

The Dark End

CFL NEED BETTER MANAGEMENT



A report by



Toxics Link
for a toxics-free world

ABOUT TOXICS LINK

Toxics Link is an Indian environmental research and advocacy organization set up in 1996, engaged in disseminating information to help strengthen the campaign against toxics pollution, provide cleaner alternatives and bring together groups and people affected by this problem.

Toxics Link's Mission Statement - *"Working together for environmental justice and freedom from toxics. We have taken upon ourselves to collect and share both information about the sources and the dangers of poisons in our environment and bodies, and information about clean and sustainable alternatives for India and the rest of the world"*



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CFL NEED BETTER MANAGEMENT



Abbreviations

CFLs	Compact Fluorescent Lamps
EPR	Extended Producer Responsibility
BLY	Bachat Lamp Yojna
CPCB	Central Pollution Control Board
MoEF&CC	Ministry of Environment, Forests and Climate Change
WHO	World Health Organization
LRU	Lamp Recycling Unit
LED	Light-Emitting Diode
GRU	Glass Recycling Units



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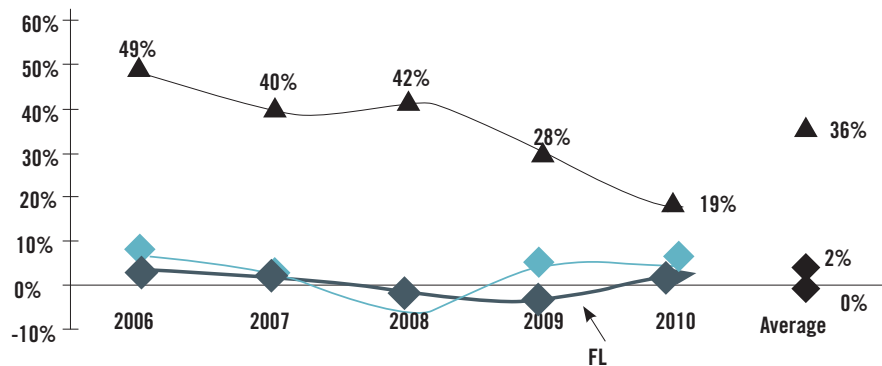
Introduction

The Compact Fluorescent Lamps (CFLs) have been widely accepted as the substitute for incandescent lamps as they provide more light per unit of electricity consumed thereby making them energy efficient. However it is a well-known fact that CFL contains tiny amounts of mercury. Even though the mercury is very detrimental to the human health, this mercury content (in CFLs) has not dissuaded consumers from using CFLs. The recent trends suggest that the CFL market in India is growing at about 36% annually (Figure 1). Though there is an exponential rise of CFL use in India, there is no standard to regulate the mercury content in CFLs. Further, India's growing energy dependency and factors of climate change have forced successive governments to promote energy saving schemes – popularly known as the “Bachat Lamp Yojna” (BLY) – to phase out incandescent bulbs. Toxics link, in its study, found the average mercury content per unit CFL to be 21.21mg, which is much higher than the standard followed in the developed countries. The Central Pollution Control Board (CPCB) has also issued a guideline known as “Guidelines for Environmentally Sound Mercury Management in FL Sector” for the sound management of mercury from the CFLs. Harikumar et. al. (2010)¹ in his research paper has also confirmed leaching of mercury into the soil from discarded CFLs. As mercury-laden CFL bulbs are being used by consumers on a large scale, it is imperative to know whether the CFL bulbs containing mercury are being used or disposed safely.

Studies have found that the average mercury content per unit CFL is 21.21mg, which is much higher than the standard followed in the developed countries

1 Harikumar P. S., Dhruvan A. Sabna V., Babitha (2010); “Study on the Leaching of Mercury from Compact Fluorescent Lamps using Stripping Voltammetry”; Research Paper, Centre for Water Resources Development and Management, Calicut, Kerala, India

Figure 1: Growth trends in India by lamp category between 2006 and 2010



1.1 Toxic Effects of Mercury

Mercury is a known toxic metal. Elemental mercury is a liquid that releases mercury vapour at room temperature. This vapour when inhaled into lungs passes into the blood stream. Elemental mercury can also enter into the blood stream through the skin. Elemental mercury gets convert to the more toxic methyl mercury in the environment and cause serious problems to human being and the environment.

Boening² (1999), as part of the Lockheed Martin Environmental Services Assistance team, published a paper on the toxic effects of mercury on ecology in which he said that the presence of mercury even at low concentrations is a hazard to microorganisms in the environment.

Mercury also has adverse health and safety effects on wildlife. This is because wildlife gets exposed to mercury from a variety of sources. According to Wolfe et. al.³ (1998), wildlife is exposed to mercury (Hg) and methyl mercury (MeHg) from such environmental sources as mine tailings, industrial effluent, agricultural drain water, impoundments, and atmospheric deposition from electric power generation.

According to a study by the United States Environmental Protection Agency (USEPA)⁴ (2013), breathing of mercury found in vapour form in air is the most common way for people to get exposed to the harmful toxic effects of mercury. This is when household items containing mercury gets broken due to mishandling during procurement, use and disposal of such items. Vaporized mercury is more dangerous than liquid mercury and is easily inhaled by human beings. Some of the ways in which mercury can stay in a living area are when the mercury, in either liquid or vapour form, gets absorbed or stays on the carpets, furniture, cracks and corners on the floor and low lying areas of the house.

2 Boening D. W.(1999); "Ecological Effects, Transport and Fate of Mercury: A General Review"; Elsevier/ Pergamon

3 Wolfe M. F., Schwarzbach S. Sulaiman A. R. (1998); "Effects of Mercury on Wildlife-A Comprehensive Review"; Environmental Toxicology and Chemistry; Vol. 17, Issue 2, p-p 146-160

4 Mercury Quick Facts-Health Effects of Mercury Exposure (2013); Agency For Toxic Substances and Disease Registry- USEPA; cited in <http://www.atsdr.cdc.gov/mercury/docs/HealthEffectsMercury.pdf>

The most common ailments that occur due to short-term exposure by inhaling mercury comprise recurrent cough, sore throat, shortness of breath, chest pain, nausea, vomiting, diarrhoea, increased blood pressure, eye irritation, headache, vision problems with sometimes a metallic taste in the mouth. Adverse health effect due to long-term exposure to inhaling mercury vapour includes fatigue, irritability, loss of appetite, changes in vision and hearing capacity, forgetfulness, excessive shyness, anxiety, anorexia, tremors and sleeping problems among others. According to a World Health Organization (WHO)⁵ publication (2007) the inhalation of mercury vapour is liable to produce adverse effects on the nervous, digestive and immune systems, including lungs and kidneys leading to fatal consequences.

The “FOOD SAFETY AND STANDARDS (CONTAMINANTS, TOXINS AND RESIDUES) REGULATIONS, 2011” of India has set the limit of 0.5 ppm mercury content in fish and 1 ppm mercury content in other foods. Considering that mercury is highly toxic and a threat to the environment and human health, a global mercury treaty known as Minamata Convention has been signed on October 2013.

1.2 Objectives of the Study

The objective of the study is to conduct field-level investigation into the present practices of handling mercury content in CFL lamps in India. Following this broad objective, the detailed objectives of the study are as follows:

- i. Documenting the entire process of end-of-life cycle management of CFLs in two cities;
- ii. Measuring the gaps present in actual performance in terms of compliance to CPCB guidelines;
- iii. Mapping and documenting the manufacturing process in informal manufacturing units of CFLs in Delhi and Bhopal;
- iv. Quantifying and assessing the amount of mercury going as waste into the surrounding environment on annual basis.

5 Exposure to Mercury: A Major Public Health Concern (2007); World Health Organization- Public Health & Environment Division; Geneva, Switzerland

Methodology and Sampling

2.1 Methodology

The methodology followed a mixture of quantitative and qualitative approach to get data and information about the study objectives from the target sample group. The target groups for the field level survey included manufacturers group, consumers group and recyclers group as per the details shown in Table 1.

Table 1: Survey Target Group

S. No.	Target group	Sub-category	
1	Consumers	Individual consumers	Small medium and large income households;
		Institutional consumers	Hotels, malls, hospitals, hostels, large shops
2	Recyclers	Collectors	Individual <i>kabadiwalas</i> collecting from households, colonies, hostels; Big <i>kabadiwalas</i> collecting from individual <i>kabadiwala</i> and selling to re-users
		Re-users	Informal recycling companies (common recycling units/lamp recycling)
3	Informal CFL manufacturing units	Small and large units	

2.2 Sampling Plan

The samples for the study were taken from Delhi and Bhopal. The broad sampling plan for the study was mentioned as a whole. The sample was proportionately divided covering the two urban areas based on availability and population size of target samples. Accordingly the different categories and numbers of samples included in the study is shown in Table 2.

Table 2: Sampling Strategy

S. No.	Target group	Sub-category		Sample numbers	Delhi	Bhopal	Survey tool
1	Consumers	Individual consumers	Small income households	90	60	30	Questionnaire based survey
			Medium income households	90	60	30	Questionnaire based survey
			Large income households	90	60	30	Questionnaire based survey
		Institutional consumers	Hotels (including 2 five-star hotels)	5	3	2	Discussion guidelines
			Malls	4	3	1	Discussion guidelines
			Hospitals	5	3	2	Discussion guidelines
2	Recyclers	Collectors	Small/individual <i>kabadiwalas</i> collecting from households, colonies, hostels	45	30	15	Questionnaire based survey
			Big <i>kabadiwalas</i> collecting from individual <i>kabadiwala</i> and selling to re-users	8	5	3	Questionnaire based survey
		Re-users	Informal Recycling Units (LRUs)	6	4	2	Discussion guidelines
3	Informal CFLs manufacturing units			5	3	2	
Total samples				348	231	115	

2.3 Survey Tools

The survey tools included questionnaires and discussion guidelines. Questionnaires were developed for the following groups shown in Table 3.

Table 3: Survey Questionnaires

Type	Questionnaires	Discussion guidelines
1	Household consumers	Institutional consumers (malls, hotels, hospitals, etc.)
2	Individual <i>kabadiwalas</i>	
3	Big <i>kabadiwalas</i>	
4	Informal manufacturing units	Process documentation of the units

Results of the Field Survey

The results from the field survey were analysed both quantitatively and qualitatively using the methods as mentioned in Table 4.

Table 4: Quantitative and qualitative methods for the analysis of field survey results

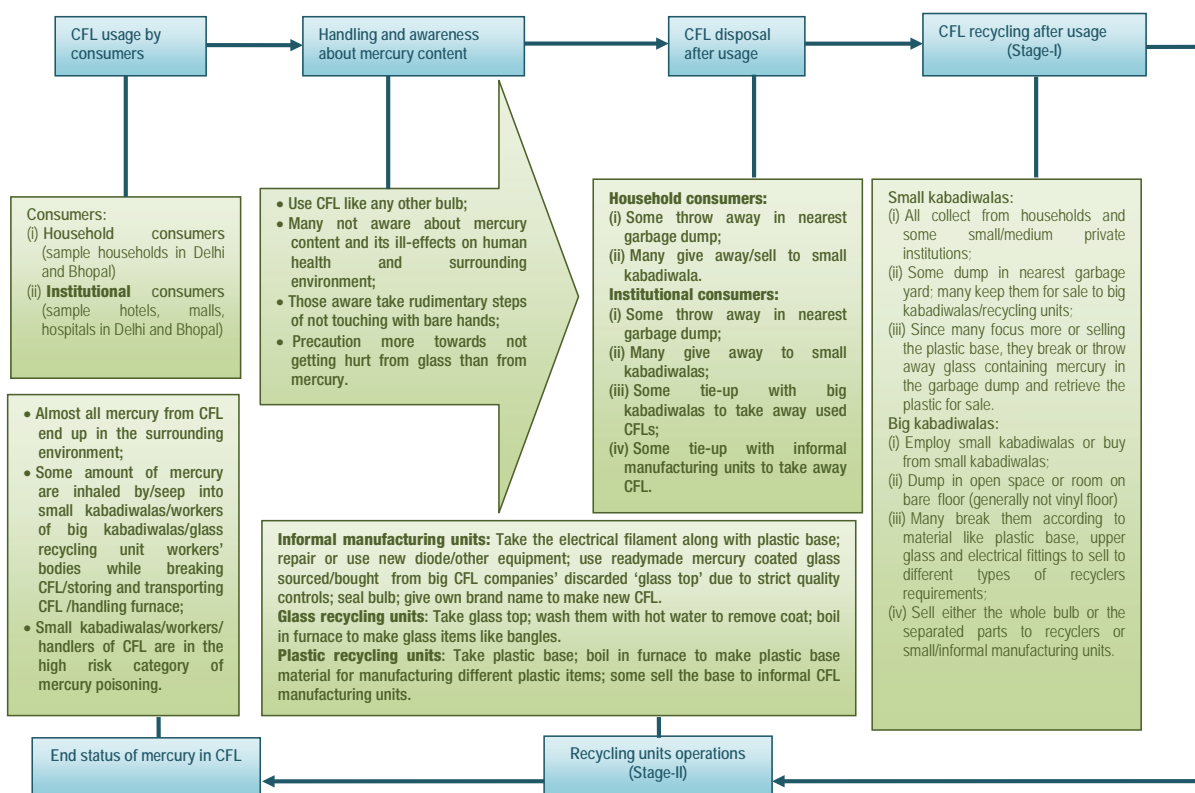
Quantitative methods	Qualitative methods
Percentage analysis	Content analysis
Ranking of outputs	Interrelation and analysis of responses to find answers to survey objectives
Cross-tabs of connected questions	Photo documentation
Data computation and estimation using actual data and assumptions for quantification of mercury spillage on annual basis in the sample cities	

The results from the above mentioned methods were applied to understand the total process of CFL lifecycle from its usage to disposal, recycling and reuse. The total process is shown diagrammatically in section 3.1.

3.1 Analysis of Field Inputs

The process diagram shows that CFL is used by both the household and institutional consumers comprising hotels, malls and hospitals like any other product. CFL is installed and discarded after use with bare hands, except when CFL is broken or tampered with. In such situations, the consumers use some glove or paper or some equipment to handle the CFL bulb. Nevertheless the precaution is more due to CFL being a glass item in which case there is the risk of getting cuts and bruises. In no situation the consumer is aware of the presence of mercury and hence the need to use glove or some other thing to install and dispose CFL bulb. It is not that many consumers are not aware of the presence of

The process diagram showing the usage of CFL by household and institutional consumers



mercury. The field survey results indicate that a good percentage of consumers are certainly aware of the presence of mercury. However, this awareness is not reflected in the consumers taking appropriate steps to carefully dispose-off the CFL after usage to prevent its breakage and spillage into the environment. After usage, the consumers either throw away the CFL in a nearby dustbin and garbage dump or, if they have contracted any *kabadiwala* to take away household and institution waste material including CFL, then these *kabadiwalas* take them away. The detail analyses of the responses collected in the field study are mentioned in the succeeding sections.

In most of the cases the small *kabadiwalas* do two things depending upon the condition of the CFLs. If the CFL is intact and in good condition, they sell it to recycling institutions at a nominal price. However if the CFL is broken, they simply taper off any remnant glass containing mercury at the dump site and sell the plastic base which has a good demand in the plastic recycling market. Sometimes, and in many instances, the *kabadiwalas* sell intact CFL bulbs to the plastic recyclers after totally breaking the glass top of the CFL at the dump site. These *kabadiwalas* store CFL like any other waste material in the open or sometimes in cardboards. They either deposit them with the big *kabadiwalas* and recyclers/informal manufacturing units or these units themselves come and take the consignment after paying the price.

There are no proper CFL recycling units available as being prescribed in the guidelines. Generally, recycling takes place in informal units and, even if they are big units, they are not professionally setup or managed. There are certain values involve in each component of the CFLs. CFLs that are handled by the plastic recycling units just focus on the plastic and discard the glass. The glass recycling units clean the glass of its white coating containing mercury in boiling water and throwaway the wastewater. There are certain informal recyclers who collect electronic ballast and send the working ballast to the informal manufacturing units.

There is a large chunk of informal CFLs unit operating in Moti Nagar area of Delhi. Better termed as assembly units, they are one to two room units where the staffs – mostly children – is involved in manufacturing CFL using some basic repairing tools for electric appliances. These recycling units mostly use refurbishing or new electronic ballast and glass top from the nearby market. Sometimes they also use discarded glass having minor defect. There are also certain units where CFLs can be repaired. The filament and the connection is generally repaired and the glass top is obtained from big manufacturing companies which, due to their strict quality control, discard many glass tops due to minor defect. They are then procured by these informal manufacturing units on lot basis.

3.2 Analysis of Household Consumer Responses on CFLs

3.2.1 Delhi Consumer Household Data Analysis

The distribution of households was made according to the income group in Delhi. The income group was identified as per locality base in the first instance – where a majority of high, middle or low income groups reside – and aided by apparent observation. This was verified by asking the respondent households on their annual household income and then categorizing them as low, middle or high income household. The broad information gathered from the survey in Delhi is mentioned in Table 5.

Table 5: Delhi sample statistics – CFL coverage

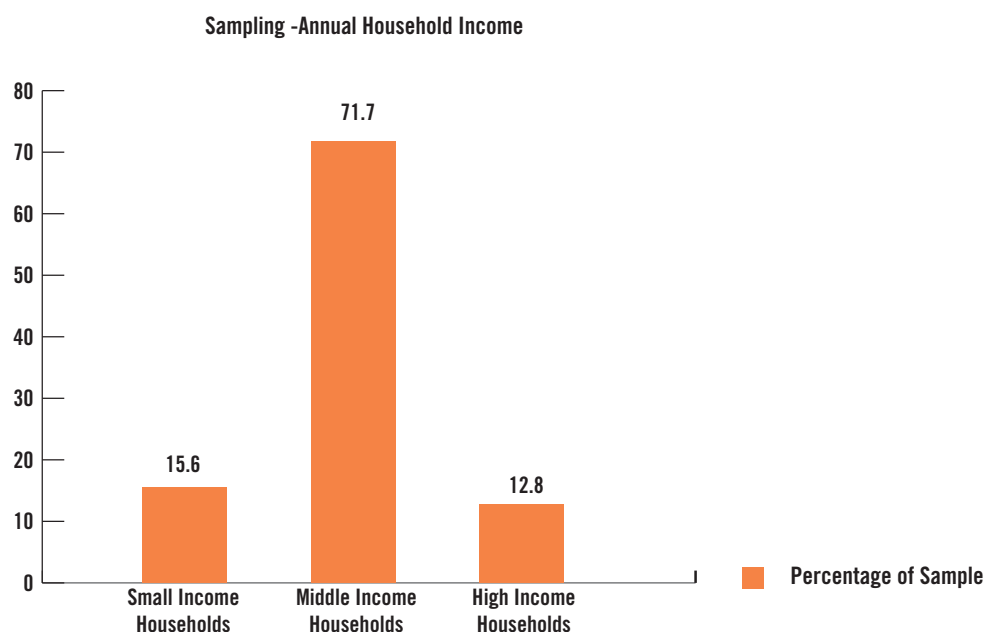
Category	Unit	Value
Number of households	(In numbers)	180
Number of light points	(In numbers)	2439
Number of CFL used	(In numbers)	1339
0-26 watt bulbs	(In numbers)	1199
27-44 watt bulbs	(In numbers)	128
45-85 watt bulbs	(In numbers)	12
Percentage coverage of CFL to number of light points	In percentage	54.9

- ◆ The total number of light points in the 180 households included in the survey is 2439. From the 2439 light points, a total of 1339 light points have CFL installed in them;
- ◆ Among the 1339 light points, around 1199 light-points have 0-26 watt CFL installed in them, 128 households also have 27-44 watt CFL installed in them and 12 households have 45-85 watt CFL installed in them;
- ◆ The overall percentage cover of CFL with regards to the number of light points is 54.9 percent. This means that of the total households surveyed, the presence of CFL in their household from among the total light points is 54.9 percent.

Table 6: Sampling of Delhi households according to annual income

Category of households	Numbers	Percentage
Low income households	28	15.6
Middle income households	129	71.7
High income households	23	12.8
Total households included	180	100.1

Figure 2: Sampling according to annual household income (In Percentage %)

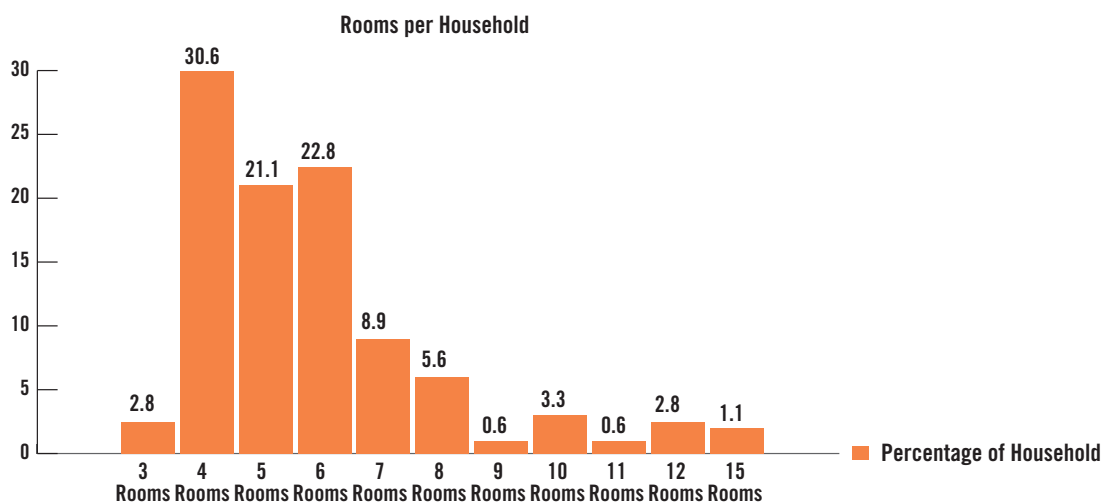


- ◆ 28 households or 15.6 percent of the samples were taken from small income households of Delhi;
- ◆ 129 households or 71.7 percent of the samples were taken from the middle income households of Delhi;
- ◆ 23 households or 12.8 percent of the samples were taken from the high income households of Delhi.

Table 7: Number of rooms per household-sample category

Number of rooms	Samples included	Percentage
3 rooms	5	2.8
4 rooms	55	30.6
5 rooms	38	21.1
6 rooms	41	22.8
7 rooms	16	8.9
8 rooms	10	5.6
9 rooms	1	0.6
10 rooms	6	3.3
11 rooms	1	0.6
12 rooms	5	2.8
15 rooms	2	1.1
Total sample	180	100.2

Figure 3: Total rooms per household-sample category

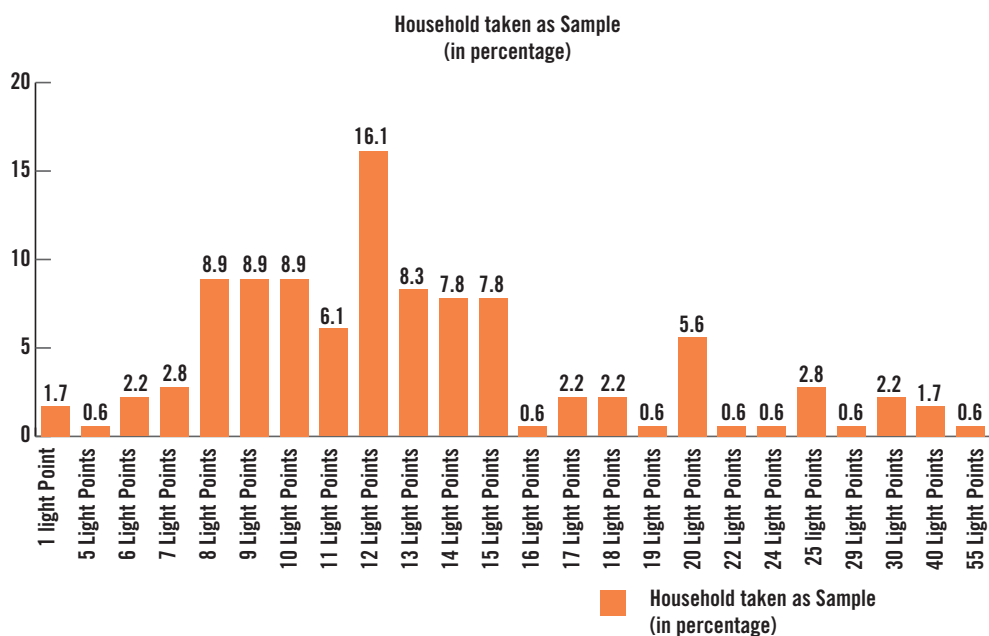


- ◆ Majority of the households taken in the sample, i.e. around 30.6 percent, have four rooms in their house;
- ◆ 21.1 percent of the sample houses have 5 rooms in their house;
- ◆ 22.8 percent of the households have six room in their house;
- ◆ Rest of the 23 percent have more than six rooms in their house;
- ◆ Only 2.8 percent of the household have three rooms in their house.

Table 8: Number of light points in each sample household

Number of light points	Number of sample	Sample percentage
1 Light Point	3	1.7
5 Light Points	1	0.6
6 Light Points	4	2.2
7 Light Points	5	2.8
8 Light Points	16	8.9
9 Light Points	16	8.9
10 Light Points	16	8.9
11 Light Points	11	6.1
12 Light Points	29	16.1
13 Light Points	15	8.3
14 Light Points	14	7.8
15 Light Points	14	7.8
16 Light Points	1	0.6
17 Light Points	4	2.2
18 Light Points	4	2.2
19 Light Points	1	0.6
20 Light Points	10	5.6
22 Light Points	1	0.6
24 Light Points	1	0.6
25 light Points	5	2.8
29 Light Points	1	0.6
30 Light Points	4	2.2
40 Light Points	3	1.7
55 Light Points	1	0.6
Total Households	180	100.4

Figure 4: Number of light points in each household



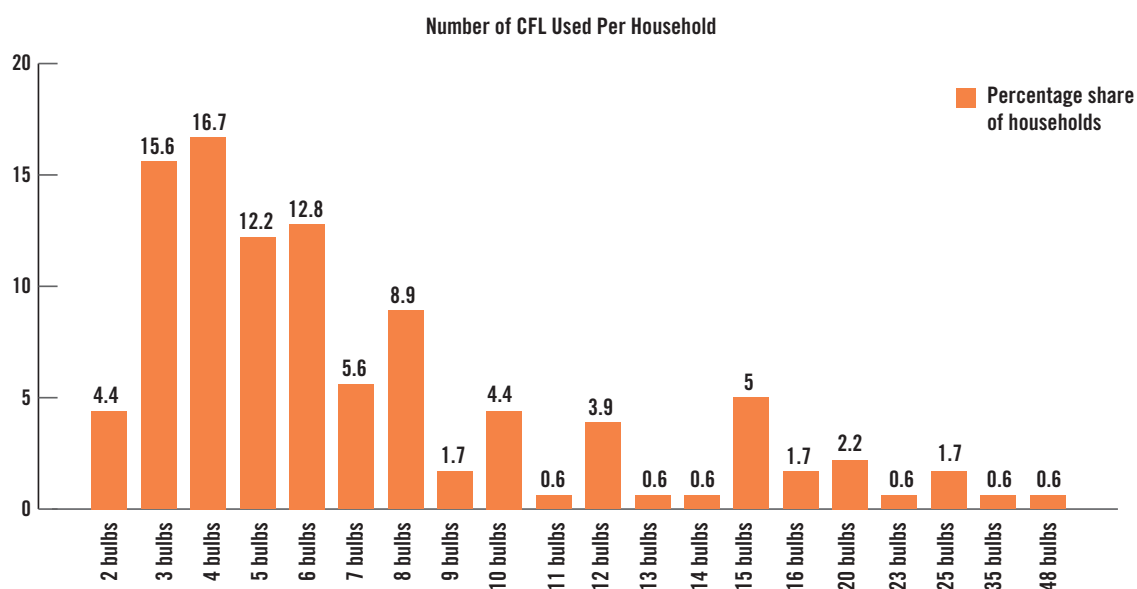
- ◆ 16.1 percent of the households have 12 light points in their houses;
- ◆ 8.9 percent of the houses each have eight to ten light points in their houses;
- ◆ 8.3 percent of the household have thirteen light points in their houses;
- ◆ 7.8 percent of the households have 14 to 15 light points in their houses;
- ◆ 1.7 percent of the household have only one light point in their house;
- ◆ Less than one percent each, have more than 15 light points in their houses;
- ◆ The overall data shows that some households have light points ranging from 30 to 50 CFL in their houses.

Table 9: Number of CFL used per household

Number of CFL used	Number of households	Percentage share of households
2 bulbs	8	4.4
3 bulbs	28	15.6
4 bulbs	30	16.7
5 bulbs	22	12.2
6 bulbs	23	12.8
7 bulbs	10	5.6
8 bulbs	16	8.9
9 bulbs	3	1.7

Number of CFL used	Number of households	Percentage share of households
10 bulbs	8	4.4
11 bulbs	1	0.6
12 bulbs	7	3.9
13 bulbs	1	0.6
14 bulbs	1	0.6
15 bulbs	9	5.0
16 bulbs	3	1.7
20 bulbs	4	2.2
23 bulbs	1	0.6
25 bulbs	3	1.7
35 bulbs	1	0.6
48 bulbs	1	0.6
Total households	180	100.4

Figure 5: Total number of CFL utilized per household

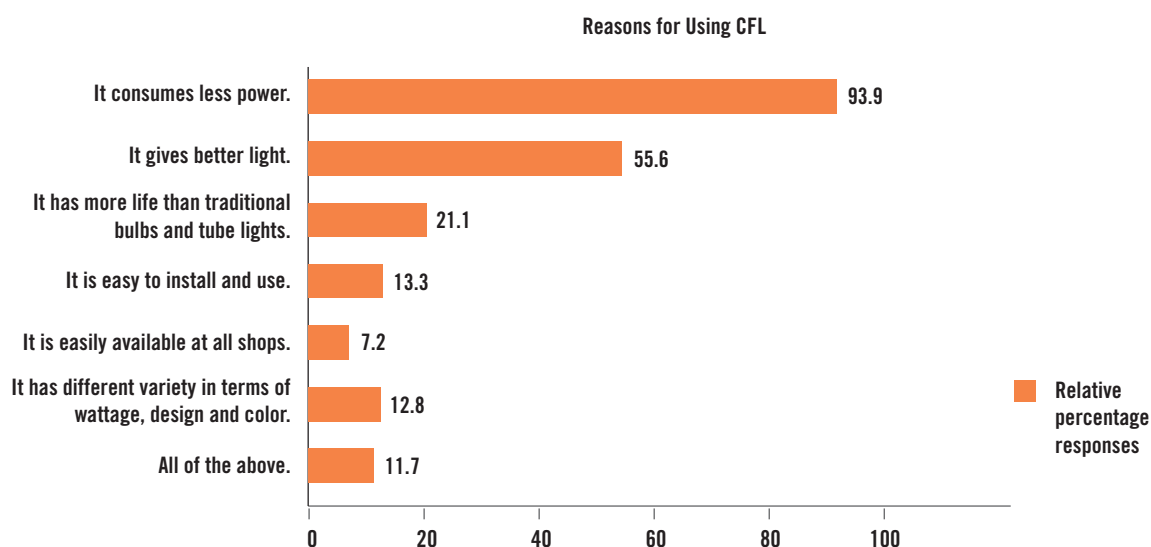


- ◆ 4.4 percent use 2 CFL, 15.6 percent of the households use 3 CFL, 16.7 percent use 4 CFL, 12.2 percent use 5 CFL, 12.8 percent use 6 CFL, 5.6 percent use 7 CFL, 8.9 percent use 8 CFL, 1.7 percent use 9 CFL and 4.4 percent use 10 CFL in their houses;
- ◆ 5 percent use 15 CFL, 1.7 percent use 16 CFL, 2.2 percent of the sample households use 20 CFL and 1.7 percent of the sample use 25 CFL in their household.

Table 10: Reasons for using CFL

Reasons	Number of responses	Relative percentage responses
It consumes less power.	169	93.9
It gives better light.	100	55.6
It has more life than traditional bulbs and tube lights.	38	21.1
It is easy to install and use.	24	13.3
It is easily available at all shops.	13	7.2
It has different variety in terms of wattage, design and color.	23	12.8
All of the above.	21	11.7

Figure 6: Details on why CFL is used

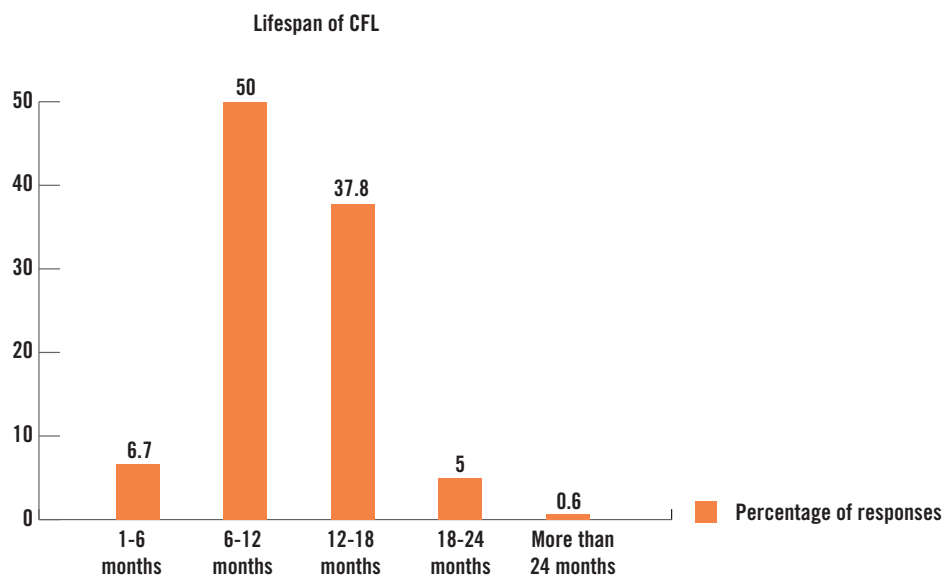


- ◆ 93.9 percent of the households surveyed said that they use CFL because it consumes less power.
- ◆ About 55.6 percent of the respondents said that CFL gives better light, while 21.1 percent of the respondents said that CFL lasts longer than traditional bulbs and tube lights. This shows that power consumption efficiency is the overriding factor for household consumers preferring CFL over other bulbs for lighting purposes. Better light and lifespan are also the influential factors in the decision-making process;
- ◆ While 13.3 percent of the respondents said CFL is user-friendly and easy to install and use, 12.8 percent of the respondents said that CFL's variety in terms of wattage, design and colour are also important factors for their preference over other bulbs;
- ◆ 11.7 percent of the respondents believed that all the factors discussed were their reasons for using CFL.

Table 11: Lifespan of CFL

Lifespan	Number of responses	Percentage of responses
1-6 months	12	6.7
6-12 months	90	50.0
12-18 months	68	37.8
18-24 months	9	5.0
More than 24 months	1	0.6
Total	180	100.1

Figure 7: Lifespan of CFL

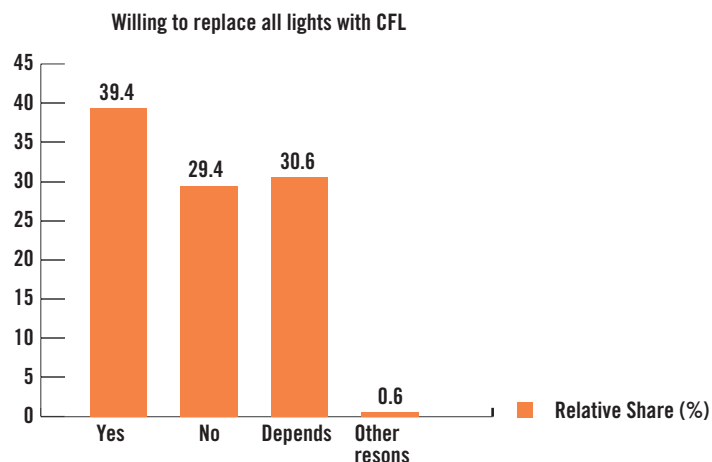


- ◆ The results from the field study show that almost 50 percent of CFL purchased last about one year and around 30 percent last for about one and a half years;
- ◆ If the cumulative percentage of the above two results are taken then it can be presumed that a majority of the bulbs last between 12 and 18 months in 90 percent of the CFL used. This is a huge inducement to use CFL over other types of bulbs for lighting purposes.

Table 12: Survey on consumers' willingness to replace all lighting points with CFL

	Number of consumers	Relative share (%)
Yes	71	39.4
No	53	29.4
Depends	55	30.6
Other reasons	1	0.6
Total	180	100.0

Figure 8: Survey on consumer willingness for CFL

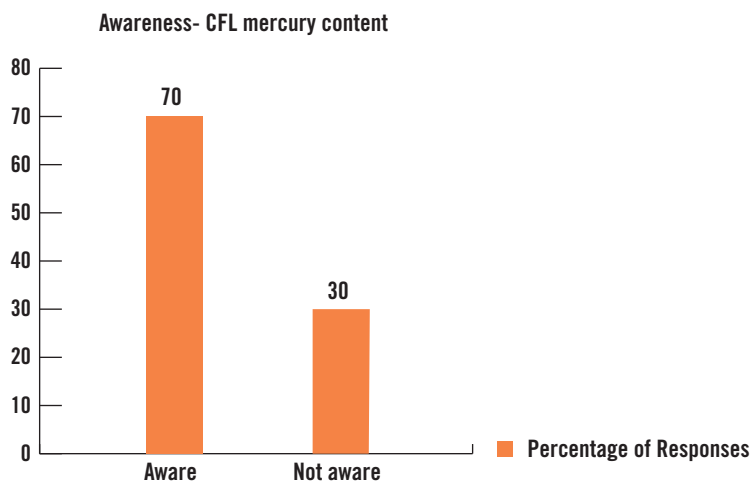


- ◆ The results from the field survey show that 39.4 percent of the households surveyed in Delhi are willing to replace all other lights in the light-points in their house with CFL, whereas 29.4 percent of the households are not that much willing to change over to CFL;
- ◆ 30.6 percent of the households surveyed said that if they can manage the cost involved and the lighting requirements of each room as compared to traditional bulbs and tube lights then they can consider about replacing all other lights with CFL. Thus, cost is a crucial factor in their case.

Table 13: Consumer response on mercury content present in CFL

Responses	Number of consumers	Relative share (%)
Aware	126	70.0
Not aware	54	30.0
Total	180	100.0

Figure 9: Survey on consumer awareness about mercury content in CFL

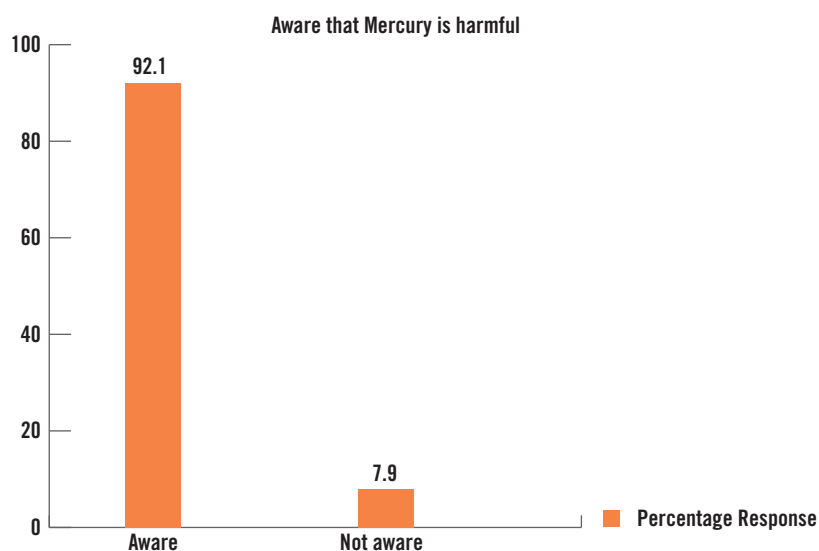


- ◆ While 30 percent of the respondents surveyed in Delhi are unaware that CFL contains mercury, 70 percent of the respondents are aware about CFL mercury content.

Table 14: Consumer alertness on whether mercury is harmful for human health (figures taken from those who know that CFL contains mercury)

Alertness	Number of consumers	Relative share (%)
Aware	116	92.1
Not aware	10	7.9
Total	126	100.0

Figure 10: Consumer awareness on the dangers of mercury on human health

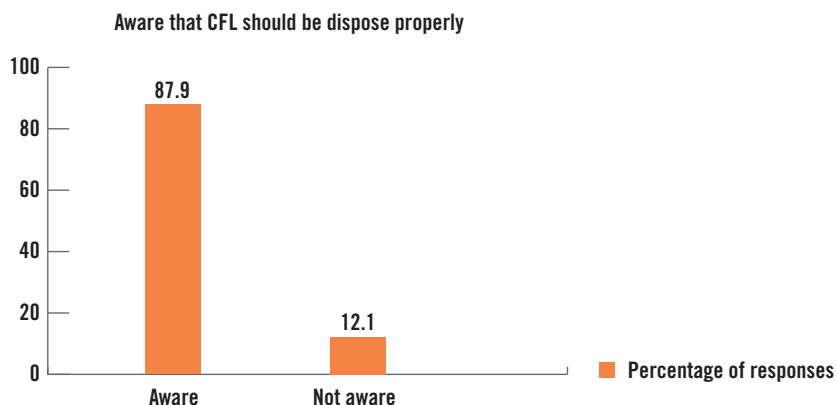


- ◆ Of the 180 respondents, 126 respondents who were aware that CFL contains mercury answered this question;
- ◆ Among them, 92.1 percent are aware that CFL mercury content is harmful while 7.9 percent of the respondents are unaware that the mercury in CFL is harmful for human health.

Table 15: Consumer response on the need for proper disposal of CFL

Responses	Number of responses	Percentage of responses
Aware	102	87.9
Not aware	14	12.1
Total	116	100.0

Figure 11: Consumer awareness survey on proper CFL disposal

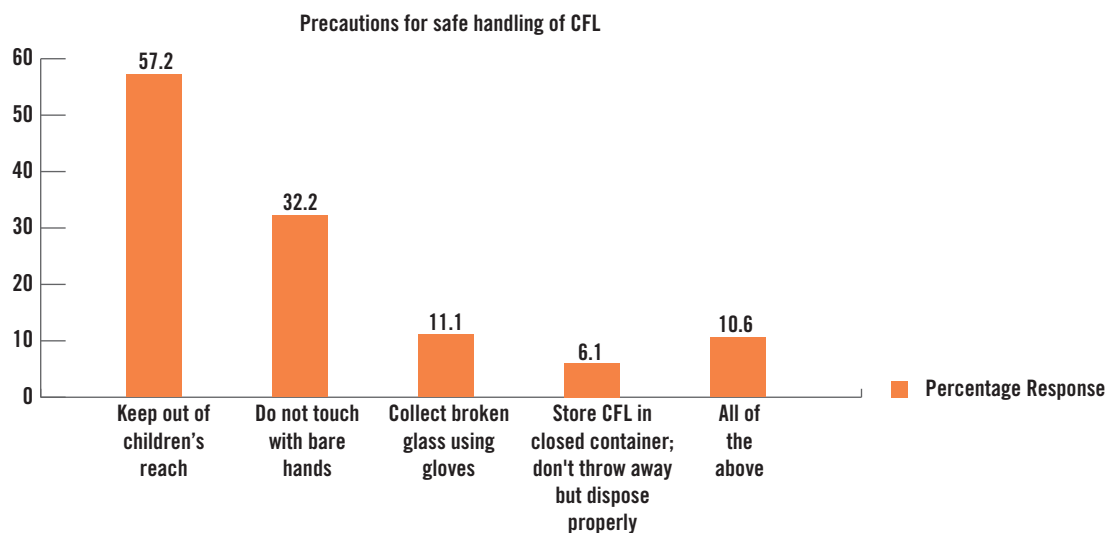


- ◆ Of the total 180 respondents, only 116 respondents who were aware that mercury is harmful for human health responded to this question.
- ◆ While 102 respondents or 87.9 percent said that they are aware about the proper disposal of CFL, 14 respondents or 12.1 percent respondents said that they are unaware of any such precaution.

Table 16: Precautions for safe handling of CFL

Responses	Number of responses	Percentage of responses
Keep out of children's reach	103	57.2
Do not touch with bare hands	58	32.2
Collect broken glass using gloves	20	11.1
Store CFL in closed container; don't throw away but dispose properly	11	6.1
All of the above	19	10.6

Figure 12: Survey on safe handling of CFL

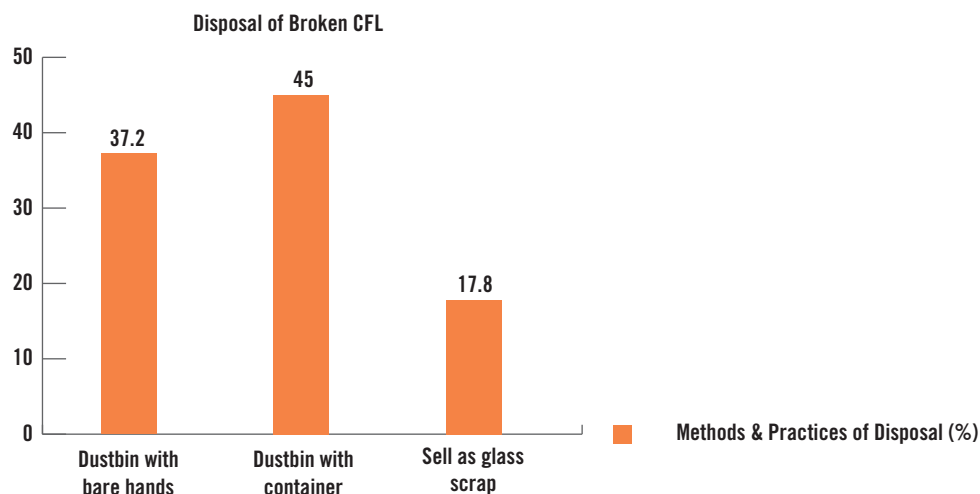


- ◆ All the 180 respondents answered this question. 57.2 percent of the respondents surveyed said that CFL should be kept out of reach of children and 32.2 percent of the respondents said that one should not touch CFL with bare hands;
- ◆ 11.1 percent of the respondents said that one should collect broken CFL using gloves and 6.1 percent of the respondents said that one should store used or broken CFL in closed containers and dispose it off properly. The CFL should not be thrown like that outside or in a dustbin;
- ◆ 10.6 Percent of the respondents said that one should take all the mentioned precautions.

Table 17: Analysis on ways of disposing broken CFL

Disposal process	Number of respondents	Relative share (%)
Dustbin with bare hands	67	37.2
Dustbin with container	81	45
Sell as glass scrap	32	17.8
Total	180	100.0

Figure 13: Disposal of broken CFLs as against methods of disposal adopted

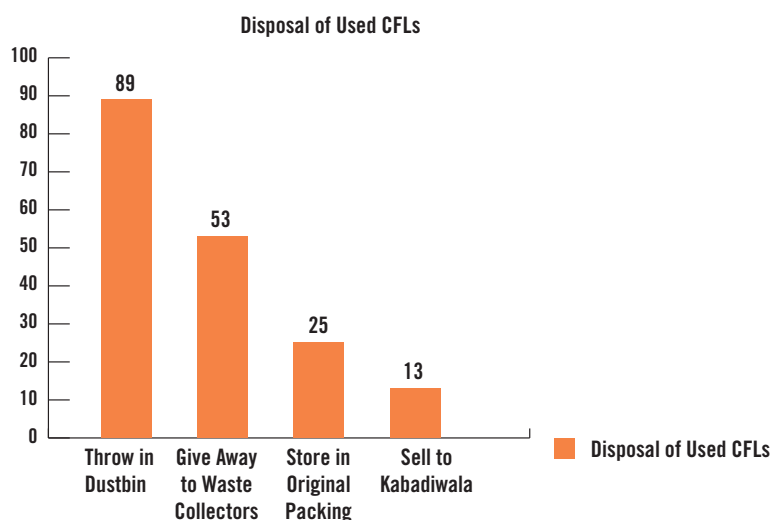


- ◆ 37.2 percent or 67 of the respondents surveyed said that they dispose-off broken CFLs in the nearest open dustbin with bare hands and sweep away the fine glasses that cannot be picked with bare hands;
- ◆ 45 percent or 81 of the respondents surveyed said that they dispose-off broken CFL in the nearest dustbin in a cover or container or after wrapping it in a piece of paper or polythene bag. Sometimes they also collect the fine glass particles in a paper and dispose-off along with the broken CFL. Occasionally they just sweep away the broken CFL fine glass particles;
- ◆ 17.8 percent or 32 of the respondents surveyed said that they keep the broken CFL and sell it later to a *kabadiwala* as glass waste material or scrap.

Table 18: Survey on disposal of used CFLs

Disposal process	Number of respondents	Relative share (%)
Throw in dustbin	89	49.4
Give away to waste collectors	53	29.4
Sell it to <i>kabadiwala</i>	25	13.9
Store in original packing	13	7.2
Total	180	99.9

Figure 14: Disposal of used CFLs as against methods of disposal adopted

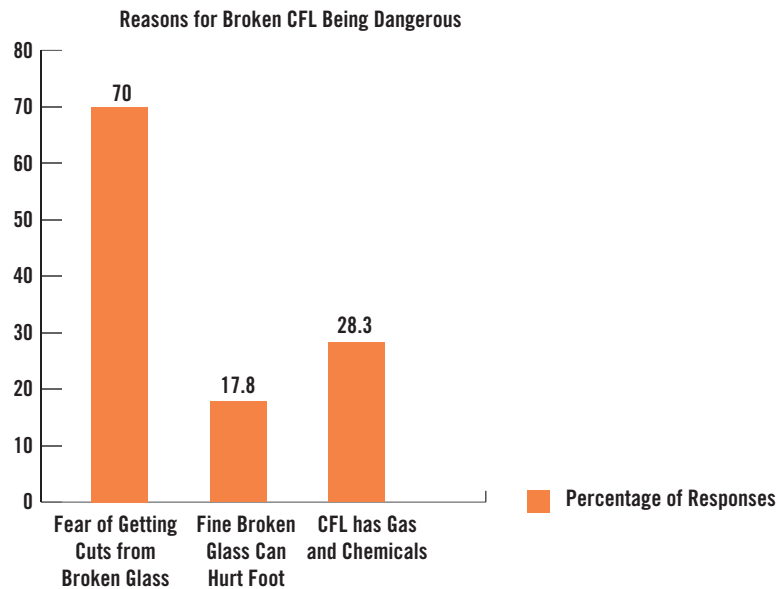


- ◆ 49.4 percent or 89 of the total respondents surveyed said that they dispose-off used CFL in the nearest dustbin;
- ◆ 29.4 percent or 53 of the respondents said that they give away the used CFL to the waste collectors who come to collect daily household waste material and garbage from their doorstep;
- ◆ 13.9 percent or 25 of the respondents surveyed said that they dispose-off the used CFL by giving them away or selling it to the *kabadiwalas* while disposing off other waste materials from their house;
- ◆ 7.2 percent or 13 of the respondents surveyed said that they keep the used CFL in original packing and later give them away to the rag picker or *kabadiwala*.

Table 19: Reasons for broken CFL being dangerous

Responses	Number of responses	Percentage of responses
Fear of getting cuts from broken glass	126	70
Fine broken glass can hurt foot	32	17.8
CFL has gas and chemicals	51	28.3

Figure 15: Survey on why respondents think broken CFL dangerous

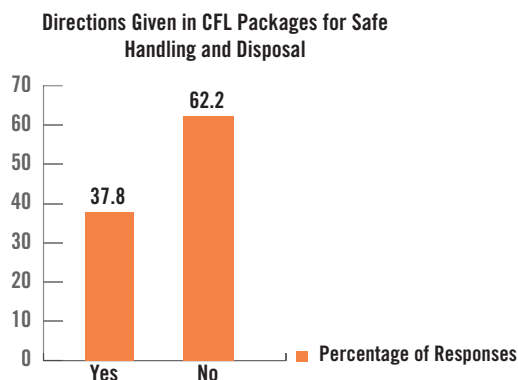


- ◆ All the respondents answered this question. 70 percent of them said that they do not touch broken CFL for fear of being cut by broken glasses;
- ◆ 17.8 percent said that fine broken glasses from CFL may hurt anyone while walking over them due to which they do not come near the place where a broken CFL is scattered;
- ◆ 28.3 percent of the respondents said that they fear getting burnt and hurt by the chemicals and gas inside a CFL due to which they take precautions.

Table 20: Responses on CFL safe handling and disposal directions

Responses	Number of responses	Percentage of responses
Yes, I have seen directions	68	37.8
No, I have not come across directions	112	62.2
Total	180	100.0

Figure 16: Survey on directions in CFL package for safe handling and disposal

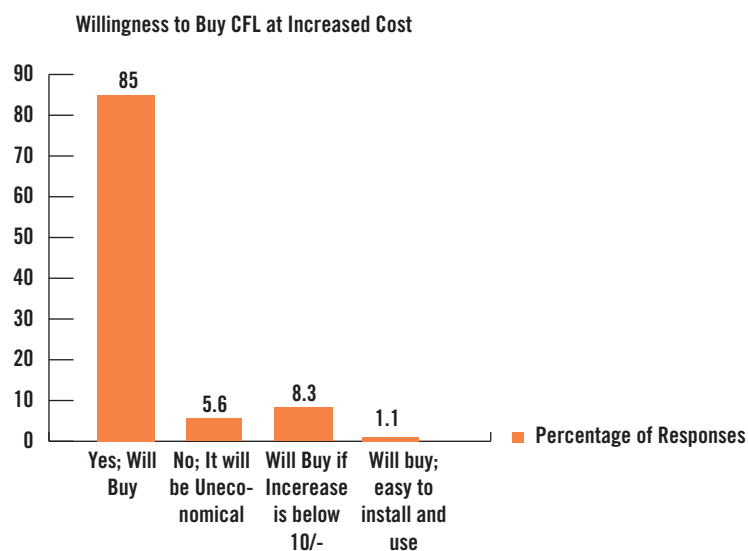


- ◆ 37.8 percent or 68 respondents said that they have seen directions for safe handling and disposal of CFL in the CFL cover package;
- ◆ 62.2 percent or 112 respondents said that they have not come across any directions for safe handling and disposal of CFL being mentioned in the CFL cover package.

Table 21: Examining the willingness to buy CFL even if selling price is increased

Responses	Number of responses	Percentage of responses
Yes, will buy even if price is high	153	85
No, price increase will make CFL uneconomical	10	5.6
Will buy if increase is between Rs. 1/- and 10/-	15	8.3
Will buy as it is easy to install and use	2	1.1
Total	180	100.0

Figure 17: Survey on the willingness to buy CFL even with increased price



- ◆ All the respondents answered this question. A whopping 85 percent said that they will continue to buy CFL even if its price is increased to any rate as CFL saves electricity cost and lasts longer;
- ◆ 5.6 percent of the respondents said that they will stop buying CFL if its price is increased between Rs 1/- and Rs 10/- as it is already costly for them and any further increase in cost will make it uneconomical for them;
- ◆ 8.3 percent of the respondents said that they will continue to buy CFL only if the increase in cost is marginal – between Rs 1/- and Rs 10/-;
- ◆ Only 1.1 percent of the respondents said that they will buy CFL even if it becomes costly by any measure as CFL is easy, flexible to install and use in all locations of the house, unlike tube lights and other bulbs.

3.2.2 Bhopal Data Analysis Report

Table 22: Bhopal sample statistics – CFL coverage

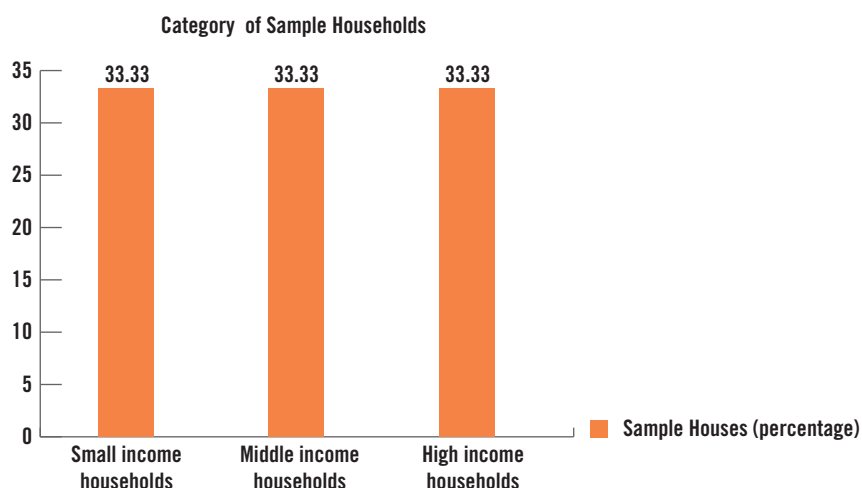
Category	Unit	Value
Number of households	In numbers	90
Number of light points	In numbers	711
Number of CFL used	In numbers	485
0-26 watt CFL	In numbers	178
27- 44 watt CFL	In numbers	108
45-85 watt CFL	In numbers	39
Percentage coverage of CFL to number of light points	In percentage	68.2

- ◆ The survey in Bhopal covered ninety households divided according to the income categorization made by the Government of India Census 2001 – like high income household, middle income household and small income household;
- ◆ These ninety households have altogether 711 light points of which 485 have CFL installed in them;
- ◆ Of these 485 CFL, 178 CFL are of power wattage range 0-26 watt, 108 are of power wattage range 27-44 watt and 39 are of power wattage range 45-85 watt;
- ◆ The percentage coverage of CFL to number of light points in the sample households is 68.2 percent.

Table 23: Sample as per annual household income

Category of households	Numbers	Percentage
Small income households	30	33.33
Middle income households	30	33.33
High income households	30	33.33
Total households included	90	99.99

Figure 18: Sampling of Bhopal households as per their annual income



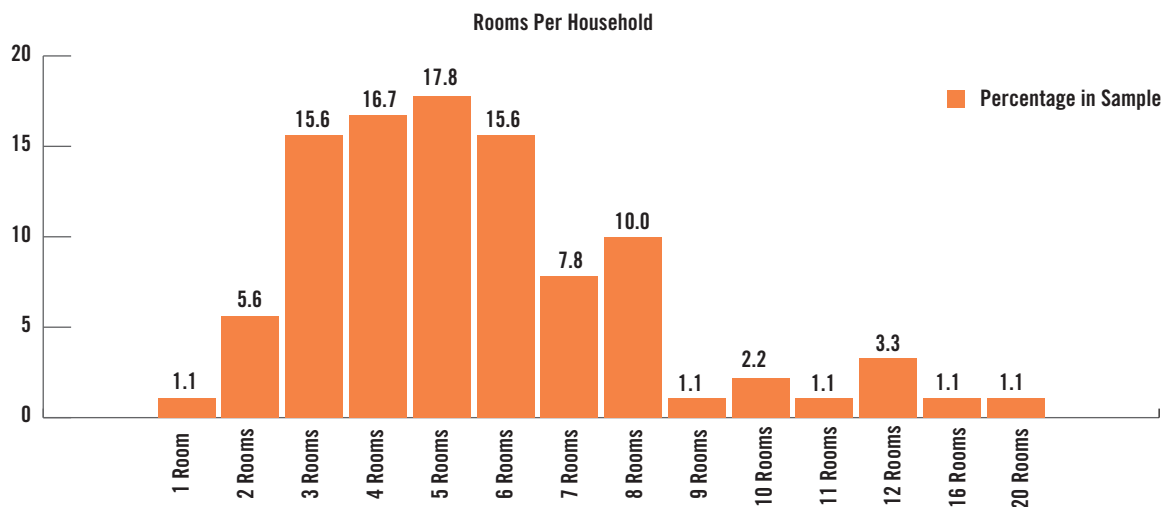
- ◆ The total sample of 90 residents of Bhopal urban area have been equitably distributed into 30 households or 33.33 percent from each category.

Table 24: Number of rooms per household

Number of rooms	Samples included	Percentage
1 room	1	1.1
2 rooms	5	5.6
3 rooms	14	15.6
4 rooms	15	16.7
5 rooms	16	17.8
6 rooms	14	15.6
7 rooms	7	7.8
8 rooms	9	10.0
9 rooms	1	1.1
10 rooms	2	2.2
11 rooms	1	1.1

Number of rooms	Samples included	Percentage
12 rooms	3	3.3
16 rooms	1	1.1
20 rooms	1	1.1
Total sample	90	100.1

Figure 19: Number of rooms per household-sample category



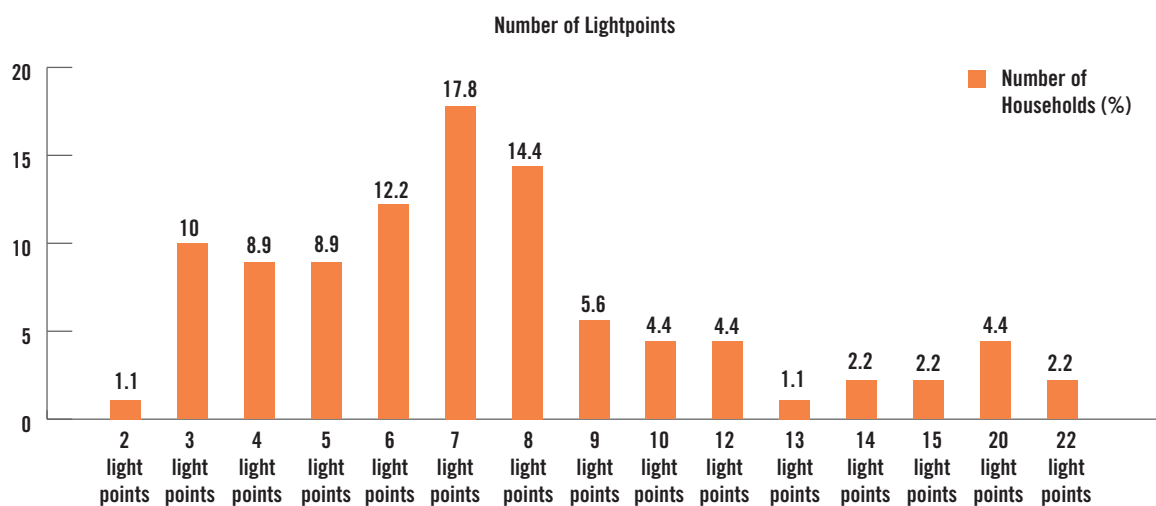
- ◆ Majority of the households taken in the sample, i.e. around 65 percent, have three to six rooms in their house;
- ◆ 7.8 percent of the sample houses have seven rooms in their household;
- ◆ 10 percent of the households have nine room in their houses;
- ◆ Rest of the 10 percent have rooms ranging from nine to twenty rooms in their household;
- ◆ 1.1 percent or one household in the sample has only one room in the household;
- ◆ 1.1 percent or one household in the sample has twenty rooms in the household.

Table 25: Number of light points in each sample household

Number of light points	Number of sample	Sample percentage
2 light points	1	1.1
3 light points	9	10
4 light points	8	8.9
5 light points	8	8.9
6 light points	11	12.2
7 light points	16	17.8
8 light points	13	14.4

Number of light points	Number of sample	Sample percentage
9 light points	5	5.6
10 light points	4	4.4
12 light points	4	4.4
13 light points	1	1.1
14 light points	2	2.2
15 light points	2	2.2
20 light points	4	4.4
22 light points	2	2.2
Total households	90	99.8

Figure 20: Number of light points in each household

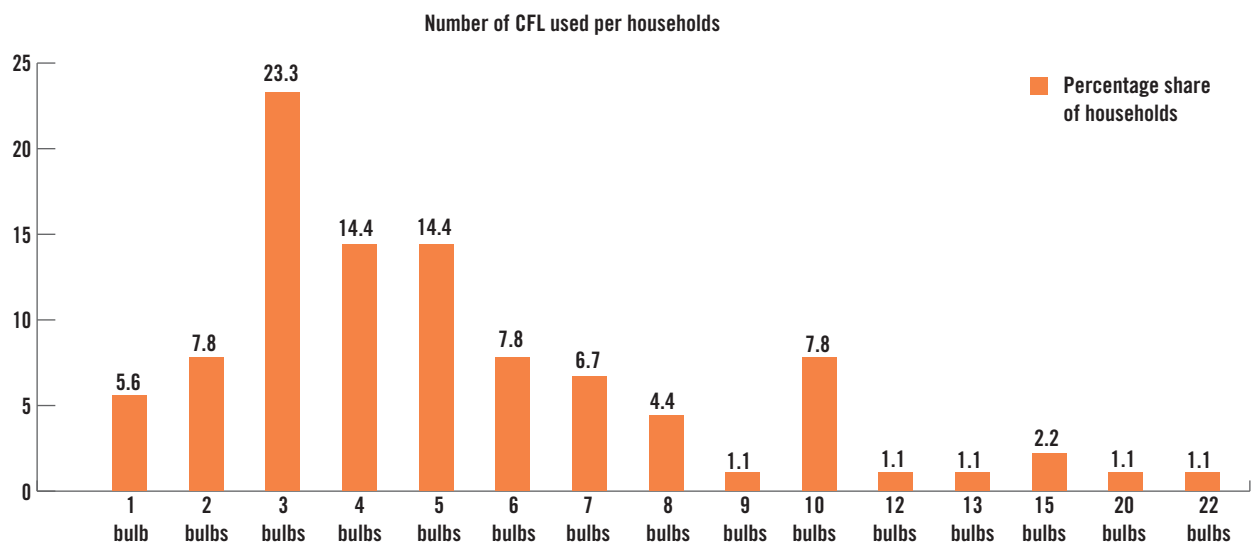


- ◆ Majority of the households in the sample, i.e. around 72.2 percent, have three to eight light points in their house;
- ◆ 2.2 percent of the households have 22 light points in their houses;
- ◆ 4.4 percent of the houses each have 20 light points in their houses;
- ◆ 2.2 percent of the household each have 14 to 15 light points in their houses;
- ◆ 15.5 percent of the households have nine to thirteen light points in their house;
- ◆ One household, or 1.1 percent of the sample, has two light points in the household.

Table 26: CFL used per household

Number of CFL used	Number of households	Percentage share of households
1 bulb	5	5.6
2 bulbs	7	7.8
3 bulbs	21	23.3
4 bulbs	13	14.4
5 bulbs	13	14.4
6 bulbs	7	7.8
7 bulbs	6	6.7
8 bulbs	4	4.4
9 bulbs	1	1.1
10 bulbs	7	7.8
12 bulbs	1	1.1
13 bulbs	1	1.1
15 bulbs	2	2.2
16 bulbs	1	1.1
20 bulbs	1	1.1
Total households	90	99.9

Figure 21: Quantity of CFL used per household



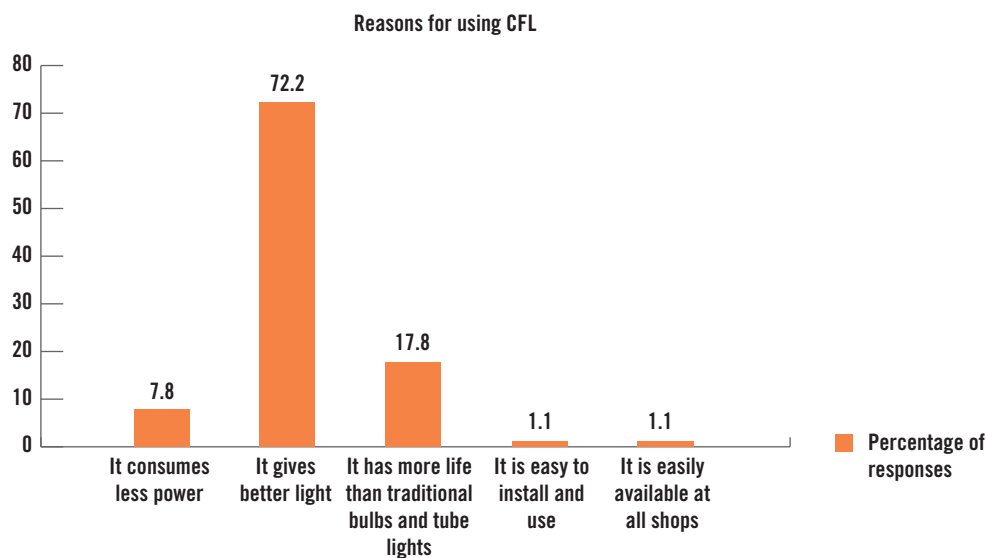
- ◆ Half of the sample households, or altogether 52.1 percent of the households, use two to five CFL in their household. Among them, a majority of the households or 23.3 percent use three CFL in their household;

- ◆ 5.6 percent use 1 CFL, 7.8 percent of the households use 2 CFL, another 7.8 percent use six CFL, 6.7 percent use 7 CFL, 4.4 percent use 8 CFL, 7.8 percent use 10 CFL and 2.2 percent use 15 CFL in their houses;
- ◆ 1.1 percent of the sample, or one household each, use 9, 12, 13, 16 and 20 CFL each in their household.

Table 27: Reasons for using CFL

Reasons	Number of responses	Relative percentage responses
It consumes less power	7	7.8
It gives better light	65	72.2
It has more life than traditional bulbs and tube lights	16	17.8
It is easy to install and use	1	1.1
It is easily available at all shops	1	1.1
Total	90	100.0

Figure 22: Details on why CFL is used

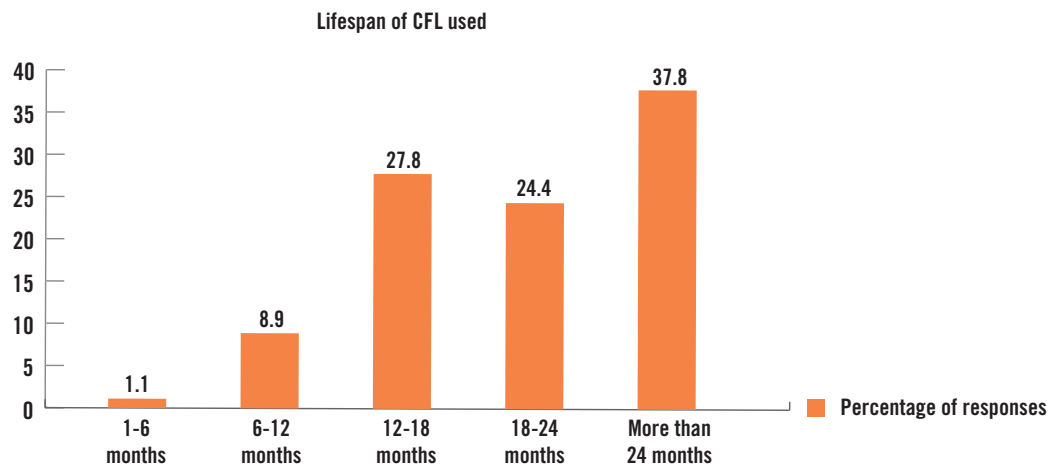


- ◆ 7.8 percent of the respondents said that they use CFL because it consumes less amount of power;
- ◆ An overwhelming 72.2 percent of the respondents said that they use CFL because it gives them better light than any other types of bulbs;
- ◆ 17.8 percent of the respondents said that they use CFL because it has more lifespan than other traditional types of bulbs and tube lights;
- ◆ Each of the 1.1 percent respondents said that they use CFL because it is easy to install and use, and also easily available at all shops.

Table 28: Lifespan of CFL

Lifespan	Number of responses	Percentage of responses
1-6 months	1	1.1
6-12 months	8	8.9
12-18 months	25	27.8
18-24 months	22	24.4
More than 24 months	34	37.8
Total	90	100.0

Figure 23: Duration of CFL

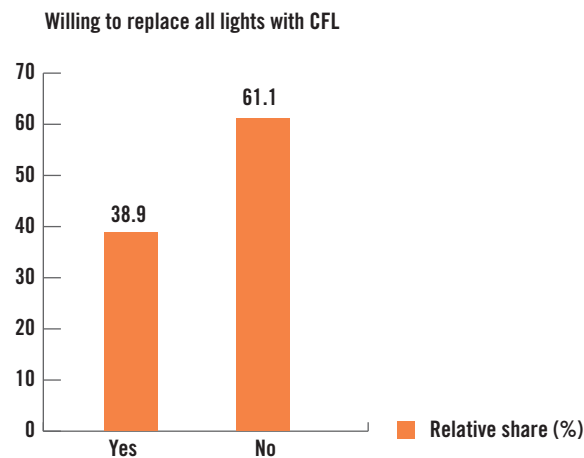


- ◆ 37.8 percent of the respondents said that their CFL lasted for more than 24 months;
- ◆ 24.4 percent of the respondents said that their CFL lasted between 18 to 24 months;
- ◆ 27.8 percent of the respondents said that their CFL lasts between 12 to 18 months;
- ◆ 8.9 percent of the respondents said that their CFL lasts between 6 to 12 months;
- ◆ Only 1.1 percent (or one resident) said the lifespan of CFL is 1-6 months.

Table 29: Survey on consumers' willingness to replace all lighting points with CFL

Response	Number of consumers	Relative share (%)
Yes	35	38.9
No	55	61.1
Total	90	100.0

Figure 24: Survey on consumer willingness for CFL

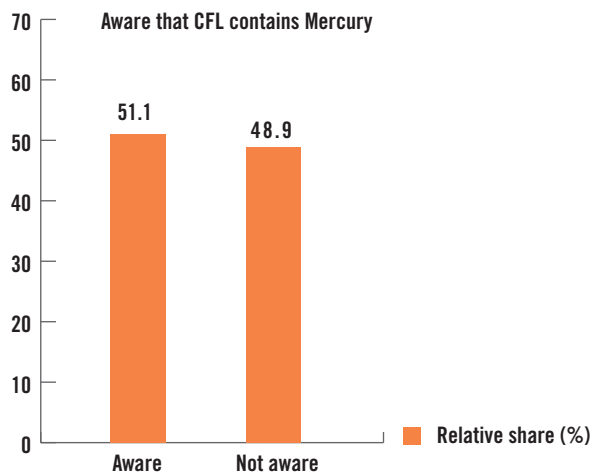


- ◆ 38.9 percent of the respondents said that they are willing to replace all their light points with CFL;
- ◆ However, 61.1 percent of the respondents said that they are not open to the idea of replacing all their light points with CFL as some of their lighting needs are better served by other type of bulbs.

Table 30: Consumer response on mercury content present in CFL

Responses	Number of consumers	Relative share (%)
Aware	44	51.1
Not aware	46	48.9
Total	90	100.0

Figure 25: Survey on consumer awareness about mercury content in CFL

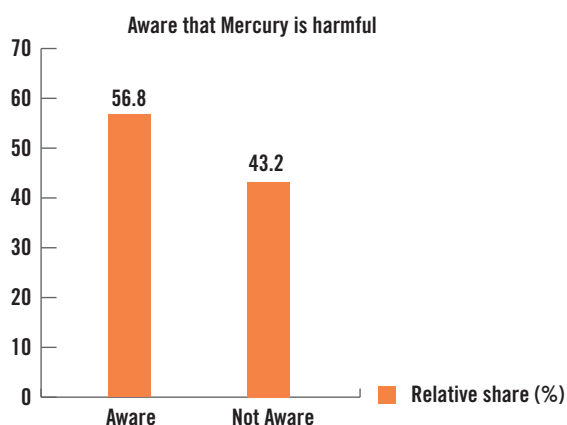


- ◆ While 51.1 percent of the respondents said that they are aware about CFL mercury content, 48.9 percent said that they are unaware about CFL containing mercury.

Table 31: Consumer alertness on whether mercury is harmful for human health (figures taken from those who know that CFL contains mercury)

Response	Number of consumers	Relative share (%)
Aware	25	56.8
Not aware	19	43.2
Total	44	100.0

Figure 26: Consumer awareness on the dangers of mercury on human health

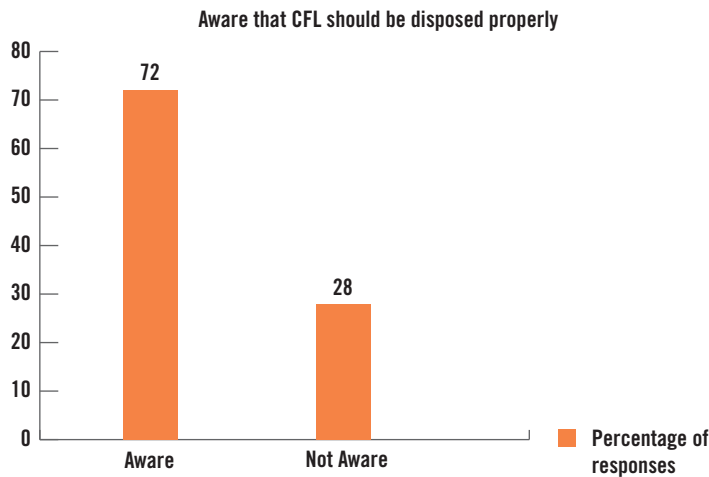


- ◆ While 56.8 percent of the 44 respondents (who were aware that CFL contained mercury) are aware that mercury is harmful for human health, the remaining 43.2 percent of the respondents or 19 respondents are unaware about mercury being harmful for human health.

Table 32: Consumer response on the need for proper disposal of CFL

Responses	Number of responses	Percentage of responses
Aware	18	72.0
Not aware	7	28.0
Total	25	100.0

Figure 27: Consumer awareness survey on proper CFL disposal



- ◆ Of the 25 respondents who are aware that mercury is harmful for human health, 72 percent or 18 of them know that mercury should be disposed-off properly;
- ◆ 28 percent or seven respondents, who are aware that mercury is harmful for human health, do not know that CFL, which also contains mercury, can be harmful for human health and therefore, should be disposed-off properly.

Table 33: Precautions for safe handling of CFL

Responses	Number of responses	Percentage of responses
Keep them out of children's reach	27	30.0
Do not touch with bare hands	48	53.3
Collect broken glass using gloves	7	7.8
Store CFL in closed container; don't throw away but dispose properly	8	8.9
Total	90	100.0

Figure 28: Survey on safe handling of CFL

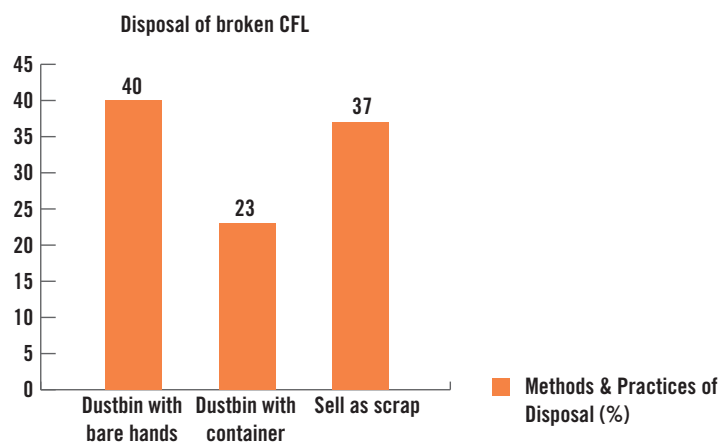


- ◆ 30 percent of the respondents said that as a precautionary measure, the CFL should be kept out of reach of children;
- ◆ 53.3 percent of the respondents said that as a precautionary measure, the broken CFL should not be touched with bare hands;
- ◆ 7.8 of the respondents said that as a precautionary measure the broken glass of CFL should be collected and disposed-off using gloves;
- ◆ 8.9 percent of the respondents said that as a precautionary measure the broken as well as used CFL should not be thrown away like that but kept in a closed container and disposed-off properly.

Table 34: Analysis on ways of disposing broken CFL

Disposal process	Number of respondents	Relative share (%)
Dustbin with bare hands	36	40.0
Dustbin with container	21	23.0
Sell as scrap	33	37.0
Total	90	100.0

Figure 29: Disposal of broken CFL as against methods of disposal adopted

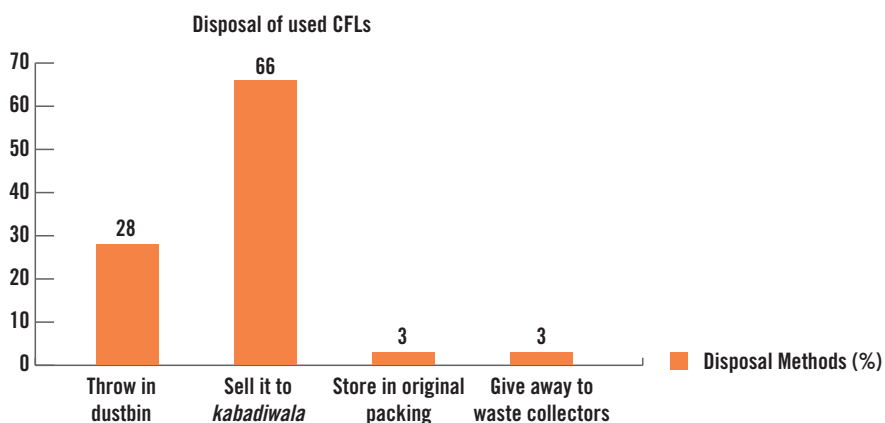


- ◆ 40 percent of the respondents said that they dispose-off broken CFL's in the nearest open dustbin with bare hands;
- ◆ 23 percent of the respondents said that they dispose-off broken CFL in the nearest dustbin in a cover or container or after wrapping it in a piece of paper or polythene bag;
- ◆ 37 percent of the respondents said that they keep the CFL and sell it later to a *kabadiwala* as glass waste material or scrap.

Table 35: Survey on disposal of used CFLs

Disposal process	Number of respondents	Relative share (%)
Throw in dustbin	25	28.0
Sell it to <i>kabadiwala</i>	59	66.0
Store in original packing	3	3.0
Give away to waste collectors	3	3.0
Total	90	100.0

Figure 30: Disposal of used CFL as against methods of disposal adopted

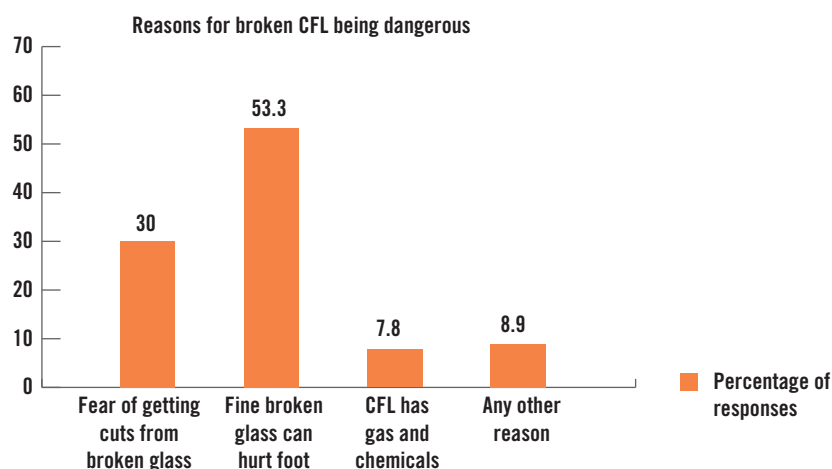


- ◆ 28 percent of the respondents said that they dispose-off used CFL in the nearest dustbin;
- ◆ 66 percent of the respondents said that they dispose-off the used CFL by giving them away or selling it to the *kabadiwala*;
- ◆ 3 percent of the respondents said that they keep the used CFL in original packing and later give them away to the rag picker or *kabadiwala*;
- ◆ 3 percent of the respondents said that they give the used CFL to the municipal waste collectors.

Table 36: Reasons for broken CFL being dangerous

Responses	Number of responses	Percentage of responses
Fear of getting cuts from broken glass	27	30.0
Fine broken glass can hurt foot	48	53.3
CFL has gas and chemicals	7	7.8
Any other reason	8	8.9
Total	90	100.0

Figure 31: Reasons for broken CFL being dangerous

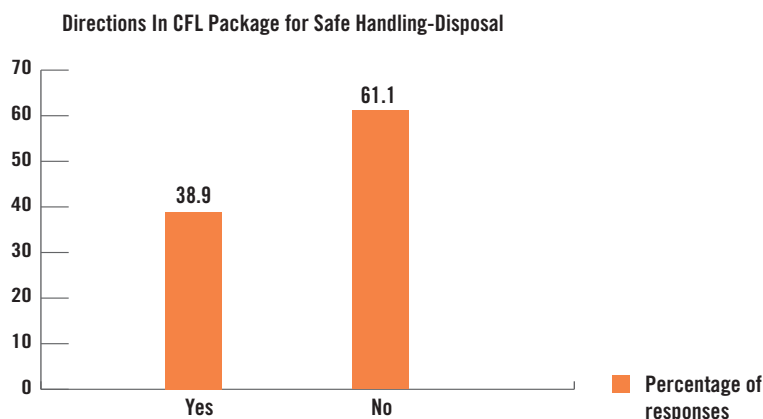


- ◆ 30 percent of the respondents said that broken CFL is dangerous as one can get hurt from broken glasses of CFL;
- ◆ 53.3 percent of the respondents feared that if a broken CFL is thrown away then splinters of broken glass strewn all over can injure the foot;
- ◆ 7.8 percent of the respondents feared that they may get affected and injured from the gas and chemicals contained in the CFL;
- ◆ 8.9 percent of the respondents gave various reasons: CFL being dangerous can cut the feet of people walking barefoot; the metal pins can hurt children; there is a risk of small children playing with broken glass and bulb and others.

Table 37: Responses on CFL safe handling and disposal directions

Responses	Number of responses	Percentage of responses
Yes, I have seen directions	35	38.9
No, I have not come across directions	55	61.1
Total	90	100.0

Figure 32: Survey on directions in CFL package for safe handling and disposal

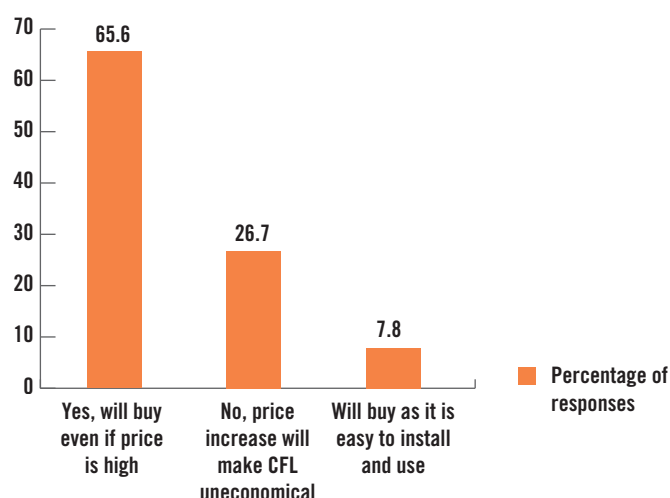


- ◆ While 38.9 percent of the respondents said that they have seen directions being written for proper handling and disposal of CFL, 61.1 percent said they have not seen any such directions in the CFL cover/package.

Table 38: Examining the willingness to buy CFL even if selling price is increased

Responses	Number of responses	Percentage of responses
Yes, will buy even if price is high	59	65.6
No, price increase will make CFL uneconomical	24	26.7
Will buy as it is easy to install and use	7	7.8
Total	90	100.1

Figure 33: Survey on the willingness to buy CFL even with increased price



- ◆ 65.6 percent of the respondents said that they will continue to buy CFL even if the price is increased between Rs 1/- and Rs 10/- but would hesitate to buy if there is a steep hike in CFL prices;
- ◆ 26.7 percent said that they may not buy CFL if the price is increased further even by Rs 1/- as it will be a case of an uneconomical proposition to buy CFL;
- ◆ 7.8 percent of the respondents said that they will continue to buy CFL even if further increase in price will pinch them because CFL are easy to install and use for a variety of lighting requirements which the traditional bulbs and tube lights cannot fulfil.

3.3 Analysis of Bulk Consumers (Hotels, Malls and Hospitals)

3.3.1 Hotels – Generation of Used CFL

The following are the responses from hoteliers on the points of discussion related to the numbers of CFLs generated monthly.

Table 39: Responses on the generation of used CFLs in hotels

Location	Hotel name	Category	Monthly CFL generation	Annual CFL generation
Delhi	Hotel Royal Plaza, 19 Ashoka Road, New Delhi	5 Star	100	1200
Delhi	The Solace E-2, East of Kailash, New Delhi-65	3 Star	15	180

Location	Hotel name	Category	Monthly CFL generation	Annual CFL generation
Delhi	Star Grand Villa, E-8 East of Kailash, New Delhi-65	2 Star	6	72
Bhopal	Hotel Golden Palace	3 Star	12	144
Bhopal	Hotel Bindal Residency	2 Star	10	120

Trend of Usage: Information gathered from the respondent hotels indicates that preference for CFL is increasing because of the following main reasons:

- ◆ Low power consumption, hence a huge cost saver;
- ◆ Longer lifespan or bigger renewal period;
- ◆ Flexibility of usage.

3.3.1.1 Awareness about CFL's Mercury Content, Safe Handling Requirements

The analysis of responses from the hoteliers on the points of discussion related to the awareness about CFL's mercury content, safe handling and disposal is as follows:

Awareness about CFL mercury content: Except for one three star hotel in Delhi – Hotel Star Grand Villa – all the other hotel staff including that of the five star hotel of Delhi – Hotel Royal Plaza – were unaware about the presence of mercury in CFL. The most common reason cited by them was that the cost, longevity as well as the usability factor diminished their need to probe further about any other aspect.

Safe handling of CFL: Information given by the respondents pertaining to safe handling of CFL during installation, usage and storage reveal that CFLs were treated more as a fragile item rather than an unsafe item that contains mercury – a harmful ingredient for human health and the surrounding environment. So all the hotels handle CFL with care to avoid breakage and hurt the person handling the CFL. Considering that hotels are organizations that procure items in lots and have a storage policy, all the hotels store some stock of CFL for immediate use and replenishment. As CFL is considered a fragile item, they are properly stored in containers by all the hotels to prevent any breakages. By this policy, the purpose of safe handling of mercury-laden CFL also got fulfilled as a co-beneficiary due to the brittleness angle of CFL. Thus, CFLs were stored in the common store house – in a separate section in close arena – to prevent them from the impact of other commodities stored there.

3.3.1.2 Disposal Practice Adopted for Used CFL

Analysis of responses for the disposal practice adopted by the hotels demonstrated that the three hotels taken in the study dumped the used CFL in the nearest garbage dump. One hotel – the 2 star rated hotel of New Delhi – gave the used CFL to the garbage collector who came daily to the hotel to collect garbage. Hotel Royal Plaza, a 5 star hotel, on the other hand, had contracted a collector of broken items (known as *kabadiwala*) to collect used and broken plastic items including CFL every two months. Generally the used CFLs were safely and separately tucked away in one corner of the general store that were intended to be disposed-off to the *kabadiwala*. The other hotels that were interviewed had no storage policy with regards to CFL. However, some of the hotels interviewed were open to the idea of hiring a specialized agency to manage the disposal of CFL bulbs if the service offered was economical and not a burden on the hotel's already huge maintenance expense.

In case of Bhopal, the two hotels – Hotel Bindal Residency and Hotel Golden Palace – kept the used CFLs in one area of the hotel till they were disposed to the *kabadiwalas* for a price. And with the hotels of non-metropolitan areas, like Bhopal, using every avenue to optimize cost and get some return, reselling of used as well as broken CFLs to *kabadiwalas* and informal recyclers seemed to be the preferred option of disposal.

3.3.2 Malls – Generation of Used CFL

The following are the responses from hoteliers on the points of discussion related to the numbers of CFLs generated monthly:

Table 40: Responses on the generation of used CFL in malls

Location	Mall name	Monthly CFL generation	Annual CFL generation
Delhi	DLF Emporio, Vasant Kunj, New Delhi	100	1200
Delhi	Ambience Mall, Vasant Kunj, New Delhi	150	1800
Delhi	DLF Mall Vasant Kunj, New Delhi	100	1200
Bhopal	DB Mall, MP Nagar Bhopal	100	1200

3.3.2.1 Awareness about CFL's Mercury Content, Safe Handling Requirements

The analysis of responses from the respondents with regards to awareness about CFL mercury content, safe handling and disposal in the hotel sector is as follows:

Awareness about CFL mercury content: While the respondents of two malls in Delhi said they were aware of the mercury content in CFL, one mall each in Delhi and in Bhopal were unaware about the presence

of mercury in CFL. The common reason cited by them was that other prominent features of the CFL – longevity, utility of usage and low power consumption – attracted most of their attention. They also said that they did not find any overt information about the mercury content in CFL and its proportionate negative effects on human health and environment either in product packaging (like that of the cigarette package warning people about it causing cancer) or on any social mass media.

Safe handling of CFL: Information given by the respondents pertaining to safe handling of CFL during installation, usage and storage revealed that CFLs were treated more as a fragile item than an unsafe item that contains mercury – a harmful ingredient for human health and the surrounding environment. Therefore all mall owners and store owners stocked CFL in their electrical store room – in separate enclosures – for immediate use and replenishment. As CFL was considered a fragile item, they were properly stored in containers to prevent breakage. By this policy, the purpose of safe handling of mercury-laden CFL also got fulfilled as a co-beneficiary due to the brittleness angle of CFL.

3.3.2.2 Disposal Practice Adopted for CFL

Analysis of responses to the disposal practice adopted by malls showed that three malls had contacted big *kabadiwalas* to take away the used CFL along with other waste materials. The *kabadiwalas* came every two months to collect used and broken plastic items including CFL. On the other hand, an informal manufacturing unit bought all the CFL for reuse from one mall. The used CFLs were usually disposed by these malls on a monthly or bi-monthly basis. Till then the malls kept the used CFLs separately tucked away in one area assigned for used items that were intended to be disposed-off to the *kabadiwala* or the vendor. Nevertheless, all the malls interviewed were open to the idea of hiring a specialized agency to manage the disposal of CFL bulbs if the service offered was economical and not a burden on the already huge maintenance expense.

3.3.3 Hospitals – Generation of Used CFL

The following are the responses from hospitals on the points of discussion related to generation of used CFL:

Table 41: Responses on the generation of used CFL in hospitals

Location	Hospital name	Monthly CFL generation	Annual CFL generation
Delhi	RML Hospital, New Delhi,	25	300
Delhi	Gangaram Hospital, New Delhi	60	720
Delhi	Moolchand Hospital, New Delhi	30	360
Bhopal	Hamidia Hospital, Bhopal	40	480
Bhopal	Bhopal Memorial Hospital, Bhopal	50	600

3.3.3.1 Awareness about CFL's Mercury Content, Safe Handling Requirements

The analysis of responses from the respondents with regards to the awareness about CFL mercury content, safe handling and disposal in the hospital sector is as follows:

Awareness about CFL mercury content: The response from the two big hospitals in Delhi – RML Hospital & Sir Gangaram Hospital in Delhi and one in Bhopal-- Bhopal Memorial Hospital-- showed that they are aware about the mercury content in CFL. However, the other two hospitals – Moolchand Hospital in New Delhi and the government run Hamidia Hospital in Bhopal – were not aware that CFL contains mercury.

Safe handling of CFL: The response from the two big hospitals – RML Hospital, Sir Gangaram Hospital in Delhi and Bhopal Memorial Hospital in Bhopal – showed the hospitals' awareness about how CFL had to be used and disposed-off carefully as it contained mercury. On the other hand, the responses from the other two hospitals-- Moolchand Hospital in New Delhi and the government run Hamidia Hospital in Bhopal –, showed that they were unaware about the danger.

3.3.3.2 Disposal Practice Adopted for CFL Bulbs

The response from the two big hospitals – RML Hospital in Delhi and Sir Gangaram Hospital in Delhi – showed that they had contracted big *kabadiwalas* to take away the CFL and other waste materials. While the Bhopal Memorial Hospital in Bhopal sold the plastic base part of the CFL through a proper channel after destroying the glass part, the Moolchand hospital in Delhi either kept the used CFLs safely or sometimes gave it to the *kabadiwala*. However, in case of the Hamidia hospital in Bhopal the cleaning staff collected the waste materials, including CFL, in containers and gave them away to local *kabadiwalas* or government sweepers and municipal vans that were cleaning the locality.

3.3.4 CFL Disposal Practices in Government Institutions

The study also included three government institutions – the Ram Manohar Lohia (RML Hospital) in Delhi, the Hamidia Hospital in Bhopal and the Bhopal Memorial Hospital.

Awareness about CFL mercury content: The response from the RML Hospital in Delhi and the Bhopal Memorial Hospital in Bhopal showed that both these hospitals were aware that CFL contained mercury. On the other hand, the Hamidia Hospital in Bhopal did not have any awareness about the mercury content in CFL. This lack of overall knowledge in the Hamidia Hospital about the mercury content in CFL is a matter that needs further prodding as they being in the health sector should have been aware about the fact.

Safe handling of CFL: The response from the RML Hospital in Delhi and the Bhopal Memorial Hospital in Bhopal showed that they were aware about how CFL should be used and disposed-off carefully as it contained mercury. On the other hand, the Hamidia Hospital in Bhopal was not aware that the mercury content in CFL should be handled safely. However, they felt that CFL being a glass item should not be thrown away carelessly.

Disposal practice adopted for CFL bulbs: The response from the RML Hospital in Delhi showed that they had contracted big *kabadiwalas* to take away CFL and other waste materials. In case of the Bhopal Memorial Hospital, there was a proper channel being setup to dispose the used CFLs and other hazardous waste. The Hamidia Hospital, on the other hand, employed their cleaning staff to collect the waste materials, including CFL, in containers and give them away to local *kabadiwalas* or government sweepers and municipal vans cleaning the locality.

This survey showed that none of the government institutions were aware or had any understanding on the provisions of the guideline issued by the Central Pollution Control Board for the mercury management of FLs.

3.4 Small and Big *Kabadiwalas*' Field Data Analysis

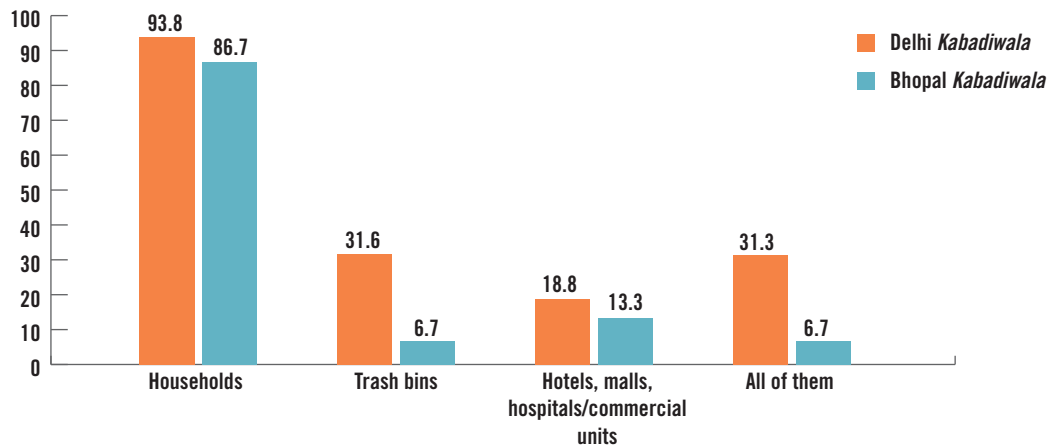
3.4.1 Small *Kabadiwalas*

Small *kabadiwalas* comprise those who collect recyclable products including CFL from households by themselves or associate some members to collect from many households and commercial units. They either go to the unit, i.e. households and commercial establishments, or are contracted by them to take away the daily, weekly or monthly waste.

Table 42: Source of collecting CFL

Categories	Values (%)	
	Delhi <i>kabadiwala</i>	Bhopal <i>kabadiwala</i>
Households	93.8	86.7
Trash bins	31.6	6.7
Hotels, malls, hospitals/commercial units	18.8	13.3
All of them	31.3	6.7

Figure 34: Survey on the source of collecting CFL (in percentage)



Analysis of Delhi Responses

The chart and table shows that:

- ◆ 93.8 percent of the *kabadiwalas* surveyed only picked CFL from households;
- ◆ 31.6 percent of *kabadiwalas* collect CFL from neighbourhood trash bins and waste dump yard sites;
- ◆ 18.8 percent of the *kabadiwalas* surveyed source CFL from big institutions like hotels, malls and hospitals;
- ◆ 31.3 percent of the Delhi *kabadiwalas* contracted CFL from several households, trash bins and commercial units including hotels, malls and hospitals.

Analysis of Bhopal Responses

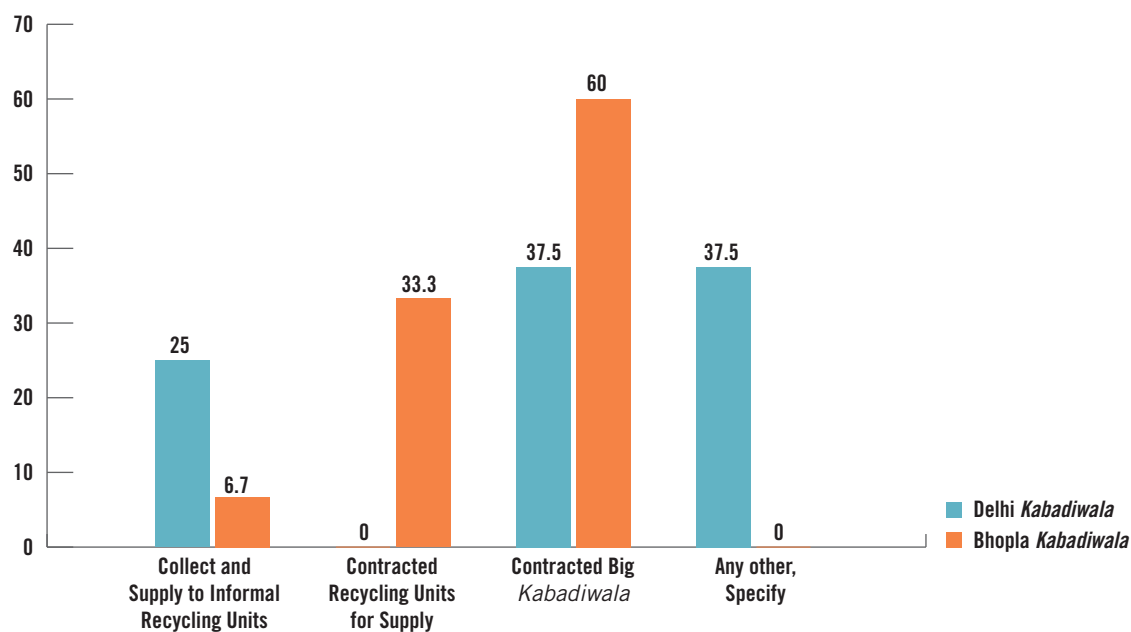
The chart and table shows that in Bhopal the persons surveyed were only *kabadiwalas*:

- ◆ A whopping 86.7 percent sourced used CFL from households;
- ◆ Only 6.7 percent sourced them from trash bins.
- ◆ 13.3 percent of the *kabadiwalas* surveyed said that they collected used CFL from shops and institutions;
- ◆ 6.7 percent of the *kabadiwalas* said that they collected CFL from all sources.

Table 43: CFL collection arrangement

Categories	Values (%)	
	Delhi <i>kabadiwala</i>	Bhopal <i>kabadiwala</i>
Collect on own and supply to informal recycling units	25.0	6.7
Contracted by recycling units for supply	0.0	33.3
Contracted by big <i>kabadiwalas</i>	37.5	60.0
Any other arrangement	37.5	0.0

Figure 35: CFL collection plan



Analysis of Delhi Responses

The data shows that:

- ◆ 25 percent of the *kabadiwalas* sell directly to different informal recycling units;
- ◆ 37.5 percent of them are contracted by big *kabadiwalas* to supply CFL to them;
- ◆ An equal percentage (37.5) of *kabadiwalas* is contracted by informal manufacturing and repair units who source CFL directly from these small *kabadiwalas*.

Analysis of Bhopal Responses

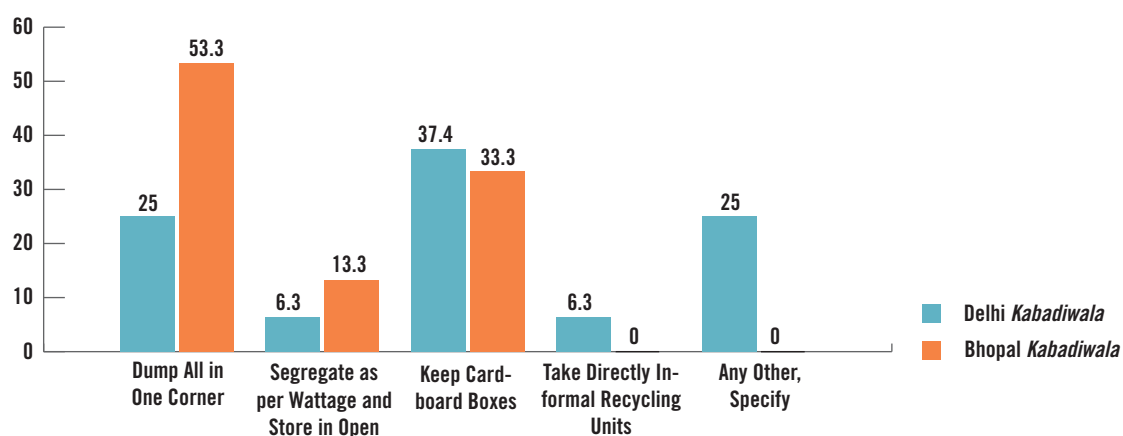
The chart and table shows that:

- ◆ A good 33.3 percent of the *kabadiwalas* are contacted directly by the informal recycling units of plastic and glass items for these CFL;
- ◆ In Bhopal, there seems to be a case where the informal recycling units come to these *kabadiwalas* to take CFL. This is because 60 percent of the *kabadiwalas* are being contacted by the big *kabadiwalas* to supply them with CFL.

Table 44: Mode of storage

Categories	Values (%)	
	Delhi <i>kabadiwala</i>	Bhopal <i>kabadiwala</i>
Dump all in one corner	25	53.4
Segregate as per wattage and store in open	6.3	13.3
Keep in cardboard boxes	37.4	33.3
Take directly to informal recycling units	6.3	0
Any other mode of storage	25	0

Figure 36: Storage approach of CFL (in percentage)



Analysis of Delhi Responses

The findings from the survey reveal that:

- ◆ 25 percent of the *kabadiwalas* dump all their recyclable waste collected, including CFL, in one corner of their living area;
- ◆ 6.3 percent of *kabadiwalas* segregate the CFL collected as per size and wattage and store in the open;

- ◆ 37.4 percent of *kabadiwalas* surveyed said that they store in cardboard boxes in the open area;
- ◆ 6.3 percent of the *kabadiwalas* said that they collect and directly take the CFL to the informal recycling units;
- ◆ Only 25 percent of the *kabadiwalas* said that they segregate and store CFL in cardboard boxes and tie them with plastic ropes to prevent breakage.

Analysis of Bhopal Response

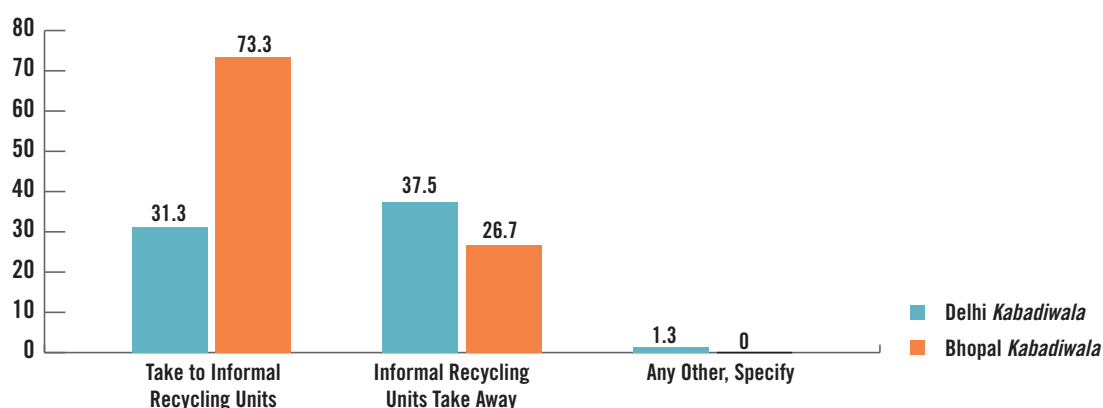
The chart and table shows that:

- ◆ Almost half of the *kabadiwalas* surveyed (i.e. 53.3 percent) said that they simply dump all the recyclable waste collected, including CFL in one corner in the open area where they are living, until disposal or sale of the items;
- ◆ 13.3 percent said that they sift the CFL from the recyclable waste collected, segregate them as per wattage and size, but store in the open;
- ◆ However, a good 33.3 percent said that they keep the segregated CFL in cardboard boxes.

Table 45: Mode of CFL delivery

Categories	Values (%)	
	Delhi <i>kabadiwala</i>	Bhopal <i>kabadiwala</i>
Take to informal recycling units	31.3	73.3
Informal recycling units take away	37.5	26.7
Any other delivery mode	1.3	0

Figure 37: Survey on the mode of CFL delivery (in percentage)



Analysis of Delhi Responses

The chart and table shows that:

- ◆ 31.3 percent of the *kabadiwalas* deposit their collection of CFL in the informal recycling units or manufacturing units that are tied up with them;
- ◆ 37.5 percent of the *kabadiwalas* have the privilege of informal recycling units coming and taking the collection of CFL from them;
- ◆ 1.3 percent of the *kabadiwalas* sometimes either supply them or the informal recycling or manufacturing unit comes and takes delivery of CFL.

Analysis of Bhopal Responses

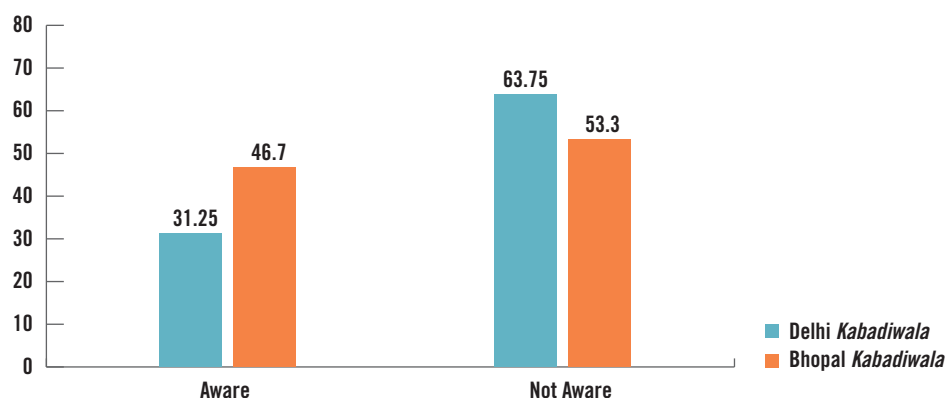
The data shows that:

- ◆ 73.3 percent of the *kabadiwalas* deposit the CFL collection with the informal recycling units;
- ◆ In the case of the 26.7 *kabadiwalas*, the informal recycling units' representative comes and takes away the CFL collection.

Table 46: Consumer awareness about mercury content in CFL

Categories	Values (%)	
	Delhi <i>kabadiwala</i>	Bhopal <i>kabadiwala</i>
Aware	31.25	46.7
Not aware	63.75	53.3

Figure 38: Awareness about CFL mercury content (in percentage)



Analysis of Delhi Responses

- ◆ 31.25 percent *kabadiwalas* are aware about mercury content in CFL;
- ◆ 63.75 percent of *kabadiwalas* are not aware about the presence of mercury in CFL.

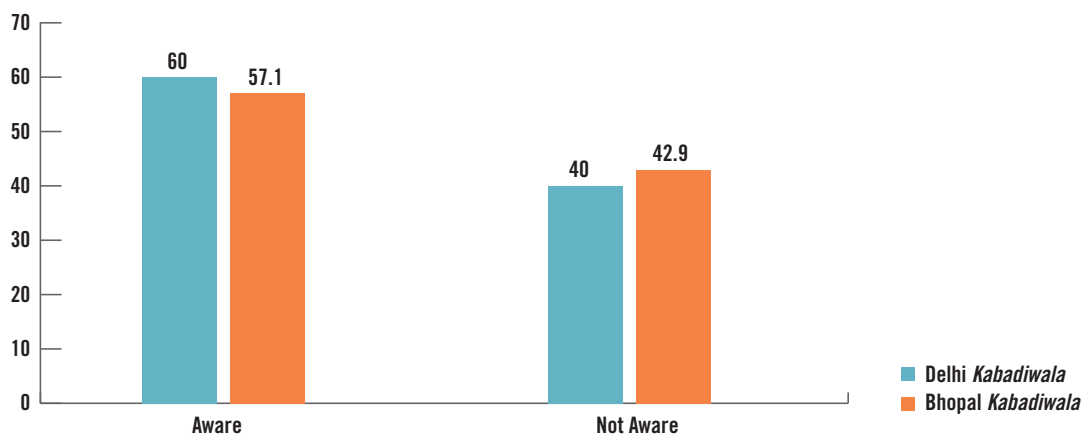
Analysis of Bhopal Responses

- ◆ 46.7 percent of the *kabadiwalas* are aware about CFL mercury content;
- ◆ 53.3 percent are not aware that CFL contains mercury.

Table 47: Consumer alertness on whether mercury is harmful for human health

Categories	Values (%)	
	Delhi <i>kabadiwala</i>	Bhopal <i>kabadiwala</i>
Aware	60	57.1
Not aware	40	42.9

Figure 39: Consumer awareness on the dangers of mercury on human health (in Percentage)



Analysis of Delhi Responses

- ◆ 60 percent of the *kabadiwalas* are aware that mercury is a harmful substance found in CFL;
- ◆ 40 percent *kabadiwalas* are not aware that the presence of mercury in CFL can be a serious threat to their general health.

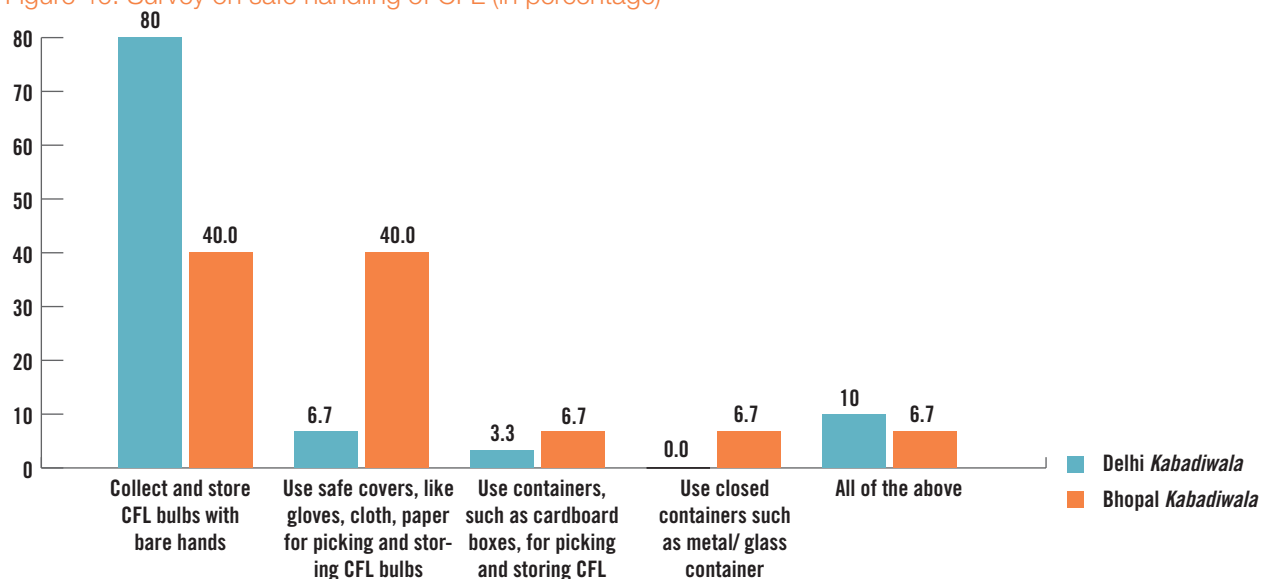
Analysis of Bhopal Responses

- ◆ 57.1 percent of the *kabadiwalas* are aware that the mercury content in CFL can be dangerous to human health. For those who were aware, the discussions with them showed that they either did not know about the precautions to be taken to avoid mercury contamination or were not equipped or provided the wherewithal to protect themselves from it;
- ◆ 42.9 percent are not aware that the presence of mercury in CFL can be harmful for their health.

Table 48: CFL safe handling practice

Categories	Values (%)	
	Delhi <i>kabadiwala</i>	Bhopal <i>kabadiwala</i>
Collect and store CFL bulbs with bare hands	80	40.0
Use safe covers, like gloves, cloth, paper for picking and storing CFL bulbs	6.7	40.0
Use containers, such as cardboard boxes, for picking and storing CFL	3.3	6.7
Use closed containers such as metal/ glass container	0.0	6.7
All of the above	10	6.7

Figure 40: Survey on safe handling of CFL (in percentage)



Analysis of Delhi Responses

- ◆ In Delhi, 80 percent of *kabadiwalas* pick up and handle CFL with bare hands, including broken CFL if any;
- ◆ Some *kabadiwalas* (6.7%) use gloves or torn cloth to pick up and handle CFL;
- ◆ Only 3.3 percent *kabadiwalas* use implements like cardboards to handle CFL.

Analysis of Bhopal Responses

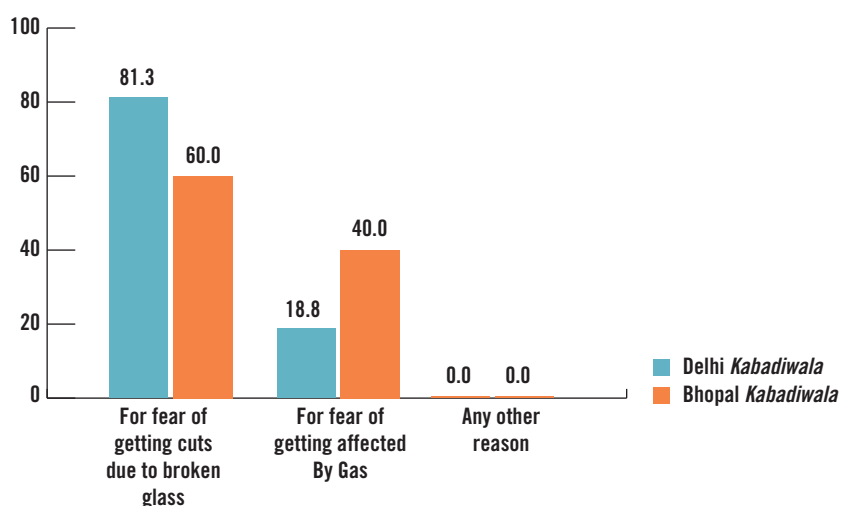
- ◆ In Bhopal, 40 percent equally, either use bare hands or any cover, like gloves, to handle CFL;
- ◆ 6.7 percent (in equal measure) use cardboards or metal containers and sheets to handle CFL.

However, all the respondents of Delhi and Bhopal who generally handle CFL with bare hands said that they do it because they are too focussed in collecting CFL than worry about such aspects. This is more so when the damage is not discernible or immediate (like burns from acid or chemicals).

Table 49: Reasons for not touching broken CFL with bare hands

Responses	Values (%)	
	Delhi <i>kabadiwala</i>	Bhopal <i>kabadiwala</i>
For fear of getting cuts due to broken glass	81.3	60.0
For fear of getting affected By Gas	18.8	40.0
Any other reason	0.0	0.0

Figure 41: Survey on the reason of not touching CFL with bare hands (in percentage)



Analysis of Delhi Responses

- ◆ 81.3 percent of the *kabadiwalas* surveyed said that whatever precaution they take is due to the fear of getting cut by broken glasses in case the CFL breaks due to careless handling;
- ◆ 18.8 percent of the *kabadiwalas* also said that they fear getting affected by the gas that emanates in case a bulb breaks due to mishandling.

Analysis of Bhopal Responses

- ◆ In Bhopal, 60 percent of the *kabadiwalas* feared getting cut by glasses;
- ◆ 40 percent also said that they feared being affected by the gas of bulbs in case it breaks due to mishandling.

None of the surveyed *kabadiwalas* of Delhi and Bhopal denied being provided with any training by any government authority or NGO regarding proper methods of handling CFL during collection, storage, transportation, and disposal and recycling.

3.4.2 Big *Kabadiwalas*

The study interviewed five big *kabadiwalas* from Delhi and four from Bhopal to get information about their CFL procurement, storage, transportation and handling practices, and also about their awareness level regarding the mercury content in CFL. The results of the discussion are as follows:

Table 50: Discussion Chart on CFL Activities

CFL activities	Delhi	Bhopal
On managing collection and deposit of CFL bulbs		
Average number of small <i>kabadiwalas</i> supplying CFL	27	11
Average number of workers engaged in handling CFL	5	3
Average number of CFL collected per month (in tons)	5.4	0.26
Store CFL in open (%)	80	25
Mode of delivery of CFL	Buyers take it themselves; no broken CFL found	Sellers generally deposit CFL at buyers point care- fully; if any broken CFL found, they are sold as broken item
Awareness about CFL bulbs' mercury content, safe handling/disposal requirement		
Awareness amongst big <i>kabadiwalas</i> and their workers about CFL containing mercury and its harmful effects on health and environment; so godown area/other area are cleaned daily with broom and the dust/dirt is collected in containers (%)	35	50

CFL activities	Delhi	Bhopal
How workers handle CFL bulbs during collection, storage and sale to LRU's	50-60% handle CFL mostly with bare hands	50-60% handle CFL mostly with bare hands
Single most reason for not touching broken CFL bulbs (if any) with bare hands during storage and selling	For fear of breaking CFL; fear of getting cuts	For fear of getting cuts, bruises and chemical burn

Operations and manpower: The operation statistics of big *kabadiwalas* – both in Delhi and Bhopal – show that they are medium units with one man ownership format. They are neither registered entities nor do they have any affiliation or are familiar with the professional approach to collect and store CFL. The reason being most of these *kabadiwalas* do not have any formal education; even if they have had education it is up to some elementary level. They are mostly focussed on using their basic human skills in operations and negotiations in order to collect items (used items of any type that can be resold for a premium) at negligible and throwaway prices.

Following are the main reasons for collecting CFL, among others, for sale:

- ◆ The plastic base and electronic ballast of CFL is quite in demand at the informal recycling market;
- ◆ The informal CFL manufacturing market is also active (especially in the Delhi) where many cottage units repair and sell the used CFLs by putting their own brand name and manufacturing date;
- ◆ Some informal recyclers carry the plastic base with electronic ballast for refurbishing. These refurbishing products again come into the market.

The big *kabadiwalas* of Delhi and Bhopal tie-up with small *kabadiwalas* based on their size of operation and capacity to manage recycle items. Among the big *kabadiwalas* contacted, majority of them employ three to five staff to manage collection, storage and handling of CFL among other recyclable items. The average number of small *kabadiwalas* contracted to supply used CFL in Delhi is 25 to 27 and for Bhopal it is 10 to 11.

Collection volumes: Each big *kabadiwala* in Delhi collects around five tons of used CFL per month; in Bhopal they collect around 0.38 tons of CFL per month. The big *kabadiwala* collects both broken CFLs and intact CFLs.

Awareness about CFL mercury content: The study revealed that only 40 percent of the big *kabadiwalas* surveyed in Delhi were aware about the mercury content in CFL. However, in Bhopal, all the *kabadiwalas* surveyed were aware about the mercury content in CFL. Statistically it may not be very shocking to say that all *kabadiwalas* in Bhopal are aware about the mercury content in CFL; on the other hand only 40 percent in Delhi know about it. This is because the sample size is small.

However, with the *kabadiwalas* being a homogenous sample category (there are no professionally managed modern *kabadiwala* units) in terms of background and nature of operations that differ only in size of operations, it can be safely assumed that many *kabadiwalas* in Delhi do not know about CFL

mercury content. A high percentage of big *kabadiwalas*, on the other hand, know that CFL contains mercury.

Discussions with the Delhi *kabadiwalas* revealed that with their operations being large and varied in nature, their focus is on all products and not one product. They further added that unlike some items like industrial substances, car batteries, computer monitors that are overtly hazardous for humans, mercury-laden CFL has not caused any overt or noticeable and immediate damage or effect to the staff managing such items. Moreover, no agency had informed them about the mercury content in CFL. Whatever awareness they had acquired was either from rumours or gathered knowledge at different times.

Bhopal *kabadiwalas*, on the other hand, also dealt with broken CFL, and many a times, some of their workers handling broken CFL were hurt (cut and bruises have happened). Some consulted doctors and they were informed that the white substance in CFL glass case contained mercury. They were advised to be careful. This information got circulated mostly amongst the worker fraternity leading to their awareness about the mercury content of CFL.

When dealing with the issue of handling CFL bulbs during collection, storage and transportation, it hardly mattered whether workers and *kabadiwalas* in Delhi were aware about the CFL content. This is because more than half of the *kabadiwalas* surveyed said that their staff handled CFL collection, storage and transportation (even broken CFL) using bare hands. Whatsoever precaution the staff had taken was due of their fear of getting cuts and bruises while handling a fragile glass item; precaution towards a hazardous item is nowhere in the picture.

Analysis and Inference

4.1 Mercury Spillage to Environment (Estimation Based on Restrictive Assumptions)

The study has taken some assumptions to calculate the prospective spillage of mercury from discarded CFL into the environment, based on the findings of the primary survey.

- ◆ The survey found that, one way or the other, the mercury from discarded CFL ends up in the environment either directly from the user or through informal *kabadiwalas*, manufacturers and recyclers. So it is assumed that all mercury from the discarded CFL ends up in the environment at a certain point of time.
- ◆ The second assumption is that with the life of CFL being comparatively high (at least one year), it is assumed that not all CFL being used are ending in the environment in a short period of time. Therefore, the calculation has taken an interval period of at least one year from the present date to do the calculation.
- ◆ The third assumption is that with the life of CFL being high, it can be grouped into three phases – new CFL, mid-life CFL and nearing end-life CFL – so that all the numbers associated with these groups can be used to do the calculation.

These assumptions are same for both household and institutional consumers.

4.1.1 Mercury Content Released by Individual Households into Environment

Table 51: Individual households' mercury usage

Particulars	Units	Values
Total population	million	16.75
Urban population	million	16.33
Total households	million	3.34
Households electrified (98%)	million	3.28
Light points per household (average assumed based on field survey data)	No's	13.00
CFL as 50 per cent share of the average light points in each household	No's	6.50
Installed base of CFLs in Delhi's households	million	21.32
Expected CFL waste generated by Delhi households (in millions)		
	2014	2015
Assuming 20% new CFLs are in the installed base, which will expire in the next 24 months	-	4.26
Assuming 40% mid-life CFLs are in the installed base, which will expire in the next 12 months	8.53	-
Assuming 30% end-of-life CFLs are in the installed base, which will expire in the next 6 months	6.40	-
Cumulative CFL waste		
Waste CFL (in million)		
2014	14.93	
2015	19.19	
Cumulative mercury released to the environment from CFL waste		
Year	Number of used CFLs in waste containing mercury (million)	Amount of mercury released into the atmosphere [in Mg' (assuming each CFL contains 5 mg' of Mercury)]
2014	14.93	74650000 mg (or 74.650 Kg)
2015	19.19	95950000 mg (or 95. 95 Kg)

The results of the estimation show that around 14.93 million pieces of CFL in 2014 and 19.19 million pieces of CFL in 2015 along with their mercury content is being used by the households in Delhi that will end up in the environment.

4.1.2 Mercury Content Released by Commercial Establishments into Environment

Table 52 : Commercial entities' mercury usage

Commercial segment	Number of entities	Average number of CFL at each commercial segment	Total CFL bulbs in each segment
Hotel (star category)	225	1,000	2,25,000
Shopping malls	120	3,000	3,60,000
Hospitals	114	500	57,000
Total	459	4,500	6,42,000
Expected CFL waste from three commercial sector segments (hotels, shopping malls and hospitals)			
Year	2014	2015	
Assuming 20% new CFLs are in the installed base, which will expire in the next 24 months	-	1,28,400	
Assuming 40% mid-life CFLs are in the installed base, which will expire in the next 12 months	2,56,800	-	
Assuming 30% end-of-life CFLs are in the installed base, which will expire in the next 6 months	1,92,600	-	
Total	4,49,400	1,28,400	
Cumulative CFL waste			
Number of used CFLs in waste containing mercury			
2014	4,49,400		
2015	5,77,800		
Cumulative mercury released to the environment from CFL waste			
Year	Number of used CFLs in waste containing mercury	Amount of mercury released into the atmosphere [in Mg' (assuming average CFL contains 10 mg' of mercury)]	
2014	4,49,400	4494000 (or 4.49 Kg)	
2015	5,77,800	5778000 (or 5.7 Kg)	

Cumulative CFL waste: The results of the estimation show that around 4,49,400 pieces of CFL in 2014 and 5,77,800 pieces of CFL (included in the study) along with their mercury content, which is being used by different commercial establishments or institutional consumers' category in Delhi will end up in the environment.

Cumulative mercury released to the environment: The number of CFL dumped as wastes into the environment are around 4,49,400 pieces of CFL in 2014 and 5,77,800 pieces of CFL. Average CFL in India contains around 10 mg of mercury. Therefore the actual amount of mercury in dumped CFL entering the environment will be around 4.49 kg by 2014 and 5.7 kg in 2015.

Conclusions and Recommendations

The study on usage, disposal, awareness and recycling practices of CFLs as well as the trend of usage amongst the identified sample group within the study area – Delhi and Bhopal – did bring up substantive results in terms of reference of the study. The broad outcomes are as follows:

Usage

The study showed that CFL usage is increasing amongst both the household and institutional consumers. The percentage of usage of CFL from the total light points of an entity ranges from around 30 to 50 percent. Though the survey found that some of the malls are shifting to LEDs, CFLs are still enjoying the preference. The reasons for their increase in usage are their longer life span, better lighting quality, fulfilment of wide range of lighting purposes and ease of usage among others. However as the hospital sector has well-defined application strategies and uses for lighting, the penetration of CFL has been found to be low.

Disposal

Almost all the users of CFL discard them after usage like any other waste material – in the nearest dustbin or dump yard. A small percentage of users in other categories in both the cities discarded CFL carefully. However, a large percentage gave them away to *kabadiwalas* and waste pickers. So, the disposal practice is almost rudimentary and bereft of any care by the users.

Recycling

There are no proper recycling facilities of CFLs existing in Delhi and Bhopal. The whole downstream management of used CFL is operated in a very informal setup. The first point of recycling is the small *kabadiwalas*, who take these used CFLs – either intact or broken – and sell them at a nominal price to the big *kabadiwalas* or recyclers of plastic and glass materials. A good percentage of small *kabadiwalas* work for big *kabadiwalas* and recyclers and collect these used CFL for them. They either directly deposit the collected CFL with the big *kabadiwalas* or keep them till the big *kabadiwalas* and informal recyclers come to collect them. Till then, they store the used CFL like any other waste material in the open or on bare floors. The demand for plastic base of CFL is higher than the glass top. So in most of the cases *kabadiwalas* break the glass top at the nearest dump site and store the plastic base for sale.

In the survey it was also found that the used CFLs, which are in good condition, were sourced by the informal manufacturing units. These units repaired them, put their brand and date of manufacturing and, sold them locally at a much reduced rate than a company-branded and quality-controlled CFL. These manufacturing units are typical one- or two-room sweat shops where the staffs use traditional electrical repairing devices to repair the wiring of the CFL.

During the survey some glass recyclers were also found. The glass recyclers washed the entire glass top containing mercury in boiling water to clean the white coating and threw away the water containing mercury into the drain. Subsequently all the used CFL containing mercury virtually ended up endangering the environment.

Awareness

A certain level of awareness was noticed among the individual consumers and bulk consumers during the survey. They were aware that CFLs had to be disposed-off properly. However there was no formal system for the collection of used CFLs. Therefore, it can be said that awareness has not led to adoption of best practices in usage and disposal.

Recommendations

- ◆ There should be mandatory standard for mercury content in CFLs;
- ◆ Labelling with cautionary (Hg) mark must be mandatory with details specifying the presence of mercury in each CFL;
- ◆ There should be a proper collection mechanism required to prevent the release of mercury into the environment;

- ◆ As suggested by the task force, the concept of “Extended Producer Responsibility (EPR)” must be brought in as well for financing and maintaining the infrastructure for the CFL/mercury management;
- ◆ Monetary percentage in the retail price needs to be included to fund the disposal mechanism that can be regulated by the government;
- ◆ There should be large scale awareness programme through mass media and social media channels to increase the awareness of best practices in usage and disposal of CFLs;
- ◆ Encouragement and incentives should be provided to establish infrastructure for recycling of CFLs and capturing mercury;
- ◆ The study shows that the present guideline is unenforceable and non implementable. So steps should be taken to have a regulation in place for the downstream management of all mercury containing lighting products.

Gaps Between the Central Pollution Control Board Guidelines and Practices

The Central Pollution Control Board (CPCB) of India has issued technical guidelines for handling mercury laden CFLs. The guideline has mentioned specific role for domestic consumers and bulk consumers to handle the used/broken CFLs. There are also certain specific provisions for environmentally sound management of used CFLs starting from collection, transportation, treatment and disposal of used CFLs.

The present study looked into the various aspects of safe handling of CFLs, particularly with regards to the consumers – domestics and bulk consumers – the informal recyclers, the transporters and the informal manufacturing units. The mode of gathering information was through a combination of questionnaires, issue based discussions with stakeholders and observation of actual site and practices adopted. The actual practices observed and gathered, as against the ideal practices prescribed by the CPCB, are mentioned and analysed in the following tables.

Annexure-I

CPCB Guidelines on Mercury Management from Fluorescent Bulbs including CFL at Various Levels

Level	CPCB guidelines	Actual practices
Domestic household consumer level (Delhi and Bhopal households)	<ul style="list-style-type: none"> The consumer must ensure that used lamps are not thrown in general trash bin but handed over (in a properly packed form) to a kabadi (an individual) or collection agency identified by an authorized informal Lamp Recycling Unit (LRU) for proper recycle/disposal of used FLs. 	<ul style="list-style-type: none"> CFL generally thrown away without any cover at the nearest general trash bin or given to a <i>kabadiwala</i> collecting waste from the household; No authorized LRU or collection agency collects directly from the household.
	<ul style="list-style-type: none"> The used intact FLs must be stored either in the same boxes in which new lamps are brought or other boxes of similar size; They should be stored upright; Due precaution must be taken while packing more than one used lamp, so as not to cause the possibility of breakage during storage and transportation. 	<ul style="list-style-type: none"> Used intact CFL not stored in the same boxes in which new lamps are brought; They are generally kept open in one corner of the house to be given to the <i>kabadiwala</i> or immediately thrown away at the nearest trash bin; Due precaution not taken to prevent breakage of used CFL.
	Even, the broken FLs, after due clean-up must be handed over for safe recycling and disposal.	Used broken CFLs generally cleaned using brooms and thrown into household dustbin or nearby general trash bin.

Level	CPCB guidelines	Actual practices
Bulk/ institutional consumer (hotels, malls, hospitals)	<ul style="list-style-type: none"> The bulk consumers must ensure that used lamps are not disposed in the general trash bin but handed over (in a properly packed form) to an authorized LRU (for proper recycle/disposal of used FLs) either directly or through a collection agency identified by such facility. 	<ul style="list-style-type: none"> Used CFL generally stored without any cover in a room or directly thrown into nearby general trash bin or collected by big <i>kabadiwalas</i> on a periodical basis rather than directly giving it to an authorized collection agency/LRU; A small percentage of institutional consumers surveyed have arrangement with informal manufacturing units/glass and plastic recycling units who take away used CFL on periodical basis.
	<ul style="list-style-type: none"> The bulk consumers must create special type of disposal bins (suitable for the purpose) at site for depositing the used lamps only; The management of the institute must issue necessary instructions, to ensure this to staff and workers handling lamps. 	<ul style="list-style-type: none"> The used CFL are generally kept without cover in cardboard boxes for eventual disposal; No specific guidelines/instructions issued for staff by management for appropriate handling of used CFL.
	<ul style="list-style-type: none"> The used intact FLs, as collected above, must be stored either in the same boxes in which new lamps are brought or other boxes of similar size; They should be stored upright. The due precaution must be taken while packing more than one used lamp, so as not to cause the possibility of breakage during storage and transportation. 	<ul style="list-style-type: none"> Used CFL is stored in open or kept jumbled in cardboard boxes; No due and overt care taken to prevent breakage of used CFL; Generally it is a matter of fact approach by the management.
	<ul style="list-style-type: none"> Even, the broken FLs, after due clean-up, must be handed over for safe recycling and disposal. 	<ul style="list-style-type: none"> The handling of broken CFLs depends upon the collector (<i>kabadi-wala</i> or informal manufacturing unit and glass recycling unit) agent; If they take it, well and fine else the broken CFL is collected and thrown in nearby general dustbin by staff; The plastic base of CFL is generally taken away by <i>kabadiwalas</i>.
	<ul style="list-style-type: none"> The concerned official of the Institute must inform the authorized LRU for the timely disposal of the used lamps; Such used lamps should not, preferably, be stored exceeding a period of one year. 	<ul style="list-style-type: none"> Collection of used CFL in bulk generally happens on a monthly basis; No evidence found of used CFL being stored for a year or beyond, pending their disposal.

Annexure-II

General Guidelines for Cleaning up a Broken CFL

Guidelines	Actual practice	
	Household consumers	Institutional consumers
<ul style="list-style-type: none"> • Open a window and leave the room (restrict access) for at least 15 minutes; • If you have fans, place the fans by the windows and blow the air out of the room. • If the room has no windows, open all doors to the room and windows outside of the room. Then use fans to move the air out of the room and to the open windows. 	<ul style="list-style-type: none"> • No such precaution followed 	<ul style="list-style-type: none"> • No such precaution followed
<ul style="list-style-type: none"> • Remove all materials without using a vacuum cleaner; • Wear disposable rubber gloves, if available (do not use your bare hands); • Carefully scoop up the fragments and powder with stiff paper or cardboard; • Wipe the area clean with a damp paper towel or disposable wet wipe; • Sticky tape (such as duct tape) can be used to pick up small pieces and powder; 	<ul style="list-style-type: none"> • No vacuum cleaner is used; • No gloves are used, but consumers use stiff paper or cardboard to collect broken glass; • This precaution is taken more due to fear of getting cut by broken glass rather than safeguarding against mercury poisoning; • No sticky tape is used. Brooms are used for sweeping away any fine glass particles. 	<ul style="list-style-type: none"> • No vacuum cleaner is generally used; • No gloves used, but institutional consumers use stiff paper or cardboard to collect broken glass; • This precaution is taken more due to fear of getting cut by broken glass rather than safeguarding against mercury poisoning; • No sticky tape used. Brooms used for sweeping away any fine glass particles.
<ul style="list-style-type: none"> • Place all cleanup materials in a plastic bag and seal it; • Then place a second sealed plastic bag, dispose it properly and wash your hands after disposing of the bags. 	<ul style="list-style-type: none"> • This procedure is not followed; • Broken CFL is thrown away or kept in one corner till disposal. 	<ul style="list-style-type: none"> • This procedure is not followed; • Broken CFL thrown away or kept in one corner till disposal.
<ul style="list-style-type: none"> • The first time one vacuums the area where the bulb was broken, remove the vacuum bag once the cleaning of the area is done (or empty and wipe the canister); • Put the bag and/or vacuum debris, as well as the cleaning materials, in two sealed plastic bags in the outdoor trash or protected outdoor location for normal disposal. 	<ul style="list-style-type: none"> • This elaborate procedure not followed. 	<ul style="list-style-type: none"> • This elaborate procedure not followed.

Annexure-III

Consumer Awareness

Guidelines	Actual practice	
	Household consumers	Institutional consumers
<ul style="list-style-type: none"> All consumers – individual, domestic and bulk consumers (offices, institutions, large residential complexes, etc.) – should be fully aware about the potential health impact of mercury-bearing lamps, through audio-visual media and product leaflets; The precautions to be taken while cleaning up the broken FLs should also be known to the consumers. 	<ul style="list-style-type: none"> No overt awareness program for consumers by any institution; Whatever awareness present is because of the latent information getting propagated by hearsay. 	<ul style="list-style-type: none"> No overt awareness program for consumers by any private/government agency/ NGO; Whatever awareness present is because of the latent information getting propagated by hearsay.
<ul style="list-style-type: none"> As a part of such awareness programs, the consumers, even at the individual level, are expected to participate actively with constructive suggestions and provide a feedback for the overall success of mercury management in fluorescent lamp sector. 	<ul style="list-style-type: none"> Nothing of such activity happening in actual as per information gathered from field study. 	<ul style="list-style-type: none"> Nothing of such activity happening in actual as per information gathered from field study.

Annexure-IV

Collection, Transportation, Treatment & Disposal of Used FLs

Guidelines		Actual practice	
Collection	Household consumers	Institutional consumers	
<ul style="list-style-type: none"> Collection of used lamp (FLs) from bulk consumers may either be arranged by the management of the above setup (institutions, etc.) for direct disposal to LRU or by the LRU which might arrange to pick up used lamps from such collection sites through an identified collection agency; Collection of used lamps (FLs) from individual domestic consumer may be arranged by the LRU, either through kabadis (individuals appointed for the purpose by LRU) or an identified collection agency for door to door pickup. 	<ul style="list-style-type: none"> No overt collection arrangement; Used CFL disposed-off at nearest trash bin or collected along with other wastes by the <i>kabadiwala</i>. 	<ul style="list-style-type: none"> Management of private institutions surveyed handle used CFL disposal; Used CFL not given to any LRU but to <i>kabadiwalas</i> on periodical basis; Some private institutions surveyed have tied up with some informal CFL manufacturing units who buy and arrange to collect CFL on periodical basis; Government institutions surveyed generally have tie-ups with big <i>kabadiwalas</i> for disposal. 	
<ul style="list-style-type: none"> As a part of such awareness programs, the consumers – even at individual level – are expected to participate actively with constructive suggestions and provide feedback for the overall success of mercury management in fluorescent lamp sector. 	<ul style="list-style-type: none"> Nothing of such activity happening in actual as per information gathered from field study. 	<ul style="list-style-type: none"> Nothing of such activity happening in actual as per information gathered from field study. 	
Transportation	Small <i>kabadiwala</i> /rag picker	Big <i>kabadiwala</i> / institutional buyer agent/staff	
The handler (e.g. kabadi or representative of LRU) of used FLs in transit should take care of the selection of proper vehicle and carriage so as to minimize breakage of used FLs.	Takes along with all other waste in cycle cart.	Take away using small pick-up carriage or other vehicle.	

Guidelines		Actual practice	
Collection		Household consumers	Institutional consumers
<ul style="list-style-type: none"> There should not be any intermediate transfer of materials in the transit stage; The collected used FLs should be straightaway transported to the LRF for further processing. 		<ul style="list-style-type: none"> They generally segregate and keep used CFL for future sale to big <i>kabadiwalas</i>; Even if contracted by big <i>kabadiwala</i> for collection of used CFL, they keep in transit for one or two days before delivery. 	<ul style="list-style-type: none"> Most big <i>kabadiwalas</i> store the collected used CFL before sale to recyclers/informal manufacturing units; Recyclers/informal manufacturing units generally take used CFL directly for processing.
<ul style="list-style-type: none"> The handler should be trained to take care of mercury spills (if any) that takes place en-route the journey to LRU. 		<ul style="list-style-type: none"> No instances seen of trained handler. 	<ul style="list-style-type: none"> No instances seen of trained handler.
Treatment, recycling and disposal		Informal recycling unit	Informal manufacturing unit
<ul style="list-style-type: none"> A Lamp Recycling Unit (LRU), developed as a common facility for the environmentally sound collection, transport, treatment, recycling and disposal of used FLs from the consumers, shall have the setup for treatment-cum-recycling in addition to the setup required for proper collection and transportation of used FLs; Such LRU may have the following facilities in addition to that which is mentioned above: Adequate used lamp storage facilities with stacking on a pucca platform, preferably under a shed; Mercury spill collection system for further treatment on-site; Mechanical feeding system, if possible, to have better check on the breakage of lamps; Training of handlers, covering manpower (either <i>kabadis</i> or a collection agency) engaged for the collection and transportation of used lamps to the treatment site. 		<ul style="list-style-type: none"> No special CFL recycling units in the informal sector; Glass Recycling Units (GRU) who collect and recycle every type of glass also take CFL glass to some extent, but not altogether; This is because substantial amount of CFL is broken by the rag pickers; They only sell the plastic base that has a higher market value and scope for recycling by the plastic recycling units and some informal CFL manufacturing units; CFL glass is stored in open or on bare floor in a room by LRU's according to type and texture; All glass from CFL boiled to remove white coating containing mercury; Waste water containing mercury thrown away and the glass sent to furnace for making molten glass; No mechanical feeding system or customized recycling facility; No customized training for handlers; The recycling process is treated like any other work and only common precautions are taken; In most cases, collectors and transporters are not attached to the unit; they are independent suppliers. 	<ul style="list-style-type: none"> There are many informal units that assemble the various parts of CFLs; Some informal manufacturing units procure used CFL in good condition to repair and make new CFL and give their own brand name; No adequate lamp storage facility is present; CFLs is stored in cardboard boxes or strewn on floor, which is generally paved; There is no training given to workers to handle CFL; Workers come with some basic training or are experienced beforehand; During the manufacturing process many CFLs are found broken; However there is no training and understanding among the workers on the safe disposal; Most of the informal manufacturing units are in one room setup without any ventilation facilities.

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