International Journal of Ecology and Environmental Sciences 49: 247-252, 2023
ISSN: 2320-5199 (Online); https://doi.org/10.55863/ijees.2023.2734

A Study of Traditionally Managed Khazan Ecosystems of Ponda Taluka, Goa

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ABSTRACT

Khazan lands are reclaimed mangrove areas located in the state of Goa where eco-friendly farming and aquaculture were practiced by villagers since thousands of years. Present study related to khazan ecosystems was carried out by selecting five villages that aims to document the ethnobotanical knowledge linked structure; management strategies; ecological and economical activities; livelihood support received by local people; community participation in protecting khazan ecosystems. Survey work was done in selected villages from Ponda taluka Goa. Data were collected through open semi structured interview with the respondents. It was observed that the structure of khazan ecosystem comprise of estuaries, backwaters, mangrove areas, outer and inner embankments, sluice gates and *poiem* (depression). The primitive khazan technology comprised of sluice gates made from wood of *Terminalia tomentosa,* canoes used in fishing are crafted from wood of *Mangifera indica.* Villagers managed khazans by forming associations called *Bous*, by growing traditional salt tolerant rice varieties like *korgut*, by protecting mangroves, following rituals like offering *choru* and *bali*, *Mange Thapni* (unique way of crocodile conservation) for protecting khazans. During the survey different types of crop plants grown in khazans, 11 true mangroves and 6 mangrove associates were recorded.

Khazan lands served as a traditional source of livelihood for native people. The villagers cultivated salt tolerant rice varieties, carry out aquaculture activities by equitably sharing the resources. This age old technology need to be preserved as environmental degradation, change in land-use patterns, tourism, and overexploitation had left many khazans marshy and fallow. The present study represented a useful inventory of management of the endemic ecosystems coupled with dissemination of indigenous knowledge.

Key words: Khazan, Ethnobotany, Bous, Korgut, Mangroves, Sluice gates, Mange Thapni, *Terminalia tomentosa*

INTRODUCTION

State of Goa has a complex interconnected system of water-channels, wherein the ocean connects to the inlands through estuaries and rivers known as Khazan ecosystems. Khazan (salt marsh) ecosystems are considered to be the heritage agro ecosystems which have been evolved over past 2000 years. These are structured systems that were designed by the early settlers of Goa for smooth functioning of the fragile land mass. The ecosystems are carefully designed as topo-hydro-engineered agro-aquacultural systems and are part of a traditional agro-aqua integrated system practiced by local communities for equitable sharing of resources between farmers and fisher folks (Kamat 2004). Khazan ecosystems are rich in biodiversity as this technology involves the use of reclaimed mangrove areas for agriculture, fish farming and salt panning by the construction of sluice gate, dykes and canals to regulate salinity and the flow of water (Ayajudin 2012). Moreover, the primitive ecosystems of Goa (Khazan lands) are a source of livelihood for their salt tolerant rice and fish fields (Sonak 2014, Jacob 2019). Bhambure and Kerkar (2016), Shingadi et al. (2018) and Lobo (2020) also studied Khazan ecosystems of Goa with respect to rice varieties grown, management of sluice gates, bunds, fisheries and mangroves etc.

It is a need of the hour to understand the ethnobotanical knowledge involved in reclamation and maintenance of the khazan ecosystem; ecological functions and interactions associated; processes in the traditional aquaculture system; the support received by local people from the khazan ecosystem; management strategies using scientific approaches and community participation. Hence present study was undertaken with the following aims and objectives: (i) To study the structure of khazan ecosystems of five villages of Ponda Taluka; (ii) To understand the ethnobotanical aspects of Khazan

ecosystems of Ponda Taluka; (iii) To record various economic activities carried out in Khazan lands; and (iv) To identify limitations associated with Khazan ecosystems of Ponda Tuluka.

MATERIALS AND METHODS

Study sites

Present study was carried out by selecting Study area from *Ponda taluka*, Goa India. Ponda is located in the north Goa district (N 15° 24' 2.6028", E 74° 0' 46.2024"). Ponda taluka is known as the home for many prominent temples and called as cultural capital of Goa. Its scenic beauty is contributed by hills, wetlands, orchards, Khazans etc. Five villages were selected for study viz. Kundai, Madkai, Bandora, Agapur and Durbhat lie on the bank of river Zuari (Fig 1). These villages show the presence of khazan ecosystems which are used by local residents since ages. The geographical coordinates and characteristic features of study sites are given in Table 1.

Collection of data was carried out by conducting field visits in Study area every fortnightly to assess the khazans. Ethnobotanical knowledge was acquired through structured interviews from the respondents about the Khazan ecosystems, type of crops grown, mangroves and their role in khazan, fishing activities, crafting of canoes and weaving of fish nets, deities and rituals associated with khazans. Enlisted plants were photographed, collected and identified using available literature (Cook 1967, Dhargalkar et al. 2014, Shukla et al. 2020).

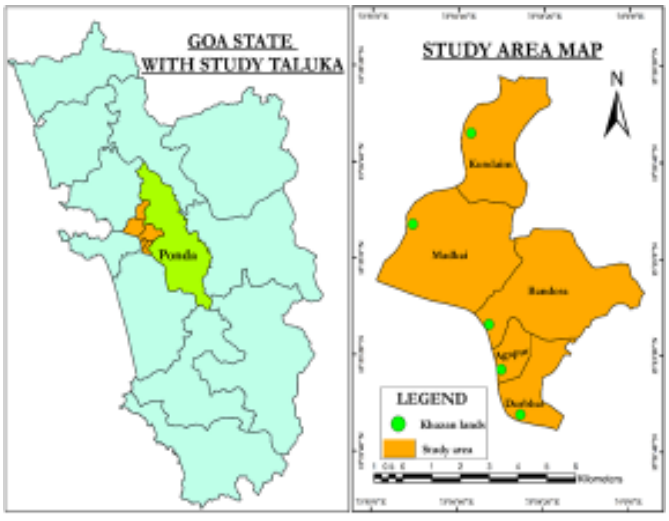

Figure 1. Map of study area

Table 1. Characteristic features of the study villages

Kundai- lies between 15.4875° N, 73.9771°E, has lot of paddy fields stretched all over. It is an industrial area yet one can enjoy the serenity where there are aquatic habitats as lakes, wetlands and Khazans
Madkai - lies between 15.4167° N, 73.9419° E, the place is famous for temples, wetlands and Khazans.
Bandora - lies between 15.4058° N, 73.9796° E, is famous for temples, churches kulagars, wetlands and Khazans adding to the scenic beauty
Agapur - lies between 15.4268° N, 74.02095° E, the village is famous for conserving art and culture through tableaus. Fishing practices are common amongst the local people.
Durbhat- lies between 15.3873799° N 73.9683032° E, there exists many fishermens' communities in the village where fishing is the main occupation. Cultural heritage is conserved through various religious activities and tableaus.

Figure 2. Structure of khazan ecosystem, (a) Water canal (b) Sluice gate (open) (c) Sluice gate (closed) (d) Hut near manos (e) Outer embankment (bandh) (f) Inner embankment (mero)

RESULTS AND DISCUSSION

It was observed that khazans are part of a traditional agro-aqua integrated system practised by local communities for equitable sharing of resources between farmers fishing community. Khazan lands are reclaimed and recovered from marshes, with bunds preventing the ingress of tidal waters. A typical village in Goa constitutes a world of its own and is structured by a long-established organisation that orders economy and redistribution, social life and its allied hierarchies, customs and ceremonies. In all studied villages estuaries or back waters, creeks, mangrove areas, outer and inner embankments, sluice gates, and drainage canals formed important components of the khazan systems (Fig.2). The unique technology involved in Khazan ecosystem protect agricultural fields and villages from tidal ingress through a system of bunds (*dykes*). In all study sites the outer embankments or bunds were found to be protective in nature, built using locally available laterite stones, mud, and clay from the khazan farms. *Chanoy* ,term used for clay filled in between the two layers of outer bunds, so that it is held tightly and resistable to wave actions. Mangroves growing along the bunds form an important feature of these protective embankments because they act as wave breakers, absorbing the impact of the tidal waves. The inner embankments (*mero*) are made up of mud and straw that prevent soil erosion and protect fields from nutrient leaching. A wooden sluice gate with vertical shutters (*manos*) made up of wood of crocodile bark tree (*Terminalia tomentosa*) helps regulate the water level in fields. Wooden shutters of the gate open and close with the pressure of the tidal flow wherein low tide, the gates open to let out the water from the fields and during high tide the gates are closed, thus preventing saline water in fields. *Adamomanos* with horizontal wooden shutters is an additional gate (*manos*) erected near the sluice gate in the monsoon to maintain the level of water in the fields. Similar observation was reported by Sonak et al. (2005) in different khazan ecosystems of North Goa. On the landward side of the sluice gate is a depression, called *poiem* (Sonak 2012). The sluice gate mechanism regulates water in the *poiem* and the size and depth of poiem determines the fish yield. Since olden times villagers use a small canoe (*ponel*) made up of mango wood (*Mangifera indica*) and different types of fishing nets called *manxechejale* (bagnet), *katalin* (gill nets) and *pagyer* (cast nets) for fishing in the fields and *poiem*. A special net is used for catching crabs which is called *koblem*. Also villagers protect their canoes from fouling by applying the oil (*dik*) extracted from shells of cashew (*Anacardium occidentale*) which has very strong aroma.

It was a fascinating experience to understand the management of khazan ecosystems in the studied villages. The respondents stated that long time before the Portuguese rule, the traditional communities in Goa formed associations for management of resources. These self-governing institutions were called *Gaunkaris* (Gaun: village and Kari: association) based on the collective management of property and resources. During the Portuguese rule in Goa (1510–1961) they were renamed as *communidades* which maintained the khazan ecosystem through *Bous* system (association of farmers or voluntary bodies that were formed for management of khazan ecosystems). Pre-1961, agrarian cooperative system for Khazan lands was based on '*Bous*' management which was as an association made compulsory for the tillers of the Khazan (Kamat 2004). Each khazan had its own association called '*Bous*' and the matters common to all the khazans of a village were dealt by the '*Bousgeral'* formed by the tillers of all the Khazans. '*Bous*' employed '*Kamat*' (Supervisor) '*Paini*' (watchman) and the accounts were maintained by *kulkarni*. The '*Bous*' received remuneration in cash or kind and had to be alert on the bunds for which it was responsible. For bund maintenance, these associations collected stakes, stones etc., and in cases of shortfall of men or material, assistance are provided by the neighbouring associations, hence revealed a systematic method of the control of maintenance and repair of bunds.

The present study led to documentation of various economic activities from khazan ecosystems viz. cultivation of paddy, legumes, horticultural crops (coconut, mango, cashew, vegetables, tubers, fruits and flowers) pisciculture including dried fishes and prawns; sluice gate auction based marginal fisheries and backwater fisheries. Building of country crafts or canoes, construction, maintenance of bunds as well

as sluice-gates, use of mangroves as food, fodder, and fuel were recorded.

In all study sites traditional salt tolerant rice variety known as *Korgut* is grown since ages. Farmers grow this variety because the grains of *Korgut* are plumpy, husky and brown. Those qualities make it well suited to the saline environment of khazan, it has ability to withstand heavy rains; the presence of an '*awn*', or prickly needle on its grain, prevents birds and pests from destroying it. As opined by the indigenous people 'if there is *Korgut*, there is khazan, and if there is khazan, there is *Korgut'*. About 45 varieties of rice native to state of Goa, had been documented by Bhosale and Krishnan (2011). However, in the last 40 years, the local varieties were replaced with hybrid, high-yielding varieties called *Jyoti, Jaya* and *Karjat* that are sponsored and pushed by state governments and seed-companies, creating a farming culture based on quantity and not quality. Since sponsored varieties promise larger yield, indigenous rice grains like *Korgut*, *Asgo, Damgo*, and *Morpis* lack of assurance by the state for purchase and sale. It is thus pertinent that the farming community cultivated and preserved the local varieties mainly for home consumption and occasional sale in small markets. Vegetables, flowers and fruit bearing plant species noticed on Khazan bunds and fields are viz. *Tagetes erecta, Vigna unguiculata, Amaranthus cruentus, Solanum lycoperscion, Raphanus sativus, Ananas comosus, Solanum melanogena, Capscicum frutescens Brassica oleracea, Anacardium occidentale, Abelmoschus esculentus, Mangifera indica, Musa acuminata, Oryza sativa, Cocos nucifera***.** Mangroves form an important part of estuarine food webs as they produce large amount of leaf litter (Kathiresan 2018). It was observed that the local people cut branches of mangrove (*Avicennia officinalis*) arranged in *poeim* and thereafter decomposed and transformed into organic matter (litter) that further served as good food for growing fishes in the khazans. Mangrove branches provided two benefits viz. increase in fish yield due to accumulation of leaf litter and protection against fish robbers. Khazan ecosystems are the sources of economically important fishes like shrimps, crabs, prawns, etc. Roots of mangroves form a mesh where marine creatures can dwell. In the study area, besides horticultural crops, 11 true mangroves and 6 mangrove associates were recorded viz. *Excoecaria agallocha , Acanthus ilicifolius, Aegiceras corniculatum, Avicennia officinalis, Sonneratia caseolaris, Kandelia candel, Rhizophora mucronata, Lumnitzera racemose, Bruguiera gymnorrhiza, Avicennia marina,*(true mangroves); *Ipomoea tuba, Clerodendrum inerme, Ipomoea pes-capre, Acrosticum aureum, Salvadora persica, Derris trifoliata* (mangrove associates). Many species of mangroves are used by local people as fuel wood and timber (*Rhizophora mucronata, Bruguiera gymnorhiza, Kandelia candel, Sonneratia cassiolaris*) fodder (*Avicennia marina, A. officinalis*), packaging material and paper pulp (*Excoecaria agallocha*), as food (*Sonneratia cassiolaris, Acrostichum aureum),* medicine (*Acanthus ilicifolius, Aegiceras cornculatum, Rhizophora mucronata*).

Rituals are followed by villagers to protect their khazans lands from evil eye. Farmers worship deity locally called *Devchar, Dev Rakhandar, Ladbai, Ravlnath, Mahishasur* and conserve scared trees located near khazans. Every Sunday and Wednesday, delicacy called *Khichdi* (made from rice, jaggary and coconut) is offered to god as and only these two days villagers are allowed to visit the sacred places. There is a strong belief that this deity takes care of their Khazan. During Diwali festival *Damgo* rice is used in making beaten rice locally called *Fov* or *poha.* Many natives of this village depend on mangroves for their livelihood. They are ardent followers of their traditional cultures. The present study revealed a unique ritual to conserve crocodiles from mangrove area of Durbhat. This ritual is called *Manage Thapni* (worshiping crocodile) which is celebrated every year on new moon day in the month of *Pausha* (Hindu month). It is believed that this festival accords with the initiation of threshing of harvested paddy crop. Key objective of the celebration is to protect the rice fields from cyclone, flooding and to get good fishery during next year. Local people believe that crocodile being top predator of environment, responsible and helps to keep marine environment clean and free of predator fishes hence as a token of appreciation crocodile is worshipped. Muddy soil from mangrove areas is scooped and collected on the bunds, it is then made into idol like a shape of crocodile and decorated with shells as eyes and thick plates on the back, teeth with small and big sticks. A

hole is scooped on the back of crocodile and live chick kept in the hole and covered with coconut shell. Puffed rice and jaggary are offered as *Prasad* and distributed amongst all village people. Pooja is performed by the elderly person of the *waddo* (locality) with a belief that crocodile is the *vahan* (vehicle) of goddess river Ganga.

At the time of Shimagotsav (Holi pornima- the festival of colours), "*Choru*" made up of cooked rice is spread in khazan land. Because they believe that, if food is given to God, their fields will be protected. Another ritual seen is of "*Gade*" which is usually practiced by villagers. People of offer life (*bali*) of *tawashi* (cucucmber – *Cucumis sativus*) and *kuvalo*, (Ash gourd – *Benincasa hispida*) is cut and placed in front of God at the time of Dusshera festival. No animal is killed for offerings in the village of Durbhat. The ceremonial functions prove that their ancestors had countless faith in the rituals and lived in harmony with the prevailing environment. Ample amount of livelihood opportunities was available for local people living in the vicinity of Khazan ecosystems. Due to mechanised agriculture these opportunities are decreasing day by day. People with craftsmanship skill are no more crafting a caone's as readymade fibre motor boats are available. At Madkai study site, we found that there dwells a community called *Gatpi community* (weaver community) that used to weave fishing nets. Since nylon nets are easily available people do not buy hand weaved nets.

CONCLUSIONS

The study concluded that khazans are very fragile but productive ecosystems. They testify to the intimate knowledge that ancient people of Goa had of climate, tidal cycles, soil properties, fish species and coastal flora, also the technical knowledge, evident in the sluice gates they used to operate. The local inhabitants earn their livelihood by cultivating rice, fish and other horticultural crops in khazans and the resource benefits are shared by all residing in the area. The elderly population are apprehensive about future of khazan ecosystems, since today's youth show very little interest in traditional farming, fishing and managing khazans. Due to water and plastic pollution the aquaculture activities are hampered, nets get blocked due to plastic waste and hence fish catch is low. Since there is lack of trained manpower in craftsmanship of traditional canoe making, *koble*/ net weaving, people depend on nylon net, fibre boats and other gadgets required for managing khazans. Nylon nets generate solid waste as it is not biodegradable hence disposal becomes a problem. Durbhat Khazan is facing problem due to sewage treatment plant that has been set up in its vicinity.

There is decline in skilled manpower involved, coconut plucking, vinegar making, bund construction. Breach management on bunds becomes difficult due to unavailability of skilled labours (required to dig a trench) and high repair cost. Fishermen suffer miserably due to use of motor boats where the fuel costs are very high.

The precious endemic khazan ecosystems which are known as *food bowls* of Goa are facing enormous problems. To some extent these issues may be resolvedby training youth in managing the traditional techniques of khazan ecosystems through capacity building workshops; conservation of germplasm of rice and ish varieties existing in khazans since ages; awareness and education by organising short term training programs in khazan management and conservation; focus on khazan awareness campaigns in schools, colleges and public gatherings; declaring khazans as protected areas; organising mangrove conservation programs; celebration and documentation of all rituals and eco-friendly practices in the vicinity of Khazans by involving youngsters may promote to save the precious eco-fragile, endemic, natural heritage assets of the state of Goa.

Authors' contributions: All authors contributed equally

Conflict of interest: Authors declare no conflict of interest

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Received:6th October 2022
Accepted:23rd November 2022