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Impacts of a Patent on *Euryale ferox* on Biodiversity at Micro Level: A Case Study

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A patent on a process for making storage - stable edible food materials from kernels of gorgon nuts or fox nut (*Euryale ferox*) has tremendous impact on biodiversity resulting in triggered mass culture and commercialization of this aquatic macrophyte. Besides ecological impact, it has social and economic impacts too. This paper studied the impact of the patent on biodiversity at micro level. The study reveals that mass culture of these plants in water bodies instead of fishes has created an interlinked ecological, social and economic imbalance. Sustainable culture of both fish and the concerned macrophyte is the need of the hour so that biodiversity is not damaged further and equilibrium of ecology, society and economy is sustained. The paper concludes with the suggestion of people's awareness and further research for better understanding.

Keywords: Biodiversity, mass culture, ecological impact

India has perhaps one of the richest ethno-medical traditions in the world. Every 100 km or so throughout the length and breadth of the country one can observe variation in the ethnic names and use of local biodiversity, indicating the intimate and independent appraisal that local communities have made for their resources.

In India, 40-70% of the plant diversity of any local ecosystem is used for human and veterinary medicine. Today biodiversity dependent rural and traditional communities are facing serious resources threat due to rapid erosion and loss of biodiversity. 'Market cultures' are unlikely to promote conservation of these resources as statistics show that out of total 7,500 (approximately) only 500 medicinal plant species used by the communities are being taken up by the market, with real benefits going to the traders but not to the primary collectors. The diversity nurtured by the communities, generation after generation got commercialized and monopolized through various forms of IP protection. As a result local diversity, knowledge and skills have been lost.

The ethnobotanical and other resources utilized traditionally are ecosystem specific and cultural diversity has been in symbiotic relationship with the local biodiversity. The relationship has been recognized and documented in folklore and indigenous knowledge systems even in Vedic and other ancient texts. For example, ancient medical treatises written in Sanskrit by a renowned medical expert, Sushruta:

Yasmin deshe tu yo jaatah
tasya tajiaushadham hitam

— *Sushruta Samhita*

Interpretation: 'Nature is so (benevolently) organized that it has provided every micro-environment, the natural resources (in the form of plants, animals and microorganisms) necessary for the typical health needs of the people living in that environment'.

A striking example of this ecosystem linkage is seen in the case of plant *Ephedra vulgaris* that is only found in the trans-Himalayan habitats. This plant has broncho-dilation properties and local people traditionally drink the herbal tea made of this plant several times a day. The tea helps in easy breathing in the rarefied atmosphere of the trans-Himalaya.[1] This linkage is being lost gradually due to overexploitation of the bioresources. It has been assessed and got evidenced from a patent on *Euryale ferox* based on field study.

The present study reveals the impacts of a patent granted on prickly water lily, *Euryale ferox* (Makhna) on biodiversity at micro level in the district of Malda, West Bengal, India.

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Case Study: *Euryale ferox* (Makhna)

Euryale ferox, the only species in the genus, is a large water lily covered with numerous spines or thorns on all surfaces. It grows in lakes, pools and slow flowing rivers, in water up to 5 meters deep. It is not weedy of nature. *Euryale's* bright green pads are 'quilted' and have thorns. The colour of the pads is royal purple on the reverse. It is a rooted plant with attached rosette of floating leaves. The plant is both annual as well as perennial, with a short rhizome stem. The juvenile leaves of the plant remain submerged in water; only mature leaves float on the surface. Leaf blade and petiole are densely covered with large spines. Inflorescence is conspicuous, solitary, pedicel having four sepals covered with large spines; petals are numerous with white, blue, red or violet colours. Method of propagation is through seed dispersal.[2]

Euryale ferox is native to temperate Asia, Japan, China, Korea and the far-eastern Russian Federation, and to tropical Asia, including India, Bangladesh[3] and Myanmar.[4]

It is one of the oldest aquatic cash crops of Mithilanchal (a part of the state Bihar in India). Makhna is a temperate plant brought into south through bird dispersal. In India, makhna has been growing in the temperate lakes of Kashmir as an ancient natural crop. It has adapted to the tropical climate of India and is found in natural, wild forms in various parts of northwest India. However, Mithilanchal is the principal area of its present existence where it is extensively cultivated in the Darvbhanga, Madhubani, Samastipur and Saharsa districts; and partly in the Muzaffarpur, Champaran and Purnea districts[5] of Bihar. Makhna is being cultivated on a mass scale in the Malda district of West Bengal in eastern India.

Nutritional Value

Makhna has high nutritional value. Calorific values of makhna correspond well with staple food materials and other carbohydrate rich cereals. Despite its low protein percentage (10-12%), it is superior to most plant and animal based diets because of higher amino acid indices (89-93%) and higher Arginine + Lysine / Proline ratio. The ratio of leucine to isoleucine is also higher in makhna. Calorific value for raw makhna is 362 kcal/100gm and 328 kcal/100gm for popped makhna.[6] It contains iron, minerals (0.5%) with traces of carotene (1.4 mg).[7] The moisture content of makhna is 12.8% and it is free of cholesterol. Researchers found that *Euryale ferox* contains a significant antioxidant activity due to the specific components having fractions of ethyl acetate and butanol.[8]

Economic Importance

Makhna seeds are delicious in taste and can be served as an alternative source of food. Its flour is used as substitute of arrowroot. A ready-to-eat non-cereal diet, mostly consumed in the form of salted and sweetened makhna; dried powder and also as flakes. Salted, roasted makhna in butter is an ideal combination of tea snacks. Makhna and its flour are used in making delicious dishes such as sweetmeat, vegetable-salad and in fried rice. Makhna is also taken as dry fruit. It forms an important ingredient of the five auspicious dry fruits offered to the deities on solemn occasion. It can be preserved for longer period without using any preservative agent. A patent has also been granted on makhna by the Indian Patent Office to two inventors, namely, Chaudhuri Utpal Ray and Bhagat Purusottam entitled, 'A process for making storage - stable edible food materials from kernels of gorgon nuts' (INPADOC database).[9]

Traditional Uses

Old Indian reference is indicative of the medicinal properties of makhna against a number of human ailments involving respiratory, circi, aptry, digestive, renal, excretory and reproductive systems. It is effective against digestive disorders and serves as an ideal food for invalids due to its less fat content. Due to the presence of high amounts of vitamins, it is used as such for the treatment of beriberi caused by the deficiency of vitamin B. It has antidiabetic properties. It has many other ethnobotanical uses for various ailments like-ache (back), artharlgia, diarrhea, fever, gonorrhea, hernia, neuralgia, poluria, also as astringent, deobstruent, restorative and analagesic.[10]

Cultivation

This aquatic macrophyte is cultivated in ponds, pools, and small reservoirs. One to two feet water level is sufficient for its cultivation. Many big 'Beels' (big and expanded ponds) are being used as makhna cultivation sites. The time for makhna sowing is generally from November to December but it varies with climate and area. *Euryale ferox* is almost exclusively self-pollinated. The seed of makhna is

usually black and round with hard and thick outer wall. The number of seeds required for sowing varies according to the size of the seed. About 100-125 kg of seeds are sufficient for sowing in one hectare. If the germination rate is poor, the seedlings can be transplanted during April-May.

Makhna is harvested in August-September. As the fruits reach maturity, the pedicel and leaves start rotting, follicle bursts out and floats on the water surface. The seeds that finally settle down on the pond surface are collected. After collection, the raw seeds are thrashed manually by foot to break the papery skin covering the seeds and then roasted. Hot seeds are transferred to a fixed wooden hammer. The seed coat breaks because of the pressure built inside the seed coat due to heating and the seed pops off, as soon as the hard shell is broken. Raw makhna is preserved for cultivation and pop off makhna is used for human consumption. Every makhna fruit contains 100-130 small seeds. It costs Rs 2,900-3,000 per quintal (1quintal = 100 kg). 2-4 quintals of makhna is produced per Bigha (a non-formal unit for measuring cultivable land in the West Bengal = 0.33 acres = 0.133551 hectare). These seeds after processing cost Rs 10,000-11,000 per quintal. These white coloured seeds are locally known as 'Laba'.

Methods of Cultivation

As a representative sample of the makhna cultivation ground two sample beels were selected for field study in Harishchandrapur-II block of Malda district: Siali Panjhowa beel [24.50 acres or 9.91515 hectare] in mouza Jagannanthpur and Katidara Magura beel [36.72 acres or 14.860584 hectare] in mouza Talgachi. Both the beels are part of two extensive water body systems locally known as 'Jalkar'. These are basically government owned water bodies, which are leased out to local primary fishermen cooperative societies for 3-7 years. Thus, for identifying these jalkars local gram panchayat members and members of fishermen cooperative societies were approached. After visiting the place in mid of February 2005, it was found that the water level in the beds was low. Makhna leaves were found to cover the surface of the water. Nearly every part of the plant including top of the pads, bottom of the pads, leaf and flower stems and even flower buds were covered with needle sharp spines. On close inspection neither any fish nor any aquatic organism or aquatic bird was found nearby. The beels were surrounded by plots on which paddy was sowed. Local fishermen (15) and cultivators (7) in the sample area of the beels were interviewed. They ascertained that earlier huge amount of fish were cultivated in these beels but recently only one-fourth of that amount is harvested during rainy season when flood water from the nearby rivers come inside the beel. As fishermen stated, before makhna cultivation these beels were used for fish cultivation by making suitable measures to keep the floodwater and rain water inside the beel. The major Indian carps (Rohu, Catla, Mrigala) and other freshwater fish species were used to be cultivated in these beels. But for makhna cultivation, chemical insecticides are being used heavily in the beel water. According to the local fishermen and paddy cultivators, because of high toxicity of these insecticides many freshwater crabs, various inland and migratory aquatic birds, few varieties of paddy that grow in adjoining lowland or in waterlogged areas, many beneficial insects, snakes, earthworms, snails, bivalves have either disappeared or reduced to greater extent from the field in the last 2-3 years.

Paddy cultivators also stated that paddy fields nearby these beels are also being toxicated gradually due to leaching effect and thus, these paddy fields are becoming non-suitable for paddy cultivation. Water of the beels has been toxicated lethally and it has become unsuitable even for cattle consumption. As these beels are the main sources of water for the local herdsmen for their cattle thus they have become the worst victim of this water toxicity. This toxicated water can neither be used for animal consumption nor for any other farming purposes. The question of human consumption does not arise at all.

The problem was noticed in late 2003. Earlier the beels were managed by the panchayats. The panchayats leased the beels to some persons who were provoked to cultivate makhna instead of fish, as makhna cultivation was more rewarding than fish cultivation. But when the management of the beels was taken over by the Collector, the lease was granted to the local fishermen cooperative societies only as per rule. The local fishermen cooperative society then found that due to makhna cultivation already done in those beels it was very difficult to cultivate fish in these water bodies.

The local fishermen stated that since they have taken lease of these water bodies they will have to pay rent to the Collector. But, as fish cannot be cultured as required, it has become very difficult for them to pay

the rent. Thus they informed the Collector and Assistant Director of Fisheries of Malda district. About 91 paddy cultivators and 21 fishermen had complained and submitted application seeking protection of local environment and immediate investigation of the matter. The Assistant Director of Fisheries after hearing both the parties ordered that makhna cultivation should be stopped immediately in the affected beels.

Impact of Makhna Cultivation

Makhna was not uncommon in the area. Usually, when the water level comes down during February-March, the makhna plants begin to grow, they mature by June-July after which they are harvested. After harvesting, the local fishermen cleared the water body so that fish can naturally breed and grow. By July, monsoon sets in and fish harvesting begins. The season continues till next January-February.

Makhna was earlier only a minor crop of the locality and never cultivated widely. But the whole scenario changed after grant of a patent (Pat No IN187500) in 2002. After grant of the patent, there was wide publicity by print media in local and regional daily newspapers about its nutritive and medicinal values. A rapid demand for processed makhna was generated artificially. As a result, almost all natural beels of the said blocks were converted to makhna cultivating areas. The presence of fish in the water and the process of fish cultivation usually disturb the growth of makhna plant. Thus, the growth of fish was deterrent for makhna cultivation. In other way, fish cultivation is very difficult due to the presence of thorny makhna in the beel water. Middlemen came into the picture and applied poison in the aquatic bodies so that the fish populations along with other aquatic organisms were killed and makhna plants can grow better than usual.

Though traditional fishermen used the sample beels for fish cultivation for generations but for the last 2 or 3 years (after grant of the patent) the beels are being used by the local Mahajans (money lender individuals) for makhna cultivation only for a greater and quick profit. Mahajans made unholy pacts with the key members of the fishermen cooperative societies. Moreover, whole business and huge profit gave a great boost of intermediaries and brought middlemen in the system in a big way. In an estimate, average yield per hectare of raw makhna is about 21.48 quintals from which a third of edible puff is obtained, giving a total income of Rs 16,000 to the growers. The same puff when sold in the city market reaches a value of Rs 150 per kg, i.e., the net selling value of the edible puff reaches up to Rs 1,07,400 per hectare (approximately US$ 2,330).[11]

Due to indiscriminate application of huge chemical insecticides, fertilizers and other agrochemicals, the water quality of the beels deteriorated beyond any kind of use or animal consumption. Many important fish species, aquatic birds, snails, insects, snakes and many other dependent species started disappearing from the area which attributed to various factors, such as: (i) low dissolved oxygen due to heavy eutrophication, (ii) water toxicity; and (iii) vast accumulation of plant debris rotting and decomposing on the surface of water as well as sedimenting on the bottom. This is mainly caused by the leftovers of the excised parts of *Euryale ferox*.[12] Locales also reported to have suffered from various skin diseases and other kind of ailments. Since, abiotic and biotic environments are linked with each other, any stress in the abiotic environment (here, water and land) will be manifested on the components or members of the biotic environment (here, aquatic and terrestrial organisms). Components of the biotic environment are linked through food chain and they are dependent on one another directly or indirectly. Thus, if any of the biotic components or species of the beels either disappears or reduces due to the stress in abiotic environment (beel water), the other species dependent on that particular component directly or indirectly will be adversely affected in terms of both number and presence.

Moreover, due to this makhna cultivation, fish cultivation more or less stopped in the area, which lead to socio-economic impact on traditional fishermen communities. They are in great hardship because they have not adapted to makhna cultivation. Many of them are leaving their traditional occupation and had migrated to other regions for their livelihood, which causes familial disintegration, and subsequently traditional societal bond are gradually becoming faded.

The whole process and its various impacts are shown in Fig. 1.

Findings

Makhna is being cultivated in more than 80% ponds and other aquatic beds in north of Malda district instead of fishes. In the year 2002, makhna was sold to the worth of Rs 18 crore or

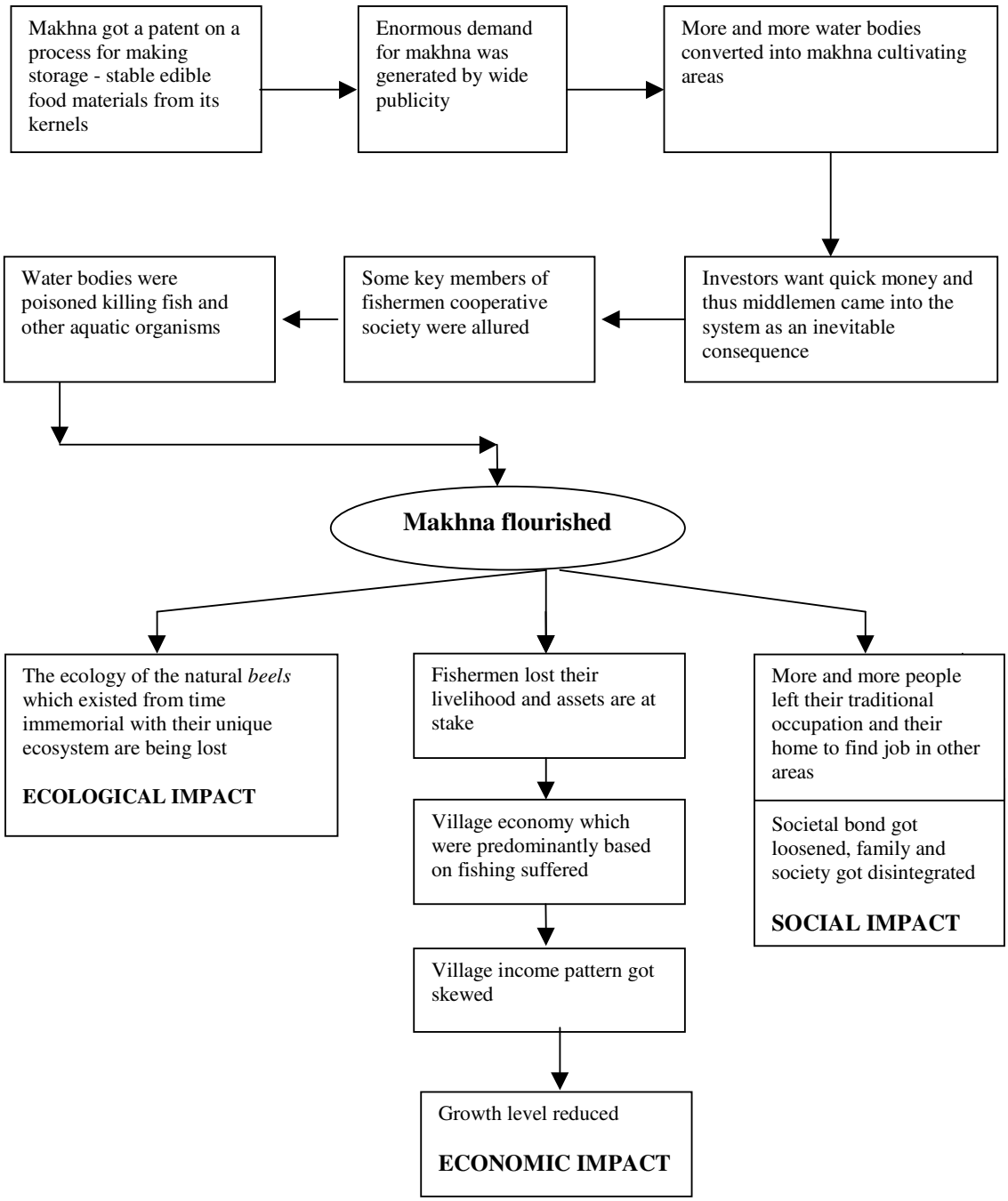

Fig. 1—Flow diagram to show various impacts of Makhna cultivation

US$ 3.94997575 million (Rs 1 crore = Rs 10 million = US$ 219 443.097) from Harischandrapur area only.[13] More and more ponds are being converted to makhna cultivating grounds due its huge monetary gain and it is being exported to many foreign countries including Saudi Arabia, Pakistan and Israel etc. Massive culture of makhna for wide commercialization and huge profit disturbed the ecological balance and it adversely impacted on the biodiversity at the micro level in the said area as per preliminary studies and corroborating evidences received from fishermen and paddy cultivators during their interviews. This loss is not quantifiable by any measurement. It may be possible to quantify it in economic term to some extent by further research. But the role once played by those disappearing species from the area and its role

in socio-cultural arena are neither measurable nor recoverable.

Conclusion

Diversity and pluralism are the main characteristics of the Indian environment and Indian society. There is a strong correlation between loss of biodiversity and erosion of socio-cultural diversity. The particular socio-cultural and ecological circumstances in which communities reside are very complex and dynamic ones. The biodiversity loss is not only a threat to ecology but also a more immediate threat to the livelihood and security of the rural and traditional communities. It is quite clear that cultivation of makhna has increased enormously with the grant of patent. Strong monitoring and strict measures by the appropriate authority should be done immediately as per the Biodiversity Act 2002 of India for this biotrade in order to arrest the present situation and sustainable growth of both makhna and fish culture and conservation of biodiversity as well in the area. Culture of a patented bioresource for its commercialization must not harm local biodiversity and traditional communities at any cost. Beels are very sensitive wetlands, delicate life supporting system and thus any kind of anthropogenic stress would result into an adverse impact. It is thus very essential to make the local people aware of the causes of present crisis, effects and possible preventive measures. More research should be carried out to understand the intricacies of the events, extent of damage on biodiversity so that effective steps can be taken immediately to redress the damage.

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References

1 Sankar D, Medicinal plants and biodiversity conservation, In *Biodiversity Conservation: Whose Resource? Whose Knowledge?* Shiva V (ed), (Intach, New Delhi, India 1994), 108.

2 http://www.lucidcentral.com/keys/APPW/html/euryale.html (16 March 2006).

3 http://www.victoria-adventure.org/victoria/euryale_intro.html (11 March 2006).

4 http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?16447 (16 March 2006).

5 Reddy G P, Makhana-fish cultivation for better economics, *Yojana*, 46 (2002), 42-43.

6 Jha V and Barat G K, Nutritional evaluation of *Euryale ferox* Salisb (Makhana), *Journal of Food Science And Technology,* 28(5) (1991) 326-328.

7 Jha V and Kargupta A N, Utilization and conservation of *Euryale ferox* Salisbury in Mithila (North Bihar), India, *Aquatic Botany*, 39 (3-4) (1991) 295-314.

8 Lee S E, Ju E M and Kim J H, Antioxidant activity from *Euryale ferox* seed, *Experimental and Molecular Medicine*, 34(2) (2002), 100-106.

9 http://www.ars-grin.gov/cgi-bin/duke/ethnobot.pl?ethnobot.taxon=Euryale%20ferox (16 March 2006).

10 Chaudhuri U R and Bhagat P, A process for making storage - stable edible food materials from kernels of gorgon nuts, *IN Pat* 187500, 4 May 2002.

11 Ghosh S K, Traditional Commercial Practices in Sustainable Development and Conservation of Man and Wetlands, *Knowledge Market Place Reports* (3rd IUCN World Conservation Congress, Bankok, Thailand) 17-25 November 2004.

12 [www.iucn.org/congress/documents/kmcd/reports/Ghosh%20-%20SD%20in%20wetlands.pdf] (30 May 2006).

13 http://www.manipuronline.com/Features/June-September 2001/environment.htm (6 March 2006).

14 Bhagat got a patent on processing of Makhna, In *Uttar Banga Sambad* (A Regional Newspaper in Bengali), (20 February 2003) 8.