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# AIR-BREATHING FISH CULTURE

## PACKAGE OF PRACTICES FOR INCREASING PRODUCTION


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## *FOREWORD*

*In India there are several thousand hectares of fallow derelict swampy waters unsuitable for carp culture. But airbreathing fishes, by virtue of the presence of accessory respiratory organs can thrive well in such adverse, low-oxygen environmental conditions. These fishes are well known for their high protein, high iron and low fat content and easy digestibility and as such, suitable for all people, particularly for those suffering from protein imbalance. The Government of India, State Governments and voluntary agencies are taking keen interest in development of air-breathing fish culture in this country. Farmers and entrepreneurs are increasingly coming forward for adopting airbreathing fish culture. CIFRI's airbreathing fish culture technologies are now available to achieve high production from such water bodies. The manual synthesises all available information from various culture experiments conducted by CIFRI and is presented here as a set of package of practices for easy adoption of farmers. The format and content of the manual is designed keeping in view the needs of extension workers, entrepreneurs, bank officials and progressive farmers. It is hoped the manual would add further fillip in the transfer of technology to users.*

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# PACKAGE OF PRACTICES FOR INCREASING PRODUCTION OF AIR-BREATHING FISHES

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The air-breathing fishes are distinguished by the possession of an accessory respiratory (air-breathing) organ, which enables them to exist for hours at times out of water, or indefinitely in oxygen poor waters and even in moist mud. Not only they are able to thrive in water containing low oxygen but they are also extremely hardy with respect to all other environmental parameters and are suited to shallow and derelict waters. They are highly priced for their high protein, high iron and low fat contents. In India, the States of Assam, Meghalaya, Bihar, West Bengal, Orissa. Andhra Pradesh, Karnataka, Madhya Pradesh, Uttar Pradesh, Maharashtra and Tamil Nadu support the most significant natural fishery of air-breathing fishes. They are generally carnivorous in nature and in culture operation they adapt excellently to supplemntary feeding with dried marine trash fish, oil cake and rice bran. Magur and Singhi are known to be feeding on gastropods, microcrustaceans, tubificid worms, insects and other larvae. Koi is gerenally microplankton feeder in younger stages and takes to insectivorous habit in later stages. Koi responds favourably to feed oriented culture with oil cake and rice bran.

## 1 CULTIVABLE SPECIES

Magur (*Clarias batrachus*), singhi (*Heteropneustes fossilis*) and murrels, *Channa marulius*—giant murrel, *C. striatus*—stripped murrel and *C. punctatus*—spotted murrel are the most important cultivable species apart from koi (*Anabas testudineus*).

## 2. CULTURAL PRACTICES

### 2.1 Pond management

The air-breathing fish culture is equally adaptable in waters unsuitable for conventional culturable species of carps as well as in carp culture ponds. It is parti-

cularly oriented to shallow waters (2-3 feet so that the fish has to spend less energy in travelling to surface for intake of atmospheric oxygen) and is essentially a short term culture system, the production being commensurate with the intensity of management. The only material input needed are the fingerlings (6-10 gms) and feed as there is no requirement of fertilizers. Replenishment of water becomes an essential input in case of very heavy stocking rate and multiple cropping to obtain very high yields. However, for effective management, the pond should not be more than 0.1-0.2 ha in size. In case of perennial ponds, care should be taken to remove or to kill existing predatory fishes by application of mahua oil cake @ 2500 kg/ha meter of water area. After 15 days of mahua oil cake treatment, the pond bottom may be raked by dragging a few bricks tied to a rope. If the bottom silt is very heavy, lime treatment @ 300 kg/ha will reduce toxicity in the pond.

Mono-culture of magur or singhi with high input technology, invariably meets with *Microcystis* bloom in summer months, particularly, in the months of May and June. It has been found that this problem can be overcome by changing the ambient water when its transparency (Secchi Disc.) comes down to 16-20 cm at 12 noon or harvesting before May when the farmer is not able to change the water.

Growth of magur and singhi goes very well upto the water temperature of 32°C. Fishes are seen to be under stress around 35°C and mortality starts from 38°C onwards. Hence, in summer months water depth should be so controlled that its temperature may never go beyond 35°C.

Air-breathing fishes can withstand very low oxygen in water but with low oxygen the surfacing activity of the fish for aerial oxygen increases to a great extent and thereby loose some body weight. Therefore, the presence of optimum oxygen value in water (5 to 6 ppm) leads to higher growth rate and consequently, higher production.

**2.2 Seed collection and transport**

Inspite of success achieved in induced breeding, the seed of magur, singhi and murrels collected from the nature continues to be the dependable source of material for stocking.

Fry of giant murrel can be identified by their dark grey body and a lateral orange yellow band from eye to the caudal fin. Fry of stripped murrel have vermillion

red body with reddish golden band and a dark black band from eye to the caudal fin. The spotted murrel fry can be recognised by their dark brown body with a golden yellow lateral band and a mid dorsal yellow line on the back. Magur fingerlings can be identified by their longer dorsal fin and slate colour while that of singhi can be known by their shorter dorsal fin and pinkish colour. Fingerlings of koi are having a dark spot on the caudal peduncle and greenish hue on the dorsal surface of the body, Murrels usually breed, in tanks, rivers and swampy beels during April to June with the onset of monsoon, singhi and magur generally breed in swampy beels and paddy fields in the rainy season, the paddy fields being the most preferred breeding ground for magur.

Small fry are collected by a quick haul with a fine meshed cloth hapa and larger fry with velon netting hapa. The fingerlngs of *C. marulius* and *C. striatus* are collected by operation of small meshed cast net. The effective way of mass scale collection of fingerlings, specially those of magur and singhi, is by dewatering the barricaded low lying areas and paddy fields. The peak season for the collection of seed of singhi and magur is pre-winter period when paddy is harvested and the low lying fields get exposed. Collection of murrel seed is generally made during monsoon. Availability of air-breathing fish seed in time and space in some parts of Assam, Andhra Pradesh, Bihar, West Bengal and Karnataka is delineated in Table—1.

Fry and fishlets of air-breathing fishes are generally transported without oxygen packing. The carrier (usually polythene drum or iron drum) in which fry and fishlets of air-breathing fishes are to be carried must have enough of open space for their habitual surfacing to breath air.

Presence of weeds in air-breathing fish culture pond not only provides protection from poachers but is also conducive to the occurrence of a variety of insects to be utilized as food for these fishes. Limited presence of water hyacinth in about 1/3 portion of the water surface helps in controlling algal bloom.

### 2.3 Nursery Management

The fry rearing phase in murrels is a littile complex due to cannibalism. The cannibalism can be reduced with sufficient supplementary feeding. High survival can be achieved by supplementary feeding and addition of micronutrients, yeast and vitamin B. Survival of 87.7% to 100% has been recorded withgoat's blood, and yeast, and tadpoles and minced trash fish respectively as food.

**Table—1** : Some collection centres of air-breathing fish seed

| Months of occurrence | State | Place | Source | Species |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| October + November | Assam | Hajo | Pitkati beel | singhi, koi |
| -do- | ,, | Monakuchi | Kochua beel | singhi, koi |
| -do- | ,, | Hajo | Channel | singhi, koi |
| -do- | ,, | Panipara village | Inundated area | singhi, koi |
| -do- | ,, | Mangaldai | Upahpara | magur, singhi, koi |
| October+November | West Bengal | Canning | Paddy fields | magur, singhi, koi |
| December | ,, | Basirhat | Paddy fields+ beels | magur, singhi, koi |
| -do- | ,, | Heldanga | Swampy areas | magur, singhi, koi |
| -do- | ,, | Kalinagar | Paddy fields | magur, singhi, koi |
| -do- | ,, | Itindaghat | Paddy fields | magur, singhi, koi |
| May+June | Karnataka | Shimoga | River Thunga | murrel (*C, marulius*) |
| -do- | ,, | Hagaribommana-halli | River Hagari | -do- |
| August | ,, | Mangalore | Inundated paddy fields | magur |
| June | Bihar | Champaran | | singhi |
| -do- | ,, | Darbhanga | | singhi ..Contd, |

Table—1 (contd.)

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| September | Bihar | Gumla | | Magur |
| -do- | ,, | Ranchi | | Magur |
| -do- | ,, | Singhbhum | | Magur |
| October | ,, | Ranchi | | Magur |
| -do- | ,, | Singhbhum | | Magur, Koi |
| -do- | ,, | Lohardaga | | Magur |
| -do- | ,, | Gumla | | Magur |
| November | ,, | Ranchi | | Magur |
| -do- | ,, | Singhbhum | | Magur |
| -do- | ,, | Gumla | | Magur |
| March | Andhra Pradesh | Malliagudem area creek | | *C. striatus* |
| April | ,, | Jakkapallay | Palair river | *C. striatus* |
| May | ,, | Anantagiri | Creek + Reservoir edge | *C. marulius* |
| August | | Palavaram | Middle reachers of Palair river | *C. striatus* |
| August | ,, | Urulukonda | Reservoir edge | *C. striatus* |
| September | ,, | Narasimhapuram | Reservoir edge | *C. striatus* |
| September | ,, | Thummagudem | Reservoir edge | *C. striatus* |

Nurseries (about 10-15 $m^2$) having a water column of 50 cm are stocked with 0.2 to 1.5 million fry/ha. Prior to stocking, manuring is done with cowdung alone @ 500 kg/ha. Sometimes soap oil emulsion has also been applied to keep the nurseries free from insects. Advanced fry and fingerlings of magur and singhi collected from natural source do not require nursery management while murrels have to be trained to accept artificial feed in the nursery ponds before stocking.

**2.4 Stocking**

Air-breathing fishes permit high stocking density. For monoculture of magur and singhi in stagnant ponds the stocking rate of 40,000-60,000 fingerlings/ha of water area is recommended. For culture of mugur with carps adopting polyculture technique, the fish may be stocked in place of common carp @ 20,000-30,000 fingerlings/ha in addition to the recommended stocking density of carps.

Giant murrel may be stocked for monoculture @ 15,000 fingerlings/ha ; the stripped and spotted murrels @ 20,000 fingerlings/ha and 25,000 fingerlings/ha respectively for monoculture. For mixed culture, the latter two species may be stocked @ 20,000 fingerlings/ha in the ratio of 1 : 1. Uniform size fingerlings raised in nurseries and trained to accept artificial feed are recommended for stocking.

Successful culture of air-breathing fishes depends upon stocking of right size of fingerlings (6-10 g), regular feeding and check on the health of the fish stock particularly when derelict ponds are utilized for culture.

Before stocking, the fingerlings should be given a dip in 200 ppm formalin solution for 40 seconds as a prophylactic measure. During periodic check on growth, the wounded fish may be treated with 0.3% acriflavin for 5 minutes.

**2 5 Feed and feed schedule**

Abundant availability of dried marine trash fish in maritime states (West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Maharastra and Gujrat) makes the culture of air-breathing fishes more economical. However, in the states where such facilities are not easily available, feeding programme for singhi and magur can be executed using fish offal or slaughter house waste or dried silkworm pupae mixed with rice bran and oil cake in the ratio of 1 : 1 : 1. A mixture of oilcake, rice bran and bio-gas slurry in the ratio of 1 : 1 : 1 has proved successful low cost feed for singhi and may be continued throughout the culture period. However, for magur the feed mixture may be reinforced proportionately with animal protein as mentioned above.

During the six-month semi-intensive culture in stagnant ponds, the air-breathing catfish stock may be fed at the following rate daily during dark hours of the day to obtain better feed utilization.

**Table-2** : Feeding schedule for magur in 0.1 ha pond stocked with 5,000 fingerlings.

| Period | kg/day | Feed ratio (trash fish : rice bran) |
|---|---|---|
| 1st month | 1.2 | 1 : 3 |
| 2nd month | 2.4 | 1 : 1 |
| 3rd month | 4.0 | 3 : 1 |
| 4th month | 8.0 | 3 : 1 |
| 5th month | 6.0 | 2 : 3 |
| 6th month | 4.0 | 1 : 3 |

Feeding may be done either by broadcasting the feed in small amounts till the fish stop feeding or by feed-containing baskets lowered near the banks in addition to broadcasting of feed to ensure feed availability to all the fishes in the pond.

Murrel fingerlings reared in nurseries become trained to accept externally provided feed, otherwise they need be trained by providing smashed trash fishes ( minnows and trash fishes ) @ 25% of the total stocking weight for about 15 days. Trained fingerlings will also accept cheaply available dried marine trash fish soaked in water which may be provided as per the following feeding schedule.

**Table—3** : Feeding schedule for murrel stock (per ha.) with dried trash fish soaked in water.

| Period | Feed (kg/day) |
|---|---|
| 1st month | 2.5 |
| 2nd month | 5.0 |
| 3rd month | 10.0 |
| 4th month | 12.5 |
| 5th month | 15.0 |
| 6th month | 20.0 |
| 7th month | 25.0 |
| 8th month | 25.0 |

**Table—4** : Gross output, operational costs and net farm income for murrel culture/ha/8 months.

| | | | | |
|---|---|---|---|---|
| **Cost Functions** | | | | |
| 1 | Culture species | Giant murrel | Stripped murrel | Spotted murrel |
| 2 | Stocking | 15,000 | 20,000 | 25,000 |
| A | **Material inputs** | | | |
| 1 | Fresh trash fish requirement (kg) | 550 | 500 | 500 |
| 2 | Dried marine trash fish requirement (kg) | 3,000 | 2,750 | 2,750 |
| 3 | Lime treatment 300 kg @ Rs. 0.60/kg | 180 | 180 | 180 |
| 4 | Cost of 100 fingerlings | 15 | 10 | 8 |
| 5 | Total cost of fingerlings | 2,250 | 2,000 | 2,000 |
| 6 | Cost of trash fish @ Rs. 2/-kg | 1,100 | 1,000 | 1,000 |
| 7 | Cost of dried marine trash fish @ Rs. 2.50/kg | 7,500 | 6,875 | 6,875 |
| 8 | Cost of chemicals | 100 | 100 | 100 |
| B | **Factor services (Rs.)** | | | |
| 1 | Rent of pond | 3,000 | 3,000 | 3,000 |
| 2 | Wages of 20 fishermen @ Rs. 10/- fisherman/day | 200 | 200 | 200 |
| 3 | Wages of 2 persons for watch and ward duty & farm management @ Rs. 300/- month | 4,800 | 4,800 | 4,800 |
| 4 | Hire charges of Diesel pump for harvesting | 1,500 | 1,500 | 1,500 |
| 5 | Total price cost (Rs) | 20,630 | 19,655 | 19,655 |
| 6 | Bank interest @ 15% on working capital | 3,094 | 2,947 | 2,947 |
| | **Total costs (Rs.)** | 23,724 | 22,602 | 22,602 |

Table 4 (contd.)

| | | | | |
|---|---|---|---|---|
| C | **Return functions** | | | |
| 1 | Average growth (g) | 400 | 275 | 160 |
| 2 | Survival percentage | 60 | 60 | 80 |
| 3 | Production (tonnes) | 3.6 | 3.3 | 3.2 |
| 4 | Sale price (Rs) on farm per kg | 10 | 10 | 10 |
| 5 | Gross sale proceeds (Rs) | 36,000 | 33,000 | 32,000 |
| 6 | Net return (Rs) (Gross sale paidout cost) | 12,276 | 10,398 | 9,398 |
| 7 | Percentage return over operational cost | 52 | 46 | 42 |

However, during culture period, the quantity of feed should be determined after assessing the response and satiation rate of the fish in the pond. Slaughter house waste and silkworm pupae as a source of animal protein in place of trash fish can also be used judiciously. Feed may be broadcast on all sides from the embankment.

### 2.6 Culture duration and production :

With satisfactory response to external feeding, the growth must be good. On an average, the conversion rate with recommended feed is approximately 2 : 1. Magur and singhi are expected to attain weight on an average upto 120g and 50g respectively in 6 months whereas giant murrel, stripped murrel and spotted murrel grow to about 400g 275g and 160g respectively in 7-8 months of culture period.

With the suggested stocking and feeding rates as per field trials in the States of West Bengal, Bihar, Karnataka and Assam, production @ 3-4 tonnes/ha/6-8 months is expected (Table 4 and 5).

The production potential of air-breathing fishes under high input technology has been amply demonstrated by this Institute in mono and mixed culture experiments.

Under semi-intensive culture practices with supplementary feed made of dried trash fish and rice bran, magur gave a production @ 5 tonnes/ha/6 months while

Table—5 : Gross output, operational costs and net farm income for magur culture/ha/6 months

| | | |
|---|---|---|
| **Cost function** | | |
| 1 | Culture species | **Clarias batrachus** |
| 2 | Stocking rate | 50,000 |
| A | **Material inputs** | |
| 1 | Fresh trash fish requirement (kg) | 4,000 |
| 2 | Rice bran (kg) | 4,000 |
| 3 | Lime treatment 300 kg @ Rs. 60/- qnt. | 180 |
| 4 | Cost of 100 fingerlings | 10 |
| 5 | Total cost of fingerlings | 5,000 |
| 6 | Cost of trash fish @ Rs. 200/- qnt. | 8,000 |
| 7 | Cost of rice bran @ Rs. 50/- qnt. | 2,000 |
| 8 | Cost of chemicals | 100 |
| B | **Factor services (Rs)** | |
| 1 | Rent of pond | 3,000 |
| 2 | Wages of 20 fishermen @ Rs. 10 - per fisherman/day | 200 |
| 3 | Wages of 2 persons for watch and ward and farm management @ Rs. 300/- per month | 3,600 |
| 4 | Hire charges of diesel pump for harvesting. | 1,500 |
| 5 | Total prime cost (Rs.) | 23,580 |
| 6 | Bank interest @ 15% on working capital (Rs.) | 3,537 |
| | **Total paidout cost (Rs.)** | 27,117 |
| C | **Return factors** | |
| 1 | Average growth (g) | 100 |
| 2 | Survival percentage | 80 |
| 3 | Production (tonnes) | 4 |
| 4 | Sale price (Rs.) on farm per kg | 10 |
| 5 | Gross sale proceeds (Rs.) | 40,000 |
| 6 | Net return (Rs.) (Gross sale paid out cost) | 12,883 |
| 7 | Percentage return over operational cost. | 47.5 |

singhi gave an yield @ 5.1 tonnes/ha/14 months with supplementary feed made of ricebran and trash fish meal and murrels gave an yield @ 4 tonnes/ha/10½ months on being fed with forage fish. Mixed culture of murrel and koi under this system when fed with rice bran, mustard oil cake and trash fish, gave a production @ 5.9 tonnes/ha/6 months while magur and singhi fed with rice bran and trash fish gave a production @ 5 tonnes/ha/yr and mixed culture of murrel (*C. marulius*, *C. striatus* and *C. punctatus*) gave a yield @ 4 tonnes/ha/yr with feed comprising of soaked dried marine trash fish and fresh silkworm pupae.

Under intensive culture, magur gave a production @ 7.8 tonnes/ha/5 months when fed on fish meal and rice bran while singhi gave a production @ 7 tonnes/ha/5 months on being fed with rice bran, mustard oil cake and fish meal.

The magur, *Clarias batrachus* is found suitable for integration in carp culture system as replacement for common carp. Magur, singhi and koi are also suitable for culture in waters along with 'makhana' (*Euryale ferox*), a highly priced aquatic crop.

### 2.7 Culture with carps

A 0.07 ha pond stocked @ 5,000/ha with Indian and Chinese carps received additional 1,000 magur fingerlings after 4½ months of culture period. The carps yielded a production of 1945 kg/ha/9 months and additional production of magur @ 1029 kg/ha/4½ months was achieved which amounted to 55% of the total income without any additional expenditure except the cost of fingerlings indicating the usefulness of inclusion of magur in carp culture system.

Similarly, magur stocked @ 20,000/ha in a 0.01 ha pond along with leftover carps and fed on rice bran+fish meal+gournd nut oil cake+minerals (50 : 30 : 17 : 3) yielded a production of 3.3 tonnes/ha/10 months.

### 2.8 Cage culture

The culture of air-breathing fishes in cages could be the effective method of utilising unmanageable, weed infested large water bodies for enhancing fish production. The cages measuring 2m x 1m x 1m are prepared from mats made of split

bamboo. The smooth outer surface of the bamboo should face inside of the cage to save fishes from injuries. The top is half covered with a mat and the uncovered portion is covered with a net made of coir rope to facilitate feeding and to prevent escape of fishes. The cages made of synthetic fibre mesh (12-20 mesh/inch) have also been efiectively employed which permit higher stocking rate. Magur stocked @ 200/cage and fed@ 10% of the body weight on dried trash fish, oil cake and rice bran gave a production @ 9.9-12 kg/ cu.m./yr. Singhi stocked @ 100-150/cage and fed @ 10% of body weight on rice bran, mustard oil cake and silk worm pupae yielded a production @ 2.8-4.8 kg/cu.m./3 months whereas koi stocked @ 50-100/cage with same feed gave production @ 1.3 kg/cu.m./3 months and *C. punctatus* fed on rice bran and trash fish yielded @ 2.2 kg/cu.m./200 days.

The cost of production in monoculture of magur and singhi varied from Rs. 4.42 to Rs. 11.78/kg and Rs. 4.10-Rs. 8.50/kg respectively. In mixed culture of air-breathing fishes the production cost has varied from Rs. 1.40-6.50/kg. The high price of air-breathing fishes in the open market (Rs. 25/kg) may permit even enhanced expenditure to improve their culture system.

## 3 INCIDENCE OF DISEASE

Air-breathing fishes are generally hardy and can tolerate a lot of pollution in their natural abode in derelict water and incidence of disease is less common in them. In intensive culture of air-breathing fishes, the fingerlings are given a dip in 200 ppm formalin solution for 40 seconds as a prophylactic measure before stocking. Again during periodic check on growth, the wounded fish may be treated with 0.3% acriflavin for 5 minutes. However, some of the diseases noted during culture operation and remedial measures adopted are as under :

i) The fry and fingerlings of *C. striatus* have been found to be affected with dropsy and fin rot in nursery. This can be controlled by giving a bath in 1% acriflavin or 0.3% formalin solution for about 10 minutes or till the fry and fingerlings show sign of distress. The operation may be continued for a week or so.

ii) The parasites most commonly seen in murrels are *Lernaea* sp. and *Argulus* sp. and can be controlled by application of lime @ 300 kg/ha.

iii) Singhi, *H. fossilis* has been known to be affected by various bacterial diseases leading to the loss of barbel and development of reddish inflamatory patches

at the base line of their anal fin and continued upto the caudal tip and can be controlled by application of terramycin at the rate of 100 mg/kg body weight in the feed. The treatment may be continued for 7 to 10 days.

iv) Singhi has been found to suffer from pox disease detected from the small reddish white spots on their body and dil-potassium permanganate @1 mg/litre bath has been found to be effective in the prevention of the disease.

v) Magur, *Clarias batrachus*,, stocked @ 3,00,000 nos./ha, suffered from bacterial disease (presumtively identified as *Pseudomonas*) showing the symptoms of ulcers, reddish lips and loss of barbels. The disease could be controlled by the application of sulphadiazine in the diet @ 100 mg/kg of feed for one week.

vi) Magur has been found to be infected with cestode worms (known from its swollen abdomen). Such fishes need be removed from the pond.

vii) Non-carcinogenic tumours of *Anabas testudineus*, probably caused by *Clostridium* sp., could be cured by the application of terramycin in the diet, dose being 100 mg/kg of feed for seven days.

viii) Koi has been found to suffer from Lymphocystis in sewage fed pond detected from proliferous growth of binding tissues on the fins as well as on the body proper. Lymphocystis can be cured by the application of terramycin or sulphadiazine as in singhi and magur.

## 4 CONSTRAINTS

### Ownership Rights of water bodies

States in eastern region abound in natural endowments, human skills, and conventional wisdom in respect of culture fisheries but adequate legislative support was often lacking for the development of inland fisheries. The devolution of ownership/control of water areas belonging to the Government in several States is vested with the departments other than the fisheries. This has led to inter-departmental conflicts. Further, community ownership through agency of Panchayats or local self bodies did not aid development of fisheries mainly due to multiple uses of water.

In respect of private waters structural rigidities namely multiple ownership, public easement rights impeded the development process. The leasing arrangements have generally been devoid of development bias. Vast majority of water bodies particularly in eastern India are privately owned where leasing agreements are a bipartiate affair depending on market forces. There is an imperative need for farming tenancy legislation similar to agricultural lands.

**Institutional finance**

Institutional financing arrangements need be streamlined with a view to reconciling them with equity objective. In order to meet the increased capital requirements of new technology, selective liberalisation in lending procedure is very essential. In case of ownership tanks, banks should accept water bodies as adequate security contrary to existing procedure.

**Poaching**

Illegal removal of fish crop has been a long production disincentive. Existing provisions in the law of land can be made more stringent.