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Problems of monitoring indoor air pollution and control in slums of Rajpur-Sonarpur Municipality, South 24 Parganas, West Bengal-An appraisal

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Abstract: ***The slum dwellers suffer from a lot of problems in day to day life in terms of socio-cultural and economic environment. They can not avail proper education due to poor economic condition and uncertainty in livelihood and thus have to choose different indoor economic activities. As per 2011 census, the total population of Rajpur-Sonarpur Municipality is 424,368 with population density of 1574/Km^2. The slum dwellers live overcrowding in lightless suffocating and unhygienic places and many of them suffer from poor indoor air quality (IAQ). As a result they have to face different health hazards like respiratory illness, lung disease, skin disease, eye dryness etc. In this paper, an enquiry has been conducted to highlight the present condition of indoor air pollution of the slum area of Rajpur-Sonarpur Municipality and also focus on the problems of monitoring indoor air pollution and its control.***

Keywords: health hazards, IAQ, suffocating and unhygienic places

I. INTRODUCTION

Indoor Air Quality(IAQ) is a part of indoor environmental quality. IAQ means the quality of the air within and around buildings and structures. Different harmful chemicals, physical and biological factors which come from building materials, furniture and living discharges worsen the indoor air quality.

These factors gathering in the room change some of the interior elements and increase the concentration of certain toxic and hazardous substances and decrease indoor air quality. IAQ can be invaded by gases(including carbon monoxide, radon, volatile organic compounds),particulates, microbial contaminates(mold, bacteria) or any mass of energy stressor that threats human health, comfort and well-being of building occupants.

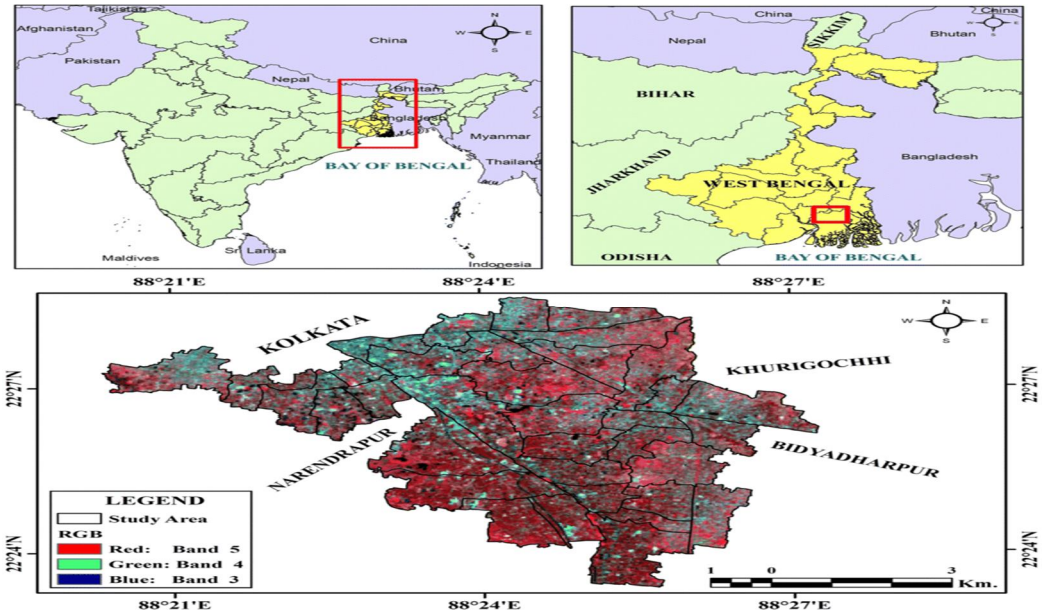
It is more harmful especially for elder, sick, frail and disabled people and also for those who have not the opportunities of outdoor activities. Poor indoor air quality can irritate the eyes, nose and throat, cause shortness of breath, provoke asthma and other respiratory conditions and affect the heart and cardiovascular system ,reduce productivity. Breathing polluted air for a long period of time can cause more serious problems.

Though the pollutant concentrations vary significantly from building to building, the levels of some common air pollutants often are greater indoors than outdoors. Since most people spend maximum time of a day at indoors than outdoors, exposure to indoor air pollutants is a vital environmental problem. Specially the slum dwellers have to live overcrowding in lightless suffocating and unhygienic places. For this reason many of them suffer from poor indoor air quality. Approximately 3.8 million people around the world die every year as a result of indoor air pollution.

II. LOCATION OF THE STUDY AREA

Rajpur-Sonarpur Municipality ,the study area is the neighborhood of South Kolkata,is a city in the district of South 24 Parganas, W.B., located at $22^0$22’56’’N to $22^0$27’53’’N & $88^0$20’02’’E to $88^0$25’48’’E with an average elevation of 9 meters above MSL. The area is bounded by Baghajatin, Bansdroni to the north, Barisha, Pailan to the west, Chakberia to the east and Baruipur to the south. The geographical area of Rajpur-Sonarpur Municipality is 49.26km^2 having 35 wards with total population 4,24,368 among which 51% is male and 49% is female. The river Piyali flows on the eastern side of this area. Some small channels and creeks also are flowing through the area which are ultimately drain into river Piyali.

Location Map Of Rajpur-Sonarpur Municipality



Map No:1[Source: District Planning Map Series, NATMO, Kolkata]

III. OBJECTIVES

The present work is undertaken with the following deliverables-

A. To observe the major human activities, polluting their indoor environment in selected slum area of Rajpur-Sonarpur Municipality.
B. To identify the causes and sources of indoor air pollution evolved from standard of living of the slum areas .
C. To study the work culture and in-house amenities of the slum dwellers in selected wards of Rajpur-Sonarpur Municipality.
D. To identify the problems evolved from household practices and sanitary system of the slum area.
E. To analyse the monitoring methods to control indoor air pollution in the slum area in the selected wards.

To analyse the government measures for improving living condition of slum dwellers.

IV. DATABASE

The present study is done by collecting both primary and secondary data to analyze the problems of monitoring air quality in slums of Rajpur-Sonarpur Municipality. Primary data has been collected through interactions with the slum dwellers of ward No-12(A.P.Nagar,Rupnagar),13(Baikanthapur,Barendrapara),14(Bagnipara,Matipara,MilanPalli),15(Natun Pally, Chanditala) of Rajpur-Sonarpur Municipality. To carry out the household survey in four wards,the sample houses are selected by simple random sampling. For selecting the samples randomly, at first the I have gone to all the surrounding slums to know the average annual income of the slum dwellers. Then they are divided into four income groups(₹≤5000,5000-10000,10000-20000,20000-40000).Thereafter simple random survey has been done by taking 40% from each economic group. I have prepared a detailed oriented questionnaire where I have penned-down all my queries associated with the problem on which I am studying and thereafter I have collected all necessary primary databases. Secondary data has been collected from Rajpur-Sonarpur Municipality, District Census Handbook, South 24 Parganas, Census of India 2011,Bureau of Applied Economics and Statistics, Govt. of West Bengal, District Human Development Report, South 24 Parganas(2009).

V. METHODOLOGY

In order to evolve the entire project on problems of monitoring air quality in slums of Rajpur-Sonarpur Municipality,has been followed like collection of census data, organising survey in the selected wards by questionnaire format. These collected data have been analyzed by the application of geo informatics with cartographic techniques and statistical tools to identify the problem and required solution.

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VI. SOURCES OF INDOOR AIR POLLUTION IN SLUMS

A. Normal Biological process – people and pets generates carbon dioxide, moisture, odours and microbes.
B. Combustion appliances such as wood stoves, gas stoves, furnaces, charcoal and from smoking habits.
C. Use of consumer products such as spray cans, air fresheners, spray cleaners and construction materials and refrigerators.
D. Dusts and open drain for discharging waste water in and around slums.

VII. ANALYSIS OF SOURCES OF INDOOR AIR POLLUTANTS IN SLUMS OF RAJPUR-SONARPUR MUNICIPALITY

1) *Use of Cooking Fuel:* Use of cooking fuel reveals the scenario of indoor pollution of any place. Percentage of use of cow dung cake and wood & coal is higher(i.e.respectively23%&28%)(Fig:1)in ward no.13 than ward no 12,14,15.Use of kerosene is also higher(18%)in ward no.13 than other wards. So the rate of indoor pollution is also tremendous here.

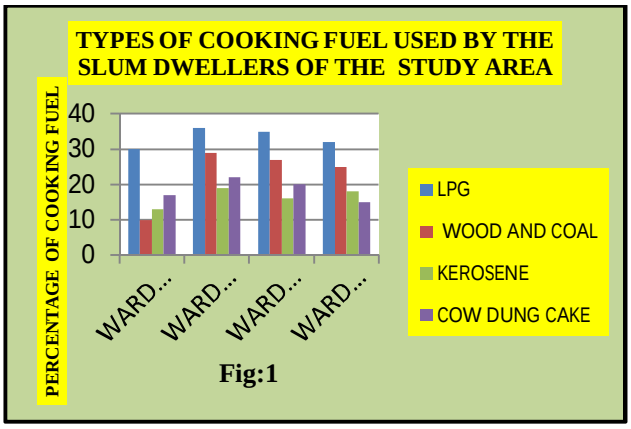

Fig:1

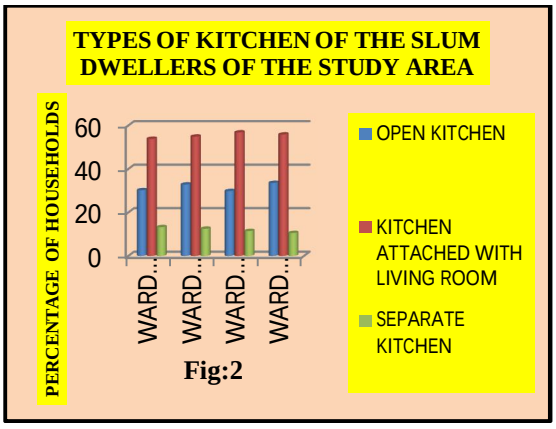

Fig:2

2) *Types of Kitchen:* Types of kitchen means whether it is open, attached with living room or separate. It is one of the main source of indoor air pollution. In the slum area of Rajpur-Sonarpur municipality ward no.14 has been recorded as highest having with 57%(Fig:2) attached kitchen whereas ward no.12,13,15 are also almost equal(respectively 52%,54%,55%).There are highest(12%)separate kitchen in ward no.12 which is quite higher than the other wards.
3) *Condition of Living Room:* In the surveyed slum area there are maximum percentage(29%) of very poor ventilated living room in ward no.15(Fig:3)whereas the minimum percentage(16%) is in ward no.12.The slum dwellers are living in overcrowding in lightless suffocating and unhygienic places.

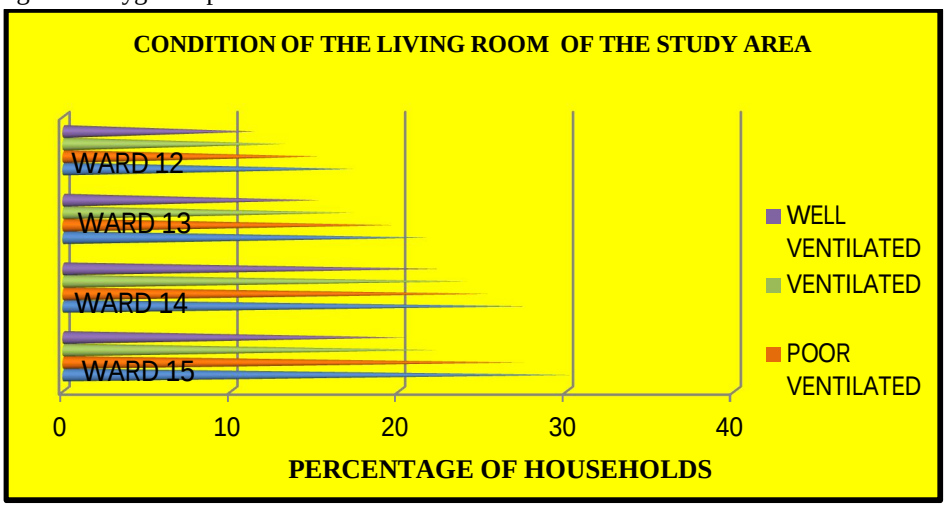

Fig:3

It is revealed from the above diagram that within the sample households about 30 percent houses has practically no ventilation facility for proper air exchange. In about 15% of houses there is no mechanical ventilation system like fans also. In these cases, excess humidity may cause infection in lungs.

4) *Condition of Drainage System:* The condition of drainage system of the surveyed slum area is very unhygienic. The percentage of no drainage system in ward no.15,14,12,13 is respectively 44%,42%,39%,36%(Fig:4)whereas the percentage of closed drainage system is respectively 8%,7%,6%,5%.Naturally the rate of indoor air pollution is tremendous here. Mould, odours and other microbial pathogens are formed here. Most of the house holds have no permanent latrine facilities of their own and only about 10 percent households have toilet with septic tank.

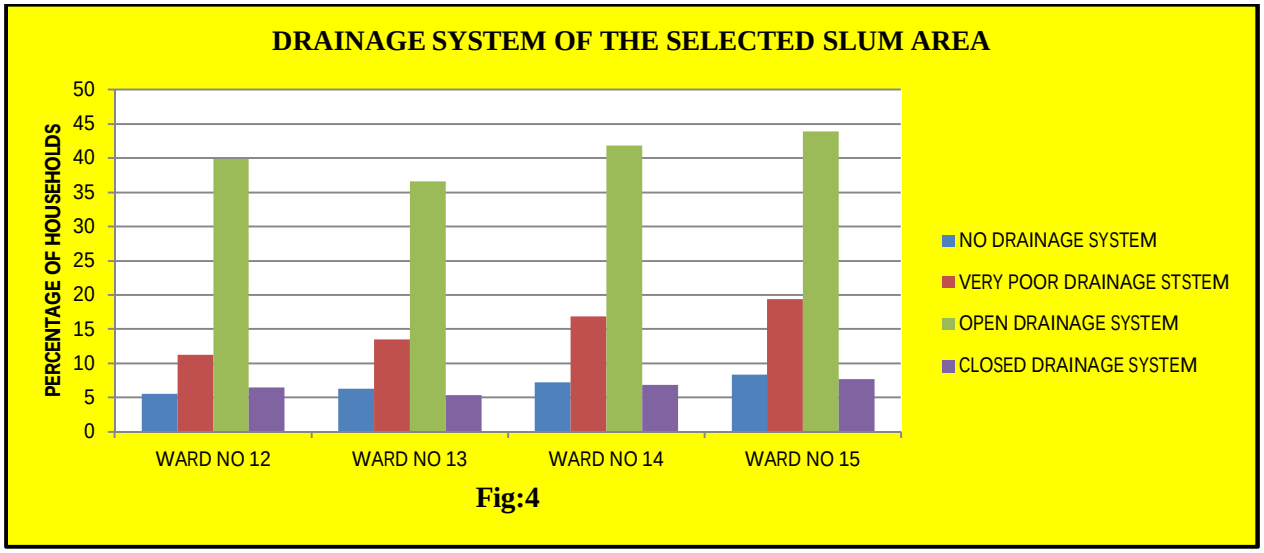

Fig:4

From the above statistical representation it is clear that in most of the houses there is no drainage to drain the waste materials and maximum house holds have no accessibilities of covered or hygienic drainage facilities being exposed to chemical pollutants.

VIII. HEALTH EFFECTS DUE TO INDOOR AIR POLLUTANTS

SYMTOM	POSSIBLE CONTAMINANTS	PRIMARY SOURCES	ENVIRONMENTAL CONDITION
• Headache	• Bio-aerosols	• Ventilation systems	• Ergonomic conditions
• Fatigue	• VOCs	• Humidifiers	• Noise & vibration
• Dizziness		• Cooling Coils in AHVs	
• Tiredness		• Outside air	
• Poor concentration		• Drip pans	
	• CO	• Incomplete combustion(vehicle exhaust,stoves,fire places)	• Economic conditions
• Ringing in ears	• Formaldehyde	• Building products	• Noise & vibration
• Pounding heart		• Furnishing	
• Dry throat	. NO_2	• Incomplete combustion	• Relative humidity
• Shortness of breath	• Formaldehyde	• Building products	
• Irritation of respiratory tract	• VOCs	Furnishing	
• Infection of respiratory tract	Particulates	Smoking	

Source: WHO

The above mentioned health hazards are very much common in the study areas where the use of biomass such as woods or dried brush are the major contributors.

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IX. MONITORING OF INDOOR AIR QUALITY

Indoor air quality monitoring is all about achieving a healthy indoor environment .In general it means:

A. There is adequate ventilation(the incoming and distribution of clean air.
B. Contaminants are controlled.
C. The temperature and humidity level are comfortable.

X. APPLICATION OF IAQ MONITORING METHODS

A. Survey Methods

1) Monitoring Exposure To Chemical Indoor Pollutants: Chemical indoor air pollutants will be monitored using passive samplers which provide data on average concentration during the sampling period. The diffusion samplers are exposed for a defined time period. The rate of sampling depends on the diffusion coefficient of the target samplers for different pollutants so that all pollutants will be monitored simultaneously and for the same amount of time. Sampling will need to be indoors and outdoors. WHO guideline values for two core pollutants and one optional pollutant are as follows:

*a) Formaldehyde:*100 µg/m^3(30 min average)
b) NO_2*:*40 µg/m^3(annual average)
c) Benzene: No safe limit of exposure to this carcinogenic compound can be recommended. Long term exposure to 0.17 ug/m3is associated with 1/1,000,000 excess life time risk of cancer. Compliance monitoring for formaldehyde would require samplers with 30 min or shorter averaging time. These would have to active samplers since samplers require a much longer sampling duration at typical formaldehyde levels in home. Since a single 30-min sample would not be representative, a large number of measurements would have to be taken at each location to characterize the distribution of concentrations.

2) Duration of Sampling: The sampling should last for one house covering 7 days while the residence are present there. One option is to always start sampling on Monday morning and finish at the end of Sunday. In this case, however, the workload will be uneven during the week if technicians only need to come to each house twice, at the beginning and the end of the monitoring period. Another option is to allow flexible schedules so that sampling can start on different days in different houses. The second option is preferable as it would reduce the number of technicians and make it easier to organise and run the survey.

3) Sampling Time: Relevant measurement time is while all residence present in home. Measuring non-stop for 24 hours per day can result in overestimation of exposure to formaldehyde, which may accumulate during the night when doors and windows are closed and it can also produce biased estimates of exposure to NO_2.(the direction of bias would depend on contributions of indoor and outdoor sources of combustions).Another issue is seasonal variability in concentrations of some pollutants. Concentrations of formaldehyde in indoor air may have a seasonal pattern due to different emission and ventilation rates in the winter and summer seasons. The peak seasonal concentrations have been reported in the winter in temperate climates due to poorer ventilation and increased emission from materials and products, such as paints and furniture, which are located near heating systems and are exposed to high temperature. Similarly ambient concentrations of benzene peak in winter. When indoor combustion sources are present,NO_2,also peaks in winter in the environment. Thus, monitoring indoor air pollution in the winter would characterize peak exposure levels.

4) Methodology Of Indoor Air Exchange Rate Monitoring: Insufficient ventilation in schools has been linked with respiratory and general symptoms, infectious diseases and impaired learning outcomes. Poor ventilation is also associated with higher levels of chemical pollutants and problems with mould and dampness. The problem of insufficient ventilation in houses specially in slums and complexes appears to be common. However, there are no representative and comparable ventilation data for houses across Rajpur-Sonarpur municipality. While insufficient air exchange rate is associated with a generally poor indoor air quality, the goal is not necessary to increase ventilation rate universally. Since greater air exchange rate during the heating season also results in greater energy consumption for heating and for mechanical ventilation, air exchange rates have to be optimized to balance the air quality and energy requirements.Air exchange rate in a room is not constant.Therefore,long-term measurements covering an entire week are necessary to characterize prevailing conditions in each room.Using CO_2 exhaled by occupants as a tracer gas offers a number of advantages,such as the ease of measurements and well established methodologies.To asses the dynamic ventilation rate,continuous CO_2 data from inside and outside the school have to be collected.

B. Methodology For Evaluating The Presence Of Dampness And Mould In Houses

Dampness and mould in homes have been linked asthma,respiratory,systems and infections while remediation of dampness and mould problems has been associated with a decline in these symtoms.The presence of both factors,dampness and mould,has to be taken in account as they are both associated with health effects.The parts of house which are affected by damps and moulds to be repaired by trained technicians.The objective of the survey is to assess the occurrence of dampness and mould problems in houses.

XI. PROBLEMS OF MONITORING INDOOR AIR POLLUTION IN RAJPUR-SONARPUR MUNICIPALITY:

In most of the Third World Countries, the rapid urban growth occurs through slums and squatter settlements. These uncontrolled settlements often face day to day life. Their living space is very small compared to population. So they have to live in a very congested place. This study aims to investigate the problems of monitoring indoor air pollution in Rajpur-Sonarpur municipality. The major problems faced by the slum dwellers in these four wards of the study area are:

A. A good measurement protocol includes appropriate methodologies and compliance of quality control and quality assurance procedures. There is a scarcity of such protocol in the study area.
B. Most of the slum dwellers are not aware about indoor air pollution.
C. In the slums area indoor ventilation system is inadequate.
D. Most of the slum dwellers have to cook in their living room and to much odour arise from their kitchen waste.
E. Most of the slum dwellers use coal, wood, dung cake as cooking fuels.
F. Drainage system and sanitary system of the area are very unhealthy.

XII. GOVERMENT MEASURES FOR IMPROVING LIVING CONDITIONS IN SLUMS:

This study aims to investigate the prospects and upgrading measures taken for the slums in the selected municipality with special reference to comparative analysis of these aspects in terms of the prevailing socio-economic conditions and measures adopted by local government, non-govt. organizations and developments on the self-help basis. The comparative improvement of housing ,living and environmental conditions is the main of the various pilot projects undertaken for the urban squatter communities. The comparative improvement of housing, living and environmental conditions is the main aim of the various pilot projects undertaken for the urban squatter communities. An important finding is the strong accomplish role played by the site planning, reblocking and housing in effective improvement and development of the slum areas. The component is applicable to a composite strategy involving slums upgrading on the one hand whereas site and service or resettlement on the other hand. Other components of strong integrating effects are the employment generation by job training, job placement as housing schemes are often very expensive for the poor people. So clearances of such squatter settlements or slums and rehousing the people in more distant areas are problematic.

Photo Gallery(Household Survey,2020)

XIII. CONTROLLING MEASURES OF INDOOR AIR POLLUTION

To prevent indoor air pollution some necessary measures should be taken.Such as:

A. Adequate ventilation to promote healthy indoor air with a good exchange of outdoor air.
B. Do not block air vents or grilles.
C. No cigarette smoking within the home to prevent the dweller from lung cancer.
D. Stop using wood, coal, dung cake, kerosene as cooking fuel.
E. Avoid bringing products into room that could release harmful or bothersome odours or contaminants.
F. If pets then necessity of washing the bedding of pets and bathing.
G. Using the doormat and to minimise the use of carpets to reduce dust and dirt.
H. Planting some indoor plants like

1) *Areca Palm:* It filters out harsh chemicals including acetone, xylene and toluene which accumulate from products such as nail varnish, detergents, wooden furniture, gasoline, cosmetics etc.
2) *Philodendron:* It purifies air by removing formaldehyde which occurs naturally and from building materials and home furnishing and becomes threatening only through long-term exposure by inhalation.
3) *Rubber Plant:* It improves indoor air by absorbing CO_2 and converting into breathable O_2.
4) *Peace Lily:* It improves indoor air by absorbing mold spores which commonly occur from dust inside. The plant can be useful in areas of high humidity- like bathrooms.
5) *Dracaena:* The plant removes formaldehyde, benzene, trichloroethylene and CO2-all which are linked to health problems.
6) *Snake Plant:* The plant is extremely effective as it absorbs formaldehyde, benzene and other harsh chemicals found in indoor air. It also produces oxygen, absorbs CO_2 in the night and has proven to be beneficial for airborne allergies.
7) *Boston FERN:* Alongside being a natural air filter, the Boston Fern also restores natural moisture to the air.
8) *Aloe Vera:* The plant acts as a natural air purifier and reduces toxic chemicals including formaldehyde and benzene-two chemicals that are present in cleaning products.
9) *English IVY:* It can stimulate mucus glands and contains expectorant properties which can help people with breathing difficulties. It also works as air purifier.
10) *Spider Plant:* It is an antioxidant as it effectively removes ammonia, formaldehyde, benzene, xylene-harsh chemicals that occur from cleaning products and furniture. This plant easily improves indoor air quality.

Education also plays an important role – Education provides people with the information necessary to make decisions concerning exposure and strategies to avoid potentially hazardous conditions in home and workplace.

XIV. CONCLUSION

The present micro level study has tried to assess the standard of living, human activities, causes and sources of indoor air pollution and to focus on controlling measures of the indoor air pollution in the selected slum area of Rajpur-Sonarpur municipality. The concentration of slum people varies in quantitative figures in different wards of the study area. The selected slum area facing many socio-economic problems in terms of education and occupation. Many children are the first generation learners in their family who are from nearby schools like Sonarpur Vidyapith, Sarada Vidyapith, Kamrabad H.S Institution, Ghasiara Vidyapith, Gorkhara Vidhyamadir(H.S), Kamrabad Girls' High School, Rajpur Padmomani Girls' High School etc. In such a condition the slum dwellers have to live congestedly where the ventilation system is very poor. They have to cook by wood, kerosene, cow-dung, coal as cooking fuel which are dangerous source of indoor air pollution. For drinking and cooking water they are dependent on hand pumps' water which is mostly arsenic affected and municipal water system. Due to lack of education and unsophistication the slum dwellers often use to gather vegetable peels in kitchen and gather the wastage in open drain which causes odors and creates indoor air pollution. There are some alternative ways to stop use of common household products. First of all, the slum dwellers should use alternative instead of wood & coal, cow-dung, kerosene etc. As cooking fuel. They should use:-1) liquid soap or mild detergent for dish washing,2)compost as fertilizer,3)herbal bouquets instead of air refresher,4)vinegar & water for floor cleaning,5)physical and biological control instead of pesticide,6)baking soda and mild kitchen and stop throwing garbage openly in drain. Lastly they must need to plant some indoor plants at home.

So over all, proper education, environmental awareness of the slum dwellers and Govt. policy and its proper application is the key to prevent indoor air pollution.

XV. ACKNOWLEDGEMENT

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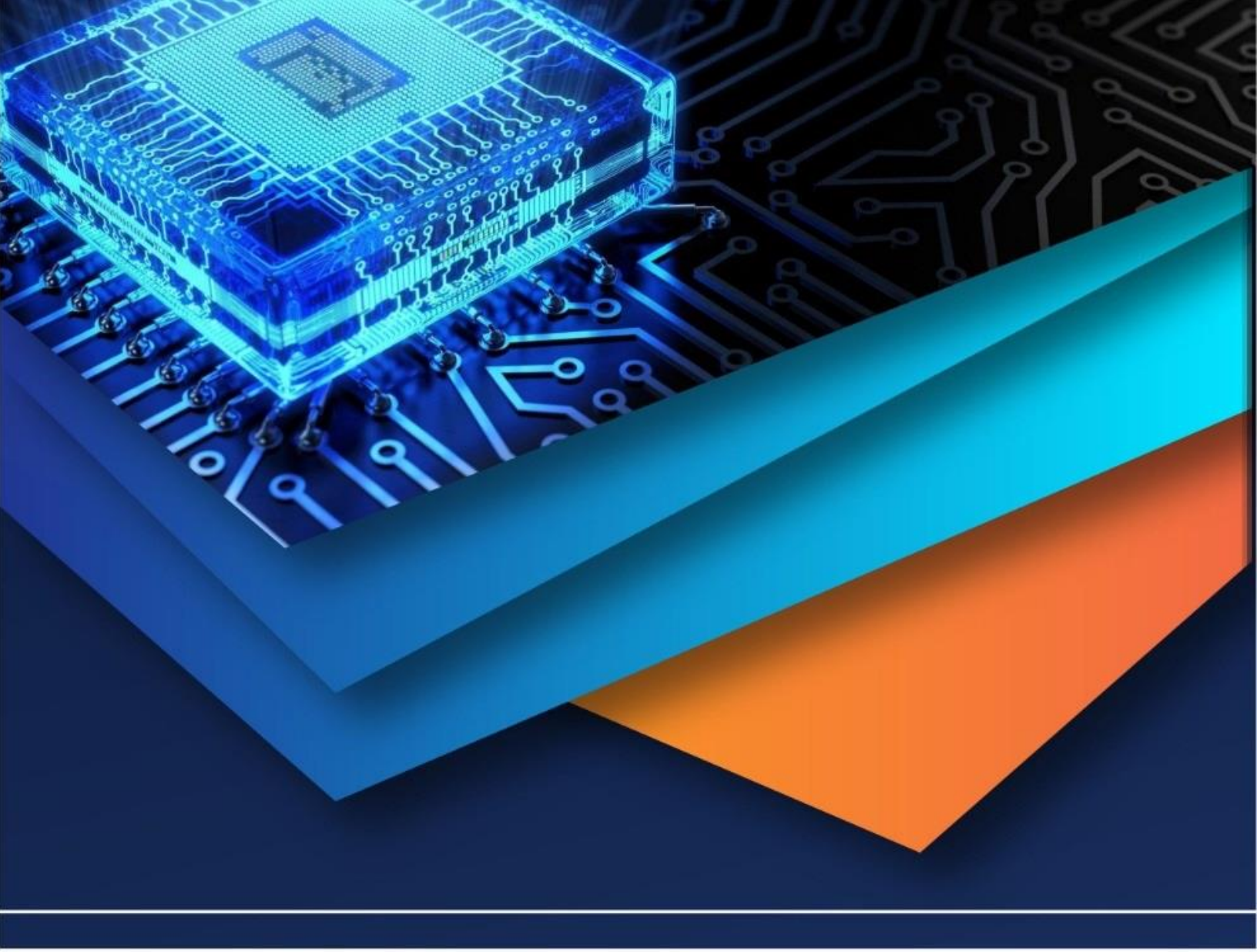

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