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Awareness and Attitude Among College Students Towards Climate Change in Kashmir

Bilal Ahmad Bhat

Abstract

Climate change is supposed to adversely impact freshwater resources, and in many settings these impacts are already evident globally. In this paper, we examine the knowledge and attitudes of college students of Kashmir valley about the causes, effects, and priority given to climate change. The study compromised of 400 students selected at random from different Colleges of Kashmir valley using a well designed questionnaire based on the literature available on the topic and validated by experts. The data collected was analysed using standard statistical tools. The results obtained from our study reveals that the students under study have low climate change awareness and attitude. Further, it was observed that statistically there is no significant difference between the male and female students mean score on climate change awareness and attitude. Finally, recommendations of the study were discussed and suggestions for further studies were made. The results obtained in our study are in agreement with the previous study (Bilal et al. 2017).

Keywords: Climate Change; Awareness; Attitude; Student; Statistics; Kashmir Valley.

Introduction

The state of Jammu and Kashmir is located in the northern part of the Indian subcontinent in the vicinity of the Karakoram and westernmost Himalayan mountain ranges. The state has been the subject of dispute between India, Pakistan, and China since the partition of the subcontinent in 1947.

The state of Jammu and Kashmir, formerly one of the largest princely states of India, is bounded to the northeast by the Uygur Autonomous Region of Xinjiang (China), to the east by the Tibet Autonomous Region (China) and the Chinese-administered portions of Kashmir, to the south by the Indian states of Punjab and Himachal Pradesh, to the southwest by the country Pakistan, and to the northwest by the Pakistani-administered portion of Kashmir known as Azad Kashmir.

The administrative capitals are Srinagar in summer and Jammu in winter. The present area is 39,146 square miles (101,387 square km) and population as per Census report 2011 is 12,541,302. The vast majority of the Jammu and Kashmir state's territory is mountainous, and the physiography is divided into seven zones that are closely associated with the structural components of the western Himalayas.

The climate of the state varies from alpine in the northeast to subtropical in the southwest. It is important to mention here that from southwest to northeast those zones consist of the plains, the foothills, the Pir Panjal Range, the Vale of Kashmir, the Great Himalayas zone, the upper Indus River valley, and the Karakoram Range. The climate varies from alpine in the northeast to subtropical in the southwest. Kashmir is world wide known for its beautiful natural resources (Figure 1.

According to Small and Nicholis (2003), climate is defined as the average weather for a particular region over a long time. This includes average weather conditions, regular weather season (winter,

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spring, summer and fall) and special weather events (like tornadoes and floods). These climate patterns play a fundamental role in shaping natural ecosystems, and the human economic and cultures that depend on them. Climate reflects changes state of the atmosphere over time scales ranging from decade to thousands of years.

In the literature (Nwagu & Nzewi, 2009; Udenyi, 2010; Okebukola & Akpan 2009; Uzochi, 2009) discussed in detail climate change. The contact of human activities to the climate change comes as a result of excessive emission of greenhouse gases (GHGs) into the atmosphere. It is reported that increasing rate of climate change has severe consequences associated with it such as desertification, drought, temperature rise, low agriculture yield, drying up of water bodies, flooding among others (Oruonye, 2011).

In the literature, we notice various definitions of awareness and attitude. Oragwam (2004) defined awareness as a state of consciousness and purpose. Further, Chinedu (2008) viewed awareness as the condition of being aware and able to understand what is happening around one.

According to Agiande (2006), attitude is an acquisitioned tendency. For Williams (2000), attitude is readiness to act in a certain way expressed by a person's words, gestures or facial expression. In view of the above discussions, attempt has been made to increase students' awareness and attitude towards climate change in educational institutes of Kashmir valley. People seem to have continued perpetuating actions such as bush burning, deforestation, burning of fossil fuel like petrol, coal, and crude oil which are responsible for climate change.

It is important to note that as these human actions continue, so shall the consequences of climate change continue to face human beings on earth. In this paper, an attempt has been made to assess the students' awareness and attitude towards climate change in Kashmir valley.

Methodology

In the present study carried out in Kashmir valley, a well designed questionnaire based on previous literature was used to collect the information from 400 college going students studying in various Colleges of Kashmir valley using stratified random sampling technique. The data collected was analysed using standard statistical tools.

In this study, based on the four-point scale, a mean score of 2.50 was used as the benchmark of the study. Therefore, any item that scored below 2.50 was rejected while the items that scored 2.50 and above was accepted. Mann-Whitney U test was used to compare the opinion of male and female respondents.

Results and Discussion

Fig. 1: Dal Lake and Gulmarg, Jammu and Kashmir State

The results of the present study are presented in the following tables:

Table 1: *Result of mean and standard deviation analyses of the climate change awareness*

S.No	ITEM	MEAN	SD	DECISION
1	Climate is dynamic and always changing through natural cycle.	2.423	.421	Disagree
2	Climate change is a measurable increase in the average temperature of earth's atmosphere.	2.854	.483	Agree
3	Change in weather condition over an extended period of time is climate change.	1.812	.423	Disagree
4	Climate change is characterized with high temperature.	2.552	.427	Agree
5	Climate change comes with rise in sea level.	1.656	.413	Disagree
6	Climate change is characterized by desertification.	1.749	.482	Disagree
7	Most streams in Kashmir are drying up as a result of climate Change	1.762	.523	Disagree
8	Most springs in Kashmir are drying up as a result of climate change.	1.711	.443	Disagree
9	There is decrease in agricultural products in Kashmir.	1.673	.427	Disagree
10	I have heard of climate change before.	3.24	.415	Agree
11	The rate of sunshine is higher now than before.	2.591	.471	Agree
12	The weather seems to be hotter nowadays.	2.721	.463	Agree
13	The atmospheric heat level is higher now than before	2.831	.483	Agree
14	There is increased rate of rainfall.	1.943	.424	Disagree
15	Cases of flooding occur more nowadays.	2.972	.423	Agree
	Total	**2.269**		

The data presented in Table 1 reveals that in response to statements 1,3,5 to 9 and 14 the students under study disagree. Further, it is observed that the overall climate change awareness mean score of college students is 2.269 which is less than 2.50 mean benchmark of the study. This indicates that the students possessed low climate change awareness. This finding of our study are in line with Ishaya and Obaje (2008), Oruonye (2011) and Bilal et al (2017) who found out that the students posses low level of climate change awareness.

Table 2: *Result of mean and standard deviation analyses of the students attitude towards climate change*

S.No	ITEM	MEAN	SD	DECISION
1	I belief that there is still plenty of time to prepare for climate change problems.	2.589	..432	Agree
2	I think climate change will bring a period of great adversity.	1.919	.542	Disagree
3	I am seriously concerned with what problem climate change may bring.	1.586	.631	Disagree
4	I think no special preparation is needed for climate change.	2.798	.672	Agree
5	I believe climate change will pass like other environmental problems, so there is no need to worry.	3.321	.521	Agree
6	I am working hard to educate my friends on climate change.	1.596	.413	Disagree
7	I am spreading news of climate change within my area.	2.421	..651	Disagree
8	I am preparing myself to manage the effects of climate change.	1.541	.612	Disagree
9	I always ask questions on climate change.	2.672	.711	Agree
10	I read available information on climate change.	2.687	.649	Agree
11	I preach to my friend against bush burning to prevent further global climate change.	1.812	.441	Disagree
12	I do not think that global climate is changing.	1.941	.523	Disagree
13	I think responding to climate change will be a waste of my time.	3.371	.597	Agree
14	I think participating in climate change related issues will lead to Waste of national resources.	3.394	.462	Agree
15	I believe climate change will only affect those who caused it.	2.321	.583	Disagree
	Total	**2.382**		

The data presented in Table 2, shows that in response to statements 2,3,6, 7,8, 11, 12 and 15 college students disagree. Further, it is noticed that the total mean score of 2.382 was obtained for students attitude towards climate change. This means that the college students' attitude towards climate change is low. The finding of our study are in agreement with earlier studies e.g., Oruonye (2011), Ishaya and Obaje (2008), Bilal et al (2017).

Table 3: Comparison between male and female students towards *climate change awareness*

Gender	Mean	Std. Deviation	N	P-value
Boys	2.342	.242	200	>0.05
Girls	2.372	.173	200	

Result in Table 3 reveals that the climate change awareness mean score of male college students is 2.342 with a standard deviation of .242 while the female students mean score is 2.372 with a standard deviation of .173. The result showed that the total mean score for male and female students on climate change awareness is 2.357. This implies that both the male and female students have low climate change awareness. The study showed that there is no significant different between the climate change awareness mean score of male and female students ($p>0.05$).

Table 4: Comparison between male and female students towards *climate change attitude*

Gender	Mean	Std. Deviation	N	P-value
Boys	2.243	.156	200	>0.05
Girls	2.231	.113	200	

Result presented in Table 5 reveal that the male college student's attitude towards climate change mean score is 2.243 with a standard deviation of .156 while the female student's attitude mean score is 2.231 with a standard deviation of .113. The result showed that the total mean score for male and female college student's attitude towards climate change is 2.237. This means that both the male and female students have low attitude towards climate change. Further, it is observed that statistically non- significant difference was observed between male and female students in the climate change attitude.

Table 5: Comparion between urban and rural students towards climate change awareness

Location	Mean	Std. Deviation	N	P-value
Urban	2.571	.245	238	<0.05
Rural	2.349	.221	162	

Result in table 5 reveals that the urban students awareness of climate change mean score is 2.571 with a standard deviation of .245 while the rural students awareness mean score is 2.349 with a standard deviation of .221. The result showed that the total mean score for urban and rural student's awareness of climate change is 2.46. This result indicated that rural students have low awareness than urban students. Statistically, there is a significant different between the climate change awareness mean score of urban and rural students ($p<0.05$).

Table 6: Comparion between urban and rural students towards climate change attitude

Location	Mean	Std. Deviation	N	P-value
Urban	2.441	.153	238	<0.05
Rural	2.181	.103	162	

Result in table 6 reveal that the urban students attitude towards climate change mean score is 2.441 with a standard deviation of .153 while the rural students attitude mean score is 2.181 with a standard deviation of .103. The result showed that the total mean score for urban and rural students attitude towards climate change is 2.311. This result indicated that both the urban and rural students have low attitude towards climate change. Statistically, there is a significant different between the climate change attitude mean score of urban and rural students. The results obtained in our study are in agreement with the earlier studies (Edema et al 2015)

Table 7: Genderwise response to "human activity is responsible for climate change".

Gender	Strongly agree	Somewhat agree	Don't know	Somewhat disagree	Strongly disagree	No response
Boys	119 (59.5)	53 (26.5)	11 (5.5)	5 (2.5)	9 (4.5)	3 (1.5)
Girls	123 (61.5)	45 (22.5)	13 (6.5)	8 (4.0)	7 (3.5)	4 (2.0)

Chisquare=1.971, p-value>0.05

The data presented in Table 7 reveals that both boys as well as girl respondents strongly agree that human activity is responsible for climate change. Statistically, there is non-significant difference in the responses of boys and girls students ($p>0.05$).

Table 8: Gender wise response to "Top environmental issues in Kashmir"

S.No.	Statement	Boys	%	Girls	%	Chisquare	P-value
1	Pollution	65	32.5	71	35.5	4.845	>0.05
2	Overpopulation	26	13.0	21	10.5		
3	Urbanization	34	17.0	23	11.5		
4	Deforestation	29	14.5	36	18.0		
5	Climate change	33	16.5	31	15.5		
6	Recycling	5	2.5	6	3.0		
7	Environmental Education	4	2.0	7	3.5		
8	Others	2	1.0	3	1.5		
9	No response	2	1.0	2	1.0		

The data shown in Table 8, reveals that in case of boys majority of the respondents 32.5% prioritized pollution as main environmental issue, followed by urbanization (17.0%), followed by climate change (16.5%), followed by deforestation (14.5%), followed by overpopulation (13.0%), followed by recycling (2.5%), followed by environmental education (2.0%), followed by others and non-response (1.0%). Further, in case of girls majority of the respondents 35.5% prioritized pollution as main environmental issue, followed by deforestation (18.0%), followed by climate change (15.5%), followed by urbanization (11.5%), followed by overpopulation (10.5%), followed by environmental education (3.5%), followed by recycling (3.0%), followed by others (1.5%) and non-response (1.0%). Statistically, there is a non-significant difference between boys and girls respondents ($p>0.05$). The results are in agreement with the earlier studies (Edema Ojomo et al 2015, Bilal et al, 2017).

Conclusion

It is concluded from our study that college students from Kashmir valley possessed low awareness of climate change and have low attitude towards climate change. It is observed that there is no significant difference in the climate change awareness and attitude in mean score of male and female students. Further, the results obtained from our study reveals that there is significant different in the climate change awareness and attitude in mean score of urban and rural students.

Recommendations

It is recommended that relevant subjects should be promoted in colleges that could be useful to promote students climate change awareness and attitude. It is important that government and other relevant non-governmental organizations should organize and or support conferences, workshops and seminars directed at exposing the scholars/ teachers on the need to reflect climate change causes and effect effectively each time environmental relevant contents in their subject are being taught in educational institutions. There is need for stakeholders in education curriculum planning particularly for the school education to consider, as a matter of necessity, the infusion of more contents that could help the students to understand the causes and effects of climate change into the relevant subjects in senior secondary schools. Further, it is important that Government and non-governmental organization should ensure that quality education activities are carried out in rural areas as it is obtainable in urban areas of Kashmir. It is suggested for further study, sample size should be taken large in order to get a good picture about the awareness, attitude and role played by students towards climate change awareness.

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Original Article

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Waste Minimisation Programmes in South Africas Secondary Mining Towns

Leon Rodney Kenny[1], Tabukeli Musigi Ruhiiga[2]

Abstract

The study was carried out in order to describe the waste minimisation programmes in place in the respective local municipalities in order to minimise the amount of waste entering landfill sites. The study area covered four provinces and for each province a single local municipality with a major mining town was selected. The study areas selected were; Klerksdorp in the North West Province; Carletonville in the Gauteng Province; Witbank in the Mpumalanga Province; and Welkom in the Free-State Province. On the basis of these results, the following findings are specified. The key findings of the study indicate that the selected study areas do not seem to have precise and clear programmes that are solely and specifically aimed at minimising waste. Instead the financial management and asset management strategies are initiated to overhaul the entire out-dated municipal systems. As a result one of the drawbacks is that the waste management systems indirectly benefit although these are not direct programmes aimed at the waste management systems. Observations suggest that suitably qualified persons should manage in-house programmes and other programmes as these have a major impact in educating people about waste minimisation. The organisational set up of local municipalities does not give adequate space and autonomy to the waste directorate. This has an adverse effect on the recruitment, retention and development of specialist skills.Waste management does not receive adequate budgetary support from local municipalities and, this constrains the ability of waste directorates to up-grade current systems and to improve their record of service delivery.Waste minimisation is a critical element of long-term government goals to protect the environment; yet, it does not receive much attention from senior management across local municipalities.

Keywords: Waste minimisation; Minimisation programmes; Landfill sites; Recycling initiatives

Introduction

According to the Department of Water Affairs and Forestry, (DWAF, 2011) waste is an inevitable consequence of development; and hence it must be managed in an integrated and sustainable manner. As the population increases and development takes place, a concomitant increase in waste generation is expected. There are a number of problems associated with increased waste generation such as the additional risk of air, soil and water pollution, and lack of suitable locations for landfill sites. In order to prolong the life of current landfills and optimally manage new ones, the waste disposed to landfill sites has to be minimised. The vision of the Polokwane Declaration (DEAT, 2012) is to reduce waste generation to 50% of current levels and for zero waste by 2022. In order to manage waste in a sustainable manner, waste management must consider the waste stream in a holistic manner, in order to optimize the use of resources and to reduce the environmental impacts (Novella, 2000). Thus an integrated approach which combines a number of techniques such as waste reduction, reusing and recycling has to be considered. One of the mechanisms to resolve this problem is to identify what portions of the waste stream can most readily be minimised and recycled. To do this effectively, a quantitative understanding of the total waste stream is necessary. Aspects that will need to be addressed include the identification of the waste stream sources and an assessment of the waste stream composition, as well as the quantification of the main waste streams for each of these sources. Certain waste streams could be targeted for recycling like the high income domestic streams

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due to their high content of packaging material and those streams that are not suitable for recycling, such as low income domestic streams due to high ash and sand content (DEAT, 2012).

Problem statement

The Department of Water Affairs and Forestry has developed an overall waste generation profile for each of the provinces (DWAF, 2011), which gives a first-order assessment of waste generation in South Africa. There is clearly a need for accurate up-to-date data on waste generation and waste disposal to landfills. This need has been articulated in the National Waste Management Strategy and the Action Plans for a Waste Information System and Integrated Waste Management Planning. It was proposed that local authorities collect and report waste generation rates, waste categorisation and identification of waste streams that have potential for recycling. It is recognised that there are practical constraints such as the unavailability of functioning weighbridges at most medium, small and communal landfills. The security risk comes into play at those landfill sites with weighbridges but no 24-hour armed security personnel. There are financial implications of providing, maintaining and protecting weighbridges. It was proposed that a first round of Integrated Waste Management Plans should be prepared. However, since this was not a legislated requirement, few local authorities have as yet completed their IWMPs, nonetheless, major metros such as Johannesburg, Cape Town, eThekwini, and Tshwane, as well as a number of other cities and towns have initiated the process of compiling IWMPs, and the required information should become available (DEAT, 2011). Recycling has the potential for job creation and is a viable alternative to informal salvaging at landfills, which is undesirable due to the associated problems of health and safety.

Research purpose

The purpose of this research is to describe the waste minimisation programmes that have been implemented in the study area.

Objectives

The following objectives are advanced:

1. To assess the current waste minimisation programmes implemented at the study areas.

2. To describe the amount of waste being generated and ultimately landfilled.

Hypotheses

H_1: There is a close relationship between the volume capacity of municipal landfill sites (x) and the annual volume of the waste disposed at landfill sites (y) in each study.

H_2: There is a consistent relationship between the resident population and the totality of landfill sites in the study area. In each of these hypotheses, the null hypothesis H_0 suggests the view that such relationships do not hold.

Rationale

A number of new developments South Africa in the political, policy and legislation fields, the Constitution (GSA, 2010), the Environmental Management Policy (DEAT, 2011), the National Environmental Management Act (GSA, 2010), the Integrated Pollution and Waste Management Policy and the National Waste Management Strategy, resulted in a re-appraisal of the recycling situation. Integrated waste management requires the implementation of a hierarchical approach to waste management, involving a sequential application of waste prevention, minimisation, re-use, recycling, treatment and ultimately disposal. Hence, recycling is an integral part of the way waste management is being implemented in South Africa (Peter and Duneed, 2013). The majority of commercial waste recycling initiatives have been developed on an ad-hoc basis and have been funded by the private sector, with minor financial inputs from the provincial and local governments. The local municipalities have tried to stimulate waste recycling by assisting with establishing waste buyback centers and garden waste drop-off centers in the larger cities and towns, at which waste is separated into different waste streams, such as glass, paper and cardboard, cans, scrap metal, plastics and garden waste (Mukawi, 2009). A number of capital-intensive recycling plants have been launched but have been unsuccessful in Klerksdorp and Witbank. Although these plants worked from a mechanical point of view, their failure has been attributed to an over-estimation of the value of recoverable materials, unrealistic requirements of the municipalities involved, and a downturn in the economy at the time the projects were launched. Due to the large quantities of recyclable materials in the waste arriving at landfill sites, informal salvaging is widespread (Leonard, 2009). This practice leads to unacceptable health and

safety risks for the salvagers, as well as operating problems for the landfill staff. The implementation of successful recycling initiatives is not a short-term activity but rather an ongoing initiative that must be reviewed and revised based on experience. An ongoing campaign will be required to change people's behaviour and to take responsibility for their waste.

Background

Johannesburg has experienced flooding, heat waves, hailstorms and other extreme weather conditions. Besides its other impacts environmental pollution produces greenhouse gases, which are considered to be a major influence in climate change (Ecotec, 2011). As a result, the City of Johannesburg is ensuring that the environmental pollution impacts stemming from waste are averted and that greenhouse gas emissions are reduced. The City's integrated waste management operation incorporates waste separation at source, garden dumping sites and composting plants. In addition, Johannesburg has successfully implemented two landfill gas-to-energy projects (Smith and Scott, 2009). At the Robinson Deep landfill site and the Marie Louise project, landfill gas is extracted, combusted and flared as carbon dioxide, to generate electricity. In the near future a total of 19MW of electricity will be generated from five landfill sites, enough power for about 12500 middle-income households. The waste separation-at-source project encouraged residents to separate their waste - paper goes into orange bags and recyclables like bottles and cans in colourless bags (Skumatz, 2008).

The city of Johannesburg has created garden dumping sites for the disposal of light garden waste, where it's chipped into manageable sizes and transported to a composting plant. The composting plant processes about 150,000 tonnes of green waste per year into soil-enhancing compost. This compost is then sold to the agricultural sector and to city homeowners for suburban gardens. The city of Johannesburg is currently disposing of about 1.6 million tonnes of waste in the four operational landfill sites. On the other hand as a result the city is spending much on transportation costs, which also contributes to air pollution and greenhouse gas emissions from the trucks used in this process. The landfill gas-to-energy projects minimise environmental damage by reducing methane emissions. Methane is sucked through the combination of vertical and horizontal pipes to the flare system where it is burnt and carbon dioxide which is less harmful than methane gas is released (Patton, 2009). The Robinson Deep landfill was completed in May 2011. For this project, 68 gas wells were installed in the first phase and this number will be increased during the second phase of the project. The project has produced 137,888 Certified Emission Reductions (CERs) and destroyed 18,288,457m^3 of landfill gas, which would have otherwise been released into the atmosphere. Construction of the Marie Louise project commenced in February 2012 with 28 wells being installed (Lehtoranta, 2010). By 2015 a total 19,042 CERs were amassed and 3,157,656 m^3 of landfill gas was destroyed since May 2012. Eventually a total of 19MW of electricity will be generated at five landfill sites, which could power about 12,500 middle-income households (Leeuwen, 2011). Construction for the three remaining sites of Goudkoppies, Ennerdale and Linbro Park will commence in the near future. In October 2013, the Department of Energy approved the project and agreed to sign a Power Purchase Agreement (PPA) with Eskom for 18MW contribution as part of the Independent Power Producers programme (McGurty, 2011). The project was registered with United Nations Convention on Climate Change (UNFCCC) in December 2012 wherein it can start selling carbon credits accrued from date of commissioning of the sites under the Kyoto Protocol. The City of Cape Town has managed to divert 10 million cubic meters of garden refuse from going to landfill. The City recently celebrated the major milestone in the war against waste, which it achieved in partnership with Reliance, the leading organic compost provider in the Western Cape. Cape Town's solid waste landfill sites are quickly filling up and waste will need to be transported to sites outside of the municipal boundaries in the near future at a significant cost. Reliance was contracted to shred green garden refuse collected from the city's drop-off facilities and landfills in 2001 and has been taking care of Cape Town's green waste since. Reliance recycles garden refuse into compost and has put over 750 000 tons of organic compost back into the soil. The company's zero organic waste to landfill mission is in line with the City's vision. Reliance is carbon neutral and has had its composting technology approved as a Greenhouse Gas Emission Reduction method according to the guidelines of the United Nations Framework Convention on Climate Change (Mechelson, 2009).

In Port Elizabeth, the municipality decided to launch a campaign in 2008 to stop the waste to landfill

practice by asking residents not to dump waste but rather exchange it to save the environment. It was called the NMB Waste Exchange, and is one of the waste reduction projects of the Integrated Waste Management Plan. It is a free web-based system that enables generators and users of waste material to exchange waste material at no cost to them, thereby reducing waste to landfill. Once a user is registered on the system, they can either post a listing or advert for wanted waste material or search on the listings of unwanted waste material posted by other users (Lynes, 2011). Waste material can be anything that can still be used by someone else such as cardboard boxes, left over building material, recyclables, wood, obsolete furniture or building rubble, to name just a few. By signing up and taking part, residents helped the Port Elizabeth municipality reduce the carbon footprint while improving their business environmental and social responsibility image (McCool and Stanskey, 2011).

Landfill sites are growing at a rapid rate and waste has direct and indirect impacts on human and ecosystem health, including contamination of surface and ground water. In addition, methane emissions from waste contribute to the greenhouse gas emissions profile of South Africa. These impacts could be significantly reduced with improved waste management practices. Although the secondary cities do not have the same resources as the metropolitan areas, many programmes can still be implemented that suit localised needs and addresses the issues affecting particular municipalities (Shen and Tam, 2010).

Methodology

This section looks at the programmes that have been identified, implemented or initiated at the different local municipalities. These programmes are aimed at maximising and aiding already established mechanisms in minimising the amount of wastage from entering the waste stream and ultimately landfill sites. These programmes are applied throughout the entire waste chain and should largely be applied at the different phases of the waste hierarchy to ensure its effectiveness and efficiency. A programme evaluation was developed that specifies key performance areas (KPA) and used to measure the performance of these programmes. These were linked to actual waste minimisation programmes that were initiated and implemented in each of the study areas.

Population and data sources

The landfill sites in each of the study areas were selected based on their status of being licensed and permitted according to Chapter 5 of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008). These sites conform to certain practices and standards and comply with national and local legislations. Non-permitted landfill sites and illegal sites were discarded as they are not recorded and the local municipalities have no control over them. They do not comply with national legislations and municipal by-laws. In the Klerksdorp Local Municipality only the Klerksdorp landfill site was selected, in the Carletonville Local Municipality only the Rooipoort Landfill site was selected, in the Witbank Local Municipality only the Ga-Nala and Phola landfill sites were selected and in the Welkom Local Municipality only the Virginia, Henneman, Odendaalsrus and Welkom landfill sites were selected.Each local municipality was found to have its own programmes in place but the more common characteristics were selected for the design of a standard table used in the evaluation of these programmes.Data for this subject matter was derived from the waste directorates of each study area. This was further reinforced with data obtained from: the Integrated Development Plan (IDP); the Integrated Waste Management Plan (IWMP); Annual Reports (AR); Local Economic Development Plan (LEDP) and waste management plans of the respective directorates.

Results and discussions

Financial mana.gement strategies programmes (FMS programmes)

Financial management strategies are programmes that have a lot of capital injected into them and are usually long term financial commitments. A series of processes are involved in authorising such projects and they benefit entire regions. They are commitments usually undertaken at higher command levels. Table 1 shows the most significant financial management strategies programmes that to date have been identified for all the four municipalities. Firstly is the on-going review of the computerised financial system. The integration of such a computerised systems and the purchase of the required hardware and software within the local municipality ensures that captured information is accurate, relevant

and prompt. This will in turn will facilitate the smooth running and effective management of the municipality. Second is the upgrading of the "Venus" software that is being currently used at the municipalities, to the "solar" software and this will greatly improve the operating systems. This software is used to generate the required job cards and improve responses in tackling outstanding issues. Thirdly is the development of a generally recognised accounting practices (GRAP) compliant and medium term revenue expenditure framework (MTREF) budget. These programmes are also aimed at reviewing and updating asset, budget and accounting policies and procedures.

The objectives of such programmes as indicated in Table 1 will be to regularly ensure that the financial and other staff members receive the required training they require to ensure a cost effective and efficient service to the municipality and its customers. It will improve budgetary controls and timeline of financial data. Building capacity of the budget and treasury office to ensure that financial information for reporting purposes is generated timeously. It will also include the monitoring and reporting on budget variances. It also provides for the development and implementation of a debt capacity policy. This policy will ensure that any loan or debt taken by the municipality will be done in responsible manner and that the repayment and servicing of such debt will be affordable. It can be depicted from Table 1 that Klerksdorp, Witbank and Welkom have committed R1.7 million in developing and renewing their financial systems. This will enable faster responses to job cards. These areas have also committed R3 million for a development of a generally recognised accounting practices compliance and a medium term revenue expenditure revenue medium term expenditure (MTREF) budget. The areas of Carletonville and Welkom have allocated R890 000 to enhance budgetary control and timeline financial data. Klerksdorp has allocated R1.6 million rand to the implementation and development of a debt capacity policy.

The importance of these programmes is that they inject much needed financial capital to improve responses along the waste chain. They address the issue of institutional red tape as challenges are speedily addressed. The implications of such commitments are that response times to immediate challenges are speedily resolved resulting in an improved service delivery and a decrease in waste backlogs.

Table 1: Financial management strategies programme

Input	Key Perfromance Area (KPA)		Value (R 000′)	Outcome
Klerksdorp;Witbank & Welkom Initiated Programmes	Review of the computerised financial system	• Integration of the computerised systems. • Acquisition of the required hardware and software. • Ensure information is accurate, relevant and prompt.	R 1.7M	• Smooth running and effective waste management.
	Development of generally recognised accounting practices compliant and medium term revenue expenditure revenue budget	• Develop and implement a uniform budget reporting framework tractable with National Treasury's Municipal Budget and Reporting Regulations. • Reviewing and updating prescripts regarding asset, budget and accounting policies and procedures; Training and development of financial and other staff.	R3M	• Ensures financial and other staff members receive required training. • Ensures a cost effective and efficient service to the municipality and its customers.
Carletonville & Welkom	Enhance budgetary controls and timeline of financial data	• Building capacity of the budget and treasury office.	R890′	• Ensures that financial information for reporting purposes is generated timeously.
Klerks Dsorp	The development and implementation of a debt capacity policy	• Ensure that any borrowings taken by the municipality will be done in responsible manner.	R1.6′	• Repayment and servicing of such debt will be affordable.

Asset management strategies programmes (AMS programmes)

These are programmes that are focused in the improvement of fixed and movable assets such as the vehicles used in the waste directorates for waste collection. The goal is to ensure that sufficient back-up collection equipment are available at all times as well as supporting equipment for the street cleansing service, illegal dumping service and for landfill. The need to ensure the availability of collection equipment will however need to be addressed by the actions of the relevant local municipality. The local municipalities can now purchase and maintain their own landfill equipment to a minimum that includes a garbage disposal vehicle, waster cart, and tipper truck and front end loader. Table 2 tabulates the financial commitment in ensuring that assets utilised along the waste chain are well maintained.

The Klerksdorp, Witbank, Welkom and Carletonville municipalities have financially committed to the application of an integrated asset management system and the re-assessment and updating of an asset and risk insurance protocol and allocations to repairs and maintenance of the existing infrastructure. The equipment currently on site is not adequate and is difficult to maintain due to procurement procedures. Landfill equipment should not be out of commission for longer than two days since the landfill site is operated on a daily basis whilst waste volumes are continually increasing over time. All indications are that outsourcing the operation of the landfill is more cost effective and that the site will be better managed from an operational point of view. There are various examples where municipal landfills are successfully operated by private contractors. The following are some of the more significant programmes that have been identified: Implementation of an integrated asset management system; Identification and implementation of a suitable integrated asset management system. This will also include the capture of all assets into a single system, the maintenance of this system and the production of a complete asset register in terms of generally recognised accounting practice document 17 and 102 and any other accounting standards requirements; Reviewing and updating of asset and risk insurance protocols and renewing the insurance portfolios. Risk identification in conjunction with insurers and departmental heads. Re-assessing of existing insurance portfolio and the renewal of the insurance policy as per the renewal terms; Repairing and maintaining of existing infrastructural assets should be prioritised since an uncontrolled increase in renewal infrastructure backlogs will negatively impact on the financial sustainability and the reliability and quality of municipal services. Adequate budget provision for asset maintenance over its useful life and the maintenance of assets according to an

Table 2: Asset management strategies and programmes

	Input	Key Performance Areas (KPA)	Value (R'000)	Outcome
Klerksdorp	implementation of an integrated asset management system	Investigation, identification and implementation of a suitable integrated asset management system.	R 895 000	Capture of all assets into a system, the maintenance of this system and the production of a complete register
Witbank	Re-assess and update of asset and risk insurance protocol and the renewal of the insurance portfolio	Entails the identification of risk in partnership with insurers and head of departments.	R 1. 5M	Incorporates the review of the existing insurance portfolios and the reformations of the insurance policy as per the renewal terms,
Carletonville And Welkom	Allocation to repairs and maintenance and the renewal of existing infrastructure assets	Uncontrolled increase in renewal infrastructure backlogs will negatively impact on the financial sustainability, reliability and quality of municipal services	R 650 M	Adequate budget provision for asset maintenance over its useful life. Maintenance of assets according to an infrastructural asset and maintenance plan
Klerksdorp	Replacement and renewal of aging vehicles and equipment	Ensure on-going health and municipal infrastructure	R 750M	Ensuring all asset owned and controlled are insured except where specifically excluded by policy

infrastructural asset maintenance plan, Maintain a system of internal control of assets to safeguard them, Replacement and the renewal of aging assets according to replacement programme to ensure the on-going health and municipal infrastructure and ensuring all assets owned and controlled are insured except where specifically excluded by policy.

Other programmes (OP's)

The following waste minimisation programmes as depicted in Figure 1 have been identified throughout the study areas and presented. These programmes are continuous programmes. They have no expiry date attached. All that is required is for them to be upgraded as regularly as possible by the responsible personnel of the waste directorates.

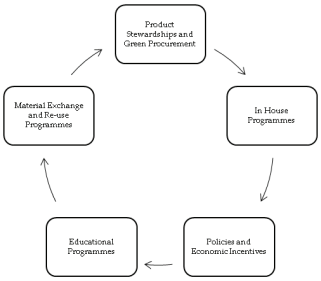

Fig. 1: Other types of waste minimisation programmes

In-house Programmes

These programmes encourage governmental agencies and solid waste departments to reduce waste generation following the cred of practice what you want to preach. Valuable lessons can be learnt with such in-house programmes initiatives about day to day practicalities and the challenge around generating less waste in the first place. In-house programmes facilitate the economic and policy incentives that require or encourage consumers and businesses to practice source reduction. Such programmes are necessary to ensure success of waste minimisation programmes. Residential, commercial and industrial educational programs are packages suited for in-house programmes that increase public awareness and participation in source reduction programmes. Educational and on-site business and industry assistance programmes advise businesses how to use materials more efficiently and reduce waste generation. The areas in the study sites all have in-house programme.

Policies and economic incentives

The policies and economic incentives involves the development of an environmental management corporate agreement with the respective local industry and association to develop targets for recycling of products and waste reduction to landfill. They hold manufacturers responsible for their products throughout their life-cycle. Local government can press for extended producer responsibility at the state and national levels. If goals are not met, the responsible or concerned will push for institution of a regulatory framework. Local government can pass producer responsibility resolutions calling on producers to share the responsibility for their products and on state and national legislatures to shift the burden of managing discarded products and packaging from local governments to the producers of those products. To facilitate such programmes, local government may need to pass local ordinances banning use and/or sale of certain types of products and packaging that cannot be reused, repaired, recycled, or composted. It was observed that the Klerksdorp, Witbank and Carletonville areas have put emphasise on such programmes whereas Carletonville has none.

Educational programmes (EP's)

Educational programmes and outreach are very important. Educational and technical assistance programs provide residents and businesses with information about 'how' and 'why' to reduce, reuse, recycle, and compost. Public information campaigns which allow consumers to make smart choices when making purchases are effective options. Public education campaigns can also highlight the environmental and economic benefits of preventing, reusing, and recycling discards and connect the role these activities play in moving toward a sustainable economy. It is proven time and time again that money spent on education to promote savings and raising awareness of environmental issues, although seeming like a significant cost, can yields significant results in waste minimisation. The local municipalities have put continuous educational programmes in place. For instance in Klerksdorp, posters are put up and waste information published in the *Lentswe* newspaper and the local radio station. In Witbank the focus is on schools and regular awareness

campaigns are initiated. For the Welkom and Carletonville local municipalities signs and posters are established in key areas.

Material exchange and re-use programmes (MERP's)

This is initiated by establishing a materials reuse program to take unwanted but reusable materials and making them available to non-profit organisation, businesses and private individuals. Material can come from anyone in the area. The advantages of such programmes are that the materials are both cost effective and environmentally beneficial. For business advantages they include: Avoidance of paying disposal cost; Free up valuable space; Receive a tax rebate; Receive cash; Use less expensive material and packaging than buying new ones; Improves the corporate images of the respective organisations or company.

Product stewardships and green procurement programmes

Product stewardship and green procurement is the act of minimising the health, safety, environmental and social impacts of a product and its packaging throughout all lifecycle stages, while also maximising economic benefits. The manufacturer, or producer of the product has the greatest ability to minimise adverse impacts, but other stakeholders, such as suppliers, retailers, and consumers, also play a role. Stewardship can be either voluntary or required by law. It incorporates human health and environmental concerns into the search for high quality products and services at competitive prices.

Key findings

On the basis of these results, the following findings are specified:

- The selected study areas do not seem to have precise and clear programmes that are solely and specifically aimed at minimising waste. Instead the financial management and asset management strategies are initiated to overhaul the entire out-dated municipal systems. As a result one of the drawbacks is that the waste management systems indirectly benefit although these are not direct programmes aimed at the waste management systems.

- Observations suggest that suitably qualified persons should manage in-house programmes and other programmes as these have a major impact in educating people about waste minimisation.

- The organisational set up of local municipalities does not give adequate space and autonomy to the waste directorate. This has an adverse effect on the recruitment, retention and development of specialist skills.
- Waste management does not receive adequate budgetary support from local municipalities and, this constrains the ability of waste directorates to up-grade current systems and to improve their record of service delivery.
- The status of operational equipment and vehicles at local municipality level indicates serious problems of maintenance. These problems relate to red-tape in the procurement systems for parts and spares and the low priority given to the recruitment of full time mechanics at municipal engineering workshops.
- Waste minimisation is a critical element of long-term government goals to protect the environment; yet, it does not receive much attention from senior management across local municipalities.

Conclusion

The findings indicate that attainable, viable and practicable waste minimisation and recycling programmes and initiatives are important and should be developed and implemented within the local municipalities. These functions and aspects can be outsourced, but it is envisaged that people be appointed within the areas to assist with the development of programmes and campaigns since they will be directly involved in the daily issues of waste management. It is also proposed that the local municipalities establish partnerships with contractors for the establishment of buy-back centres. Separation at source should also be investigated to establish its feasibility. Thereafter, pilot projects should be initiated in certain suburbs of the municipality and progressively extend it to the other suburbs. There is no single best approach but instead a variety of approaches are needed to reduce waste generation. Educational initiatives, at-home composting, unit-based pricing, and materials exchange and reuse programs are the most common waste minimisation programmes practiced in general. However, a growing number of local governments are expanding their

programs to include on-site technical assistance to businesses, economic and policy incentives and in-house source reduction policies. Spending money to change the way the community thinks so that waste minimisation becomes a voluntary way of life for everyone always works out cheaper than money spent to enforce such practices on an ignorant community.

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Original Article

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Do Industrial Wastes is a Reason for Water Pollution?

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Abstract

Industrial effluents can be classified into waste rich in organic matter and waste rich in inorganic matter. Heavy metals are naturally occurring elements that have a high atomic weight and a density at least 5 times greater than that of water. The use of heavy metal in multiple industries likedomestic, agricultural, medical and technological applications have led to their wide circulation in the Environment and this leads to various harmful effects on human health and ecosystem. The toxicity of heavy metals dependson numerous factors including the dose, route of exposure, and chemical species, as well as the age, gender, genetics, and nutritional status of exposed individuals. Because of the high degree of toxicity of heavy metals like arsenic, cadmium, chromium, lead, and mercury rank among the different metals that areof public health significance. These metallic elements are considered to be universal toxicants that are known to induce multiple organ damage, even at lower levels of exposure and also classified as human carcinogens (known or probable).

Keywords: Heavy metals, Industrial waste, pollution, Environment, Exposure.

Introduction

Industrial waste plays a foremost part for the water pollution, usually lots of water used in industries and lots of waste water generated from the industries due to their working procedures, this waste water contains heavy metals that is hazardous for the environment and public health also[1]. Heavy metals are natural component of the Earth Crust that cannot be degraded or destroyed. Heavy Metal refers to any metallic components that have high density and it is poisonous and toxic at low concentrations, some of the heavy metals that are creating mess in the environment Example: Mercury (Hg), Cadmium (Cd), Arsenic (As), Chromium (Cr), Thallium (Tl), Zinc (Zn) and Lead (Pb) [2]. Different metal have different properties to affect the environment, large volume of waste water that contain heavy metals are discharged from the industries in water bodiesand contaminate the water, because in low concentration they enter in our bodies via food , air and water and create harmful effects [3].And some trace metals that are essential to maintain the metabolism of the human body **(e.g. copper, selenium, zinc),** However at higher concentration they can be carcinogenic.

Industrial waste leads to heavy metal excretion in the water bodies, though heavy metals are naturally occurring elements that are found in the earth's crust [4]. Mostly contamination in the environment and human exposure result from usage of heavy metals in industries like electroplating industry, tannery, automobile and steel and discharge large volume of heavy metal from the industries.

Effect of different metals on the environment:

Arsenic

It is an abundant element that is identified at very low concentrations in nearly all

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environmental matrices. Arsenic present in two inorganic forms that include the trivalent arsenite and the pentavalent arsenate, and the organic form are methylated metabolites monomethylarsonic acid (MMA), dimethylarsinic acid (DMA) and trimethylarsine oxide [5]. The pollution caused by arsenic such as volcanic eruptions and soil erosion. Arsenic also have lots of industrial application like insecticides, herbicides, fungicides, algicides, sheep dips, wood preservatives, and dye-stuffs and also used in veterinary medicine.

It is assessed that millions of people are exposed to arsenic chronically throughout the world, especially in countries like Bangladesh, India, Chile, Uruguay, Mexico, and Taiwan, where arsenic is present in high concentration in ground water and exposure to Arsenic occur via oral route inhalation, ingestion, dermal contact and parental route to some extent. Its water concentration is generally less than 10µg/L, although higher levels can occur near natural mineral deposits or mining sites [6].

The average intake of arsenic is about 50 µg per day. Workers who work in industries are more prone to exposed substantially higher levels of arsenic. It has also been identified at 781 sites of the 1,300 hazardous waste sites that have been proposed by the U.S. EPA for inclusion on the national priority list. Contamination with high levels of arsenic is of concern because arsenic can cause a number of human health effects. A number of epidemiological studies have described a strong suggestion between arsenic exposure and increased risks of both carcinogenic and systemic health effects [7].

Cadmium

Cadmium is a heavy metal that is widely distributed in the earth's crust at an average concentration of about 0.1 mg/kg [8]. In the Environment the highest level of cadmium compounds is accumulated in sedimentary rocks, and marine phosphates. Cadmium is commonly used in various industries like alloys, pigments and batteries, because of various application this show considerable growth in recent years, But some of the developed countries has declined the use of cadmium in response to Environmental concern [9]. The toxicological properties of cadmium derive from its chemical similarity to zinc i.e. an essential micronutrient for plants, human and animals.

Exposure of cadmium to human beings is possible through a number of ways like inhalation, ingestion of food, smoking the cigarettes and several sources include like employment in metal industries, cadmium contaminated places, smelting and manufacturing of batteries, pigments,

Stabilizers and alloys [10]. Long term exposure to cadmium generally associated with the renal dysfunction and changes in Pulmonary function and lung disease that later become lung cancer[11].

Chromium

Chromium is a Heavy metal; Atomic number 24 is naturally occurring and most abundant element in the earth crust and is widely dispersed in the Environment [12]. The oxidation states of Chromium ranging from -2 to +6 but in environment the stable form of chromium is trivalent and hexavalent form. Chromium which is present in 0 oxidation state are biologically inert and are not naturally present in earth crust, while +3 and +6 are originated from industries. Normally the concentration of Cr(VI) in industrial effluents ranges from as low as 1mg/l to as high as >1000mg/l [13]. The Indian statutory limit of Cr (VI) for industrial effluent discharge in inland forsurface water is 0.1mg/l.

Hexavalent chromium is the second most stable form of chromium that have strong oxidising property and very hazardous for ecosystem, when binds to oxygen form a chromate i.e.CrO_4^{-2} (an oxyanion), it will act as electron acceptor for microorganisms and dichromate i.e. K_2CrO_4. Cr (VI) has three half-life excretion i.e., 7h, 15-30 days and 3-5 years [13]. Chromium in the radioactive form is used in medicine to tag, or label, red blood cells inside the human body. The labelling of that cell is permanent for the lifetime, so that it is a useful way to look at long-term patterns of blood cell turnover in the body, to look for evidence of internal bleeding and for similar studies [14].

According to the Toxics Release Inventory, in 1997, the approximate releases of chromium were 708,205 pounds to the air from 3,399 large processing facilities which accounted for about 2.5% of total environmental releases. Coal and oil combustion contribute an estimated 1,725 metric tons of chromium per year in atmospheric emissions; however, only 0.2% of this chromium is Cr(VI) [15]. In contrast, chrome-plating sources are estimated to contribute 700 metric tons of chromium per year to atmospheric pollution, 100% of which is believed to be Cr(VI) [ATSDR 2000]. In water chromium was 111,384 pounds to

water from 3,399 large processing facilities which accounted for about 0.5% of total environmental releases [16]. Electroplating, leather tanning, and textile industries release relatively large amounts of chromium in surface waters. Leaching from topsoil and rocks is the most important natural source of chromium entry into bodies of water. A Disaster is also reported because of chromium pollution in pacific gas and electric company. From 1952 to 1966, PG & E dumped [5].

"roughly 370 million gallons" hexavalent chromium wastewater" into unlined wastewater spreading ponds around the town of Hinkley, California. PG&E used Cr (VI) one of the cheapest and most efficient commercially available [17]. In July 2014 California became the first state to acknowledge that ingested hexavalent chromium is linked to cancer. (Erin Brockovich movie) .In soil the contamination of chromium was 30,862,235 pounds to soil from 3,391 large processing facilities accounted for about 94.1% of total environmental releases. Total chromium has been identified in 939 soil and 472 sediment samples collected from 1,036 hazardous waste sites [18].

Workers who work in chromium bearing industries are come in contact with hexavalent chromium containing material and were reported to have chronic ulcers of the skin and irritative dermatitis and if inhaled it cause irritation in respiratory tract, perforation in nasal system and ulceration. It is already been reported that Chromium and its compound gets absorbed in human body through the exposure to oral ,dermal and inhalation routes Cr(III) is less absorbed than Cr(VI) and this leads the difference in their transport to the cell, because of its high oxidising potential, Cr(VI) cause mutagenic and carcinogenic effect on biological organisms [19]. Cr(VI) does not interact directly with DNA, Hence its genotoxicity is attributed to its intracellular reduction to Cr(III) via reactive intermediates. As chromate CrO_4^{2-} is structurally similar to sulphate SO_4^{2-} crosses the cell membrane in some species via sulphate transport system. Under normal physiological conditions, after crossing the membrane Cr(VI) reacts spontaneously with intracellular reductants (e.g., ascorbate and glutathione) to generate the short-lived intermediates Cr(V) and/or Cr(IV), free radicals and the end-product Cr(III) [20].Cr (V) undergoes a one-electron redox cycle to regenerate Cr (VI) by transferring the electron oxygen. The process produces reactive oxygen species (ROS), including single oxygen (O) and superoxide (O2) hydroxyl (OH) and hydrogen peroxide (H2O2) radicals that easily combine with DNA-protein complexes. Therefore, Cr(IV) binds to cellular materials and deters their normal physiological functions. The genotoxic effects of the Cr ion however cannot be solely explained by the action of ROS. Intracellular cationic Cr(III) complexes also interact electro statically with negatively charged phosphate groups of DNA, which could affect replication, transcription and cause mutagenesis [21].

Lead

Lead is naturally occurring heavy metal found in the earth crust in very less amount, arises from both natural and anthropogenic activity like fossil fuel burning, mining etc., and this is the first metal that is used by humans and recorded the first disease in a 4th century BC, named lead colic, (Metal worker) [22], Because of so many industrial, Agriculture and domestic application, It is currently used in batteries production, ammunitions, metal products and devices to shield. In 2004, the estimated 1.52 million metric tons of lead is used in industries for various applications in U.S. An estimated 1.6 million metric tons of lead in 2012 is used by USA industries for different application. Of that amount, 342,000 metric tons of lead is produced in U.S mines [23].

It is widely used as a corrosion inhibitor and pigment in paints but disquiets over its toxic properties. This led to the Consumer Product Safety Commission (CPSC) in 1977 to ban the use of lead in paint for residential and public buildings [24]. Exposure to lead during the removal, renovation, or demolition of structures painted with lead pigments. Workers may also be exposed during installation, maintenance, or demolition of lead pipes and fittings, lead linings in tanks and radiation protection, leaded glass, work involving soldering, and other work involving lead metal or lead alloys. Inindustry, workers come in contact with lead in solder, plumbing fixtures, rechargeable batteries, lead bullets, leaded glass, brass, or bronze objects, and radiators [25]. Lead exposure can occur not only in the production of these kinds of objects but also in their use (e.g., firing ranges), repair (e.g., radiator repair), and recycling (e.g., lead-acid battery recycling).

In daily life, lead may be present in small but hazardous concentrations in food, water, and air. Children under the age of six are at risk of

developing mental health effects even at very low blood lead levels. Pregnant women or those who might become pregnant must avoid lead exposure because it is toxic to the foetus [26]. Exposure to lead, leads to damage the organ system as this enters through inhalation and ingestion and mostly adults are exposed to lead by inhaling the lead containing dust and fumes while working in the industries. This may develop variety of ailments neurological effects, gastrointestinal effects and kidney disease.

Another source for identifying where lead exposure occurs at work is the NIOSH Adult Blood Epidemiology & Surveillance (ABLES) program [27]. ABLES currently has 41 states participating in the collection of elevated blood lead levels in adults. This program identifies industries and occupations where workplace exposure to lead is occurring [28].

Mercury

Mercury is a transition metal in the periodic table and found in nature in three forms Elemental, Inorganic, and Organic. It is a global Pollutant with complex physical and chemical properties with each having its own toxicity [29]. The Natural Source of mercury is earth crust, emission of volcanoes and evaporation form water bodies. It is an environmental toxicant which brings severe alteration in the body and cause harmful effects. Mercury exist as a liquid in room temperature which is having high vapour pressure and is released into the environment as vapour.Mercury also exists as a cation with oxidation states of +1(mercurous) or +2 (mercuric) [30]. Methylmercury is the most commonly encounteredcompound of the organic form found in the environment, and is formed as a result of themethylation of inorganic (mercuric) forms of mercury by microorganisms found in soil andwater [31]. Bothhumans and animals are exposed to various chemical forms of mercury in the environment. These include elemental mercury vapour (Hg0), inorganic mercurous (Hg+1), mercuric(Hg+2), and the organic mercury compounds [32]. Because mercury is ubiquitous in theenvironment, humans, plants and animals are all unable to avoid exposure to some form of mercury. Mercury is exploited in the electrical industry (switches, thermostats, batteries), dentistry(dental amalgams), and various industrial processes including the production of causticsoda, in nuclear reactors, as antifungal agents for wood processing, as a solvent for reactiveand precious metal, and as a preservative of pharmaceutical products [33]. The industrialdemand for mercury peaked in 1964 and began to sharply decline between 1980 and 1994 asa result of federal bans on mercury additives in paints, pesticides, and the reduction of itsuse in batteries [34]. It is toxic substance which has no known function in human Biochemistry, and not naturally occurring in living organism. Poisoning from Inorganic form of mercury leads to tremors and minor psychological changes and together with abortion and congenital malformation, one form of mercury that is Monomethylmercury caused damage to brain and central nervous system.

World-wide mining of the metal leads to unplanned expulsions into the Environment. Mercury is used in industries processes and in various products e.g. lamps, thermometer and batteries. It is also used in dentistry as an amalgam for fillings and by the pharmaceutical industry. It is mostly present in the atmosphere in an unreactive form of gaseous element.

Natural biological processes can cause methylated forms of mercury to form which bio-accumulate over a million-fold and concentrate in living organisms, especially fish. These forms of mercury: monomethylmercury and dimethylmercury are highly toxic, causing neuro-toxicological disorders. The main pathway for mercury to humans is through the food chain and not by inhalation.

The main sources of mercury emissions in the UK are from the manufacture of chlorine in mercury cells, non-ferrous metal production, coal combustion and crematoria UK emissions of mercury are uncertain and it is estimated that the range is from 13 to 36 tonnes per year (DERA). Emissions are estimated to have declined by around ¾'s between 1970-1998 (NAEI), mainly due to improved controls on mercury cells and their replacement, and the fall in coal use [35].

Whilst there has been a decline in the level of European emissions of mercury, emissions from outside of Europe have started to increase – increasing the level of ambient concentrations in the continent

Prospects

A wide-ranginginvestigation of available data shows that heavy metals such as arsenic, cadmium, chromium, lead, and mercury, occur naturally

in the environment. However, anthropogenic activities contribute significantly to environmental contamination. These metals are total toxicants known to bring adverse health effects in humans, including cardiovascular diseases, developmental abnormalities, neurologic and neurobehavioral disorders, diabetes, hearing loss, hematologic and immunologic disorders, and various types of cancer. The main pathways of experience include ingestion, inhalation, and dermal contact. The brutality of adverse health effects is related to the type of heavy metal and its chemical form, and is also time- and dose-dependent. Among many other factors, speciation plays a key role in metal toxicokinetics and toxicodynamics, and is highly influenced by factors such as valence state,particle size, solubility, biotransformation, and chemical form. Several studies have shown that toxic metals exposure causes long term health problems in human populations [36].

Although the acute and chronic effects are known for some metals, little is known about the health impact of mixtures of toxic elements. Recent reports have pointed out that these toxic elements may interfere metabolically with nutritionally essential metals such as iron, calcium, copper, and zinc However, the literature is scarce regarding the combined toxicity of heavy metals. Simultaneous exposure to multiple heavy metals may produce a toxic effect that is additive, antagonistic or synergistic [37].

A recent review of a number of individual studies that addressed metals interactions reportedthat co-exposure to metal/metalloid mixtures of arsenic, lead and cadmium produced moresevere effects at both relatively high dose and low dose levels in a biomarker-specific manner. These effects were found to be mediated by dose, duration of exposure andgenetic factors [38].

Also, human co-exposure to cadmium and inorganic arsenic resulted in amore pronounced renal damage than exposure to each of the elements alone. In manyareas of metal pollution, chronic low dose exposure to multiple elements is a major publichealth concern. Elucidating the mechanistic basis of heavy metal interactions is essential forhealth risk assessment and management of chemical mixtures. Hence, research is needed tofurther elucidate the molecular mechanisms and public health impact associated with humanexposure to mixtures of toxic metals [39].

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Article in supplement or special issue

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who own the newspaper and particulars of	:	3/258-259, Trilok Puri, Delhi-91
shareholders holding more than one per cent of the total capital		

I Asharfi Lal, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Sd/-

(Asharfi Lal)

Revised Rates for 2018 (Institutional)

Title	Frequency	Rate (Rs): India		Rate ($):ROW	
Community and Public Health Nursing	3	5500	5000	430	391
Dermatology International	2	5500	5000	430	391
Gastroenterology International	2	6000	5500	469	430
Indian Journal of Agriculture Business	2	5500	5000	413	375
Indian Journal of Anatomy	4	8500	8000	664	625
Indian Journal of Ancient Medicine and Yoga	4	8000	7500	625	586
Indian Journal of Anesthesia and Analgesia	4	7500	7000	586	547
Indian Journal of Biology	2	5500	5000	430	391
Indian Journal of Cancer Education and Research	2	9000	8500	703	664
Indian Journal of Communicable Diseases	2	8500	8000	664	625
Indian Journal of Dental Education	4	5500	5000	430	391
Indian Journal of Forensic Medicine and Pathology	4	16000	15500	1250	1211
Indian Journal of Emergency Medicine	2	12500	12000	977	938
Indian Journal of Forensic Odontology	2	5500	5000	430	391
Indian Journal of Hospital Administration	2	7000	6500	547	508
Indian Journal of Hospital Infection	2	12500	12000	938	901
Indian Journal of Law and Human Behavior	2	6000	5500	469	430
Indian Journal of Library and Information Science	3	9500	9000	742	703
Indian Journal of Maternal-Fetal & Neonatal Medicine	2	9500	9000	742	703
Indian Journal of Medical & Health Sciences	2	7000	6500	547	508
Indian Journal of Obstetrics and Gynecology	4	9500	9000	742	703
Indian Journal of Pathology: Research and Practice	4	12000	11500	938	898
Indian Journal of Plant and Soil	2	65500	65000	5117	5078
Indian Journal of Preventive Medicine	2	7000	6500	547	508
Indian Journal of Research in Anthropology	2	12500	12000	977	938
Indian Journal of Surgical Nursing	3	5500	5000	430	391
Indian Journal of Trauma & Emergency Pediatrics	4	9500	9000	742	703
Indian Journal of Waste Management	2	9500	8500	742	664
International Journal of Food, Nutrition & Dietetics	3	5500	5000	430	391
International Journal of Neurology and Neurosurgery	2	10500	10000	820	781
International Journal of Pediatric Nursing	3	5500	5000	430	391
International Journal of Political Science	2	6000	5500	450	413
International Journal of Practical Nursing	3	5500	5000	430	391
International Physiology	2	7500	7000	586	547
Journal of Animal Feed Science and Technology	2	78500	78000	6133	6094
Journal of Cardiovascular Medicine and Surgery	2	10000	9500	781	742
Journal of Forensic Chemistry and Toxicology	2	9500	9000	742	703
Journal of Geriatric Nursing	2	5500	5000	430	391
Journal of Microbiology and Related Research	2	8500	8000	664	625
Journal of Nurse Midwifery and Maternal Health	3	5500	5000	430	391
Journal of Organ Transplantation	2	26400	25900	2063	2023
Journal of Orthopaedic Education	2	5500	5000	430	391
Journal of Pharmaceutical and Medicinal Chemistry	2	16500	16000	1289	1250
Journal of Practical Biochemistry and Biophysics	2	7000	6500	547	508
Journal of Psychiatric Nursing	3	5500	5000	430	391
Journal of Social Welfare and Management	3	7500	7000	586	547
New Indian Journal of Surgery	4	8000	7500	625	586
Ophthalmology and Allied Sciences	2	6000	5500	469	430
Otolaryngology International	2	5500	5000	430	391
Pediatric Education and Research	3	7500	7000	586	547
Physiotherapy and Occupational Therapy Journal	4	9000	8500	703	664
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