

# Cremation Practices *Analysis and Recommendations*

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## GRBMP: Ganga River Basin Management Plan

*by*

Indian Institutes of Technology



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Bombay**



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## Preface

In exercise of the powers conferred by sub-sections (1) and (3) of Section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government has constituted National Ganga River Basin Authority (NGRBA) as a planning, financing, monitoring and coordinating authority for strengthening the collective efforts of the Central and State Government for effective abatement of pollution and conservation of the river Ganga. One of the important functions of the NGRBA is to prepare and implement a Ganga River Basin Management Plan (GRBMP).

A Consortium of 7 Indian Institute of Technology (IIT) has been given the responsibility of preparing Ganga River Basin Management Plan (GRBMP) by the Ministry of Environment and Forests (MoEF), GOI, New Delhi. Memorandum of Agreement (MoA) has been signed between 7 IITs (Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and MoEF for this purpose on July 6, 2010.

This report is one of the many reports prepared by IITs to describe the strategy, information, methodology, analysis and suggestions and recommendations in developing Ganga River Basin Management Plan (GRBMP). The overall Frame Work for documentation of GRBMP and Indexing of Reports is presented on the inside cover page.

There are two aspects to the development of GRBMP. Dedicated people spent hours discussing concerns, issues and potential solutions to problems. This dedication leads to the preparation of reports that hope to articulate the outcome of the dialog in a way that is useful. Many people contributed to the preparation of this report directly or indirectly. This report is therefore truly a collective effort that reflects the cooperation of many, particularly those who are members of the IIT Team. A list of persons who have contributed directly and names of those who have taken lead in preparing this report is given on the reverse side.

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## 1. Introduction

In several towns located on the banks of sacred rivers across the country, and more so in the northern part, the poorest of the poor often resort to disposal of dead bodies in rivers. This method of disposal is resorted primarily on account of relatively higher expenses involved in conventional wood based cremation. Although Hindu scriptures suggest this mode of disposal as one of the options in very rare circumstances, increasing instances due to higher population loads have made it an environmental/ river water quality and public health concern. In order to address this issue, over the years a number of agencies have attempted to introduce alternate methods of cremation apparently termed 'environment friendly' and claimed to involve lower expenses e.g., electric furnace or metallic perforated grills for wood cremation. However for a variety of reasons virtues of the alternative methods have not appealed to the society at large. The reservations could be attributed to socio-religious beliefs, customs and traditions or plain technical issues related to their performance and cost.

In this context, it is appropriate to review these issues and develop a fresh perspective on the places of cremation as integral part of social infrastructure for any community, town, city or village - be it on river banks or otherwise. However, it is pertinent to recognize that in view of the matter of 'life-and-death', and the socio-cultural and religious dimensions attached to it, the subject of cremation is quite nebulous. For a rationalist with scientific/ technology perspective, prima facie the arguments based on religion and beliefs may appear unacceptable. However for any new alternative on offer for a subject as sensitive as cremation, it would have to gel with the beliefs, customs and traditions of the target society before it could be promoted at a wider scale. In this respect, this report commences with a description of the sensitive subject of religious beliefs to help develop a perspective, then takes on issues related to technology, analyses lessons from successful initiatives in the past in selected towns and finally presents a set of recommendations for possible future initiatives.

At the outset it is to be mentioned that this report is based on a comprehensive research study which was carried out by the Foundation for Greentech Environmental Systems back in 2004 at the behest of the Japan Bank for International Cooperation (now JICA) and for the Ministry of Environment and Forest. This study was conducted under the context of the Yamuna Action Plan to identify issues associated with societal resistance towards use of alternate technology based crematoria which were constructed along the River Yamuna and to identify ways for their promotion.

## 2. Religious Beliefs and Socio-Cultural Aspects

The custom of cremation of a dead body is practised mainly in the Hindu religion and those religions which have emerged out of it i.e., Jainism, Buddhism and Sikhism. Among others, these oriental religions are characterised by strong presence of rituals and undoubtedly the process of cremation is also dominated by a series of rituals. The rituals are in turn determined or governed by the belief system of a religion or society. In this context, the following paragraphs offer an overview on the origin and persistence of rituals in the Hindu religion.

### 2.1. Hindu Rituals and Identity

'Rituals' - meaning patterning of actions strongly characterise Hindu religion and the society as a whole. Hindu ritual patterns are considered to constrain life from birth, through childhood, to marriage and finally to death and therefore are followed during the course of various religious and social activities and prayers performed to mark special occasions. Depending on geography and other factors, ritual behaviour can be extremely diverse, however it is also stable in a certain way in behaviour patterns which are passed through generations and which give shape and a degree of unity to the Hindu traditions. Ritual action also gives people a sense of deeper identity and belonging. Therefore rituals have seldom been abandoned within Hindu traditions and this is particularly true for the ceremonies performed at the time of birth, marriage and death.

Many rituals can be traced to very early Hindu texts such as *Vedas* and *Upnishads* and therefore they have been performed for several millennia. Hindu rituals have existed under diverse social and political contexts and therefore have exhibited high degree of persistence which has survived great political upheavals, colonial repressions and ecological catastrophes. In some sense, ritual structures with links to the *vedic* solemn (*srauta*) seem to have defied history. Changes, if any have come over the generations at a very slow pace. Rituals also cut across theological distinctions. In the rich variety of Hindu ritual, there are cultural forms which do not demand belief in any particular doctrine, but rather demand action in certain ways. Therefore different sections of the Hindu society can be found to follow same or similar rituals.

Rituals can be compared to a language as a system of communication – they have a structure, a syntax, and for a believer some meaning. While the formal meaning of *vedic* rituals may not be explicitly obvious and may not stand the scrutiny of a scientific rational analysis, however with respect to the domestic rituals, the *grhya* (householder's) rites involving birth, marriage and death are considered important and sacred activities.

### 2.2. Belief in Rebirth and Transmigration

In Hindu religion it is believed that the soul is distinct from the body and it goes through a long cycle of birth and death according to the *karmic* credits or debts accumulated during its

various lifetimes – human and other species. It is also believed that birth in human form is the highest level of evolution of a soul which offers it an opportunity to ‘escape’ the unending cycle. This ‘escape’ represents attainment of *moksha* or *mukti* which a soul may strive to achieve (and therefore the name *moksha-dhama* or *mukti-dham* typically given to cremation grounds) and which is then related to the ‘rites of passage’ of an individual. It is also believed that upon death the astral body (*sukshma sharer*, comprising *maan*, *budhi* and *ahankar*) carries the *karmic* account of a soul for its onward journey.

### 2.3. Rites of Passage

In Hinduism ‘rites of passage’ are believed to constrain a soul’s passage through time from birth to death by moulding and helping construct social identities. The Sanskrit term for ‘rites of passage’ is *samskara*, implying the putting together of a person as a social actor. The closest meaning for *samskara* is sacrament which connotes sanctifying the soul in its human form. In other words *samskaras* are believed to make a person cultured, disciplined and conditioned as a complete being. It is believed that *samskaras* also help a person in facing difficulties in life and enable achievement of the ultimate purpose of attaining *moksha*.

According to *ManuSmriti*, there are sixteen *samskaras* which are recommended at specific stages of a soul’s journey from the stage of conception to death. Among the sixteen, the most important *samskaras* are performed at the time of birth (*Jatkarma*), initiation (*Upanayana*), marriage (*Vivahasamskara*) and funeral (*Antimsamskara*) – the latter two marking the beginning and end of a householder’s life. In general all *samskaras* are performed in ritualistic and elaborate ceremonies typically involving worshiping of fire and other elements of nature, with the accompaniment of chanting of sacred mantras. The mantras are supposed to have profound effect of invoking the cosmic powers and receiving blessings of the Gods.

### 2.4. Funeral Rites

Funeral rites performed at the time of cremation are called *antyeshtisamskara*, which mean not the absolute ‘end’ but encoding for the next life. Unlike other religions wherein upon death the soul is believed to rest in peace, in Hindu religion it is believed that its journey will go on, and therefore the purpose of the cremation ceremony is to pray for it to be peaceful and evolutionary. The purpose of performing a ritualistic ceremony is therefore for the soul to either get a superior human form in its next birth or attain *moksha*. Evidently to the extent possible the next-of-kin want to perform the ritualistic ceremony as per the scriptural prescriptions without any compromises so as to facilitate the ultimate, i.e., attainment of *moksha* for the departed soul.

The *antyeshtisamskara* in particular and rest of the 15 other *samskaras* in general have evolved over the millennia. Therefore in general, the structure of the *antyeshtisamskara*

including the preceding and following rites and rituals is fairly uniform among different sections of the Hindu society located in different parts of the country and the world. Among the three broad versions, the toughest to perform is called *shastrachar* which is strictly based on the scriptures. Two simplified versions are called *lokachar* and *kulachar* which are evolved at the level of a society and family/community respectively, according to the local social, cultural, geographical and environmental circumstances.

#### 2.4.1. Preceding and Following Rituals

Before cremation invariably a corpse is bathed, anointed with sandalwood paste, shaved if male and wrapped in a red cloth. Significance of the first two rituals is to reduce or suppress odour during the time the corpse is kept at home and during the cremation. Use of red cloth signifies positive feeling or blessings for the onward journey of the soul as red is considered to be the colour of life.

Death in Hinduism, as in many other cultures, is believed to be fraught with the danger of an ominous influence for the bereaved and their being haunted by a malevolent ghost. This belief in after-life and/or danger of transmigration into a ghost spirit leads to performance of a set of rites immediately before and after the cremation which are called *pinddaan* and *sraddha* respectively.

*Pindadan* is performed to facilitate migration of the spirit from the realm of ghosts to the realm of the ancestors or *pitras*. This ritual is symbolic of seeking peace for the soul or the astral body. It comprises offerings of five balls (*pinda*) made of flour of barley, wheat or rice to the deceased at various stages during its last journey from home to the cremation ground. First *pinda* is offered at home, second is offered outside the home, third is offered at a square or cross road, fourth is offered at a resting place before the crematoria and the last *pinda* is burnt along with the dead body in the pyre.

On the same lines, *sraddha* is performed as the final rites over several days immediately following the cremation, as the family members are considered to be under the inauspicious influence. These again involve offerings of *pinda* to the deceased which are believed to construct a virtual body in an intermediate realm - the world of the ghosts (*preta-loka*). These daily offerings continue for ten days, recapitulating the ten lunar months of the embryo's gestation, at which time the ghostly body is complete and with the rite known as *sapindikarana*, transmigrates into the realm of the ancestors (*pitra-loka*) for its onward journey.

Therefore the *antyesthisamskara* and the preceding and following rites in totality are believed to control the inauspicious influence of death. In several communities invariably a feast is organised on the 11<sup>th</sup> or 13<sup>th</sup> day after the death to mark end of the mourning period and getting the family back into the routine life.

### 2.4.2. Belief in Cremation

In Hindu religion it is believed that the human body is made of five basic elements of the nature i.e., earth, water, air, fire, and *aakash* (sky) and in the end it should merge with the same elements in their micro form. In conformity with this belief, for time immemorial Hindus have followed the practice of cremation which enables merging with the elements in the shortest possible time. There are several references to cremation in the scriptures, particularly in the *Rigveda* - considered to be the oldest scripture in the world. According to some, it is believed that along with the smoke of the burning firewood the soul rises to the heavens while another belief is that after burning of the body its link with the departed soul is severed and therefore the latter would not wander.

### 2.4.3. Antim Samskar - The Process of Cremation

This section describes salient features of the process of cremation which offers an understanding of the significance of certain rituals and how the traditional arrangement of a pyre made of wooden logs is found to be in compliance for their performance. This description is also intended to help in appreciating the limitations of alternative systems on offer and their general lack of acceptance by the society at large.

#### *Preparation of a pyre*

A conventional pyre comprises a pile of wooden logs wherein the body is placed in the middle. There are no scriptural prescriptions for the quantity of wood to be used but depending on size of the body and other factors, traditionally 5, 7, 9 or 11 *mann* are used, where one *mann* is 40 kg. Dung cakes are also used in varying quantity to supplement wood.

The process of cremation is also considered as performance of a *havan* or *yajnya* which involves worshipping the fire and invoking the cosmic powers through chanting of mantras. As in the case of a *havan* in normal times, here also the process is carried out with frequent offerings (*ahuti*) of ghee and *samagri* (a mixture of herbal additives). Other materials such as camphor, forest-gum, etc. are also used. While there are no rules for the quantity of these additives, customs have evolved based on local circumstances. Generally quantity of ghee is about the weight of the body and that of the *samagri* is about twice as much. However given the high cost of *ghee*, affordability is a major factor and variations are common.

The purpose of addition of these materials is two fold. Firstly they act as catalysts for the fire and secondly the fragrance that pervades in the surroundings helps in suppressing the odour released from burning of the body. For the latter, at times sandal wood is also used, albeit in small quantity. Addition of these materials also imparts an element of sanctity to the whole process.

Depending on the *lokachar* and *kulachar*, members of the family and the community also make an offering (*ahuti*) of wood and *samagri* into the pyre. In rural areas it is a common practice for every attendee to bring along offering of small log of wood or dry dung cake for the pyre. Purpose of this custom is to ensure adequate quantity of fuel for complete burning of the body and show solidarity with the bereaved.

The ritualistic process is considered sacred, purifying and in conformity with the natural laws of blending the gross body with the five elements described earlier. It represents a hygienic disposal method which is also safe from environmental health point of view as it does not leave behind any objectionable or infectious residues or does not involve blockage of land/space, etc. If looked scientifically, the burning of wood and the body does not constitute a polluting activity in the sense that it does not lead to emission of any hazardous or poisonous gases.

### **Orientation of the body**

As a rule, the body is laid along north–south direction. The head points in the north as it is believed to be the direction of light, dominant of fire and source of knowledge. It is also considered to be the realm of *Kubera*, the demigod of wealth. The feet point towards the south as it is considered to be the realm of *Yama*, the demigod of death and connotes the direction of darkness.

Generally the body is kept slightly tilted, with head being about 6 inches higher. More wood is placed on the head side and less towards the feet as the former requires more heat to burn completely and this arrangement enables optimal use of wood.

### **Pinda dan**

As stated earlier, the fifth *pinda* brought from the home is placed on the pyre and is burnt along with the dead body. This is considered to be one of the important rituals.

### **Mukhagni**

This ritual comprises offering fire to the pyre by the eldest son or closest relative which signifies deliverance of one of the obligations towards the deceased. Moreover, among the *pouranik* Hindus it is the fire brought from the home which is used for lighting the pyre. As per the scriptures, it is believed that the use of kitchen fire leads to the accumulated good karmas of the person in this life time (*prarabdh*) getting attached to the transmigrating astral body and carried forward into the next life.

Another interpretation of this ritual is related to the importance of fire and its ability to take the soul to the *swargloka* (heavens). The person offering the *mukhagni* is asked to chant a specific mantra which means ‘the deceased was born out of this fire and this all pervading fire should reappear and it should take the deceased to the *swargaloka*.’

### ***Kapal Kriya***

*Kapal Kriya* is one of the rituals performed about half an hour or one hour after lighting the pyre. The actual practice and its significance vary among communities. In some communities it comprises merely touching the skull with a long bamboo. It is believed that the astral body carries the 'engrams' i.e., trace of the past life in the memory, which may be misused by evil spirits or it might interfere with the life in its next birth. Touching of skull with a bamboo is symbolic of erasing this memory.

On the other hand in some north Indian communities, *Kapal Kriya* involves breaking of the skull by hitting it with a bamboo. It is believed that the soul escapes through the top of the head and unless the skull is broken it will not have a smooth passage for the next life.

## **2.5. Reasons for Rigidity in Cremation Procedure**

From the above description it is evident that the rituals associated with cremation of a body have certain significance and the Hindu society has deep belief in them. People do not view cremation as a mere process of combustion of organic material or dead biological cells, tissues and bones, and considerations of economy are secondary. To the extent possible the rich and the poor alike prefer to carry out the *antim samskara* as per the scriptural rules or prescriptions of the supervising priests. Moreover, as death is 'once in a life time' event, resources permitting, the bereaved family members do not like to compromise on rituals if they are believed to 'guarantee salvation' for the soul. Among the poor and especially rural communities, there is a tendency to even borrow or collect community contribution so as to be able to carry out all the rituals including the following rituals and rites over the next 13 days.

One of the reasons for this ritualistic process is that it is being followed since ancient periods (for over 5000 years) as it is believed to be originating from the *Vedas* (believed to be revelations straight from the God and not written text of recent origin). It is believed that if the process is carried out as per the scriptures, it leads to salvation of the deceased and also ensures peace, harmony and happiness in the family. Among the *Puranik Hindus* it is a strong belief that the above described rituals of *Pind Daan*, *Mukhagni* and *Kapal Kriya* are integral and it is only by following them the soul of the deceased attains *moksha* and reaches the heavens. Accordingly the traditional wood based cremation process has evolved which has been more suitable for their performance.

In addition, there is social pressure to follow the rituals and carry out subsequent rites. One of the purposes of this is to maintain the so called prestige in the community. Particularly in the semi-urban and rural areas people would not like to be perceived to be cutting cost on such obligations. On the other hand, elaborate cremation procedures followed among the better section of the society, for eminent leaders and persons of prominence have also served as a deterring example for middle class and the poor to take initiatives for alternate methods.

For a rationalist, while the traditional Hindu process of cremation may not fit into a scientific analysis, however on account of the above described factors there is inherent rigidity within a large section of the society in adhering to it.

### 2.5.1. Flexibility Among Selected Communities

It is understood that those societies which have undergone social reforms have been able to adopt a degree of flexibility in various rituals including the process of cremation. This effect is observed in the state of West Bengal where reformers like Raja Ram Mohan Roy, Ishwar Chandra Vidyasagar, Debendranath Tagore, and others had taken radical initiatives in early nineteenth century for removing several deep rooted ill practices of sati, child marriage, and disapproval of marriage of widows. Similarly the followers of Arya Samaj have also adopted several reforms to simplify the overall process, for instance reverting to normal life within three days of death. However, it needs to be noted that this flexibility can not be attributed to short-term public participation and awareness creation campaigns of recent origin but to social reforms spread over couple of centuries.

Certain degree of unorthodoxy is also observed in a small section of the urban society of the country. Particularly in large cities like Mumbai, Kolkata and perhaps to a limited extent in Delhi exigencies of urban life have reduced the scope for conducting ritualistic cremation and subsequent rites over an extended period. People like to get over with the obligations and get back to routine at the earliest. However, a large part of the society across the country still adheres to the traditional way of cremation which apparently gives to the bereaved family member a sense of consolation of having performed their obligations towards the deceased.

### 2.6. Variations in Cremation Procedure

As stated earlier, rituals evolve along *lokachar* and *kulachar* depending on the local circumstances. As Hinduism is not just a religion but a way of life, there are several sects and groups in different parts of the country. Accordingly there are significant variations in the rituals performed by the followers of different sects, however their structure may remain by and large same. For instance in rural communities use of dung cakes for cremation is very common while in urban communities this is limited to carrying the *mukhagni* and igniting the initial fire in the pyre as their availability may be limited.

On the other hand, *sanyasis* and children are usually buried. A holy man is buried in a tomb or *Samadhi*, indicative of the belief that the body and the soul is absorbed into a higher state of consciousness. On the other hand body of a renouncer, who is believed to have undergone his own funeral during the rite of renunciation, might simply be placed in a river. The latter practice originates from the belief that while alive the body did not serve any purpose, upon death it should at least serve as a source of food to the aquatic life. However, scriptural reference or justification for this practice is not available.

With regard to protection of the tree stock, there is the case of the Bishnoi community in western Rajasthan which is fiercely protective of its forests. In order to prevent cutting of trees this community has adopted an extreme form of *lokachar* of inhumation or burial as practices in other religions. It is understood that there is another Hindu sub-caste in the state of Tamilnadu in southern India which also follows this custom. These practices are not in conformity with the *shastrachar* and in fact are considered as violations.

It is also learned that due to financial reasons the poor often resort to use of 'inferior' fuels. For instance in order to minimise expenses on wood, there is a tendency to use waste tyres in the pyre. Moreover, as the ritual of offering the *ahuti* of ghee is unaffordable, addition of kerosene is not a rare practice either.

The latter three illustrations have been included only to present the extent of variation that exist in the society and are in no way indicative of alternatives with which the larger society would be comfortable or would approve of.

## 2.7. Social Responsibility of the Business Community

In the context of the costs involved in a traditional cremation process and thereby the poor resorting to disposal of dead bodies in rivers, it is interesting to learn what the scriptures have to say. The scriptures exhort the business community to take this as its social responsibility and bear the burden of the poor. Extending financial help to a poor family towards deliverance of its obligation for a dignified cremation of its deceased member is considered to be a social duty of a very high order.

In view of this, it is often found that in several large and small towns alike, the crematoria are managed by civil society, trusts, etc. which are in turn financially supported by the local trading or business community. Invariably the infrastructure at the crematoria is built through donations received from local business houses, industries, etc. The entire establishment is run on no-profit basis which provides selfless service, firewood and other materials required for cremation at affordable prices.

## 2.8. Significance of Trees and Environment in Hindu Religion

Hindu religion is one of those oriental religions in the world which has accorded very high value to preservation of environment and it has a designated presiding deity called the demigod *Dattatray*. With such belief several traditions and customs have evolved wherein components of the ecosystem such as rivers, ponds and trees are revered and worshiped. Respect towards nature and environment is ingrained in the Hindu religion in the form of the principle of sanctity of life for both human and non-human.

This principle translates into accordance of high importance to trees/forests and plants, whereby several species e.g., *Pipal*, *Amala*, *Banyan*, and *Tulsi* are worshiped regularly. In this respect it is interesting to note that some of the dense patches of forests across the country have survived due to this value and which are recognised as 'sacred groves'.

According to scriptures planting of trees is considered a very sacred duty and cutting of trees is forbidden. Planting of a tree is considered to be equivalent to giving birth to 10 sons and it is also recommended that during his/her entire life time a person should plant at least one tree for every completed year. Such scriptural injunctions characterise *Hindu* religion with a value system enabling harmony with the ecosystem. Drawing from this, many civil society organisations have promoted the concept of *SmritiVan* along side cremation grounds.

### 3. Technology Options for Cremation

On account of concerns related to high costs involved in wood based traditional cremation and those related to conservation of forest, various agencies have tried to develop alternate solutions based on a variety of fuels. In terms of technologies and fuel, the available alternatives are listed as follows:

- Conventional pyre on ground
- Improved wood cremation system (IWC)
- Electric crematorium (EC)
- Diesel, LPG or CNG fired crematorium
- Combined gas and wood fired crematorium
- Biomass gassifire based crematoria, and
- Solar crematorium

Salient features of these technologies vis-à-vis their compatibility with the traditional procedure of cremation are described in the sections that follow.

#### 3.1. Conventional Pyre

A conventional pyre is about 6-8 ft long, 3-4 ft wide and about 3-4 ft high. In lay man's terms, size of such a pyre is defined as that corresponding to a person of normal size with both arm stretched out. A margin of about a foot on either side along the length is preferred for complete covering of the body. The pyre is prepared on a slightly raised ground by placing bigger/heavier wooden logs at the bottom and smaller logs at the top. This arrangement provides for effective circulation of air through the pyre and improves combustion. To this effect in some parts of the country pyres are also made on a platform of large loose stones and boulders. In order to prevent falling of the upper logs and spreading of the fire, it is a common practice to put some logs in inclined position on the two long sides of the pyre. The body is placed at about mid-height. Depending on size of the body, moisture content of the wood and weather conditions, traditionally 5, 7, 9 or 11 *mann* are used, where one *mann* is equal to 40 kg. Average consumption is between 300 to 400 kg and in rare cases it could be as much as 500 kg. Readily combustible biomass e.g., dry grass, bamboo, etc. are also placed to facilitate the fire.

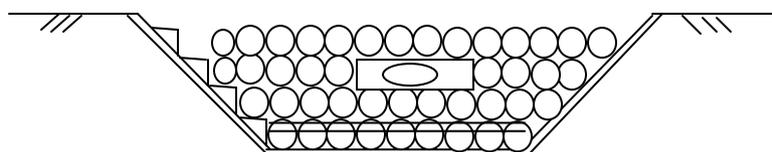
In some parts of the country it is a common practice to use dung cakes as main fuel and straw for start up. This alternative biomass could be cheap as it is available in-house or can be procured from neighbours. Typically 200 kg of dung cake is required for one cremation.

Typically in urban areas, a platform and a shed are constructed to designate and safeguard the place of cremation and to offer protection against rains, etc. The shed typically has openings for creation of draught and thereby facilitate ventilation.

### 3.2. Pyre in a Vedi

As the process of cremation is symbolic of performing a *havan oryajnya* among the follower of the *Arya Samaj*, the layout of the location for the pyre also corresponds to a *vedi* – a fire altar typically used for performing a *havan*. For this purpose ideally a 4 ft deep trough with sloping sides (2v:1h) is made. At the bottom, the trough length and width are same as for a traditional pyre on ground as described above. Steps are provided for easy access for arranging the pyre and cleaning. A schematic of this type of pyre arrangement is shown in Figure 1. Although this arrangement is not very common it offers following advantages:

- Unlike a pyre on a raised platform the fire in a pit is not affected by wind and therefore it is contained.
- As a result, in this case the fire grows slowly which is apparently convenient for performance of initial rituals while standing close by and offer *ahuti*.
- As the fire grows slowly, the rate of burning of dry wood is not disproportionately high compared to the body which takes longer to initially dehydrate primarily due to 80-90% moisture content and then start combusting. From these points of views, compared to a conventional pyre this arrangement is considered to be optimising consumption of wood. However there are no data available to support this claim.
- The trough does not allow spread of foul matter if any, released from the body and thus helps in maintaining the place clean.



**Figure 1: Arrangement of Pyre in the form of a Vedi**

### 3.3. Improved Wood Cremation System

An improved wood cremation system (IWC) comprises raised metallic perforated platform with two flanges. It is designed with the objective of optimisation of combustion by augmenting the air to fuel ratio wherein it is claimed that fire wood requirement can be brought down by 100 kg and the complete cremation process can be completed in 3-4 hours.

Amongst all available options this IWC comes closest to the traditional process of cremation followed in the Hindu religion as it allows performance of the last rites in the prescribed ritualistic manner. IWCs were developed with the objective of reducing consumption of wood by as much as one third and were piloted under, among others, the Ganga and the Yamuna Action Plans with the objective of offering an option of lower cost cremation for the poor. However the response from the society has not been encouraging for a variety of socio-religious and technical reasons.

### **3.3.1. Principle of IWC**

In its most basic form, an IWC comprises a metallic grill as in the case of a furnace. It is designed on the principle of increasing the air to fuel ratio by providing openings in the bottom. In addition, side flanges are provided to contain the wood and the heat from spreading out. The heat gradient creates a draught and as a result the perforations in the bottom and sides allow entry of plenty of air at a rapid rate. These features apparently lead to improvement in the rate and efficiency of combustion.

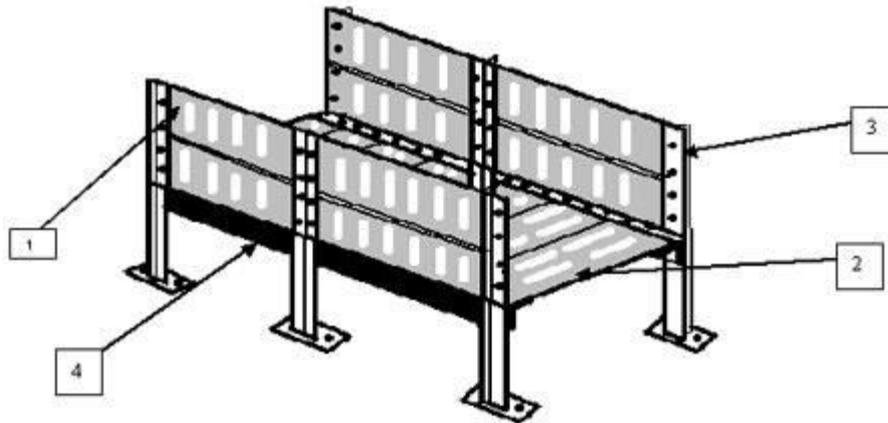
### **3.3.2. Forms of IWC**

Different forms of IWCs have been introduced by various agencies. As shown in Figure 2, in its most basic form an IWC comprises the following four components:

- (a) A perforated bottom plate about 7-8 feet long and 3 feet wide
- (b) Perforated flanges along the two long sides of the bottom plate
- (c) Six short columns supporting the fire place and enabling movement of air from underneath
- (d) Hearth underneath the bottom plate for collection and retention of ashes

The bottom plate is made of either thick cast iron blocks or welded grill of angle iron and mild steel bars. The side flanges are again made of either cast iron blocks or fire bricks. The columns are made of either steel or cement concrete. The hearth is typically paved with clay bricks or cement concrete.

Where fire bricks are used instead of the iron plates, fire brick walls are joined by fire clay. Openings are provided in the lower part of the walls below the bottom plate and there are no openings in the upper parts. Thus the air flow takes place only from the bottom while the brick walls act to restrain the wood logs from spreading out and prevent heat loss.



**Figure 2: Basic Form of an Improved Wood Crematorium**

The IWC is installed on a raised concrete/masonry platform and a steel shed is provided for cover. In relatively new installations a hood and chimney are also provided for improved ventilation which afford a degree of convenience to the attendees. At some locations mild steel trays are provided underneath for ease in collection of ashes and performance of multiple cremations on a single installation.

### 3.3.3. Performance and Benefits

In a conventional pyre which is lit on the ground, typically about 300-350 kg of wood is required and the ashes are collected next day. As against this, it is claimed that a cremation on the IWC requires about 200 kg of wood. In addition, complete cremation takes about 3-4 hours which enables early collection of ashes. Thus from cost and time point of views it is claimed that the IWC offers economy and ease of operation, and the two advantages together hold promise mostly for the urban poor.

### 3.3.4. Reservations of the Community

It is understandable that the subject of cremation is rather sensitive matter and any community which follows the traditional ritualistic procedures is likely to have reservations against any procedural changes or technological interventions. Some of the identified reservations which are entirely attributed to beliefs and none whatsoever to a scientific argument are as follows:

- Lack of contact of the pyre and therefore the body with the ground is not a desirable feature.
- Iron as the material of construction is not a sacred or auspicious metal.
- Presence of holes in the place or mat or mattress (*aasan*) used for worship/prayer, etc. and for that matter the IWC is considered inauspicious.

### 3.3.5. Limitations

Some of the functional and technology related limitations associated with IWCs are listed below:

- One of the most serious reported limitations is the inability to achieve complete burning of the body within the claimed lower quantity of wood. This is attributed to, among others, falling of cinders through the perforated bottom plate which otherwise help in complete burning of bones and other body parts in a conventional pyre.
- On account of exposures to multiple cycles of rapid heating (up to 1000° C) and cooling (due to spraying of water for removal of ashes for next operation) the structural elements (comprising cast iron or refractory bricks) experience thermal stresses and as a result rapid damage.
- Along with the above, the bottom plate is also subjected to corrosion leading to creation of holes and thereby falling of larger wooden pieces and cinders. This again leads to inefficient use of fuel value of the wood.
- Combined effect of corrosion and deposition of black soot leads to poor aesthetics which puts off people to use them.
- Maintenance and replacement of damaged plates is not easy as very few mechanics or blacksmiths are ready to accept work related to objects associated with cremation/ death. Moreover, lack of spares makes replacement of damaged metallic parts difficult.
- At open installations, lack of security makes iron parts prone to pilferage. Likewise when the joints loosen the fire bricks in the side flanges are also prone to pilferage.
- Difficulty in placing a body on the pyre due to the height of the side flanges.

### 3.3.6. Evolution of IWC

Based on the above experience, some of the agencies involved in promotion of IWCs subsequently considered incorporation of some of the following improvements in their designs and specifications:

- Use of *Ashtha Dhatu* (an alloy of eight metals) for the platform, flanges and other metallic parts which is apparently considered sacred and is expected to have improved heat, elongation and corrosion resistance.
- Use of appropriate high grade steel for all other metallic components e.g., bottom tray, hood and chimney, etc.
- Use of heavy duty corrosion proof galvanized steel for columns, trusses and corrugated sheets for the shed which could withstand harsh operating environment.

## 3.4. Electric Crematoria

Electric crematoria (EC) have been around for a much longer time in large urban centres of the country. First EC was installed way back in 1960s in Kolkata and by now there are more

than 125 installations across the country. Under the Yamuna Action Plan two such facilities were installed in Delhi.

### **3.4.1. Principle**

An electric crematorium is essentially an electric furnace where the body is heated to a temperature of over 600 °C with the help of a series of resistance elements in a closed chamber. Fresh air is drawn from one end which helps in combustion and the exhaust is released from the other end. The fats contained in the body add to the process which raises the temperature to as much as 1000 to 1200 °C and to a large extent the subsequent combustion becomes self sustaining. However, unlike a conventional pyre and an IWC, in electric crematoria no herbal additives or *Ghee* are added and therefore there is an unavoidable aspect of odour emission.

### **3.4.2. Forms**

Unlike an IWC, an EC is technology intensive system involving electrical and mechanical components, and requires dependable supply of electricity. There are very few technology suppliers in the country and the available options are limited.

#### ***Conventional model***

The commonly used EC model has 12 resistance elements of 4.5 kW each, representing a total load of 54 kW. These are grouped into two circuits of 6 elements each. In addition, there are ancillary electrical components e.g., blowers, etc. which take the total power load to about 64 kW.

The air passed in 'once through' mode and the exhaust air is taken to a scrubber for removal of volatiles and suspended particles. The gases are released through a chimney which is generally 15 m high.

The wastewater from the scrubber is stored in a tank and released intermittently into a drain or a sewer. The settled solids are removed as necessary and disposed off in land fill. Besides plain sedimentation, the effluent does not receive any other treatment.

#### ***After burner model***

In this model, a secondary combustion chamber is provided after the main furnace. This chamber essentially heats up the exhaust gases to a temperature of over 1000 °C and thereby helps in removal of odorous volatile organic compounds. As a result, this model does not require a scrubber and wastewater storage system. Instead the height of the chimney is increased to 30 m. Because of additional heating and taller chimney, the total electric load of this model is about 81 kW. However, due to comparatively higher capital costs fewer installations of this model are found.

### 3.4.3. Operations

As the arrival of bodies at a crematorium is uncertain, and the heating up of a cold furnace to the required temperature of 600 °C takes inordinately long time, the system is required to be kept switched-on round the clock. It takes about 1-2 hours for cremation of one body including initial preparations and collection of ashes, etc. In view of the practice of cremation only during day light hours, the crematoria are typically kept open between 6 am to 8 pm and therefore the possible daily throughput for one EC is only about 4-5 bodies. However, in some large cities, e.g., Kolkata where average daily arrival is high, the crematoria are operated round the clock.

### 3.4.4. Performance and Benefits

One of the benefits of electric crematoria is the apparent saving of fire wood and therefore the claim of its being 'environment friendly'. This may be relevant in urban areas where fire wood has to be brought from long distances, however in view of low energy efficiency on account of long idling hours, this claim does not hold.

Another claimed benefit is its lower potential for air pollution compared to a conventional pyre as the system is equipped with scrubber and/or after burner. However, this needs to be verified as emission data from a conventional pyre in terms of hazardous, poisonous or corrosive substances (which might otherwise endanger life of human beings, flora and fauna or structures in the vicinity) are not available.

### 3.4.5. Reservations of the Society

In spite of a number of installations of this alternative system in large cities and efforts by municipal bodies and other agencies to promote their usage, the society in general has not accepted ECs for various reasons. Some of the reservations are discussed below:

- Inability to perform *Mukhagni* and *Kapal Kriya*.
- Inability to offer *ahuti* of *ghee* and *samagri* by the attendees and thereby derive a sense of having performed a sacred *havan*.
- Uncertainty of collecting ashes as higher temperature often leads to charring of bones.
- Unacceptable odour of ashes due to inability to blend herbal additives.
- Poor aesthetics of the furnace.

However, these reservations are subjective and would vary among sections of society depending on their background and circumstances at that point of time.

### 3.4.6. Limitations

ECs have both technical and financial limitations, and some of the key issues are summarised in the paragraphs that follow.

### ***Technical aspects***

ECs require dependable power supply as power failure during the course of a cremation would constitute a horrendous experience. However, to avoid such untoward incidences, typically a diesel generator is provided as a standby.

Considering the requirement of round the clock heating of the furnace, generally both circuits of heating elements (27 kW each) are kept on. Energy consumption during idling is unavoidable and turns out to be significant, leading to very high expenses on electricity. On this account, an EC may not necessary qualify as an 'environment friendly' alternative.

While it is possible to switch-off one of the circuits during idling, municipal operators seldom do so. Similarly, sensors and circuit breakers to cut off electricity when temperature rises above a certain limit are commonly not included apparently due to capital cost consideration.

The insulation material typically comprises glass wool while an efficient alternative of ceramic fibre is not used again due to cost considerations. The former leads to higher energy losses and thereby higher operating costs.

Often the wastewater treatment unit attached to the scrubber is not operated, instead the effluent is let out into a drain or a sewer. This leads to creation of unaesthetic and undesirable conditions.

### ***Financial aspects***

In large cities, typically two ECs are installed at a facility to take care of more than one body at a time. This leads to a total installed load of over 130 kW which, being higher than 100 kW entails a dedicated high tension power connection. Although high tension power supply is reliable and stable, it comes at a higher price. Secondly, irrespective of the actual energy consumption, the monthly bill from the utility corresponds to the total installed load which turns out to be high.

The overall energy charges due to idling and the above factors turn out to be in the range of Rs. 125,000 to Rs. 150,000 pm, however generally the user charges are reported to be only at around 50%. After including other typical operation and maintenance costs of the facility, a typical urban local body finds it difficult to sustain the operations on its own. On account of these reasons, it is understood that the Municipal Corporation of Delhi has been considering to convert its existing ECs into gas fired crematoria.

### **3.4.7. Evolution**

As described earlier, electric crematoria are now available in two models i.e., conventional and with 'after-burner'. In addition, other features include energy saving measures e.g., sensors, circuit breaker system and insulation, etc.

### **3.5. Other Technologies**

A number of agencies in the country have been working on developing alternative fuel based cremation systems. Some of these developments are profiled in the paragraphs that follow.

#### **3.5.1. Biomass Gassifier Based Crematoria**

The Tata Energy Research Institute (TERI) and other agencies have developed biomass gassifier based cremation systems where the producer gas derived from wood chips is used for combustion. It comprises primary and secondary combustion chambers where the operating temperature is 800 and 1100 °C respectively. The system is equipped with necessary controls to optimise and economise operations, a venturi scrubber for emission control and an effluent treatment unit.

It is claimed that this system requires 150-200 kg of wood chips for one cremation which is about half of what is required in a conventional pyre. Average time taken for full cremation is reported to be 60 – 90 minutes and at the end it enables collection of ashes for performance of subsequent rites.

First such system was installed in Ambarnath in Thane district in February 2002. Subsequently more such plants have been installed in Goa and Tamil Nadu (Ambattur, Alandur and Pallavaram). However, information on their performance, social acceptance and current status is not available.

#### **3.5.2. Gas and Diesel Based Crematoria**

On the same lines as above, LPG/ CNG and diesel based crematoria have been developed. A diesel based crematorium was installed by the Pune Municipal Corporation in 2001 which is claimed to be cheaper than an electric crematorium in terms of capital and operating costs. Current status of this facility is not known.

Likewise it is claimed that a CNG based crematorium takes about 2 hours for complete cremation and in terms of operating costs involves about half that of a wood based conventional pyre. In view of these advantages, in recent years the Municipal Corporation of Delhi (MCD) has installed CNG based crematoria at some of its main cremation grounds and it has also been planning to convert the existing electric crematoria into CNG based facilities. However it is understood that some of these installations have experienced technical problems relating to gas supply, burner, control system, etc. and are reported to be out of order.

#### **3.5.3. Solar Energy Based Crematoria**

M/s Ghadia Solar Energy Systems Pvt. Ltd. Gujarat has been involved in developing a solar energy based cremation system since late nineties. Its prototype comprises a metallic pyre box/ furnace 2m long and 60 cm wide which is heated by two reflectors. The latter comprise

50 sqm parabolic shape scheffler mirrors made in acrylic. The pyre box is kept about 6 m above ground and the reflectors are about 7 m away on the sides. The system is designed to generate a temperature of about 700 °C.

Initial R&D work has been carried out at the Goraj Ashram, near Vadodara in Gujarat. However it is understood that further work is required to be carried out to make it foolproof and before it could be promoted for wider installation.

#### 4. Experience from Selected Towns

In the context of the special class of social infrastructure that is being discussed in this report, it is worth covering experience from selected towns where commendable work has been carried out by the local civil society organisations. These towns are among others, Rajkot, Jamnagar and Sidhdhapur in Gujarat, Mathura in UP and Kinshargarh in Rajasthan. The objective of portraying experience from these towns is to present some of the innovative measures, which are well accepted by the community making the operations sustainable, and thereby offer a perspective for similar developments elsewhere. For the sake of brevity, key lessons are presented collectively.

In all the above mentioned towns the civil society organisations in collaboration with the local business community and the respective urban local bodies have established conducive institutional mechanisms demonstrating successful public private partnerships. The resources thus mobilised have been utilised for development of good quality basic infrastructure and create an aesthetic, congenial and pious environment at a place which is associated with death and which otherwise arouses repulsive or depressing feelings among visitors and passers by alike.

Common features in varying degree at the crematoria in all these towns comprise a majestic entrance, wall paintings depicting religious/scriptural messages of profound significance on the repetitive cycle of birth and death, mythological fables, text from *Bhagwat Geeta* and the four *Vedas*, depiction of the 'wheel of life' highlighting its cyclic nature; clean pathways and resting places with appropriate sheds; amenities for washing, bathing; landscaping and water fountains, suitably located office, prayer and assembly rooms, storage for wood, etc.

At Rajkot this paradigm has been taken to an artistic level whereby the otherwise gloomy and desolate setting of a typical crematorium is replaced by beautiful ambience, converting it into a kind of a tourist spot and a source of inspiration. On a typical weekday visitor count (comprising all age groups) is around 2000 which rises to 5000 during weekends. Similar works have been carried out at Mathura and Jamnagar in varying degrees. Selected photographs of the Rajkot and Mathura crematoria are presented in Figures 3 to 6.

At all these locations the operations are managed by a local civil society organisation in partnership with the local business community and the urban local body. A dedicated team of workers/volunteers offers a range of services and helps in maintaining a high level of cleanliness and aesthetics. Part of the operation costs are met through user charges and grants from the ULB and the rest through donations from the local business community and

philanthropic organisations. It is noteworthy that for poor families, the agencies provide free or subsidised services and also offer to send ashes for immersion into the Ganges at Haridwar free of cost. Such costs are borne particularly out of the corpus created through donations from the business community. Such partnerships epitomise the scriptural prescriptions on the subject and help create the necessary social framework to support the poor of the society.



**Figure 3: The Ambience at Sadguru Muktidham, Rajkot**



**Figure 4: Amenities at Sadguru Muktidham, Rajkot**



**Figure 5: The Tourists at Sadguru Mukti Dham, Rajkot**



**Figure 6: Aesthetics at Mathura and Jamnagar Crematoria**

An interesting observation at some of these locations is the fair degree of acceptance of alternate technologies for cremation, particularly the improved wood cremation system. As shown in Figure 7 the IWCs installed here are found to be well designed with high material specifications and effective in operation. Apparently the congenial ambience created at these cremation grounds could be one of the factors in lowering reservations towards their usage.



**Figure 7: Simple Cot Shaped IWCS in Use at Rajkot**

## 5. Conclusions and Recommendations

For a typical Indian city cremation grounds constitute part of the essential social infrastructure and their provision and maintenance are the responsibility of the respective urban local bodies. Instead of viewing cremation grounds as sites for merely consigning mortal remains of a person to flames, ULBs need to adopt a paradigm shift and view them as the 'last resort' of a human life. In this respect beyond their physical elements, the facilities, ambience and the services at the cremation grounds need to be planned and developed such that they blend with the value and belief systems of the Hindu society at large.

Further, in the context of the Ganga River Basin Management Plan (GRBMP) one of the main objectives of developing cremation grounds is to facilitate the poorest strata of the society and thereby prevent disposal of dead bodies into the rivers. From environmental conservation point of view, another objective would be to reduce pressure on forest resources.

Based on the above considerations a set of recommendations are evolved which can be classified broadly into four categories viz., socio-religious aspects, institutional aspects, infrastructure requirements, and finally technological aspects. Each of these is described in the paragraphs that follow.

### 5.1. Socio-Religious Aspects

*Hinduism* is greatly characterised by rituals which offer a sense of identity to its followers. Rituals which have persisted for millennia have scriptural basis and carry significance in relation to the belief system propounded by the *Hindu* philosophy. As the followers of *Hindu* religion believe in reincarnation of the soul - the cycle of birth and death and *moksha* (salvation), these beliefs govern the rituals performed at the time of cremation i.e. the final rites of passage. Therefore the underlying belief behind *Anthyesthi samskara* - the way it is performed, is to achieve purification of the migrating soul for its onward journey in next life form with an enlightened and easy passage.

Given the sensitive and profoundly socio-religious considerations associated with performance of last rites in Hindu society at large, a key factor for success of any intervention in this area would be to adopt a holistic approach wherein the technical inputs are necessarily preceded by eliciting perceptions and opinions, creating awareness and exploring participation from different sections of the respective local communities. The infrastructure, the facilities and the services should be planned and developed in consultation with the local community, keeping in consideration the subtleties behind performance of a range of rituals and associated specific requirements. Figure 8 attempts to capture and summarise this paradigm through a diagram and the relevant features are described in the sections that follow.

It is of utmost importance that the ambience created at the cremation grounds is soothing not merely to the physical senses of the distressed visitors but it should also invoke their

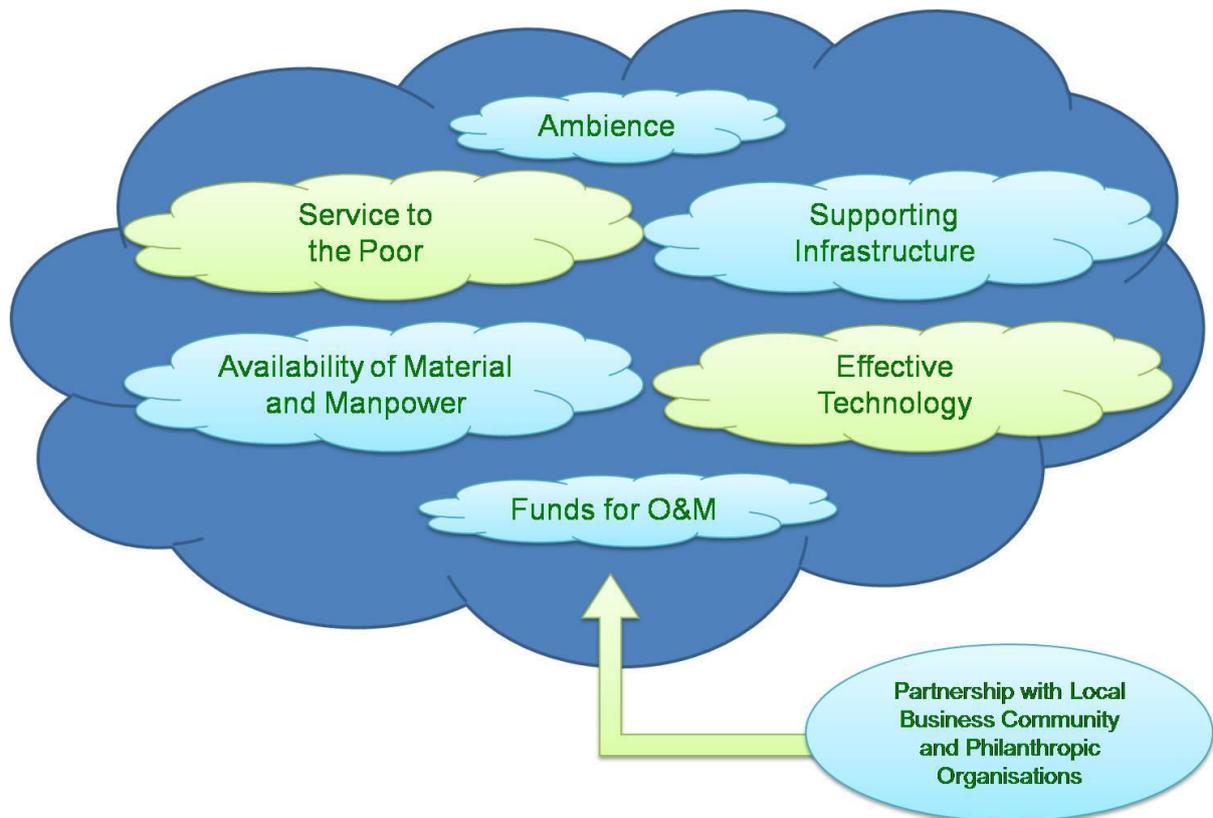
spiritual side. It should help them connect with the profound tenets of Hinduism pertaining to the theory of *Karma*, the repetitive cycle of birth and death, the significance of living a virtuous life and performing good deeds with the ultimate objective of salvation. The ambience from the point of view of aesthetics as well as religious/spiritual setting should invoke the conscience being of every visitor such that he/she gets an opportunity for introspection on the profound significance of human life and how it relates to day to day activities.

With regard to the concern on depleting forest resources arising out of fire wood requirements for cremation, it would be desirable to take advantage of scriptural prescriptions on afforestation and tree conservation. In their respective geographical areas, the urban local bodies and other concerned agencies could promote the institution of *smriti van* (memorial forests) which signify *Vrikshanjalias* a form of *Shradhanjali* (condolence through afforestation). Similarly residents in their respective areas can be motivated to adopt the practice of plantation on any solemn occasions, leading to improvement in the local ecosystem and in the long run augmenting the supply of wood.

## 5.2. Infrastructure Requirements

Besides a shed and a place for making a pyre, a cremation ground should ideally have among others the following infrastructure and facilities:

- A boundary wall with a gate for protection from anti-social elements and stray animals.
- A covered place for resting, washing, bathing, urinals and toilets separately for male and female attendees.
- Platform for performing a set of rites prior to cremation.
- Multiple raised platforms for making pyres.
- Adequate arrangement for lighting and power supply.
- An office room for the operating agency.
- A hall for holding condolence/prayer meeting which is usually performed immediately after the cremation.
- A storage yard for stocking firewood and other necessary materials.
- Lawns and paved pathways.
- Parking ground.



**Figure 8: Combination of Enabling Factors at a Cremation Ground**

The entire facility should ideally be planned and developed in consultation with the local community incorporating considerations of aesthetics, religious sentiments and beliefs, convenience, etc. The size of the facility/infrastructure should be in line with the size of the habitation/population that it is expected to serve. The material specifications and the quality of construction must be in line with the anticipated large footfalls and demanding working conditions such that the infrastructure has long life.

### 5.3. Institutional Aspects

In order to bring a humane and soothing touch to the services offered at cremation grounds it is recommended that wherever feasible, urban local bodies should establish partnership with a committed local community based organisation (CBO), civil society organisation or non-governmental organisation. This partnership should ideally be established at the time of planning and developing the facility/infrastructure so that the agency finds it convenient to take up its operation and maintenance. It is also recommended that wherever feasible the partner organisation should be asked to mobilise own resources (may be 10-20%, which could be through donations, grants, etc.) towards part of the construction cost so as to impart a sense of ownership. Such an arrangement could be classified as a subsidised DBFO (design, build, finance and operate) arrangement.

With regard to operation and maintenance, it is recognised that user fees alone can not help in meeting entire cost of a typical establishment of a cremation ground. Further, if the facility has to render service at subsidised cost to the poor, it is imperative that other avenues for financial support need to be established. In this respect it is recommended that the ULBs should facilitate capacity building and corpus creation for the operating agency with the help of, among others, the local business/trading community and philanthropic organisations. Through such arrangements, the latter will get an opportunity to discharge their scripturally defined social obligations in this most sensitive matter and the poor will not be forced to resort to undesirable methods of disposal of dead bodies e.g., into rivers.

Lastly, to ensure sustainability of operation, appropriate institutional mechanisms in the form of management committees, etc. with representation for various stakeholders should be put in place.

#### 5.4. Technical Aspects

Recognising that a typical wooden pyre comes closest with regard to compliance with performance of a range of rituals at the time of cremation and considering the customs and traditions followed by different sections of the society, it is recommended to offer options for the same. These could comprise:

- (a) Raised platforms for traditional / conventional pyres, and
- (b) Pits of about 9'L x 5'W x 5'D for making pyres in the form of a *hawanvedi*

A wood pyre in the form of a *hawanvedi* is more in line with traditional Hindu practices, has a high degree of sanctity, offers comparatively higher combustion efficiency and is free from any structural or material lacunae. Innovative design modifications for increased air supply from the bottom can help in further improving its combustion efficiency.

Improved wood cremation systems in their basic form can be considered as an option however they should be adopted with a fair degree of caution in terms of size, design and material specifications. An IWC should not be perceived to be offering significant economy in wood consumption. An effective IWC should have following construction features:

- A minimum width of 3' for holding required quantity of wood.
- Exclusion of flanges which otherwise entail raising the dead body and cause difficulty in its placement on the pyre.
- Smaller openings (< 3 mm) in the bottom plate to prevent falling of cinders.
- Higher clearance from the ground for convenience of removal of ashes.
- Material of construction comprising alloy steel of high specifications as so as to be able to withstand thermal stresses corresponding to multiple cycles of heating up to 1000 °C followed by rapid cooling; and prevent corrosion.

Given high energy consumption of electric crematoria during long idling, they can not be termed 'environment friendly'. Further due to their incompatibility with the ritualistic process of cremation they are found to be 'tradition unfriendly'. Instead of considering EC as

an option for meeting the social obligation towards unclaimed bodies and those from poor families, as recommended above, the urban local bodies should arrange to provide subsidised or free cremation service on conventional wood pyres. If at all, improved electric crematoria (with technical features for energy savings) should be adopted with a high degree of caution and only in large metropolitan cities where a net throughput of at least 10 dead bodies per day is expected.