

Effectiveness of mediation in the resolution of environmental complaints against the activities of gold mining industries in the Witwatersrand region

Olusegun Oguntoke^{*1,2} and Harold J. Annegarn¹

¹Department of Geography, Environmental Management and Energy studies, University of Johannesburg
PO Box 524 Auckland Park, 2006, Republic of South Africa, hannegarn@uj.ac.za

²Department of Environmental Management and Toxicology, University of Agriculture

PMB 2240 Abeokuta, Federal Republic of Nigeria, oluseguo@uj.ac.za; oguntoke@funaab.edu.ng

Abstract

In the Witwatersrand gold mining area, there have been recurring public complaints about dust dispersed from gold tailings storage facilities (TSFs) that traverse the landscape. Although weather aggravates the frequency and intensity of dust emission from TSFs in the study area, the rapid conversion of buffer areas around the dumps to residential land-use is exposing more people to dust hazards. This study assessed the effectiveness of Crown Mines Dust Monitoring forum in Johannesburg as an alternative environmental dispute resolution mechanism. Records of complaints from 1995 to 2010 that were made available through the forum were collated and analysed with the aid of descriptive statistics. Within the study period, complaints about mine pollution were more frequent between August and October, i.e. the dry months. More than 70% of the complaints were made by companies whose properties, operations and employees were affected by dust emission from the TSFs. While 52% of the complainants reported pollution problems for the first time within the study period, other cases were follow-up to previous complaints. Mining companies responded to 31% of the public's grievances about dust pollution from their facilities within one week and another 12% in two weeks; response to the remaining complaints took much longer time. As part of mines' response to public complaints, site visits were organised to indicted facilities, and pollution control measures and mitigation plan adopted at sites were also explained. Moreover, additional control measures were installed in critical circumstances to ameliorate dust pollution. Only a few of the complaints reported to the forum escalated to litigation or issuance of penalty by government agency. Although, the forum provided an avenue for resolution of environmental conflicts in a pragmatic and mutually beneficial manner, the right of the public to a clean environment is still not being realised fully.

Keywords

environmental pollution, conflict resolution, public complaint, mine tailings, dust forum, environmental right sustainable mining

Introduction

Generally speaking, all informal channels of dispute resolution apart from full-scale court processes are regarded as alternative dispute resolution (ADR) mechanisms (Bingham 1986; the World Bank Group 2011). In ADR, disputants are generally encouraged to negotiate directly with each other through negotiation, conciliation, mediation or arbitration. The popular acceptability and use of ADR systems by the citizenry in many societies can be linked to their informal setting, flexibility, ease of access and, the acceptable and peaceful manner in which cases are handled. The World Bank Group (2011) noted that ADR increases access to justice for population groups by reducing cost and time, and also increases disputant satisfaction with outcomes. The mechanism is also capable of supporting disadvantaged people against the overriding influence of multinational companies.

Although the court of law is the last resort in the resolution of environmental conflicts in most civil societies, the use of alternative dispute resolution mechanisms is growing rapidly

(Lee 2008). In China for instance, while the formal channels are dominant, Liang (2012) observed the active role of the informal channels in the resolution of environmental disputes. Similarly, public complaint is well established as a veritable means of seeking redress for perceived adverse impact of environmental pollution in Portugal and Brazil (Dong *et al* 2011; Carvalho and Fidélis 2011). This emerging significance of extra-litigation channels can be linked to a major setback suffered by public litigation against environmental pollution. In most cases when litigation is employed as a means of seeking redress for observed violation of the public's right to a harmless environment 'lack of sufficient evidence' thwarts such effort.

As a means of protecting the rights of the public, the South African constitution of 1996 (act 108) indicates that everyone has the right to an environment that is not harmful to their health and well-being; and to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of

natural resources while promoting justifiable economic and social development.

In order to give effect to this constitutional provision, mandatory standards are set for selected air quality parameters that are considered critical to human health. These include; sulphur dioxide (48 ppb/24 hours), nitrogen dioxide (21 ppb/24 hours), carbon monoxide (26 ppm/1 hour), PM₁₀ (120 µg/m³), ozone (61 ppb/8 hours), benzene (3.2 ppb/1 year), and lead (0.5 µg/m³/year) as published by South Africa Government Gazette (No. 32816, volume 534) of 2009. Moreover, environmental limits of dust-fall emanating from mining activities were set for residential (≤600 mg/m²/d) and non-residential areas (≤1200 mg/m²/d) (SANS 1929: 2005). In spite of these afore-mentioned constitutional and policy measures to safeguard the welfare of communities, complaints against dust dispersal into areas occupied by humans has been significant in the Witwatersrand areas.

Community complaints and protests in the Witwatersrand area stem from the irritation that is associated with human exposure to coarse dust, commonly referred to as nuisance dust. Additional worry is raised among exposed communities as mine dust is perceived to be hazardous (Wright *et al* 2014; Liu *et al* 2011), hence, capable of impairing their health and well-being. Among people that are generally aware of constitutional provision for human rights, environmental pollution by airborne mine dust that affects residential areas is considered a denial of their right to a clean environment.

An analysis of frequency and intensity of dust episodes in the Witwatersrand environment showed a recurrent emission of dust well above set limits in some of the areas where tailings storage facilities (TSFs) are located (Oguntoke *et al.* 2013). This implies that despite constitutional and policy provisions for the rights of the public to an environment free of harm to their health, air pollution from mine facilities is frequent.

The Crown-Mines Dust Monitoring (CDM) forum that was inaugurated in the Witwatersrand region in 1992 is a proactive effort geared towards resolving environmental pollution complaints arising from mining activities. The aim was to provide information and resolve public complaints about the negative impact of mining operations in a practically feasible and peaceable manner.

CDM forum receives complaints against observed pollution from mines' operations, documents such and promptly addresses them. Once complaints are received, the owner of the indicted mine facility is identified and requested to respond to the allegation. For every case handled by the forum, the Secretary keeps a register of proceedings and circulates the minutes prior to the subsequent meeting. Follow-up actions to ensure a satisfactory mitigation of observed environmental pollution are monitored and reported to the forum.

Having operated for two decades, the current study aimed to assess the role of the CDM forum in resolving public complaints

against pollution arising from mining operations in the Witwatersrand region, South Africa. As a voluntary, non-formal and alternative environmental dispute resolution mechanism, the information about its operations, successes and defects are valuable for upgrading its operations so as to enhance the public's access to their right to a clean and healthy environment.

The study area

Mining activities and sites of dumps (TSFs) occupy approximately 12,200 km² of land area in the Witwatersrand basin of South Africa (Rossouw *et al* 2009). Coincidentally, this area serves as residence for a dense urban population in Gauteng province (Figure 1). In terms of the eco-climatic region, the Witwatersrand area is situated within the Highveld grassveld-savannah with summer rainfall ranging from 500–750 mm (O'Connor and Bredenkamp 1997). Daily temperature ranges between 2–12°C in the dry winter months, and from 14–30°C during the summer (Schulze 1997).

In Gauteng province, summer days are warm and winter days are crisp, clear and wind free. There are about six weeks of cold weather in mid-winter (from July to August) and summer offers warm sunshine followed by balmy nights (October to March). The rainy season is in summer rather than winter (June–August). Rainstorms are often harsh accompanied by much thunder and lightning and occasional hail, but they are brief and followed by warm sunshine. The moisture and wind characteristics of the seasons in the region have implications for dust storm frequency and severity during the year. Specifically, the absence of rainfall (dry conditions) coupled with high wind speed provide an enabling condition for dust dispersal from poorly vegetated TSFs.

From historical records, grasses, shrubs and trees were planted on some of the TSFs as early as 1969 and 1970 (GSG 1997). While additional re-grassing has been conducted, the general assessment of vegetation coverage of the TSFs showed varying degrees of degradation. These degraded sections of the TSFs have constituted a source of dust emission especially, during the dry and windy periods. The dust emission problem in the area is further worsened by the location of human settlements within the precinct of the TSFs. Some human residences are sited less than 100 m away from mine dumps in the area (Rossouw *et al* 2009).

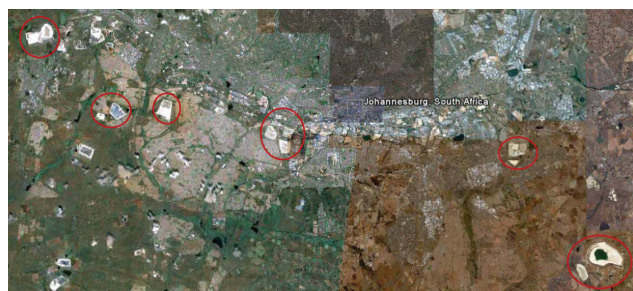


Figure 1: Location of the Witwatersrand Mega-dumps within residential land-use (Ojelede and Hannegarn, 2010)

Method

In this study, a retrospective study design was adopted for data collection (Mann 2003). Records of dust pollution complaints from 1995–2010 that were documented by the Crown-Gold Dust Monitoring forum (now, ERGO Gold Dust Monitoring forum) in Johannesburg were accessed. The forum has a chairperson, secretary, statutory member from relevant government departments, representatives of the mine companies, affected community members and interested individuals and organisations. Complaints from individuals, communities and companies that were communicated to the forum through email, telefax, letter, phone call and personal communication were printed on paper and compiled. From each of the cases, information such as date of complaint, nature of the complaint, the complainant, time between complaint and response, resolution of the complaint or otherwise, and whether the complaint escalated to legal action or issuance of penalty by a government agency or not, were extracted.

Registered cases that had insufficient information about the complainant, nature of complaint and relevant dates were excluded from the data analysis conducted in this paper. Similarly, six complaints about overgrown mine sites, noise emission from machinery and other complaints that are not directly related to dust pollution from mining activities were excluded. While it is practically impossible for all environmental complaints in the region to have been reported to the forum, those that were accessed provided valuable information about the forum’s operations and mines’ response to pollution complaints.

The attributes of each complaint registered with the forum were extracted and entered into an Excel™ spread-sheet. This data was exported into Statistical Package for the Social Sciences (IBM™ SPSS version 21) for statistical analysis. Descriptive tools such as frequency run, chi square and graphs were employed to analyse and summarise the data.

In order to complement the information retrieved from the CDM forum’s register, participant observation was employed. The experience garnered from the scheduled meetings of the forum by the foundation chairperson and the participation of one of the authors between 2011 and 2013 were incorporated into this study. This additional information, unprinted though, formed a useful component of the discussion. It takes participation in the forum’s proceedings for one to gain insight into the manner in which emotional out-bursts, intense arguments, and grievances of individuals are handled and amicably resolved in the most tactful and satisfactory manner.

Results

Within the study period, 75 complaints against dust pollution were documented by the CDM forum in Johannesburg. The annual trend of reported complaints showed the highest proportions in 1997 and 2006 (13.3% each). The second highest

proportion (12.0%) of complaints was reported in 2009 (Figure 2). Although few new complaints about dust pollution were reported in 2007 and 2008, some of the complaints in the previous years were follow-up cases.

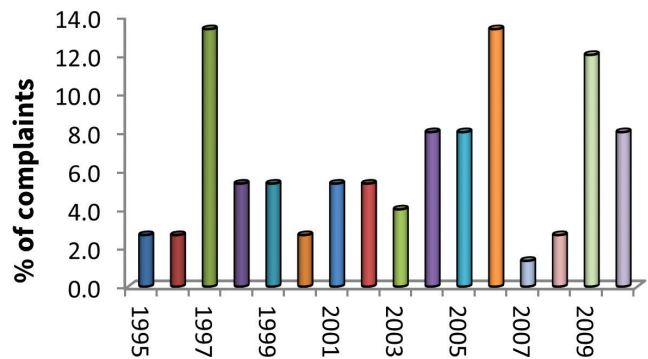


Figure 2: Annual trend of reported dust pollution complaints

Over the 16 year period considered in this study, reported complaints were more frequent from August to November (Figure 3). This period marks the transition from winter to spring, which is the dry and windy months in the study area, hence, the high frequency of complaints about mine dust pollution.

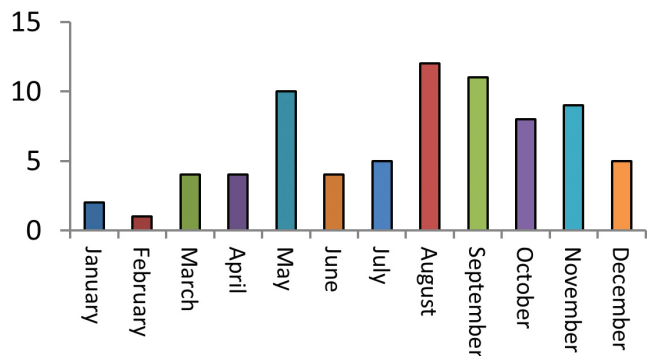


Figure 3: Monthly frequency of dust pollution complaints (1995-2010)

Seventy-two percent of the documented public complaints were reported by corporate organisations whose properties, operations and employees were affected by dust from mine facilities (Figure 4). Additionally, individuals, communities and government agencies brought 28% of the registered complaints to the CDM forum.

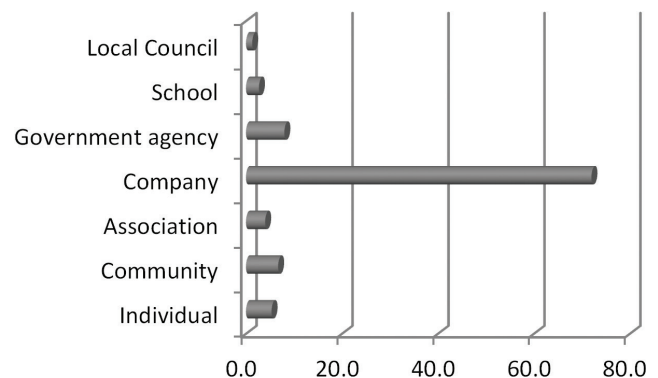


Figure 4: Profile of registered complainants at the CDM forum

While 52% of the complainants reported a pollution problem for the first time, other cases were follow-up to previous complaints already communicated to the concerned mines. Most complainants cited the nuisance caused by dust pollution (35%) and perceived health hazards (28%) as the motivation for registering their grievances against the mines (Table 1). Other reasons for filing cases against the mines included damage to factory equipment and property (17%), noise pollution (3%) and washing of mine materials into drains, roads and building premises (9%) among others. Whether real or perceived, mine dust pollution was indicated as the cause of irritation, discomfort, diseases and impaired human well-being.

Table 1: Nature of complaints reported to the CDM forum

Nature of the Complaint	Frequency	Percent
Dust deposition causing nuisance	26	34.7
Dust deposition and health concerns	21	28.0
Dust deposition, health hazard, property/equipment damaged	14	18.7
Dust deposition and Noise pollution	3	4.0
Mine materials washed on road, premises and drainage	7	9.3
Others	4	5.3
Total	75	100

The industrialists in areas affected by dust pollution attributed property damage and degradation, reduction in clients' patronage and the disruption of industrial processing to deposition of mine dust. They claimed that air-borne dust from mine tailings was deposited in their business premises, on vehicles parked within the premises and also, on offices' windowpanes. In the factories where manufacturing took place, damaged machines and contaminated production rooms were ascribed to mine dust pollution. Glass producing companies were at the fore-front of complaints against production room contamination. Dust pollution in the production environment is an inhibitory factor that could stall production. Hence, the limit of ultra-fine dust in the production room is set at 2930 microns (ISO Standard 14644).

Table 2: Media used for registering air pollution complaints with the CDM forum

Medium	First complaint	Follow-up	Issuance of ultimatum	Others	Total
Letter	16	6	1	2	25
Fax	11	11	0	1	23
Email	4	10	0	0	14
Telephone	6	4	0	0	10
Telephone / Email	0	1	0	0	1
Not mentioned	2	0	0	0	2
Total	39	32	1	3	75
Percent	52	43	1	4	100

About 65% of the registered complaints were communicated to the forum through physical letters and fax messages (Table 2). Other methods employed by the complainants to communicate their grievances against the infringement of their right to clean air were electronic mails (19%) and telephone calls (13%). These messages are normally printed and archived in the forum's register for discussion. After thorough consideration of each complaint, the final decision and follow-up activities are inscribed on hard-copies of the complaints.

In 32% of the reported cases, there were no clear indications of response time to complaints; the mines responded to 34% of the registered cases within a week (Figure 5). Twelve percent of the complaints received responses by indicted companies within two weeks and, another 12% between two to four weeks. In about 11% of the cases, concrete response to complaints took between one and two months. Considering the time lag between complaints and response, many complaints got delayed responses apart from 11 cases that received prompt attention from the mines.

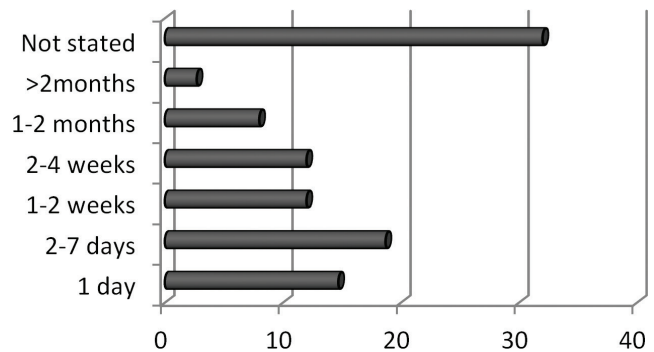


Figure 5: Response time of mines to pollution complaints

In addition to the time lag between complaint and response, the nature of the responses to pollution allegation is quite germane. For instance, it is pertinent to consider whether or not the responses were adequate to abate dust episodes and were satisfactory to the complainants. In 25% of the cases, the indicted mines explained to complainants the mitigation measures adopted for pollution control in their facilities (Table 3). Similarly, meetings were organised with affected and concerned communities in order to address their complaints and or resolved issues raised against the operations of the mining companies. Immediate intervention which entailed fixing malfunctioning dust suppressants, and installation of additional mitigation facilities were done only in a quarter of the registered cases. There were no specific actions taken with respect to 32% of the registered complaints, due to the unwillingness of mines to commit funds to solve the alleged pollution problem. In all cases where dust pollution allegations were traced by the mines to off-site activities such as open ground, road works and other non-mining sources, no specific actions were taken to control the pollution.

Only 3 of the registered cases escalated to litigation, threat of litigation and liability claims. However, it is possible that other

cases might have gone to court for legal processes without the knowledge of the CDM forum. Since the forum is a voluntary conflict resolution medium and hence, has no legal power to enforce actions on mines, complainants are at liberty to litigate against mines if they are not satisfied by the response received. The exercise of constitutional right of individuals and communities was not precluded by registering their grievances with the CDM forum. The fact that cases are considered objectively, realistic mitigation plans and timelines indicated and sometimes, immediate action were engaged at no cost to the complainant, positioned the forum as a viable alternative for conflict resolution in the study area.

Table 3: Responses of the mining companies to public complaints

Response of mines to complaint	Frequency	Percent
Explanation of adopted mitigation plan	5	6.7
Arrangement of site visit with concerned individuals	14	18.7
Installation of additional mitigation measures	11	14.6
Meeting held with concerned individuals for resolution	12	16.0
Immediate response for intervention	5	6.7
No specific action or response	24	32.0
Others	4	5.3
Total	75	100

Considering the proportion of cases (62.7%) that were resolved by the forum over the years, some level of success was achieved. The *modus operandi* of the forum, transparency and openness of the arbitration process, dissemination of seemingly technical information in comprehensible manner, and the friendly atmosphere in which proceedings are conducted are commendable and perhaps, enhanced the level of success achieved on the cases handled. Equally commendable is the effort of the forum in arranging the meeting of complainants and mining companies for mutual discussion so as to arrive at a feasible action plan, which is monitored by the forum.

Discussion

The variation in the number of new cases reported to the forum annually can be associated with the prevalent weather conditions and possibly, public awareness of the forum's activities. According to the analysis of rainfall pattern over the study area between 1978 and 2009, 1997 and 2006 were identified as dry years with rainfall amount (526 mm and 364 mm) below the overall average in summer (Dyson 2009). On the other hand, 2000 and 2007 with few complaints had higher rainfall (793 mm and 708 mm) during summer.

The fact that August and September mark the transition from winter to spring, which is the dry months in the study area, explains the prevalence of complaints about mine dust pollution within the period. While it is true that operating

mines employ mitigation measures to curtail dust emission from the tailing facilities, the dry conditions of spring make dust readily available for air-lifting that results in dust episodes (Annegarn and Sithole 2002, Preston-Whyte and Tyson 1988). Closely related to the paucity of rainfall between August and September is the increasing average monthly wind speed in the study area. From the weather data of Johannesburg (South Africa Weather Service, 2014) from 2001–2010, the average wind speed increased from 4.0 to 4.6 m/s within the dry months. As predicted by Annegarn *et al* (1991) and Oguntoke *et al* (2013), a wind speed ≥ 4 m/s was critical for dust episode incidence.

Moreover, mines re-processing old tailings for further gold extraction produce finer dust particles that are capable of being transported over longer distances (Ozkan and Ipekoglu 2002). Generally, residents reacted negatively to dust pollution once dust episodes formed plumes that caused irritation and concerns of possible negative health consequences. The mines will require greater effort in the dry and windy months to suppress dust emission from tailings by engaging integrated tailing management strategies.

High intensity of dust-fall in non-residential areas and the fact that companies, being corporate entities, are better informed and more capable to pursue legal issues may explain their higher visits to the CDM forum. The voice of a community or interest group is considered stronger than the single voice of an individual when seeking redress against the infringement of their rights by multi-national companies. Hence, individuals seek the support of their community, associations, and government agencies to register complaints of right abuses on their behalf. For example, Kerona, a Community-based Association and Redirile Development Project lodged a complaint against dust pollution from a mine dump in Diepkloof (May 2004), after harvesting signatures of more than 300 people in the community that supported the complaint. This observation agrees with the submission of Liu *et al* (2011) that a collective complaint is preferred by the citizens against environmental pollution.

The specific ailments attributed by the complainants to mine dust exposure included asthma, breathing difficulty, sore throat, cough, irritation, bronchitis, sneezing, tuberculosis, lung cancer, and eye, skin and hearing problems. Other issues raised as a basis of lodging complaints were vehicular accidents due to poor visibility caused by dust, fear of cyanide residues in the environment and general hazards. The fear of the complainants, whether real or perceived that mine dust is hazardous agrees with the submissions of Naicker *et al.* (2003), Bright (2007) and ATS (1997) that exposure to respirable mine dust that contains silica poses health hazard to humans living within the vicinity of TSFs.

A critical evaluation of the response time of the mines to pollution allegations showed unacceptable delay. A situation where more than half of the complaints did not receive immediate response is tantamount to serious violation of the right of affected individuals.

Conclusion

Over the years, the public living around mine dumps in the Witwatersrand area have been exposed to dust pollution from TSFs. In an effort to resolve the ensuing grievances and create easier access to their environmental rights, the CDM forum was inaugurated. Complaints against mine dust pollution were received by the forum, registered, processed and followed-up until some respite was received by the complainants. This enhanced public confidence in the forum particularly as litigations to redress environmental pollution are tricky and often fail due to lack of evidence.

Although, the forum provided an avenue for resolution of environmental conflicts in a pragmatic and mutually beneficial manner, the right of the public to a clean and healthy environment is not being realised fully. The gold mining companies operating in the area need to demonstrate greater commitment to pollution control so as to protect the public's environmental rights.

While the CDM forum is not an official or legal body, it should be accorded the support of the government in view of the valuable services it provides in respect of environmental conflict resolution. For instance, the agencies of government that are directly connected with mine operations and environmental monitoring should take special interest to follow-up cases that are reported to the forum. The forum is capable of providing first-hand information on areas that require immediate and urgent intervention for community protection and environmental preservation. Furthermore, the achievement of sustainable development in the mining industry, which centres on maximising net environmental and human welfare, is enhanced.

Acknowledgement

We sincerely appreciate the information made available to us by the Crown-Mines Dust Monitoring forum (now, ERGO Gold Dust Monitoring forum). Special thanks to the Secretary of the forum for her painstaking record keeping. The opinions expressed by various attendees over the study period have been of tremendous benefit to us.

References

American Thoracic Society-ATS 1997, Adverse effects of crystalline silica exposure: American Thoracic Society Committee of the Scientific Assembly on Environmental Occupational Health. *Am J Respir Crit Care Med.* 155: 761–765.

Annegarn H.J. and Sithole S.J. 2002, Dust Monitoring and Mitigation on Gold tailings reclamation. Paper presented at Mine Ventilation Society Symposium, 1-13.

Annegarn HJ, Surridge AD, Hlapolosa HS, Swanepoel DJ, Horne AR. A review of 10 years of environmental dust monitoring at

Crown Mines. *Journal of the Mine Ventilation Society of South Africa* 1991; 43: 46–60.

Bingham G. 1986, *Resolving Environmental Disputes: A decade of experience.* The Conservation Foundation, Washington D.C. 1-12.

Carvalho D.S. and Fidélis T. 2011, 'Citizen complaints as a new source of information for local environmental governance', *Management of Environmental Quality: An International Journal*, 22(3): 386 – 400.

Dong Y., Ishikawa M., Hamori S. & Liu X. 2011, The determinants of citizen complaints on environmental pollution: An empirical study from China. *Journal of Cleaner Production*, 19: 1306-1314.

Dyson L.L. 2009, Heavy daily-rainfall characteristics over the Gauteng Province. *Water SA (Online)* 35(5), Available from <http://www.scielo.org.za/scielo.php?pid=S1816-79502009000500011&script=sciarttext#nt> (accessed June 12 2012)

ISO Standard 14644-1, Clean room class limits for particulates. Available online at: http://www.engineeringtoolbox.com/clean-rooms-iso-d_933.html (accessed July 18 2012).

Lee J.C. 2008, 'Pollute first, control later' No more: Combating Environmental degradation in China through an approach based in Public interest litigation and public participation. *Pacific Rim Law & Policy Journal Association*, 7(3): 795–823.

Liang M. 2012, Pollution Severity, Alternative Judicial Channels, and Citizens' Environmental Complaints: Evidence from Chinese Provinces. Paper prepared for the 3rd Global Forum of Chinese Scholars in Public Administration, Shandong University, Jinan, June 1-3, 2012.

Liu X., Dong Y., Wang C., & Shishime T. 2011, Citizen Complaints about Environmental Pollution: A Survey Study in Suzhou, China. *Journal of Current Chinese Affairs*, 3: 193-219.

Mann C. J. 2003, Observational research methods. Research design II: cohort, cross sectional and case-control studies. *Emergency Medicine Journal* 2003; 20: 54-60

Naicker K., Cukrowska E. & McCarthy T. 2003, Acid mine drainage arising from gold mine activity in Johannesburg, South Africa and environ. *Environmental Pollution*, 122: 29–40.

O'Connor T.G. and Bredenkamp G.J. 1997, Grassland. In *Vegetation of Southern Africa.* Cowling, R.M., Richardson, D.M. and Pierce, S.M. (eds). Cambridge University Press, Cambridge. 215-257.

Oguntoke O., Ojelede E.M and Annegarn, J.H. 2013, Frequency of mine dust episodes and the influence of meteorological parameters in the Witwatersrand area, South Africa. *International Journal of Atmospheric Sciences*, 1: 1–19.

Ojelede M.E. and Annegarn H.J. 2010, The implications of aeolian emissions from gold mine tailings on ambient air quality: the Witwatersrand scenario. A paper presented at the Waste Revolution Seminar Series: Mining, Witbank, 4 November 2010. Available at http://alive2green.com/conference-presentations/MiningWaste2010/MatthewOjelede_the%20implications%20of%20aeolian%20emissions%20from%20gold%20mine%20tailings%20on%20ambient%20air%20quality%20the%20Witwatersrand%20scenario.pdf

Ozkan S. and Ipekoglu B. 2002, Investigation of Environmental impacts of tailings dam. *Environmental Management and Health*, 13(3): 242-248.

Preston-Whyte R.A. and Tyson P.D. 1988: The Atmosphere and Weather of Southern Africa. Oxford: Cape Town.

Rossouw A.S., Furniss D.G., Annegarn H.J., Weiersby I.M., Ndolo U. & Cooper M. 2009. Evaluation of a 20-40 year old mine tailings rehabilitation project on the Witwatersrand, South Africa. Mine Closure (Fourie AB, Tibbett M.: Eds.) Australian Centre for Geomechanics, Perth; 123-136.

SANS-1929. 2005, Ambient Air Quality – Limits for Common Pollutants, SANS 1929: 1.1, 13-14, Pretoria, South Africa.

Schulze, R.E. 1997, *South African Atlas of Agrohydrology and -climatology*. Water Research Commission, Pretoria, South Africa. Report TT82/96.

South Africa Government Gazette (No. 32816, volume 534) of 2009. As available from [http://www.google.com/l?sa=t&rct=j&q=South+Africa+Government+Gazette+\(No.+32816,+volume+534\)+of+2009](http://www.google.com/l?sa=t&rct=j&q=South+Africa+Government+Gazette+(No.+32816,+volume+534)+of+2009) (accessed May 27, 2013)

South African Weather Service 2011, Hourly Rainfall, Temperature, Wind Speed, Wind Direction, Humidity and Pressure Data (1985–2010). Weatherline: 082 162

The Constitution of the Republic of South Africa, Act 108 of 1996. As seen in Environmental Right available from http://www.sahrc.org.za/home/21/files/Reports/4th_esr_chap_8.pdf (accessed May 7 2013)

The World Bank Group (WBG), 2011. Alternative Dispute Resolution Guidelines. Investment Climate Advisory Services of the World Bank Group, 1818 H Street, N.W., Washington D.C. 20433.

Wright C.Y., Matooane M., Oosthuizen M.A. & Phala N. 2014, Risk perceptions of dust and its impacts among communities living in a mining area of the Witwatersrand, South Africa. *Clean Air Journal*, 24(1): 22-27.