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OPTIMIZATION OF COPPER OXIDE NANOPARTICLES SYNTHESIZED via CO-PRECIPITATION METHOD

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ABSTRACT

Copper oxide nanoparticles (CuO-NPs) are synthesized for optimization via Co-precipitation method using Copper (II) Sulphate pentahydrate and Sodium Hydroxide for different annealing time. The samples are analysed by X-ray Diffraction (XRD), UV-Vis Spectroscopy, Scanning Electron Microscope (SEM), Energy Dispersive X-ray (EDX). CuO NP samples are annealed for 3 hrs, 4 hrs and 6 hrs and 4 hr annealed samples exhibit pure CuO peaks. Regardless of the techniques utilized, the synthesised nanoparticles possess spherical shapes and sizes in the nano scale. The average crystallite size of CuO nanoparticles calculated from XRD pattern was 18 nm for the optimized sample is indicative of nanostructure of the sample. SEM images of the samples show spherical nanoparticles with a restricted size distribution. EDX's spectrum shows only elemental copper (Cu) and oxide (O) and no other elemental impurity was observed. The UV-Vis absorption spectrum of CuO nanoparticles shows a strong blue shift compared to that of bulk. Measurements and analysis of the material's absorbance indicated that it had an energy bandgap of 2.67 eV and an absorbance peak at 257 nm. The band gap energy was calculated from the absorption spectra. Overall, the outputs of different synthesis techniques have been highly interesting and remarkable.

Keywords: Coprecipitation, Copper oxide Nanoparticles, XRD, SEM, UV-Vis Spectroscopy.

INTRODUCTION

CuO, a I-VI metal oxide, is a widely investigated material due to their application in superconductors, optical (Dagher et al., 2014), electrical (Bouazizi

et al., 2015), nanofluids (Priya et al., 2012), biosensors (Hong et al., 2013) etc. Numerous techniques, including the sonochemical method (Kumar et al., 2000) electrochemical method (Borgohain et al., 2000), sol-gel technique (Eliseev et al., 2000) and microwave irradiation (Wang et al., 2002) are widely accepted techniques for the synthesis of nanoparticles. Due to their low environmental toxicity and abundance in the earth's crust, cuprous and cupric oxides (Cu₂O and CuO) have gained increased attention as promising materials for optoelectronic applications (Paracchino et al., 2012; Golden et al., 1996; Pierson et al., 2003; T Mayuramma et al., 1998) Another important application of CuO nanoparticles is its use as antimicrobial agents. Nanostructured materials have a high antimicrobial effect due to its high surface area to volume ratio. Further, CuO becomes attractive because of various cost-effective methods for its preparation. Co-precipitation technique is one among them.

In the present study, co-precipitation method (Pandey et al., 2012) was chosen because of its simplicity, reaction rates at low temperatures and low cost. In this paper we are presenting the optimization of CuO nanoparticle synthesized via a simple Co-precipitation method based on structural properties, morphological behaviour and optical studies

MATERIALS AND METHODS

a. Chemical Reagents

Copper (II) Sulphate pentahydrate and Sodium Hydroxide pellets (Merck, India) are of Analytical grade reagents used without further purification.

b. Synthesis

The CuO Nanoparticles were prepared by coprecipitation method using Copper (II) Sulphate Pentahydrate solution and sodium Hydroxide as precursors. Copper (II) Sulphate Pentahydrate 0.5 M was dissolved in distilled water. After complete dissolution of copper sulphate 1M of sodium hydroxide solution was added under control stirring, drop by drop touching the walls of the vessels. The reaction is allowed to proceed for 2 hr. the solution was allowed to settle for an overnight and the supernatant solution was then discarded carefully. The precipitate is washed several times with distilled water. For optimization, the washed sample was annealed at 80° C for 3 Hr (CuO:1), 4 Hr (CuO:2) and for 6 Hr (CuO:3).

c. Characterisation

The obtained product was characterized with the aid of XRD, UV–visible, SEM. The structure of the compounds was investigated using X-ray Diffraction (Bruker D8 Advance) with Cu K α ($\lambda = 1.5406 \text{ \AA}$). The average crystallite size was

calculated from line broadening using Scherrer's equation. Optical absorption properties of CuO were characterised by UV2600 DRS SHIMADZU UV-Vis Spectrophotometer. The absorption spectra of the sample were recorded in the wavelength range of 200 nm - 800nm. Morphological features were studied by using Scanning Electron Microscopy (Jeol 6390LA).

RESULTS AND DISCUSSION.

Structural Properties.

Powder XRD is a quick analytical method that mainly serves to determine the phase of a crystallite material and can reveal details about unit cell dimension. Figure 1(a)-(c) shows the XRD patterns of CuO-NPs annealed at temperatures at 80° C for 3 Hr, 4 Hr and 6 Hr which will be designated as CuO:1, CuO:2 and CuO:3 respectively throughout the manuscript. The peaks in the XRD patterns of CuO-NPs compared with the standard ICDD (00-045-0937) values affirms monoclinic phase of CuO (tenorite) for the lattice.

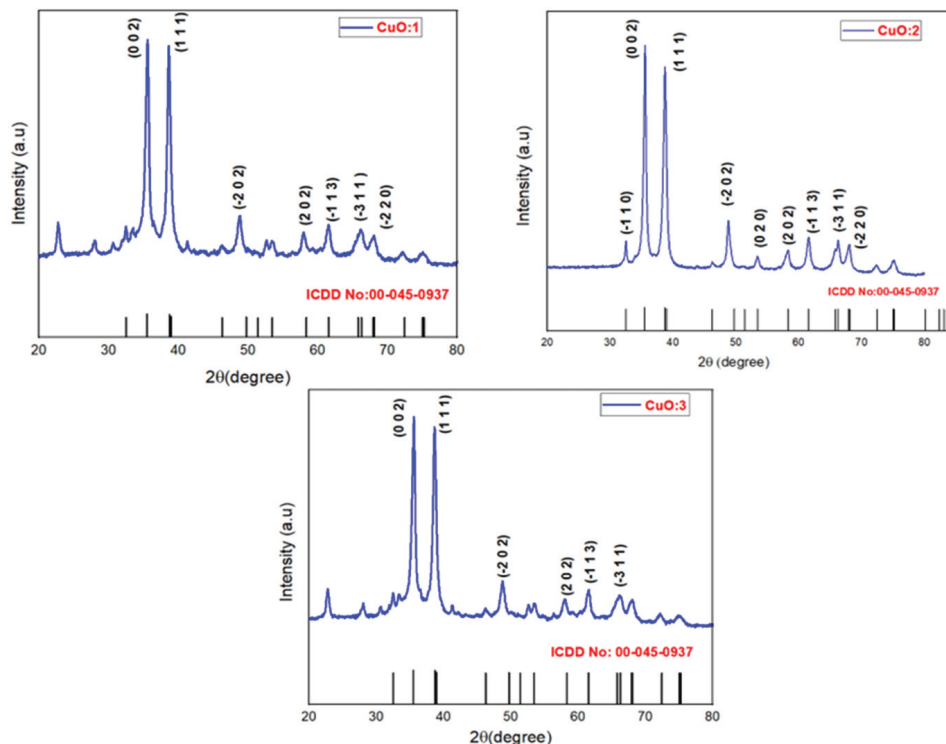


Figure 1: (a) XRD of CuO:1, (b) XRD of CuO:2, (c) XRD of CuO:3

XRD pattern of sample CuO:1 exhibits peaks corresponding to CuO lattice with extra peak at 2θ 22.52° (2 0 0) ICDD (01-076-0754) which shows the compound formation is incomplete whereas it is eliminated on annealing the sample for 4 hrs as in sample CuO:2. The intensities and positions of peaks of the sample heated for 4Hr is in good agreement with that of reported values [14]. It was also observed that with increasing the

annealing time to 6 hrs (sample CuO:3), the XRD graph does not provide noticeable difference. It is evident from XRD spectra that samples CuO:1 and CuO:3 exhibit undesired peaks that did not correspond to pure CuO NPs. Thus, primarily CuO:2 appears as suitable for further investigation as optimized sample which is annealed for 4 hr. Table 1 illustrates observed 2θ of all samples with standard values and corresponding hkl values.

Table 1: observed calculated XRD data oxide. The and 2θ values of copper

Observed 2θ (degrees)			Standard Value	h k l values
CuO:1	CuO:2	CuO:3	CuO	
22.742	-	22.787	-	
28.018	-	28.121	-	
32.480	32.518	32.538	32.497	(-1 1 0)
35.586	35.545	35.534	35.496	(0 0 2)
38.592	38.715	38.660	38.731	(1 1 1)
48.818	48.798	48.761	48.727	(-2 0 2)
-	53.44	-	53.453	(0 2 0)
58.001	58.308	58.016	58.337	(2 0 2)
61.58	61.601	61.490	61.535	(-1 1 3)
66.141	66.264	66.065	66.25	(-3 1 1)
68.023	68.084	-	68.091	(-2 2 0)

nanoparticles.

According to ICDD data (00-045-0937), for the sample CuO:2, the exhibited diffracted peaks at $2\theta = 31.51$ (-1 1 0), 35.54 (0 0 2), 38.75 (1 1 1), 48.79 (-2 0 2), 53.44 (0 2 0), 58.308 (2 0 2), 61.601 (-1 1 3), 66.26(-3 1 1) and 68.08(-2 2 0) corresponds to monoclinic phase of CuO NP. For the samples CuO:1 and CuO:3 they exhibit

diffracted peaks at $2\theta = 22.52$ (2 0 0) and 28.254 (0 2 0) which corresponds to peaks of Copper Oxide Sulphate ($\text{Cu}_2\text{O}_2\text{S}$) ICDD (01-076-0754) given in Table 1. The lattice parameters of CuO sample are calculated from XRD data using the equation of d-spacing

$$\frac{1}{d_{hkl}^2} = \frac{h^2}{a^2 \sin^2 \gamma} + \frac{k^2}{b^2 \sin^2 \gamma} - \frac{2hk \cos \gamma}{ab \sin^2 \gamma} + \frac{l^2}{c^2} \quad \text{----- (1)}$$

The average crystallite size has been calculated using Debye Scherrer equation

$$D = \frac{k\lambda}{\beta \cos \theta} \quad \text{----- (2)}$$

where D is the crystallite size, λ is the wavelength (1.5406 Å) of the X-ray radiation, $\Delta 2\theta$ is the full width at half maximum FWHM of the peaks at the diffracting angle θ . Crystallite size is calculated from the prominent peaks is found to be nearly 13 nm,

18 nm and 14 nm for CuO:1, CuO:2 and CuO:3 respectively.

Micro strain, and dislocation density are calculated using formula (3) & (4) and tabulated along with evaluated cell parameter in Table 2.

$$\text{Micro strain, } \varepsilon = \frac{\beta}{4 \tan \theta} \text{ ----- (3)}$$

$$\text{Dislocation density, } \delta = \frac{1}{D^2} \text{ -----(4)}$$

Table 2: Lattice parameter, Crystallite size, microstrain and dislocation density of CuO nanoparticles.

Sample	a (Å)	b (Å)	c (Å)	Crystallite size D (nm)	Micro strain (ε) $\times 10^{-3}$	Dislocation Density $\delta \times 10^{-3} (nm^{-2})$
CuO:1	4.0949	3.7223	5.044	13.63	7.281	9.734
CuO:2	4.6216	3.4278	5.0496	18.2118	4.917	3.4095
CuO:3	4.0894	3.42	5.0511	14.6203	6.5424	5.3504

3.2. Morphology and Energy dispersive Spectroscopy Analysis.

Figure 2 (a)-(c) represent SEM images of as-prepared CuO samples. For the sample CuO:1 in which formation of pure CuO is not complete, the particles appear to be agglomerated significantly. But on increasing annealing time it is noted that the particles are spherically distributed and well-aligned. The morphology of the synthesized CuO

NPs indicate that on increasing annealing time from 3hrs to 6hrs, the surface becomes more uniform without voids. But at 6hr annealing, the sample CuO:3 exhibits a tendency for further agglomeration which is not a desirable factor. Thus, morphologically also, sample CuO:2 is found more suitable for further investigation.

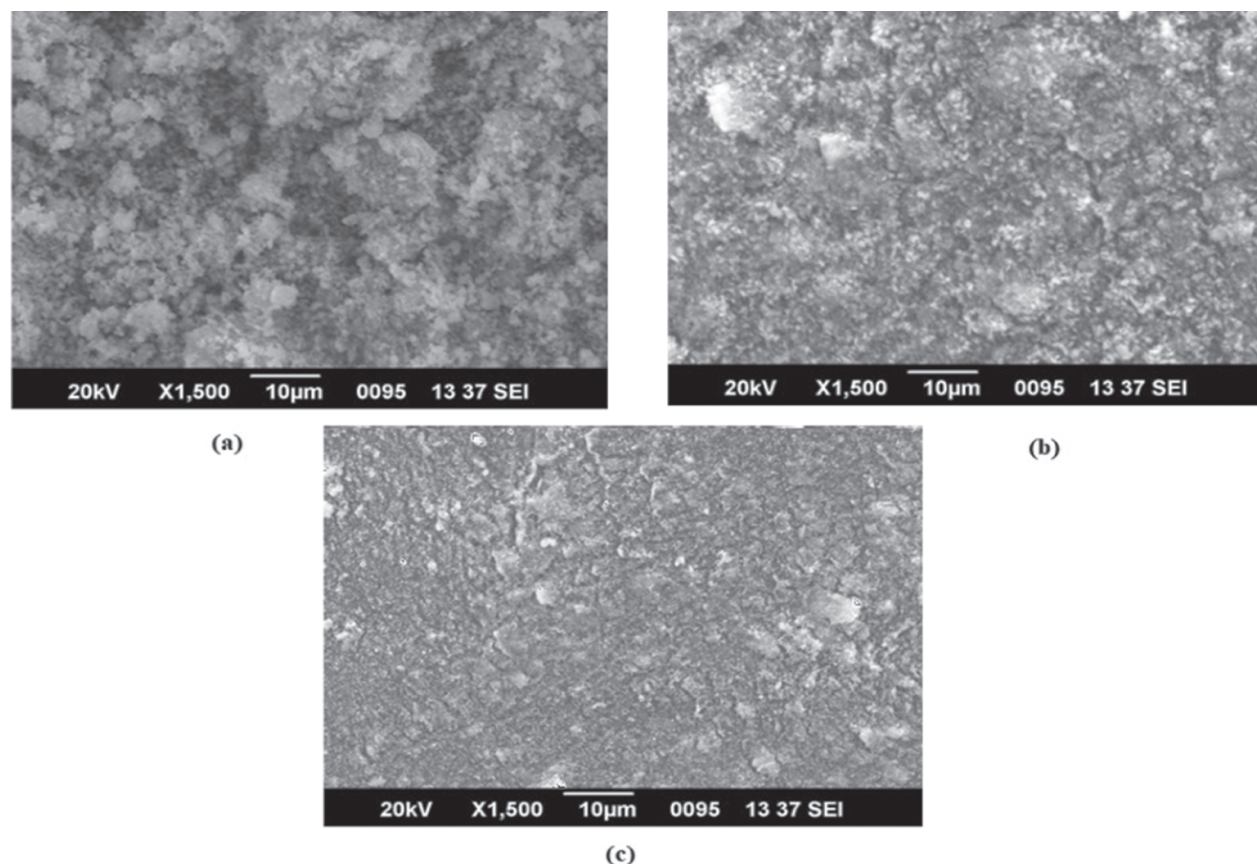


Figure 2: (a) SEM of CuO:1, (b) SEM of CuO:2, (c) SEM of CuO:3

Figure 3(a)-(c) showed the EDX spectra of CuO-NPs. The Energy dispersive spectra EDAX used to provide elemental identification and quantitative compositional information. Results revealed the presence of elemental copper (Cu) and oxygen (O) in CuO-NPs indicating the nearly stoichiometric distribution of the elements. The EDX result

showed the presence of nearly uniform distribution of copper to oxygen with atomic ratio of 1:1 in CuO. This result confirmed the formation of pure CuO-NPs.[15] The elemental analysis of the sample shows that the prepared sample was copper oxide, which is in concordance with the results of XRD.

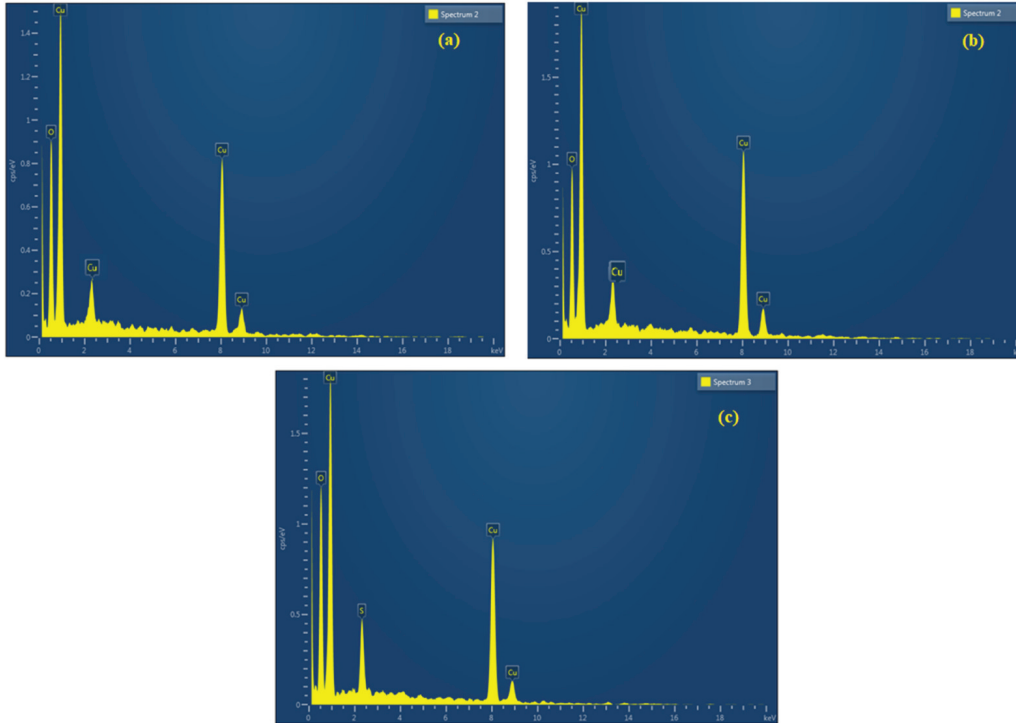


Figure 3: (a) EDAX of CuO:1, (b) EDAX of CuO:2, (c) EDAX of CuO:3

Optical Properties.

UV-vis spectroscopy is one of the most widely used technique to investigate the optical properties of the particles [16]. Optical properties of CuO nanoparticles have been studied by UV-Vis spectrum and absorbance graph of all CuO NP samples are shown in Figure 4. The absorption coefficient peaks are observed at 230.7 nm, 257 nm and 243 nm for CuO:1, CuO:2 and CuO:3 respectively. It shows high absorbance for the samples in the visible region of the spectrum with a slight decrease exhibited by the sample CuO:1.

The optical band gap energy of (E_g) of the obtained CuO nanoparticles is estimated from the Tauc's relation and is illustrated in Figure 5.

$$(\alpha h\nu)^2 = A(h\nu - E_g) \text{ ————— (5)}$$

The energy band gap of as-prepared CuO NPs is estimated from the energy intercept of the extrapolation of the linear portion of the curve. Of the samples, CuO:1 exhibits larger energy bandgap of 3.71eV whereas as annealing time increases, there occurs noticeable decrease in bandgap. The values of bandgaps are displayed in the Tauc plot. The red shift in the bandgap energy is attributed to the quantum confinement effect brought on by the reduction in the dimensional structure and size of the nanoparticles [17]. The optical bandgap energy of the sample CuO:2 with a 4-hour annealing period is comparable to previously published values [18] corresponding to CuO NP. On further increasing annealing time for 6 hrs, it does not show noticeable difference in Bandgap energy. For the same reason, the sample CuO:2 becomes the favourable candidate for further studies.

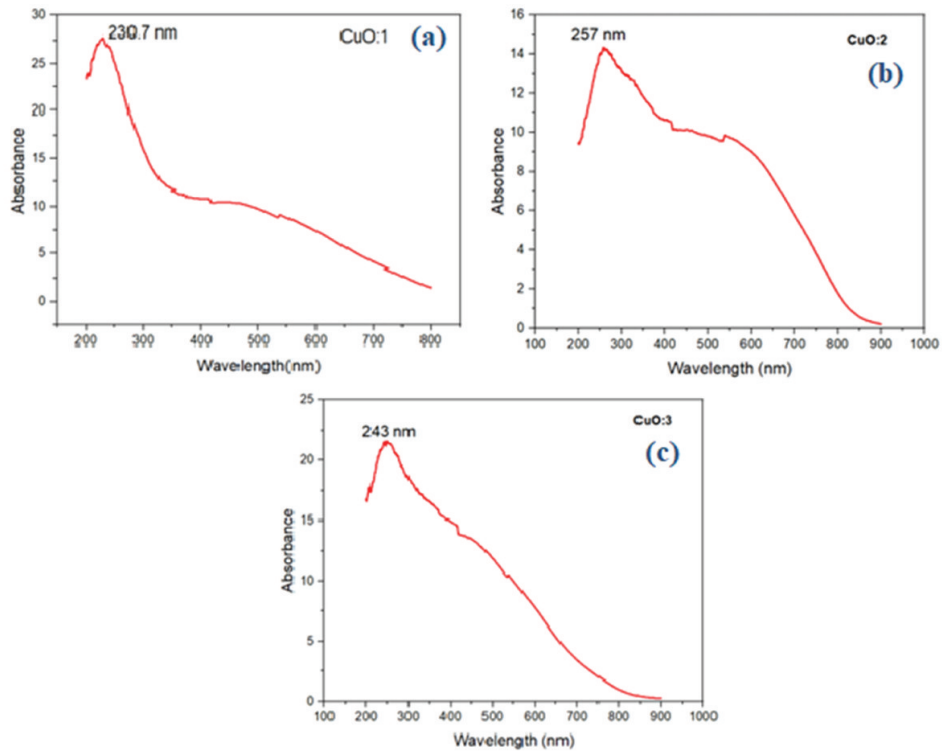


Figure 4: Optical absorption spectrum of (a) CuO:1, (b) CuO:2, (c) CuO:3

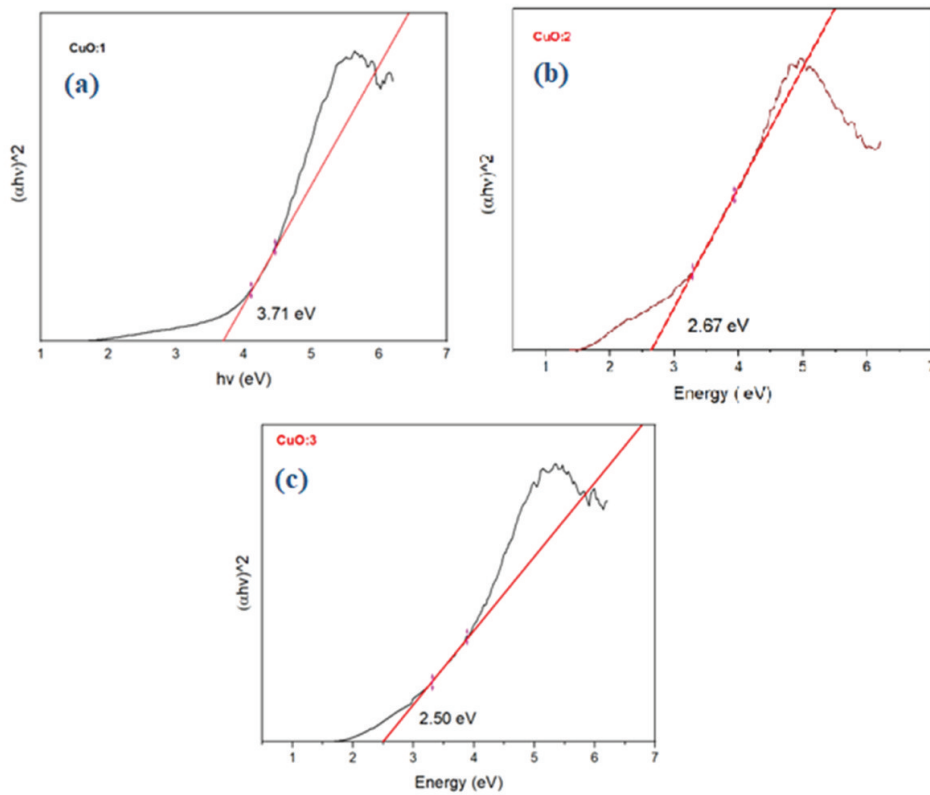


Figure 5: Band gap energy of (a) CuO:1, (b) CuO:2, (c) CuO:3

CONCLUSION

In the present study, CuO nanoparticles with monoclinic structure have been synthesized and optimized by co-precipitation technique. CuO NPs annealed at 4 hrs possess the optimized properties of the sample. Structural properties using XRD diffractograph of the samples affirms the formation of pure CuO NPs for an annealing time of 4 hrs at 80°C. The crystallite size determined is indicative of nanostructure of the particles. SEM images exhibit gradual evolution of smooth surface on increasing annealing time. Elemental composition verified from EDS spectrum illustrates the most comparable composition of Cu and O for annealing time of 4 hrs. Bandgap energy estimated from Tauc plot illustrate a red shift on increasing duration of annealing time and shows reported values for 4hr annealing time. Thus the sample CuO:2 NPs annealed for 4 hrs has been chosen as optimized sample for further investigation.

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ONLINE TEACHING DURING COVID-19: PERCEPTION AND SATISFACTION AMONG COLLEGE STUDENTS

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ABSTRACT

In 2020, Corona was emerged as a pandemic situation in the whole world and due to this pandemic situation, it led to worldwide lockdown for the safety of health of the public and also to control the virus spreading in our community. Education system was badly affected by this pandemic situation and it led to transform face to face teaching to online teaching method. The present research was intended to explore the perception and satisfaction of college students towards online teaching, influence of different classes towards students' perception and satisfaction on online teaching, to examine the requirements for getting access to effective online teaching and relationship between student perception and satisfaction during the pandemic COVID-19. Quantitative researches with a descriptive survey method, purposive sampling technique were used to select 100 students from MES Asmabi College. Data were collected through a structured questionnaire by sending Google forms. Data were analysed through diagrams, percentage analysis and SPSS based on correlation and ANOVA for testing of variance. The major findings of the study as to whether the

students were satisfied with their online classes and the teachers were very supportive and interactive during the pandemic situation. There were some issues like network connection, range issues etc sacrificed by students. There is a relationship between student perception and student satisfaction.

***Keywords:** online teaching, students' satisfaction, students' perception, COVID-19, pandemic situation.*

1. INTRODUCTION

COVID-19 was announced as a worldwide pandemic in March 2020. This situation was affected to all walks of life including the education system. Schools and institutions were forced to close as a result of the epidemic. This closure placed a huge strain on academic institutions as they attempted to handle the unprecedented move from traditional system of learning to online teaching-learning. Merriam-Webster Dictionary (2020) defines a pandemic as "an outbreak of a disease that occurs over a wide geographic area and affects an exceptionally high proportion of the population." The breakout was active with new ways of teaching mode through online. The worst interruption to higher education institutions in

recorded history affected more than 190 countries. People required remaining at home as a result of the partial or complete lockdown caused by the COVID-19 outbreak. In this situation, educational institutions forced to start online classes through different digital platforms. Colleges and institutions closed down as a result of the government's implementation of a countrywide lockdown. This was widely regarded as the worst public health disaster of the century and the greatest threat that humans faced since World War II (Chakraborty, & Maity, 2020).

Due to this pandemic COVID-19, traditional classroom was replaced by online classroom with some instructions and they implemented traditional way of classes through digital platforms. Education is important in all life and it should continue at any situation. So, in this pandemic situation it helped to develop the online teaching- learning process through various platforms. Although the concept of online learning is not a new method or idea, there are certain risks involved and also have more benefits. Student participation in actual class activities is hindered by online teaching. Students also lack the influence of peer learning. The main duties of teachers also include teaching, supervising and giving guidance and support to the students. This problem serves as a reminder of importance of technology and the internet usage in today's world, particularly in education. In this pandemic era, it is very important to move the education system to online classes. This movement of online classes has provided educators with the possibility to try new teaching methods online. Thus teaching methodologies are such as developing and gamification can be put in the online classroom to engage students.

The present study examines the requirements of online teaching and to analyse the perception and

satisfaction of college students about online teaching in the pandemic situation with special reference to M.E.S Asmabi college, P. Vemballur.

2. OBJECTIVES

1. To examine the requirements for getting access to effective online teaching among college students during COVID-19.
2. To analyse the perception of college students about online teaching during the pandemic COVID-19.
3. To measure the college student satisfaction with online teaching during the pandemic COVID-19.
4. To analyse the influence of different classes towards student perception and satisfaction on online teaching during the pandemic COVID-19.

3. HYPOTHESIS

1. H_0 : There is no relationship between student perception and student satisfaction.
 H_1 : There is relationship between student perception and student satisfaction.
2. H_0 : There is no influence of different classes towards student perception on online teaching.
 H_1 : There is an influence of different classes towards student perception on online teaching.
3. H_0 : There is no influence of different classes towards student Satisfaction on online teaching.
 H_1 : There is an influence of different classes towards student satisfaction on online teaching.

4. LITERATURE REVIEW

Ankita Keri (2021) the aim of the paper was to give a brief overview of the tools used in online classes at the examined university and also to find out student satisfaction with the applied teaching methods with the tool of questionnaire. In this study, it showed the result that the students were most satisfied with their teachers' preparation and least satisfied with quality of online classes.

Akthar Parveen & Naushad Husain (2021) in their study explored the perceptions of University students towards online teaching-learning process. They found out that there had a great implication for students, parents, teachers, research scholars and etc. There was a high need for improve the online teaching=learning process at higher education level. So, they stated that there was a need of improvement in online teaching- learning process to get an effective result.

Zakariya Almahasees et al (2021) this study aimed to identify both students and faculty perceptions of online learning by utilizing two surveys to identify the challenges, effectiveness and advantages of online education. They stated that they had found out those both the faculty and students agreed that online education is very useful during the pandemic COVID-19, and also it was less effective than the face to face learning and teaching.

Sujeewa Hettiarachchi et al (2021) the factors that contributed to students' satisfaction with their online learning during the COVID-19 epidemic were examined in their quantitative study. They found that the poor interaction led to decreased student's satisfaction. Online learning is affected by a number of variables that are categorised by e-learning obstacles, learner motivation, and interaction. The major objective of this study was to ascertain the

relationship between these three phenomena and student satisfaction with online learning.

T. Muthuprasad et al (2021) during the COVID-19 epidemic, the idea of students' perceptions and preferences for online education was put forth. Examining student's opinions and perceptions of online classrooms was the major goal of this study. According to this study, the majority of students exhibited a favourable view about online education in the wake of the corona. The majority of students also stated that due to technical difficulties, online classes were more difficult than regular classrooms. Therefore, this study supported the need for restructuring the higher education to include elements that utilize the online form.

Abhinandan Kulal & Anupama Nayak (2020) the goal of this study was to examine teachers' and students' attitudes toward online classrooms. He tried to demonstrate how students feel about the usefulness of online classes and their comfort in this study, as well as the support from their professors in online classes, as well as instructor comments on efficiency, practice followed, and training obtained for an online class. According to this report, students were quite at ease attending classes online and receive adequate support from their professors. Additionally, it claimed that professors were having trouble with online classes because they have not get adequate training.

5. RESEARCH METHODOLOGY

The study is descriptive and analytical in nature. The sample under the study were taken from the college students in MES Asmabi College P. Vemballur. A questionnaire was prepared to collect information regarding the motive of analysing the student's perception and satisfaction towards online teaching. Convenience sampling method was

used for selecting sample. Secondary data were collected from journals, articles, books and websites. The collected data were analysed by using simple statistical tools like tables, charts and

diagrams and percentage analysis and SPSS through correlation and ANOVA for testing of Variance.

6. DATA ANALYSIS

Table No. 6.1 shows that class, type of device and preference of online teaching

Particulars		Number of response	Percentage of response
Class	1 st UG	13	13
	2 nd UG	28	28
	3 rd UG	16	16
	1 st PG	19	19
	2 nd PG	25	24
Types of device	Smart phone	94	94
	Laptop	4	4
	Computer	1	1
	Other devices	1	1
Preference of online teaching	Live online class	51	51
	Live classes that can be recorded	36	36
	Recorded classes that is uploaded in any websites	8	8
	WhatsApp live recorded classes	5	5
Total		100	100

Source: primary data

Interpretation

From the table 28% of respondents are in the class of 2nd UG, followed by 24% respondents are in the class of 2nd PG, 94% of respondents are using smart phones for attending online class, followed

by 4% of respondents are using laptop, 51% of respondents are like to attend live online classes, followed by 36% of respondents are like to attend live classes that can be recorded.

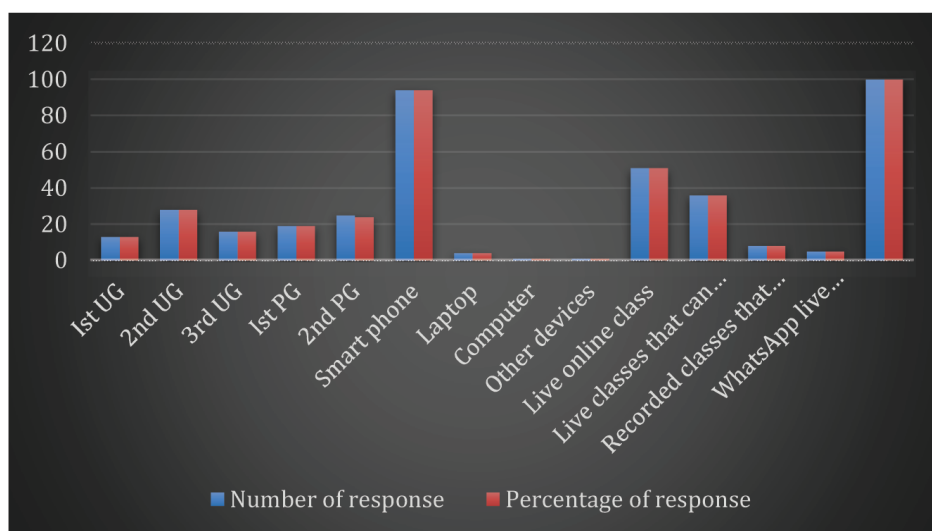


Table No. 6.2 shows Requirements for Accessing online teaching

Particulars	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
To attend online class, it needs sufficient virtual know-how and IT capabilities.	23	53	24	0	0	100
There are numerous digital platforms (google meet, webX, google classroom, Teams App etc.) to attend online classes.	44	52	4	0	0	100
The ultra-modern digital devices will most effective for accessing online classes.	24	55	19	2	0	100
To attend online classes, it needs enough mobile data/ balance.	64	26	5	5	0	100
Network connectivity is most important one to attend online classes smoothly.	81	13	5	0	1	100

Source: primary data

Interpretation

Table 6.2 showed that 53% of respondents are agree that it needs sufficient virtual know-how and IT capabilities, 52% of respondents are agree that numerous digital platforms to attend online classes, 55% of respondents are agree that the ultra-modern

digital devices are most effective for accessing online classes, 64% of respondents are strongly agree that needs enough mobile data or balance, 81% of respondents are strongly agree that network connectivity is most important.

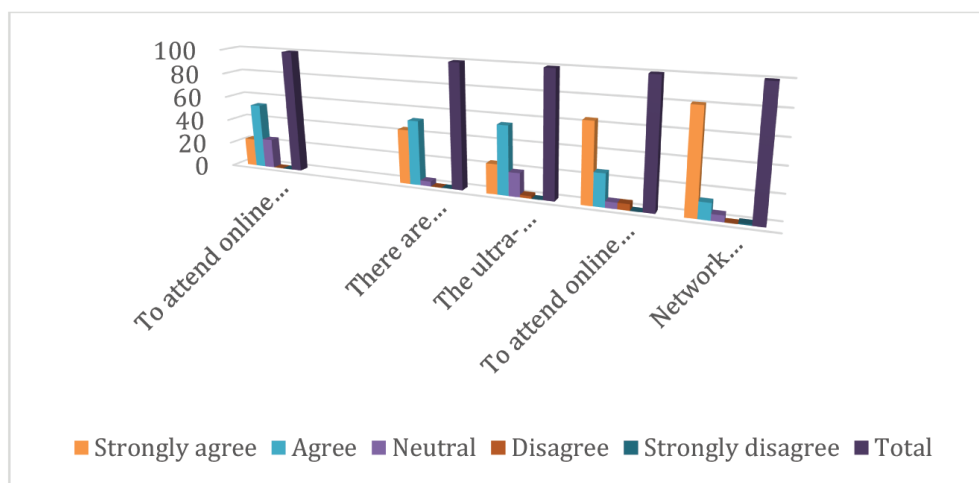


Table No. 6.3 shows students' perception towards online teaching/classes

Particulars	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
I prefer my online teaching as they may be established with the set due dates and time just like traditional teaching.	19	38	29	12	2	100
There is enough support getting from the teachers in their online teaching.	16	50	25	8	1	100
Online teaching will improve student's technological knowledge and digital literacy.	19	38	28	12	3	100
Online teaching has greater flexible to attend classes.	14	45	24	13	4	100
Students have facilities to clear their doubts at the time of online teaching.	12	44	30	11	3	100
Home environment is more suitable to the students for participating in online teaching	27	45	20	7	1	100

Source: primary data

Interpretation

Table 6.3 represented 38% of respondents are agree with online classes may be established with set due dates and time just like traditional teaching, 50% of respondents are agree with getting enough support from the teachers, 38% of respondents are agree with online teaching will improve student's

technological knowledge, 45% of respondents are agree with it has greater flexibility to attend the classes, 44% of respondents are agrees that they have facilities to clear the doubts at the time, 45% of respondents are agree with home environment is more suitable.

Table No. 6.4 shows students' satisfaction towards online teaching/classes

Particulars	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
I am able to access the expected classes via online teaching as same as offline teaching	15	24	36	19	6	100
I agree that teacher's preparation for online teaching can increase our understanding very easily	13	40	32	14	1	100
Online teaching has a high quality & greater feedback & it can improve my studies	9	29	36	25	1	100
I am satisfied that interaction amongst teachers and buddies at the same time as attending classes	8	36	25	24	7	100
I agreed that online teaching contents and materials are enough for my studying.	10	33	31	20	6	100
I agreed that online teaching is parallel or substitute of traditional way of teaching	10	29	29	26	6	100
I am satisfied that I have sufficient knowledge and IT skills for attending classes.	19	51	22	7	1	100
I am comfortable with numerous platforms and digital devices for attending online classes.	17	39	37	6	1	100
I can attend online teaching/classes even at remote areas and distant places.	10	37	33	15	5	100

Source: primary data

Interpretation

Table 6.4 shows that 36% of respondents are neutral with accessibility of expected classes via online teaching as same as offline teaching, 40% of respondents are agree with teacher’s preparation for online teaching can increasing our understanding very easily, 36% of respondents are neutral with that high quality and greater feedback and it can improve my studies, 36% of respondents are agree with interaction among teachers and students, 33% of respondents are agree with online contents and

materials are enough for the study, 29% of respondents each are agree and neutral with online teaching/classes are parallel or substitute of traditional way of teaching, 51% of respondents are agree with satisfaction of sufficient knowledge and IT skills, 39% of respondents are agrees that they are comfortable with numerous platforms & digital devices, 37% of respondents are agree that online classes can attend even at remote areas and distant places.

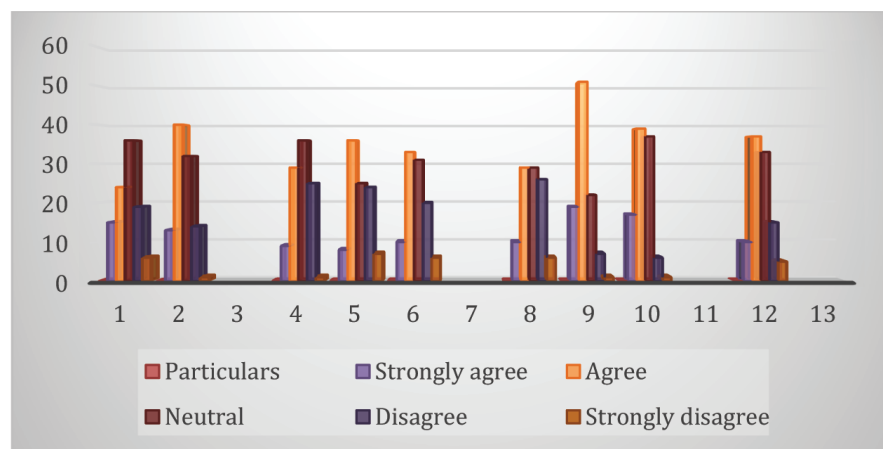


Table No.6.5

Influence of different classes towards student perception on online teaching

H₀: There is no influence of different classes towards student perception on online teaching

Variable1	Variable2	Test	F-Value	Sig.	H ₀
Classes (categorical)	student perception	ANOVA	3.092	0.019	Reject

Source: primary data

Interpretation:

Since P value is less than 0.05, the null hypothesis is rejected at 5% level with regard to Influence of different classes towards student perception on

online teaching. Hence, there is an Influence of different classes towards student perception on online teaching.

Table No.6.6**Influence of different classes towards student satisfaction on online teaching**

H_0 : There is no influence of different classes towards student Satisfaction on online teaching

Variable1	Variable2	Test	F-Value	Sig.	H_0
Classes (categorical)	student satisfaction	ANOVA	0.588	0.672	Accept

Source: primary data

Interpretation:

Since P value is greater than 0.05, the null hypothesis is accepted at 5% level with regard to Influence of different classes towards student

satisfaction on online teaching. Hence, there is no Influence of different classes towards student satisfaction on online teaching.

Table No.6.7**Relationship between student perception and student satisfaction on online teaching**

H_0 : There is no relationship between student perception and student satisfaction online teaching.

Variable1	Variable2	Test	Value	Sig.	H_0
student perception (Scale)	student satisfaction (Scale)	Correlation	0.589	0.000	Reject

Source: primary data

Interpretation:

Since P value is less than 0.05, the null hypothesis is rejected at 5% level with regard to Influence of different classes towards student perception and satisfaction on online teaching. Hence, there is a relationship between student perception and student satisfaction.

7. CONCLUSION

Online teaching also became an important means of education during the pandemic situation. Online

instruction makes it possible to successfully created from a distance, allowing students to identify the time required to travel to and from traditional classrooms. Online teaching has been motivated for so many years and the Covid-19 pandemic situation promoted in India in a large scale. Online teaching is a form of teaching that is introduced and administered the use of the internet. Teachers are using digital sources to share classes with their students and they are available to attend classes at any time through virtual platforms. It presents a

variety of freedom to students to study, teach, and develop capabilities at their own pace. Each individual's relationship with their students is facilitated by this teaching method. So, by concluding this study students are satisfied with online teaching and they have enough requirements to attend online teaching and also perception about online teaching is positive. There is a problem, that is network connectivity and other issues may cause so many problems to the students and teachers. The preparation of teachers will have an impact on the effectiveness of online teaching approaches.

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STRUCTURAL AND FUNCTIONAL ANALYSIS OF TROPICAL HOMEGARDENS: A CASE STUDY OF AVANOUR GRAMA PANCHAYATH, THRISSUR

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ABSTRACT

Homestead farming or home gardening is a historical tradition that has evolved in many tropical countries over a long period of time. It is normally regarded as a system for the production of various crops for a family. The present research work was a detailed investigation on the diversity and functional characteristics of home gardens in Avanour Grama panchayath Thrissur district in Kerala. From the results of the research work, it was found that the diversity of plant species was low in this panchayath compared to other similar studies. Among the three types of home gardens (small, medium and large), the diversity of plant species in small homegardens was found to be high when compared to large home gardens. This is mainly due to the small-scale farmers' dependence exclusively on their home gardens for their day to day need, so there the cultivations of food crops and vegetables are more in small home gardens. In large-scale home gardens, the cultivation of vegetables is low and they give more importance to the economically important cash crops and timber trees.

Keywords: Crops, cultivation, farming, home gardens, timber

INTRODUCTION

Homegardens are worldwide recognised sustainable agroforestry systems. They can be characterised as a land-use system located close

to the house where woody and non-woody species are intimately arranged in several overlapping canopy layers, sometimes in association with domestic animals. The basic objectives for maintaining this agroforestry system is to ensure availability of multiple products such as food, fuel, vegetables, fruits, fodder, medicines besides generating income and employment (Hoogerbrugge and Fresco 1993; Kumar and Nair 2004). The structural diversity of the home garden is a deliberate strategy that should be adopted by farmers to achieve higher efficiency of resource use by efficiently harvesting solar energy and using soil nutrients and moisture. Homegardens in Kerala effectively serve as human ecosystem with their low input demand, staggered supply of output and enhancement of habitat quality. A large population of the Kerala homegardens is being converted into small-scale plantations of coconut and rubber or cropping system consisting of fewer crops due to commercialization and fragmentation of land holding (Kumar and Nair, 2004). In the present research work an attempt is made to characterize the structural and functional attributes of selected homegardens by analysing the species composition from Avanour Gramapanchayath (10 wards), Thrissur block, Thrissur District, Kerala. The study was also with the objective to study the nature of dynamics of homegardens characteristics and to know the changing trends in cultivation practices in this panchayath.

MATERIALS AND METHODS

Study area

The present the study was carried out at the Avanoor Gramapanchayath of Puzhakkal Block in Thrissur District, Kerala. The total geographic area of the panchayath is 18.25km².

Methodology

A field survey was conducted in selected gramapanchayath to explore the structural and functional attribute of the homegardens. The field activity involved a Diagnosis and Design survey using semi structured questionnaire (Raintree, 1987). The selected gramapanchayath areas were subjected to stratified sampling at 50% intensity. Accordingly 10 wards (administrative unit) were randomly selected for the study in the Avanoor Gramapanchayath. Homegardens with holding sizes small (<30 cents), medium (30-50 cents) and large (>30 cents) were selected for each of the selected wards. Thirty homegardens were selected for each of size class from the panchayath.

The plant diversity in the selected homegardens was assessed following total counting. All the vegetation types were separately recorded. The service of experienced taxonomists and flora were used for identifying the plant specimens. The data on the plants were later tabulated into different functional groups. The counts were represented on average basis per homegarden. Also, the number of plants belonging to each functional group were represented on per ha basis for making effective comparisons.

Functional diversity is a tool for predicting the functional consequence of species traits in ecosystem level process (Petchey and Gaston 2006). Diversity index was calculated using Simpson equation.

$$\text{Simpson's diversity index (D)} = 1 - \frac{1}{\sum [n \div N]^2}$$

Where n represents the total number of a particular species and N is the total number of all species.

RESULTS

The results of the study on the structural and functional analysis of the selected homegardens in 10 wards viz. Velappaya, Medical College, Velappaya South, Manithara, Choolissery, Kolangattukare, Ambethkar Gramam, Avanoor, and Karore (ward numbers 1,3,4,5,6,7,10,12,14 and 15 respectively), of Avanoor Gramapanchayath of Thrissur District, Kerala were presented here.

Species Diversity

In general, there was wide variability in crop composition among the homesteads studied. Timber trees, Medicinal Plants, Fruit trees, and spices are predominant in almost all homestead chosen randomly from the 10 wards (1,3,4,5,6,7,10,12,14,15) of Avanoor Gramapanchayath in Thrissur District.

Presence of timber trees noticed in all the 90 homesteads but the number and kind varied. Coconut, arecanut and banana constituted the most important cash crops. The most popular one was coconut and which was seen in almost all Homegardens. Density of most of the components was higher in small- scale homegardens compared to medium and large homegardens. Functional diversity was shown in the Table 1. The results suggested that the fruit trees, medicinal plants and vegetables in the Small Homegardens were higher in number when compared to medium and large homegardens. The timber species and spices were higher in the medium homegardens.

Table 1: The Functional Diversity of various crop components in Avanoor Grama Panchayath, Thrissur District

SI NO	Components	Number per hectare in different Homegarden types		
		Small	Medium	Large
1	Timber	6	8	7
2	Fruit trees	10	8	6
3	Fodder	1	1	1
4	Medicinal plants	7	6	4
5	Spices	4	6	3
6	Vegetables	12	8	10
7	Rhizome and tuber	2	4	4

Medicinal trees

The density of medicinal trees was higher in small homegardens compared to that of large and medium (Table 2). The major medicinal trees of rural and urban homegardens are *Azadirachta*

indica, *Phyllanthus emblica*, *Myristica fragrans*, *Saraca asoca* and *Strychnos nux vomica*. The major medicinal tree species was nutmeg, and was also included in the cash crop.

Table 2: Occurrence of medicinal trees in homegardens of Avanoor Gramapanchayath, Thrissur District

SI NO	Species	Number of occurrence	Frequency (%)
1	<i>Azadirachta indica</i>	40	44.44
2	<i>Strychnos nux vomica</i>	5	5.55
3	<i>Myristica fragrans</i>	69	76.66
4	<i>Phyllanthus emblica</i>	26	28.88
5	<i>Saraca asoca</i>	3	3.33

Fruit trees and crops

Fruit trees are the major components in the homegardens of rural area. The most dominant fruit plant species are Mango, Jack, *Psidium guajava*, Guava, Annona, *Phyllanthus emblica*, Citrus, Papaya etc (Table 3).

Table 3: Density of fruit tree species in different homegardens of Avanoor gramapanchayath, Thrissur District

SI NO	Species	Density (Number of trees per acre)		
		Small	Medium	Large
1	<i>Artocarpus integrifolia</i>	11	7	3
2	<i>Mangifera indica</i>	15	8	7
3	<i>Citrus limon</i>	2	3	0.4
4	<i>Phyllanthus emblica</i>	7	2	3
5	<i>Annona squamosa</i>	5	2	1
6	<i>Psidium guajava</i>	9	8	5
7	<i>Passion fruit</i>	3	1.9	1.5
8	<i>Manikara zapota</i>	4	7	9
9	<i>Syzygium samarangense</i>	9	10	6
10	<i>Carica papaya</i>	8	10	5

Plantation crops

Plantation crops include Coconut, arecanut, rubber, banana and nutmeg. These were the main income crops of the homegardens. The density of the plantation crops was less in small homegardens compared to medium and large homegardens (Table 4).

Table 4: Density of Plantation crop species in different homegardens of Avanoor gramapanchayath, Thrissur District

SI NO	Plantation crops	Number of crops per acre		
		Small	Medium	Large
1	<i>Cocos nucifera</i>	30	39	44
2	<i>Areca catechu</i>	15	25	30
3	<i>Hevea brasiliensis</i>	10	15	50
4	<i>Musa spe.</i>	85	66	130
5	<i>Myristica fragrans</i>	6	14	35

Vegetable Crop density

Vegetable cultivation is widespread in medium and small homegardens, while the large farmers prefer commercial crops over vegetable crops (Table 5). Cowpea dominated in the

vegetable crops, and its cultivation was higher in medium homegardens. Murraya is widespread in all the homegardens. The cultivation of vegetables was more in medium homegardens compared to small and large homegardens.

Table 5: Density of Vegetable crop species in different homegardens of Avanoor gramapanchayath, Thrissur District

SI NO	Species	Density		
		Small	Medium	Large
1	Cow pea	18	25	11
2	Chilly	23	30	28
3	Tomato	20	19	10
4	Cucurbits	15	16	11
5	Murraya	9	15	7
6	Amaranthus	12	15	9
7	Bittergourd	30	26	18
8	Cauliflower	10	12	18
9	Lady finger	17	22	12
10	Brinjal	14	18	9
11	Yam	22	18	14
12	Ivy gourd	10	8	5
13	Snake gourd	25	28	15
14	Pumpkin	11	15	12

Spices and Condiments

The diversity of spices and condiments was more in large homegardens. Pepper is the most common. Cinnamon is relatively low in the three homegardens (Table 6).

Table 6: Density of Spices and Condiments species in different homegardens of Avanoor gramapanchayath, Thrissur District

SI NO	Species	Density		
		Small	Medium	Large
1	Pepper	15	18	25
2	Ginger	10	14	19
3	Cinnamon	2	1	2.9
4	Turmeric	12	18	17
5	Nutmeg	5	11	23

Rhizome and Tubers

The major tuber crops like tapioca, elephant yam, ginger, turmeric and colocassia. The tapioca, elephant yam and colocassia in higher in small homegardens. Turmeric and ginger density low in the small homegarden. Colocassia is very low in the large homegarden (Table 7).

Table 7: Density of Rhizome and Tubers species in different homegardens of Avanoor gramapanchayath Thrissur District

SI NO	Species	Density		
		Small	Medium	Large
1	Turmeric	12	18	17
2	Elephant yam	22	18	14
3	Ginger	10	14	19
4	Tapioca	37	35	30
5	Colocassia	30	14	8

Timber species

Results indicated that *Mangifera indica* was the most common timber tree species in all homegardens. *Artocarpus heterophyllus*, *Tectona grandis*, *Garcinia gummi-gutta* are the

other commonly cultivated trees. *Tamarindus indica*, *Swietenia magagoni* and *Ailanthus excelse* were recorded from only a few homegardens (Table 8).

Table 8: The Functional diversity of the timber species in different homegardens of Avanoor Grama Panchayath, Thrissur District

SI NO	TIMBER	Number per hectare in different homegarden types		
		Small	Medium	Large
1	<i>Mangifera indica</i>	1.8	2.7	3.36
2	<i>Artocarpus heterophyllum</i>	0.73	0.63	1.4
3	<i>Tectona grandis</i>	0.37	0.83	0.57
4	<i>Tamarindus indica</i>	0	0.2	0.26
5	<i>Garcinia gummi-gutta</i>	0.1	0.07	0.07
6	<i>Swietenia mahagoni</i>	0	0.07	0
7	<i>Ailanthus excels</i>	0	0	0.07
8	<i>Anacardium occidentale</i>	0.07	0.07	0
9	<i>Ficus callosa</i>	0.07	0.23	0.07

Livestock

Livestock population is higher in large homegarden. The poultry density is higher in the

three categories of the homegardens. In small homegarden the cow density is low compared to medium and large homegardens (Table 9).

Table 9: Density of Livestock in different homegardens of Avanoor gramapanchayath, Thrissur District

SI NO	Species	Small	Medium	Large
1	Cow	10	15	12
2	Goat	12	10	11
3	Poultry	25	28	33

DIVERSITY INDEX

The plant diversity index was calculated by Simpson index formula. The Simpson index was 0.625, 0.631, and 0.593 for small, medium and

large homegardens, respectively. The diversity index was high in medium homegardens compared to small and large homegardens (Table 10-12).

Table 10: The Diversity Index of small scale Homegardens

SI NO	Species	Number of individual (n)	(n/96) ²
1.	<i>Mangifera indica</i>	53	0.3047
2.	<i>Artocarpus heterophyllum</i>	22	0.0525
3.	<i>Tectona grandis</i>	11	0.0131
4.	<i>Garcinia gummi-gutta</i>	3	0.0009
5.	<i>Anacardium occidentale</i>	2	0.0004
6.	<i>Ficus callosa</i>	5	0.0027
	Total	N =96	0.3743
		$D = 1 - (\sum(n/N)^2) = 0.625$	

Table 11: The Diversity Index of medium scale Homegardens

SI NO	Species	Number of individuals (n)	(n/144) ²
1.	<i>Mangifera indica</i>	81	0.3164
2.	<i>Artocarpus heterophyllum</i>	19	0.0174
3.	<i>Tectona grandis</i>	25	0.0301
4.	<i>Tamarindus indica</i>	6	0.0017
5.	<i>Garcinia gummi-gutta</i>	2	0.0001
6.	<i>Swietenia mahagoni</i>	2	0.0001
7.	<i>Anacardium occidentale</i>	2	0.0001
8.	<i>Ficus callosa</i>	7	0.0023
	Total	N = 144	0.3682
		$D = 1 - (\sum(n/N)^2) = 0.631$	

Table 12: The Diversity Index of large scale Homegardens

SI NO	Species	Number of individuals (n)	$(n/174)^2$
1.	<i>Mangifera indica</i>	101	0.3369
2.	<i>Artocarpus heterophyllum</i>	42	0.0582
3.	<i>Tectona grandis</i>	17	0.0095
4.	<i>Tamarindus indica</i>	8	0.0021
5.	<i>Garcinia gummi-gutta</i>	2	0.0001
6.	<i>Ailanthus excels</i>	2	0.0001
7.	<i>Ficus callosa</i>	2	0.0001
	Total	N = 174	0.407
		$D = 1 - (\sum(n/N)^2) = 0.593$	

The diversity index of the timber species was high in the medium homegardens and was lower in the large homegardens. The Diversity Index of the

species in the small homegardens was found to be in between the large and medium home gardens (Table 13).

Table 13: The Diversity Index of the Timber species of various Homegardens

DIVERSITY	SH	MH	LH
	0.625	0.631	0.593

DISCUSSION

Homegardens in Kerala represent a subsistence land -use system typical of tropical south Indian, where interaction and intimate association of different production components (crop-tree-animal mix combine) *in situ* are intensively facilitated and managed by family labour so as not only to meet the food production but also to generate additional income through the sale of farm surplus. The structural diversity of the home garden is a deliberate strategy that should be adopted by farmers to achieve higher efficiency of

resource use by efficiently harvesting solar energy and using soil nutrients and moisture. The functional diversity of the system helps to meet the many demands of food, fodder, fuel, timber, organic mulch and medicinal plants.

The study carried out in the homegardens of 10 wards of Avanoor Grama Panchayath revealed the presence of the various plant species comprise of 9 Timber trees, 12 Vegetable species, 8 Medicinal plant, 8 Fruit species, 6 spices species and 4 Rhizome and Tuber crops. Kumar et al.

(1994) encountered 127 woody species from 17 selected taluks of Kerala state. Nair and Sreedharan (1986) had reported 30 arboreal taxa from the homegardens of Kerala. Babu et al. (1982) however observed a total of 36 species of woody perennials from the homestead of Southern districts of Kerala. However, the major species reported in the present research work include cash crops like coconut, arecanut, nutmeg dominated in most of the homegardens. The dominant timber trees include Teak, Jack, Mango tree, Mahogany etc. While the dominant fruit trees include Mango, Jack fruit Guava, Garcinia etc.

Coconut based systems were predominant in all the categories of homegardens. Other annual and perennial components were distributed in time and space around coconut. Arecanut based system had only subsidiary importance compared to coconut - based system. Monoculture of rice was predominant among large and medium farmers taking advantage of the kole lands. Monoculture of rubber was also observed though not coming under the purview of homestead cultivation. Regeena (2007) surveyed the homestead farms of the South zone of Kerala comprising of the three districts of Thiruvananthapuram, Kollam and Pathanamthitta and the data revealed that the homegardens, though under threat from monocultures of commercial crops like *Hevea brasiliensis*, were repositories of plant biodiversity and warranted to be documented and conserved. Animals provide nutrient - rich food products, draught power, dung as organic manure and domestic fuel, hides and skin, and are a regular source of cash income for rural households. Teak, mahogany ailanthus etc. was raised along the boundary in double hedge rows of 3m x 3m spacing. *Gliricidia* was planted mostly at a closer spacing 1x1 m mainly to accommodate more number of plants more biomass. It is also used as pepper standard in some medium and larger

homegardens. Studies of Kerala homedardens have traditionally emphasized species inventories (Nair and Sreedharan, 1986).

CONCLUSION

Homestead farming or home gardening is a historical tradition that has evolved in many tropical countries over a long period of time. It is generally understood to be a system for the production of subsistence crops for the cultivator and his/her family. The present study was a detailed investigation on the diversity and functional characteristics of home gardens in Avanoor Grama panchayath Thrissur district in Kerala. The diversity of plant species was low in this panchayath compared to other similar studies. The diversity of plant species in small homegardens was high compared to large home gardens. This is because the small-scale farmers depend exclusively on their home gardens for their day to day need, so there are large cultivations of food crops and vegetables are seen. In large-scale home gardens the cultivation of vegetables is low and they give more importance to the economically important cash crops and timber trees. Future strategies to improve homestead farming should aim at watershed-based development with focus on a whole-farm or systems approach; restructuring and refining existing home gardens, and developing sustainable models through a farmer-participatory approach for each agro-ecological zone; forming homestead clusters; creating germplasm registers; bridging the yield gap by improving crop productivity; developing post-harvest technology of home garden products; generating non-farm employment opportunities; promoting and improving rural financial networks; providing essential rural infrastructure; creating coalitions to address policy concerns at all levels; and broadening consumer perspectives.

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THE FLORISTIC AND FUNCTIONAL DYNAMICS OF HOMEGARDENS OF MULAKUNNATHUKAVU GRAMA PANCHAYATH, THRISSUR DISTRICT, KERALA

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ABSTRACT

A survey was conducted in 90 home gardens in 10 wards of Mulakunnathukavu Gramma Panchayath in Thrissur district, Kerala to study the structural and functional attributes of home gardens. The study also intended to know about the density and diversity of plant species also standing stock of timber trees in the home gardens. The home gardens were classified in to three categories based on the size of the land holding viz. small home gardens (below 30 cents), medium home gardens (30 - 50 cents), large home gardens (above 50 cents). The main type of land use pattern was coconut based home gardens. In small home gardens, under storey was rich with shade tolerant crops that were maintained to meet the food requirements of the households. While the medium home gardens consisted more fruit trees and large home gardens consisted more cash crop crops and timber trees. All the three categories of home gardens had different structural and functional character ventures. In integrated farming system, the trees crops and livestock are deliberately managed in the same land management unit which produced a continuous, reliable, and balanced supply of foods as well as cash for basic needs and recurrent farm expenditure. The present trend towards single crop based commercial ventures pose serious threats to the diversity and there by ecological stability of homegardens which were once the harbingers of biodiversity.

Keywords: Crops, cultivation, farming, homegardens, timber

INTRODUCTION

Globally, home gardens have been documented as an important supplemental source contributing to food and nutritional security and livelihoods. Home gardens can be described as a mixed cropping system that encompasses vegetables, fruits, plantation crops, spices, herbs, ornamental and medicinal plants as well as livestock that can serve as a supplementary source of food and income. Food production on small plots adjacent to human settlements is the oldest and most enduring form of cultivation (Ninez,1987).

This study was an attempt to characterize the structural and functional attributes of selected home gardens, by analysing the species composition from Mulakunnathukavu Gramma panchayath (10 wards), Puzhakal block, Thrissur district, Kerala. The study was also undertaken with the objective of accessing the nature of dynamics of home gardens characteristics and to know the changing trends in cultivation practices and present status of the panchayath and how much importance they given for its maintenance. It also indicates the relevance and maintenance of home gardens that is important for the present and future generations.

MATERIALS AND METHODS

Study area

The study was carried out in the Mulakunnathukavu gramapanchayath, Puzhakal block, Thrissur district, Kerala. It is located 9 kilometres (5.6 mi) north of Thrissur city. Ten wards from this panchayath were selected for the study. About 90 homegardens in ten wards of Mulakunnathukavu gramapanchayath belonging to various socio-economic levels were selected for the present study. First-hand information of the panchayath was obtained from the panchayath officer and Agriculture officer. Prior to the survey the homegardens in the selected panchayath wards was divided in to small, medium and large based on the extend of area which would be a reflection of socio-economic status of the farmers..

Methodology

About 90 home gardens from 10 wards in the Mulakunnathukavu grammapanchayath belonging to various socioeconomic levels were selected for the present study.

Functional diversity

Diversity index was calculated using Simpson equation. Simpson diversity index is the measure of diversity which takes in to account the number of species present, as well as the relative abundance of each species. It is calculated using below equation;

$$\text{Simpson's diversity index (D)} = 1 - \left(\sum \frac{n}{N} \right)^2$$

Where n represents the total number of a particular species and N is the total number of all species.

Computation of the standing stock of timber of major tree species

Standing stock of important tree species in the selected homegardens was calculated using basic equation; $V = (G^2/4\delta) \times F \times H$, where V is the individual tree volume; G is the girth at breast height; F is the form factor and H is the total height of the tree

RESULTS

The result of the present study on the structural and functional analysis of homegardens of Mulakunnathukavu grama panchayath, Thrissur district Kerala are presented in the following sections.

NATURE OF COMPONENTS

It was observed that a variety of timber trees, fruit trees, agricultural crops, plantation crops, medicinal plants, fodder plants, livestock are the main components of homegarden studied.

Species diversity

It was found that the cash crops comprising mainly of coconut and arecanut occupy large share in home gardens. The density of fruit trees, medicinal plants, vegetables, livestock and other miscellaneous species were higher in small category of home gardens, whereas the density of timber trees was higher in large home gardens (Fig. 1).

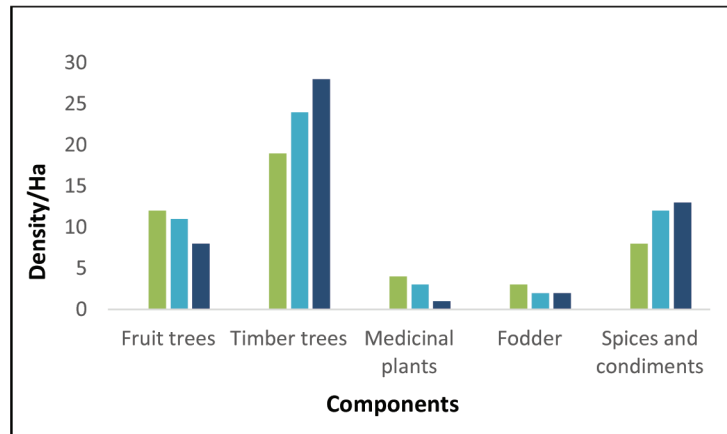


Fig. 1: Graphical representation of species density of various components in the home gardens studied in Mulakunnathukavu Grama Panchayath.

Medicinal trees

The density of medicinal trees was higher in small home gardens compared to that of large and medium. The major medicinal trees of rural and urban home gardens were *Azadirachta indica*,

Phyllanthus emblica, *Saracaasoca* and *Strychnosvomica*. The major medicinal tree species was nutmeg, it is also included in the cash crop (Fig. 2).

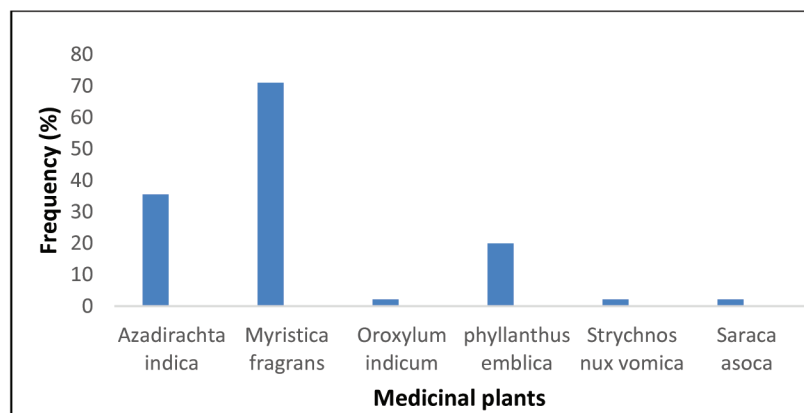


Fig. 2: Graphical representation of frequency of medicinal trees in home gardens of Mulakunnathukavu Grama Panchayath

Fruit trees and crops

The most dominant fruit plant species were mango, jack, champa, guava, Annona, nelli, citrus etc. The

influence of new farming style and the import of exotic fruit trees like rambutan, Garcina, passion fruit were observed (Fig 3).

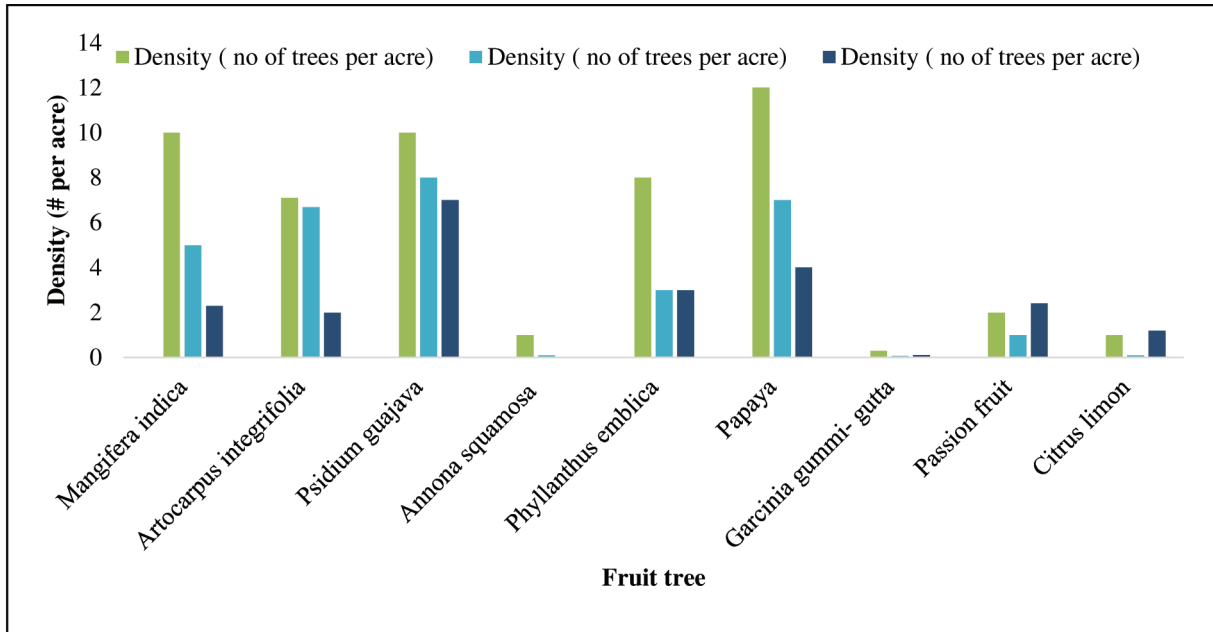


Fig. 3: Graphical representation of density of fruit trees in three categories of homegardens of Mulakunnathukavu Gram Panchayath

Horticultural plantation crops

Horticultural plantation crop includes coconut, arecanut banana and nutmeg. The occurrence of

plantation crops in small home garden was less compared to medium and large (Fig. 4).

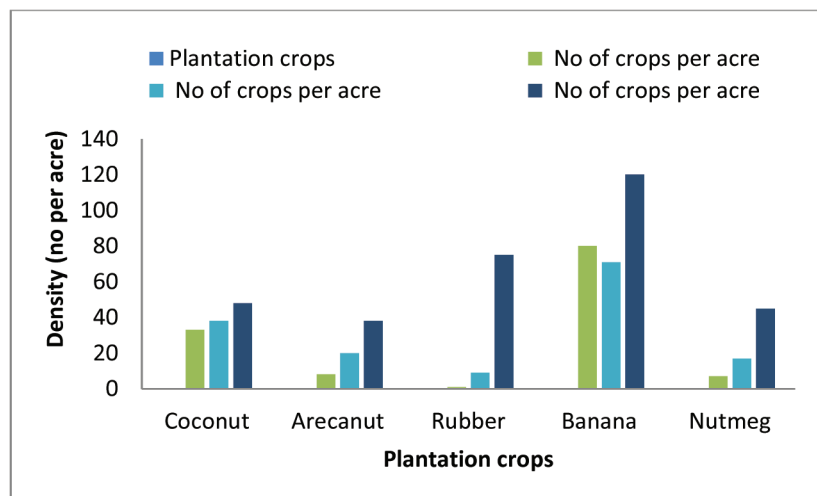


Fig. 4: Graphical representation of density of plantation crop in three categories of homegardens of Mulakunnathukavu Gram Panchayath.

Spices and condiments

The economically important crops like nutmeg and pepper were mainly cultivated. Higher cultivation of spices can be seen in large home gardens (Fig. 5).

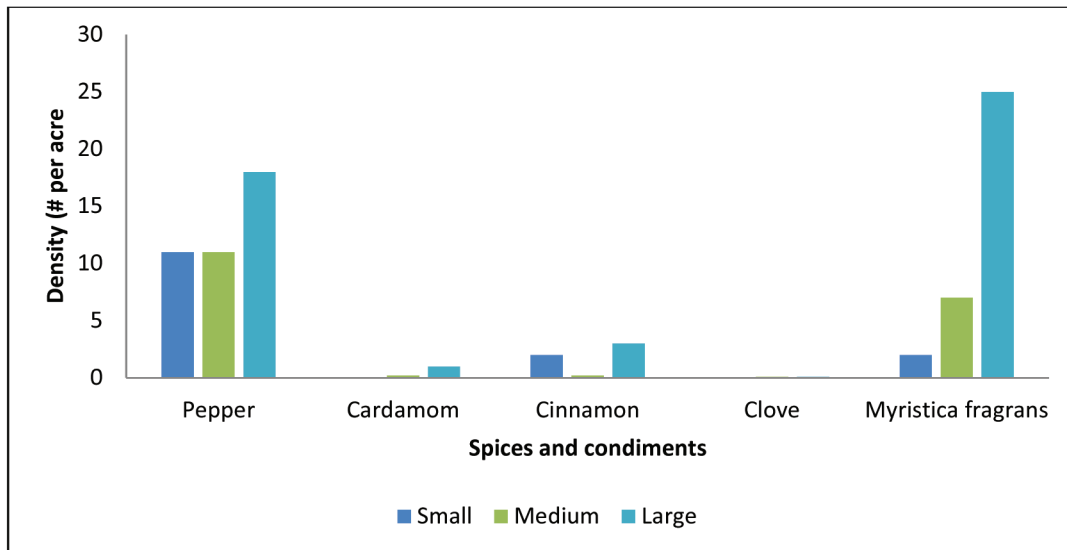


Fig. 5: Graphical representation of density of spices in spices and condiments of Mulakunnathukavu Gram Panchayath.

Vegetable crops

The most cultivated vegetable were Pea, Brinjal, Chilly, Tomato, Amaranthus etc. the cultivation of vegetable were more seen small home gardens compared medium and large (Fig. 6).

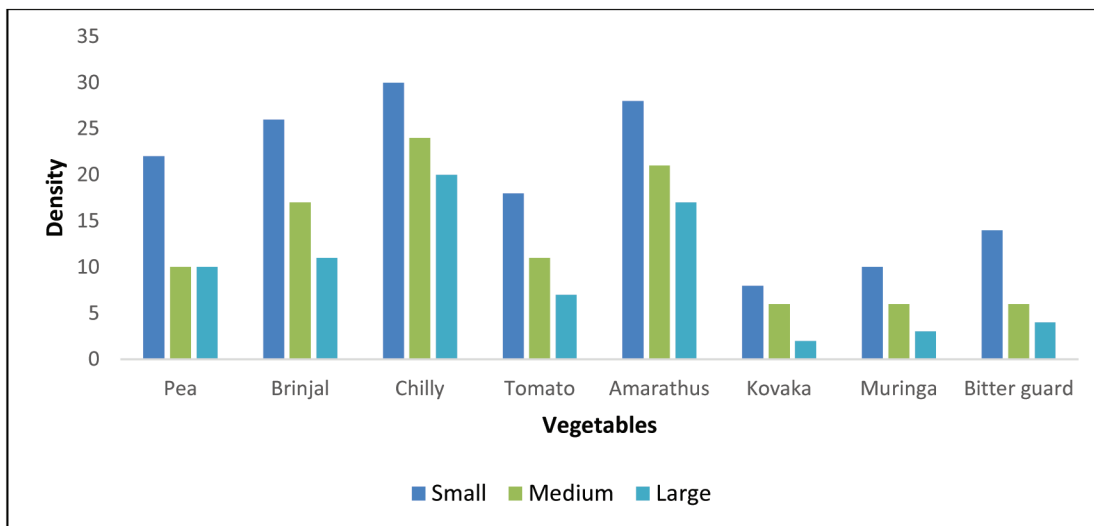


Fig. 6: Graphical representation of occurrence of vegetables in three categories of home gardens of Mulakunnathukavu Gram Panchayath.

Timber

The density of timber species were higher small home gardens which was followed by medium and large home gardens (Fig. 7).

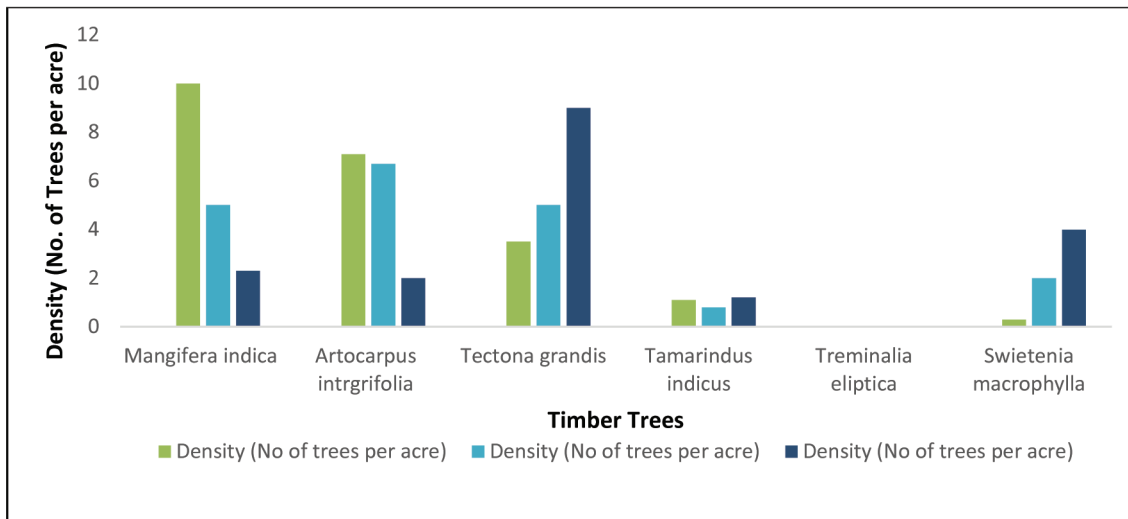


Fig. 7: Density of timber trees in three categories of home gardens of Mulakunnathukavu Gram Panchayath.

DIVERSITY INDICES

The Simpson index was 0.66, 0.70 and 0.75 for small, medium and large home gardens, respectively.

The functional diversity index was high in large scale home gardens compared to small and medium (Table 1, 2 and 3).

Table 1: Details of functional diversity index of small-scale home gardens

SI No	Species	Number (n)	(n/135) ^2
1	<i>Tectona grandis</i>	21	0.024198
2	<i>Mangifera indica</i>	62	0.210919
3	<i>Artocarpus integrifolia</i>	42	0.096790
4	<i>Swietenia macrophylla</i>	2	0.000219
5	<i>Tamarindus indicus</i>	6	0.001975
6	<i>Garcinia gummi-gutta</i>	2	0.000219
	Total (N)	135	0.334102
		D= 1-(Σ(n/N) ^2) = 0.6657	

Table 2: Details of functional diversity index of medium- scale home gardens

SI NO	SPECIES	NUMBER(n)	(n/149) ²
1	<i>Tectona grandis</i>	43	0.083285
2	<i>Mangifera indica</i>	62	0.173145
3	<i>Artocarpousintegrifolia</i>	28	0.035314
4	<i>Sweitenia macrophylla</i>	3	0.000405
5	<i>Tamarindus indicus</i>	7	0.002207
6	<i>Garcinia gummi-gutta</i>	1	0.000045
7	<i>Terminalia elliptica</i>	5	0.001126
	TOTAL(N)	149	0.295527
		D= 1-($\sum(n/N)^2$)== 0.704472772	

Table 3: Details of functional diversity index of large-scale home gardens.

SI NO	SPECIES	NUMBER(n)	(n/368) ²
1	<i>Tectona grandis</i>	123	0.111716
2	<i>Mangifera indica</i>	113	0.094289
3	<i>Artocarpous integrifolia</i>	43	0.013653
4	<i>Swietenia macrophylla</i>	60	0.026583
5	<i>Tamarindus indicus</i>	16	0.001890
6	<i>Garcinia gummi-gutta</i>	6	0.000266
7	<i>Terminallia elliptica</i>	2	0.000030

8	<i>Delonix regia</i>	3	0.000066
9	<i>Anacardium occidentallae</i>	2	0.000030
	TOTAL(N)	368	0.248523
		$D= 1-(\sum(n/N)^2)= 0. 751477$	

DISCUSSION

The present study was carried out in homegardens of Mulakunnathukavu Grama Panchayath (10 wards) in Thrissur to explore the crop and tree diversity, farmer's preference in crop selection, arrangement of plants and its management and the overall change in land use system and probable reasons in the Mulakunnathukavu grama panchayath in Thrissur district Kerala. The study was carried out in 90 homegardens of 10 wards in Mulakunnathukavu grama panchayath. In the study, 42 plant species (excluding vegetables) with 9 timber tree species, 9 fruit tree species, 2 fodder species, 9 medicinal species, 6 spices and condiment species, 7 rhizome and tuber species were reported. Cash crops like coconut, arecanut, nutmeg were dominated in most of the home gardens. The dominated timber trees include teak, mango, mahogany and jack. Fruit trees include guava, tamarind, annona, garcinia, loobica and citrus. Colocasia and cassava were the food crops in home gardens apart from rice.

Nair and Sreedharan (1986) had reported 30 arboreal taxa from the homegardens of Kerala. Babu et al.(1992) however observed a total 36 species of woody perennials from the homesteads of southern district of Kerala. In small scale home garden of this panchayath, *M indica*, *A integrifolia*, *T indicus*, *Garcinia gummi- gutta*, *T. grandis* etc were commonly found for timber.

In addition to that small-scale cultivations of coconut and arecanut were also seen. The functional diversity of plant species was lower compared to the small scale homegardens. This type of homegardens practice cultivation of cash crops such as Coconut and arecanut and cultivations of nutmeg, pepper, rubber were also seen. The cultivations of food crops and vegetables were low when compared to small homegardens. The land use patterns of the farmers were all different from one another. However, all practices were predominantly coconut based. In smaller home gardens farmers cultivate short duration plants compared to long duration plants. In these home gardens, farmers were raising food products such as fruit trees, vegetables and tuber crops. From medium to large homegardens a trend commercialization was clearly visible. Livestock such as cow, goat buffalo, hen duck were found in few homegardens. Livestock helped in generating extra income in addition to meeting dietary needs of the family. Home garden is an example of multi layered farming system, in which crowns of tree components are arranged in such away that they occupy different vertical layers, with the tallest component that are tolerant to strong light and high evaporative demand and shorter components that are tolerant to shade and high humidity (Nair, 1979)

CONCLUSION

The diversity of plant species was low in this panchayath compared to other similar studies. The diversity of plant species was high in small homegardens when compared to medium and large homegardens. In medium and large-scale homegardens, the cultivation of vegetables was low and they gave more importance to the economically important cash crops and timber trees. However, the standing stock of timber trees appears to be stable with major contribution from *M. indica*, *A. integrifolia*, and *T. grandis*. A large proportion of homegardens were being converted in to small scale plantations of coconut, arecanut, nutmeg, timber trees, rubber etc. due to their commercial advantages. Integrated farming system approach may be a viable option in this scenario where the integration of different components such as tree, crop, fish, livestock etc. can be seen in more systematic framework.

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A STUDY ON WORK LIFE BALANCE OF WORKING WOMEN WITH SPECIAL REFERENCE TO SCHOOL TEACHERS IN KODUNGALLUR TALUK

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ABSTRACT

The goal of the current study is to determine the variables influencing work-life balance and to measure this in school teachers. Female teachers are supposed to be dedicated, creative and honest in both sentimental and non-sentimental ways. In addition to being responsible for providing high quality teaching, teachers also have a significant influence on the direction of our country. So analyse their problems are very important. Here the sample consists of 60 school teachers from Kodungallur taluk. Data analysis was done by using simple percentage and statistical packages for social sciences (SPSS) based on chi-square test. The results show that the majority of the teachers have a moderate level of work life balance and a quite number of factors affect the work life balance of school teachers.

Key words: *Work life balance, working women, school teachers.*

1. INTRODUCTION

Work life balance is a balancing or state of equilibrium between the personal and professional life. The life we are living is just like a coin which

has two sides, personal life and professional life. So proper prioritising between work and personal life is very important, because the pressures in the work environment and demands in the social roles will affect the lifestyle.

The status of employment is important in the empowerment of women. Compared to the olden days, the situations have changed and women started exploring the profession and creating a strong sense of self-esteem (R. Rangarajan, 2018). And it motivated them to undertake the different challenging job responsibilities at work places.

A teacher is king of the entire education system (Surinder Kaus, 2011). So a teacher is a person who have the ability to assist the learners and help others to acquire knowledge or values. And they have a lot of responsibilities in the workplace as well as the family. In order to prepare for the next day's work, teachers' responsibilities not only need them to spend time in the classroom but also at home (Valcous, 2007). Compared to other professions, teaching has a higher proportion of female employees. Therefore, the topic of work life balance is crucial for studying teachers.

2. LITERATURE REVIEW

S. Anbalagan (2022) makes an attempt to analyse the dimensions of work life balance, family and work. He was focus on female teachers working in higher secondary schools of integrated vellore district. The study revealed that the private school teachers live a balanced work life compared to government school teachers.

Sareena umma, Falima sahana (2020) attempts to study the factors affecting the WLB. This study conducted among the teachers of government school in Sri Lanka. They try to understand the work life balance not only for employees also for employers too. For this purpose, the study selected three important independent variables such as work load, social support and childcare, and the work life balance selected as dependent variable. They collect 82 responses and analyse the data, the results helpful for the school administrators to known the importance of WLB.

Naveen Kumar (2019) studied the various factors of work life balance among school teachers. He has picked up consideration in corporate segment. The researcher used the Green Raus concept in this study. Here, he discovers that six factors, including workload, working hours, stress management, marital relationship, workplace circumstances, and family relationships, contribute to teachers' ability to maintain a work-life balance.

R. Gayathri (2019) tries to analyse the work life balance of university teachers. Study included the emotional and spiritual intelligence as variables which can influence work life balance. She covered most of the demographic variable. And she

concludes that the work life balance has positive impact on the life and job satisfaction of university teachers.

R. Suryakumar and V. Suresh (2018) made an attempt to examine work life balance among school teachers is influenced by demographic factors such as family structure, employment history and childcare. They selected 172 respondents from two private schools in Chennai. They observed the significant difference between the selected 3 factors.

A. Pandu (2017) Selected 69 respondents from IT employees and 104 school teachers from Chennai for his study, through simple random sampling. He stated that work life balance is the maximum level balance attained between work and personal life. The study's focus is on work-family conflict, family work conflict, work environment and feelings about work. He has learned from the study that the most important element impacting work life balance and the requirement for creating and putting into effect work life balance related policies and practices is how people feel about their jobs.

3. OBJECTIVES

1. To identify the factors affecting work life balance.
2. To measure the level of work life balance of teachers.
3. To find out the designation difference in the level of work life balance.

4. HYPOTHESIS

H_0 : There is no designation difference in the level of work life balance.

H_1 : There is a designation difference in the level of work life balance.

5. RESEARCH METHODOLOGY

The study is descriptive and analytical in nature. The samples under the study are taken from the school teachers in kodungallur Taluk in Thrissur

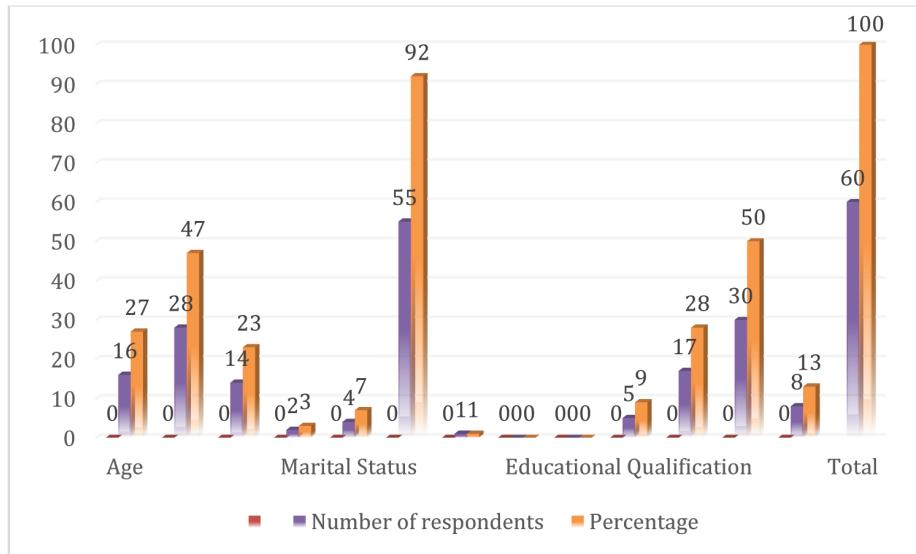
district. A questionnaire was prepared to collect information regarding the motive of analysing work life balance of school teachers. Secondary data has been collected from various publications, journals and articles related with the study. Convenient sampling method is used for selecting the respondents. The collected data were analysed by using simple statistical tools like tables, charts, percentage analysis and SPSS.

6. DATA ANALYSIS

Table No 6.1: Table showing Age, marital status and educational qualification

Particulars		Number of respondents	Percentage
Age	20-35	16	27
	36-45	28	47
	46-55	14	23
	56 and above	2	3
Marital Status	Single	4	7
	Married	55	92
	Widowed	1	1
	Separated	0	0
	Divorced	0	0
Educational Qualification	Bachelor Degree	5	9
	Master Degree	17	28
	Bachelor's in education (B.Ed)	30	50
	Others	8	13
Total		60	100

Source: Primary data



Interpretation:

The above table shows that out of 60 respondents, 47 percent of respondents are in the age group of 36-45 years followed by 27 percent are in between 20-35 years, 23 percent are in the age group of 46-55 years and only 3 percent are 56 years and above. Hence, the majority of the respondents (47%) were in the age group of 36-45 years. The about table indicates that out of 60 respondents 92 percent of respondents are married 7 percent

of respondents are single and only 1 percent of the respondents are widowed. Hence, the majority (92%) of the respondents were in the category of married. The above table indicates that out of 60 respondents 50 percentage of respondents are B.Ed qualified, 28 percent are post graduated, 13 percent have other qualification and 9 percent are graduated. Hence, the majority (50%) of the respondents falls under the bed level.

Table No 6.2: Table showing Designation, Work Experience and Monthly Income

Particulars		Number of respondents	Percentage
Designation	Primary school teacher	20	34
	High school teacher	20	33
	Higher secondary teacher	20	33
Work Experience	Less than 5 years	12	20
	6-10 years	17	28
	11-15 years	14	23
	16-20 years	7	12
	20 and above	10	17
Income Level (in Rupees)	Below 20000	14	24
	20001-40000	14	23
	40001-60000	15	25
	60001-80000	11	18
	Above 80000	6	10
Total		60	100

Source: Primary data

Interpretation:

The above table exhibits that there is equal number of primary teacher comma high school teacher and higher secondary teacher. The above table indicates that out of 60 respondents, 28 percent of respondents are having 6-10 years of teaching experience, followed by 23 percent of respondents having 11-15 years of experience, 20% percent of respondents have only less than 5 years of experience, only 17 percent of respondents have 20 years and above experience and 12 percent of

respondents have 16-20 years of work experience. The above table indicates that out of 60 respondents, 25 percent of people are having the average monthly income of ₹ 40001-₹ 60,000 followed by 24 percent having income below ₹ 20000, 18 percent of people having the average monthly income of ₹ 60001-80,000 and only 10 percent of people are having the average monthly income of above ₹ 80,000.

Table No.6.3.1**Quartile calculation of work life balance**

First quartile	3.80
Third quartile	4.60

Interpretation:

Based on the first quartile (3.80) and third quartile (4.60), the level of work life balance is classified as low, medium and high.

Table No 6.3.2**Level of work life balance**

Level of work life balance	Number of respondents	Percentage
Low level	18	30
Medium level	26	43.3
High level	16	26.7
Total	60	100

Interpretation:

The above table shows that there is 30 percent of teachers having low level of work life balance, 43.3 percent of teachers having medium level of work

life balance and 26.7 percent of teachers having high level of work life balance

Designation difference in the level of work life balance

H_0 : There is no designation difference in the level of WLB

Table No 6.4**Chi square test for designation difference in the level of WLB**

Variable 1	Variable 2	Test	Z value	Sig.	H_0
Designation	Level of WLB	Chi square test	3.163	0.531	Accept

Interpretation:

Since P value is greater than 0.05, the null hypothesis is accepted at 5% level with regard to designation difference in the level of WLB. Hence, there is no significant difference in the level of WLB based on designation.

7. CONCLUSION

Work life balance is about developing and maintaining supportive and healthy work environments which allows employees to create a balance among their professional and personal duties and, therefore strengthens their loyalty to the organization and productivity. The workforce nowadays has many critical obligations like work, children, family chores, spouse and aged parent care and all this place a number of stress on individuals, households and the communities wherein they live.

In order to better understand the factors affecting the work-life balance of school teachers, this research was performed out. The study undertaken addressed the effect of demographic variables on work life balance and there is a medium level of work life balance among teachers. It can be further concluded that there will be quite a number of factors aside from demographic variables which may affect work life balance.

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