

Lesson Plan 11: Indoor Air Pollution



Lesson Description



This lesson focuses on describing indoor air pollution, main causes of air pollution inside house. This lesson plan also discuss impacts of indoor air pollution and identifies the 4 possible solutions to mitigate the indoor air pollution.

Learning Outcomes

By the end of this session, participants will be able to:



1. Describe Indoor air pollution and its impacts.
2. Identify appropriate ways to mitigate Indoor air pollution mitigation (impact reduction)



Materials

- Brown sheet paper
- Permanent markers
- Meta cards
- Sticky Note
- Masking tape
- Push pin
- Picture of proper kitchen
- Projector
- Computer



Preparation

- Write the session Learning Expectations on flipchart paper
- Write four major Impact of IAP in meta-card in four different color.
- Write four major mitigation for indoor air pollution
- Prepare Power Points (Pictures of traditional kitchen with stove, Impacts and Mitigation of IAP)

Introduction

5 minutes



1. Show the power-point presentation of traditional cooking stove and rural kitchen to all participates.
2. Say them to close their eyes and imagine them that if you had to cook on that kitchen how would you feel?
3. Ask two to three participants to express their feelings.
4. Link if it feels good or bad to cook in the environment.
5. Present learning outcomes of session.

Indoor Air Pollution

10 minutes



1. Ask participants to find a pair and ask them to discuss, what is Indoor Air Pollution?
2. Ask some pair to share their views and note down the major points on newsprints. Discuss further summarizing the points and adding information if missed any.



Trainer Note: Indoor air pollution is a term which refers to the air quality or air pollution within and around buildings and structures, especially as it relates to the health and comfort of building occupants. Indoor air pollutants can be gases like

carbon monoxide, radon, volatile organic compounds, particulates, microbial contaminants like mold and bacterial or any mass or energy stressor. IAP does not always mean the smoke or pollutants from the kitchen only but also include the smoke induced by generator, heater, smoking, etc.

Source control, filtration and the use of ventilation to dilute contaminants are the primary methods for improving indoor air quality in most buildings. Residential units can further improve indoor air quality by routine cleaning of carpets and rugs.

Around 3 billion people cook and heat their homes using solid fuels (**i.e. wood, charcoal, coal, dung, crop wastes**) on **open fires or traditional stoves**. Such inefficient **cooking and heating practices** produce high levels of household (indoor) air pollution which includes a range of **health damaging pollutants** such as fine particles and carbon monoxide.



In Nepal Every Year 7500 people die due to Indoor Air Pollution

Daily cooking in firewood is equal to smoke a package (20 sticks) of cigarette

In poorly ventilated dwellings, smoke in and around the home can exceed acceptable levels for fine particles 100-fold. Exposure is particularly high among women and young children, who spend the most time near the domestic hearth.



Impact of Indoor Air Pollution

20 minutes

1. Provide each participant one meta-card and say them to write impact of Indoor Air Pollution.
2. Collect the meta-card and pin all cards in the board basically in four categories.
3. Present power points with the picture of traditional kitchen with stove and impacts of indoor air pollution
 - Health impact: diseases - ARI (pneumonia, eye disease,);
 - Gender Issues: Lost of time collecting firewood, gender violence during firewood collection, washing black pots,
 - Education impact: Late to reach school, Absentees in school, Drop out, Difficulty to do assignment in smoky room, etc.
 - Environment: Deforestation, landslide, climate change
 - Economy: Waste of time low investment in productive work, medical treatment for health problem.

Mitigation for Indoor Air Pollution

30 minutes



1. Ask all participants to remember the kitchen which was shown in introduction, ask them to think what they would like to improve in same kitchen for easy and clean kitchen and write it on sticky note.
2. Provide 3 minutes as think time.
3. Present the major four things need to be changed to decrease the impact of Indoor Air Pollution using power-point presentation.
 - Change kitchen
 - Change stoves
 - Change fuel
 - Change behaviors
4. Ask participant's to pin that sticky note where their points falls and why??



Trainer Note: Concluding the points describe the following points if missing from participants by showing the pictures in power points.

- Proper kitchen (L and T shape: water, waste, drainage, caution) - cooking stoves, utensils, water, fuel etc; (pic)
 - Cross ventilation- for *khar* as per wind flow,
 - bright/ enough light;
 - prioritize kitchen among other rooms in houses,
 - Raise stoves above (so that the smoke does not effect eye)
- ICS- change stoves (Present the power points)
 - What is ICS?
 - Types of ICS
- Fuel
 - Types of fuel consumption
 - As per decreasing rate of air pollution: **Guitha and/ or fodder**- being high rate of smoke, **Daura** (woods), **Kerosene**, **gas** and **electrical appliances**

Trainer notes: Alphabets and numbers in LPG gas container indicates the expiry date of the container. Like ABCD indicates the quarter of a year (months) and the number indicates year. Ex. A represents: Jan, Feb and Mar; B represents: Apr, May, Jun; C represents: Jul, Aug, Sep; D represents: Oct, Nov and Dec

- Behavior
 - Preparation time, dry wood, fuel consumption- e.g., soaking pulses before cooking, taking out food from fridge before)

Review

5 minutes



1. Ask participants to make a group of three and near them and ask them to share about impacts of IAP.
2. Ask participants to discuss in same group, which mitigation of IAP is easier to change in daily life and which is hardest.

Reflections on Lesson

Trainer Reference

1. What is indoor air pollution- definition

Indoor air pollution is a term which refers to the air quality or air pollution within and around buildings and structures, especially as it relates to the health and comfort of building occupants. Indoor air pollutants can be gases like carbon monoxide, radon, volatile organic compounds, particulates, microbial contaminants like mold and bacterial or any mass or energy stressor. IAP does not always mean the smoke or pollutants from the kitchen only but also include the smoke induced by generator, heater, smoking etc.

Source control, filtration and the use of ventilation to dilute contaminants are the primary methods for improving indoor air quality in most buildings. Residential units can further improve indoor air quality by routine cleaning of carpets and rugs.

2. Why do we need to discuss about indoor air pollution, what are the impacts of air pollution

Cooking and heating with solid fuels (wood, charcoal, crop waste, dung, and coal) produces high levels of smoke in and around the home that contains a variety of health-damaging pollutants.

Health Impacts

Globally, 4.3 million deaths were attributable to household air pollution (HAP) in 2012, almost all in low and middle income (LMI) countries. The South East Asian and Western Pacific regions bear most of the burden with 1.69 and 1.62 million deaths, respectively. Almost 600'000 deaths occur in Africa, 200'000 in the Eastern Mediterranean region, 99'000 in Europe and 81'000 in the Americas. The remaining 19'000 deaths occur in high income countries.

http://www.who.int/phe/health_topics/outdoorair/databases/HAP_BoD_results_March2014.pdf?ua=1

Acute lower respiratory infections

There is substantial evidence that exposure to smoke from the use of solid fuels in the home increases the risk of acute lower respiratory infections (ALRI) in young children, particularly pneumonia. Exposure to household air pollution accounts for more than half of deaths to childhood pneumonia in children under five years of age.

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is a progressive and incompletely reversible airflow obstruction. There is a substantial body of evidence showing that household air pollution is an important risk factor for such disease (and possibly the most important cause of COPD in non-smoking populations).

Lung cancer

Smoke from both coal and biomass contains substantial amounts of carcinogens (chemical substances known to increase the risk of cancer). A consistent body of evidence shows that individuals exposed to smoke from biomass and coal fires in the home have an elevated risk of lung cancer.

Cardiovascular Disease

Particulate matter is a health-damaging pollutant common to air pollution from different combustion sources including ambient air pollution, second-hand smoke and active smoking. Recent epidemiological evidence from these combustion sources estimates the risk and mortality for ischemic heart disease and stroke. These estimates have been applied to similar combustion sources from household energy use, to generate mortality estimates of ischemic heart disease and strokes from household indoor air pollution.

Cataract

Cataract is the main cause of blindness of the adult population in developing countries. An increasing number of epidemiological studies and toxicological evidence provide good evidence that household solid fuel use for cooking is associated with cataract formation, especially among women.

Burns & poisonings

Fire-related burns from fuel use in low and middle income homes are an important cause of death, especially among children. Deaths are only part of the problem - for every child and adult person who dies from burns, many more are left with lifelong disabilities and disfigurements. A high proportion of these burns and scalds results from the dangers posed to children and women by solid fuel and kerosene stoves which are often located at floor level in poorly lit kitchens increasing the safety risk.

Poisoning is another previously underestimated health risk, which is posed by the unintentional ingestion of kerosene, particularly among young children. In low and middle-income countries kerosene is commonly bought and stored in soft drink or milk bottles, which explains this health risk and the need to protect children from this hazard.

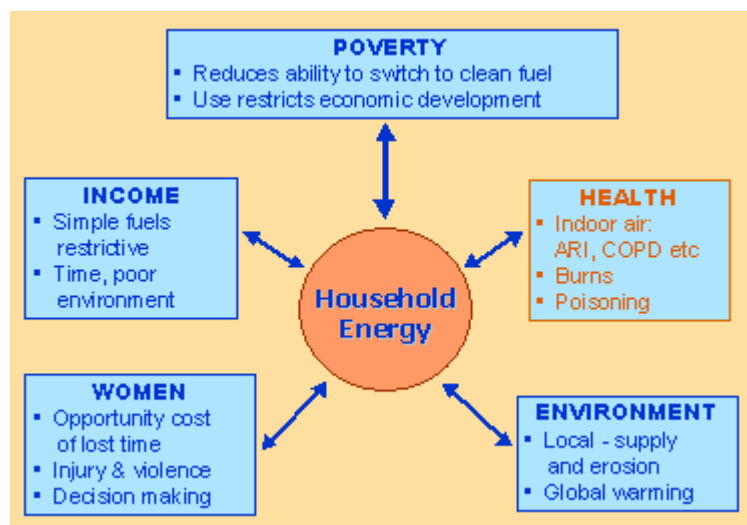
Other health outcomes

There is emerging evidence which suggests that household air pollution in developing countries may also increase the risk of other important child and adult health problems, although this evidence is tentative and based on fewer studies. It includes conditions such as:

- low birth weight and perinatal mortality (still births and deaths in the first week of life)
- asthma
- otitis media (middle ear infection) and other acute upper respiratory infections
- tuberculosis
- nasopharyngeal cancer
- laryngeal cancer
- cervical cancer

http://www.who.int/indoorair/health_impacts/disease/en/

Broader impacts of household energy



ARI: Acute Respiratory Infections

COPD: Chronic Obstructive Pulmonary Disease

Household energy and poverty

Dependence on polluting and inefficient household fuels and appliances is both a cause and a result of poverty:

Poor households often do not have the resources to obtain cleaner, more efficient fuels and appliances. Conversely, reliance on inefficient household fuels and appliances limits the time available for income generation, schooling and other opportunities for economic development, creating a vicious cycle of poverty and reliance on polluting, inefficient fuels.

For example, households reliant on traditional biomass fuels often spend many hours a day on fuel collection and thus have less time available for other essential tasks. Similarly, households with limited or no access to a clean and reliable source of lighting (e.g. electricity) can lose opportunities for educational and income-generating activities outside of daylight hours.

Gender issues

In most developing countries, it is women who carry out household tasks related to cooking and heating the home. Women are therefore particularly affected by smoke in the home as well as the time loss due to fuel collection and stove tending. However, in many homes, men appear to have more decision-making power and household energy needs may be given lower priority than women would wish.

Environmental Impacts

Deforestation

The reliance on wood as a household fuel can put considerable pressure on forests, particularly in areas where fuel wood is scarce and the demand for wood outweighs natural re-growth. Unsustainable wood harvesting can lead to forest degradation which may result in a consequent loss of habitat and biodiversity.

Climate change

Simple biomass and coal stoves used in most low and middle income country homes typically are inefficient. As a result, a large percentage of the energy when burning

these fuels is lost as products of incomplete combustion. These products of incomplete combustion include powerful short-lived pollutants such as a black carbon and methane, which significantly contribute to climate change.

<http://www.who.int/indoorair/impacts/en/>

What can be done to minimize the effects ?

Interventions on the source of pollution

Alternative fuels

The largest reductions in indoor air pollution can be achieved by switching from solid fuels (biomass, coal) to cleaner and more efficient fuels and energy technologies such as:

- liquidified petroleum gas (LPG)
- biogas
- producer gas
- electricity
- solar power

Improved stoves

In poor, rural communities where access to alternative fuels is very limited and biomass remains the most practical fuel, pollution levels can be lowered significantly by using improved stoves. These stoves, provided they are adequately designed, installed and maintained, are effective in reducing smoke because of better combustion, lower emission levels and potentially also shorter cooking times.

Interventions to the living environment

Improved ventilation of the cooking and living area can contribute significantly to reducing exposure to smoke. There are a number of ways to achieve better ventilation of the living environment including:

- chimneys
- smoke hoods (with flues)
- eaves spaces
- enlarged and repositioned windows (cooking window)

User behavior

Changes in user behavior can also play a role in reducing pollution and exposure levels. For example, drying fuel wood before use improves combustion and decreases smoke production. Keeping young children away from smoke reduces exposure of this most vulnerable age group to health-damaging pollutants.

Such changes in user behavior are unlikely to bring about reductions as large as those expected from a fuel switch or the installation of a hood or chimney. However, they should be seen as important supporting measures for other interventions.

Change in kitchen

Use of vertical and horizontal space of kitchen for optimal use of space, comfortable movement, easiness, etc

Improved Cooking Stoves

Improved cook stove (ICS) is a device that is designed to improve combustion efficiency of biomass, consume less fuel, save cooking time, convenient in cooking process and creates

smokeless environment in the kitchen or reduction in the volume of smoke produced during cooking against the traditional stove.

Alternative Energy Promotion Centre (AEPC) promotes both mud-brick and metallic ICS. Metallic ICS is for High Mountain and Hilly region (above 2,000m.) and Mud-brick ICS is for Terai region.

Several types of ICS are now available in Nepal. Among these the most common are the mud-brick which are simple, low cost and can be built by using locally available materials. Various models of mud-brick ICS have been developed and promoted in Nepal. Among these, the two pothole stove and tagari rocket stove are the most popular.

Metal Stoves and Gasifiers have also been introduced and are gaining popularity. These stoves are generally more efficient but comparatively more expensive than mud-brick ICS. The metal stove can be useful where space heating is also required.

Benefits of Improved Cooking Stoves

Impact on environment

- Fuel wood consumption reduced by about half.
- 30 to 90 percent reduction in indoor air pollution.
- Reduction in greenhouse gas emissions by about 2.5 ton CO₂ per year stove

Impact on health

- Fewer respiratory disease, particularly lower respiratory infections such as pneumonia among children and chronic obstructive pulmonary disease (COPD) among women.
- Fewer eye problems as well as other health problems such as headaches.
- Reduced fire hazard in the kitchen.

Impact on gender

- Reduced drudgery of women as they spend less time collecting fuel wood, cooking and washing dishes.
- Improved Health of women due to reduced exposure to smoke.
- Increased participation by men in kitchen work because of clean environment.

http://www.aepc.gov.np/?option=renewable&page=biomassics&mid=2&sub_id=15&sid=12&cat=Improved%20Cooking%20Stoves

Mud ICS

Introduction

Improved cook stoves (ICS) particularly mud-brick ICS with and without chimney is one of the most simple, inexpensive and widely used technologies designed to improve combustion efficiency of biomass and reduce exposure to indoor air pollution.

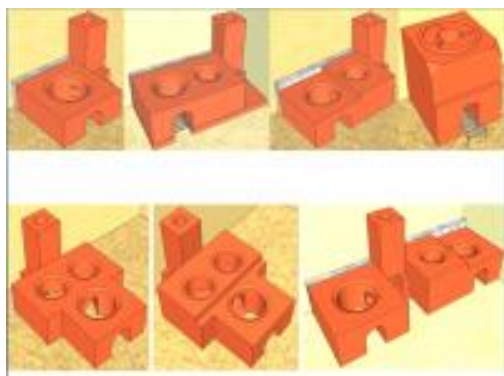
The benefits of ICS includes: increased thermal efficiency, conservation of forests by reducing fuel wood consumption, reduction in women's' drudgery, reduction in indoor air pollution and hence smoke-related health disorders, and prevention of fire hazards.



Traditional stoves used in Nepal are simple structures made from clay or having stone or metal tripods. These stoves are very inefficient because they have poor air flow and insulation. As a result, they consume a lot of biomass and produce high levels of indoor air pollution.

ICS was introduced in Nepal in 1950s and continues to be relevant in the present context. AEPC/NRREP, together with other government, non-government and private organizations, is involved in developing and promoting different types of ICS in Nepal and so far more than 700,000 improved cook stoves have been installed in 63 districts

ICS Models



http://www.aepc.gov.np/?option=renewable&page=biomassics&mid=2&sub_id=15&ssid=12&cat=Mud%20ICS

Metallic ICS

Introduction

Biomass is the primary fuel of the country. Various types of mud and metallic improved cooking stoves have great scope to replace the traditional cooking stoves that burn fire wood for cooking and heating. Alternative Energy Promotion Centre (AEPC) has been promoting Metallic Improved Cooking Stoves (MICS) since 2009 under Biomass Energy Support Programme. The main objective of this programme is to address dual purpose of simultaneous



Cooking as well as Space heating need of people living in remote high hills of Nepal. The target beneficiary of MICS is very remote places, above 1500m, from sea level. The Dissemination has been carried out through the Pre-qualified manufacturer and installer companies with government subsidy. This subsidy is just a quality assurance discount for these beneficiaries that do not cover entire cost.

The programme has disseminated more than 10,500 MICS with disbursement of subsidy till June 2013 covering high hill region of 39 districts. AEPC has been implementing National Rural and Renewable Energy Programme (NRREP) form July 2013. NRREP has targeted 475,000 ICS disseminate in rural area of Nepal, among the target 35,000 is Metallic Improved Cooking stove (MICS).

MICS Models



In the beginning BESP has promoted three pot hole metallic stoves with water tank, developed through technical support from Kathmandu University. This model was targeted for high hills where ICS is needed for cooking and space heating. Especially Water tank is used to tap waste heat from MICS body. Furthermore, other MICS model is identified and modifications on existing model were done with the learning & feedback provided by users, manufactures, installer and other stakeholders.

At the moment AEPC is promoting three models of MICS as following:

- Three pot hole with water tank
- Three pot hole with grate & ash tray
- Two pot hole with grate & ash tray

http://www.aepc.gov.np/?option=renewable&page=biomassics&mid=2&sub_id=15&ssid=12&cat=Metallic%20ICS

Institutional Improved Cooking Stoves

Introduction

Institutional Improved Cooking Stoves are used in hotels, hospitals, hostels, barracks, teashops, restaurants, small scale industries like wool dyeing, daalmoth (snacks) factory etc. IICS can be used for heating water with some modification like joining back-boiler or running metal pipes inside its body.



BESC with technical assistance from Kathmandu University had finalized three different models of large size IICS which requires different metallic components for reinforcement. Later, the household ICS have also been installed with proper reinforcement at vital parts as well as scaling up the size as per need. These stoves have been widely used in the local teashops of the rural villages.

A pilot project was also conducted in Malekhu Bazar, one of the busiest local markets on the national highway. This project was specially focused on the installation of the IICS with chimney in the hotels, tea shops located along the Malekhu Bazar area. The project was very successful.

Furthermore, the recently promoted IICS technology is based on the rocket principle and is comparatively affordable than the previous models due to less reinforcement and space requirements and user's

claim that it saves a lot of money by saving the expensive fuel wood up to 40 to 50%. It is also easy to use and reduces cooking time significantly. These days IICS based on rocket technologies and those up-scaled are more popular.

So far, AEPC have been able to declare 2 IICS clusters as IAP FREE in Bara and Rautahat districts and few others are ready to be declared.

http://www.aepc.gov.np/?option=renewable&page=biomassics&mid=2&sub_id=15&ssid=12&cat=Institutional%20ICS

Rocket Stoves

Introduction

A rocket stove is an efficient cooking stove using small diameter wood fuel which is burned in a simple high-temperature combustion chamber containing an insulated vertical elbo which ensures complete combustion prior to the flames reaching the cooking surface.



A rocket stove achieves efficient combustion of the fuel at a high temperature by ensuring a good air draft into the fire, controlled use of fuel, complete combustion of volatiles, and efficient use of the resultant heat. It has been used for cooking purposes in many energy poor locales as well as for space and water heating.

BESC has developed portable mud rocket stoves suitable for house hold use in Terai settlements. The sole purpose of this model is to cater the users who cook inside as well as outside their house.

Further, BESC has disseminated these newly developed portable mud rocket stoves in the labor settlement inside the Brick Kilns of Kathmandu Valley & Jhapa district as well as in Veneer Industry in Jhapa district.

Benefits

- Low cost
- Fuel efficient
- Easy to transport
- Locally built able
- Accepted technology, particularly in Terai

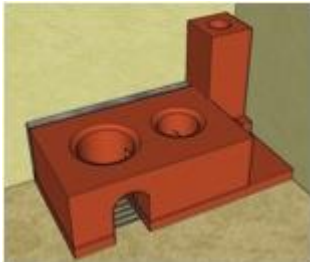
http://www.aepc.gov.np/?option=renewable&page=biomassics&mid=2&sub_id=15&ssid=12&cat=Rocket%20Stoves

Benefits of ICS

Impact on Environment

Fuel wood consumption reduced by about half

- 30 to 90 percent reduction in indoor air pollution
- Reduction in greenhouse gas emissions by about 2.5 ton carbon dioxide per year per stove



2 pot plain mud-brick ICS



Institutional ICS



Metallic ICS

Impact on Health

- Fewer respiratory disease, particularly lower respiratory infections such as pneumonia among children and Chronic Obstructive Pulmonary Disease (COPD) among women
- Fewer eye problems as well as other health problems such as headache
- Reduced fire hazard in the kitchen

Impact on Gender

- Reduced drudgery of women as they spend less time collecting firewood, cooking and washing dishes
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http://www.aepc.gov.np/old/index.php?option=com_content&view=category&layout=blog&id=73&Itemid=94

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