Environmental and Health Risk of Bush Burning

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ABSTRACT

Bush burning has been a detriment to the environment and health of mankind. It involves the production of air pollutants, such as carbon monoxide, hydrocarbons, hydrogen sulphide, nitrogen oxides, sulphur oxides, ozone and other oxidants. Particulate pollutants like dust, fume, mist and smoke are also obtained from bush burning. The sources and effects of these pollutants were treated in this study. The effects and problems of bush burning on man and his environment were also reported. Other health and environmental hazards reported in this study were acid rain, the greenhouse effect, depletion of ozone layer and deforestation. Further, the quantification, control and monitoring techniques of these pollutants were reported in this review.

Key words: Bush burning, Air pollutants, carbon monoxide, nitrogen oxides, acid rain, ozone layer, deforestation

Introduction

Population explosion, industrialization, urbanization and intensive agriculture have caused tremendous damage to our environment. Man’s ignorance of laws of nature and his over-exploitation of natural resources have further aggravated the problem. Fortunately, during the last few years, we have started realizing our past mistakes and begun to make amends to prevent further degradation of our environment.

Environment means the surroundings in which we live. It is a life-sustaining system in which various living beings like animals, including man, birds, insects, micro-organisms like algae, fungi, protozoa, amoeba and non-living beings like air, water and soil are inter-related. Like man, his environment too is beautiful. The earth is a wonderful planet that has perennial sources of water to quench his thirst with their sweet water. Its atmosphere supplies pure air for him to breathe and has a natural ozone umbrella that protects him from sun’s dangerous ultra-violet rays. It has a green carpet to utilize the carbon dioxide that we exhale to recycle into oxygen essential to sustain life on this planet. It has number of attractions like the rainbow to wonder at. The atmosphere, the lithosphere and the hydrosphere form the biosphere in which life is-it man, animal or plant exists. The biosphere is not only a source of life sustaining elements but also a sink into which all waste products are dumped. From the time immemorial, the biosphere is discharging faithfully its duty of recycling waste products to make good the loss so that every generation finds it the same as the one before it. But this self-cleaning and equilibrium maintenance of the biosphere is disastrously disturbed if waste products released into it exceed its capacity to purify herself. Of late, this is what is happening. We are loading it with enormous amounts of waste product that the biosphere is becoming more and more poisonous and soon a day will be reached when it becomes inhabitable.

Primitive man ate uncooked food available from plants, birds or animals within his reach. He ate the raw meat. He drank the water from the rivers. He lived in caves or huts made of mud, wood and leaves of some trees. This sort of living never polluted the environment. When promethenes stole fire, man’s travails began. He used it not only to...
cook food but also as a weapon to destroy the neighbour and the series of air polluted disaster affected millions all over the world [1].

Ecology and environmental science

Man’s environment is under constant threat from his own activities. Man’s expanding population is the biggest challenge to the quality of the environment. The developments in industrial and agricultural sectors to provide food and other basic amenities to the increasing population have further deteriorated the environment. Uncontrolled mechanization, over-exploitation of natural resources, deforestation and extensive use of chemical fertilizers and pesticides have brought about many changes in different components of the environment. On the other hand, nature has been striving hard to compromise with man bear the on slaught of his activities. In fact nature gave warning signals to man in the form of droughts and floods in many countries of the world.

The domestication of plants and animals gave impetus to agricultural technology. With the increase in productivity of land, crop production started increasing at a faster speed. Human population started increasing beyond the limits previously fixed by natural food supply. The development in machinery, fertilizers pesticides and high yielding varieties caused unprecedented increase in agricultural productivity. Overgrazing, widespread destruction of forests and intensive agricultural practices denuded the land and converted productive regions to barren areas. The discovery of new medicines and improved sanitation enhanced human survival and population began a rapid ascent.

Basic concepts on changes in the environment Caused by man

The changes brought in by physical environmental process on the earth’s surface occur in such away that equilibrium is maintained through negative feed back mechanism if man does not interfere in the natural state of physical environmental process. Now man has emerged as a very important geomorphic agent and is capable of changing the earth’s surface at a much faster rate than many of the natural processes. Thus it is important to study the role of man in changing the environmental processes because these processes affect the energy system, hydrological cycle, chemical element cycle, and sediment cycle which in turn maintain unity of biosphere ecosystem.

Man’s impact on environmental processes

The external environmental processes originate from the atmosphere and are basically related to solar energy which affects the basic elements of atmospheric processes. Man, by affecting solar radiation and thus the heat energy, may affect the processes of precipitation and air circulation which in turn would affect the environmental processes [1].

Air pollutants

Air pollutant can be defined as those substances, which exist in such concentrations as to cause unwanted effect. These pollutants can be natural such as smoke from forest fire or man –made such as automobile exhaust and can be in the form of gases or particulates.

Gaseous pollutants include substances that are gases at normal temperature and pressure as well as vapours of substances that are liquid or solid at normal temperature and pressure. Among the gaseous pollutants of greatest important are carbon monoxide, hydrocarbons, hydrogen sulphide, nitrogen oxides, sulphur oxides, ozone and other oxidants. Carbondioxide is added to this list because of its potential effect on climate.

Particulate pollutants include dust, fumes, mist, smoke and spray.

Dust:

dust are solid particles which are :(a)entrained by process gases directly from the maternal being processed e.g coal ash and cement (b) direct offspring of parent material undergoing a mechanical operation, e.g saw dust from wood working;(c) entrained material used in a mechanical operation e.g sand from sand blasting. Dust from grain elevators and coal-cleaning plants typify this class of particulate. Dust consists of relatively large particles.

Fume:

fume is a solid particle frequently a metallic oxide, formed by the condensation of vapours, by sublimation, distillation, calcinations or chemical reaction process. Examples of fumes are zinc and lead oxides resulting from the condensation and oxidation of metal volatilize in a high temperature process. The particles in fumes are quite small with diameters from 0.003 to 0.3micron.

Mist:

This is a liquid particle formed by the condensation of a vapour and perhaps by chemical reaction. An example of this process is the formation of sulphuric acid mist.

\[
SO_{(g)} + 2\text{H}_2\text{O} \rightarrow H_2\text{SO}_4
\]
Sulphurtrioxide gas becomes a liquid since its
dew point is 22°c and SO3 particles are hydroscopic,
mists typically range from 0.5 to 3micron in
diameter.

Smoke:

smokes are solid particles formed as a result of
incomplete combustion of carbonaceous materials. Although hydrocarbons, organic acids sulphur oxides
nitrogen oxides are also produced in combustion
process, only the carbonaceous materials are smoke. Smoke particles have diameters from 0.5 to
approximately 1micron.

Spray:

Spray is liquid particles formed by atomization
of a parent liquid.

Sources of air pollution

There are a number of pollutants that are formed
and emitted through natural process. For instance,
naturally occurring particulates include pollen grains,
fungus spores, salt spray, smoke particles from forest
fires and dust from volcanic eruptions .Gaseous pollutants from natural sources includes carbon
monoxide as a breakdown product in the degradation
of hemoglobin, hydrocarbons in the form of terpenes
from pine plant, hydrogen sulphide resulting from the
breakdown of cysteine and other sulphur containing
amino acids by bacterial action, nitrogen oxide and
methane.

Anthropogenic pollutants can be conveniently
classified as stationary combustion, transportation,
industrial process and solid waste disposal sources.
The principal pollutant emission from stationary
combustion processes are particulate pollutants, as fly
ash and smoke, and sulphur and nitrogen oxides.

Sulphur oxide emissions are, of course, a function of
the sulphur present in the fuel. Thus combustion of
coal and oil both of which contain considerable
amount of sulphur yield significant quantities of
sulphur oxides.

Effects of air pollution on man and his environment

(a)Respiratory system:

The major target of air pollutants is the
respiratory system. Air and entrained pollutants enter
the body through the throat and nasal cavities and
pass to the lung through the trachea. The respiratory
system can be damaged by both particulate and
gaseous pollutants. Chronic bronchitis, which is a
disorder characterized by excessive mucus secretion
in the bronchial tubes result. Also, emphysema,
which is the breakdown and destruction of the
alveolar walls in the lungs, takes place.

(b) Effect on vegetation:

Vegetation is injured by air pollutants in three
ways:
(1) necrosis (collapse of the leaf tissue)
(2) Chlorosis (bleaching or other colour changes)
(3) Alterations in growth.

(c) Effect on domestic animals:

Air pollutants affect animals other than man. Chronic poisoning usually result from ingesting
forage contaminated pollutants. Pollutants important
in this connection are the heavy metals arsenic lead
and molybdenum.

(d) Effect on atmosphere:

The ability of air pollutants, especially
particulates, to reduce visibility is well known. The
visibility reduction results from light scattering other
than obstruction of light. The particles primarily
responsible for this effect are quite small in the range
of 0.3 to 0.6 micron in diameter [2].

Bush burning as a source of air pollutants

Forest reserves as it is known as an ecosystem
and is made up of organism, matured trees grasses
and some floral plants which are made up of
Gaussian \((C_{6}H_{10}O_{5})_n\) as the structural unit block,
which is formed in all plants , where n is a large
number.

Burning of bush as been identified to give out gaseous pollutants like CO, NO, hydrocarbons and SO2

<table>
<thead>
<tr>
<th>Source</th>
<th>Particulate</th>
<th>SO2</th>
<th>CO</th>
<th>hydrocarbons</th>
<th>NOx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor vehicles</td>
<td>0.4</td>
<td>0.3</td>
<td>97.8</td>
<td>17.1</td>
<td>6.7</td>
</tr>
<tr>
<td>Incineration</td>
<td>1.4</td>
<td>0.2</td>
<td>7.9</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Agricultural refuse</td>
<td>2.4</td>
<td>N*</td>
<td>8.3</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Forest</td>
<td>-</td>
<td>N*</td>
<td>9.4</td>
<td>2.9</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Where N* is negligible
The emission of pollutants from forest and agricultural refuse open burning is given above as this shows the extent to which forest fire can cause environmental hazards compared to emission from motor vehicles incineration etc. [4].

**Major pollutants of bush burning**

The major air pollutants that are emitted during bush fire are carbon monoxide, carbon dioxide, oxides of nitrogen, oxides of sulphur, particulates and some hydrocarbon. (Which result due to incomplete combustion of cellulose materials). [5]

**Effects of bush burning on man his environment**

Bush burning as it is being studied not only poses health hazard to man alone but also affects the environment in general via the emission of the various pollutants. From the data above, it is glaring that particulates, carbon monoxide, hydrocarbons, oxides of nitrogen a negligible percentage of oxides of sulphur are the major pollutants of bush burning and they all have various effects on man and his environment, like reduction of visibility by particulate matters, especially during periods of air stagnation and causing some respiratory diseases. Oxides of sulphur and nitrogen are also hazardous as they cause respiratory disorders and irritant respectively.

Apart from the soil destruction and desert encroachment caused by bush burning, it has also had a marked increase in global warming due to the emission of NO₂, SO₂, SO₃, NO, CO and CO₂ gases which have tremendous effect on the ozone layer and also formation of acid rain which deteriorate plant life, damage calcium containing soils and also increase the acidity of surrounding lakes and rivers [6].

**Problem of bush burning**

Bushfires are part of some countries way of life. All state and territories have experienced catastrophic fires over the years and observed the adverse effects on air quality as one of the consequences.

Smoke from prescribed burning is also common in some countries like Australia and the levels of smoke from this source vary depending on the nature of the vegetation the extent of the fire. Smoke form prescribed burning can be minimised if fires are lit at the right time of year and manage correctly smaller hotter fires are preferred as this minimizes air pollution.

Fire is also a common land management practices in many agricultural areas of some countries like Australia where it is used to burn the by-products of some agricultural crops, e.g. Sugarcane waste, wheat or rice stubble and forest residues, extensive areas of crop residues are burnt each year which can create large amounts of smoke for extended periods.

**Smoke from bush burning**

Biomass burning is the combustion of organic matter. Burning can be from natural or man made fire. Examples are the burning of crop stubble, forest residues vegetation burnt for land cleaning. Prescribed burning is term used to describe the deliberate use of fire management purposes. Fire is used to reduce risk of wild life by clearing out highly inflammable leaves and branches shed by native vegetation in parks reserves, on farms and bush blocks. Burning of biomass is a major source of many air borne particles and traces gases that influence the concentration of ozone at ground level.

**Composition of smoke from bush burning**

When a fire is first lit the moisture is driven off. As it gets hotter, chemical reaction occur that produce gases. Smoke contains the unburnt portion of these gases. Smoke is a complex mixture of any many chemicals including carbon dioxide, water vapour carbon monoxide, particles, hydrocarbons, nitrogen oxides and thousands other compounds. The actual composition of smoke depends on the type of wood and vegetation being burnt, the temperature of the fire and the wind conditions.

Particle from smoke tend to be very small less than one micron meter in diameter. Biomass burning also produces carbon monoxide. The concentrations of carbon monoxide are highest when the fire is smouldering. Benzene and formal aldehyde are present in smoke but at much lower levels than particles and carbon monoxide [7].

**Health effects of smoke from bush burning**

Smoke has a range of health effects from eye and respiratory tract irritation to serious disorders such as breathing problems, bronchitis, increased severity of asthma, cancer and premature death. The very fine particles in smoke can go deep into the lungs and fine particles, by themselves or in combination with other air pollutants, can make pre-existing diseases of the heart and lungs worse. Where there is short-term exposure to smoke, the particles are the most significant threat to public health. High levels of carbon monoxide are poisonous to humans. However, carbon monoxide arising from smoke events does not usually reach levels that pose a risk to the general population, although firefighters and people with heart disease can be at risk.
Most susceptible people to health effects of smoke

Most healthy people, including children, recover quickly from exposure to smoke and do not suffer long-term consequences. However, certain sensitive groups can experience more severe short-term and chronic effects. It appears that the same population groups that are susceptible to particles in cities are also susceptible to particles from biomass burning. These groups are: people with asthma and other respiratory disease, people with cardiovascular disease, children and the elderly. Pregnant women and unborn children are potentially susceptible, given that smoke from biomass burning contains many of the same compounds found in cigarette smoke [7].

Effects of carbonmonoxide on man

Carbon monoxide is a colourless gas, it is highly poisonous. The toxicity of CO lies in its unusual ability to bind very strongly to hemoglobin [8]. Hemoglobin's oxygen-binding capacity is decreased in the presence of carbon monoxide because both gases compete for the same binding sites on hemoglobin, carbon monoxide binding preferentially in place of oxygen.

The binding of oxygen is affected by molecules such as carbon monoxide (CO). CO competes with oxygen at the heme binding site. Hemoglobin binding affinity for CO is 200 times greater than its affinity for oxygen, meaning that small amounts of CO dramatically reduce hemoglobin's ability to transport oxygen. When hemoglobin combines with CO, it forms a very bright red compound called carboxyhemoglobin, which may cause the skin of CO poisoning victims to appear pink in death, instead of white or blue. When inspired air contains CO levels as low as 0.02%, headache and nausea occur; if the CO concentration is increased to 0.1%, unconsciousness will follow. In heavy smokers, up to 20% of the oxygen-active sites can be blocked by CO [9].

Fate of carbonmonoxide

It is known that the life time of carbon monoxide in the atmosphere is not long, perhaps of the order of 4 months. It is generally agreed that carbon monoxide is removed from the atmosphere by reaction with hydroxyl radical, HO;

\[
\text{CO} + \text{HO} \rightarrow \text{CO}_2 + \text{H}
\]

The reaction produces hydroperoxyl radical as a product.

\[
\text{O}_2 + \text{H} + \text{M} \rightarrow \text{HO}_2 + \text{M}
\]

HO is regenerated from HOO by the following reactions.

\[
\text{HOO} + \text{NO} \rightarrow \text{HO} + \text{NO}_2
\]
\[
\text{HOO} + \text{HOO} \rightarrow \text{H}_2\text{O}_2 + \text{O}_2
\]

The latter reaction is followed by photochemical dissociation of \( \text{H}_2\text{O}_2 \) to regenerate \( \text{HO}^+ \):

\[
\text{H}_2\text{O}_2 \xrightarrow{\text{hv}} 2\text{HO}^+
\]

Methane is involved through the atmospheric cycle that relates \( \text{CO}, \text{HO}, \) and \( \text{CH}_4 \). Soil microorganisms act to remove CO from the atmosphere. Therefore, soil is a sink for carbon monoxide.

Effects of sulphur dioxide

Though not terribly toxic to most people, low levels sulphur dioxide in do have some health effects. It primarily effect is on respiratory tract, producing irritation and increasing air way resistance, especially to people with respiratory weakness and sensitized asthmatics. Therefore, exposure to the gas may increase the effort require to breathe. Mucus secretion is also stimulated exposure to air contaminated by sulphur dioxide. Although \( \text{SO}_2 \) caused death in humans at 500ppm, it has not been found to harm laboratory animals at 5ppm.

Atmospheric sulphur dioxide is harm to plants. Acute exposure to high levels of gas kills leaf tissue (leaf necrosis).The edges of the leaves and the areas between the leaves veins are particularly damaged. Chronic exposure of plants to sulphur dioxide causes chlorosis, a bleaching or yellowing of the normally green portion of the leaf. Plant injury increases with increasing relative humidity. Plants incur most injury from sulphur dioxide when their stomata (small opening in plant surface tissue that allow inter change of gases with the atmosphere) are open. For most plants, the stomata are open during the day light hours, and most damage from sulphur oxide pollution, plants may be damage by sulphuric acid aerosols. Such damage appears as small spots where sulphric acid droplets have impinged on leaves.

One of the more costly effects of sulphur dioxide pollution is its tendency to cause deterioration of building materials limestone; marble and dolomite are calcium and/or magnesium carbonate minerals that are attacked by atmospheric sulphurdioxide. These reactions form products that are either water soluble or in the form of poorly adherent solid crusts on the rock’s surface, adversely affecting the appearance, structural integrity, and life of the building. Although both \( \text{SO}_2 \) and \( \text{NO}_x \) attack such stone, chemical analysis of the crusts shows predominantly sulphate salts. Dolomite, a calcium/magnesium carbonate mineral reacts with atmospheric sulphur dioxide as follows:

\[
\text{CaCO}_3.\text{MgCO}_3 + 2\text{SO}_2 + \text{O}_2 + 9\text{H}_2\text{O}\rightarrow \text{CaSO}_4.2\text{H}_2\text{O} + \text{MgSO}_4.7\text{H}_2\text{O} + 2\text{CO}_2 \ [1]
\]
Removal of sulphurdioxide

SO₂ removal involves acid-base reactions with SO₂. When sulphur dioxide dissolves in water, equilibrium is established between SO₂ gas and dissolves SO₂:

$$\text{SO}_2 (g) \rightleftharpoons \text{SO}_2 (aq)$$

This equilibrium is described by Henry’s law,

$$[\text{SO}_2 (aq)] = K \cdot P_{\text{SO}_2}$$

Where $[\text{SO}_2 (aq)]$ is the concentration of dissolved molecular sulphurdioxide; $k$ is the Henry’s law constant for SO₂; and $P_{\text{SO}_2}$ is the partial-pressure of sulphurdioxide gas. In the presence of base reaction the above equilibrium is shifted strongly to the right by the following reactions:

$$\text{H}_2\text{O} + \text{SO}_2 (aq) \rightarrow \text{H}^+ + \text{HSO}_3^-$$
$$\text{HSO}_3^- \rightarrow \text{H}^+ + \text{SO}_3^{2-}$$

Harmful effects of nitrogen oxides

Acute exposure to NO₂ can be quite harmful to human health. For exposure ranging from several minutes to one hour, a level of 50-100ppm of NO₂ causes inflammation of long tissue for a period of 6-8 weeks which the subject normally recovers. Exposure of the subject to 150 - 200ppm of NO₂ causes bronchiolitis fibrosa obliterans, a condition fatal within 3-5 weeks after exposure to 500ppm or more of NO₂. “silo-filler’s disease”, caused by NO₂ generated by the fermentation of ensilage containing nitrate, is a particularly striking example of nitrogen dioxide poisoning. Deaths have resulted from the inhalation of NO₂ containing gases from burning celluloid and nitrocellulose film and from spillage of NO₂ oxidant.

Although extensive damage to plant is observed in areas receiving heavy exposure to NO₂, most of this damage probably comes from secondary products of NO₂ and from NO₂ generated by the fermentation of ensilage containing nitrate, is a particularly striking example of nitrogen dioxide poisoning. Deaths have resulted from the inhalation of NO₂ containing gases from burning celluloid and nitrocellulose film and from spillage of NO₂ oxidant.

Control of nitrogen oxides

Removal of NO₅ presents some formidable problems. These problems arise largely from the low water solubility of NO the predominant nitrogen oxide species. Possible approaches to NO₅ removal are catalytic decomposition of nitrogen oxides; catalytic reduction of nitrogen-oxides, and sorption of NO₅ by liquids or solid uptake of NO₅. NO₂ is facilitated by oxidation of NO to more water soluble species, including NO₅,N₂O₅,N₂O₆,HNO₂ and HNO₃. A typical catalytic reduction of NO in stack gas involves methane:

$$\text{CH}_4 + 4\text{NO} \rightarrow 2\text{N}_2 + \text{CO}_2 + \text{H}_2\text{O}$$

Production of undesirable by-products is a major concern in these processes. For example, sulphurdioxide reacts with carbonmonoxse to reduce NO to produce toxic carbonyl sulphide (COS):

$$\text{SO}_2 + 3\text{CO} \rightarrow 2\text{CO}_2 + \text{COS}$$

Most sorption process have been armed at the simultaneous removal of both nitrogen oxides and sulphur oxides. Sulphuric acid solutions or alkaline scrubbing solutions containing Ca (OH)₂ or Mg(OH)₂ may be used. The species N₂O₅ produced by the reaction NO₂ + NO is most efficiently absorbed. Therefore, since NO is the primary combustion product, the introduction of NO₂ into the flue gas is required to produce the N₂O₅, which is absorbed efficiently.

Photochemical smog formation

Photochemical smog is formed from the reaction of NO₂ with light and the ultimate formation of ozone when the atomic oxygen formed in the process reacts with molecular oxygen. Ozone (O₃) is not emitted as such from a source and is considered a secondary pollutant. So the sequence of reaction shows how gases leading to photochemical smog are formed.

$$\text{NO}_2 \rightarrow \text{NO} + \text{O}$$
$$\text{O} + \text{O}_2 \rightarrow \text{O}_3$$
$$\text{O}_3 + \text{NO} \rightarrow \text{N}_2 + \text{O}_2$$
$$\text{HCO}_x \rightarrow \text{peroxyacetyl nitrates}$$

In the sequence, ozone in turn reacts with hydrocarbons to form a series of compounds, which includes aldehydes, ketones, organic acid sand epoxy compounds.

Formation of acid rain

Acid rain is one of the problems arising from
the discharge of gaseous or vapours substances in to the atmosphere. Some substances involved in acid rain formation are discussed here:

**Sulphur dioxide:** Sulphur dioxide forms by oxidation of sulphur during combustion.

\[ \text{S(s)} + \text{O}_2 (g) \rightarrow \text{SO}_2 (g) \]

Sulphur trioxide \((\text{SO}_3)\) forms through the atmospheric oxidation of \(\text{SO}_2\) by ozone or by oxygen in a reaction catalysed by dust.

\[ \text{SO}_2 (g) + \text{O}_3 (g) \rightarrow \text{SO}_3 (g) + \text{O}_2 (g) \]

\[ 2\text{SO}_2 (g) + \text{O}_2 (g) \rightarrow 2\text{SO}_3 (g) \]

Sulphur trioxide forms sulphuric acid \((\text{H}_2\text{SO}_4)\) in the contact with water.

\[ \text{SO}_3 (g) + \text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{SO}_4(l) \]

**Nitrogen oxides** form in the reaction of \(\text{N}_2\) in air. Rain water converts \(\text{NO}_x\) to \(\text{HNO}_2\) and \(\text{HNO}_3\).

\[ 2\text{NO}_2 (g) + \text{H}_2\text{O} \rightarrow \text{HNO}_2(l) + \text{HNO}_3(l) \] [2].

**Effects of acid rain**

Every year acid rain causes hundred of million dollars worth of damage to stone building and status throughout the world. The term “stone leprosy” is used by some environmental chemists to describe the corrosion of stone by acid rain.

Acid rain is also toxic to vegetation and aquatic life. Many well documented cases show dramatically how acid rain has destroyed agricultural and forest lands and kill aquatic organisms.

**The greenhouse effect**

Although carbon dioxide is only a trace gas in the earth’s atmosphere, with concentration of about 0.033% by volume, it plays a critical role in controlling our climate. The so-called green house effect describe the trapping of heat near earth surface by gas in the atmosphere particularly carbon dioxide acts some what like a glass roof, except that he temperature rise in the greenhouse is due mainly to restricted air circulation inside. Calculations show that if the atmosphere did not contain carbon monoxide, earth would be 30°C cooler!

**Depletion of ozone layer**

Ozone in the stratosphere prevents UV radiation emitted by the sun from reaching earth’s surface. The formation of ozone in this region begins with the photo dissociation of oxygen molecules by solar radiation at wavelengths below 240nm:

\[ \text{O}_2 \text{ UV, 240nm} \rightarrow \text{O} + \text{O} \]

The highly reactive \(\text{O}\) atoms combine with oxygen molecules to form ozone as follows:

\[ \text{O} + \text{O}_2 + \text{M} \rightarrow \text{O}_3 + \text{M} \]

Where \(\text{M}\) is inert substance such as \(\text{N}_2\)

**Effects of \text{co}_2\text{ on man**

Carbon dioxide is a product of combustion. In the presence of an abundant supply of oxygen, \(\text{CO}_2\) is formed. Carbon dioxide is not a toxic gas, but it does have an asphyxiating effect. In airtight buildings, the concentration of \(\text{CO}_2\) can reach as high as 2000ppm by volume. Workers exposed to high concentrations of \(\text{CO}_2\) in skyscrapers and other sealed environments become fatigued more easily and have difficulty concentrating [10].

**Effects of deforestation**

Deforestation is the process of converting forested lands into non-forest sites that are ideal for crop raising, urbanization and industrialization. Because deforestation is a serious concept, there are also serious effects to the surroundings. Effects of deforestation can be classified and grouped into effects to biodiversity, environment and social settings. Because deforestation basically involves killing trees in forests, there are so many effects that can be enumerated as results of the activity.

Pollution is rapidly growing along with population. Forests are greatly helping reduce the amount of pollutants in the air. So, the depletion of these groups of trees is greatly increasing the risk that carbon monoxide would reach the atmosphere and result in the depletion of the ozone layer, which in turn results to global warming.

**Environmental change:**

One major effect of deforestation is climate change. Changes to the surroundings done by deforestation work in many ways. One, there is abrupt change in temperatures in the nearby areas. Forests naturally cool down because they help retain moisture in the air [11].

**Global climate change:**

As mentioned above, deforestation has been found to contribute to global warming or that process when climates around the world become warmer as more harmful rays of the sun comes in through the atmosphere.
**Water table underneath the ground:**

Water table is the common source of natural drinking water by people living around forests. Water table is replenishing. That means, the supply of water underground could also dry up if not replenished regularly. When there is rain, forests hold much of the rainfall to the soil through their roots. Thus, water sinks in deeper to the ground, and eventually replenishing the supply of water in the water table. Now, imagine what happens when there is not enough forests anymore. Water from rain would simply flow through the soil surface and not be retained by the soil.

Or other than that, the water from rain would not stay in the soil longer, for the process of evaporation would immediately set in. Thus, the water table is not replenished, leading to drying up of wells.

**Effect to biodiversity:**

Forests are natural habitats to many types of animals and organisms. That is why, when there is deforestation, many animals are left without shelters. Those that manage to go through the flat lands and residential sites are then killed by people [11].

**Quantification**

NO$_2$ gas in concentrations of 25 - 250ppm inhibits plant growth and cause defoliation. At 0.3 - 0.5ppm, it also inhibits tomato and bean seedling if applied continuously for 10 - 20days. In concentration of 3ppm for one hour, NO$_2$ causes bronchi constriction in man, and short exposure at high levels of about 150-220ppm produces changes in the lungs which may be fatal.

Exposure to 0.3-1ppm of O$_3$ for 15mins to 2hours can cause respiratory irritation, choking, coughing and severe fatigue. At level of 0.2-0.5ppm cause a decrease in night vision [12].

**Transport of biomass smoke to the upper troposphere by deep convection**

Vegetation fires, particularly in the tropics, are major source of atmospheric pollution, affecting large areas of the globe. Most fires occur in the dry tropics, where large scale subsidence prevent deep convection associated rainfall, and thus allows the vegetation to become dry enough to burn. Since deep convection, which is needed to transport smoke to the upper troposphere, also produces rainfall and thus precludes fires, it was often assumed the lower troposphere. However, observation showed large amounts of pollutants such as CO and O$_3$ in the upper troposphere over the tropics [13, 14] which could only be explained as resulting from vegetation fires. Loffing of the smoke to upper troposphere may be taking place in episodic frontal convective events [15].

A more general mechanism was proposed to explain the transport of smoke, to high altitudes, which entailed transport by the trade wind circulation towards the ITCZ followed by convective transport to the middle and upper troposphere [16].

**Convective transport of biomass burning smoke**

Biomass smoke is an important contribution to the chemical dynamics in the upper troposphere. Long-range transport of biomass smoke reaches even the most remote regions of the troposphere, as shown by measurements over the tropical and south pacific [17]. Since net upward motion across the tropopause takes place in the tropics, some of the biomass burning effluents may even reach into the stratosphere [18].

**Control and monitoring techniques for environmental pollutants**

Air pollution control programmes and regulatory approaches include;

- Equipment standards based on design or operating parameters for the control of numerous sources
- Effect standards based on concentrations in ambient air, vegetation, relating to man’s health or welfare.
- Emission standards based on mass emitted, concentration or plume visibility, related to pollutant type, size of source, topography etc [19].

Monitoring is a systematic observations of parameter related to a specific problem, designed to provide information on the characteristics of the problem and their changes with time. The chemical method of monitoring is used in monitoring sulphates and nitrates by collecting particles on polystyrene fiber filters, the filters are extracted and the extracts analysed using colorimetric techniques. [20].

**Conclusion**

The issue of bushfire (wildfire) appears as a central theme in this report because bush burning is one of the challenging 'man versus environment' conflicts. Burning is embedded in the cultural values and traditional farming systems of some people. The effects of bushfire on rural livelihoods and on the ecosystem are increasingly becoming extensive and damaging. However, it has been difficult to reduce or completely eliminate bushfires.

The difficulties of eliminating bushfires completely means that there is need for a clear understanding of the causes and effects of bushfires.
so that bushfire policies can address the undesirable effects with respect to forestry, arable agriculture, rangeland, soil conservation and wildlife.

Also, Education and community awareness material needs to focus especially on the threat to the environment and property of inappropriate use of fire, particularly burning which is too frequent, extensive in area, of excessive intensity, badly timed or carelessly implemented [21].

References