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Agro-biodiversity Park for Conservation and Preservation of Native Flora and Fauna in Professor Jayashankar Telangana State Agricultural University, India

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Abstract: In newly developed agro-biodiversity park, several plantation blocks were developed in phased manner, such as teak (2,200 plants in 2.2 ha), mahuva (1,500, 1.5 ha) plant dominant community blocks and mixed forest tree block (4,600, 2.5 ha). Besides, a separate generic blocks of, viz., palm (300, 0.4 ha), medicinal trees (700, 0.7 ha), bael (*Aegel marmelos*) (200, 0.4 ha) and minor fruit tree block (1,200, 1.0 ha). A species diversity *Ficus* block (225 no. of 30 species in 0.4 ha) was also developed and maintained. Of late rare, endemic, endangered and threatened species *Ceropegia* (Asclepiadaceae) was identified in 2014. Since then, utmost care was taken for conservation and preservation in agro-biodiversity park. Every year during monsoon, the gap filling was done to maintain greenery in different block plantations. Water ponds and bodies were also created as a source of water for all resident and migratory bio-creatures for promotion of fauna genetic resources. The natural fauna present in agro-biodiversity park are wild boars, field rabbits, small mammalians, field peacocks, reptiles, lizards, avians, amphibians, toads, etc.. Besides, 24 species of insects, five species of fish and eight species of reptiles were recorded. Out of 120 species of butterflies present in the state, 56 were found in the park. The bird species increased from 35 to 172 species within eight years of duration. The creation of different plantation blocks has facilitated to increase flora and fauna in the park. The native flora and fauna were protected by erecting chain link mesh as border fencing against movement of trespass and livestock animals. The agro-biodiversity park was aimed mainly to preserve, conserve and promote the native flora and fauna through *ex-situ* conservation of species and to establish 15-20 biotic communities, including wild relative field crops, such as cereals, millets, pulses, oilseeds and fiber crops as a repository that flourished in the Deccan plateau in the past. The other objectives were to restore and develop the existing dry land and wet land habit to preserve and conserve the genetic resources.

Key words: Agro-biodiversity, native flora and fauna, conservation.

1. Introduction

The agro-biodiversity park in the Professor Jayashankar Telangana State Agricultural University (PJTSAU), Hyderabad, India, was an area of 60 ha. The park site is naturally spread with jungle scrub, hillocks, boulders, undulated rocky terrain with sloppy lands covered with diverse vegetation, such as herbs, shrubs, creepers, trees and grass species, besides a natural water tank. Biodiversity is the key that sustains agricultural production. Conservation of diversity on-farm and *in-situ* in forests and protected areas is likely to backup food and agricultural security options of the future. The loss of diversity is alarming across several known species groups. Knowledge and information are limited about the distributional pattern and conservation status of the threatened tree species of India facing profound climate changes with predictions suggesting around 10% loss of all the tree

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species of India in near future [1]. Approximately 600 tree species in India are threatened with extinction, a sizable percentage being located in South India. Deccan plateau region with rich biodiversity is a highly over exploited one by several anthropogenic activities, resulting in loss of life supporting resources, biodiversity, gene pool and nature self-sustaining ameliorative capabilities. Keeping in view an attempt was aimed mainly to conserve, preserve and maintain rich native flora and fauna present in Deccan plateau region of Hyderabad. To create field gene bank for the threatened landraces and wild genetic resources of field crops, such as cereals, millets, pulses, oilseeds and fiber crop, as a repository that flourished in the Deccan plateau in the past. To restore and develop the existing dry land and wetland habitat, to preserve and conserve the genetic resources of both flora and fauna, the identification and authentification of the names of plant taxa are based on Manfold's Encyclopedia, 1986 [2].

2. Materials and Methods

2.1 Description of Study Site

The PJTSAU, Hyderabad is the first agricultural university in India to initiate the establishment of agro-biodiversity park in August 2008, in 60 ha areas with natural ecosystem. The site selected for agro-biodiversity park in PJTSAU campus is originally under jungle scrub, hillocks, rock structures, water bodies, undulating rocky terrain with different topography lands covered with different natural tree species: shrubs, herbs, creepers and diverse grass species. Out of 60 ha, 50% areas are under natural water tank. At initial stage, with minimum disturbance, the exotic weed species, such as *Parthenium hysterophorus*, *Lantana camara* and *Prosopis juliflora* present in the vicinity were removed, as they are considered as very dangerous invasive alien species, whose spread will adversely affect the native biodiversity and prevent forest regeneration [3]. After removing these alien species, several block plantations were developed, such as teak and mahuva, dominated plant community with 30% main plants and rest of 70% with different generic plants. In addition, separate generic blocks are also developed, such as *Ficus*, palm garden, medicinal tree garden and mixed forest tree garden. Besides these, a *Ficus* species diversity block is also developed. As a part of other activities, water ponds and water bodies are also given importance as survival and spread of fauna in the park. The existing natural flora, including tree taxa, like babul, *Butea*, neem, sissoo, *Pongamia*, *Prosopis*, *Syzygium cumini*, *Ficus* species, *Albizia lebbeck*, *Acacia*, *Cassia*, tamarind, custard apple and diverse species of shrubs and grasses, was allowed to remain undisturbed in the ecosystem. The existing fauna in the area includes peacocks, rabbits, wild boars, foxes and different species of snakes, lizards, mongoose, chameleons, birds and other wild animals.

2.2 Data Collection

Base line data, land use cover and aerial view maps of agro-biodiversity park were collected with the assistance of Salim Ali Centre for Ornithology and Natural History (SACON), Hyderabad.

The main conservation activities carried in agro-biodiversity park are as follows:

(I) At beginning, itself the entire border and boundaries were strengthened by link mesh, as such valuable young plants in different blocks were protected from grazing by cattle.

(II) Since planting onwards, utmost care has been taken for survival in general and in particular to important, sensitive and rare species in terms of watering, maturing and intercultural operations.

(III) During summer at high temperatures, to over moisture stress, timely watering was done to some sensitive species.

(IV) Dead and dried plants were removed immediately, gap filling was also done.

(V) Against slopes, *in-situ* soil and water conservation were taken by planting vetiver grass, formation of counter bunds and stone dams to utilize

monsoon rain water and to increase water recharging.

(VI) Alien species, such as *Parthenium, Lantana* and *P. juliflora*, as soon as found were removed regularly, so as to encourage the spread of native floras. Otherwise, they will suppress the growth of local seasonal, annual herbs and many grass species [4].

(VII) Cultivated traditional varieties of rainfed paddy (10), red gram (3) and safflower (3).

Depending upon topography, soil profiles were dug initial surface and sub-surface soils, and water samples from different locations of tank were collected and analyzed for different parameters by following standard methods [5]. Based on soil profile description and nutrient status, characterization and classification were done.

3. Results and Discussion

3.1 Soil Analysis

Soil data of agro-biodiversity park revealed that most of the soil types were red gravelly to sandy loams with shallow to medium deep soils. A few black clay loamy deep soils are close to water tank area. Soils are near neutral to alkaline in reaction (6.54 to 8.69) and non-saline to medium saline in nature (0.06 to 1.87 dS/m). Organic carbon content from low to high is 0.45%-1.2%. Regarding nutrient status, it was found to be very low in terms of available N (125-326 kg/ha), P medium to very high (34.6-130.2 kg/ha) and K low to high (233-782 kg/ha) [6]. It is well known that different plant species promote different groups of soil biota, and that changes in below ground organisms can enhance the rate of vegetation change. Therefore, the planting of different species into degraded soils might be used to promote soil biodiversity and functions, thereby enhancing the rate of restoration [7].

3.2 Water Analysis

The initial water samples of existing polluted tank are slight to strongly acidic (pH 6.4-4.6) and very low in electrical conductivity (EC) (0.1 dS/m). Regarding soluble anions, chlorides content was high and ranged from 2.2 mEq/L to 36.6 mEq/L, whereas CO_3^{2-} was absent and HCO_3^- was very low (1.9-3.56 mEq/L). The soluble cations Mg^{2+} content was more as compared to Ca^{2+}.

3.3 Different Plant Community Dominated Blocks in Agro-biodiversity Park

The aims of agro-biodiversity park are:

(1) To preserve and conserve, as well as to promote the native flora and fauna through *ex-situ* conservation of the species.

(2) To establish 15-20 biotic communities, including wild relative field crops, as a repository that flourished in the Deccan plateau in the past. Genes for specific traits are often available in wild species and landraces and have thus to be exploited fully to achieve desired objectives [8].

(3) To restore and develop the existing dry land wetland habitat to preserve and conserve the genetic resources of both flora and fauna.

(4) To create field gene bank for the threatened landraces and wild genetic resources of millets, cereals, pulses, oilseeds and fiber crops.

(5) To create different habitat types, which will provide material for resident and migratory birds, mammals, reptiles, amphibians, insects, etc..

(6) To promote and create awareness on nature conservation through education.

(7) To promote scientific research for preserving the keystone species of ecosystem importance.

(8) To promote ecotourism, which will act as cultural and aesthetic center for urban dwellers [9].

Different specific plant community dominated blocks have been developed in the agro-biodiversity park site, as listed below:

3.3.1 Teak Dominated Plant Community Block (2,200 Trees Planted in 2.20 ha)

In block 1, plantation was done during the month of September, 2008 with mixed plantation of different plant species with the object of creation of natural

habitat, where plant species will have different forms, shapes, canopy structures and growth, promoting the native flora and fauna in the locality. Teak was planted with a coverage of 30% in mixed plant community in the blocks. Hence, it is called teak dominated plant community block (Table 1).

3.3.2 Mahuva Dominated Block (1,500 Trees Planted in 1.50 ha)

This block (block 2) was also established in September 2008 with 30% coverage in a mixed plant community. A total of 16 tree species are planted in this block (Table 1).

3.3.3 *Ficus* Garden Block (202 Trees of *Ficus* with 30 Species in 0.4 ha)

In this block (block 3), different species of genus *Ficus* were planted during September 2009, with wide diversity in the species (Table 2).

3.3.4 Medicinal Tree Garden Block (535 Plants in 0.6 ha)

Twenty seven species of medicinal species were planted in September 2009, in this block (block 4) (Table 3).

3.3.5 Palm Garden Block (300 No., 22 Species in 0.4 ha)

Twenty two species of palms were planted in this block (block 5) to establish a model for genetic diversity of palm species during November 2009 (Table 4). Some of the palms, like sugar date palms and date palms, will withstand hardy dry conditions.

3.3.6 Mixed Forest Trees (No. of Plants 6,000 in 4.0 ha)

Nearly six thousand saplings having large and small crown growing habits were planted in block 6 in 4.0 ha in July 2010 itself (Table 5). As these were planted in

Table 1 Non-dominant tree taxa in mixed block (block 1 and block 2).

Non-dominant tree taxa in mixed block	
Alstonia scholaris	*Madhuca latifolia* (Mahuva)
Azadirachta indica (Neem)	*Peltophorum ferrugeneum* (Copper Pod tree)
Bauhinia spp. (Camel foot tree)	*Pongamia pinnata* (Pongamia)
Emblica officinalis (Anola)	*Spathodea companulata*
Ferrunea elephant (Wood apple)	*Syzygium cumini*
Ficus religiosa (Peepal)	*Tabebuia rosea*
Lagarstromia florsegene (Pride of India)	*Tamarindus indica* (Tamarind)
Millingtonia hortensis (Indian cork tree)	*Tectona grandis* (Teak)

Table 2 Tree species planted in block 3.

Details of species diversity in *Ficus* block	
F. pandurata	*F. mysorensis*
Benjamina blackiana (*Ficus* black)	*F. elastica* (Variegated)
F. prestige	*F. dammaropsis* (*Ficus* round highland)
F. reginald	*F. bushking*
F. wasteland	*F. triangle*
F. benghalensis	*F. milenusi*
F. religiosa	*F. religiosa* (Prop root)
F. glomerata	*Ficus* drooping
F. benghalensis (Variegated)	*Ficus* avoa gold
F. noda	*Ficus* long leaf
F. hispida (Fig)	*F. tussila*
F. benjamina (Golden King)	*F. mexicana*
F. iceland	*F. pleurocarpa*
F. pumila	

Table 3 List of medicinal plants in block 4.

Medicinal plants	
Acacia sinuata	*Commiphora wightii*
Adhatoda vasica	*Dalbergia latifolia*
Adenanthera pavonina	*Emblica officinalis*
Aegle marmelos	*Erythrina indica*
Alstonia venenata	*Haemophyllum canophyllum*
Asparagus racemosus	*Holarrhena antidysenterica*
Azadirachta indica	*Madhuca latifolia*
Butea monosperma	*Plumbago jailana*
Cassia alata	*Pongamia pinnata*
Cassia fistula	*Simarouba glauca*
Cassia glauca	*Sterculia foetida*
Cassia siamea	*Sterculia urens*
Ceiba pentandra	*Syzygium cumini*
Tabebuia avalanda	*Terminalia bellirica*
Thespesia populnea	

Table 4 Taxa of palms planted in block 5.

Large crowned species	Small crowned species
Peepal—*Ficus religiosa*	Anola—*Emblica officinalis*
Banyan—*Ficus benghalensis*	Camel foot tree—*Bauhinia racemosa*
White Terminelia—*Terminalia arjuna*	Pogada—*Mimusops elengi*
Tamarind—*Tamarindus indica*	Sandal wood—*Santalum album*
Wild almond—*Sterculia foetida*	Indian cork tree—*Millingtonia hortensis*
Almond—*Terminalia catappa*	Rose wood —*Dalbergia latifolia*
Black Terminalia—*Terminalia tomentosa*	Bamboo—*Dendrocalamus strictus*
Kadamba—*Anthocephalus cadamba*	Wood apple—*Ferronia elebphantum*
Ficus mollis	*Cassia fistula*
Madhuca longifolia	*Putranjiva roxburghii*
Sizygium cumini	*Swietenia mahagoni*
Hardwickia binata	

Table 5 Tree species planted in block 6.

Common name	Scientific name	Common name	Scientific name
Betel nut palm	*Areca catechu*	Ruffled fan palm	*Licuala grandis*
Sago palm	*Arenga saccharifera*	Sugar date palm	*Phoenix sylvestris*
Palmyra palm	*Borassus flabellifer*	Date palm	*Phoenix roebelenii*
Cane palm	*Calamus linden*	Needle palm	*Rhapidophyllum*
Clustered fish tail palm	*Caryota mitis*	Large lady palm	*Rhapis excelsa*
Wine palm	*Caryota urens*	Royal palm	*Roystonea regia*
Coconut palm	*Cocos nucifera*	Blue palm	*Sabal adansonii*
Talipot palm	*Corypha umbraculifera*	Wind mill palm	*Trachycarpus fortunei*
Kentia palm	*Dictyospermusn album*	Foxtail palm	*Wodyetbrightia bifurcata*
Triangle palm	*Dypsis decaryi*	Chinese fan palm	*Latania chinensis*
Oil palm	*Elaeis guineensis*		

monsoon season, almost all plants were survived [10].

3.3.7 Minor Fruit Trees Block (1,200 No., in 100 ha)

Minor fruit trees, such as *T. indica*, *S. cumini*, *E. officinalis*, *F. elephant*, *A. marmelos* were planted in degraded marginal lands as block 7 during the year 2012.

3.3.8 Beal Block (200 No. in 0.4 ha)

A separate sole beal plantation as block 8 was initiated in polluted area near water tank during 2014 and maintained further to take up the studies on influence of pollution.

3.4 Identification of Endangered Species

During the year 2009, a rare, endemic, endangered and globally threatened species *Ceropegia* (Asclepiadaceae), commonly called as chain of hearts, was identified. From then onwards, utmost care was taken towards conservation in agro-biodiversity park. *Ceropegia* is an old world tropical genus having 200 species. About 48 species are found in India and out these 28 are endemic to the peninsular region. In Telangana and Andhra Pradesh states, four species are reported, such as *C. attenuate*, *C. odorata*, *C. spirals*, *C. pusilla*. The roots and tubers containing an alkaloid called ceropegin, are having medical importance and active against many diseases, especially diarrhea, dysentery, ulcers and inflammations [11].

3.5 Preservation, Conservation and Maintenance of Traditional Varieties and Landraces of Pulses and Oil Seed Crops

Three crop wild varieties, such as rice (10), red gram (3) and safflower (3) were conserved and stored.

3.6 Other Activities

Some water ponds and water bodies have been already created as a source of water for all resident and migratory bio-creatures for promotion of faunal genetic resources. At present, agro-biodiversity park has 29 species of insects, five species of fish and 10 species of reptiles. Regarding butterflies, out of 120 species present in Telangana, 56 were recorded in the agro-biodiversity park. The bird species increased from 35 species to 172 species within the eight years of duration [12].

3.7 Plans for Future

In addition to maintaining and sustaining the developed plantation blocks, future plans are also kept in mind with availability of manpower and funds for further development in phased manner, viz., establishment of shade net nursery, green houses, besides development of range lands, butterfly garden, rock garden, water ponds, tank bund beautification, wetland ecosystem, eco-tourism, etc..

3.8 Expected Outcome of the Agro-biodiversity Park

The expected outcome from agro-biodiversity is enormous in many ways, such as the park may nurture variety of medicinal, herbal, ornamental and aromatic, aquatic plants, orchids, palm groves, bamboo groves and mixed forest trees, etc.. It creates the joy of aesthetic exploration. It is a good resource for academic study and to take up research activities for long term benefits.

4. Conclusions

Establishing and maintenance of agro-biodiversity park in PJTSAU, Hyderabad are essential and highly appreciated, as it will promote and conserve the native flora and fauna diversity of Deccan plateau in Hyderabad region that flourished in the past. In addition, it also improves the micro climate, environment, vegetation and soil biota, as well as enhances carbon sequestration. The developed plantation blocks will be sustained for future studies. In future, some more development activities will be taken up in phased manner. The agro-biodiversity park will create awareness and promote scientific research on education and also encourage ecotourism in future.

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References

[1] Van Ginkel, M. 2010. "Role of Dry Land Agro-biodiversity in Buffering Adverse Effects of Climate Change." In *Proceedings of International Conference on Biodiversity in Relation of Food and Human Security in a Warming Planet*, Chennai, India, 10-1.

[2] Haneltpete, ed. 1986. *Manfold's Encyclopedia of Agricultural Crops*. Berlin: Springer Verlag.

[3] Muniappan, R., and Viraktamath, C. A. 1993. "Invasive Alien Weeds in Western Ghats." *Current Science* 64 (8): 555-8.

[4] Prabhavathi, K., Aariff Khan, M. A., and Subrahmanyam, M. V. R. 2009. "*Ex-Situ* Conservation of Native Flora and Fauna through Development of Biodiversity Parks." In *Proceedings of National Seminar on Land Use Planning for Biodiversity Conservation*, Thrissur, India, 73-5.

[5] Association of Official Analytical Chemists (AOAC). 1980. *Official and Tentative Methods of Analysis.* Washington, D.C.: AOAC.

[6] Aariff Khan, M. A., Kamalakar, J., Umadevi, M., Mani, A., and Govardhan, V. 2011. "Soil Properties and Available of Ago-biodiversity Park of Acharya N. G. Ranga Agricultural, Hyderabad, Andhra Pradesh, India." *International Journal of Tropical Agriculture* 29 (3-4): 217-25.

[7] Kamalakar, J. 2011. "Characterization and Classification of Agri-biodiversity Park Soils of Acharya N. G. Ranga Agricultural University, Hyderabad, AP, India." M.Sc. thesis, Acharya N. G. Ranga Agricultural University, Hyderabad, AP, India.

[8] Anil Kumar, N., Arivudainambi, V., Nampoothiri, K. U. K., Geetharani, M., and Israel Oliver King, E. D. 2010. *Biodiversity Programme Hindsight and Forethought: Evolving Priorities for Next 20 Years.* Chennai: M. S. Swaminathan Research Agricultural Foundation, 12-3.

[9] Datta, S. K. 2013. "Conservation and Use of Plant Genetic Resources for Food and Agriculture: India Efforts." Global Consultations on Use and Management of Agro-biodiversity for Sustainable Food Security. Biodiversity International, New Delhi, India, 17-21.

[10] Srinivasulu, C. 2010. "Biodiversity News of Andhra Pradesh." *A News Letter of Andhra Pradesh State Biodiversity Board* 3 (1): 1-8.

[11] Long, C. L., Li, H., Ouyang, Z., Yang, X., Li, Q., and Trangmar, B. 2003. "Strategies for Agrobiodiversity Conservation and Promotion: A Case from Yunnan, China." *Biodiversity and Conservation* 12 (6): 1145-56.

[12] Vasudeva Rao, V., and Parasharya, B. M. 2009. "Invasive Alien Species of Avi-Fauna and Their Impact on Agriculture." In *Proceedings of State Level Workshop on Invasive Alien Species: A Great Threat to Agriculture*, Hyderabad, India: ANGRAU, 76-80.