

**DEPARTMENT OF BOTANY**  
**DETAILS OF STUDY PROJECTS**  
**2020-21**

S.NO	ACADEMIC YEAR	TITLE OF THE FILED PROJECT/STUDY PROJECT	STUDENTS PARTICIPTED			
						Total Projects
1.	2020-21	The Use of Tree Rings as Environmental Sensors	D.RajKumar	03220-3201		01
			P.Pavan Kumar	03220-3211		
			V.Rajesh	03221-3037		
			V.Greeshma	03221-3026		
			P.Nikhil			

## DECLARATION

This to certify that we hereby declare that this Project work entitled **“The use of Tree Rings as Environmental Sensors”** is a bonafide work carried out by us under the guidance of **Dr.K.Vijay kumar Asst.Professor of Botany J.V.R Government College, Sathupally, Khammam Dist. during February, 2021.**

This work has not been previously submitted in part of full for any publication, award or Prize.

SI.NO	NAME OF THE STUDENT	YEAR	GROUP	ROLL NUMBER
1	D.RAJ KUMAR	III	BZC	032-20-3201
2	P.PAVAN KUMAR	III	BZC	032-20-3211
3	V.RAJESH	II	BZC	032-21-3038
4	V.GREESHMA	II	BZC	032-21-3037
5	P.NIKHIL	II	BZC	032-21-3026

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# **JIGNASA STUDY PROJECT**

**2021**

## **“The use of Tree Rings as Environmental Sensors”**

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## **Abstract**

Wood samples of 12 tree species from the Kistaram-Lankapally road cut during road extension were analyzed macroscopically for occurrence and formation of growth rings. Well defined annual rings were found in tree species studied. Diameter of the growth rings and age relationships were estimated using scale and tape which showed a wide range from 12 to 48 years. The method used is simple inexpensive measurement of growth rings using scale, tape and lens. The main aim of the study is to relate the impact of environmental conditions on growth rings of trees and to know their past and study open cast impact on past life of trees.

## **Introduction**

Growth rings in Tropical trees are distinct and trees produce only one ring each year. When a species is shown to have identifiable annual rings, a ring count can normally provide age when the rings are counted its age can be estimated that is accurate for many purposes (Duever & McCollom 1987) Growth rings in woody plants and width of the growth rings show some degree of function of both natural and anthropogenic conditions (Fritts 1976). Generally Trees with good canopy are planted on either side of the roads for shade purpose and to promote biodiversity.

## **Origin of Research Problem:**

During a preliminary study on the various health issues at Kistaram villages majority found to be suffering from lung infections, breathing, throat, skin allergies and eye related issues due to Fly ash, dust emissions from high-intensity blasting and explosions daily at Open cast situated at 2 kms. When trees along the Kistaram-Lankapally road were cut in February 2021 due to road extension it provided an opportunity to relate the impact of environmental conditions on growth rings of trees and to know their past and study open cast impact on past life of trees.

Tree species planted on either side of the road are of top canopy, middle canopy and lower canopy. Six tree species were found to be more along the Kistaram-Lankapally road of which *Tamarindus indica*, *Bombax ceiba*, *Syzgium cumini* and *Albizia lebek* are top canopy trees and *Azadiracta indica*, *Pongamia pinnata* are middle canopy trees.

## **Azadirachta indica**

### **Classification:**

Kingdom : plantae  
Family : Meliaceae  
Order : Sapindales  
Genus : Azadirachta  
Species : indica  
Common name : Neem,indian lilac  
Telugu Name : vepa

- Life span of Neem tree 150 – 200 years .
- Bark is dark grey outside and reddish on the inside .
- It's canopy symmetry : Irregular
- It's canopy density : Medium
- It's canopy texture : Fine

### **SECONDARY WOOD STRUCTURE**

- Neem is a medium to large sized tree has straight trunk and long spreading branches forming a broad round crown and hence grown as Avenue tree.
- Neem sapwood is grayish white, and the heartwood is mottled and pinkish red when first exposed.
- It fades to reddish brown and resembles mahogany on drying .The wood is scented ,moderately hard and heavy and medium to coarse – textured with narrowly interlocked grain.annual growth rings are distinct , numbering 2.0 to2.4 per cm of radius.

## *Pongamia pinnata*

### Classification

Kingdom : plantae  
Phylum : spermatophyt  
Class : dicotyledonae  
Family : Fabaceae  
Genus : Pongamia  
Species : pinnata  
Order : Fabales  
Common name : Pongam tree  
Telugu name : Kanuga

- *Pongamia pinnata* also planted as avenue tree.
- It can grow in full shade, semi – shade or no shade. It prefers moist or wet soil.
- Tree with dense globose canopy.
- Bark is smooth and grayish brown .
- A solitary mature gall in long sections and transections appears more or less circular in outline. It's periphery is constituted by 3-4 phelloid layers. The cortex is narrow and consist of parenchyma .

### SECONDARY WOOD STRUCTURE

- It is delimited internally by a narrow discontinuous sclerieds. Between this scleried zone and inner zone of vascular tissue, there is broad parenchymatous zone. The pith is broad and is composed with isodiametric parenchyma cells.



**Tamarindus indica L.**

**Classification**

Kingdom : plantae  
Class : magnoliopsida  
Order : Fabales  
Family : Fabaceae  
Genus : Tamarindus  
Species : indica  
Common name : Tamarind  
Telugu name : Chintha chettu

- Life span tamarindus indica is 80 – 200 years.
- It is a dome shaped tree. Dappled shape which will allow enough sunlight to penetrate for lawn to thrive beneath this upright.
- Bark : Gray brown to blackish and rough ,with vertical fissures and horizontal cracks.
- Canopy symmetry : Irregular
- Canopy density : Dense
- Canopy texture : fine

**SECONDARY WOOD STRUCTURE**

- Xylem was diffuse porous with indistinct growth rings .However ,annual amount of xylem increment can be discerned by the tangential layer of initial parenchyma and crystaliferous formed at the end of the cambial activity .The arial parenchyma were vesicentric aliform to confluent . vessels were mostly solitary but radial multiples of 3-6 cells were also observed occasionally. The length and lumn diameter of the vessel elements varied from 193 – 25 micrometers and 130-190 micrometers .

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**Bombax ceiba L.**

**Classification**

Kingdom : Plantae  
Phylum: spermatophyta  
Class : Dicotyledonae  
Order : Malvales  
Family : Malvaceae  
Genus : Bombax  
Species : cieba  
Common name : Red silk cotton tree  
Telugu name : Buruga

- Life span is 25 – 50 years .
- Fibre from the inner bark and gum containing tannins from the bark .
- It cannot grow in the shade it prefers dry or moist soil.
- Canopy symmetry : Irregular
- Canopy density : open
- Canopy texture : fine
- It is an avenue plant
- The stem is circular in outline and remains surrounded by a few layered zone of cork followed by cork cambium and secondary cortex. The endodermis and pericycle are not clearly demarcated .
  
- **SECONDARY WOOD STRUCTURE**
  - During secondary growth vascular cambium cuts secondary phloem towards outside and secondary xylem towards inside.
  - Due to the presence of vessels the wood is porous. vessels present in the early wood are very large and form conspicuous rings in this wood while those present in the late wood are small or only moderately large. The wood with this characteristics is called ring porous .
  - Wood or secondary xylem is formed by tracheids, vessels ,xylem fibres and xylem parenchyma .
  - Distinct annual rings or growth rings are seen in the wood. A gradual transition from early – wood to late- wood is also visible

## *Syzygium cumini* (L.)

### Classification

Kingdom: plantae  
Phylum: magnoliophyta  
Class: magnoliopsida  
Order : Myrtales  
Family : Myrtaceae  
Genus : Syzygium  
Species : cumini  
Common name : Java plum  
Telugu name : Neredu

- It can live more than 100 years.
- The bark is white in colour with light pink interior. The bark is rough and dark grey at base of the tree becomes lighter and smoother higher up. Its dense foliage provides shade and it has grown for its ornamental value .
- Canopy symmetry : symmetrical
- Canopy density : dense
- Canopy texture : coarse
- Syzygium cumini cultivated as avenue plantation.

### Secondary wood structure

- Indistinct heartwood and sapwood , wood colour ranges from pale grey or grayish brown in the outermost region to dark brown or reddish brown towards the centre;
- Wood is hard to hard and dense to heavy ; grain generally shallowly
- 33interlocked , sometimes wavy ,medium to coarse – texture .
- Anatomical features :- A semi – ring porous , diffuse – porous wood .
- Growth rings :- Both distinct and indistinct .
- Vessels mostly solitary in radial multiple of 2-4 circular in outline , barrerl shape without the tail , with very long or small tail at one end or both ends,500 to 1200 micrometers , $868.83 \pm 147.66$  micrometers in length, vessel frequency 6- 20 .
- Ray :- uniseriate , biseriate and multiseriate , mean ray height and ray width 352.52 – 944.07 micrometers ,30 – 77.56 micrometers, 1 – 3 cells wide , rays both homocellular,all homocellular rays upright / square cells disjunctive parenchyma cells present

## *Albizia lebbek*

### Classification

Kingdom : plantae  
Class : Dicotyledons  
Family: Fabaceae  
Order : Fabales  
Genus : Albizia  
Species : lebbek  
Common name : womens  
tongue  
Telugu name : Dirisena

- It is a tree growing to height of 18-30 m tall with a trunk 50cm – 1m in diameter .
- Growth rate : Fast
- Tree shape : Spreading
- Canopy symmetry : Irregular
- Canopy density : Medium
- Canopy texture : Coarse
- Bark : The bark is 1.2cm thick ,variable in colour from pale to dark brownish grey , with numerous short , Irregular cracks , elevated and horizontal lines.
- It is valued for its timber , as an ornamental and road side tree ,and as a source of shade and fodder.

## **Objectives:**

1. To conduct dendrochronology studies on the cut trees along Kistaram-Lankapally Road
2. To count the growth rings and calculate the age of the trees
3. Measure the width of the growth rings and fluctuations in the width
4. Relate the fluctuations in the growth rings to past environmental conditions
5. Study the impact of the Opencast mining on the past life of the cut trees and meteorological data of past years

## **Review of Literature**

Several studies have been carried out on the wood anatomy of tropical trees in order to identify the growth rings and their temporal sequence and several methods have been used to reach this objective (Mariaux 1967; Catinot1970; Tomlinson&Craighead1972; Eckstein *et al.* 1981; Lieberman et al. 1985; Villalba1985; Worbes 1985, 1986). Growth rings widths can provide valuable information on how woody plant growth varies temporally or spatially as a function of various environmental conditions and depends on the species and sites. Long term exposure to sulfur dioxide is cumulative in nature and lead to reduced growth and yield with no clear visible symptoms (WHO Reports, 2000).

## Methodology:

### Site of Study

Kistaram-Lankapally road is adjacent to Singareni Collieries Open cast situated at Kistaram village longitude 80.776246° and 17.214214° latitude. J.V.R Opencast-I is functional since 2005 with a capacity of 0.7 MTPA and J.V.R Open cast-II is functional since 2015 with a capacity 5.0 MTPA Kistaram-



Source: Google earth

The study was conducted to determine the dendrochronological characteristics of the age old trees cut along the Kistaram – Lankapally road due to road extension. A preliminary study of the age and growth was undertaken on the basis of their growth ring widths.

### **Meterological data:**

Meterological data was taken from various previous study reports as secondary data to relate the width of the growth rings of past environmental conditions at the site of the study. Air quality index, temperature, rainfall, fires were taken from previous years to relate the growth rings changes to the previous environmental conditions.

### **Survey on health issues**

A survey was conducted during study period to assess the impact of open cast mining, air and water quality on the health issues of people of Kistaram Village at which open cast is situated.

### **Dendrochronological studies**

Dendrochronological measurements of trees cut at breast height were measured macroscopically with scale and tape to measure the width of growth rings and diameter of tree trunk. The values were tabulated.

Circumference and Diameter was also measured with tape and calculated as per standards formulae.



**Plate1. Counting of Annual rings in Albizia lebek**

## Results:

On analysis of the meteorological data and other parameters of past years from 2005 to 2018 at the site of study reveal that wind speed Average max temperature, Air quality, Rainfall, PM<sub>2.5</sub> and emissions at the site of study are more than the normal range.(Table 1). Air quality, temperature, PM<sub>2.5</sub> and emissions values indicate high levels of pollution. Long term exposure to SO<sub>2</sub> 9.6 µg/M<sup>3</sup> to 14.4 µg/M<sup>3</sup> might have led to reduced growth and yield of trees as evident in the width changes of Annual rings analyzed in the cut trees.

**Table 1.Meteorological Data**

S.No	Parameter	Values (Avg. Up to 2018)
1	Wind speed	8.0 m/s
2	Temperature	43.3°C Max 18.1°C Min 30.7°C Avg
3	Relative Humidity	66.5%
4	Air Quality	43.3µg/M <sup>3</sup>
5	Rainfall	676.0 mm 11.83mm 1155.8mm
6	PM <sub>2.5</sub>	SO <sub>2</sub> -9.6 µg/M <sup>3</sup> to 14.4 µg/M <sup>3</sup> NO <sub>x</sub> 13-21.5 µg/M <sup>3</sup>
7.	Emissions	EFPM10=246.4Kg/day at Blasting of Coal site EF PM10=45.4Kg/day at Drilling of coal site

**Source:** Environment Protection Training & Research Institute (PTRI NOV.2019)



Dendrochronological measurements in terms of Circumference of the tree, Diameter of the trunk, Number of Annual Rings and width of Annual growth Rings and were measured on cut tree trunks of breast height. A total 12 tree species studied belonging to 06 families were studied namely *Azadiracta indica*, *Pongamia pinnata*, *Tamarindus indica*, *Bombax ceiba*, *Syzgium cumini* and *Albizia lebeck*.

**Table 2.Dendrochronology analysis**

S.No	Name of the Tree	Diameter of the stem (Cms)	Circumference of the stem (Cms)	Total No. of Annual Rings counted	Age	Average width of Annual ring (Cms)
1	<i>Azadiracta indica</i> (AI -I)	63	186	12	12	1.916
2	<i>Pongamia pinnata</i>	44	171	18	18	1.111
3.	<i>Tamarindus indica</i>	57	1.91	41	41	0.6121
4		60	160	14	14	1.626
5.	<i>Azadiracta indica</i> (AI-II)	31	93	12	12	1.125
6.	<i>Bombax ceiba</i> (BC-I)	72	210	32	32	1.356
7.	<i>Syzgium cumini</i>	49	145	29	29	0.774
8.	<i>Albizia lebbek</i> (AL-I)	64	192	22	22	1.436
9.	<i>Bombax ceiba</i> (BC-II)	46	160	48	48	0.614
10.	<i>Bombax ceiba</i> (BC-III)	47	158	14	14	1.207
11.	<i>Bombax ceiba</i> (BC-IV)	47	170	17	17	1.158
12	<i>Albizia lebeek</i> (AL-II)	44	138	21	21	1.261

As per the table 2 on analysis age of the trees range from 12-48 years and years where the width of annual rings studied show fluctuations when compared to the average width of the growth rings correspond to mostly from 1980 -2019 years and mostly 2015 – 2018 years showed marked deviations in the width of growth rings in most of the studied trees.

**Table 3**

S.No	Year	Avg.Day Temperature (°C)	Avg.Night Temperature (°C)
1	2015	28.66	26.66
2	2016	32.00	26.50
3	2017	31.83	26.16
4	2017	32.16	26.16
5	2018	31.66	26.50
6	2019	30.58	26.00
7.	2020	31.41	26.50

Correspondingly these years showed increase in average temperature as per values in Table 3 which might have impacted tree growth and hence marked fluctuations in width of the growth rings.

## **Findings:**

- Age of trees range from 12-48years and past years range from 1980 to 2019
- Annual rings in the cut trees along the site of study showed normal width of rings prior to the starting of opencast mining but showed marked width changes in annual rings in later years
- Years of 2015-2019 correspond to increase in coal mining due to start of second Open cast unit showed increased pollution and hence changes in Air quality, temperature and PM<sub>2.5</sub>
- Decrease in width and marked fluctuations in growth rings also corresponds to years 2015-2019

## **Conclusion**

Tree rings in tropical trees are distinct with each growth ring showing alternate light and dark rings that correspond to a single year. During the dendrochronological studies conducted in February, 2020 on cut tree trunks along widening of Kistaram to Lankapally road the growth rings showed distinct width patterns corresponding to fluctuations in environment due to adjacent Opencast emissions and high intensity blasting. The fly ash matter in the air and pollutions of Coal tippers resulted in observed growth ring patterns.

Dendrochronology studies of trees not only helped to calculate age of the tree but also most accurate evidence of the past environmental conditions tree faced in its life time and act as environmental sensors.

## References

1. Studies on tree rings, growth rates and age-size relationships of tropical tree species in misiones, Argentina J.A. Boninsegna, R. Villalba, L. Amarilla, and J. Ocampo IAWA Bulletin n.s., Vol. 10(2), 1989: 161-169
2. Methods of Dendrochronology Application in the Environmental Sciences Springer- ISBN 978-90-481-4060-2 ISBN 978-94-015-7879-0 (eBook)  
DOI 10.1007/978-94-015-7879-0
3. Gamble, J.S 1922 A manual of Indian timbers 2d ed. London: Sampson low, Martson and Co.866p.
4. Effects of Sulphur dioxide on vegetation; Critical levels,Air quality guidelines-Second edition WHO Regional office for Europe,Copenhagen,Denmarks,2000

## Field work





## FIELD WORK COVERED IN NEWS PAPERS

### వృక్షాలపై అధ్యయనాలు జరిపిన జేవీఆర్ విద్యార్థులు

సత్తుపల్లి, ఫిబ్రవరి 19, ప్రభాతవార్త:



వృక్షాలకు చుట్టు కొలతలు తీసుకుంటున్న విద్యార్థులు

సత్తుపల్లి జేవీఆర్ ప్రభుత్వ డిగ్రీ కళాశాల వృక్షశాస్త్ర విద్యార్థులు కిష్టారం, లంకపల్లి హైవే రోడ్డు విస్తరణలో భాగంగా తొలగించిన పెద్ద పెద్ద వృక్షాలపై డెండ్రో క్రోనాలజీ అధ్యయనాలు జరిపి వృక్షాల వయస్సును అంచనా వేశారు. ఈ అధ్యయనం శుక్రవారం రోడ్డు విస్తరణలో ఇరువైపులా నరికివేసిన సుమారు 50 వృక్షాలను ప్రానులలో వార్షిక వలయాలను ప్రాను కాండం, చుట్టుకొలత, వ్యాసార్థాలను విద్యార్థులకు తెలిపారు. ఈ అధ్యయనాలు జేవీఆర్ ప్రభుత్వ కళాశాల వృక్షశాస్త్ర విభాగాధిపతి అసిస్టెంట్ ప్రొఫెసర్ డాక్టర్ కె. విజయ్ కుమార్ నేతృత్వంలో నిర్వహించారు. రోడ్డుకు ఇరువైపులా నరికినటువంటి మఱి, వేప, కానుగ, బూరుగు, గిరిశన, నల్లమద్ది, నేరేడు మొదలైనటువంటి నీడనిచ్చే అనేక వృక్షాలుగా గుర్తించి వాటి వయస్సు దాదాపు 12 నుంచి 70 సంవత్సరాలు ఉన్నట్లుగా విద్యార్థులు గుర్తించడం జరిగింది. కలప, కాండం నమూనాలు సేకరించి అంతర్నిర్మాణ అధ్యయనాలు జరుపడం వల్ల విలువైన సమాచారాన్ని సేకరించిన స్టడీ ప్రాజెక్టులు చేయడం వల్ల విద్యార్థిని, విద్యార్థులకు పరిశోధనలపై ఆసక్తి కలుగుతుందని కళాశాల ప్రిన్సిపల్ పానెం రామచంద్రారావు అన్నారు.

**వార్త** Sat, 20 February 2021  
<https://epaper.vaartha.com/c/58566383>



### వృక్షాలపై 'జేవీఆర్' పరిశోధనలు

సత్తుపల్లిటౌన్: సత్తుపల్లి జేవీఆర్ ప్రభుత్వ డిగ్రీ కళాశాలలోని వృక్షశాస్త్ర విద్యార్థులు శుక్రవారం కళాశాల వృక్షశాస్త్ర విభాగాధిపతి డాక్టర్ కె.విజయ్ కుమార్ ఆధ్వర్యంలో కిష్టారం-లంకపల్లి రోడ్డు విస్తరణలో తొలగించిన వృక్షాలపై నిర్వహించిన డెండ్రో క్రోనాలజీ పరీక్షల ద్వారా వాటి వయస్సును అంచనా వేశారు. రోడ్డుకు ఇరువైపులా నరికిన సుమారు 50 వృక్షాల ప్రానులలో వార్షిక వలయాలను, కాండం, చుట్టుకొలతలను విద్యార్థులు కొలిచారు.

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# Trees felled for open cast mine

**A. RAVINDRA SESHU | DC KHAMMAM, FEB. 19**

Botany students of JVR government degree college in Sattupalli who conducted a dendro-chronology study on trees felled for the open cast mine of Singareni Collieries have found that the average age of these trees were of 12 to 80 years. The students studied the

dendro-chronology of 42 felled trees as part of a macro anatomy exercise. The trees had been felled between Lankapally and Kistaram in Khammam district. They counted the annual growth rings of dead trunks. Each annual ring had dark and light colours. The study exposed the environmental imbalance caused as a result of the tree-felling.

D. Rajkumar, second-year B.Sc student, said the dendro-chronology method helps find the age of felled trees. This is the science of dating events, environmental change etc by using the characteristic patterns of annual growth rings in timber and tree trunks. The annual rings of the timber showed the seasonal variations a tree faced

in its lifetime. Irregular and close-overlapping annual rings showed frequency of dry periods, levels of pollution and wounds to trees. The trees felled for road widening etc included Banyan, Neem, Pongamia, Cieba, Albizzia, Nallamaddi, Jambul and other shade-giving varieties. In dendro-chronology, two rings are calculated as a one-year period.