Sukabumi and Bogor. To region around Accumulating basin of Jatiluhur or Sub-Province of Purwakarta all big merchant and dealers usually come by themself because all merchant usually have known cropping schedules all farmers while sale to outside Accumulating basin of Jatiluhur and Sub-Province of Purwakarta usually farmer deliver to all middleman, farmer pittance in Accumulating basin of Jatiluhur conducting the product promotion of exit of Accumulating basin of Jatiluhur or Sub-Province of Purwakarta caused by limitation of medium had so that farmer most still rely on existences of compiler paar.

Concluding Remarks

This paper shows that carp culture production in Indonesia is still at low production level at this time. This phenomenon is caused by low level input technology on feed and degrading of environmental water quality. Carp culture industry in Indonesia, representatively by West Java Provinces conditions, also facing some problems, there are lower and fluctuate accepted price on fish farmer, limited on infrastructure of market and market institution and lack of fund to support related institute.

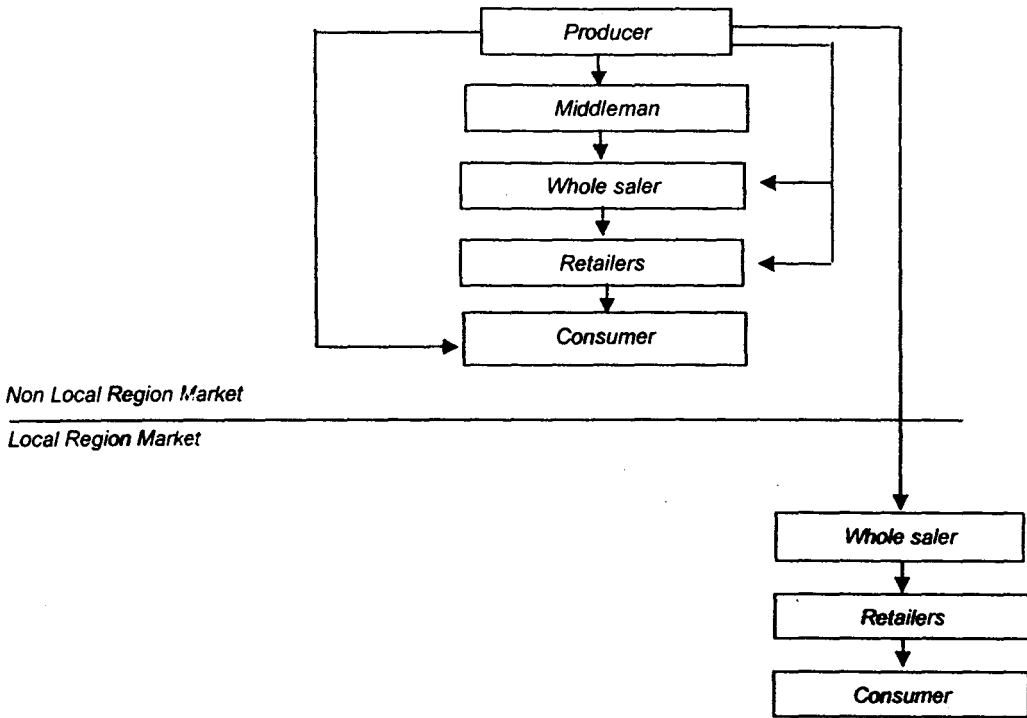


Figure 2. Fish Marketing Channel of Marketing of Monoculture and Polyculture Type at Jatiluhur Dam.

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Reference

- Anonymous, 2003. Annual Book of Indonesian Aquaculture Statistics. Directorate General of Culture Fisheries. Jakarta.
- Anonymous, 2003. Annual Book of West Java Aquaculture Statistics. Marine Affairs and Fisheries Service of West Java Province. Bandung.
- Anonymous, 2002. Annual Book of West Java Aquaculture Statistics. Marine Affairs and Fisheries Service of West Java Province. Bandung.
- Anonymous, 2001. Annual Book of West Java Aquaculture Statistics. Marine Affairs and Fisheries Service of West Java Province. Bandung.
- Anonymous, 2000. Annual Book of West Java Aquaculture Statistics. Marine Affairs and Fisheries Service of West Java Province. Bandung.

Anonymous, 1999. Annual Book of West Java Aquaculture Statistics. Marine Affairs and Fisheries Service of West Java Province. Bandung.

Anonymous, 1998. Annual Book of West Java Aquaculture Statistics. Marine Affairs and Fisheries Service of West Java Province. Bandung.