

EMERGING NEEDS OF WETLANDS PROTECTION FOR THE CONSERVATION OF WILD RICE BIODIVERSITY IN NEPAL: A CASE STUDY FROM LUMBINI AREA

Mohan Siwakoti* and Sagendra Tiwari**

*Natural History Museum, Tribhuvan University, Swayambhu, Kathmandu, Nepal.

**137/7-Kumari Club Marg, Balkhu-14, Kathmandu, Nepal.

Abstract: Nepal's wetlands are recognized critical habitats for several rare and endangered flora and fauna. Wild rice is one of the wetland products. There are 4 species of wild rice, *Oryza rufipogon*; *O. nivara*, *O. granulata* and *O. officinalis* occurring in Nepal, of which 3 species, *Oryza rufipogon*; *O. nivara* and *O. officinalis* are wetlands dependent. *Oryza rufipogon* and *O. nivara* are considered as progenitors of Asian cultivated rice (*O. sativa*). Attempt is made to assess the status of wetlands and wild rice in Lumbini area, distributed in Rupandehi and Kapilvastu districts. Many wetland sites, the important habitats of wild rice are degrading and getting lost due to encroachment for conversion into rice fields, fishponds, extended settlements, and sedimentation. A number of wild rice locations are observed in private wetlands that are prone to conversion into rice fields and fishponds. Although, local communities use wild rice during religio-cultural ceremonies, they are not well aware about the values of wetlands and often consider wild rice as weeds. The government policy has also not given due importance to the conservation of wild rice. It is expected that many wild rice sites would be lost in a few years time. This paper discusses conservation needs of some of the wetland sites of Lumbini area such as Budhi Tal, Ajingara Tal, Rangpur Tal and Kale Khan Tal for the preservation of wild rice gene pool.

Key words: Wetlands; Conservation; Wild rice; Lumbini area.

INTRODUCTION

Nepal endows a number of important freshwater wetland sites distributed from tropical lowlands to alpine highlands ranging from permanently flowing rivers to seasonal streams, ponds, lowland ox-bow lakes, high altitude glacial lakes, swamps and marshy lands, paddy field and reservoirs. These wetlands house several species of rare and endangered flora and fauna. It is estimated that Nepal's wetlands harbor about 25% of country's vascular plants (Bhandari, 1992). There are 26 species of endemic plants, 11 species of globally threatened plants and 3 species of legally protected plants, of which some are fully and some are partially dependent upon wetlands. Of the 861 species of Nepal's birds, 193 species (22.5%) are wetlands dependent (Baral *et al.*, 1996; Suwal and Shrestha, 1990). Similarly, over 12 species of mammals, 43 species of amphibians, 12 species of turtle, 2 species of crocodiles, 19 species of snakes and 185 species of fish are associated with Nepalese wetlands (Bhandari, 1998; notification on Aquatic Life Protection Act, 1961 by the Ministry of Agriculture and Cooperatives, 2002). Nepal's wetlands are also known to hold several species of plants with economic values. Wetlands of Nepal's flat plains (known as *terai* region) house 21 species of medicinal plants. Over 30

species are used as wild vegetables and fruits, 11 species are used for making items of daily household use and there are 11 species of wild cultivars and relatives of cultivated crops (IUCN, 2004).

Nepal has approximately 21% of its total land area under cultivation of crops. Rice is a major staple crop of Nepal basically occurring in majority of wetland habitats. Rice belongs to the tribe *Oryzaceae*, which includes 12 genera, out of which 3 genera (*Oryza*, *Hygrorhiza* and *Leersia*) generally occur in Nepal. The genera *Oryza* comprises of 2 species of cultivated and 20 species of wild rice all over the world. Of these, one species of cultivated (*Oryza sativa*) and 4 species of wild rice (*Oryza rufipogon*; *O. nivara*, *O. granulata* and *O. officinalis*) are reported from Nepal. Cultivated rice has more than 95 local aromatic and fine rice landraces developed and grown by farmers in Nepal. More than 75 local landraces are grown in Seti river valley of Kaski district alone, however, only 11 varieties are widely grown and the remaining landraces are being replaced or discontinued due to the introduction of modern varieties (Nepal Biodiversity Strategy, 2002). The wild relatives of rice grown in Nepal are *Hygrorhiza aristata* and *Leersia hexandra*, and they are also wetlands dependent species. *O. rufipogon* and *O. nivara* have considered as the

Author for Correspondence: Mohan Siwakoti, Natural History Museum, Tribhuvan University, Swayambhu, Kathmandu, Nepal.
Email: mohansiwakoti@yahoo.co.uk.

progenitor of cultivated Asian rice (*O. sativa*).

Wild rice species are known to occur in the Himalayan foothills, Asian river deltas, tropical Caribbean islands, the Amazon River basin areas, the inland swamplands of southern and western Africa as well as in temporary pools of the arid Savannas of the tropics. The wild species are found almost exclusively within the boundaries of the tropics. However, the existence of *Oryza rufipogon* in Pokhara valley area up to the northern upper limit and surrounding the Bulbule Lake area of Surkhet in the highest latitude (28°56'N) ever reported in the world (Shahi, 1999).

Cultivated rice, however, is grown as far as 50° N in China and 40° S in Argentina (Vaughan, 1994). Wetlands are typically ideal habitats for rice and 3 species of wild rice *Oryza rufipogon*; *O. nivara* and *O. officinalis* are basically wetland dependent species. *O. granulata* however, is an upland species and generally occurs at the edge of forests and bamboo thickets. In Nepal, *Oryza rufipogon* is reported to occur from Mahendranagar (far west) to Biratnagar (east) in terai, and in the Mid-Hills at the wetlands of Pokhara valley, Kamalpokhari of Palpa district and Bulbule lake area of Surkhet district. Similarly, *Oryza nivara* is reported from Kapilvastu, Nepalgunj (near Indian border) and Mahendranagar. This species is found generally mixed with *O. rufipogon* and is also considered as a natural parent of Asian cultivated rice owing to its similarity in characteristics with some local landraces (Shrestha and Upadhaya, 1999). *Oryza granulata* is reported from the adjoining area of Lothar forest in Chitwan district (central terai) and the surroundings of the Kankai Irrigation headwork area in Jhapa district. *Oryza officinalis* is reported from Sundarpur Agricultural farm of far western of Kanchanpur district and also from Nijgadh area of central terai of Bara. *O. officinalis* remains an extremely rare species for Nepal. *O. minuta* is reported in Nepal as a synonym of *O. officinalis* (Hara *et al.*, 1978; Press *et al.*, 2000). Vaughan (1994) however, has differentiated the *O. minuta* from *O. officinalis* and has claimed that only *O. officinalis* is found in Nepal. Also there are evidences of the occurrence of *Oryza sativa f. spontanea* (a weedy wild rice) mixed with cultivated rice especially in terai wetlands. Lumbini area is considered as hotspot for wild rice in Nepal.

The wild genetic resources of rice are the main source of natural resistance to diseases and tolerance to adverse soil conditions. However, the resources are in a state of rapid depletion due to modification of land use and introduction of high yielding varieties of rice. Several wetlands in Lumbini area (Kapilvastu and Rupandehi districts) have been converted into rice fields, fishponds, settlements, etc. In lack of proper attention to conserve the wild rice the valuable genetic resource is in the threshold of lost. Therefore, an attempt has been made to assess the status of wild rice in Lumbini area.

METHODS

The paper is based on reviewed of earlier publications related to wild rice (Bhandari, 1992; IUCN, 2004; Nepal Biodiversity Strategy, 2002; Shahi, 1999; Shrestha and Upadhaya, 1999; Vaughan, 1994) and field survey. Attempt had made in the beginning of October, 2002 to conduct a field survey for the assessment of the status of wild rice in Lumbini area. The methodology adopted was a rapid appraisal, site visit and informal interviews with local people. Information was collected mainly from Bardhawa village of Bayerghat VDC, Jignihawa Tal of Marchawar area, Kale Khan Tal, Gadaiya Tal, Naukhan Tal, Lumbini Garden and Khungai Churah of Rupandehi district. Similarly, a rapid appraisal was also undertaken at Taulihawa bazaar, Ajingara Tal, Bajah Tal, Rangpur Tal, Dohanihat and Dharmapaniya areas of Kapilvastu district.

Lumbini lies in central terai, is well known being the birthplace of Lord Buddha. Lumbini area has a number of wetlands distributed in Kapilvastu and Rupandehi districts. These wetlands have been well recognized for relatively occurrence of high population of wild rice and can be considered as hotspot for wildrice. An inventory of Terai wetlands by IUCN Nepal (1998) recorded 8 and 16 wetlands sites from Kapilvastu and Rupandehi districts respectively. This inventory showed the occurrence of wild rice (*O. rufipogon*) in Budhi Tal¹ (50 ha in size including Deuriko Tal) located in Budhi Village Development Committee (VDC)² ward no 7 - just 4 Km away from Gorusinge, and Ajingara Tal (25 ha in size) - 4 km away from Bahadurganj in Kapilvastu.

WILD RICE HABITATS IN LUMBINI AREA

Most of the wild rice species occurring in these sites were found at the beginning of their flowering stage during our field visit. The species *O. rufipogon* has found associated with *Eleocharis congesta*, *E. dulcis*, *Cyperus corymbosus*, *Fimbristylis dichotoma*, *Schoenoplectus articulatus*, *Ludwigia prostrata*, *Ipomoea aquatica*, *Commelina benghalensis*, *Paspalum distichum* etc. The invasion of *Eichhornia crassipes* (water hyacinth) with wild rice was not observed in Lumbini area, whereas, the *Eichhornia crassipes* has invaded the wild rice in the western sector of southern submerged area of Koshi barrage in eastern Nepal. Birds such as Sarus crane and egrets are generally observed in wild rice area. The month October was found to be the best time for the flowering/fruitlet of wild rice. Local people used to call *Tinna*, *Tinniya* and/or *Tumba* for wild rice in local language. The status of wild rice in each of the observed sites at Lumbini is briefly discussed here (Table 1):

Bardhawa Paschim Tole³ along Marchawar area used to have about 5 hectares of marsh fully covered with wild rice. Sometimes, local farmers removed the wild rice to replace it

¹ Lakes are known as Tal in Nepali vernacular. In Lumbini area however, marshes are also called Tal indicating that in the past these marshes used to hold water round the year and possibly this is why they are even now a days called Tal.

² A Village Development Committee is a politico-administrative unit and a local government body comprising a number of settlements divided into generally 9 wards.

³ Settlement located in the western flank of Bardhawa VDC.

Table 1: Major Wild Rice Locations in Lumbini Area.

S.N.	Locations	Name of wetlands	Wetlands size (ha)	Wild Rice species	Status
1	Kapilvastu (near Gorusinghe)	Buddi Tal, Deuri Tal	50	<i>Oryza rufipogon</i>	Medium
2	Kapilvastu (near Khunwa Churah along Nepal-India border)	Rangpur Tal	50	<i>Oryza rufipogon</i>	Medium
3	Kapilvastu (near Bahadurjung)	Ajingara Tal	25	<i>Oryza rufipogon</i> * <i>O. nivara</i>	High
4	Kapilvastu (near Taulihawa)	Dohanihat, Dharmapaniya	Roadside marsh	<i>Oryza rufipogon</i>	Medium
5	Rupandehi (near Marchawar)	Marchawar marsh	5	<i>Oryza rufipogon</i>	Medium
6	Rupandehi (near Marchawar)	Jingnihawa Tal	5	<i>Oryza rufipogon</i>	Low
7	Rupandehi (near Bhairahawa)	Semari and Ramuwapur	Roadside marsh	<i>Oryza rufipogon</i>	Medium
8	Rupandehi (Khungai Chaurah, near Lumbini garden)	Kale khan Tal, Gadaiya Tal	7	<i>Oryza rufipogon</i>	Medium

Source: Field Survey.

*may occurs in other wetlands too, more work necessary.

with cultivated rice considering wild rice as a weed. Still this marsh holds a fairly good population of wild rice regenerating in the area and coming up nicely mixed with cultivated rice. Jignihawa Tal happens to be originally a marsh under private holding. Major portion of this marsh has already been converted into typical flat land rice field. Fishpond has however, been created in relatively deeper areas holding water round the year. Wild rice nevertheless was observed especially in some parts of the relatively little disturbed marshes of this site. Semari and Ramuwapur are located about 250 m west of Bhirahawa- Lumbini main road. Some sizeable population of wild rice is observed in these sites. Since this wild rice occurring sites are mostly under private holdings and the farmers also do not have any economic benefit or incentive to keep growing wild rice they are converting most of their marshes into cultivated rice fields. Khungai Chaurah lies about 1 km south from Lumbini Gardens across Padaria-Kakarhawa road. Wild rice is commonly observed along roadsides. It is a potentially expanding urban area with the rapid emergence of new buildings that are replacing the sites holding naturally occurring wild rice.

Kale Khan Tal – a marshy site under private holding, lies about 200 m west from Khungai Chauraha⁴ along the Hulaki⁵ road. This site still sustains a small marsh of about 5 ha holding wild rice. A general tendency of converting all existing water bodies and marshes into rice fields and fishponds prevails since cultivated rice fields and fish farming pays relatively higher return in the area. A small marsh of about 2 ha known as Gadaiya Tal, located in the north-western boundary of Kale Khan Tal is also a public wetland holding good population of wild rice. But this is facing threat of extinction due to encroachment from the surrounding landowners. An approximately 5 ha big water body called Naukhan Tal lies in Bhagwanpur VDC adjoining Balrampur high school. This water body is intensively invaded by water hyacinth and wild rice could not be observed during the field visit despite the local people's claim of the existence of wild rice in this site. Lumbini Garden (a World Heritage Site) used to be a

settlement area before its restoration. Hence, the occurrence of wild rice in the Lumbini Garden area is limited. Since the area however used to hold wild rice in the past, Lumbini Crane Sanctuary (a NGO) has been trying to rehabilitate wild rice in the area, and it has been transplanting a wild rice in some area near the Shanti Stupa (Peace Pagoda) since 2000.

A significantly important site for wild rice is a big marsh of about 25 ha locally known as Ajingara/Ajgara Tal. It tends to be a common property located between the boundaries of Ajgara and Karmahawa VDCs in Kapilbastu district. The large population of wild rice is reported from this marsh. Over 75% area of this marsh is covered with wild rice. Remaining area is dominated with *Sesbania javanica*, *Polygonum barbata*, *P. lapathifolia*, *Ipomoea carnea* ssp. *fistulosa*. The fringes particularly in west and north portions are being gradually encroached for rice fields. A rapid appraisal in this Tal area revealed that the inhabitants of Karmahawa village have been harvesting the water for irrigation in wheat cultivation, leading to negative impact over the fish population. The activity was against the interest of the inhabitants of Ajingara village; however, they have been encroached the marsh and converting into cultivated rice field.

A big marsh known as Rangpur Tal, lies about 1 km east of Khunuwa Churah at Rangpur border of Kapilvastu, along the Nepal– India border. It covers about 50 ha of land. Of this about 16 ha lying under the ownership of Local school, about 16 ha under the ownership of Rangpur VDC and remaining is under private holdings. The areas under the school and VDC are given to fish contractors as lease. Similarly, the Bajaha Tal is a reservoir in India along the Nepal-India border, about 2 km east from Rangpur Tal, which has created a large submerged area in Nepal's portion and wild rice has been started to regenerate in this submerged portion of Nepal. Dohanihat and Dharmapaniya wetland areas lie along Lumbini- Taulihawa main-road, about 2 km east from Taulihawa bazaar. A sizeable population of wild rice is observed along these roadsides. But the gradually increasing urbanisation

⁴ Chauraha is the locally known word for a Square.

⁵ Hulaki road is meant for the rough roads existing in early years for the mail runners.

with upcoming settlements and developmental activities along roadsides are the biggest threat to the existence of wild rice population in these areas. South-west portion of Taulihawa across the Hulaki road for Bahadurjung, and the Parsaha Chauraha and road sides of Iklha VDC, east of Lumbini Adarsh High School of Lumbini also hold some patches of naturally occurred wild rice. But the increasing settlements have consequently been resulting in the loss of their habitat.

USES OF WILD RICE

Wild rice is a rich source of genetic diversity for pest and disease resistance as well as tolerance for some adverse soil conditions. Different uses of wild rice are recorded in literature. For instance, *O. nivara* is capable of resisting the sheath blight and grassy stunt virus biotype 1 (Khush and Ling, 1974). *O. rufipogon* is reported to be resistant to 6 Philippine race of bacterial blight (Ikeda *et al.*, 1990), it has also traits for principal source of cytoplasmic content of male sterility used in the hybrid rice program (Lin and Yuan, 1980), the elongation of stem makes suitable in deep water rice field, the specimen collected from Ghodaghodi lake of far-western Nepal is more than 3 m long (Green Energy Mission/Nepal). The species is also tolerant for salinity. *O. officinalis* has sources of resistance to yellow stem borer, brown planthopper, and leaf hopper (Khan *et al.*, 1991) and *O. granulata* is shade tolerant (Vaughan, 1994).

In Lumbini area wild rice (*O. rufipogon*) has been culturally associated with the local communities. Terai ethnic communities (Hindu) use wild rice grains during various religio-cultural ceremonies. These ceremonies are *Teen Chhatti Tihari*, *Rishipanchami*, *Krishna Asthami*, *Thuli Ekadashi* and *Navratri*. *Teen Chhatti Tihari* is a major cultural ceremony, celebrated during the month of August (Bhadra month according to Nepalese Calender) for the prosperity and long life of male children. Often mothers who have a son observe fasting during the daytime and eat cooked wild rice with yogurt (curd) in the evening. In case if mothers are unable to observe fasting due to physical inability then fathers will observe this ceremony. During this festival visiting crop fields, handling agricultural implements, and eating cultivated crops are culturally prohibited. Wild rice is a must in “*Teen Chhatti*” festival but not in other local festivals.

Although, wild rice is associated with local culture among the communities in Lumbini area but these communities have not been harvesting the wild rice grains except in some submerged area of Bajaha Tal and Rangpur Tal for domestic use. Otherwise, the wild rice plant is mainly used as grass for cattle. Harvesting of wild rice grains tends to be a tedious job as every single grain in the bunch attains maturity at different times. Those involved in wild rice harvesting tie the panicles in a bundle immediately after the grains have developed in order to secure the harvest. A significant amount of grains fall on the ground due to their ripening in different timings. This basically forms the seed source for their regeneration next year.

Wild rice grains are relatively easily available in border Indian markets (Nautnuhawa, Kakarhawa, Sunauli, Shoharatgadh)

especially during the festival time. So it has become more convenient for communities in the Nepalese territory to procure whatever small amount of wild rice grains they need during their festival time from Indian markets even at a fairly high price (about NRs 65 per Kilogram) rather than conserving and harvesting wild rice in their own communal and private lands.

CONCLUSION

Nepal's Terai have traditionally been known as the food grains' basket for the country. Over 90% of the population of Rupandehi and Kapilvastu districts is engaged in agriculture. There exists a high demand for the agricultural land everywhere in Terai of which these two districts are also no exception. Consequently, wetlands have been exposed to relatively high pressure for conversion into rice fields especially in the face of the rapidly growing population in the country as a whole. This trend is likely to continue placing additional pressure on all wetlands in private, communal and/or public domain. Some of the wetlands under private holdings have also been found quite valuable site for a good population of wild rice. This however, is unfortunate that with the growing demands to maximize the farm production all such valuable wetland sites are likely to convert into rice fields or fishponds, because, these farmers have no incentive to keep the land as pristine wetland site for wild rice. Wetlands in public domains are also rapidly degrading due to sedimentation at a fairly rapid rate (Bhandari, 1992). The wild rice hot spots along urban areas and road sides are also degrading and getting lost due to increasing settlements, developmental activities and pollution. It has now become urgent for the government at the central as well as local level to adopt and regulate conservation supportive land use planning in order to a) sustain farmlands and farm production; b) promote conservation supportive farming practices through creation of incentives and markets; c) provide protection to the wild gene pool in Nepal wherever possible for the potential use in future.

Nepal needs to develop and enact appropriate policy measures being a party to various international conventions related to agro-biodiversity. Party nations have sovereign authority over their biological resources and this requires that they ensure farmers rights and adopt policy measures for protection of plants.

Nepalese farmers having failed to realize any benefit from wild rice have been treating wild rice as weeds. It is unfortunate that the government till to-date finds it more convenient to rely on International Rice Research Institute (IRRI) for plant genetic materials of rice for breeding rather than protecting and utilizing locally existing native wild rice species. Despite huge potentiality little has been done so far to study the significant traits and breeding habits of wild rice species. This is a high time for Nepal to conserve the wild genetic resources of wild rice and safeguard Nepalese farmers' indigenous knowledge of rice breeding.

It is not possible to protect all wild rice hot spots in Nepal as they are threatened both from natural as well as socio-

economic perspectives. It is however, very much possible to identify and protect some very promising hot spots for *in-situ* conservation of wild rice which has emerged as an urgent need for Nepal. In Lumbini area, four key sites namely Ajingara, Rangpur and Budhi Tal of Kapilvastu and Kale Khan Tal of Rupandehi districts are recommended as ideal sites for “wild rice in-situ conservation and research sites”.

ACKNOWLEDGEMENTS

We are thankful to IUCN Nepal for providing opportunity to conduct this work. Thanks are also to Mr. Harun Khan of Lumbini for helping us to collect the information at field.

REFERENCES

- Baral, H.S., Inskipp, C., Inskipp, T. and Regmi, U.R. 1996. *Threatened Birds of Nepal*. Bird Conservation Nepal and Department of National Parks and Wildlife Conservation, Kathmandu, Nepal.
- Bhandari, B. 1992. *The Current status of Wetlands in Nepal*. A country report presented at the Asian Wetland Symposium organized by Ramsar Centre, Japan, 14 – 20 October, Otsu-Kushiro, Japan
- Hara, H., Stearn, W. T. and Williams, L.H.J. 1978. *An Enumeration of the Flowering Plants of Nepal Vol. 1*, British Museum (Nat. Hist.), London.
- Ikeda, R., Busto, G.A. Jr. and Ogawa, J. 1990. *Resistance of Wild rice to bacterial blight*. Int. Rice Res. Newsl. **15**(3):14.
- IUCN. 1998. *An Inventory of Nepal's Terai Wetlands* (ed.Bhandari, B.). IUCN Nepal, Kathmandu.
- IUCN. 2004. *A Review of the Status and Threats to Wetlands in Nepal*. IUCN Nepal, Kathmandu.
- Khan, Z.R., Litsinger, J.A., Barrion, A.T., Villanueva, F.F.D., Fernandez, N.J. and Taylor, L.D. 1991. *World Bibliography of rice stem borers*. IRRI-ICIPE, Manila, Philippines.
- Khush, G.S. and Ling, K.C. 1974. *Inheritance of resistance to grassy stunt virus and its vectors in rice*. J. Hered. **05**:184-186.
- Lin, S.C. and Yuan, L.P. 1980. *Hybrid Rice Breeding in China*, 35-51 pp. in innovative approaches to rice breeding. IRRI, Manila.
- Press, J.R., Shrestha, K.K. and Sutton, D.A. 2000. *Annotated checklist of the flowering plants of Nepal*. The Natural History Museum, London.
- Shahi, B.B. 1999. *Genetic role of Wild relatives of Crop plant – A case study of Oryza sativa L. with Nepal's perspective*. In Wild Relatives and Cultivated Plants in Nepal. The Green Energy Mission / Nepal.
- Shrestha, G.L. and Upadhyaya, M.P. 1999. *Wild relatives of cultivated rice crop in Nepal*. In wild relatives of cultivated plants in Nepal. The Green Energy Mission / Nepal.
- Suwal, R.N. and Shrestha, M.K. 1990. *Large waders and Wetlands in Terai*. A Survey report. US Fish and Wildlife Service and King Mahendra Trust for Nature Conservation, Kathmandu, Nepal.
- Vaughan, D.A. 1994. *The Wild relatives of Rice*. A Genetic Resources Handbook. IRRI, Manila.