# Indoor Air Quality in Asian Countries

**The rapid growth in economic development, urban population, transport and energy use in Asian countries has resulted in environmental degradation. In particular urban air pollution has emerged as significant threat to public health. A recent air quality management assessment, conducted by Clean Air Initiatives for Asian cities (CAI-Asia, 2010), has identified a small improvement in air quality but the levels of $PM_{10}$ and $SO_2$ are still higher than World Health Organisation air quality guidelines. Out of 230 Asian cities, 58% had annual $PM_{10}$ levels exceeding the WHO Interim Target-1 (70 μg/m³) and only 2 cities had annual $PM_{10}$ concentrations within the WHO air quality guidelines.**

*"The reduction in indoor air pollution due to combustion can contribute significantly to improve health, especially of women and young children."*

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Consequently considerable, attention has been paid to air quality management in Asian cities. Air pollution is often assumed as an urban and ambient issue and indoor air pollution is therefore considered beyond the scope of urban air quality management. However exposure to various pollutants can be far greater indoors. This is particularly important in many Asian countries due to the use of solid fuels as a domestic energy source. In low income countries household fuel use is the main source of indoor air pollution while in middle income countries non-combustion sources are important. When clean household fuels are used environmental tobacco smoke, various gaseous pollutants, bio-aerosols and volatile or semi-volatile chemicals emitted from materials are main indoor air quality concerns. Consequently, indoor air quality in offices, public facilities and underground transport has gained considerable attention in rapidly developing Asian countries. The control and management of indoor air quality is a complex issue due to great variation in different indoor micro-environments. However, in many public facilities the regulation of indoor air quality is relatively easy. In Asian countries, Korea and Japan have formulated indoor air quality standards.

More than half the world's population rely on wood, dung, coal or agricultural residues for household energy needs. The use of these fuels in simple stoves or open fires, under limited ventilation, leads to substantially higher levels of indoor air pollutants. Exposure to these pollutants is higher among women and children who spend more time indoors. There is strong evidence linking indoor air pollution with pneumonia and other acute lower respiratory infections among children under five years of age, and chronic obstructive pulmonary disease and lung cancer among adults (WHO, 2007). Indoor smoke from solid fuel is responsible for 2 million deaths, out of which 65% occur in low income countries and 35% in middle income countries. Worldwide it causes about 21% of lower respiratory infection deaths, 35% of chronic obstructive pulmonary deaths and about 3% of lung cancer deaths. Of these deaths, about 64% occur in low-income countries, especially in South-East Asia and Africa (WHO, 2009a).

In Asia a vast proportion of population depend on solid fuels for cooking and heating. Table 1 shows the percentage of population using solid fuels and WHO estimated deaths & DALYs attributable to indoor air pollution in Asian countries. One DALY can be thought of as one lost year of "healthy" life. Indoor air pollution is responsible for over 1.3 million deaths per year in Asia. Of these almost half of the deaths occur in South Asia followed by North East Asia (41%), mainly in China. The worst hit countries are China, India, Pakistan, Afghanistan, Bangladesh, and Indonesia.

Alongside the health impacts, biomass usage contributes to climate change and loss or depletion of many ecosystem services. Many papers have been published on indoor air quality in Asian countries from both urban and rural areas. These studies have mainly focused on the mass concentration of particulate matter in either the $PM_{10}$ or $PM_{2.5}$ size fraction; measurements of number concentration are rare. The results of these studies have highlighted that the levels of particulate matter are many times higher than WHO guidelines, especially in the households using solid fuels for cooking and heating. A recent study on indoor air quality in Pakistan (Colbeck et al., 2010) has revealed that 24 hour

| Region/ Country | Population (000) | Population using solid fuel (%) | Deaths per year | DALYs /1000 capita per year |
|---|---|---|---|---|
| **Central Asia** | | | | |
| Kazakhstan | 15107 | <5 | 100 | 0.2 |
| Kyrgyzstan | 5153 | 76 | 2,100 | 9 |
| Turkmenistan | 4766 | <5 | - | 0.1 |
| Uzbekistan | 26209 | 72 | 6,200 | 7 |
| Tajikistan | 6467 | 75 | 3,300 | 17 |
| **North East Asia** | | | | |
| China | 1304983 | 80 | 548,900 | 3.2 |
| Mongolia | 2557 | 51 | 300 | 3.2 |
| Republic of Korea | 47684 | <5 | - | - |
| Japan | 127798 | <5 | - | - |
| **South Asia** | | | | |
| Afghanistan | 24076 | >95 | 54,000 | 78 |
| Bangladesh | 150528 | 89 | 49,400 | 8 |
| Bhutan | 623 | 67 | 200 | 7 |
| India | 1116985 | 82 | 488,200 | 8 |
| Maldives | 291 | 43 | <100 | 1.6 |
| Nepal | 26554 | 81 | 8,700 | 8 |
| Pakistan | 155333 | 81 | 56,100 | 9 |
| Sri Lanka | 19040 | 67 | 4,300 | 3.2 |
| **South East Asia** | | | | |
| Cambodia | 13720 | >95 | 6,600 | 16 |
| Indonesia | 223225 | 72 | 45,300 | 4 |
| Lao Peo.Dem.Rep. | 5574 | >95 | 2,600 | 11 |
| Malaysia | 25191 | <5 | <100 | 0.0 |
| Myanmar | 47565 | >95 | 18,100 | 9 |
| Philippines | 82868 | 45 | 7,200 | 2 |
| Singapore | 4274 | <5 | - | - |
| Thailand | 62565 | 72 | 10,500 | 1.9 |
| Vietnam | 83839 | 70 | 23,800 | 2.8 |

*Table 1. Estimated deaths & DALYs attributable to indoor air pollution in Asia (Source WHO, 2009b)*

average concentration of $PM_{10}$, $PM_{2.5}$ and $PM_1$ in rural kitchens using biomass fuels were 1581 µg/m³, 1169 µg/m³ and 913 µg/m³. A maximum hourly average of more than 8000 µg/m³ was observed. In comparison, in the living room the 24 hour averages for the same size fractions were 953 µg/m³, 603 µg/m³ and 548 µg/m³. On the other hand 24 hour concentrations at an urban site were 533 µg/m³, 402 µg/m³, 362 µg/m³. Studies on bioaerosols and other gaseous air pollutants in indoor air have also been conducted as well as measurements in offices and cars/buses.

Given the burden of disease many interventions have been carried out in the region. The best known are the Indian National Programme for Improved Chulhas (NPIC) and the Chinese National Improved Stove Program (NISP). However, NPIC was reported to be less successful than NISP. The success of NISP has been associated with extensive community participation and use of the local resources with strong administrative and technical support from the government. In cases where improved stove programmes were not successful, the lack heavy subsidy from government and local community participation and knowledge of their needs were identified as the main reasons. In late 2010 the United States announced that it was to commit $50.82 million over the following 5 years to help develop clean cook stoves. The Global Alliance for Clean Cookstoves, a public-private partnership led by the United Nations Foundation, aims to achieve its "100 by 20" target - 100 million households adopting clean cook stoves by 2020.

Although use of solid fuel as household energy source is worldwide, there are large differences in usage across the regions. A recent study on entho-environmental knowledge to combat indoor air pollution in rural communities of Pakistan carried out by Interdisciplinary Centre for Environment and Society at Essex University showed that communities, to varying extent, are aware, not only, of the health impacts of indoor air pollution but also have their own ways to reduce indoor smoke. However, they may not be using these methods due to many socio economic reasons. For a cost effective and sustainable intervention this knowledge must be utilised and, at the same time, needs, social norms and economic conditions should be taken into account.

The reduction in indoor air pollution due to combustion can contribute significantly to improve health, especially of women and young children. In addition improved cooking practices have many social, economic and environmental benefits. Consequently improved household energy practices play a crucial role in achieving the Millennium Development Goals towards reduction in children mortality, poverty eradication, gender equality and environmental sustainability.

## References


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