Trends in water chestnut *Trapa bispinosa* farming in West Bengal, India

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Harvested purple-red and green T. bispinosa.

Characteristics of *Trapa bispinosa* fruit

Water chestnut *Trapa bispinosa* (or paanifol in Bengali vernacular) is a perennial aquatic herb and economically important crop of lentic freshwater bodies. It is commercially cultivated for its edible fruit in perennial ponds with low depth, wetlands and railway track-side water bodies. The fruit are harvested only in the post-monsoon until the beginning of winter (until the 3rd week of December in West Bengal). Leaf stalks of *T. bispinosa* hold air and the upper leaves, i.e., leaf crown develop as a rosette at each stem, with the apex kept afloat. Green or purple-red fruit bear a rough peel/skin with distinctive two sharp spines, one on each side at the same level, facing opposite directions.

Besides being nutritious and easily-digestible, water chestnut fruits are useful for patients suffering from jaundice, lower abdominal pain, diarrhoea and affections in connection with liver bile along with diarrhoea. Flatbread or Indian roti prepared from sun-dried and powdered water chestnut (grated chestnut kernel flour) is a traditional medicine for allergy and swelling of the arms and legs. Peeled raw fruit crushed and made into paste can relieve insect bites and stings if applied externally over the affected areas.

Position of fruit beneath leaves.

T. bispinosa in South 24 Parganas, West Bengal

Water chestnut is cultivated mostly in South 24 Parganas, Nadia (at Kalinarayanpur, Ranaghat, and Chakdaha villages), and Hooghly and East Midnapore districts, with the peak availability of fruits in November and December every year. In South 24 Parganas, since 2008-2009, water chestnut has been extensively cultivated and marketed in a well-organised manner at Hogla and neighbouring villages namely Bejra, Jugdia and Jangalia under the Joynagar-I Community Development (CD) Block, where a total of 400-550 farmers have adopted this profession as a means of livelihood, with 54-64 hectares water area under culture. Individual farming plots, demarcated and partitioned by white mosquito net and split bamboo fencing normally range between 480-3,000 m^2 in area (water depth: 75-180 cm) with the substrate typically a clay-rich soil covered in a thick layer of silt. Here *T. bispinosa* farming is a regular activity like any mainstream crop.

The author observed the state of farming practices of *T. bispinosa* in the stretch between the Hogla and Gocharan railway stations of the Sealdah-Lakshmikantapur railway route along both sides, and interacted with elderly *T. bispinosa* farmers. This region in Hogla Village is the nucleus of *T. bispinosa* production in South 24 Parganas; some farmers cultivate it in their own waterlogged land (*bada* and *jola maatth* in local dialect) while others lease areas for farming, that amounts to INR 8,000-10,000/1,320 m^2/year (equivalent to one bigha, a locally used unit of area). Additionally these farmers commercially cultivate guava fruit *Psidium guajava* on adjacent lands, which is usual practice. Brinjal and green chilli are mainly cultivated in this region during summer.

Sowing of *T. bispinosa* saplings

During mid-April to June, farmers produce healthy saplings of *T. bispinosa* (30-50 cm long) in large earthen bowls or water tanks (*mechhla* in local dialect; used to feed boiled hay and other supplements to cows) having a soil base, or in undisturbed 40-60 m^2 nursery ponds of 75-120 cm depth, where ducks do not swim. In such ponds low productivity is typical, so farmers apply 2.5-3.5 kg sundried poultry manure and NPK fertiliser (25-60-20). Desirable large-sized mature moist fruits are used as seed material. During early- to mid-June and a little later (pre-monsoon), slender *T. bispinosa* saplings are planted in bottom soil of main farming plots with at least 30-40 cm water depth after manual eradication of aquatic weeds *Eichhornia* sp and *Pistia* sp, freshwater snails and lime application. During June-July, around 2,000 saplings (@INR 2/piece) are planted per 1,320 m^2 plot at one metre spacing and 3,000-3,500 saplings are required if planted during late-July. Alternatively, at end of spring season, mature

Railway track-side plots at Hogla.

T. bispinosa farming plots.

fruit developed at the basal portion of rosettes (that remained unplucked) will drop off on its own into the bottom sediment of farming plot, and will give rise to a new plant.

T. bispinosa propagates from its side branches. As explained by farmers, the main stem produces several primary branch stems, and each primary branch stem produces a higher order of it. Numerous branching stems extend out to the water surface and the entire farming area is slowly and steadily filled with leaf crowns. According to a farmer, plants sown even at 4.5 m depth will rise through the water column up to the surface. About 700 *T. bispinosa* plants will be produced from 10 plants sown during the period end-May to end-July. In preparing cuttings, some farmers cut out 30-50 cm long segmental branch stems from the stock plant for use as saplings in farming plots @ 1,500-1,700/720-760 m^2 area. To carry out de-weeding and other works conveniently in deeper *T. bispinosa* plots, farmers use a 1 metre long floating platform indigenously made of halved bamboo placed in parallel to each other and fastened to two earthen water pots by their necks at both ends. The pots are upturned and hold air, serving as floats. Using this device, a respondent

Farmers removing aquatic weeds and snails.

Harvesting water chestnuts.

farmer harvests 35-40 kg of fruit every hour but the rate of harvest is more in shallow plots where the platform is not needed. At Erapur village in East Midnapore District, an elderly *T. bispinosa* farmer having a 2,400 m^2 plot ties four *T. bispinosa* cut-out branch stems at the bottom in a single knot, forming a bundle, and plants 150-180 of such bundles in the mud bottom. In Balasore district of Odisha state, about 4,400 to 4,500 bundles of *T. bispinosa* seedlings (3-4 seedlings in each bundle tied in a knot) are used for planting in a one hectare area[1].

Production and income

An elderly farmer explained that in a 1,320 m^2 plot, he harvests *T. bispinosa* from mid-October till the end of December six times at an interval of 12-13 days; 240kg are obtained in the first harvest and 640-720 kg in the subsequent harvests, provided sufficient and proper rainfall occurs from initiation of the culture period, which favours firm fixation of *T. bispinosa* in the mud and promotes good growth. Good harvests are obtained with onset of winter and mild cool weather. In every season (5-6 months), he invests INR 20,000 and gets an income of INR 40,000 from sale of marketable-sized *T. bispinosa* fruits (25 g size) in conditions of favourable weather and very good yield. For him, the profit margin is INR 20,000 and sometimes increased to INR 25,000. Another farmer harvests 220-240 kg of fruit on each harvest day from his 440 m^2 waterlogged plot (with favourable environmental conditions and good yield) having 60cm depth; a total of five harvests are made at an interval of ten days. He applies 5-6 kg urea and 5 kg diammonium phosphate four times each during culture period and Gromor 14-35-14 three times during the period. Gromor application beginning at the fruiting stage helps prevent blackish colouration of ripe fruits, this farmer opined.

A third *T. bispinosa* farmer stated that from every 1,320 m^2 plot in a season, at every ten days interval, 80-160 kg fruits are obtainable in the first harvest, 320-400 kg in the second, and 520-600 kg in each of rest four harvests. A fourth farmer owning a 2,800 m^2 plot (150-170 cm depth) stated that due to late arrival of monsoon in 2019, he will be able to harvest a total of 3,300-3,400 kg this season in all harvests at medium level of yield (3 pieces weighing 50 g). INR 25,000 is obtainable as profit from every 1320 m^2 plot but will be reduced to INR 12,000-14,000 in late 2019. He applies SPM once @ 175 kg/1320 m^2 area; 6-7 kg urea and 10 kg diammonium phosphate/1320 m^2 twice on the 30th and 50th day of culture. He stated that *T. bispinosa* may be produced in end-March (with onset of summer) and be ready for plantation if mature fruits are seeded in nursery plots in January. According to him and other farmers, application of 2 kg urea, 4.5 kg single super phosphate and 2 kg muriate of potash/1,320 m^2 at the time of sowing saplings before arrival of the monsoon gives good results. From the 60th day of culture until flowering

Farmers removing aquatic weeds and snails.

stage, a zinc-based micronutrient 'Chelamin Gold' is applied @ 0.5 g/litre 3-4 times at 15 day intervals. Urea is particularly essential when immature fruits appear on plants.

Both men and women are employed as labourers at time of harvest of *T. bispinosa* fruit. In this region, harvesting begins from around 5.30am and is completed by 10.00am and each labourer is paid INR 90-100/day for this duration. At times of good yield, 4-5 labourers working in a plot collect 350-360 kg of fruit per day, 2-5 fruits may be harvested from each plant. But at a low to medium level of yield, two labours will harvest 70-90 kg of fruits in two hours, each plant yielding around two fruit. With progress of colder weather and strong winter with persisting fog, harvest of *T. bispinosa* stops and the plants die off. If the arrival of strong winter and foggy weather is delayed, then the period of harvest may be extended and production is higher. According to a farmer, *T. bispinosa* traders (wholesalers) will buy the product @ INR 8-9/kg from farm site and the same will be sold @ INR 15/kg in retail markets in South 24 Parganas and the outskirts of Kolkata city. *T. bispinosa* fruit are sent to nearby and distant markets via road and rail within 11.00am-2.30pm on harvest days and will be sold by late evening in fresh condition.

On the first week of October, a *T. bispinosa* farmer at Hogla Village gets INR 40-55/kg from wholesalers which is the maximum price. Farmers are paid INR 32-36/kg produce on the grand occasion of Lakshmi Puja festival (3rd/4th week of October) and sometimes farmers get INR 55/kg fruit on the two days of this festival and same is sold in markets @ INR 80-90/kg. From end-October and till mid-December, *T. bispinosa* farmers get INR 20-29/kg produce, price falling towards end of season. The majority of fruits harvested in Hogla and afore-mentioned neighbouring villages are transported to wholesale markets at Baruipur Kacharibazar, Sealdah Koley market, Namkhana, Lakshmikantapur, Mathurapur, Sagar islands, Mograhat and Diamond Harbour in South 24 Parganas. Fresh produce has high market demand and the fruit loses its freshness (turns a blackish colour) if sold

Floating platform used to work in deeper farming plots.

after 24 hours from harvest onwards. A few advantageous farmers who had sown *T. bispinosa* plants in their plots using shallow groundwater pumps during end-March and early-April and begun cultivation are able to harvest fruits from end-September, which fetches them a high price.

De-weeding and other management practices

Aquatic pest snails (*Pila globosa*, *Bellamya* sp., *Gyraulus* sp.) are removed from *T. bispinosa* farming plots individually or using small locally-made nylon scoop nets as the snails destroy young *T. bispinosa* leaves. Growing aquatic grass and *Colocasia* sp. from peripheral areas is cut off; eradication of naturally-growing aquatic weeds *Lemna major*, *Lemna minor*, submerged *Naja* sp., *Hydrilla* sp. and *Ceratophyllum* sp. is strictly done routinely by hand-picking and sieving using scoop nets (hand nets) from water column during the culture period, which is a major component of proper management practice. Undesirable weeds consume nutrients of applied fertilisers, proliferate, occupy space and hamper growth of *T. bispinosa*.

According to farmers in Hogla village, the fishes *Clarius batrachus* and *Anabas testudineus* naturally thrive in these less-deep *T. bispinosa* farming plots and feed upon detritus food matter and aquatic insects. But non-judicious use of insecticides meant to protect *T. bispinosa* will kill these indigenous fishes.

Production in other districts of West Bengal

With an investment (i.e. expenditure) of INR 11,000-12,000 (including lease amount) in a 1,320 m^2 plot, each *T. bispinosa* farmer in Arambagh CD Block of Hooghly district makes an income of around INR 36,000 from sale of fruits (culture duration: 6-7 months) in conditions of good yield, thus net income being INR 24,000-25,000 and each farmer harvests 300 kg fruit every week from such plot during early-October to mid-December (Source: News published in Bengali daily 'Bartaman', 16/10/2019). Also at Singur, Goghat and Khanakul CD Blocks in this district, a large part of wetlands is utilised for *T. bispinosa* cultivation. *T. bispinosa* cultivation is well-known in railway jheels of Kamarkundu area in Hooghly[3].

At Kalinarayanpur village in Ranaghat-I CD Block in Nadia, farmers have practiced *T. bispinosa* cultivation for nearly four decades. According to a local farmer, INR 2,000 and INR 1,000 is spent for procuring *T. bispinosa* saplings and fertilisers-medicines respectively for every 1,320 m^2 plot and harvest begins from the third week of September; a total of

Close view of just-harvested fruits.

Washing and cleaning of fruits.

Weighing of washed fruits.

Freshly harvested fruits in sacks at Erapur village.

Weighed and packed fruits ready for transport.

1,000-1,200 kg fruit are obtained in five harvests. Fruit are sold @ INR 30/kg in the beginning, later reduced to INR 18/kg. Plants once sown will produce fruit for next twelve years via natural seed germination and reproduction (Source: News published in 'Anandabazar Patrika', 1/8/2014). At villages including Sahapur, Barduari, Arjuna, Talsur, Malior and Haldibari in Harishchandrapur CD Block of Maldah District, INR 5,000 is invested in every 1,320 m^2 plot and 1,000 kg of fruit obtained in a season, which is sold for INR 25,000. Net income for a farmer is INR 20,000/1,320 m^2. But they are seriously worried about high day temperature during late September-November, less rainfall and shrinking water resources in left-fallow ponds, canals and beels where *T. bispinosa* is under culture (Source: News published in 'Anandabazar Patrika', 3/11/2015).

A *T. bispinosa* farmer in Erapur village of East Midnapore harvests 6,000-6,500kg fruits in all harvests in a season from a 2,400 m^2 plot and his profit margin is INR 42,000-45,000. According to him, price soars to INR 70-75/kg at times of the Lakshmi Puja festival and Vishwakarma Puja (mid-September) in Howrah market and normally sell at INR 35-40/kg. He plants *T. bispinosa* saplings during May-June and experienced the same during July-August as less remunerative. As the spines of mature fruits are poisonous, some *T. bispinosa* pluckers get Tet-Vac injections just before second phase of harvest to protect from accidental injury caused while plucking fruits. The author also visited areas in Baruipara, Sibaichandi and Kamarkundu villages in Hooghly and Erapur, Khirai, Uttar Katal, Gajna and Bakharabaj villages under Ghoshpur GP in East Midnapore where *T. bispinosa* cultivation has flourished and is in vogue. A layer of 15-20 cm soft mud rich in organic matter at the bottom of a water body favours better growth of *T. bispinosa*[1]. With rising cost of medicines, fertilisers, labour and less-favourable weather, respondent farmers in South 24 Parganas opined that a profit margin @ INR 8,000-20,000/farmer/1,320 m^2/season is obtainable in *T. bispinosa* plots taken on lease and upto INR 34,000 in own and parental plots.

Epilogue

Impoverished and marginal households in Dalbari and Badeshwaria villages in Dewanganj upazilla of Jamalpur District in Bangladesh are getting Tk. 8,000-10,000/1,320 m^2 area as profit from *T. bispinosa* cultivation in flooded beels, where sowing the plants in deeper farming plots (160-210 cm) is quite tough. Wetland ecosystems flooded during monsoon, waterlogged borrow pits, waterlogged low-lying agricultural lands unfit for paddy, semi-derelict ponds and shallow ponds having high organic load can be utilised for cultivation of *T. bispinosa* where farming of economically-important freshwater fishes is not possible. Vegetables and other fruits

rot or decay in farming plots but *T. bispinosa* does not; also poaching is impossible. As during the 3rd-4th quarter of 2019, paddy cultivators in Hogla, Bejra and neighbouring villages have suffered heavy loss due to unexpected late arrival of monsoon and heavy rain thereafter. But it has not affected *T. bispinosa* cultivation. A respondent farmer at Hogla had just harvested 1,750kg *T. bispinosa* from 4,000 m^2 plot on his third harvest on 27th and 28th October 2019. Several hundred rural families in West Bengal are engaged in this vocation and commercial farmers at Hogla and other afore-mentioned villages are helping in its extension.

References

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