Pathologic Analysis of Control Plans for Air Pollution Management in Tehran Metropolis: A Cross-Sectional Study

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Abstract

Background: The centralization of human activities is associated with different pollutants which enter into environment easily and cause the urban environment more vulnerable. Regarding the importance of air pollution issue for Tehran metropolis, many plans and regulations have been developed. However, most of them failed to decline the pollution. The purpose of this study was to pathologically analyze air-pollution control plans to offer effective solutions for Tehran metropolis.

Methods: A Qualitative content analysis in addition to a semi-structured interview with 14 practicing professional were used to identify 1) key sources of Tehran's air pollution, 2) recognize challenges towards effective performance of pertinent plans and 3), offer effective solutions.

Results: Related challenges to air-pollution control plans can be divided into two major categories including lack of integrated and organized stewardship and PEST challenges.

Conclusion: For controlling the air pollution of Tehran effectively, various controlling alternatives were identified as systematization of plan preparation process, standardization and utilization of new technologies & experts, infrastructural development, realization of social justice, developing coordination mechanisms, improving citizens' participatory capacity and focusing on effective management of fuel and energy.

Controlling air pollution in Tehran needs a serious attention of policymakers to make enforcements through applying a systemic cycle of preparation comprehensive plans. Further, implement the enforcements and evaluate the environmental impact of the plans through involving all stakeholders.

Keywords: Air pollution management, Pollutants, Control plan

Introduction

Pollution is predicated to all tiny particles in the air which are produced due to human or natural activities (1). Since the centralization of human activities is associated with metabolic human interactions in urban areas, different pollutants enter into air easily and cause the urban environment more vulnerable (2). It is such that, World Health Organization (1992), has addressed the air pollution as a serious problem (3).

Improper use of fuel and inappropriate topography of Tehran caused air pollution due to the entrance of approximately 1.5 million tons of pollutants annually. Hence, the combination of natural and artificial factors causes Tehran to be one of the most polluted cities in the world, standing by Mexico City, Beijing, Cairo, Sao Paulo, Shanghai, Jakarta, and Bangkok (4). Air pollution has also caused painful events all around the world: the

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pollution event in Meuse (1930), in which 63 people experienced respiratory problems; or the death of more than 400 people in London due to the contaminated thick smog in 1952 are two examples of such irrecoverable events (1). Accor-ding to an environmental program of United Nations 4–8 % of premature deaths are due to exposure to particulate matter in both outdoor and indoor environments, with potentially 500000 excess deaths annually due to particulate matter in outdoor situations (5). Likewise, the Air Quality Control Agency's report indicates that more than 4500 people are dying every year in Tehran due to air pollution (6).

The most important sources of air pollution can be divided into four key groups including overcrowding (7), economic growth (8), natural factors (exp: geographical situation and topography, temperature inversion etc.) (9), and mobile and stationary sources (exp. Non-standards and poor fuel consumption of motor vehicles, industries in and around the city, home heating and cooling systems) (1, 10).

Depending on the type and sources of pollutants, metropolises around the world took different measures to control the air pollution. Among developing countries, South Africa has benefited from a collection of best legal solutions in order to reduce the air pollution; among them are objective and standard setting, status quo assessment and priority area delineation, control strategy preparation and implementation (11). China, as a developed country has also taken effective measures to control air pollution including Integrated Monitoring Program on Acidification of Chinese Terrestrial Systems (IMPACTS), permanent control of vehicles' emissions, increasing the quality of fuels, taking advantage of new technologies, developing transportation systems, providing five-year plans to understand causes and sources of pollution, current status, effects, and control of acid rain (12-16). In Italy, special measures have been taken for energy management in industry, transportation systems and domestic systems (17). Economic and industry growth plus overcrowding in India, caused city planners to take serious measures including banning polluting vehicles,

developing roads, escalating standards and regulations enforcement and etc. (3).

Despite the efforts of many countries, just some of them have been successful to decline air pollution, while the others failed to effectively and efficiently control air pollution. In South Africa, despite numerous plans and policies for controlling air pollution, they failed due to some major challenges such as lack of relationship between district and local municipalities, lack of relationship between provincial and local authorities, plan's integration, public's roles, technical capabilities in programs, extending a partial focus on some polluter sources and lack of systemic approach in air pollution planning, plans and climate change management, shortage of funding and etc. (11). Improper prioritization of environmental intervention, lack of funding, unwillingness of the countries to plan with a systemic approach, lack of enforcement and poor communication between all public and private sectors are the most principal factors causing the failure to successfully control air pollution (18-21).

From 1334, lots of case and cross-sectional plans, programs and projects had been developed individually or as a part of a national document to control the air pollution of Tehran. They are including the first five-year development plan (1988-1993), clean air plan (1995), transportation emission reduction project (1997), comprehensive plan of Tehran's combating air pollution (1997), second five-year development plan (1996-2000), third five-year development plan (2001-2005), 20 year visionary plan (2005), forth five-year development plan (2006-2010), Tehran's master plan (2007), fifth five-year development plan (2011-2015) and master plan of metropolises' combating air pollution (2011) (22). Despite the fact that all these plans had been precisely codified, the present evidence implies that expected results based on reducing the air pollution have not been met due to lack of an integrated stewardship responsible for regulating, coordinating and monitoring the process and the gained results of air pollution control plans (23). Hence it is necessary to analyze the air pollution controlling plans with a patho-

logic approach to identify a set of practical solutions for Tehran.

This paper bears a twofold purpose: first, pathologically analyze air pollution control plans of Tehran from the viewpoint of experts; and secondly offer appropriate and effective solutions for controlling the air pollution.

Materials & Methods

A descriptive case study method was used in 2012 for pathologic analysis of air pollution control plans in order to offer solutions for Tehran metropolis as the capital city of Iran. The research team provided a semi-comprehensive review of the literature which contained more than 70 articles of different metropolises all around the world for developing an initial conceptual framework as a springboard for developing the interview questions. The scope of the review is limited to developed and developing metropolises (China, Italy, India and South Africa) which faced the same air pollution difficulties as in Tehran.

By developing the framework, a qualitative content analysis was drawn to identify the manifest and latent contents relating to different air pollutants and plans for their control. The key contents around which the interview questions were organized consists of 1) Causes and sources of air pollution, 2) Challenges & obstacles towards effective performance of air pollution control plans and 3) the most effective controlling solutions for air pollution in metropolitan areas.

A semi-structured face-to-face interview was done to survey Tehran's air pollution control plans, from the aspects mentioned above. The participants were chosen by snow-balling sampling and according to their context of work (practicing professionals and Tehran, Tarbiyat Modarres and Shahid Beheshti university professors). The interviews were continued until the saturation in data and no more information was gathered by interviewing and about 80% of data were repeated by experts, so about 14 experts, professors and managers' interviews were practical and applied for data analysis. They were asked to answer nine

main open-ended questions. The context of the interview consists of the extent to which air pollution control plans of Iran are appropriate and the ways to cope with the air pollutants in different sectors (industry, transportation systems and domestic system) with regard to other metropolises' experience in the very same field. In addition, they were asked to provide more information about the relevant issues, if possible. As the interview sessions precede, the quality, relevancy and comprehensiveness of questions were developed simultaneously. Afterwards, the opinions collected from the interviews were analyzed qualitatively. Whole interview texts were determined as a unit of analysis during the process. All the opinions (meaning units) were reviewed, condensed and labeled as a code through a back and forth movement between the whole and part of the interview texts. Then the codes with the same meaning grouped together under higher order heading to create categories (27 sub-categories and 8 categories) in a way that each group of codes dealt with a specific issue or content area. Next, the primitive title and content of all categories and sub-categories were discussed by the article research team. Finally, the underlying meanings which were the latent contents of the categories were formulated into four main themes.

Results

The analysis results of all 14 viewpoints from practicing professionals were categorized into four main themes. The first theme is demonstrated in Table 1 as "Causes and sources of air pollution of Tehran metropolis". As it is depicted in the table, the most vital sources of air pollution corresponds to the process of policy making, lack of attention to environmental changes, topogherafic status of Tehran, pollutant due to Mobile and stationary sources and the matter of improper energy management. The second theme is demonstrated in Table 2 as "Challenges & obstacles towards effective performance of air pollution control plans' of Tehran metropolis".

Table 1: Causes and sources of air pollution of Tehran metropolis

Theme	Causes and sources of air pollution of Tehran metropolis				
Category	**Managerial factors**			**Non-managerial factors**	
Sub-category	Improper policymaking	Lack of attention to environmental changes	Natural status	Mobile & stationary sources	Improper energy management
Codes	Improper site choice for industries Poor transportation system Improper site choice for capital city Improper sustainable development plan.	Constant changes of pollutants Rising new pollutants Emerging haze phenomenon	Tehran's topography Accumulation of pollutants in inversion condition Windblown from the west of Tehran	Non-standard & old vehicles High volume of vehicles idling traffic factory chimney pollution due to residential air conditioning systems	Inconsistency between gasoline production's standards in Iran & international standards Non-standard fuel Excessive consumption of energy

Table 2: Challenges & obstacles towards effective performance of air pollution control plans' of Tehran metropolis

Theme	Challenges & obstacles towards effective performance of air pollution control plans' of Tehran metropolis													
Category	Stewardship challenges							PEST challenges						
Sub-category	Poor communication & socialization	Poor evaluation & monitoring system	Poor resource generation and infrastructure	Poor standards, rules and regulation	Poor performance	Lack of a reference observatory system	Political & economical	Social & cultural	Technological					
codes	Poor performance of mass media Poor public participation Poor cross sector cooperation among responsible stakeholders	Lack of transparency in the positioning of supervisory Lack of feedback mechanism Lack of integrated monitoring system for the air pollutants	Poor prioritization of effective intervention High cost of creating & maintaining the green spaces	Poor technical examination of vehicles Low quality fuel Poor attention to standardization and its promotion	Decision making Instability of oil ministry on its decision Improper benchmarking based on developing infrastructure Lack of plan's sanction	Poor, scattered information about the pollutants and the air pollution sources Poor information about the mortality rates due to air pollution	Malfunction of automobile industry Dictated political requirement based on improper site choice for industries	Unaffordability of some families to perform some pertinent rules Livelihood dependency of a stratum of society to old vehicles	Poor technical & financial capacity to identify and provide the required Technologies for controlling the air pollution					

As it is shown, the most important challenges of Tehran's air pollution management are focused on nine areas which we abstracted them into two wider categories including firstly, air pollution stewardship challenges and secondly, environmental (political, economic, social and technical) challenges.

Some factors such as lack of information for evidence-base decision making, poor vertical and horizontal coordination among urban developmental goals and plans, improper funding, following unfit pattern and mores are categorized as stewardship challenges, on the other hand political intervention in plans provision and performance, sanctions against Iran, unaffordability of some families to exchange their non-standard cars with new ones and some more are identified as environmental challenges, which are presented in the Table 2 in detail.

In order to demonstrate the challenges importance, the amount of their repetitions were accounted and shown in Table 3 in percentage:

Table 3: Challenges priority

No.	challenges	Percentage
1	Poor communication & socialization	22.5
2	Poor performance	15.3
3	Poor standards, rules and regulation	14.4
4	Political & economical challenges	11.7
5	Poor evaluation & monitoring system	10.4
6	Poor resource generation and infrastructure	9
7	Technological challenges	8.1
8	Social & cultural challenges	4.5
9	Lack of a reference observatory system	4.1

The third theme is demonstrated in Table 4 as "The most effective controlling solutions for air pollution in the metropolitan areas". With regard to the fact that air pollution is one of national planning priorities in metropolitan areas, there are numerous evidences demonstrating effective measures taken by metropolises challenging air pollution. Table 4 categorizes some of the most significant ones.

The forth theme is demonstrated in Table 5 as "The most effective controlling alternatives for air pollution in Tehran metropolis" which is broken into two main categories, first of all technical & infrastructural factors, then managerial & administrative factors. planning based on reliable evidences, involving all responsible key stakeholders in planning process, developing the parks & green sites, monitoring the amount & type of different pollutant in the air by the help of new technology, fair distribution of facilities and development, non-individual based planning, considering the implementation & monitoring capacities in contemporary with planning, improving the mutual understanding and communication among authorities and citizens, considering revision loops for plan, developing environmental standards and mores are categorized as technical and infrastructural factors. Furthermore, improving the cooperative & mutual communications among the education deputy of Tehran Municipality and the other authorities for culturalization & informing, developing public participation capacities, are categorized as managerial & administrative factors**.** Tables 5, there are those alternatives which suites to Tehran's status and were mentioned by the interviewees. In order to estimate the alternatives importance, the amount of their repetitions were accounted and shown in Table 6 in percentage.

Table 6: The priorities of most effective controlling alternatives for air pollution in Tehran metropolis

No.	Alternatives	Percentage
1	Realization of social justice through capacity evaluation of regional district of Tehran	18.9
2	Developing coordination & controlling mechanism	17.1
3	Focus on effective management of fuel & energy	15.2
4	Culturalization & infrastructure development	13.4
5	Systematization of plan preparation process	11.6
6	Organizing the Stewardship	9.8
7	Improving the participatory capacity in Tehran	8.5
8	Standardization & utilization of new technology &professional experts	5.5

Table 4: The most effective controlling solutions for air pollution in the world

Theme	The most effective controlling solutions for air pollution in the metropolitan areas				
Category	Technical & infrastructural Agents		Managerial & administrative measures		
Sub-category	Culture & infrastructure development	Applying economical control levers	Utilizing internal & external participatory capacities	Strategic planning	Focus on public transportation
Codes	Implementing self-judgment plan for industries Recognition of electronic documents and developing the requirement of e-city Developing electricity plants working based on nuclear power Stop non-standard incineration	Providing high insurance cost for road transportation for industries Increasing the cost of using the personal vehicles Impose huge taxes on old and non-standard vehicles	Asking for international funding and technical capacity contribution in order to implement their plan effectively Asking for public participation	Implementation of environmental assessment Taking a system approach in all phases of planning Considering the interrelationship of parallel and hierarchical policy and plans Replace the long-term plan with the short-term ones Impose administrative enforcement to perform the plan completely Improving practical technologies	Paying serious attention to traffic & transportation management Expand the use of public hybrid and electronic vehicles Energy consumption management in industrial institutions& service providers

Table 5: The most effective controlling alternatives for air pollution in Tehran metropolis

Theme	The most effective controlling alternatives for air pollution in Tehran metropolis							
Category	Technical & infrastructural factors				Managerial & administrative factors			
Sub-category	Systematization of plan preparation process	Culturalization & infrastructure development	Standardization & utilization of new technology &professional experts	Realization of social justice through capacity evaluation of regional district of Tehran	Developing coordination & controlling mechanism	Improving the participatory capacity in Tehran	Focus on effective management of fuel & energy	Organizing the Stewardship
Codes	Comprehensive studies on environmental, social, economical, geographical situation of Tehran in advance-Considering futurology approach determining the precise role of all participants in the plan	Organizing & Maintaining pathways Training citizens about correct use of vehicles	Utilizing of academic and executive experts to prepare master plans which are appropriate for Tehran's conditions and citizens	Applying the economical levers for fining offending drivers Developing a penalty system fits to different kinds of air pollutants	Constant monitoring of industries activities Updating standards constantly	Providing appropriate situation for developing citizens' participation according to expected plans' achievements Advocacy for taking the political & supportive confirmation of superior authorities	Quality improvement & developing the fuel consumption patterns Applying clean energy (solar, wind etc.)	Creating e-governance with the aim of integrating & coordinating the implementation of air pollution plans

Discussion

Our findings confirm that Tehran's air pollution has been due to five major reasons including improper policy making, no attention to the pollutants' changes, geographical situation, mobile and stationary sources and nonstandard energy production.

Paying inadequate and incoherent attention to the sources of pollution caused the authorities face with some important challenges including those which could be due to not having a unique and organized stewardship and of course those challenges could be due to the environmental changes which are not controllable by the air pollution management authorities. As all metropolises confront such challenges, their authorities implement different plans in order to manage air pollution. Some of the best and effective controlling solutions are focused on culturalization, infrastructural development such as public transportation (16) and applying economical control levers in China (13), utilizing participatory capacities and strategic planning in South Africa (11), applying solar battery to produce clean energy in Italy (24), identifying emission limits for automobiles and industry in India (3). In Iran, same as other metropolises, several plans are prepared and some are implemented, but, unfortunately, thanks to some challenges mentioned above, they failed to control Tehran's air pollution as it was expected to be achieved in the plans. To solve the challenges and improve the quality and effectiveness of controlling air pollution plans, some noticeable controlling alternatives were proposed by the practicing professionals. Among them should name paying more attention to the matter of stewardship in the field of air pollution management, cultural and infrastructural development, focusing on effective management system doing systematic studies before planning in other words systematizing the plan preparation process, standardization of fuel and energy production and consumption, enhancing public participation capacity, developing appropriate coordination and controlling mechanism, realization of social justice through capacity evaluation in regional scope, standardizing and utilizing new technologies and professional experts, stopping manufacture of the low quality automobiles and reducing import tariff of the high quality ones, applying economical control levers, making transparency in deaths statistic due to air pollution, providing environment organization's box to centralize polluting industries penalties, and legitimizing air pollution control plans to enhance their implementation's guarantee (22).

Same studies have been conducted in other metropolises facing the same issues. Our findings about the air pollution control plans' challenges replicate the finding of a survey on controlling air pollution plans in South Africa conducted by Niaiker et al. (11). In the viewpoint of Niaiker poor standards and regulations to support plans' implementation, poor cooperation among stakeholders (key authorities, planners, policymakers, citizens etc.), poor resource generation and poor attention to the type and source of pollution are the most important challenges caused the failure of control plans. Also, Asadollah (23) mentions that poor and disorganized stewardship is a key factor which leads to the failure of Tehran's air pollution control plan. Furthermore, our finding about controlling alternatives for Tehran's air pollution is similar to the findings of a survey on the same subject in this metropolis (19). He believed that developing an appropriate evaluation and monitoring mechanism to enforce different responsible authorities through evaluate the performance of them, realization of social justice and improving the participation capacities are success factors of plan implementation.

These finding can help Tehran's authorities to look at plan preparation process with a new approach and would be practical for every developing large cities which are confronting such problems. In other words, authorities can positively benefit the viewpoints of the practicing professionals who consider the plan's deficiencies from unlike aspects in diverse levels of initials in advanced studies requirements, plan's preparation to plans' implementation.

We considered only the most important challenges of Tehran's air pollution control plans in

order to offer effective controlling solutions. Further, more researches should be done to determine priority of the offered solutions in accordance with Tehran's facilities and requirements.

Conclusion

Controlling air pollution of Tehran needs a serious attention from policymakers to make an effectual enforcement through applying a systemic cycle of preparation and revising effective and comprehensive plans, implementing enforcement and evaluating the environmental impact of the plans through involving all stakeholders

Ethical consideration

Ethical issues (including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission redundancy, etc.) have been completely observed by the authors.

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