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Livelihood prospect in relation to domestication of invasive aquaphytes: A case study of north Bihar

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Abstract

North Bihar is one of the major flood affected region in the state. Being a land of high recurring floods, the region witnesses prolonged water loggings and as such it has been a repository of invasive aquaphytes since four or five decades. North Bihar started witnessing such a colossal water logging for the first time during 1974 within years of raising of these embankments in the post independence dispensation. People are in the habit of adjusting their lifestyle depending upon the exigencies of the situation and have been led to the domestication of some invasive aquaphytes for their livelihood purposes.

Many aquatic non-native invasive aquaphytes species are of tremendous importance, so far as their capacity to provide food, fodder, fuels, fence, biofertilizer, pisciculture etc. are concerned. People in the region of north Bihar further adapted the practice of utilizing a number of invasive aquaphytes to their need like *Eichhornia crassipes*, *Sesbania rostrata*, *Vetivera zizanioides* etc. have since emerged as life-line of the region. Majority of water bodies get easily infested with no. of invasive aquaphytes of which hyacinth is the most prominent. The much maligned *E. crassipes* provide a basis to capture fishery and has the potential to provide row material to the biomass industries. Farmers made it habit grow *S. rostrata*, fast growing plant in the waterlogged areas in which plantation of food crops was impossible. A part from being potential fence-cum fuel crop, the plant provides green fodder to animal particularly peak flood situations. Its multifaceted use is further visible in the form of biofertilizer.

Vetiveria zizanioidies occupies special significance in flood ridden areas in view of its deep penetrating roots which help check the process of soil erosion. Vetiver supports the local *sikki* art and also associated with rituals and festival. Thus domestication of invasive aquaphytes in this region provides fine example that any negative effects are clearly overshadowed by positive effect in the concept of economical benefit.

Keywords: North Bihar, aquaphytes, livelihood, domestication, invasive

Introduction

North Bihar is endowed with diverse groups of wetlands comprising a fine network of Perennial rivers. Geomorphic factors have made these rivers to change their courses over millennia and this has led to the formation of hundreds of big and small chauras (land depressions) and moins (ox-bow lakes) in this area. All these water bodies constitute a repository of invasive aquatic phytobiodiversity and support the livelihood patterns of the local human populations.

A large number of invasive aquaphytes domesticated in the diverse forms of wetlands address to the needs of food, fodder, fuel, fence, biofertilizer and housing materials. The much maligned *Eichhornia crassipes* provides a basis to capture fishery and has the potential to provide raw material to the biomass industries along with a number of other invasive species. The region holds a promise for commercial cultivation of aquatic plants like *Vetiveria zizanioides*, *Sesbania rostrata*, are another invasive species which has emerged as a life-line in the floodplains of Kusheshwarasthan bird sanctuary area, situated at the eastern tip of Darbhanga district in north Bihar. It is growing for utilization as fodder with no other alternatives left when there is water all around. It also helps contain the intensity of floods. *Vetiveria*, *zizanioides* growing luxuriantly in these flood plains acts as major carbon sink on account of its extensive growth through seed propagation. Fine vetiver stalks form a basis of Sikki cottage industry which has since emerged as a tool of women's empowerment. Sikki handicraft symbolizes the folk art in Mithila. A number of modern gadgets are prepared to suit the present day market demands. Its leaves are transformed into mats and stalks cast into fishery appliances for capture of small fishes. Young leaves are used as fodder.

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Mature plants are used as thatching material. Roots are used for making hands fans.

Materials and Methods

Investigations were made on the pattern of uses of aquatic plants in the floodplains of Kusheshwarasthan bird sanctuary area of north Bihar which remain waterlogged for a period ranging from 4 to 6 months at a stretch. Frequent troops made to the study sites during flood seasons and afterwards. Attempt was made to elaborate the circumstances of how a plant is domesticated during adverse situation like flood which visit this area almost every year. Information were gathered through personal observations of the utility pattern of number of aquaphytes to use during peak flood season and afterwards. Knowledge gained on the multifaceted use of the versatile invasive aquaphytes like *Eichhornia crassipes* (Kechuli), *Vetiveria zizanioides* (Katara), *Sesbania rostrata* (Manegera).

Result & Discussion

An all pervading presence of obnoxious weed (*E. crassipes*) has led the farmers devise its innovative uses for a number of livelihood purposes. Dried hyacinth uses as fuel and manure. Dried plants are also use in this region for covering potato and sugarcane plantations in early stages. It is of great help to earthen pot makers (Kumhaars) who use it as fuel in their kilns. Hyacinth fronds are fed to the cattle as fodder. Farmers collect young hyacinth frond after cutting them with sickle and feed the same to their cattle. Those rearing animals for milk carry to their homes when the same is mixed with dry fodder. Hyacinth fronds, available in plenty, help overcome this problem. The process, however, involves a risk. The animal that gets infected with mollusc egg associated with these fronds. There is a practice of depositing the heaps of hyacinth on the sides of water bodies. The benefit that accrues out of this practice is the refreshed availability of nutrient after these heaps undergo decay. Jhang is a method of capture fishing that involves creation of round shelterbelts of floating hyacinth (*Eichhornia crassipes*) over an average area of 200 sq. m. in the stagnant water. The system remains in operation for about six months starting from October to April. The submerged weeds growing sparkingly inside the hyacinth cover facilitate the creation of habitat cum breeding ground to a number of fish species including *Boari*, *Saura*, *Rohu*, *Gainchi*, *Bhaura*, *Katla*, *Commoncarp*, etc. Fertilizers used in the cultivation of wheat, maize and other arable crops in the

nearby fields find their way into the wetlands along with rain and flood waters. (Miller 1992, Mooney et. al., 2000) [9, 11]. Economics of raising a Jhang in north Bihar wetlands investments are made on rope, bamboo, poles, nets, transportation of hyacinth (including its removal from the site during harvest and its restoration). Investments in the initial round are to the tune of Rs. 15000/- to Rs. 20,000/-. An average of 5 to 6 persons remain involved with one Jhang. Harvests of fish are mad 4 to 5 times at intervals of approximately 45 days. An average of 500 kg of catch is obtained per harvest with a net profit approaching Rs. 50,000/-. In view of capture fishing serving as major source of livelihood, even non- Mallah (Fishing community) have adopted this vocation in this area (Sharma et al., 2005; Jha, 2012) [12, 8].

Hyacinth based capture fishing in Kusheshwarasthan wetlands is fine example of innovative utilization of invasive weed. It very much supports the dictum of nothing is waste" and it is only a case of misplaced priority that we label something as 'useless'. *E. crassipes* being now used as a base material for phytoremediation of toxic components, production of paper, fiber, biogas and compost, mushroom cultivation etc. (Arora 1987; Jha 2005) [1, 4] very much depicts the present day ordeal of the 'difficult to tame' aquaphyte.

Sesbania rostrata plant initially uses by people to adopt the practice of growing regularly for meeting their requirements of firewood as well. Gradually it also met the requirements of fodder and housing material. It is under this context that the plant was locally designated as "Managera" (Jha et al., 2011a) [6]. The plant was initially tipped for serving the purpose of a fence to protect the young seedling plantations of *Oryza sativa* (agahani, bhadaï paddy) from being overshadowed with the all pervading *Eichhornia crassipes* in the floodplains of Kusheshwarasthan. On account of rapaid vegetative growth, *Sesbania rostrata* maintained a pace with the rising levels of flood water. Another use of this plant as fence is observed in the kitchen gardens ('baaris') adjacent to the households on uplands. People are in the habit of encircling these gardens with live plants of Manager. Farmers found the plant producing enough of biomass in relatively short time and as such growing plant as a potential fuel crop became a normal practice. Heaps of the dried stems of *S. rostrata* are thrown to the erosion sites caused by the high floods. On account of being cheaper as compared to other flood control devices like boulders sandbags etc. Table-1 depict multiple uses of *Sesbania rostrata* in the floodplain of north Bihar.

Table 1: Multiple uses of *Sesbania rostrata* in the floodplain of north Bihar

Uses	Duration	Purpose	Stage of plant
Fodder	(A) Rainy season	Emergency ration along with other cereals.	Apical green part.
	(B) Throughout the year	As supplementary fodder.	Dried and stored plant part.
Flood protection device	(A) May to October	To break the current speed of flood water.	Living plant.
	(B) May to October	To check erosion at the seepage side.	Dried stacks (stem).
Fence	(A) Rainy Season	For protecting young paddy plantation against infestation of water hyacinth.	growing plant.
	(B) Throughout the year	As boundary of kitchen gardens in the flood prone areas.	Mature plant.
Housing material	Throughout the year	To serve as "chhip" in lowcost thatched houses.	Dried stem.
Subsidiary food item	Throughout the year	Used as subsidiary pulse after mixing with other legumes.	Dried stored seed.
Mixed cropping	April to November	To get maximum productivity through mixed cropping of paddy varieties, green gram.	From sowing of seed upto harvest.
Green fertilizer	May- June to November – December	To raise the fertility of soil.	Young and mature plant.
Shelter for birds	July to October	To provide food and shelter to resident and migratory birds.	Early fruiting stage.
Fuel	Throughout the year	As alternative source of firewood.	Dried stacks (stem).

Seeds of *Sesbania rostrata* are formally harvested and stored by the farmers who now adulterate them with those of the seeds of black gram (Urad; *Phaseolus mungo*). The practice flourishes on account of black colour of the two seeds. Its seeds are fed to the cattle as fodder and are sold @ Rs. 40 to 40 per kilogram. Its seeds are also mixed with those of maize in the form of “darra” (broken rough pieces). Generally it is given to lactating cows and buffaloes in the form of “ghaththa” which is obtained after boiling its seeds in water and mixing in it jiggery, azwain (*Trachyspermum ammi*) and mangrail (*Nigella sativa*). Apical portions of the growing plants are utilized as green fodder. It is only during extreme cases of waterlogging (when no other option is left) that the farmers feed the apical fronds of the plant to their cattle by mixing them with grains / husks of rice, wheat etc. The plant also meets the requirement of cheaper housing material in the flood affected areas. Its stem replaces the bamboo made traditional “koro” and “chip” (the scaffoldings meant for raising the strength of the roof structure of thatched houses). Housing priorities in disaster flood prone areas now favour the use of locally available natural resources.

With the price of pulses soaring day by day, people take the recourse of mixing the seed of *Sesbania rostrata* with those of green gram (*Phaseolus aureus*). It is gradually emerging as a subsidiary pulse crop and is being sown as such every year by the farmers in adjacent villages of Kusheswarasthan. It has the potential of emerging as a non-traditional pulses. *Sesbania rostrata* belong to Fabaceae and are held as potential biofertilizers on account of their capacity to fix up the atmospheric nitrogen.

North Bihar floodplains witness the lush growth of a grass called ‘Kataraghas’ which has been botanically identified as *Vetiveria zizanioides* (L) Nash. of the family Poaceae. It is a multifaceted wetland grass which has been found to be highly effective in soil and water conservation in agricultural lands (Truong *et al.* 2004)^[13] and also in waste water treatment. As against the south Indian strains which produce non-viable seeds, the vetiver strains in north India rapidly propagate through viable seeds, this achieving an invasive status. *V. zizanioides* is reported to tolerate extreme flood submergence and temperature levels ranging from – 20°C to 55°C. It could thrive under annual rain fall ranging from 300mm to 6000mm. Vetiver stalks (inflorescence stalks / peduncles) are mostly collected by the rural women upon their maturity. Normally it is done after the rainy season is nearing its end. Mature ‘sikki’ stalks on the plant are pulled by holding the inflorescences which by this time have developed into siliceous structures having sharp edges. Repeated pulls often produce cut wounds on the palms and fingers of the collectors who bear this trouble in order to earn their livelihood. Collected stalks are sold as ‘muthias’ (handfuls) @Rs. 10 to 20 per handful. The sikki artisans make dozens of items based on plant and animal design, both of traditional and modern hues. Quite a few of these designs are based on leaf of Karmi (*Ipomoea aquatica*), flower of Kumhar (*Benincasa hispida*), fruit of Singhara (*Trapa natans*) etc. The ‘khus’ business in Bihar is still monopolized by the entrepreneurs from Kerala /Tamilnadu who bring the vetiver roots from their states, khus cultivation in these states is in an organized shape (Jha *et al.* 2006)^[5].

Table 2: List of *Vetiveria* farmers in Madhubani district of North Bihar

S. No.	Location (village & C.D Block)	Associated farmers	Area
1	Yogiya (ladania block)	Sri Lal Bahadur Sing (Kisan Sri Awardee- 2008)	3acres
2	Jaynagar (Jayanagar block)	Sir Lal Bahadur Singh	2.5 acres (on lease)
3	Selara (jaynagar block)	Sri Lal Bahadur Singh With Sri Rajiv Gupta	3 acres
4	Kumar Khat (Ladania block)	Sri Arvind Mishra	1 acre
5	Manharba (Ladania Block)	Sri Ram Prasad Singh	1 acre
6	Ekahari (Ladania block)	Sri Chandra Veer Singh	1 acre
7	Phulparas (Phulparas Block)	Sri Sukhi Mahto	1 acre
8	Narahiya (Laukahi block)	Md. Ziaullah Payami	40 acres
9	Pakariya (Phulparas block)	Sri Yogendra Sah	6 acres
10	Pakariya (Phulparas block)	Sri Ashok Sah	2 acres

Food items stored in Sikki containers escape a loss in their quality for a relatively longer period as there are no reports of attacks of insect or other pests on them. As such there is a practice of presenting gifts (to daughters and their grooms) of spice and dried nuts in Sikki containers. Traditional ‘Sikki’ gadgets/containers includes *Mauni*, *Pauti*, *Changeri*, *Phuldali*, *Virahara* etc. Modern gadgets like soap-case, casserole, telephone box table mattress, costar feeder, pen holder, knife holder etc are also being carved from Sikki stalks. Roots of vetiver are used for making hands fan commercially.

Certain social practices still prevalent in this area, speak of the deep cultural nuance associated with this grass. Kataraghas has been provided with an exalted status, which is apparent from the fact that this wetland grass is formally worshiped by the rural women as a sequel to ‘sun worship’ asking for a good health of family members. Katarapuja (*Vetiver* worship) in Mithila region is essentially a land conservation practice under which the grass is revered alongwith cowdung and clay blocks as an essential component for maintaining the soil health (Jha *et al.*, 2002)^[3]. Sikki stalks are also used for carving characters in ‘*Sama Chakeba*’ festival solemnized

during Kartik month (October- November) as a sequel to welcoming the migratory birds (Jha *et al.*, 2002)^[3]. Besides forming a basis the sikki industry, *Vetiver* has since emerged as a potential aromatic plant in the north Bihar floodplains, its cultivation is being supported under the schemes of National Horticultural Mission. At several places it is being cultivated along with Japanese mint (*pudina*) and lemon grass as a corollary to agricultural diversification. The plant is globally acclaimed as a source of fragrant. Vetiver oil use in perfumes, cosmetics and sweet scented drinks. The oil extracted from its roots which are used for making screens with sprinkled water. Sikki stalks are also used for making brooms. Voluntary agencies active in this field are imparting training to the needy women in developing their skill in sikki handicraft. Sikki artists from this area have also been honoured with high civilian awards like Padmashri in recognition of their excellence (Jha *et al.*, 2011b)^[7].

Conclusion

Majority of water bodies of north Bihar get easily infested with a number of invasive aquaphytes, many of which are of tremendous importance. There is a need to harness invasive

aquaphytes through identification of economically feasible and ecologically sustainable alternatives for various livelihood purposes. Such efforts reduce the spread of exotic aquaphytes and pose a less alteration, disturbance of native biota and provided tools for livelihood. Exoloratory research should be initiated to access the value of invasive aquatic plant like *V. zizanioides*, *E. crassipes* and *S.rostrata*. Such innovative utilization of aquatic plants and making people aware of the national benefit of these natural resources will be useful to India as a developing region. Despite of positive uses, aquatic plant are often misunderstood and undervalued parts of aquatic ecosystem.

Local fishing community are using *E. crassipes* under the “Jhang” method of capture fishing. *S. rostrata* are proving instrumental in the success of second green revolution in Bihar. *V.zizanioides* is being cultivated for aromatic oil as well as for land conservation. It provides a basis to the famous “Sikki art” of Mithila region of north Bihar.

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