Air Pollution and Health in Ethiopia: Review of Literature

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1. Introduction

- **Air pollution (AP) is a problem in both the LMIC and non-LMIC settings. The sources and magnitude differ in both cases.**
- **In non-LMIC setting: AP is mainly from industrial and motor vehicle sources;**
- **AP in LMIC, mainly from HH solid fuel use (urban + rural), with emissions from motor vehicle & industries (urban)**
- **The lack of capacity and data on AP makes the LMIC rely on non-LMIC models, which may not suit the LMIC settings.**
- **Moreover, it poses difficulty to undertake studies; i.e. Health impact linked with AP magnitude to inform policy.**
- E.g. South Africa issued Air Quality Act on 1965

Intro’ #2

- **Air Pollution occurs when toxic aerosols are released in to the environment in quantities that can adversely affect health and human wellbeing.**

- **AP is a local as well as regional and global problem via trans-boundary movement of air.**
- **Ethiopia, as an emerging developing country is challenged by AP**

- **Sources can be from Indoor and /or Outdoor Environments (Natural Vs Anthropogenic; Stationary Vs Mobile)**
  - Indoor cooking, lighting or space heating
  - Industries, agricultural or construction activities
  - Motor vehicles

Intro' #3

- **The latest WHO guideline on PM pollution was updated on 2005**
- **The US EPA identify 6 criteria pollutants:**
  - **Ozone (O_3),**
  - **Particulate Matter (PM);**
  - **Nitrogen Oxides (NOx),**
  - **Carbon Monoxide (CO),**
  - **Sulfur Dioxide (SO_2), and**
  - **Lead (Pb),)**
- **$PM_{2.5}$: is the most health impacting pollutant**

Intro' …cont'd

- **Health Impacts**:
  - **ALRI,**
  - **COPD,**
  - **Asthma & Allergies,**
  - **Lung cancer,**
  - **Eye disease,**
  - **Cardiovascular problem,**

- **Regular Monitoring and Concerted Action can reduce the impact of air pollution**

- **Thus, the aim of the SANA - systematic review is to understand the levels of air pollution in Ethiopia, and identify the gaps**

2. Methods

- **The literature review used a set criteria to select the Peer-reviewed articles**
- **As literature from peer-reviewed articles is very limited, the review also included gray literature such as:**
  - **Government publications, Annual reports, Environmental Outlook Report**
- **A secondary source of qualitative data from SANA .**
- **Scope: Not included Meta-analysis; Ethiopia**

Methods…cont'd

- **Criteria for checking the quality of data, reports, and publications include:**

1. **Adherence to the principles of objectivity in the collection, processing, and dissemination;**

2. **Methodological soundness**

3. **The type of Study Design;**
   - longitudinal vs cross-sectional; prospective vs retrospective
4. **Accuracy and reliability**

5. **Ethical clearance obtained/or have no/any ethical concern;**

6. **Higher ranking for studies with ethical clearance and/or studies** which have no/any ethical concern.

3. Results

- **There is paucity of evidence on OAP as well as IAP**
- **Relatively more Studies conducted on IAP than OAP, though in few areas:**
  - ✓ **Northern** - Tigray
  - ✓ **Western** - Jimma and West Wollega
  - ✓ **Eastern** - Kebribeyah
  - ✓ **Central** - Butajira (2) and Addis Ababa (3)
- **The few outdoor air pollution studies were concentrated in Addis**

Magnitude of IAP in Ethiopia

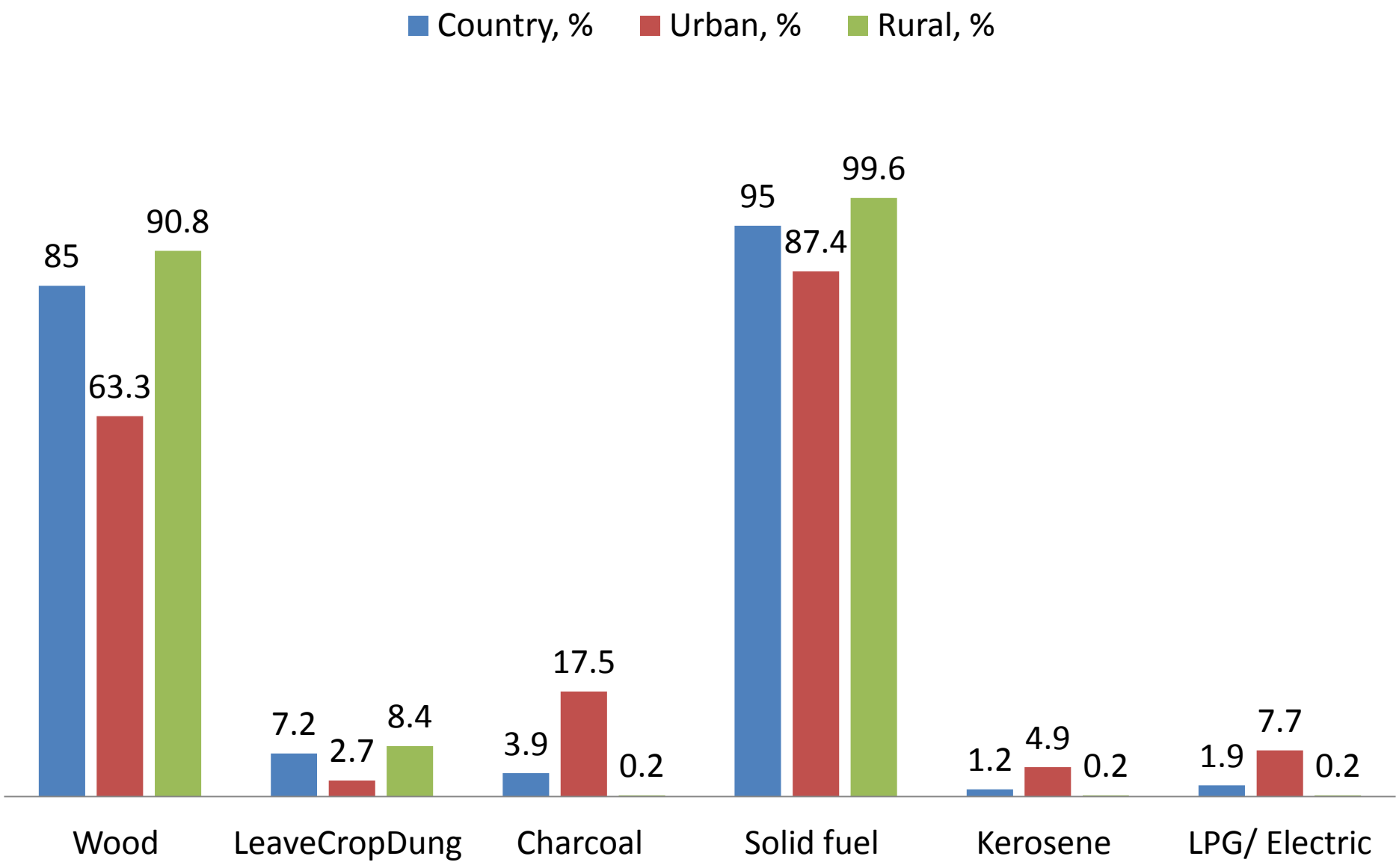
Author, Year	Study Design	Criteria pollutant Magnitude (Microg/m^3; ppb)				n	Setting
		CO (ppm) (8-hr WHO Guidel. 10ppm)	PM (10)	PM (2.5) (US EPA 24-hr 35 mu g/ cu m; WHO - 15 mu/ g/cu m)	NOx		
Kumie, A., et al. 2009	Longitudinal study				Wood =71.2, cowdung =67.5, crop res =56.1	3300	Rural
Usinger, J., 2008	UNKNOWN	X=44				11	Rural
Habtamu S. et al 2012	Comparative Cross-Sectional study			X=2417, R=483-2904		60	urban
Gaia Assoc. 2007	Exposure Assessment	Traditional=80.7, Cleancook =16.7		Traditional =2170, Cleancook =130		11	rural
Graham, Megan, 2011	Mixed method	X=16.08 R=0.66-69.65		X=1580 R=136- 12,739		69	urban
Faris, K., 2002	Cross sectional study	82.46	197			382 (18)	Rural
Keil, C., et al. 2010	Cross-sectional Study	Area samp=38 Personal=57		Area= 846 Personal= 905		10	urban
Kumie, A, et al. 2009	Longitudinal study				NO2= 97	3300	Rural
Gaia Assoc. 2007	Pre-Post Experimental design	Before=28.2 , After=6.8		Before=640, after=280		9	Urban

HH Energy Use Pattern in Ethiopia

Citations: Author & Year Type of Fuel Used for Cooking (%)	WMS, 2011*			Kumie, A. 2009	Desalegn, B. 2012	Faris, K. 2008	Senbeta, H. 2012
	Country, %	Urban, %	Rural, %	Rural, SNNPR, Butajira, %	Rural, SNNPR, Shebedino, %	Rural, Jimma, %	Urban, Addis Ababa, %
Wood	85	63.3	90.8	52.1	97.3	86	21.1
Leaves/Crop residue/ Animal dung	7.2	2.7	8.4	47.8	2	14	4.7
Charcoal	3.9	17.5	0.2	0.1	0.7	-	34.4
Solid fuel	95	87.4	99.6	99.9	100	100	60.2
Kerosene	1.2	4.9	0.2	0	-	-	18
LPG/ Electricity	1.9	7.7	0.2	0	-	-	21.8
Total	100	100	100	100	100	100	100

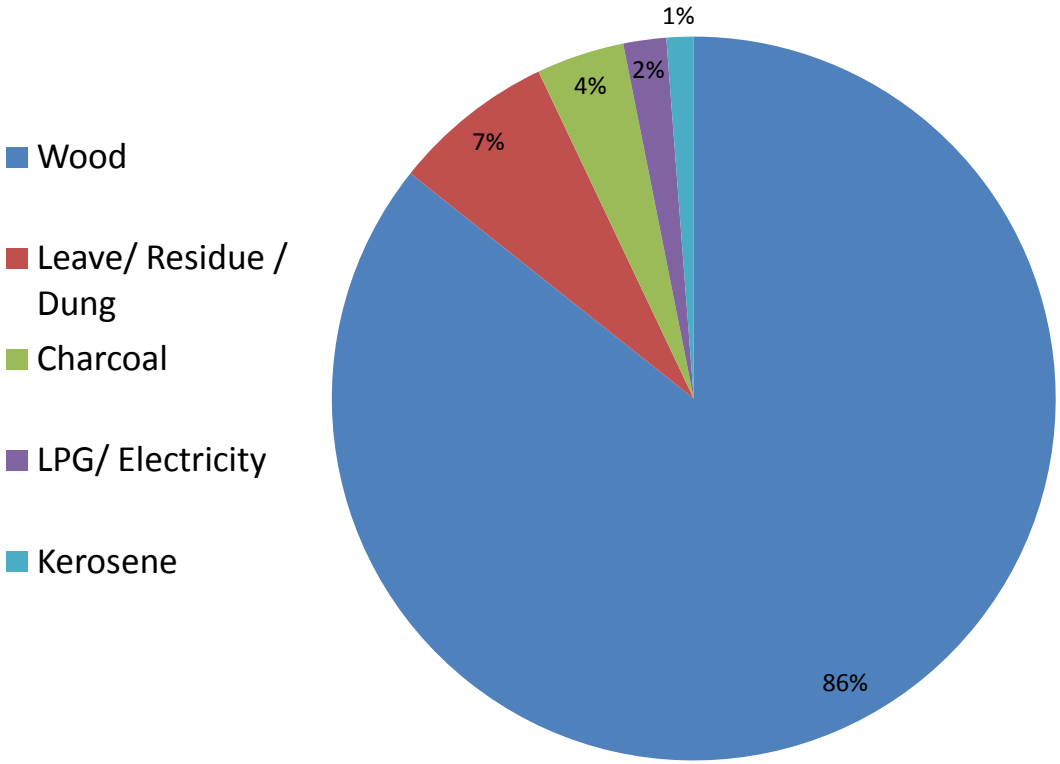
National HH Energy Use

(Source: WMS, 2011)



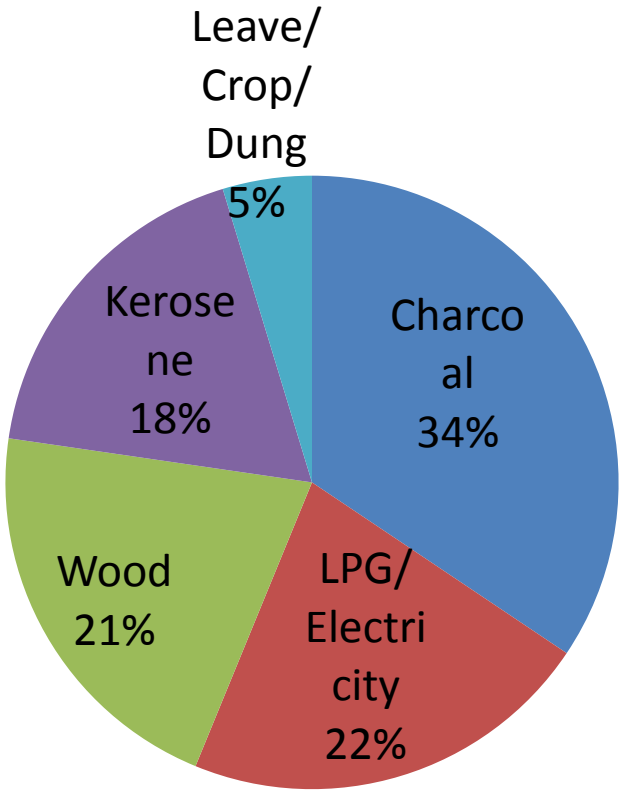
Household Energy Mix

Ethiopia
(Source: WMS, 2011)



Addis Ababa

[Habtamu S. et al. 2012]



Factors Determining Health Outcome

- **The following factors were identified:**

- Type of fuel & Cooking stoves used,
- Ventilation & Number of Rooms,
- Ecology, Weather condition & season of the year
- Frequency of fire events & N0. of Foods cooked per day
- Mothers' cigarette smoking status
- Child holding behavior while cooking

- **Children and Women are most affected groups**

Traffic-related Ambient AP

- **Only few studies** published on outdoor/traffic-related AP
- **Addis Ababa** - 3 peer-reviewed articles
  - **CO (Longitudinal) – (Kumie, A. et al. 2010)**
  - **PM10, CO, & O3 – Cross-Sectional**
  - **TSP and PM10 (Longitudinal) ; PM10 speciation**
- **Jimma** - 1 peer-reviewed
  - **Health Outcome Vs. Distance from Road & Traffic volume (no pollutant measurement)**
  - **effect of living close to traffic bearing roads (<150 m) had more risk of wheezing**
  - **No statistically significant difference in the overall prevalence of wheeze.**
  - **Increased risk of wheeze observed within 150m close to roads**

Factors Affecting Asthma/Wheeze (Traffic-related & Indoor AP)

- **Some identified risk factors in Jimma study:**
  - **Living in Proximity to Traffic-Roads**
  - **The volume of vehicular traffic per day**
  - **The use of Kerosene for cooking food**
  - **Indoor Smoking , Biomass fuel combustion, and**

- **Other environmental factors:**
  - **weather, season, altitude**

may attribute to the onset or exacerbation of Allergies

Policy, Legal & Organ. Framework (AP)

- **Policy and Legal Framework**
  - **The FDRE Constitution**
  - **The Environment Policy**
    - **Pollution Control Proclamation**
    - **The Environmental Impact Assessment Proclamation**
    - **Air Quality Guideline (focusing on industrial emissions)**
  - **The Health Policy, Energy Policy, Water Policy**

Major Gaps on AP Control (KII)

- Less priority given to AP (budget allocation)
- There is paucity of evidence/research on AP:
  - No strategic direction, priority research agenda, and established Key pollutants set on AP;
- No reference laboratories, research centers & facilities for AQ monitoring
- Training centers on AP not available
  - Skill gaps on monitoring, data analysis
  - On-the-job-training, short-term and long-term training are limited
- Organizational structure lacks focus on AP, lacks coordination mechanism among key stakeholders
- No regular Monitoring on AQ (Ambient/Indoor environs)

Priority Needs

- **Need for encourage multi-sectoral/multi-disciplinary AQ research of high-quality standard**
- **Key pollutants to be monitored, targeted for control; and to establish well equipped AQ lab and testing center for new technologies**
- **Design Strategic direction, research priority agenda on AP**
- **Design Short & Long-term training programs & courses; On-the-job-training; and address issue of AP in curricula**
- **Envisage & act towards establishing regional excellence on AQ and AP training in Ethiopia**

4. Discussion

- LMIC have technological and technical capacity limitations (India..)
- In Sub-Saharan Africa,
  - few countries has data on air quality and
  - very limited monitoring network for air pollutants
- In South Africa, air pollution sources are:
  - Mainly motor vehicles and coal burning for energy production elevating the PM, SO2 levels;
  - Solid fuel use is important source of IAP (source: Caradee W. & Rietta O., 2010)
- Global focus on Climate Change adaptation and mitigation benefiting LMIC countries to give the necessary attention to Air Quality
- Ethiopia adopted WHO guideline on Air Quality although monitoring suffers from lack of expertise, facilities and coordination
  - Indoor air pollution levels exceeded guidelines in key parameters, yet limited ambient parameters studied not yielding conclusive..

5. Conclusion

- **Given limited available data, NOx, RPM, CO were found to be important pollutants (I/OAP),**

- **The policy framework on the environment is in place, yet**
  - **key stakeholders lacks coordination, not mainstreamed AP, and given less priority to AQ**

  - **There is little capacity in terms of technical, financial, training facilities, and Research**

- **No regular monitoring or surveillance on AQ except in one NMA station (most recently established)**

6. Recommendations

- **There is a need for more high quality evidences focusing on key pollutants such as PM2.5, NOx, SO2, O3 and CO (both indoors & Traffic-related)**
- **There is a need for establishing air monitoring stations in Urban centers and Industrial areas**
- **The current effort to monitor Nox, O3 and CO at NMA need be strengthened by expanding the stations across country**
- **Actions needed to cut the pollutant emissions from motor vehicles and solid fuel burning to minimize exposure of vulnerable groups**
- **Health linked air pollution studies are recommended to quantify the attributed impact of air pollution on human health**

Way Forward (GEOHealth EA.)

- Conduct AQ study in Addis, including PM2.5 in 5 locations of Addis (1-in-3 days for a year)
- Speciation of chemical composition
- Conduct NOx measurement and Model traffic-related pollution
- Associate the pollution with Hospital health outcomes data
- Conduct similar studies in EA

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Breathing Quality Air is not a luxury good, yet a constitutional right
Thank you for your attention!!