www.nesa-india.org • E-mail: nesapublications@gmail.com
International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 35-42
ISSN No.: 0976-4534

STATUS OF PLANT BIODIVERSITY IN WAGHUR RIVER BASIN OF KHANDESH REGION IN MAHARASHTRA

Abhijit S. Thorat[1], Shridhar K. Jadhav[2] and S. R. Thorat[3]

[1,2,3]School of Environmental and Earth Sciences
Kavayitri Bahinabai Chaudhari North Maharashtra University Jalgaon, Maharashtra

Research Article

Received: **18.05.2022** Accepted: **28.05.2022** Published: **07.06.2022**

ABSTRACT

River and its basin biodiversity are the economical and natural value of Planet Earth are with a rich diversity of life forms, and millions of these living organisms have been well attached by the laws of nature. Plant on the river basin shows its characteristics and regional specification of the climatic system. A study was conducted to assess the status of biodiversity in the submergence zone of Waghur river near Jalgaon in this point of view of ecological components and their biological value. The richness of plant community and diversity study involves the study of species richness, diversity, and land-usepatterns. The present study shows the vegetation represents dry deciduous types, River basin area found 150 plant species were identified of their 30 tree species, 20 shrub species, 80 herb species, and 20 climbers were recorded from the river basin of Waghur

Keywords: Plant Biodiversity, Waghur River Basin, Waghur, Land Pattern, Species.

INTRODUCTION

The river basin is one of the majors diversify and species richness of flora, fauna, birds, and all types of biodiversity it's also economical value to the sustainable development of that area. Human life base of the current global food supply is depending on phenotypical variety of plant species and genotypes with genetic constitution characteristics for cultivation and human nutrition by early farmers (Ebert. et al., 2020).In the recent years, new disputes have reached for the conservation of useful genes for agriculture. Enhanced stress on Sensitive land resources has created a broad threat to biodiversity. As well the Species richness has become a valuable factor of biodiversity estimation. global biodiversity is very often considered in terms of global number of species in each of the different taxonomic groups ((Pullaiah et. al., 2015; Chavan et. al., 2018). India's mega biodiversity countries of the world, holding nearly 7-8% of the recorded species of the world, as well as 4 of the 34 globally identified biodiversity hotspots (Himalaya, Indo-Burma, Western Ghats and Sri Lanka, Sunderland). Traditional knowledge of biodiversity is the glory of Indian over 91,200 species of animals and 45,500 species of plants have been recorded in the ten biogeographic zones of the country (Rao. et al., 2010; Sonawane et al., 2008). In species richness and endemism, India is top position, its more than 300 wild ancestor plants and the diversity of crop plants is the highest. The biodiversity of plants is the genetic wealth of a country. Farmstead represents a land-use pattern involving deliberate management of multipurpose trees and shrubs in intimate association with seasonal vegetables (Fernandes and Nair,1990; Gaikwad and Thorat, 2004). Plant biodiversity of planet Earth is significantly exposer in composition from any that its ancestors would have experienced. Fluctuations in the intensity of the major greenhouse gases (CO_2, CH_4, N_2O) are air-borne pollutants that can also impact plant diversity (Corlett, 2014b). Recent century much interest has been given to diversity

*Corresponding author: *abhi11855@gmail.com*

conservation and utilization. Plant biodiversity is an important component of total biodiversity. It has been projected that there exist 5-30 million species of living forms on the Earth, of which 1.5 million have been recognized involving 300.000 plant species (Agrawal. 1999; Sheejan and Thorat 2016). The of occurrence of a particular species in an area is one of the clues of its biodiversity in that area (Haque. et al., 2015).

A study was conducted to assess the status of biodiversity in the submergence zone of waghur river near Jalgaon. In this study, various ecological components were studied for their biological value. It involved studying the richness of plant community, avifauna, aquatic fauna, and mammalian diversity. Biodiversity study involves studying species richness, diversity, and land use pattern of a biological community. Species richness refers to the total number of species, diversity refers to the number and abundance of different species and rarity refers to the total abundance of individual species in the area. For this study emphasis was given on the land use pattern and to find out how many rare, common, and uncommon species are found in the area.

MATERIAL AND METHODS

Methods used to know plant diversity of Waghur river basin: To understand the floristic diversity in the region, a transect consisting of alternate 20 x 20 m quadrats was used for sampling the habitat. Transect length depended on the species composition and diversity. All the trees at or above 10cm diameter at breast height (DBH) on 30cm girth at breast height (GBH) were enumerated at 1.3 meters above ground, identified, or samples collector (whenever possible). If field identification was not possible then it pressed for herbaria for future identification. Additional characteristics like aerophytes, climbers, parasites, any disturbance like lopping, logging, etc., were also noted. Canopy cover was noted, and ground litter quantity was weighed. Shrubs (GBH < 30cm and height >1m) were enumerated in two shrubs quadrates of 5 x 5 m laid diagonally inside 20 x 20m quadrates. Inside each shrub quadrate two 1 x 1m herb plotted (height < 1m) were laid diagonally and studied. Also, information such as ground control using a Global Positioning System (GPS), name of the locality, range of human activities such as lopping, logging, non-timber forest produces (NTFTP), fuel, and litter collections, fire incident, grazing, etc. were noted down. The photographs of different plant species have been presented systematically on the photo sheet in the result and discussion section.

Methods Used: Two methods were used to study in the plant community in waghur river basin is as follows.

- Stratified random sampling technique: In this form of sampling segment is stratified into several sub-segments within these areas.
- Quadrates sampling techniques: this technique involves quantifying vegetation in a non-grid of known measurement.
- Measuring trees and shrubs by plotting quadrates 10 x 10 meter, A1 x 1 meter quadrate was used for herbaceous vegetation sampling.
- All experiments were used for sampling river basin vegetation. In this process, the parameters noted are as follows.
- Species and number of trees, shrubs, herbs, and grasses
- Height and girth at breast height of trees.
- Phenophase (fruiting or flowering stage) of the trees, shrubs, herbs, and grasses

RESULT AND DISCUSSION

During the field study, 150 plant species were identified of their 30 tree species, 20 shrub species, 80 herb species, and 20 climbers were recorded from the river basin of waghur during Feb. 2018 to Jan 2020. The vegetation represents dry deciduous forest. Trees species such as Palash (local name) were the most dominant with associate species such as Arjun, Beheda. Dhooda species were the most dominant. The result obtained for plant species is presented in Table no 1.

Land Use Pattern: Recently increase in areas under non-Agricultural uses was due to a sharp increase in the population of the state. A substantial area from forest area has been put to non-agricultural uses causing negative growth in forest area for the entire study period. Further, it was observed that there has been a higher concentration for land under misc. trees, groves, barren and unculturable land, and land put to non-agricultural uses (Dekha et. al., 2018).

Forest land: The forest in waghur river basin area was dry deciduous with some semi-evergreen elements. The forests have a very poor diversity of trees and shrubs as per the result shown table no 1. The most dominant species was *Cordia dichotoma.* Other associate tree species were *Zizhyphus Mounatina* and *Lemmelia Belleena* the average height was measured up to 10 meters.

The study shows ground flora is abundant especially in the winter season with greater diversity. 15 grass species were recorded among which *Chrysopogon Spp*. was dominant. 39 species of the herb were recorded from the area. Species such as *Cassia tora, Indigofera trio, Evolvulus Alsionoides, Justicia Spp, Tephrosia Villosa, Vernonea Spp* were more common. Apart from this herb such as *Carallumaadscendens* were noted as rare in waghur area. In the case of the climber, six climbers *spp* were recorded

among which *Ampelocicus latifolia* was dominant whereas *Gloriosa superba* was rare to this area. Liana like *Butea Superba* has been recorded as shown in the table no 1.

Cultivated fields: According to the locals, part of the land could yield crops throughout the year whereas in some parts the yield was seasonal and water fed. The main crop of this area is cotton, bajara, and jawar. Along with this wheat, udad, chawli, moong, pea and tomatoes were cultivated. At places, there were banana and guvava orchards also. These crops were supplied water from the bore wells owned by the farmers. There was a small patch of teak *(Tectona Grandis*) plantation on some fields.

Wastelands: This area was intermixed with the crop fields, grassland, and forest land in the patches. This area showed signs of frequent grazing. The trees were stunted in growth with an open canopy. The area represents typically bioedaphic forest *i.e.*, dominance of *Butea Monosperma* Spp. Other associate species were *Terminalia Arjuna, Phonix Sylvestris, Cordia Dichotoma, Accacia Nilotica, Accacia Leocophloea, Zizipus Mauritiana,* and *Anogeissus Latifolia*. Grasses such as *CoixSpp* and *Chrysopogon Spp* were common in this area as.

Open water area: The east, left and right bank of Waghur River were studied for floristic diversity. This area also had a very sparse tree and shrub growth and abundant flora. In the study area 24 herbs species recorded. Dominant species among them were *Sida cordial*, *Sopubiadelphinifolio,* and *Acanthospermunmhispidium*. 9 species of climber were recorded in the area such as *Hemidesmus Indicus* and *Cyclea Peltata* was common. Amongst the shrubs most common were *Lantana camara, Cassia auriculata,* and *Maytenusheyneaa*. 15 trees species were recorded from the area. The dominant among them includes *Butea monosperma, Accacia nilotica, Terminalia crenulate, Morindapubscems,* and *Azadircta indica*. There was no natural tree growth near the village the species such as *Ailanthus excels* and *Azadirchta indica* were recorded. As expected, there were shrubs and climbers near the houses of the village. The observations made during the biodiversity survey are described in the subsequent points;

- The area studied of the river waghur basin does not show the presence of any endemic or endangered plant species. A detailed list of plants studied, and their status is given below in the table.
- As per the records, 393.51 ha of forest area were under submergence. However, the study revealed that a very low percentage of the area can be classified as forest area.

CONCLUSION

Table 1: Showing list of plant species in the entire study area.

Plant Species	Family	Type	Abundance
Abelmoschus manihot (L.) Medic	*Malvaceae*	Herb	F
Abelmoschus pannosum (Forst.f) Schlect	*Malvaceae*	Tree	F
Abitulon indicum (L.) sweet	*Malvaceae*	Tree	C
Acacia chundra (Roxb ex. Rottle) wild	*Mimosaceae*	Tree	C
Acacia leucophloea (Roxb.) wild	*Mimosaceae*	Tree	C
Acacia nilotica (L.) spp indica (bth.) Brenam	*Mimosaceae*	Tree	F
Acalypha malbarica Muell-Arg	*Euphorbiaceae*	Herb	VC
Acanthosprmumhispidum DC.	*Asteraceae*	Herb	C
Achyranthes aspera L.	*Amaranthaceae*	Herb	R
Aegle maemelos (L) DC.	*Rutaceae*	Tree	R
Alternanthera sessile (L) DC.	*Amaranthaceae*	Herb	C
Alysicarpous tetragonolobus Edgew.	*Fabaceae*	Herb	C
Ampelociccus latifolia (Roxb.) planch	*Vitaceae*	Climber	VC
Andropogon pumilus Roxb.	*Poaceae*	Herb	VC
Anogeissus latifolia (Roxb ex DC) wall	*Combretaceae*	Tree	C
Apludamutica L.	*Poaceae*	Herb	VC
Areva lantana (L.) A. L. Juss	*Amaranthaceae*	Herb	C

Argyreia sericea Dalz.	*Convolvulaceae*	Climber	F
Aristida adscensionis L.	*Poaceae*	Herb	VC
Azadirchta indica (L.)Delile	*Meliaceae*	Tree	C
Azanza lampas Alef.	*Malvaceae*	Herb	R
Balanites aegyptiaca (L.) Delile	*Balanitaceae*	Shrub	VC
Barlerialawii T.	*Acanthaceae*	Herb	C
Bauhinia racemosa lam.	*Caesalpinaceae*	Herb	C
Biophytumsensitivum DC.	*oxylidaceae*	Herb	VC
Boerhaviadiffusa L.	*Nyctaginaceae*	Herb	VC
Boswellia serrata Roxb. Ex colebr	*Burseraceae*	Tree	C
Brachiarariaeruciformis (J.E.Sm) Erseb	*Poaceae*	Hreb	VC
Bridelia retusa (L.) Spr.	*Euphorbiaceae*	Tree	C
Butea monosperma (Lam.) Taub	*Fabaceae*	Tree	VC
Butea superb Roxb.	*Fabaceae*	Climber	R
Caesaria elliptica Willd	*Flacourtiaceae*	shrub	F
Caesuliaaxillaris Roxb.	*Asteraceae*	Herb	F
Calatropisprocera (alit) R. Br.	*Asclepiadaceae*	shrub	R
Capparis decisua (Forsk.) edgeworth	*Cappariaceae*	Shrub	F
Capparius spinosa L	*Cappariaceae*	Shrub	F
Carallumaadscendens (Roxb.) R. Br	*Asclepiadaceae*	Herb	R
Cardiospermum microcarpa Kunth	*Sapindaceae*	Climber	F
Cassia auriculata L.	*Caesalpinaceae*	Shrub	VC
Cassia fistula L.	*Caesalpinaceae*	Tree	R
Cassia Pumila Lam.	*Caesalpinaceae*	Herb	VC
Cassia tora L.	*Caesalpinaceae*	Herb	VC
Cayratiatrifolia (L.) Domin	*vitaceae*	Climber	F
Celastruspaniculatus Wild.	*Celastraceae*	Climber	F
Chloris barbata Swartz.	*Poaceae*	Herb	C
Cissus woodrowii Santapau	*Vitaceae*	Climber	C
Cleome monophylla L.	*Cleomaceae*	Herb	C
Cleome viscosa L.	*Cleomaceae*	Herb	C
Cocculus hirsutus (L.) Diels	*Menispermaceae*	Herb	C
Coixgangantea Koen ex Roxb	*Poaceae*	Herb	VC
Commelina benghalnesis L.	*commelinaceae*	Herb	C
Corchorus aestuans L.	*Tiliaceae*	Herb	C
Cordia dichotoma Frostf.	*Cordiaceae*	Tree	C
Crysopogan fulvus (Spr.) Chiov.	*Poaceae*	Herb	VC
Cycleapeltata (Lam.) Hook and Thoms.	*Menispermaceae*	Climber	R
Cynodondactylon pers.	*Poaceae*	Herb	F
Cyperus rubicundusvahl.	*Cyperaceae*	Herb	F

Desmodiumheterocarpum (L.) DC.	*Fabaceae*	Herb	C
Desmodiumgangeticum (L.) DC	*Fabaceae*	Herb	C
Discoriabulbifera L.	*Dioscoraceae*	Herb	C
Discoria pentaphylla L.	*Dioscoraceae*	Climber	R
Diospyros melanoxylon Roxb.	*Ebenaceae*	Tree	C
Diplocyclospalmatus (L.) C. Jeffry	*Cucurbitaceae*	Climber	F
Dolichandrone falcate Seem.	*Bignoniaceae*	Tree	R
Duranta spp.	*Verbenaceae*	Shrub	F
Elephantopusscaber L.	*Asteraceae*	Herb	R
Eluesineindica (L.)	*Poaceae*	Herb	R
Eluesineindica (L.) Gaertn.	*Poaceae*	Herb	C
Enicostemaaxillare (Lam.) Raynal	*Gentianaceae*	Herb	C
Euphorbia thymifolia L.	*Euphorbiaceae*	Herb	C
Euphorbia geniculata Orteg.	*Euphorbiaceae*	Herb	C
Evolvulusalsinoides (L.) L.	*Convolvulaceae*	Herb	VC
Flacoutia indica (Burm.f.) Merr.	*Flacourtiaceae*	Shrub	F
Gloriosa superb L.	*Liliaceae*	Climber	R
Grewia tiliaefolia var tiliaefolia Vahl.	*Tiliaceae*	Shrub	C
Helicteresisora L.	*Sterculiaceae*	Shrub	F
Hemidesmus indicus (L.) Schultes	*Asclepiadaceae*	Climber	F
Heteropogoncontortus (L.) P. Beauv.	*Poceae*	Herb	C
Indigofera linifolia (L.f.) Retz.	*Fabaceae*	Herb	VC
Indigofera triata L.	*Fabaceae*	Herb	VC
Ipomea eriocarpa R.Br.	*convolvulaceae*	Climber	F
Ipomea mauritiana Jacq.	*convolvulaceae*	Climber	F
Justicia quinqueangularis var peploides Koen.	*Acanthaceae*	Herb	VC
Justicia simplx D.	*Acanthaceae*	Herb	VC
Lagaceamollis Cav.	*Asteraceae*	Herb	F
Lanneacoromandelica (Haut.) Merrill	*Anacardiaceae*	Tree	F
Lantana camara var. aculeate (L.) Moldenke	*Verbanceae*	Shrub	C
Lepidagathis cristata Willd	*Acanthaceae*	Herb	R
Leucas cephalotes (Roxb.) Spr.	*Lamiaceae*	Herb	C
Leucas zeylanica (L.) R. Br.	*Lamiaceae*	Herb	C
Luffa acutangula (L.) Roxb. Var amara (Roxb) C.B.C.L	*Cucurbitaceae*	Climber	R
Malva coromandeliana L.	*Malvaceae*	Herb	R
Mangifera indica L.	*Anacardiaceae*	Tree	C
Maytenusheyneana (Roth) Raju and Babu	*Celastraceae*	Shrub	VC
Melanocenchrisjacquemontii Jaub.	*Poaceae*	Herb	VC
Mimosa hamata Wild	*Mimosaceae*	shrub	C
Mitragynaparvifolia (Roxb.) Korth.	*Rubiaceae*	Tree	C

Morindapubescens J.E. Sm.	*Rubiaceae*	Tree	C
Moringa concanesis Nimmo	*Moringaceae*	Tree	C
Mucuna pruriens (L.) DC.	*Fabaceae*	Climber	R
Neonitisrheedii (Wall ex Wight and Arn.) W.H. Lewis	*Rubiaceae*	Herb	F
Opuntia spp.	*Euphorbiaceae*	Shrub	R
Orthosiphon pallidus Royle ex Bth	*Lamiaceae*	Herb	C
Oscimumgratissium L.	*Lamiaceae*	Herb	C
Oxalis carniculata L.	*Oxylidaceae*	Herb	C
Panicum notatum Retz.	*Poaceae*	Herb	C
Parthenium hysterophorus L.	*Asteraceae*	Herb	C
Phonix sylvestris (L.) Roxb.	*Asteraceae*	Tree	F
Phyllanthus fraternus Webster	*Euphorbiaceae*	Herb	C
Plumbago zeylanica L.	*Plumbaginaceae*	Herb	C
Pulicariawightiana (DC.) C. B. Cl.	*Asteraceae*	Herb	C
Pupalialappacea (L.) A. L Juss	*Amaranthaceae*	Herb	C
Rhynchosiarothi Bth ex Ait.	*Fabaceae*	Herb	R
Scrophulariachinesis L.	*Scrophulariaceae*	Herb	F
Senecio dalzellii C. B. Cl	*Asteraceae*	Herb	C
Sida cordata (Burm. f.) Borssum	*Malvaceae*	Herb	C
Sida spinosa L.	*Malvaceae*	Herb	C
Sitaria pumila (poir) R and S	*Poaceae*	Herb	VC
Solanum nigrum L.	*Solanaceae*	Herb	F
Sopubiadelphinifolia (L.) D. Don	*Scrophulariaceae*	Herb	C
Spermacocepusilla Wall	*Rubiaceae*	Herb	VC
Spoindios pinnata (L.f.) Rurz.	*Anacardiaceae*	Tree	R
Sporobolus coromandelianus (Retz.) Kunth	*Poaceae*	Herb	C
Tamarixericoides Rottl	*tamaricaceae*	herb	C
Tectona grandis L.	*Verbenaceae*	Tree	C
Tephorsiavillosa (L.) pers.	*Fabaceae*	Herb	VC
Terminalia arjuna (Roxb ex DC.) Wight &Arn	*Combretaceae*	Tree	C
Terminalia bellerica (Gaertn.) Roxb.	*Combretaceae*	Tree	C
Terminalia crenulata Roth.	*Combretaceae*	Tree	F
Themeda quadrivalvis (L.) O.Ktze	*Poceae*	Herb	C
Tragia involucrate L.	*Euphorbiaceae*	Climber	F
Tribulus terrestris L. H.	*Zygophyllaceae*	Herb	C
Tricodesma indicum (L.) R. Br.	*Boranginaceae*	Herb	C
Tridax procumbens L.	*Asteraceae*	Herb	C
Triumphetta rotundifolia L.	*Tilaceae*	Herb	VC
Triumphettapilosa Roth	*Tilaceae*	Herb	C
Tylophoradalzellii	*Asclepiadaceae*	Herb	C

Var fimbriata (Wall.) Grav and Mayur	*Asclepiadaceae*	Herb	C
Vernonia cinerea (L.) less	*Asteraceae*	Herb	C
Vigna trilobata (L.)Verdc.	*Fabaceae*	Herb	C
Vitex nifundo L	*Verbenaceae*	Shrub	C
Wrightia tinctoria (Roxb.) R. Br.	*Apocynaceae*	Tree	R
Xanthium strumarium L.	*Asteraceae*	Herb	VC
Zizipusmauritiana Lamk.	*Rhamnaceae*	Tree	C
Zizipus rugosa Lamk.	*Rhamnaceae*	Tree	R

Abundance code: C= common, F= Frequent, VC= very common, R= rare

A study was conducted to assess the status of biodiversity in the submergence zone of Waghur basin near Jalgaon. In the present study, various ecological components were studied for their biological value. It involved studying the richness of plant community, avifauna, aquatic fauna diversity. The vegetation of any area and the habitat types found there is a principal determining factor in the biodiversity of an area. The dominant vegetation type in the submergence area is agricultural fields. However, these do not have varied biodiversity from the point of view of vegetation. They support bird communities akin to grassland birds and such as wren-warblers, munias and pipits.

The diversity of other biotic components in this area is also not very high. The other main habitat types are scrub, grassland, open forest, and rivera in forest. The scrub forest and grassland are a result of the degradation of the forests and are kept in that state by biotic factors such as lopping and grazing. Scrub and seasonal grassland of the type found in the study area is a common habitat found in degraded areas and wasteland all over peninsular India. So, it cannot be said to be a very valuable area from a biodiversity point of view. The forests are of dry deciduous type. They are also considerably degraded by lopping and cutting and show no structural complexity in terms of vegetation layers. These forests are dominated by *Butea monosperma*. Some vegetation diversity in the forest was found only in a small patch in the Gangapuri area.

REFERENCES:

1. **Agrawal, K. C.** 1999. Biodiversity Agro botanical. Vyas nagar, New delhi.
2. **Chavan Tukaram P., Harshad R. Kakade, Abhijit S. Thorat and Thorat S. R.** (2018): The Status of Sediment and Heavy Metal Pollution in Waghur River of Jalgaon in Khandesh Area of Maharashtra, India, International Journal on Environmental Sciences 9 (1): 9-14, April Special Issue 2018, ISSN No.: 0976-4534; UGC Approved Journal No. 7783.
3. **Corlett, R.** (2016). Plant Diversity in a Changing World: Status, Trends, and Conservation Needs. Plant Diversity. 38. 10-16. 10.1016/j.pld.2016.01.001.
4. **Corlett, R.T.,** 2014b. Forest fragmentation and climate change. In: Kettle, C.J., Koh, L.P. (Eds.), Global Forest Fragmentation. CAB International, Wallingford, pp. 69-78.
5. **Douglas Gollin**. Conserving genetic resources for agriculture: economic implications of emerging science Food Security (2020) 12:919–927 https://doi.org/10.1007/s12571-020-01035.
6. **Ebert, A.W.; Engels, J.M.M.** Plant Biodiversity and Genetic Resources Matter! *Plants*. **2020**, *9*, 1706. https://doi.org/10.3390/plants9121706.
7. **Fernandes, E.C.M. and Nair, P.K.R.,** 1990. An evaluation of the structure and function of tropical homegardens. *Agricultural Systems*. 21: 279-310.
8. **Gaikwad S. R., S. R. Thorat and T. P. Chavan**. (2004): Diversity of phytoplankton and zooplankton with response to pollution status of river Tapi in North Maharashtra Region. *J. Curr. Sci*. 5(2): 749-754.
9. **Haque, Md. Maksudul, Mannan, Md. Abdul, Saiful, Mohammad** (2015) Plant-Biodiversity at Ajmerigang Haor Homesteads of Bangladesh.
10. https://www.cbd.int/countries/profile/?country=in
11. **N. Deka, J.P. Hazarika, P.P. Bora and R. Buragohain** (2018) Change in Land Use and Cropping Pattern in Assam: An Economic Analysis, Economic Affairs, Vol. 63, No. 1, pp. 39-43.
12. **Pullaiah, T. & Bahadur, Bir & Krishnamurthy, Kulithalai**. (2015). Plant Biodiversity. Plant Biology and Biotechnology: Plant Diversity, Organization, Function, and Improvement. 1. 177-195. 10.1007/978-81-322-2286-6_6.
13. **Rao G.R., Subash Chandran M.D. and Ramachandra T.V.**, (2010). Plant Diversity in the Sharavathi River Basin in Relation to Human Disturbance. *The Indian Forester. Vol. 136, No. 6, June 2010*, Pp. 775-790.

14. **Sheejan P. G. and S. R. Thorat** (2016): Studies on Phytoplankton of River Waghur in Jalgaon in Area of Khandesh Region, (MS) India. *International Journal in Management and Social Science*. Vol-4 Issue-07 Pp. 38-43. ISSN: 2321-1784.

15. **Sonawane A. C., Ram Mridula B. and Thorat S. R.** (2008): "Study of medicinal plants in North Maharashtra University campus of Jalgaon city in Khandesh area of Maharashtra, India", *J. of Biosciences Biotechnology Research Asia*, Vol. 5(2), Pp 741-746. ISSN: 0973-1245.