FACILITATING KNOWLEDGE TRANSFER ON AIR QUALITY MANAGEMENT

Beti Angelevska
Faculty of Technical Sciences Bitola, R. N. Macedonia, beti.angelevska@tfb.uklo.edu.mk
Kristina Jakimovska
Faculty of MechanicalEngineering Skopje, R. N. Macedonia, kristina.jakimovska@gmail.com

Abstract: There is already a lot of technical knowledge about air quality, both regarding the effects and the causes of air pollution, as well as useful measures (Urban agenda, 2017). Enhancing the transfer of scientific knowledge on air quality management is significant for policy making in order to effectively control the levels of air pollution. Decision Support Tools (DSTs) are undeniably an important mechanism for transfer of knowledge from researchers to decision makers (Liu et al, 2012). They are also a valuable opportunity to foster synergies in urban planning between different policies (air quality, energy, mobility, housing, health etc.) (Urban agenda, 2017). Policymakers and the stakeholders who influence their decisions can access and use knowledge on air quality and related areas more effectively to further policy development activities (Clean Air Asia). In air quality management, several DSTs are used: monitoring, modeling, GIS and public information. Integrated, they contribute for maintenance of air pollution in tolerable levels. Hence, this paper elaborates the importance of Decision Support Tools for transfer of knowledge, used for decision making at various levels and by various stakeholders in the process of air quality management.
Keywords: decision support tools, air quality, knowledge transfer

1. INTRODUCTION

Air pollution is the most pressing environmental concern and has become a major challenge to global health as a leading cause of death. The World Health Organization (WHO) Global Ambient Air Quality Database 2018 shows that more than 80% of people living in urban areas that monitor air pollution are exposed to air quality levels that exceed WHO limits. The combined effects of ambient (outdoor) and household (indoor) air pollution cause about 7 million premature deaths annually (KSTA, 2018).
Hence, air quality management is becoming a very serious issue in urban areas. But, what are the obstacles for the conduction of processes in the air quality management? Each country and city face specific challenges that are unique to their national or local context, but common air quality management challenges include (KSTA, 2018):

- weak institutional capacity and arrangements
- inappropriate policies, strategies, and supporting regulations
- lack of reliable baseline data
- lack of awareness regarding the health and environmental impacts of air pollution
- lack of knowledge about, willingness to adopt, and access to process improvements and cleaner technologies
- lack of a technology transfer program
- absence of financial support, incentives, and innovative financial mechanisms or approaches.

Having in consideration these challenges, and also the importance of knowledge transfer in air quality management, the main objective of the paper is to explain the concept of currently available and widely used DSTs in the field of air quality management, their potentials and benefits needed for facilitating transfer of the knowledge.
Because DSTs in air quality management focuses on policy development and transferring knowledge to policy makers, it is important to bridge the gap between research and policy. Development research can identify what tools, methods, and approaches no longer work; test new ways of doing things; and link ways that inform policy and practice. In other words, good research should inform policy makers to produce good policies (ADB, 2010). And transfer of knowledge based on DSTs (monitoring, modeling, GIS and public information) could produce good policies in air quality management.

2. CONCEPT OF DECISION SUPPORT TOOLS (DSTs) IN AIR QUALITY MANAGEMENT

Additional knowledge of the complex problems surrounding environment increasingly highlights questions regarding the relation between policy and research (Liu et al, 2012). Hence, comes the idea of integration of air quality management within an adaptive management framework, supported by tools.
Decision support tools (DSTs) (also known as decision aids or decision support technologies) permit the making of the decisions based on complex and wide-ranging information. DSTs can take the form of written guidance, data,

models and/or software. They aim not only to facilitate decision making, but to help ensure that the process is transparent, documented, reproducible and robust (Liu et al, 2012).

In air quality management, DSTs will provide (KSTA, 2018):

- conduction of air quality studies (focusing on the current situation, its impacts, and management);
- identification of measures to address air quality, including innovative technological options, policy recommendations, and enabling capacity support.

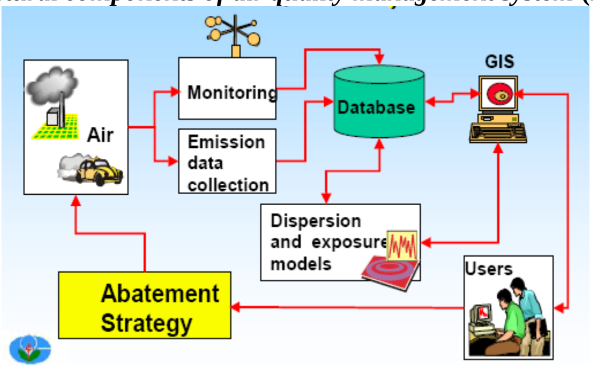
It is important to note that during the process of identification and selection of measures, based on the results on the integrated analysis of DSTs, several principles should be considered (Lorentz et al, 2016):

- measures should directly address the source of air pollution
- all sources should be addressed that have a relevant contribution to the exceedances
- measures should preferentially be applied to those sources contributing most to the exceedances
- cost efficiency should be taken into account when selecting and applying measures
- measures that have maximum effect and least effort should be selected
- public interests should be taken into account.

In air quality management, several DSTs are used: monitoring, modeling, GIS and public information. Additionally, an open access web-based database could be created in order to establish a firm information base of emission sources affecting air quality and of measures taken to improve air quality. In air quality management the analysis processes should start with modeling, including emission and dispersion models in order to correlate emission with ground ambient concentrations and to understand the contribution of sources. This activity should be supported by monitoring and GIS assessment (Buscaglia et al, 2004). Usually, related reporting and public information is a final task.

Hence, a basic method for assessment of air pollution are emission and dispersion models supported with GIS. Integration with monitoring data that is both spatially referenced and at the same time dynamic and with a real-time nature, adds an additional dimension in the management process (Fedra, 1999). To provide decision relevant information that support planning and management, these tools are integrated in a system for air quality management, whose purpose is scenario analysis and optimization tasks (figure 1) (Fedra, 1999).

Figure 1: ***Structural components of air quality management system*** **(Larssen, 2006)**



Very often, modeling and monitoring identified significant variation in air quality between air monitoring sites, with transport being a key factor affecting that variation. And again, very often, quantification of this variation remains challenging task due to the small number of monitoring sites. Developing monitoring networks with greater spatial coverage may build support for actions and policies that could result in air quality improvements, especially for most affected urban areas (Toronto Public Health, 2015).

Using these DSTs, a transfer of knowledge and analysis of data will be achieved providing (Lorentz et al, 2016):

- assessment of the current air quality situation,
- selection of suitable air pollution control measures to improve air quality,
- assessment of emission reduction potentials,
- monitoring the implementation of mitigation measures,
- ex-ante and ex-post assessment of the effective mitigation measures and, thus, the success of air quality plans, adapting the already planned measures.

Exchanging lessons from successful strategies, policies, and approaches can help to achieve better air quality (KSTA, 2018).

Local measures are often developed for specific local circumstances, so it is useful to share best practices between different cities. The exchange of details and experience with these local measures is required to complement the overview of efficient and effective measures and to help other cities to develop their own specific strategies to improve air quality taking into account local circumstances (Urban agenda, 2017).

All these previously mentioned decision support tools are designed to address difficult analytical problems with large volumes of data, and at the same time provide a convenient and easy to use user interface.

3. IMPROVING KNOWLEDGE AND COMMUNICATION FOR DECISION MAKING ON AIR POLLUTION: TRANSFERRING RESEARCH INTO PRACTICE

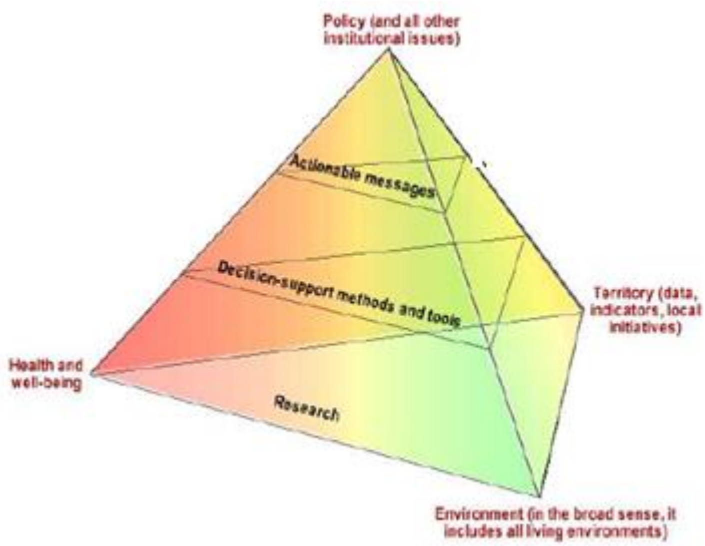
As a general rule it must be assumed that knowledge transfer may occur to some extent provided that the scientific data (Remvikos et al, 2011):

- is understandable and convincing
- covers the needs of the different stakeholder categories
- corresponds to legitimate, credible and relevant scientific results.

Knowledge management mechanisms must be used to build capacity (BIPM, 2018). Knowledge management promotes an integrated approach to the creating, capturing, retrieving, sharing, and evaluating of information assets. These assets include structured databases, textual information such as policy and procedure documents, and most importantly, the knowledge and expertise resident in individual's heads (ADB, 2010).

The knowledge-transfer pyramid which is shown in figure 2, identifies components which include environmental factors that can influence health and well-being as well as the territory which is concerned (where the policy would apply). It also shows simplified levels at the limit of which knowledge-translation can occur (Remvikos et al, 2011).

Figure 2: The knowledge transfer pyramid (Remvikos et al, 2011)

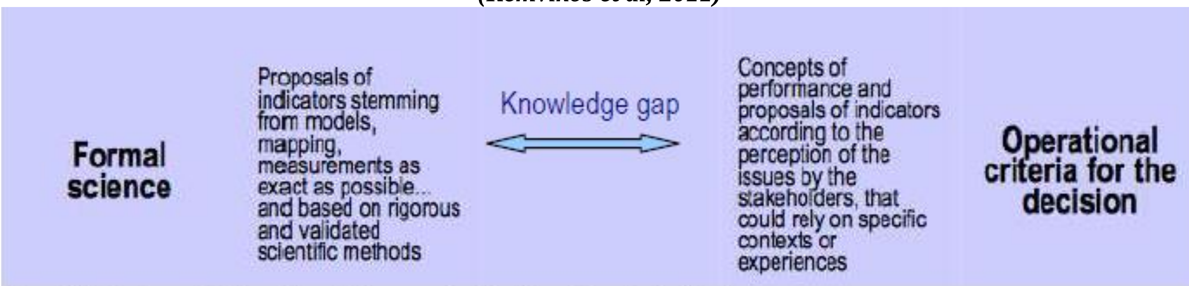


The efficacy of knowledge transfer is often viewed in terms of communication quality, i.e. when a decision does not seem to stand up to what public health scientists consider as adequate protection against air pollution. It is attributed to a possible lack of convincing evidence about health impacts, or to their inadequate presentation resulting in poor understanding by the decision-makers (Remvikos et al, 2011).

Air quality management knowledge is available but must be captured and transferred. While information and knowledge on air quality management is increasingly being generated in the region to address this problem, the capture and transfer of this knowledge to policy makers often do not occur, resulting in investment decisions that are not always based on sound science and international best practices (ADB, 2010). Thus, there is a need to improve knowledge transfer and knowledge sharing on air quality management.

Representatives of the general public are particularly receptive to health impact data, a point that needs to be considered in the communication formats. But mostly, the gap which has to be bridged consists in "transformation" of the knowledge itself, from its formal presentation that fundamental research produces to an operational or actionable set of performance criteria and indicators (Remvikos et al, 2011). The use of decision-support tools by scientists is meant to make information more amenable to policy decisions. In the same process, the information can be adapted to local settings and enriched by local experiences.

Figure 3: Basic characteristics of knowledge on each side of the science/policy interface (Remvikos et al, 2011)



The improvement of the understanding of the problem and the various solutions can be depicted as a "transformative" learning which can be visualized through the output of the different activities that are part of the knowledge-transfer process (Remvikos et al, 2011).
There is also a need to better consider how air quality outcomes can be better integrated into existing funding mechanisms. To this end, it would be useful to include considerations regarding the impact on air quality as early as possible in the planning process as a possible criterion for funding infrastructural or industrial development projects (Urban agenda, 2017). This would be an ideal way to communicate with stakeholders, financers and government and to contribute to make it harder to fund projects that would contribute negatively to air quality.

4. STRENGTHENING KNOWLEDGE FOR AIR QUALITY USING DSTs

Phase 1: Current air quality situation and management practice assessed (KSTA, 2018)**:**

- conducting diagnostics on air pollution levels, impacts and sources to increase knowledge for air quality management, carry out studies to assess air quality and management practices (i.e., emission inventory, source apportionment, effectiveness of air quality management measures, and mitigation potentials)
- identify appropriate portable air quality monitoring stations and train local institutions to be responsible for the operation and maintenance of the equipment
- apply DSTs to better understand pollution impacts and assess public vulnerability
- conduct roundtable and policy dialogue with the government and other stakeholders (private sector, NGOs and financial institutions)
- design awareness programs.

Phase 2: **Innovative cost-effective technological and policy options for addressing air quality evaluated** (KSTA, 2018):

- assess energy efficiency and emission reduction technology in terms of its applicability, performance, efficiency, cost-effectiveness, and local context
- conduct assessment of capacity building, policy reforms, technology transfer, and other issues
- provide national and provincial-level policy recommendations linked to city-level air quality management
- identify appropriate technological solutions, including basic and well-known technologies and recently introduced innovative, advanced, and adaptive technologies for energy efficiency and emission reductions
- organize targeted training program for the government, private sector, and financial institutions
- undertake visits to better understand the other more developed experiences, technologies, and financial mechanisms
- coordinate a technology fair to build linkages between technology providers and potential government and private sector users.

The following recommendations can be made for the long-term measures planned for the future (Lorentz et al, 2016):

- do not hide weaknesses/data/knowledge gaps
- put the focus on justification, description and definition of measures
- try to be as concrete as possible
- if concrete action is not possible for the moment, stipulate a clear commitment for future study/investigation and subsequent decision on action

- add steps to improve emission databases/modeling or evaluation tools/required resources as measures.

Knowledge of best practices in the selection, design, funding, and implementation of air quality measures is essential to facilitate the choice of the relatively most effective measures, and such knowledge should be continuously improved (Urban agenda, 2017).

5. CONCLUSION

Despite a general agreement on the importance of transferring knowledge (or knowledge translation as it is sometimes called), there is still a lack of practical conclusions on emerging methods and tools that can enhance the appropriation of research results by the potential users (Remvikos et al, 2011).

The need for decision support is widely recognized. In recent years, a large number of DSTs have been developed, with varying degrees of success in their practical use. In the broadest sense, a DST is any guidance, procedure, or analysis tool that can be used to help support a decision (Liu et al, 2012).

Air quality management integrates several DSTs: monitoring, modeling, GIS and public information. Hence, to provide scientifically sound and decision relevant information integration of GIS with data bases, monitoring results from observation networks, and spatially explicit dispersion modeling must be provided. All these DSTs enable the user not only to describe and evaluate the present situation, but also to undertake environmental planning for a sustainable unpolluted future.

In this way, a knowledge transfer is provided, through the DSTs for air quality planning, which can be used at the national, regional and local levels (Urban agenda, 2017).

This paper provides an overview of the work undertaken, with the aim to encourage and facilitate additional effort in making DSTs in air quality management better known, more used, and therefore, more useful in the process of transfer of knowledge (Liu et al, 2012).

LITERATURE

ADB. (2010). *Knowledge management on air quality: case studies*. Asian Development Bank and Clean Air Initiative for Asian Cities Center. Manila, Philippines. ISBN 978-92-9092-212-4. p. 125.

BIPM. (2018). Metrology for Clean Air - A BIPM Capacity Building and Knowledge Transfer Programme Outcomes and Impact of the 2016-2018 Activities. Retrieved from https://www.bipm.org/en/cbkt/clean-air.html

Buscaglia, G. et. al. (2004). A GIS model for urban air quality analysis. *Mecanica Computacional, Vol. XXIII*, Bariloche, Argentina, pp. 1-20.

Clean Air Asia. Knowledge Air: Capturing and Transferring Air Quality Management Knowledge in Asia**.** Retrieved from https://cleanairasia.org/knowledgeair-capturing-and-transferring-air-quality-management-knowledge-in-asia/

Fedra, K. (1999). Urban environmental management: monitoring, GIS and modelling. *Computer, Environment and Urban Systems. No. 23*, pp. 443-457.

KSTA Knowledge and Support Technical Assistance. (2018). Strengthening Knowledge and Actions for Air Quality Improvement. Project Number: 51347-00. Asian Development Bank. p.16.

Larssen, S. (2006). Proposed plan for the development of an AQM strategy for Bangladesh, Air quality management (AQM) project. Norwegian Institute for air research. Norvey.

Liu et al. (2012). Facilitating knowledge transfer: decision support tools in environment and health. *Environmental Health 2012, 11(Suppl 1):S17*, p. 13. http://www.ehjournal.net/content/11/S1/S17

Lorentz, H., Müller, J., W. (2016). *Guideline on Air Quality Plans*. German Environment Agency. ISSN 2363-832X Dessau-Rosslau, Germany, p. 77.

Remvikos, Y., Eshai, K. and Bouland, C. (2011). Guidelines on appropriate tools and formats for better dissemination of scientific findings for use in decision making on air quality management. Work Package 7, Deliverable D12. Grant Agreement No. 2007105. Aphekom, Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe, p.55.

Toronto Public Health. (2015). Summary of Air Quality Monitoring Roundtable Discussion #2. Clean Air partnership. p.7

Urban agenda for the EU. (2017). *Final Draft Action Plan*. Partnership for Air Quality. p. 47.