Indian J.Sci.Res.1(2) : 127-132, 2010

SUSTAINABLE EXPLOITATION OF FRESHWATER PRAWN DIVERSITY OF INDIA FOR FOOD AND LIVELIHOOD SECURITY WITH EMPHASIS ON PLANNING

K .V. JAYACHANDRAN[a1] AND B. INDIRA[b]

[a]College of Fisheries, Kerala Agricultural University, Cochin, India
E-mail: chandrankvj@gmail.com
[b]Department of Zoology, S.N. College, Cherthala, Kerala
E-mail: chandrankvj@yahoo.co.uk

ABSTRACT

In India, the population has been increasing at an alarming rate for the last five decades. This has created a wide gap in the supply and demand of basic commodities, such as food, clothing, shelter, fuel for man and also fodder for their livestock. In India, 60-70 per cent of the people are living in rural areas who neither have adequate land holdings nor alternate service opportunities to meet their livelihood. Over 85 per cent of the rural income is from agriculture and allied areas. They spend about 75-80 per cent of their earnings for food. Livestock is an important source of supplementary income. Another area where the rural people are going to depend on is aquatic resources. In the present context, the paper has been compiled and presented here to highlight the importance of freshwater prawn biodiversity as a source of food and livelihood security. The paper provides a complete picture on the diversity of freshwater prawns of India. The species are grouped under six broad categories on the basis of habitat preferences. It is noteworthy to see that only a few species are utilized at present either as capture or culture fisheries. The paper highlights on the other feasible areas of the diversity utilization, namely, introduction of new potential candidate species for aquaculture, ornamental purposes, as forage organisms etc. A new method of organic farming is also described in the paper. A detailed management planning process is described for proper and sustainable utilization of freshwater prawns. Food security is regarded as the major index of development of a country. Every effort should be oriented towards this goal. Freshwater prawns form an important dollar earning commodity, proper managerial planning is absolutely necessary for sustainable utilization of the resources. The foregoing discussion may help in this line for food and livelihood safety.

KEYWORD : Diversity, livestock, *Macrobrachium ronsenbergii*

In India, the population has been increasing at an alarming rate for the last five decades. This has created a wide gap in the supply and demand of basic commodities, such as food, clothing, shelter, fuel for man and also fodder for their livestock. In India, 60-70 per cent of the people are living in rural areas who neither have adequate land holdings nor alternate service opportunities to meet their livelihood. Over 85 per cent of the rural income is from agriculture and allied areas. They spend about 75-80 per cent of their earnings for food. Livestock is an important source of supplementary income. Another area where the rural people are going to depend on is aquatic resources. In the present context, the paper has been compiled (Jayachandran, 1984; 2001; 2004; 2005; 2006 a; b; Jayachandran et al., 2007; Sundaram et al., 2004; Balachandran et al., 2006) and presented here to highlight the importance of freshwater prawn biodiversity as a source of food and livelihood security.

OBSERVATIONS AND DISCUSSION

Freshwater prawn diversity of India

Freshwater prawns belong to the genus *Macrobrachium* Bate, 1868, under the family Palaemonidae. Nearly 60 species have been reported from India so far and a list of these species is given below. They size range is from a few centimeters (*Macrobrachium honnaense* 4.2 cm) to around 38.0 cm (*M. ronsenbergii*).

Macrobrachium aemulum (Nobili, 1906) ***

Macrobrachium altifrons altifrons (Henderson, 1893) *****

Macrobrachium altifrons ranjhai Tiwari, 1963 *****

Macrobrachium andamanicum (Tiwari, 1952) *

Macrobrachium assamense assamense (Tiwari, 1955) *****

Macrobrachium assamense peninsularae (Tiwari, 1955) *****

Macrobrachium australe (Guerin-Meneville, 1838) **

Macrobrachium banjarae (Tiwari, 1958) ***

Macrobrachium birmanicum (Schenkel, 1902) ***

Macrobrachium canarae (Tiwari, 1958) ***

[1]**Corresponding author**

Macrobrachium cavernicola (Kemp, 1924) ******
Macrobrachium dayanum (Henderson, 1893) ***
Macrobrachium divakarani Jayachandran, 2001 *
Macrobrachium elatum Jayachandran.1989 *
Macrobrachium equidens (Dana, 1852) *
Macrobrachium gangenticum Bate, 1868 **
Macrobrachium gurudeve Jayachandran & Raji, 2004 *****
Macrobrachium hendersodayanum (Tiwari, 1952) ****
Macrobrachium hendersoni hendersoni (De Man, 1906) ****
Macrobrachium hendersoni cacharense (Tiwari, 1952) ****
Macrobrachium hendersoni platyrostre (Tiwari, 1952) ****
Macrobrachium honnaense Thampy, Jayachandran & Arunachalam, 2007 *****
Macrobrachium idae (Heller, 1862) **
Macrobrachium idella idella (Hilgendorf, 1898) **
Macrobrachium idella georgii Jayachandran & Joseph, 1985 **
Macrobrachium indicum Jayachandran & Joseph, 1986 *****
Macrobrachium javanicum (Heller, 1862) **
Macrobrachium jayasreei Jayachandran & Joseph, 1985 *****
Macrobrachium johnsoni Ravindranath, 1979 **
Macrobrachium josephi Jayachandran, 2001 **
Macrobrachium kempi (Tiwari, 1952) ***
Macrobrachium kistnense (Tiwari, 1952) ***
Macrobrachium kulsiense Jayachandran, Lal Mohan & Raji, 2007 **
Macrobrachium kunjuramani Jayachandran & Joseph, 1985 *****
Macrobrachium lamarrei lamarrei (H. Milne Edwards, 1837)**
Macrobrachium lamarrei lamarroides (Tiwari, 1952) ****
Macrobrachium latimanus (von Martens, 1868) *****
Macrobrachium malcolmsonii (H. Milne Edwards, 1844) **
Macrobrachium manipurense (Tiwari, 1952) ***
Macrobrachium mirabile (Kemp, 1917) **
Macrobrachium naso (Kemp, 1918) ***
Macrobrachium nobilii (Henderson & Matthai, 1910) ***
Macrobrachium novaehollandiae (De Man, 1908) *
Macrobrachium ornatus Jayachandran & Raji, 2004 ***
Macrobrachium peguense (Tiwari, 1952) ***
Macrobrachium rogersi (Tiwari, 1952) ***
Macrobrachium rosenbergii (De Man,1879) **
Macrobrachium rude (Heller, 1862) *
Macrobrachium sankolli Jalihal & Shenoy, 1988
Macrobrachium scabriculum (Heller, 1862) **
Macrobrachium siwalikense (Tiwari, 1952) ***
Macrobrachium sulcatus (Henderson & Matthai, 1910) *
Macrobrachium tiwarii Jalihal, Sankolli & Shenoy, 1988
Macrobrachium unicarnatakae Jalihal, Sankolli & Shenoy, 1988
Macrobrachium veliense Jayachandran & Joseph, 1985 *
Macrobrachium villosimanus (Tiwari, 1947)***
Macrobrachium sp. nov.
Macrobrachium sp. nov.
Macrobrachium sp. nov.
Macrobrachium sp. nov.

The above species can be categorized into the following groups based on their habitat preferences

1. Prawns living and completing their larval life cycle in saline water - (*)
2. Prawns living in estuaries and / or lower stretches of the rivers with or without salinity, but completing their larval life cycle in saline water (**)
3. Prawns living in freshwater and without estuarine larval phase (***)
4. Prawns living in interior water logged areas (ponds and lakes) with limited distribution (****)
5. Prawns living in hill streams without down stream breeding migration (*****)
6. Prawns living in caves (******)

Present Utilization of the resources

At present the resources are utilized in the following ways

1. Species of capture importance : A few species are

reported to be commercially important in different states of India. These prawns are either marketed locally or exported (*) and are *M. rosenbergii* (*), *M. malcolmsonii* (*), *M. gangenticum, M. idella idella, M. idella georgii, M. divakarani, M. equidens, M. sulcatus, M. dayanum, M. lamarrei lamarrei, M. lamarrei lamarroides, M. mirabile, M. scabriculum, M. rude, M. villosimanus.*

Vembanad Lake is the natural abode for *M. rosenbergii* and catch data of the species from the lake for the years 1997 to 2004 is given below.

Year	Landings (kg)
1997	186685
1999	330095
2000	390444
2001	490748
2002	489502
2003	232929
2004	266068

It is disappointing to note that during the peak breeding season (June to December) nearly 40 to 60 % of the catch constituted berried females. This single factor is the major threat to the wild population of the species in the lake. Personal observation is that the population size of the lake is dwindling alarmingly and the present catch comes due to the artificial stocking of the seeds by Government agencies. In the light of the above, the following observations and suggestions are made for the maintenance of sustainable fishery of the species

1. Revival of the fishery was recorded from 1997 to 2004, which was due to the artificial restocking of the scampi seed in the Vembanad Lake. This programme was implemented under the people's planning programme by the Government agencies.
2. Out of the total scampi captured during peak breeding period, 40 60 % were berried females. Once berried females are removed in this manner, the stock depletion must take place.
3. Fishermen should be made aware of the importance of berried females in the propagation of species. The biological characteristic must also be described to them. They must also be made aware of their returns when the stock is conserved.
4. There are large number of hatcheries, farms and processing plants in the state. They are making huge profit out of the species by way of export. Therefore they must be morally held responsible to safeguard the species for its survival and growth. So they must willfully come forward for artificial restocking of the seeds of the species under strict technical advise.
5. The processing plants should take a decision not to accept the berried females for processing at least during the peak breeding season.
6. Minimize pollution of the backwaters.

2. Species of Aquaculture importance : Though the species diversity of the genus is rich, only a few species are at present utilized for aquaculture production. The species of importance include : *M. rosenbergii, M. malcolmsonii, M. gangeticum.* Mass larval production attempts were successful to an extent with regard to these species.

There are various kinds of aquaculture practices going on in Kerala. These are monoculture, polyculture, integrated culture of freshwater prawns. Of these special mention has to be made about Rice cum prawn culture ('Oru Nellum oru Meenum' in Malayalam or One rice One fish programme). This programme was developed by Kumarakom Unit of Kerala Agricultural University, under the leader ship of Dr. K. G. Padmakumar. He has designated it as the win win Land Use model (Padmakumar, 2006). In this system the rice and fish are grown alternatively or in sequence. Joseph (2003) also revealed that yield and returns (per ha) in rice-prawn rotational farming system is highly profitable. The table 1 reveals the fact.

The advantages of this system is that

a. It enriches the soil, thus increases the rice production
b. It helps to control insect pests and aquatic weeds
c. Large areas of paddy fields utilizing for such fish culture do not demand any major modifications in its natural physiography
d. Such fields a more suitable for rice farming
e. Such fields are ecological harmonious
f. More productive and profitable than popular crop rotations.
g. It is a strategic technological intervention to protect our vanishing wetlands and sustain rice production
h. Generates employment

3. **Species having aquaculture potential, but unutilized :** *M. josephi, M. villosimanus, M. latimanus* are potential species which can be utilized for aquaculture. The potentialities of these species include -

a. Grows to bigger size, but available in a few numbers in the wild

b. Edible

c. Good survival and stability

In addition to the above species, there are a few species which are to be considered for ecosystem based cultivation. *M. idella, M. dayanum, M. equidens, M. sulcatus, M. rude* are medium sized species to be considered in this angle. *M. idella* for example establishes itself in the freshwater as well as low saline areas without any intervention from man. Therefore management of such species is important for augmenting production in rural areas. One advantage of this method is that production can be achieved without altering the prevailing ecology.

4. **Species with great ornamental value :** Recently Jayachandran (2006a; b) and Jayachandran et al. (2005) have introduced 7 species of prawns and shrimps of ornamental value to the aquarium. This is a first step in this direction. The species of ornamental value include *M. canarae, M. latimanus, M. gurudeve, M. rosenbergii* (juveniles), *M. ornatus, Caridina jalihali, C. natarajani*. This programme will certainly improve the livelihood security of rural people.

5. **A new concept in Aquacuture :** Cultivation of lesser species along with *M. rosenbergii, M. malcolmsonii, M. gangeticum* etc. proved beneficial. The lesser species will act as forage. This is a novel approach of organic farming. This is being practiced under the supervision of the author. The advantages of the present practice are improved health of cultivating species, reduction of disease problem in ponds and drastic reduction of feed inputs.

6. **Value addition :** College of fisheries, K A U has attempted to develop a number of products utilizing the lesser species of *Macrobrachium.* The products developed are Prawn Pickle, prawn cutlet, prawn stick (Pavunny et al., 2007). The other products that can be produced include flavour extract and chitin and chitosan production from shell waste.

7. **Managerial planning process :** From the above discussion it is clear that we have a rich resources of water and diversity of freshwater prawns. In order to have a sustainable utilization, a managerial planning process is necessary. This process covers the ecosystem as a whole and is outlined below -

Phase I

1. Land

- Catchment are details
- Parent geology
- Geomorphology
- Bathymetry
- Basin formation
- Drainage pattern and system
- Assessment of catchment activity
- Climate
- Biota

2. Water quantity

- Hydrology
- Seasonality
- Catchment and subcatchment contribution
- Water budget
- Tributary contribution

3. Water quality

- Hydrogeochemical cycle
- Biogeochemical cycle
- Suspended solids
- Nutrients
- Ions
- pH
- Temperature
- Stratification
- Pollution

4. Water utilization

- Hydro-electric project
- Irrigation project
- Domestic use
- Industrial use
- Inland water transport
- Biota management
- Tourism
- Capture fisheries
- Aquaculture

5. Community structure

- Biodiversity / taxonomy
- Attached algae / periphyton
- Macrophytes
- Macroanimals
- Benthos
- Phytoplankton

- Zooplankton
- Micro-organisms
- Light
- Chlorophyll concentration
- Eutrophication
- Dissolved Oxygen
- Subcatchment contribution
- Tributary contribution
- Parasites / predators

Phase II (Ecosystem functions and remedial measures)

6. Multidisciplinary team activities

- Effects of activities on water quality and quantity

7. Multipurpose activities on water spread

- Effects of utilization of water on water quality, quantity and community structure

8. Community Function

- Trophic relationships
- Factors affecting community structure
- Discharge
- Substrate
- Organic matter and riparian vegetation
- Functional feedings groups
- Stratification
- Light
- Nutrients
- Grazing
- Disturbance including waste accummulation

9. Catchment activities

- Effects on community structure and community function via water quantity, quality and utilization

10. Resource Management

- Resource dynamics
- Effect of catchment activities via multidesciplinary team activities and community structure

Phase III

11. Explolitation

- Resource assessment
- Extensive use of aquatic resources
- Use of water

12. Target species assessment

- Life history
- Ecology
- Growth
- Capture fisheries
- Aquaculture
- Endangered species

13. Target species development

- Capture ban periods
- Nutrition
- Diseases
- Conservation of endangered species

Phase IV

14. Disturbance

- Natural / Man made
- Remedial measures, effects on water quality, quantity and utilization

15. Management

- Remediation of effects on community structure, multidisciplinary team activities, multipurpose activities on water spread via remediation effects on water quality, quantity and utilization

16. Exploitation

- Resource Management
- Management of effects on exploitation via disturbance and management

Table : 1 Yield and returns (per ha) in rice -prawn rotational farming system

Partculars	Rice (mono)	Rice-rice	Integrated system prawn	Total
Cost of cultivation (Rs./ha)	12218	12696	90066	102762
Yield (Q/ha)	14.64	12.98	5.84	-
Gross returns (Rs./ha)	9225	8325	131765	14090
Net returns (Rs./ha)	-2993	-4371	41699	37328
Benefit-cost ratio	0.76	0.66	1.46	1.36
Labour use per ha in man days	126	128	225	353

(Source : Joseph, 2003).

Phase V

17. Exploitation

- Resource Potential
- Combination of target species assessment and exploitation

18. Exploitation

- Resource utilization
- Combination of target species development and resource menangement
- Permits sustainable capture, culture and ornamental fisheries
- Nutritional security

CONCLUSION

Food security is regarded as the major index of the development of a country. Every effort should be oriented towards this goal. Freshwater prawns form an important dollar earning commodity, biologically rich in diversity, proper managerial planning is absolutely necessary for sustainable utilization of the resources. The foregoing discussion may help in this line for food and livelihood safety.

REFERENCES

Balachandran P. V., Louis V. and Padmakumar K. G. ; 2006. Rice fish integration through Organic Farming. Agrotech Publishing Academy, Udaipur:304.

Jayachandran K. V.; 1984. Studies on the Biology of palaemonid prawns of the South-west coast of India. Ph. D. Thesis, University of Kerala (unpublished).

Jayachandran K. V.; 2001. Palaemonid prawns Biodiversity, Taxonomy, Biology and Management. Science Publishers, Inc., U S A :624.

Jayachandran K.V.; 2004. Biodiversity of palaemonid prawns of India. Silver Jubilee Souvenir, College of Fisheries: 100-102.

Jayachandran K. V.; 2005. Biodiversity survey of palaemonid prawns of Keala and studies on the Biology of *Macrobrachium latimanus* (Von Martens, 1868). Final Report, I C A R Project.

Jayachandran K. V.; 2006 a. Freshwater prawns of ornamental value from Kerala. In : Training workshop on Ornamental fishes, College of Fisheries, Kochi : 96-99.

Jayachandran K. V.; 2006 b. Why not prawns and shrimps in Aquaria. In : Proc. Conferenced on Ornamenal Fishes, S. N. College, Nattika (Hari and Ramesan, eds.) : 19-22.

Jayachandran K. V., Lal R. S. Mohan and Raji A. V.; 2007. A new species of *Macrobrachium* Bate, 1868 from Dolphin Trenches of Kulsi River, Brahmaputra, India. Zoologischer Anzeiger, **246 :** 43-48.

Jayachandran K. V., Raji A. V. and Thomas Tessa;2005. Prawns and shrimps of ornamental value. In : Recent Trends in Mariculture, St. Peters Collge : 77- 79.

Joseph K. J.; 2003. Coastal economy of Kerala. A profile. Kerala Agricultural University, Thrissur, : 40.

Padmakumar K. G.;2006. Rice Fish Integration a win-win farming model for low lands. In : Rice Fish integration through Organic Farming. (Agrotech Publishing Academy), Udaipur : 86-100.

Pavunny O. S., Krishnakumar, P. M., Sherief D. D., Nambudiri and Joseph S. M.;2007. Development of value added products from undersized freshwater prawns In : Advances in biology, aquaculture and marketing. Proc. Freshwater Prawns, 2003 : 648 658.

Sundaram K. V., Moni M. and Jha M. M. (eds.); 2004. Natural Resources Management and Livelihood Security Survival Strategies and Sustainable Policies. Bhoovigyan Vikas Foundation : 575.