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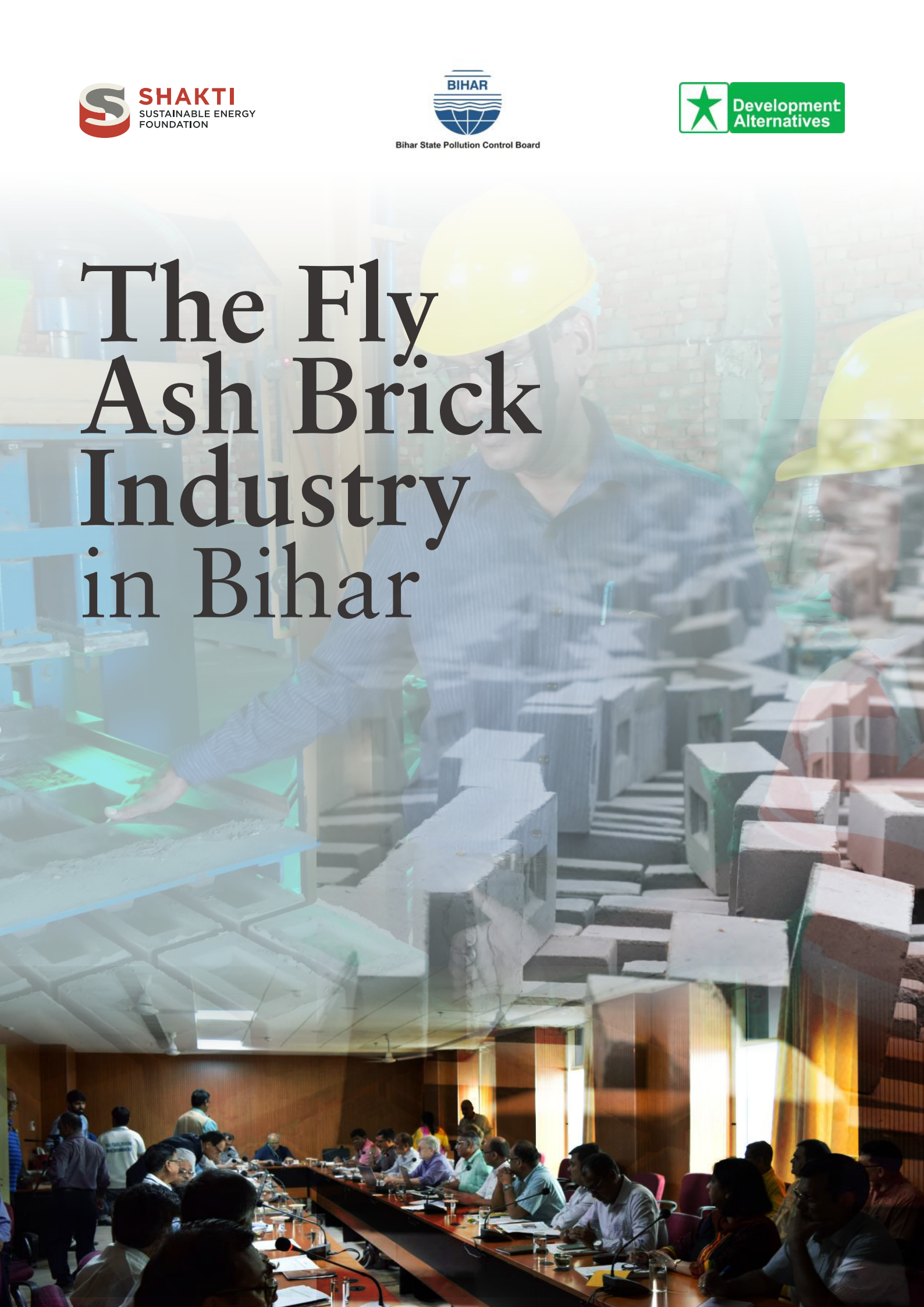
Development Alternatives

The Fly Ash Brick Industry in Bihar



The Fly Ash Brick Industry in Bihar

Status Report - 2019

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Acknowledgement

Development Alternatives, with support from Shakti Sustainable Energy Foundation, has analysed the status of the fly ash brick industry in Bihar, over the last six years. These observations have been documented in the first and second editions of the report, published in 2014 and 2016 respectively. These reports have been appreciated by public and private organisations, for the in-depth analysis of the fly ash brick industry. Since then, quite an appreciable change has been influenced in the sector, which has prompted the third edition of the report. We hope that this study will turn out to be useful for all relevant stakeholders.

Undertaking this analysis would not have been possible for the project team of Development Alternatives, without the active involvement, support and invaluable contributions of certain individuals and organisations. We would like to take this opportunity to acknowledge them. A major credit for the success goes to Bihar State Pollution Control Board -- Shri. Ashok Kumar Ghosh (Chairman), Shri Alok Kumar (I.F.S, Member Secretary) and Dr. Naveen Kumar (Scientist), who have taken a keen interest in the study and have strategically guided and supported us through the entire study. We extend our special gratitude to other members of the Task Force, including National Thermal Power Corporation (NTPC) Eastern region, Department of Environment, Forest and Climate Change (DoEF&CC), Building Construction Department (BCD), Department of Industries, District Industries Centres, and Bihar Fly Ash Brick Industry Association for their support. We would also like to thank Mascot Foundation for their constant support to the team through the entire study. A special mention to the brick entrepreneurs, without whom the study would not have been possible. We thank them for sharing data and insights on their plants and the sector with us. The openness and alacrity with which they have shared their information and ideas has been commendable.

Last, and most importantly, we would like to thank Shri Siddharth Chatpalliwar and Mr. Aman Gupta from Shakti Sustainable Energy Foundation, for their guidance, support and critical inputs at every step. We do hope that the study will provide an accurate overall status of the fly ash brick sector in Bihar, encourage the development of a favourable ecosystem to accelerate the large scale adoption of such technologies, and create a road map for the fly ash brick sector in Bihar.

Development Alternatives

List of Abbreviations:

FAB	:	Fly Ash Brick
FCBTKs	:	Fixed Chimney Bull's Trench Kilns
SPM	:	Suspended Particulate Matter
CO_2	:	Carbon Dioxide
SO_2	:	Sulphur Dioxide
CSEB	:	Compressed Stabilised Earth Blocks
GDP	:	Gross Domestic Product
MT	:	Million Ton
BT	:	Billion Ton
WHO	:	World Health Organization
BSPCB	:	Bihar State Pollution Control Board
MoEF&CC	:	Ministry of Environment, Forest and Climate Change
DoEF&CC	:	Department of Environment, Forest and Climate Change (Bihar)
BCD	:	Building Construction Department (Bihar)
GIS	:	Geographic Information System
GOI	:	Government of India
GW	:	Giga Watt
DA	:	Development Alternatives
SSEF	:	Shakti Sustainable Energy Foundation
DICs	:	District Industry Centres
DoI	:	Department of Industries
CEA	:	Central Electricity Authority
NTPC	:	National Thermal Power Corporation
RRLA	:	Road Reclamation and Low-Lying Areas
FAM	:	Fly Ash Mission
FAU	:	Fly Ash Unit
DST	:	Department of Science and Technology
GHG	:	Greenhouse Gas
BIS	:	Bureau of Indian Standard
FABQRS	:	Fly Ash Brick Quality Rating System
OPC	:	Ordinary Portland Cement
SLMC	:	State Level Monitoring Committee
PMAY-G	:	Pradhan Mantri Awas Yojana - Gramin
NCAP	:	National Clean Air Programme
SoR	:	Schedule of Rate
AMRUT	:	Atal Mission for Rejuvenation and Urban Transformation
PMAY-U	:	Pradhan Mantri Aawas Yojna – Urban

Executive Summary

The Bihar brick industry is currently dominated by energy intensive, resource depleting and highly polluting technologies, such as Fixed Chimney Bull's Trench Kilns (FCBTKs). The production of fired clay bricks consumes around 4.8 million tonnes of coal per year, leading to the emission of 16 million tonnes of carbon dioxide (CO_2) and consumption of 53 million tonnes of topsoil. The increasing emissions of greenhouse gases, sulphur dioxide (SO_2), nitrogen oxides and Suspended Particulate Matter (SPM) from this production process contribute massively to climate change.

In response to the negative impact of brick kilns, the Bihar State Pollution Control Board (BSPCB) mandated all traditional brick kilns to adopt cleaner brick production technologies, such as fly ash bricks, zig-zag or vertical shaft brick kiln (VSBK) methods of brick firing. The zig-zag, despite being an upgraded form of the existing FCBTK technology, does not resolve the issue of soil depletion. Thus, mere conversion to zig-zag or vertical shaft technologies might not be sufficient, and calls for encouraging the production and utilisation of fly ash bricks. This technology utilises waste from thermal power plants and does not consume any topsoil nor use any thermal energy. It is, therefore, an opportunity for Bihar to shift to an almost zero-emission technology that also creates decent jobs for the local community.

The third edition of "Fly Ash Brick Industry in Bihar" is in continuation to the previous editions of 2014 and 2016. The first edition provides an analysis of the fly ash brick industry, while the second tracks the growth of the fly ash brick industry. The third edition assesses the current state of fly ash bricks in Bihar. It delves deeper into the barriers faced by the industry, on the demand and supply side in particular. It bases the analysis on surveys conducted by Development Alternatives (DA) through the ArcGIS mobile application. The information collected through this platform has been mapped through a Geographic Information System (GIS).

The fly ash brick units tracked during the survey were categorised into 'operational', 'production stalled', 'closed', 'upcoming' and 'data not available', depending on the status of their functionality. Analysis of the survey results revealed that the number of units had increased in 2018 as compared to 2016 – reaching 147. However, about one third of the units had their production stalled, mainly due to lack of demand from market. The lack of demand of fly ash bricks is mainly due to poor and inconsistent quality of bricks affecting both private and public consumers. Lack of awareness, promotion and construction techniques is also affecting the marketability of fly ash bricks and therefore the acceptance of the technology. To address the above issues, DA in association with Shakti Sustainable Energy Foundation (SSEF) has launched the quality audit rating of fly ash bricks. This has resulted in enrolment of 31 enterprises spread across 14 districts in Bihar. The impact of this programme can be seen through the improvement in brick quality for 11 enterprises, and maintenance of quality for the others.

The report seeks to address the issues faced in manufacturing and selling of fly ash bricks – poor quality bricks leading to weak demand from consumers. It gives an insight into the measures taken for overcoming these issues – quality audit has been performed by DA with support from SSEF.

Despite the initial success of fly ash bricks in Bihar, even though the current rate of utilisation of fly ash has slightly increased in 2018 (43%) as compared to the previous year 2017 (32%), it is still low in comparison to the national level (67%). Further steps, thus, need to be taken in order to achieve 100% utilisation of fly ash in Bihar. This calls for implementation of policies that can facilitate an improved supply of fly ash bricks and augment the demand through quality assurance of the bricks produced. While the Government of Bihar has already taken measures in this direction by issuing the notification for 100% fly ash utilisation in construction projects, ensuring its enforcement is crucial.

To overcome the barriers for adoption of fly ash bricks in Bihar, it becomes critical to create awareness around the technology, its benefits and related government schemes, training entrepreneurs on production of quality bricks, bridging gaps in finance and market services, and influencing the overall policy ecosystem.

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Introduction

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1.1 Background

The construction sector is one of the most widely recognised sectors across the globe. In India, this sector is the second largest employer after agriculture, and is slated to grow at an average of 6.2%[1] over the next decade (2018-2027). This growth places a consequent demand for increased building materials, especially bricks, among others such as sand, aggregates, cement, steel, aluminium, timber, glass and tiles.

India is the second largest producer of bricks, after China. Its estimated annual production of bricks is 240-260[2] billion, manufactured using around 140,000[2] brick kilns. The Indian brick sector relies majorly on technologies that are inefficient in energy consumption and resource utilisation, such as Fixed Chimney Bull's Trench Kiln (FCBTK) and clamps, with minimal signs and intent of shifting to efficient technologies.

The traditional clay brick sector consumes nearly 35-40[2] million tonnes (MT) of coal annually, emits around 66[2] MT of carbon dioxide (CO_2) accounting for 5.5% of total Greenhouse Gas (GHG) emissions from India, and depletes approximately 500[2] MT of fertile topsoil. While over the last decade, there has been a relative growth in the market for alternate building materials, such as fly ash bricks, AAC blocks, Compressed Stabilised Earth Blocks (CSEB) and concrete blocks, the share is almost negligible. In India, almost 65% of the total burnt clay brick production is from the Indo-Gangetic plains, with Uttar Pradesh, Bihar, West Bengal, Punjab and Haryana being the major producers.

1.2 Current Trends in the Brick Sector of Bihar

In 2017, the consumption of fossil fuels alone contributed to 2.45[3] billion tonnes (BT) of CO_2 emissions from India. In Bihar, the brick sector is one of the major emitters of CO_2, after agriculture and energy. The high rate of GHG emissions is due to the prevalence of coal-based technology for clay brick firing (FCBTK) in the state. The GHG emissions are expected to increase further, considering the growth trajectory of the construction/building industry in India, which is projected

1 World Cement, India's construction industry to grow strongly, Jonathan Rowland, 14 March 2018. <https://www.worldcement.com/indian-subcontinent/14032018/indias-construction-industry-to-grow-strongly/ > (accessed on 25 March 2019)

2 Kamyotra, J S. 2016. CPCB presentation titled "Brick Kilns in India". Presentation made at the workshop on "Roadmap for Brick Kiln Sector Challenges and Opportunities", organised by the Centre for Science and Environment at New Delhi on 8 February 2016

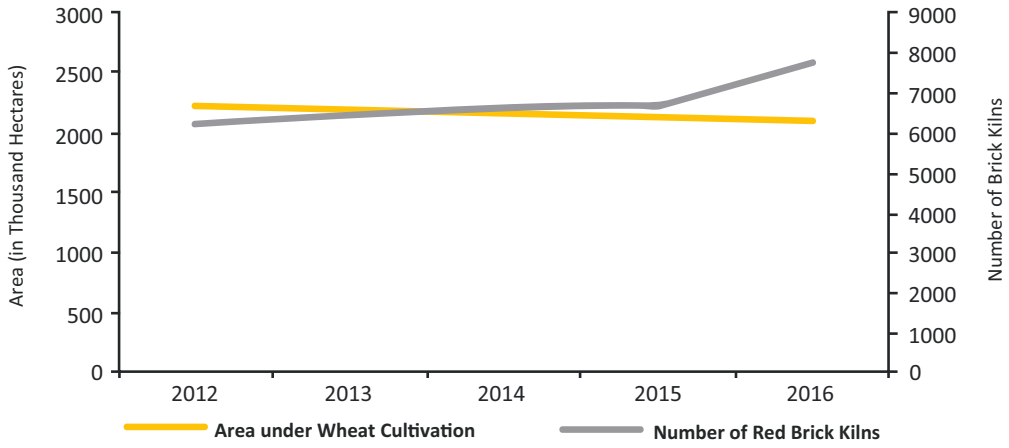
3 Global Carbon Atlas, India, CO2 emission 2017. < http://www.globalcarbonatlas.org/en/CO2-emissions> (accessed on 25 March 2019)

Bihar has 6,602 (2017-18) registered operational burnt clay brick kilns, producing approximately 19.8 billion fired clay bricks annually. This removes approximately 55.44 billion kg of fertile soil and emits 16 MT of CO_2.

to grow at a rate of 15.7% annually to reach USD 738.5 billion by 2022[4]. This will also result in a proportionate escalation in the demand for building and construction materials, especially from the housing sector, in India and as well as Bihar. Currently, Bihar has 6,602 (2017-18)[5] registered operational burnt clay brick kilns, producing approximately 19.8 billion[6] fired clay bricks annually. This removes approximately 55.44 billion kg[7] of fertile soil and emits 16 MT of CO_2. The high dependence on cultivable soil threatens agricultural activity, which is the backbone of Bihar's economy contributing nearly 24.84% to the state Gross Domestic Product (GDP) and employing 77% of the state's workforce. Parallel to this, the brick sector in Bihar provides employment to around 6.6 million people, generating a revenue of INR 135 billion annually. Thus, there is a need to strike a balance between environmental and public health and jobs created, without affecting the revenue of the state. This is true especially for an agricultural economy like Bihar, where it is extremely important to take initiatives for promoting cleaner brick technologies and waste management.

Environmental Impact of the Clay Brick Sector in Bihar: To produce approximately 19.8 billion clay bricks annually, 252 square km[8] of agricultural land is required. Due to high housing and infrastructure demand, the growth of brick kilns has surged, leading to loss of land under cultivation for some of the most prominent crops in Bihar during the year 2012-2016 (Refer to Figure 1).

Figure 1: Growth of brick kilns and loss of cultivable land for prominent crops of Bihar



Source: Department of Agriculture, Government of Bihar

Brick kiln units, currently operating in all districts of Bihar, are found in the highest numbers at Gaya, Patna and Saran (Refer to Figure 2). In fact, according to the World Health Organization (WHO), Patna and Gaya are also among the most polluted cities in the world in terms of PM 2.5. (ToI, 2018)[9] Their PM 2.5 concentration was recorded at 144 and 149 micrograms per cubic metre, respectively, compared to the most polluted city of Kanpur which stands at 173 micrograms per cubic metre.

4 Reddy, Ashwin 2019 ***Building materials industry to grow by 10% in 2019 backed by massive infra developments***, Accommodation Times, accessed 26 March 2019, < https://accommodationtimes.com/building-materials-industry-to-grow-by-10-in-2019-backed-by-massive-infra-developments/>.

5 Mines and Geology Department, Government of Bihar

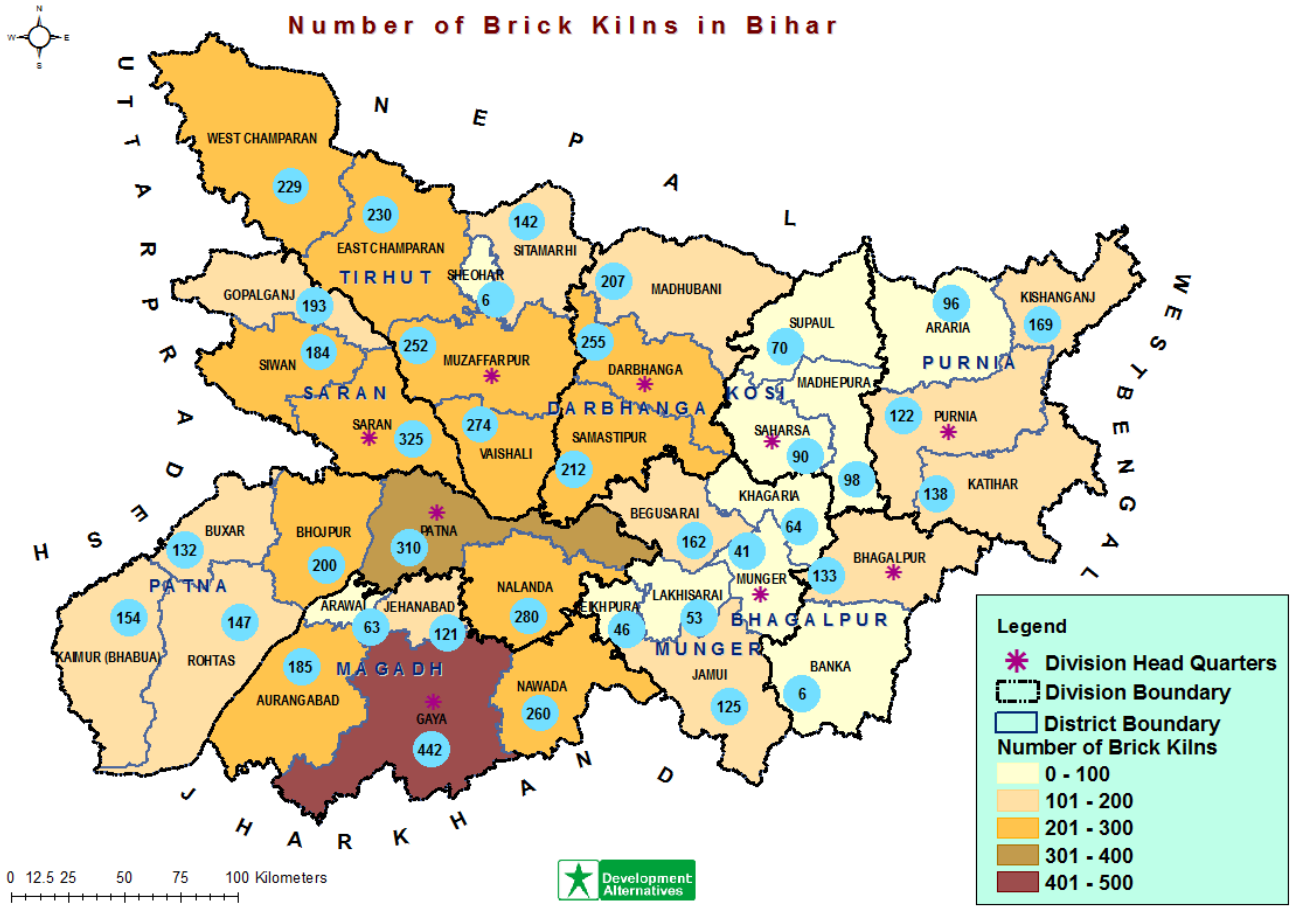
6 Average annual brick production of 1 FCBTK is 30 lakh. Assuming all bricks kilns are functional

7 1 brick consumes 2.8 kg of soil

8 1 sq km is equal to 0.22 million tonne of soil. Bulk density of soil taken as 1.5g/cu cm and depth of topsoil taken as 1 metre.

9 Patna 5th, Gaya 4th most polluted – WHO, article by Ayesha Hassan, TNN 3rd May 2018. https://timesofindia.indiatimes.com/city/patna/patna-5th-gaya-4th-most-pollutedwho/articleshow/64005067.cms> (accessed on 25th March 2019)

Figure 2: District wise status of clay brick kilns in Bihar



Source: Development Alternatives

Clay bricks in Bihar are currently manufactured using the Fixed Chimney Bull's Trench Kiln (FCBTK) technology – an energy inefficient and polluting technology. This technology originated in Germany in the 1980s and is currently existing only in south Asian countries viz. India, Nepal, Bangladesh, Afghanistan and Pakistan. Firing of bricks in FCBTK emits CO_2, other harmful (non-GHG) gases and particulate matter, which are responsible for causing climate change and negatively impact the health of local populace. Suspended road dust particles, vehicular emission and smoke billowing out of brick kilns have been linked to higher levels of respiratory suspended particulate matter (PM 10) in Bihar. It has been estimated that per kg of brick fired in these kilns releases around 131 g of CO_2, 0.13 g of black carbon, 1.18 g of PM, 2.0 g of CO and further consumes 1.30 MJ of energy[10] (primarily supplied through burning of coal).

In response to the negative impact of brick kilns, the Ministry of Environment, Forest and Climate Change (MoEF&CC) released a notification in March 2018 for the adoption of cleaner technologies for brick making processes, following which the Bihar State Pollution Control Board (BSPCB) mandated the same for all existing brick kilns. Many clay brick kiln units are now moving towards cleaner technologies – either adopting fly ash brick making processes or converting to zig-zag or Vertical Shaft Brick Kiln. The zig-zag kiln, despite being an upgraded form of the existing FCBTK technology, does not resolve the issue of soil depletion. Thus, mere conversion to zig-zag or vertical technologies might not be sufficient, and calls for encouraging the production and utilisation of fly ash bricks. This technology utilises waste from thermal power plants and does not consume any topsoil. It is, therefore, an opportunity for Bihar to shift to an almost zero-emission technology that also creates decent jobs for the local community.

10 Climate and Clean Air Coalition "Factsheets about Brick Kilns in South Asia and South-East Asia". Accessed from https://www.ccacoalition.org/sites/default/files/resources/Bricks-SEA.pdf

1.3 Potential of Fly Ash Bricks in Bihar

Bihar currently has 4.77 Giga Watts (GW) of installed thermal power capacity spread across four thermal power plants. These power plants generated 7.38 MT[11] of fly ash in 2017-18, of which only 42.78% (3.16 MT) was utilised. A further capacity of 3.96 GW thermal power is expected to be added in the state by 2021, generating additional 6.12 MT of fly ash per year. Given this, there would be enough fly ash available to produce about 10 billion bricks per year, which will be approximately 56% of the total annual clay bricks produced in terms of current numbers (18 billion).

Environmental Benefits of the Fly Ash Brick Technology:

- **Conserves fertile soil:**
  28 tonnes of soil saved per 10,000 fly ash bricks[12]

- **Uses fly ash and other wastes:**
  14 tonnes of waste utilised per 10,000 fly ash bricks[13]

- **Reduces greenhouse gas emissions:**
  5 tonnes of carbon saved per 10,000 fly ash bricks[14]

- **Conserves natural resources:**
  2.3 tonnes of coal saved per 100,000 fly ash bricks[15].

A further advantage of using fly ash bricks is that these can be produced in a variety of strengths and sizes. This means that apart from their conventional use in building walls etc., fly ash bricks can also be used for construction in a variety of infrastructure projects such as roads and pavements, dams and bridges. Thus, the utilisation of fly ash bricks will further lead to social and economic benefits, generating employment for a considerable size of unskilled workforce and contributing to the revenue of the government.

11 CEA (2018). "Report on Fly Ash Generation on Coal/Lignite Based Thermal Power Stations and its Utilisation in the Country for the year 2017-18". Accessed from http://www.cea.nic.in/reports/others/thermal/tcd/flyash_201718.pdf
12 1 brick consumes 2.8 kg of soil
13 Assuming 1 fly ash brick consumes 1.4 kg of fly ash
14 1 fly ash brick saves 0.05 kg of CO_2 emissions
15 1 fly ash brick consumes 0.023 kg of coal

Overview of the Fly Ash Brick Industry in Bihar

2

2.1 Current Status of Fly Ash Brick Units

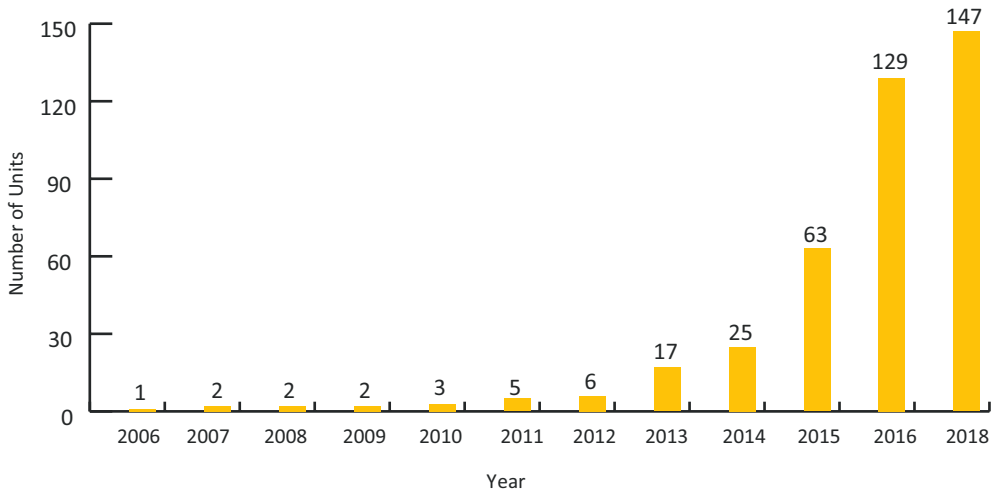
Fly ash brick making units have seen an exponential growth in Bihar since 2012. Development Alternatives' (DA's) surveys conducted across Bihar in the years 2013 and 2016 have shown that the number of fly ash brick units has grown from 17 to 129 within that period[16]. The last survey conducted in 2016 revealed that only 46 out of these 129 units were operational. The others were either non-functional or had shut down due to lack of market demand for fly ash bricks. The manufacturers faced several barriers to entry, such as negative mindset regarding fly ash bricks, lack of fiscal incentives, problems with fly ash sourcing, and lack of regulation leading to uncertainty and unawareness. Despite the government's mandate to use fly ash bricks in all construction projects, a severe mismatch between demand and availability of this technology was a topic of constant debate in various state level meetings conducted in Bihar. In spite of all assurances and steps taken by the Government of Bihar, problems of direct sourcing of quality fly ash from thermal power plants persist.

Recognising this and to update the status, DA supported by Shakti Sustainable Energy Foundation (SSEF), in 2018, conducted another detailed survey of all the 38 districts in Bihar to map fly ash brick units. This exercise was different from the ones conducted in 2013 and 2016, as the aim of this survey was to map fly ash brick units on an interactive Geographic Information System (GIS). To collect data, the team visited the units, verified their existence, and collected details from entrepreneurs. A mobile application was developed for recording details of the unit – name of unit, production capacity, name of entrepreneur, mobile number of entrepreneur, GPS coordinates of unit, functional status of enterprise, etc. This data was sent in real time to ArcGIS platform for plotting these units on the district map of Bihar. The survey team also interacted with the officials of various district and state level departments concerned with fly ash bricks and fly ash brick entrepreneurs, who revealed that in many cases the officials had no information on where these units are located in their respective districts. District Industry Centres (DICs), too, had limited data on fly ash brick enterprises. In certain cases, data of brick units was also not made readily available by brick entrepreneurs and Fly Ash Brick Associations due to concerns of data being made public and other undisclosed issues.

The survey results of 38 districts showed that Bihar has 147 fly ash brick making units, a meagre increase of 18 units from 2016, as shown in figure 3.

16 Maity, S., Chandran, K. The Fly Ash Brick Industry in Bihar. Development Alternatives, New Delhi. Accessed from https://www.devalt.org/images/L2_ProjectPdfs/(4)FlyAshBrickIndustry.pdf?Tid=162

Figure 3: Growth of fly ash brick units in Bihar



Source: Development Alternatives

The fly ash brick units tracked during the survey were categorised into 'operational', 'production stalled', 'data not available', 'closed' and 'upcoming', depending on the status of their functionality and other criteria, as defined in table 1.

Table 1: Categories of fly ash brick units surveyed

Category	Definition
Operational	Functional enterprise; continuing to sell bricks throughout the year
Production stalled	Temporarily closed due to lack of demand or raw material availability
Closed	Completely shut down
Data not available	No physical presence found on the location registered
Upcoming	Registered; in pipeline at the time of survey

This survey found that:

- 76 units were operational. The increase in number from 2016 (42 units) has been depicted in figure 4.
- Units not producing fly ash bricks at the time of survey reported that they would immediately start production if they receive an order. Such units were marked as 'production stalled' and were 52 in number.
- There were only 2 units that completely closed down their operation and disassembled their machines. These were marked as 'closed'.
- There were only 5 units for which data was not obtained because the owners were not available or the units were not found at the registered address.
- There were 12 units that were upcoming at the time of survey.

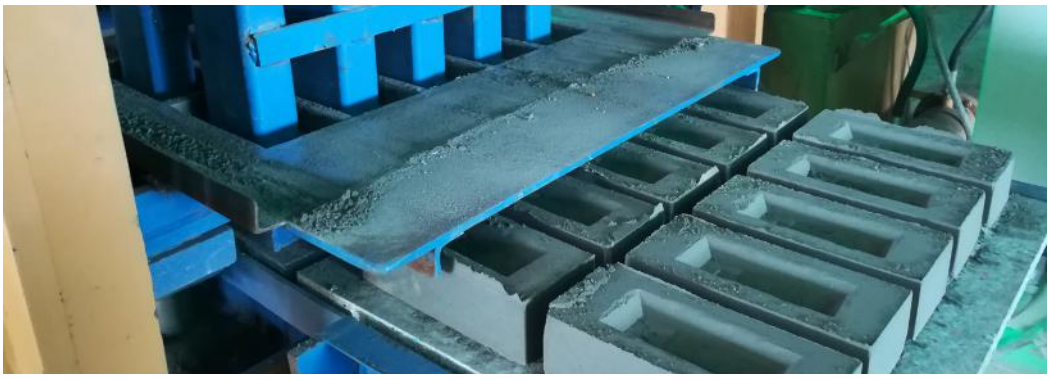
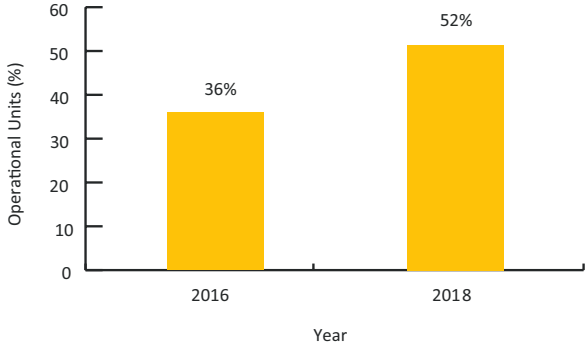


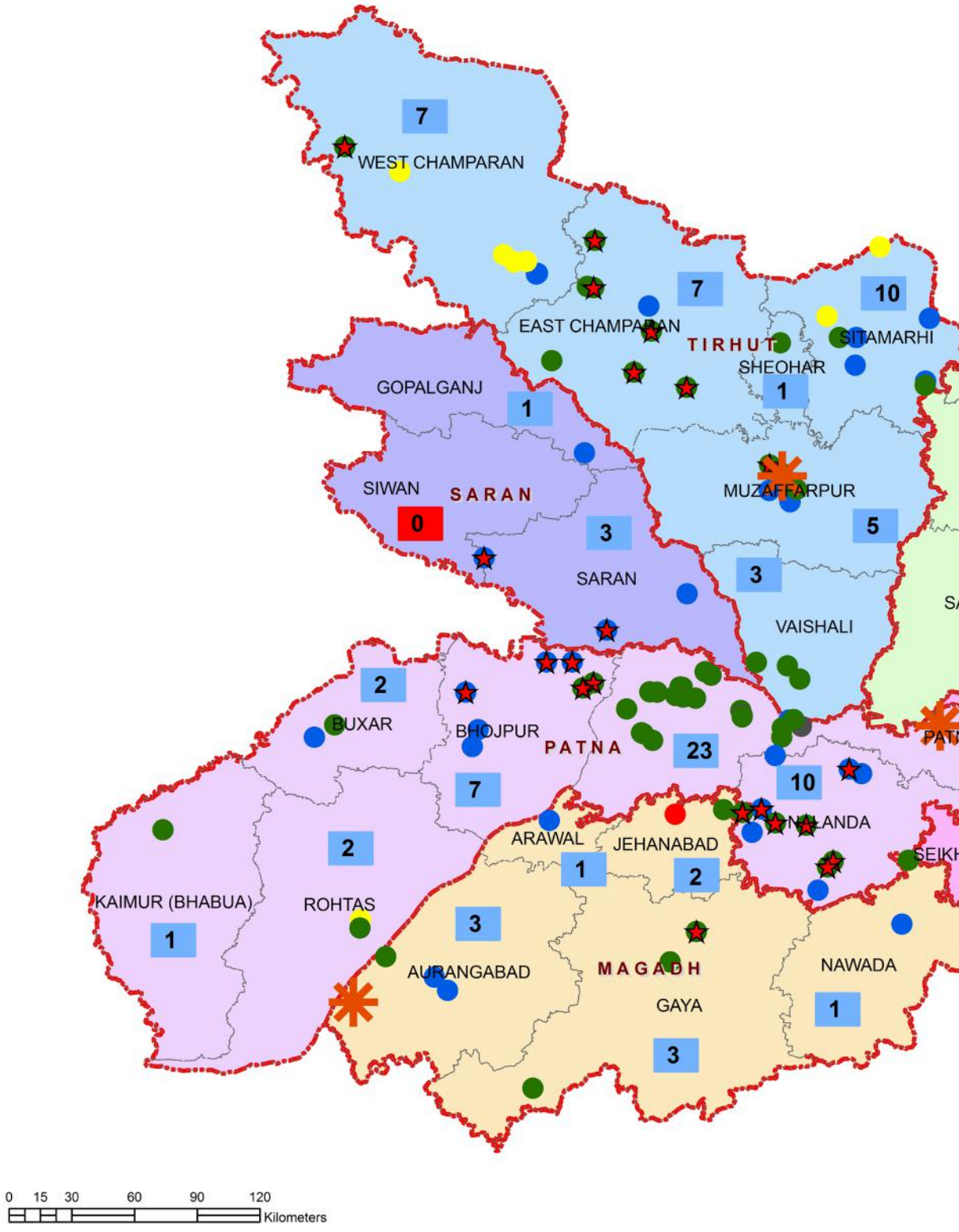
Figure 4: Share of operational fly ash brick units in Bihar



Source: Development Alternatives

Currently, fly ash brick units are spread across all nine divisions of Bihar, barring a few districts with long transportation distance, hampering the economic feasibility of fly ash bricks. Patna, Tirhut, Darbhanga, Bhagalpur and Kosi divisions were identified to be the five major fly ash brick producers. Majority of the fly ash brick units in the state are situated in regions surrounded by thermal power plants. Map 1 depicts the status of fly ash bricks in Bihar.

Map 1: Status of Fly Ash Brick Availability in Bihar



Source: Development Alternatives

Note: The above map was also plotted on an interactive GIS map which can be used by all stakeholders to access information about all fly ash brick units in Bihar. The interactive map can be accessed using the link, *http://dagroup.maps.arcgis.com/apps/webappviewer/index.html?id=0ad2375c5d114ed191ae27b9667941f6*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MADHUBANI
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SUPAUL
ARARIA
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KISHANGANJ
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DARBHANGA
DARBHANGA
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KOSI
PURNEA
SAHAR
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MADHEPURA
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PURNIA
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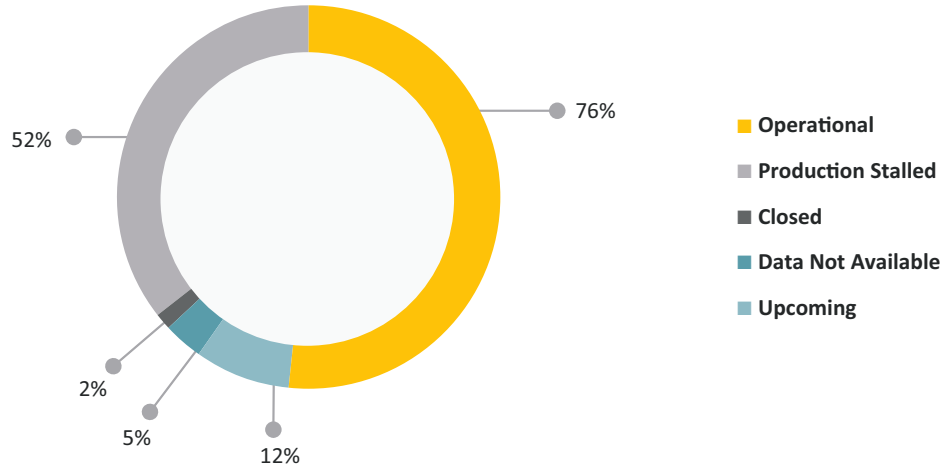
0
KATIHAR
BEGUSARAI
KHAGARIA
2
BHAGALPUR
10
LAKHISARAI
MUNGER
MUNGER
1
1
0
BHAGALPUR
JAMUI
0
BANKA
1
Legend
Status of Fly Ash Enterprises
Data Not Available
Operational
Production Stalled
Upcoming
Closed
Quality Checked as per FABQRS
Thermal Power Plant
(00) No of Fly Ash Unit
(0) District Not Surveyed
Division Boundary
District Boundary

Figure 5 summarises the status of fly ash brick units in Bihar, according to different categories of functionality as on July 2018.

Figure 5: Status of fly ash brick units by category as on July 2018



Source: Development Alternatives

The division[17] wise distribution of enterprises, along with their annual production capacity, is depicted in table 2 and figure 6.

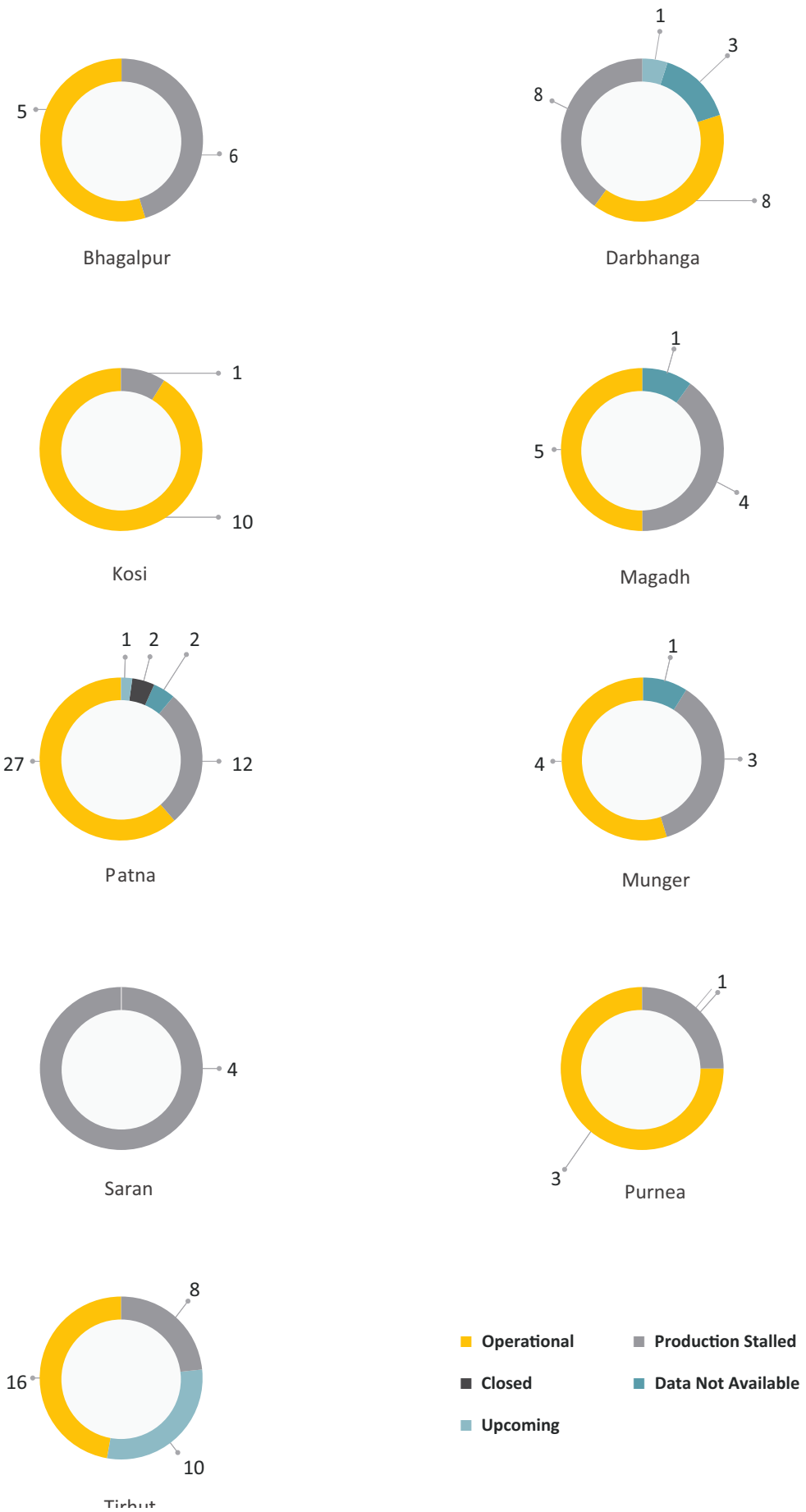
Table 2: Status of fly ash brick availability in Bihar as on July 2018

Division	No. of Districts	No. of Fly Ash Enterprises	Annual installed capacity (in Millions)	Present Status				
				Data Not Available	Production Stalled	Operational	Upcoming	Closed
Bhagalpur	2	11	31.2	0	5	6	0	0
Darbhanga	3	20	18.6	1	8	8	3	0
Kosi	3	11	41.3	0	1	10	0	0
Magadh	5	10	8.4	1	4	5	0	0
Munger	6	8	15.0	1	4	3	0	0
Patna	6	45	107.3	2	13	27	1	2
Purnea	4	4	2.4	0	3	1	0	0
Saran	3	4	12.2	0	4	0	0	0
Tirhut	6	34	61.1	0	10	16	8	0

Source: Development Alternatives

17 Structurally, Bihar is divided into nine administrative divisions

Figure 6: Division wise status of fly ash brick enterprises



Source: Development Alternatives

The above figures provide empirical evidence of fly ash brick availability in Bihar. These also indicate that even though fly ash brick units are spread across the state, the number of units in each district is too less as compared to clay brick units. Production was stalled at many units due to lack of demand, because:

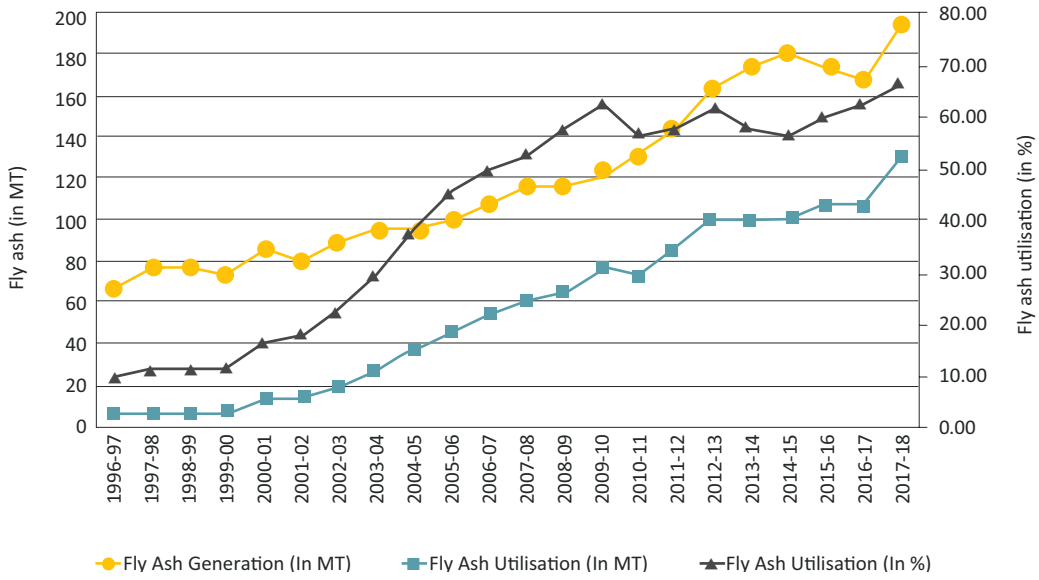
- Government stakeholders were unaware of the availability of fly ash brick units in their respective districts, and hence not procuring fly ash bricks for public construction
- Fly ash brick entrepreneurs were not taking initiatives to promote fly ash bricks in private and public sectors
- Fly ash bricks of inconsistent quality have created a negative image among consumers, and thus were not being accepted by public and private consumers.

Despite low market demand and huge competition from clay bricks, the fly ash brick industry is growing. All current surveyed units put together can manufacture about 0.3 billion fly ash bricks per year. The current utilisation of fly ash in the country is around 132 MT (i.e. having an overall utilisation rate of 67.13%), with the brick industry. Assuming a utilisation rate of 60% by the cement industry alone (currently the largest consumer of fly ash in India), it is estimated that the fly ash brick industry would still have the capacity to produce around 3 billion bricks per annum in Bihar. This implies that the state has the potential to support at least about 1,000 more fly ash enterprises, which will further lead to job creation for about 10,000 people.

2.2 Status of Fly Ash Availability in Bihar

About 70-75% of the total power generation in India is met from coal based power plants. In 2017-18, 624.88 MT of coal was consumed by the thermal power sector, resulting in 196.44 MT of fly ash generation. Of this total fly ash generation, only 67% was utilised (CEA, 2018)[18] and the remaining 33% remained unutilised (Refer to figure 7).

Figure 7: Fly ash generation and its utilisation during the period from 1996-97 to 2017-18 in India



Source: Central Electricity Authority, 2018

Bihar currently has 4.77 GW of installed thermal power capacity spread across four thermal plants, which generated 7.38 MT of fly ash in 2017-18. However, only 42.78% (3.16 MT) of the generated fly ash was utilised. The figures from each plant (Table 3) highlight these low rates. Based on the CEA report 2018, Bihar has a low fly ash utilisation percentage (42.78%) as compared to the national

18 CEA (2018). "Report on Fly ash generation on Coal/Lignite Based Thermal Power Stations and its Utilisation in the Country for the year 2017-18". Accessed from http://www.cea.nic.in/reports/others/thermal/tcd/flyash_201718.pdf

percentage (67%), though this rate has increased in comparison to that of 2017 (32.37%). The low rate of fly ash utilisation in Bihar clearly indicates the high potential for fly ash brick production.

Table 3: Thermal power stations with fly ash utilisation level during the year 2017-18

Name of Thermal Power Station (TPS)	Power Utility	Installed Capacity (MW)	Fly Ash Generation (MT)	Fly Ash Utilisation (MT)	Fly Ash Utilisation (%)
Muzaffarpur	Kanti Bijlee Utpadan Nigam Ltd. (Bihar)	610	0.44	0.19	42.44
Kahalgaon Super	NTPC Ltd. (Bihar)	2340	4.18	1.92	45.88
Barh Super	NTPC Ltd. (Bihar)	1320	2.49	0.97	39.20
Nabinagar	Bharatiya Rail Bijlee Company Ltd. (Bihar)	500	0.27	0.08	28.24

Source: Central Electricity Authority, 2018

2.3 Modes of Fly Ash Utilisation

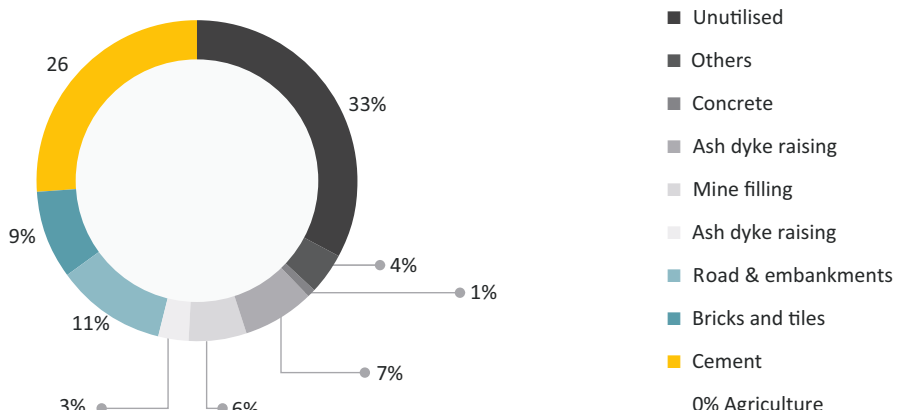
Over the period of last twenty years, the perception of fly ash has completely changed from a 'hazardous waste' to a 'resource material'. This has been achieved due to the efforts of Fly Ash Mission (FAM) and Fly Ash Unit (FAU), Department of Science and Technology (DST), India. Various policies of the Ministry of Environment, Forest and Climate Change (MoEF&CC), and implementation and monitoring by regulatory agencies (State Pollution Control Board) have also helped in increased fly ash utilisation. Fly ash is being used in all fields, either as a whole or in parts – such as in the form of cement, for Road reclamation and Low-Lying Areas (RLLA), road embankments, mine fillings, ash dyke raising, bricks and tiles, agriculture, concrete and others. A major portion of fly ash is being used for civil construction, especially cement, while a very less amount is being used for bricks and tiles. This is because of unawareness of consumers, or their discomfort with the different colour (greyish) of the produced bricks. Yet, the data below (Table 4) shows that the utilisation percentage in bricks and tiles has increased from the year 2010-11 to 2017-18, reaching about 18 MT, which is the highest until now.

Table 4: Major modes of fly ash utilisation in MT from the year 2010-11 to 2017-18

Mode of utilisation	Cement	RLLA	Road embankment	Mine fillings	Ash dyke raising	Bricks and tiles	Agriculture	Concrete	Others	Total
2010-11	35.47	9.31	8.52	6.04	-	4.61	1.27	-	7.91	73.13
2011-12	38.08	14.21	5.54	7.74	5.86	5.83	0.88	-	6.28	85.05
2013-14	19.56	5.20	2.20	5.37	4.27	5.03	1.47	0.68	3.32	47.10
2014-15	21.27	5.06	1.39	6.44	4.25	4.92	1.07	0.37	3.88	48.65
2016-17	40.59	11.03	6.194	11.78	11.88	14.91	1.92	0.76	7.98	107.04
2017-18	50.30	20.58	6.67	12.52	13.55	17.69	0.57	1.30	8.69	131.87

Source: Central Electricity Authority, 2018

Figure 8: Modes of fly ash utilisation in 2017-18 across India



Source: Central Electricity Authority, 2018

Utilisation of fly ash in building materials (bricks and tiles): Building material (bricks and tiles) is the major mode of fly ash utilisation (9%), after the cement industry (38%) and RLLA (11%). Nowadays, all civil construction material or building material, i.e. bricks, tiles, concrete blocks (particularly fly ash bricks), utilise fly ash in variable compositions, which indirectly helps in saving the fertile topsoil. CEA report 2017-18 reveals that in the year 1998-99, only 0.70 MT fly ash was used in building materials, which increased to 17.69 MT in the year 2017-18. In 2017-18, the total utilisation of fly ash in bricks and tiles was 0.29 MT in the state of Bihar, which comprises only 9.4% of the total utilised fly ash in Bihar.

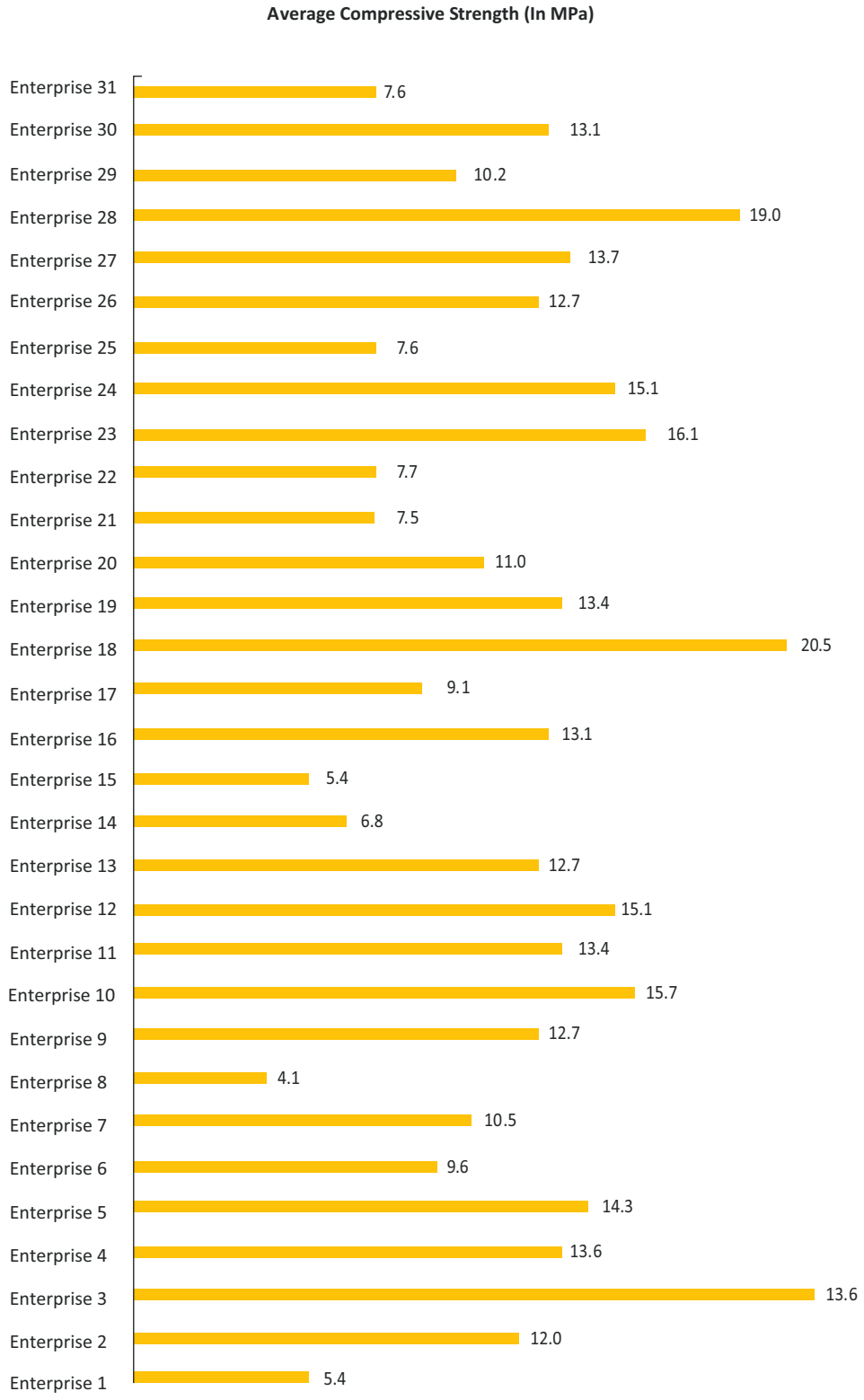
2.4 Quality of Fly Ash Bricks in Bihar

There has been an increasing recognition of utilisation of fly ash bricks in the construction sector. However, the lack of initiatives on quality assurance has restricted the proliferation of these bricks in the sector. Quality is a critical parameter for all products, and more so for sustainable products such as fly ash bricks which are used for infrastructure development. Accordingly, compliance with standards defined by the Bureau of Indian Standards (BIS) for fly ash bricks is important. While quality parameters for traditional clay bricks and fly ash bricks are similar, there is a significant difference in terms of awareness between the two categories of bricks. Production of quality fly ash bricks requires accurate knowledge about the technology. The lack of access to this information leads to compromised quality of bricks, which is currently a major issue being faced by the industry, as well as consumers (public and private sectors), in the state of Bihar.

To address this issue, the Society for Development Alternatives (DA) designed a **Fly Ash Brick Quality Rating System (FABQRS)** with support from Shakti Sustainable Energy Foundation (SSEF), in consultation with Mascot Foundation, entrepreneurs, private builders and state government departments such as BSPCB and Department of Environment, Forest & Climate Change (DoEF&CC, Government of Bihar). FABQRS intends to create an enabling environment for changing the perception and increasing the uptake of fly ash bricks in Bihar. It is a voluntary initiative to improve the market of quality fly ash bricks. As per BIS (IS 12894:2002), FABQRS is based on four quality parameters: compressive strength, water absorption, efflorescence and dimensional tolerance. It was designed to provide acceptable quality criteria for production of fly ash bricks across the state of Bihar.

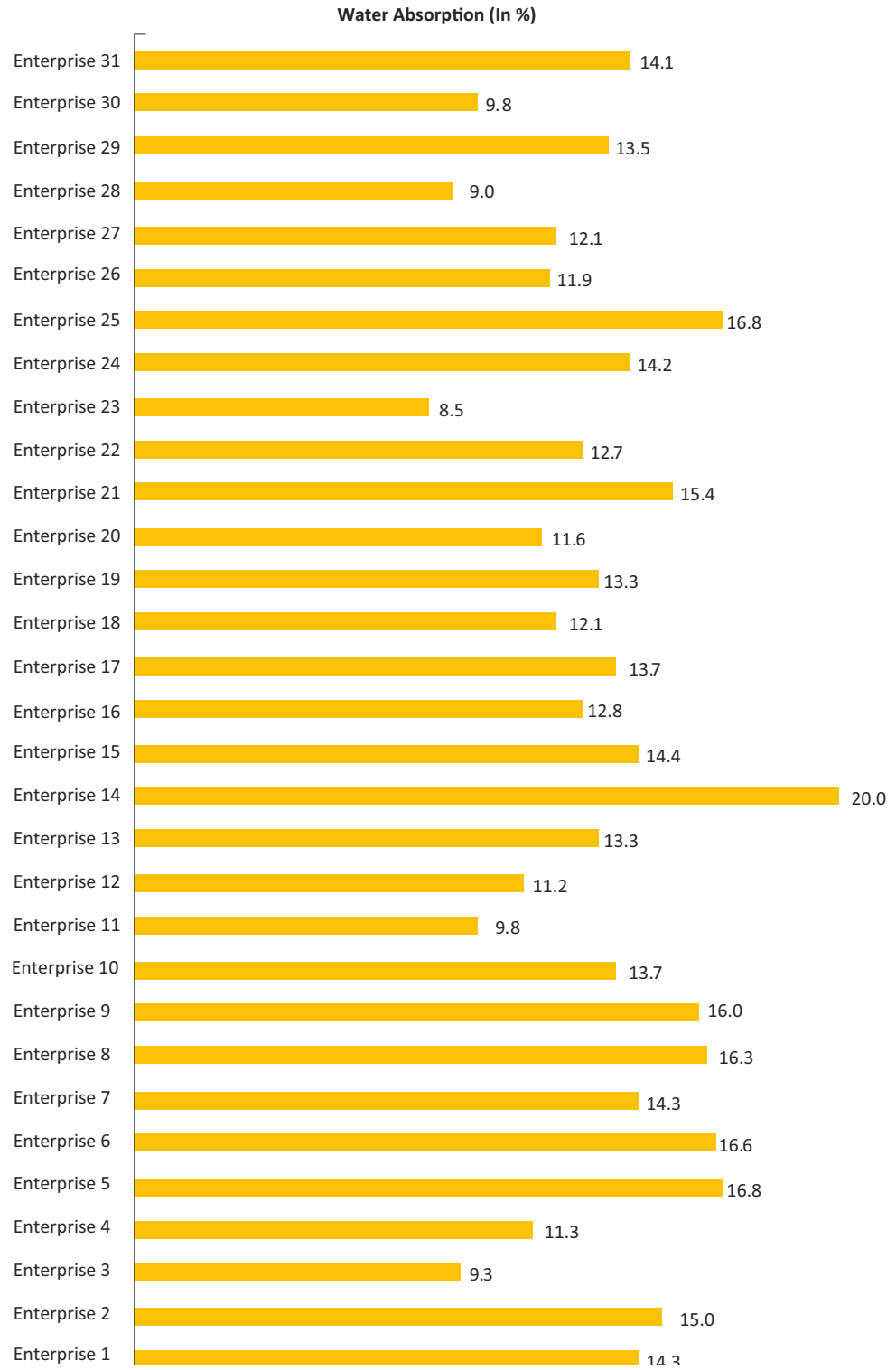
Fly ash brick quality audit was done for 31 enterprises based on BIS guidelines and FABQRS. According to BIS code (IS 12894:2002), the minimum strength should be 3.5 MPa and water absorption should be at a maximum of 20%. All the 31 enterprises tested met the quality standards set as per the BIS guidelines. The average compressive strength for these 31 enterprises was found to be 11.9 MPa, as depicted in figures 9 and 10.

Figure 9: Compressive strength of fly ash bricks



Source: Development Alternatives

Figure 10: Water absorption of fly ash bricks



Source: Development Alternatives

Highlights:

- 96.7% of the fly ash brick enterprises tested have conformed to the compressive strength and water absorption requirements mentioned as per IS :12894: 2002.
- Average compressive strength of the bricks produced across the state of Bihar has been found to be 11.9 MPa, which is an increase by 2.8 MPa from 2016 (9.14 MPa).

2.5 Market Trends

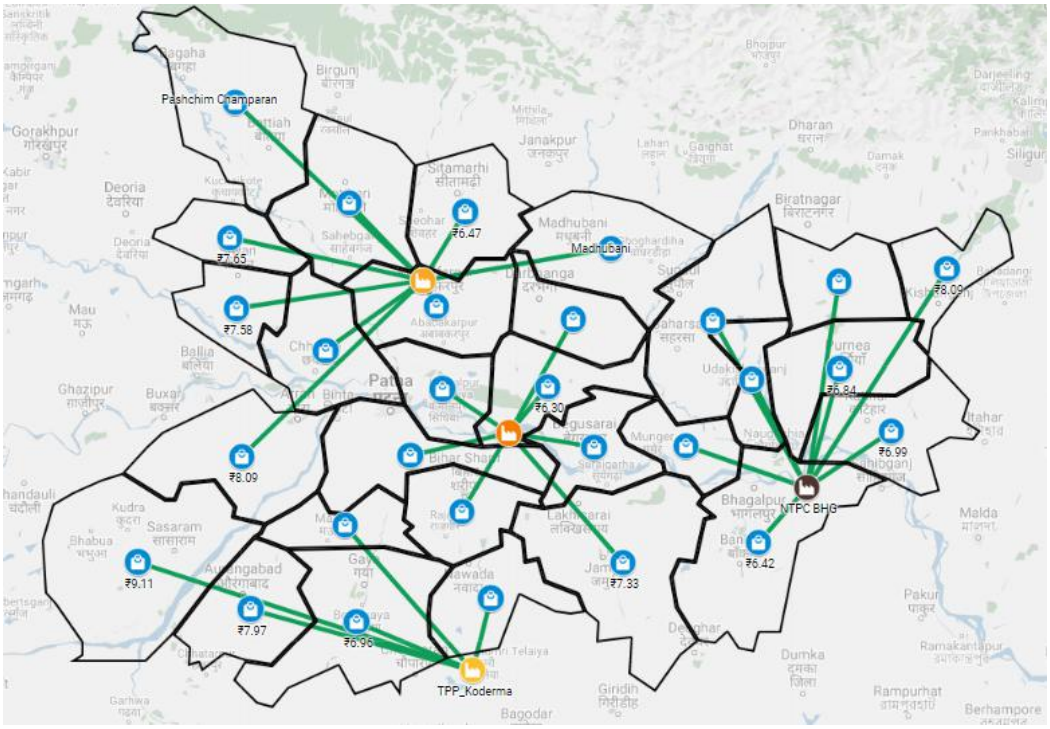
Production cost

The production cost of fly ash bricks mainly depends on the cost of raw materials, contributing to more than 50% of the total cost. The primary raw materials used for production of fly ash bricks are fly ash, sand/stone crusher dust, cement or lime/gypsum as a binder and water. In Bihar, since lime is not readily available, cement is mainly used as a binder across all surveyed fly ash units. Consultations with various entrepreneurs revealed that steadily rising cost of sand combined with inflated prices of OPC 43 and 53 grade cements (varying across regions) lead to escalating production costs of fly ash bricks in the state. According to the notification by MoEF&CC, Government of India, 20% of fly ash should be provided free of cost to fly ash based building material enterprises within 100 km radius of thermal power plants. However, this is not being implemented, since the enterprises are made to bear the transport and bagging charges. Hence, the total cost of procuring fly ash depends on the distance of the brickmaking unit from the source of fly ash (as depicted in figure 10). For example, in Supaul, which is the furthest from NTPC Kahalgaon, the price of procuring fly ash is around INR 1300 per tonne. On the other hand, Bhagalpur, which is nearest to the power plant, obtains fly ash at mere INR 200 per tonne. Therefore, while some enterprises are able to produce fly ash bricks at affordable rates, others find it difficult to maintain the market rate as compared to traditional clay based bricks.

Selling price

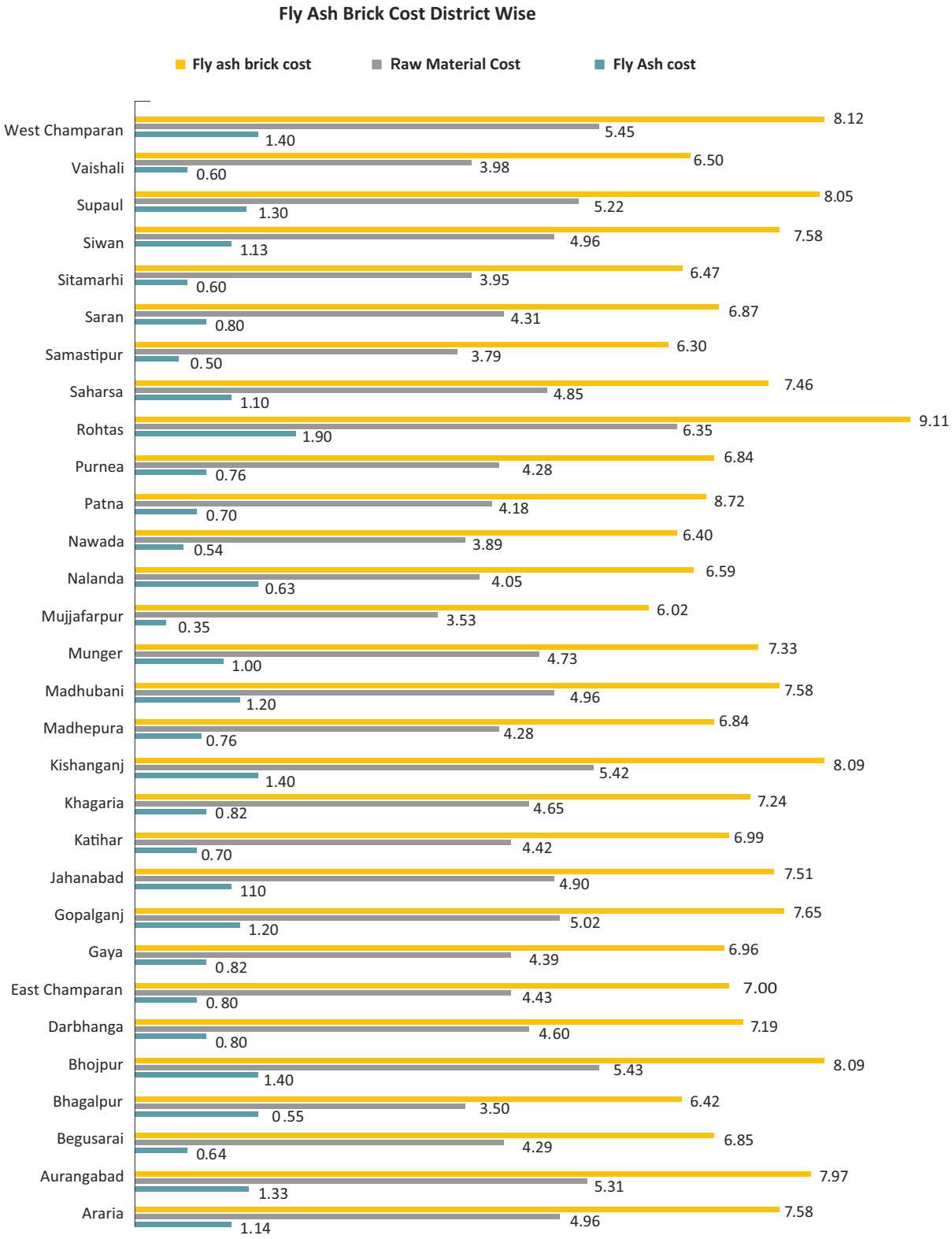
Across the state of Bihar, the selling price of quality clay bricks varies between INR 7 and 10. However, its production cost has been increasing over the years, due to rising coal costs and increasing royalty mining of soil. This leads to significantly reduced profit margins. In this scenario, fly ash bricks have a competitive advantage, seeming more attractive to entrepreneurs for production, since these bricks do not rely on coal or soil mining. Currently, the selling price of quality fly ash bricks across Bihar varies between INR 6 and 9, subject to distance from source of fly ash (depicted in figure 11). If the government mandate of providing fly ash free of cost is implemented successfully, the variations in price can be avoided, thus enabling selling of fly ash bricks at a constant rate of INR 6 throughout Bihar, making it the preferred choice of bricks.

Figure 11: District wise cost of fly ash bricks



Source: National Fly Ash Brick Association

Figure 12: District wise cost analysis of fly ash bricks



Source: National Fly Ash Brick Association

2.6 Impact

Assuming all fly ash brick enterprises are functional, producing 300 million fly ash bricks per year will result in the following benefits (when compared to traditional brick production methods):

- 0.063 MT of coal conserved
- 0.202 MT of carbon emissions reduced
- 0.84 MT of soil saved
- 1500 green jobs in safe work environment created.

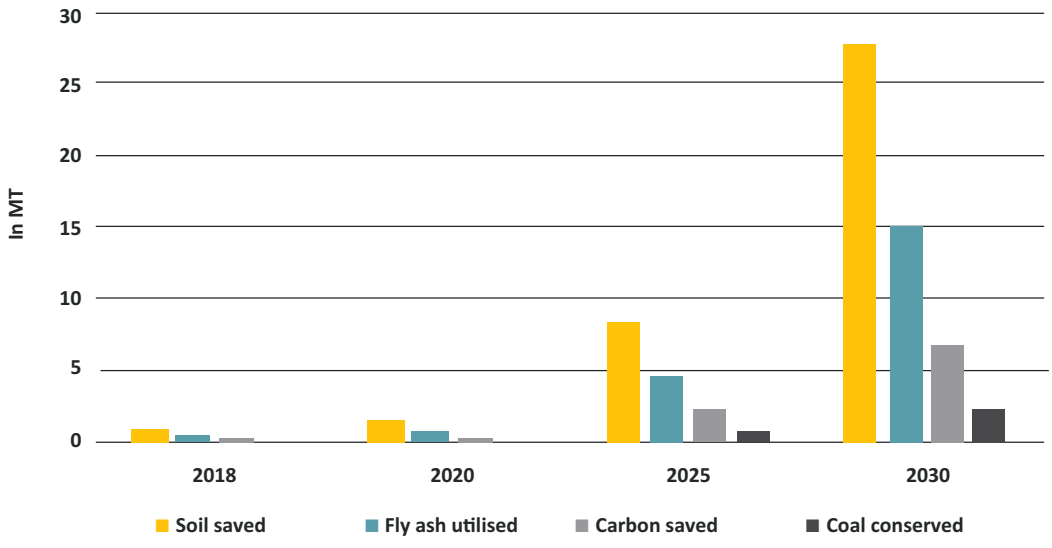
Future Impact

In terms of future projections, if we assume that the existing four power plants in Bihar continue to operate in full capacity, fly ash brick makers will be able to acquire almost 14 MT of fly ash. This means that there is a potential for 5000 new fly ash units to be established, producing 10 billion bricks annually. The following data (table 5) and figure 12 depict year wise projections for the same.

Table 5: Year wise impact of fly ash brick units

Year	2018	2020	2025	2030
Number of Enterprises	150	250	1500	5000
Number of Bricks (In Billion)	0.3	0.5	3	10
Number of Green Jobs	1500	2500	15,000	50,000
Soil Saved (In MT)	0.84	1.4	8.4	28
Fly Ash Utilised (In MT)	0.45	0.75	4.5	15
Carbon Saved (In MT)	0.202	0.34	2.02	6.73
Coal Conserved (In MT)	0.063	0.105	0.63	2.10

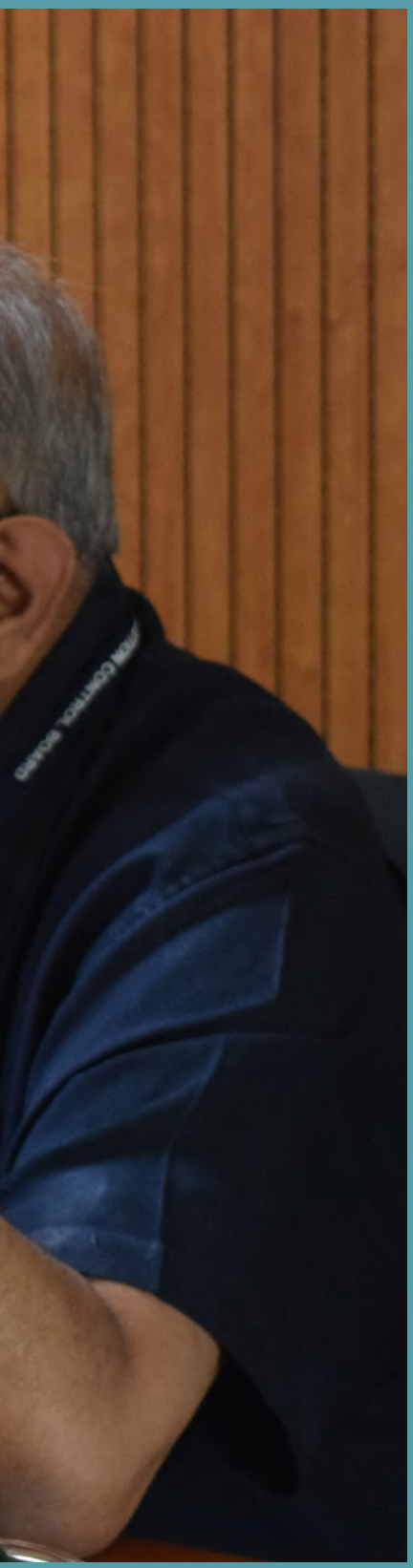
Figure 13: Future impact of the fly ash brick industry



Source: Development Alternatives

Policy Ecosystem for Fly Ash Bricks

3



Currently, 56.4%[19] of total electricity generated in the country is from coal and lignite based thermal power stations. The share of coal and lignite in the overall electricity mix is expected to remain significant in the near future. Indian coal is of low grade having a high ash content of the order of 30-45%, which results in generation of large quantities of fly ash during power generation. At present, low rates of fly ash utilisation in the country result in the creation of surplus ash stock in ash ponds, which has been increasing every year. The management of fly ash has, thus, been a matter of concern in view of requirement of large areas of land for its disposal, since it has the tendency to cause air and water pollution.

In order to protect the environment and conserve topsoil, which is extensively depleted in clay brick manufacturing, and to promote utilisation of fly ash generated from coal and lignite based thermal power plants, which is still a big challenge for many of the power plants, MoEF&CC (Government of India) has issued a notification under E.P. Act 1986 dated 14 September 1999. This was amended in subsequent notifications dated 27 August 2003 and 3 November 2009, which has been further amended by the notification dated 25 January 2016. This notification has the following salient directions/provisions:

- No person shall, within a radius of three hundred kilometres from coal or lignite based thermal power plants, manufacture clay brick, tiles or blocks for use in construction activities without mixing at least 25% of ash (fly ash, bottom ash or pond ash) with soil on weight-to-weight basis.
- Every construction agency engaged in construction of buildings within a radius of three hundred kilometres from coal or lignite based thermal power plants shall use only fly ash based products for construction, such as cement or concrete, fly ash bricks or tiles, or clay fly ash bricks.

In response to the notification issued by MoEF&CC, the DoEF&CC (Government of Bihar), with BSPCB, constituted a State Level Monitoring Committee (SLMC) on fly ash utilisation, and an Inter Departmental Task Force on clean building materials. DoEF&CC has also issued a notification on 100% use of fly ash bricks for the construction of public infrastructure.

19 Ministry of Power, Government of India, March 2019

Figure 14: Key government initiatives

The Building Construction Department (BCD) and Urban Development and Housing Department, Government of Bihar (Annexures 1 and 2 respectively), responding to the notifications issued by the MoEF&CC, mandated 100% use of fly ash bricks for the construction of public infrastructure. However, in spite of these notifications and guidelines, the fly ash brick industry is facing hurdles in upscaling and operating at the installed capacity. As mentioned earlier, on the one hand, the fly ash generated in Bihar is not being utilised completely, indicating the potential for establishing new fly ash brick enterprises; and on the other hand, the production of fly ash bricks is stalled at some of the existing fly ash brick manufacturing units, indicating the lack of demand for fly ash bricks despite enough demand for bricks in Bihar.

उपजाऊ मिट्टी खत्म होने से परेशानी

पटना | वरीय संवाददाता

मिट्टी से बनाए जाने वाले ईंटों में कृषि योग्य उपजाऊ मिट्टी का उपयोग बढ़ गया है। बिहार जैसे कृषि प्रधान राज्य में आने वाले दिनों में यहां की कृषि उपज और किसानों पर विपरीत प्रभाव पड़ने की आशंका है।

बिहार राज्य प्रदूषण नियंत्रण पर्षद और डेवलपमेंट अल्टरनेटिव के सहयोग से ग्रीनिंग दी ब्रिक सेक्टर इन बिहार विषय पर आयोजित कार्यशाला में ये बातें विशेषज्ञों ने कही। प्रदूषण बोर्ड के अध्यक्ष अशोक कुमार घोष ने बताया कि ईंट निर्माण में करीब दस हजार हेक्टेयर उपजाऊ मिट्टी की ऊपरी परत प्रत्येक वर्ष

चर्चा

- ईंट निर्माण में फ्लाई ऐश के प्रयोग से समस्या हो सकती है कम
- ग्रीनिंग दी ब्रिक सेक्टर इन बिहार विषय पर आयोजित हुई कार्यशाला

समाप्त हो रही है। डॉ. घोष ने कहा कि फ्लाई ऐश से ईंट बनाने वाले उत्पादनकर्ता और उपभोक्ता आपस में जुड़ें इसके लिए प्रदूषण बोर्ड अपनी वेबसाइट पर सूचना तंत्र को विकसित करेगा। इससे समस्या खत्म होगी। देश में कुल ऊर्जा उत्पादन में 73 फीसदी थर्मल पावर प्लांटों द्वारा उत्पादित किया जाता है। कोयले का उपयोग होता है, जिससे करीब 11 करोड़ टन फ्लाई ऐश निकलता है। इसका निपटारा करना भी एक बड़ी समस्या है, लेकिन फ्लाई ऐश से ईंट निर्माण कर इसका उपयोग किया जा सकता है। अभी मात्र 14 फीसदी फ्लाई ऐश का ही इस्तेमाल हो पा रहा है। 31 अगस्त के बाद नहीं मिलेगी अनुमति प्रदूषण बोर्ड के वैज्ञानिक नवीन कुमार ने बताया कि पटना शहर के पांच प्रखंडों में 120 ईंट भट्ठों ने स्वच्छतर तकनीक का इस्तेमाल कर लिया है। राज्य भर के सभी परंपरागत ईंट भट्ठों को 31 अगस्त तक समय दिया गया है। इसके बाद कोई ईंट भट्ठा स्वच्छतर तकनीक नहीं अपनाएंगे तो उन्हें चलाने की अनुमति नहीं दी जाएगी।

Source: Hindustan, Patna Bihar

Barriers to the Fly Ash Brick Industry in Bihar

4

It is evident from various discussions with entrepreneurs and consumers (especially those engaged in carrying out public construction) that there is a gap between demand and supply of fly ash bricks. On one hand, entrepreneurs are ready and willing to set up enterprises for producing fly ash, but the demand is limited or absent, i.e. a non-existent market. While on the other hand, public consumers, mandated by the GOI to use fly ash bricks, fail to fully/partially comply with the usage requirements due to inadequate supply and poor quality of fly ash bricks.

Thus, barriers do exist in uptake and subsequent usage of fly ash bricks in Bihar. Some of these are:

- **Poor enforcement of existing policies –** Over the years, there has been an increasing recognition by the government on the issues of management and utilisation of fly ash. This is reflected in the policies formulated by the government. MoEF&CC issued various notifications in the last few decades stipulating the use of fly ash bricks in all construction within a radius of 300 km of the thermal power plants. Compliance to this notification is yet to be achieved. Fiscal measures like reduction of excise duty have also been granted to entrepreneurs. However, the entrepreneurs lack support from the state government in terms of incentives, schemes and a preferential regime to switch to fly ash bricks.

  The March 2018 notification, issued by the DoEF&CC on 100% fly ash brick use in public infrastructure by all concerned departments, is not being implemented as desired. Further, in September 2018, the Ministry of Rural Development circulated a notice on the utilisation of fly ash based construction material in Pradhan Mantri Awas Yojana-Gramin (PMAY-G)[20] construction as part of the discussion under the National Clean Air Programme (NCAP). All states have been requested to furnish details regarding the utilisation of fly ash based construction material in constructions under the PMAY-G. The notification also highlights that fly ash must constitute a minimum of 50% of the total input material in non-clay based bricks, blocks and tiles (IS-12894). This, too, is not being adhered to by the departments.
- **Preference for traditional bricks –** Despite huge market potential for bricks, the demand for fly ash bricks is low due to the lack of awareness among producers and consumers on the eco-friendly technology, and their preference for traditional clay bricks.
- **Inadequate utilisation in public infrastructure projects** – Many public infrastructure projects are currently not being able to utilise 100% fly ash bricks either due to gaps in timely supply of quality bricks or preference for traditional bricks. This lack of market demand debars entrepreneurs from setting up more units.
- **Lack of knowledge about the fly ash brick technology –** The level of awareness among existing and potential entrepreneurs and end users on the fly ash brick production technology and process is very low. The know-how on fly ash brick technology is fragmented and resides primarily with technology providers, research institutes and development agencies working in this sector. The fly ash brick manufacturers, however, are not acquainted with this knowledge.

20 Ministry of Rural Development, Government of India. 2018. Use of fly ash based construction materials PMAY-G notification. https://pmayg.nic.in/netiay/writereaddata/Circulars/fly%20ash%20construction%20info%20states.pdf (accessed on 25th March 2019)

Benefits of producing these bricks – such as reduction in topsoil consumption, waste management, coal savings and reduction in carbon emissions – are not well known to the stakeholders, including both producers and consumers. In fact, in case of few entrepreneurs, the lack of knowledge on the production process and curing time of these bricks has led to poor supply of fly ash bricks in the market.

- **Quality control of fly ash bricks –** Consumers are reluctant to use fly ash bricks because of inferior quality. Low quality bricks distort the market. Even though quality standards for bricks have been prescribed by BIS, there is no quality control system in place to ensure that the production units stick to these standards. Stimulating demand for fly ash bricks requires ensuring good quality.
- **Lack of easy access to finance –** The lack of easy access to finance acts as a constraint in the scaling up of fly ash brick technology. The credit-worthiness of brick entrepreneurs is currently not viewed so favourably by banks, and therefore, entrepreneurs either fail to avail formal loans from banks or face massive delays in the process. Entrepreneurs are also facing troubles in benefitting from government subsidies, either due to lack of awareness about these subsidies or the cumbersome procedure to apply for it.
- **Lack of branding to stimulate market demand for fly ash bricks –** Inadequate efforts from entrepreneurs, as well as the government, to promote and advertise the use and benefits of fly ash bricks has restricted fly ash entrepreneurs from increasing their market share. Fly ash bricks, being a relatively new product, require some promotion to retain its market competitiveness, the lack of which prevents changing consumers' mindset about fly ash brick utilisation.

Barriers restricting the uptake of Fly Ash Bricks (FAB) in Bihar		
	Demand Side	Supply Side
Technology	• Lack of know-how on technical guidelines of FAB – engineers, developers, contractors, masons, architects	• In terms of FAB making machines: o Poor quality o Poor customer service o Lack of locally available spare parts
Enterprise	• Lack of marketing and branding initiatives to stimulate demand for FAB	• Lack of knowledge about the FAB technology among entrepreneurs • Lack of easy access to finance • Poor quality of FAB
Policy Influence	• Poor implementation of notification by BCD (100% procurement of FAB in Bihar) • Preference for traditional bricks • Consumers' misconception about the quality of FAB – strength and durability	• Poor enforcement of fly ash notification (free transportation of fly ash) • Periodical bans on sand mining • Low Schedule of Rate (SoR) – impacting the competitiveness of entrepreneurs, and compromising the quality

Recommendations

5

The information stated in the previous few sections indicates the state of brick sector in Bihar. It also highlights the case for greening the brick sector in Bihar, as this could potentially benefit the state in terms of saving fertile soil, conserving natural resources, utilising waste efficiently, and improving climatic conditions by reducing CO_2 emissions. Going forward, greening the brick sector would require initiatives such as:

- **Undertaking awareness programmes on fly ash bricks and its technology** – The state government should take initiatives for increasing awareness on fly ash bricks. Such awareness programmes can be done under the purview of the Department of Industries (DoIs) and DoEF&CC at state level, and by the DICs at district level. Platforms such as regular workshops, seminars, media, hoardings, pamphlets, radio programmes and other awareness campaigns must be utilised for effective communication and outreach on knowledge about the financial and environmental merits of fly ash bricks. There should be active engagement and participation from government stakeholders such as DICs, BCD, Mines and Geology Department, brick industry associations, real estate developers, technology providers, civil society organisations, etc. An information campaign targeting potential entrepreneurs and users would increase market awareness of fly ash bricks – promoting financial and social merits of fly ash bricks: cheaper to produce, equal or better in quality to clay bricks, no requirement for traditional brick kilns that produce harmful emissions, and lesser risk for workers owing to safer machinery. The use of fly ash bricks in government construction will also aid in popularising these among other consumers. BCD can play a crucial role in promoting 100% use of fly ash bricks in their own construction, and erecting demonstration buildings at the district and block level to reiterate the benefits of this technology.

- **Conducting training programmes on the fly ash brick technology –** As mandated by MoEF&CC, National Thermal Power Corporation (NTPC) has conducted training programmes in the neighbouring states of Uttar Pradesh and West Bengal, for spreading awareness within 100 kilometre radius of thermal power plants for promoting use of fly ash bricks in the construction sector. Similar trainings should also be organised in Bihar.

- **Supporting State Government in Implementation of policies for utilisation of fly ash bricks –** DoEF&CC should ensure regular monitoring of fly ash or fly ash based products utilisation in the state of Bihar. It must enlist the departments mandated to use fly ash in all construction projects being undertaken across the state, conduct surveys at the construction site to check whether or not the notification is being implemented by these departments, and monitor their actual rate of fly ash utilisation. This would ensure the mandatory use of fly ash bricks in projects under various Central and State Government Schemes such as Pradhan Mantri Aawas Yojna-Urban (PMAY-U), AMRUT (Atal Mission for Rejuvenation and Urban Transformation), Smart City Mission and Swachh Bharat Mission.

- **Scaling up of adoption of FABQRS for quality control –** Given the success of FABQRS in

improving the quality concern surrounding fly ash bricks, the FABQRS porgramme must be scaled up and out to cover all functional enterprises in the state of Bihar. A targeted approach must be developed to enrol more enterprises under the system. The results obtained under FABQRS must be continuously monitored and analysed, and necessary training and technical support provided to the enterprises to maintain brick quality. Validation of FABQRS must be sought from the Quality Council of India (central certifying agency), DoIs, BCD and BSPCB to add credibility and set it as an industry norm for wider acceptance. Formal government procurement procedures should be influenced to include FABQRS as a component.

- **Improving access to finance –** State level consultations should be held with financial and banking institutions and the concerned government departments to discuss the current status of enterprises and the role of finance. This should be led by DoIs, in association with other government departments. Through these consultations, the DoIs and the financial institutions should come up with an implementable plan of action to revitalise the fly ash brick industry in a time bound manner. Given that the fly ash brick industry is relatively new, the enterprises must be backed by financial support from the government in terms of tax breaks/exemptions, subsidies and other incentives. Government support would also aid in viewing the fly ash industry as more than just a resource efficient brick producing industry – it would make it more attractive in terms of its value propositions and for private investments, which is a must for its long-term sustainability.

- **Building a network of stakeholders to facilitate exchange of technology know-how –** A network of stakeholders should be created to facilitate exchange of knowledge and information on best practices, technology providers, suppliers, service providers, etc. This can enable a seamless flow of know-how for the overall development of the sector. For this, the Fly Ash Brick Association, with support from DoIs, should take the initiative to create such collaborative networks.

- **Compliance with MOEF&CC regulations by fly ash generators –** The regulations formulated by MOEF&CC should specifically target NTPC and other coal/lignite based power generators in the country. Failure to comply with the same shall incur a 5% surcharge, to be levied on the amount of fly ash not utilised. The amount shall be transferred to a common Corpus Fund responsible for providing easy finance to fly ash enterprises.

- **Setting up of Fly Ash Processing Zones** – Fly Ash Processing Zones (FAPZs) are envisaged as regions (akin to Special Economic Zones or SEZs) comprising facilities dedicated to utilisation of fly ash, received directly from thermal power plants, in making building materials and products for other applications. Thus, the facilities existing within an FAPZ will not be limited to fly ash manufacturing units but will include production units of various building materials, Ready Mix Concrete (RMC) plants etc. FAPZs should be located near thermal power plants, preferably at a distance less than 100 km. Establishing FAPZs will have a host of direct benefits, both for the supplier and the entrepreneur, as listed below:

  i. As they will be located near thermal power plants, the transportation cost shall be significantly reduced, thereby decreasing costs of production

  ii. Being direct receptacles of fly ash from thermal power plants, they will help in overcoming regular supply shortages faced by entrepreneurs

  iii. Through a mechanism of tracking and monitoring, they will enable more transparency in the supply chain, thereby ensuring accountability

  iv. Bricks and other products manufactured in various facilities can be sold to the connected thermal power plant at discounted rates.

Overall, FAPZs will help enhance the utilisation of fly ash in the state by providing solutions to key challenges (mentioned above) and building an effective mechanism of value addition.

Change Makers in Bihar

Smt. Mikki Devi, former *Mukhiya* of Madhura South in Araria district, was looking for an opportunity to set up an enterprise during her post-*Mukhiya* days. This is when a tenant, an engineer working with NTPC Kahalgaon, shared the idea of setting up a fly ash brick manufacturing unit within the area. She consulted with Shri Abhay Kumar Singh, present *Mukhiya* of Madhura South in Araria. And in March 2017, with his support, a fly ash brick manufacturing unit – Bhawani Shankar Fly Ash Bricks – was set up on his piece of land in the village. The unit became operational in April 2018.

The unit was set up with an initial investment of INR 4.5 million, out of which INR 2.35 million was sourced through PMEGP, a credit linked scheme, and the rest was raised through alternative means.

The total number of bricks manufactured and sold by the unit until 15 July 2018 was 0.3 million. Of this, about 70-75% bricks were supplied to private households in Araria, within a radius of 50 km from the unit, and the rest were supplied to government projects. Each brick costs INR 6.5 to INR 7, depending on its size and mixing practice.

Bhawani Shankar Fly Ash Bricks receives fly ash from NTPC, Kahalgaon. Frequency of the fly ash supply depends on the production capacity and demand of fly ash bricks. At present, the unit has one machine worth about INR 1.5 million, installed with the capacity to manufacture 10,000 bricks per day. The machine supplier, while installing the machine, trained five employees on the process of manufacturing fly ash bricks.

Impact of Mikki Devi's Industry

Environment:

- 63 tonnes of coal was saved from burning during manufacturing processes
- 9.6 tonnes of carbon emissions from coal burning were reduced, as fly ash bricks do not require coal
- 900 tonnes of topsoil was saved from being excavated
- 450 tonnes of fly ash was utilised in the brick manufacturing processes.

Social:

- People's mindset about using fly ash bricks in the Araria district was influenced – over time, they became more accepting of the products
- 16 locals were employed by the fly ash unit, for skilled and unskilled labour.

Business:

- Initially, the enterprise was under loss due to the lack of knowledge on pricing of bricks based on the material used, labour invested and the size of bricks. On correcting the size, they were able to recover the losses and generate more revenue than before.

Future Scope

Mikki Devi aims to install more machines in the fly ash brick unit in the next few years, to increase supply to the stakeholders. Besides expansion of the enterprise, Mikki Devi aspires to start a charitable foundation that would support an old age home for senile citizens in the Araria district.

Imran, an MBA graduate with expertise in finance and business management skills, after completing his post-graduation, tried different avenues for earning a livelihood. But he could not succeed, and later joined his father's construction business. However, his dissatisfaction with this work provoked him to run an independent business. While he was exploring ideas and opportunities to start a new business, a friend of his suggested to invest in a fly ash brick manufacturing unit. Imran was amazed with this opportunity and immediately applied for a loan under the Prime Minister's Employment Generation Programme (PMEGP) for setting up a fly ash brick manufacturing unit. Working with his father helped him in developing knowledge and networks relevant for the fly ash utilisation process.

Imran with a stock of fly ash bricks at his unit

The government granted him a loan of INR 2 million under the PMEGP scheme, which helped him in setting up the enterprise by October 2016, in Supaul. Indus Fly Ash Bricks was set up with an initial investment of INR 5 million, out of which INR 2 million was sourced through PMEGP, a credit linked scheme, and the rest was raised through alternative means. Manufacturing and other operations in the unit started in May 2017. The total number of bricks manufactured and sold by the unit until 15 July 2018 was 0.4 million, which was mainly supplied to the private sector at a cost of INR 9 per brick. Recently, the unit also got a contract for supplying 5 million bricks for different government projects at the rate of INR 7 per brick.

Indus Fly Ash Bricks sources fly ash from NTPC Kahalgaon, at the rate of INR 1,400 to 1,800 per tonne. At present, the unit has one machine worth about INR 1.6 million installed for brick making processes, with a capacity to manufacture 18,000 bricks per day. The unit currently has a staff of 10 to 12, out of which only one employee is trained and skilled to operate the machinery, and the remaining have been hired for unskilled labour on wages. They have two different types of unskilled labourers – ones that manage the raw materials and are paid hourly wages, and ones that manage the stacking of the fly ash brick stocks and are paid daily wages. The business is currently operating at break-even and most of the revenues generated are spent on labour costs and purchase of raw materials.

Impact of Imran's Fly Ash Brick Industry

Environment:

- 126 tonnes of coal was saved from burning during manufacturing processes
- 19.2 tonnes of carbon emissions from burning of coal were reduced, as fly ash bricks do not require coal
- 1,800 tonnes of topsoil was saved from being excavated
- 900 tonnes of fly ash was utilised in the brick manufacturing processes.

Social:

- People's mindset about using fly ash bricks in Supaul district was influenced – over time, they became more accepting of the products
- 10 locals were employed by the fly ash unit, for skilled and unskilled labour.

Business:

- Initially, the economic growth of the enterprise was slow due to the lack of demand of fly ash bricks from the community. Once they started addressing concerns of their customers, the enterprise started picking up pace.

Future Scope

Imran aims to explore newer markets in the fly ash brick industry to increase sales, especially within the public sector. He also aims to attract more investments in his enterprise through non-governmental organisations to increase his income.

Arun Kumar at RAS fly ash brick unit

RAS Fly Ash Bricks was established in West Champaran in July 2018, by Smt. Rekha Verma. Shri Arun Kumar Verma, Rekha's husband, had been involved in the red brick industry since 2011. Learning about the government notification to adopt cleaner brick production technologies, he started exploring alternative and cleaner technologies. He used this opportunity to set up a fly ash brick manufacturing unit, sourcing the investment from a loan they availed through PMEGP, a credit linked subsidy scheme offered to entrepreneurs. Interestingly, since the Verma family already had a brick kiln unit, they used the site to set up and install the fly ash unit as well. The machine and equipment was bought from Hi-Tech engineering, Gujarat, having a production capacity of 8,000 bricks per day with a 4 bricks per stroke mould. The initial investment was INR 2.5 million, out which INR 1.5 million was sourced from the PMEGP scheme, and INR 1 million through alternative means.

While Arun Kumar currently handles all technical operations, Rekha manages the administrative operations at RAS Fly Ash Bricks. The unit has about five to six trained employees to keep operations running. These employees were previously involved in the red brick making operations, and are therefore closely associated with the brick making processes. RAS sources its fly ash from Kanti Thermal Power Station, located 180 km away from the fly ash brick making unit. The unit purchases fly ash at INR 1,400 per tonne from the thermal power plant. This rate includes labour charges to load and unload the vehicles, packaging of the fly ash in old cement bags, transportation costs and other extra charges. The unit has manufactured about 75,000 fly ash bricks in the span of one month – which is since the start of their operations.

Impact of RAS Fly Ash Brick industry

Environment[21]:

- Approximately 15.75 tonnes of coal was saved from burning
- Carbon emissions of 2.4 tonnes were saved
- 225 tonnes of topsoil was saved from being mined for manufacturing
- Approximately, 150 tonnes of fly ash was used and prevented from being dumped.

Social:

- The unit generated employment for 6 labourers, including both skilled and unskilled.

Future Scope

RAS Fly Ash Bricks has just begun their journey in the fly ash brick industry. They aim to install more machines with a capacity of 8 bricks per stroke, once the business picks pace. With the current trends in the market, the enterprise has several challenges ahead. The Vermas are exploring other avenues to boost their business. In the rare chance that the fly ash brick business does not pick up pace, they aim to invest in the zig-zag or vertical method of brick making in their red brick kilns to comply with the government rules. They are hoping for the government to take some initiatives to encourage, promote and support fly ash brick manufacturing enterprises in the state.

21 These numbers are calculations with respect to the 75, 000 bricks manufactured by RAS Fly Ash Brick Enterprise.

Shri Ranjay Kumar Singh belonged to Odisha before he moved to Bihar to set up his fly ash brick unit in Nalanda. His father worked at the mines in Odisha. Ranjay, while being in Odisha, noticed that the fly ash brick industry in Odisha was flourishing with high sales of bricks, but at slightly low profit margins. Later, when he learned that a new power plant was commissioned in Bihar in 2012, he decided to move to Bihar to set up a fly ash brick making unit to get ahead in the industry, as the concept of fly ash bricks was comparatively new in Bihar. In 2010, he got a piece of land on lease in Silao, Nalanda, for a period of 30 years for his manufacturing unit.

UPS Fly Ash Bricks was set up with an initial investment of INR 3.7 million, out of which INR 2.35 million was sourced through PMEGP, a credit linked scheme, and the rest was raised through alternative means. Manufacturing and operations in the unit started in 2013. The total number of bricks manufactured and sold by the unit until August 2018 was approximately 2.5 million.

The bricks were mainly sold to the public sector. Each brick costs INR 5 to INR 5.5, depending on its size and mixing practice.

UPS Fly Ash Bricks currently sources fly ash from NTPC Barh at INR 500 per tonne of fly ash. However, initially when the unit was set up, it sourced fly ash from NTPC Kahalgaon at INR 1,200 per tonne of fly ash. After this, owing to the high costs, he switched to Damodar Valley Corporation Bokaro Thermal Power Plant in Jharkhand, procuring fly ash at INR 700 per tonne. At present, the unit hast two machines worth about INR 1 million, installed for the manufacturing process. The machines have a collective capacity to manufacture 25,000 bricks per day. Currently, however, they only manufacture 7,000 bricks per day. The machine supplier, while installing the machine, trained the employees on the process of manufacturing fly ash bricks. The total investment made in this business by Shri Ranjay Kumar Singh, until July 2018, was INR 10 million. His enterprise was classified as a non-performing asset (NPA) in March 2018, as he was unable to repay his debts as planned. However, in the following months, his enterprise experienced an increment in sales, and he was able to recover from being an NPA. The enterprise is now operating at break-even.

Impact of Ranjay Kumar Singh's Industry

Environment:

- 525 tonnes of coal was saved from burning during manufacturing processes
- 80 tonnes of carbon emissions from coal burning were reduced, as fly ash bricks do not require coal
- 7500 tonnes of topsoil was saved from being excavated
- 3750 tonnes of fly ash was utilised in the brick manufacturing processes.

Social:

- 12 locals employed by the fly ash unit, for skilled and unskilled labour.

Business:

- The enterprise is now experiencing increment in sales of fly ash bricks due to demand from government projects in the Nalanda district, and is functional at break-even.

Future Scope

Shri Ranjay Kumar Singh has a huge debt to repay, and is working hard to keep his enterprise functional, hoping that the government would implement some incentives for fly ash brick enterprises in the near future. On the off-chance of the business not picking pace, he plans to move back to Odisha and manage a mining extruder to earn a decent salary.

6 References

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4. Arun Jyoti Nath, Rattan Lal, and Ashesh Kumar Das. “Fired Bricks: CO2 Emission and Food Insecurity”. Global challenge (www.global-challange.com).

5. Virendra Kumar Yadav and M.H. Fulekar. “The current scenario of thermal power plants and fly ash: production and utilisation with a focus in India”. International Journal of Advance Engineering and Research Development. Volume 5, Issue 04, April 2018.

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BSF

7 Annexures

Annexure 1: 100% utilisation notification issued by Building Construction Department, Govt. of Bihar

पत्रांक–भ0/अभि0प्र0 (यो0)–07 बैठक–09/2013 (खण्ड)......5226 (भ)

बिहार सरकार
भवन निर्माण विभाग

प्रेषक,

लक्ष्मी नारायण दास
अभियंता प्रमुख–सह–अपर आयुक्त–सह–विशेष सचिव
भवन निर्माण विभाग, बिहार पटना।

सेवा में,

सभी मुख्य अभियंता
सभी अधीक्षण अभियंता
सभी कार्यपालक अभियंता
भवन निर्माण विभाग, बिहार, पटना

पटना, दिनांक......31/5/18

विषय:– राज्य में संचालित किये जा रहे योजनाओं में 100% फ्लाई ऐश ईंट के उपयोग के संबंध में।

प्रसंग:– पर्यावरण एवं वन विभाग के ज्ञापांक–499(ई0) दिनांक–04.05.2018 एवं विभागीय पत्रांक–1567(भ0) दिनांक–19.02.2018

महाशय,

निदेशानुसार उपर्युक्त विषयक प्रासंगिक पत्र की छायाप्रति संलग्न करते हुए कहना है कि पर्यावरण एवं वन विभाग के पत्रांक–131 दिनांक–30.03.2015 द्वारा निदेशित किया गया था कि सभी विभागों/एजेंसियों द्वारा कार्यान्वित किये जा रहे सभी कार्य योजनाओं में फ्लाई ऐश ईंट का 100% उपयोग किया जाय। तदआलोक में भवन निर्माण विभाग द्वारा 100% फ्लाई ऐश ईंट का उपयोग किये जाने हेतु निदेश दिया गया। परन्तु कई भवनों प्रमंडलों से फ्लाई ऐश ईंट की पर्याप्त एवं गुणवत्तापूर्ण उपलब्धता नहीं होने की सूचना प्राप्त हुयी, जिसके कारण कार्य योजनाओं को लक्ष्य पूर्ण करने में हो रही कठिनाई के संदर्भ में विभागीय पत्रांक–10726(भ0) दिनांक–30.11.17 द्वारा 60% तक चिमनी उत्पादित लाल ईंट का प्रयोग निर्माण कार्य योजनाओं में करने हेतु अनुरोध पर्यावरण एवं वन विभाग, पटना से किया गया था। पर्यावरण एवं वन विभाग ने अपने पत्रांक–45(ई0) दिनांक–15.01.18 द्वारा राज्य में फ्लाई ऐश के उपयोग के अनुश्रवण हेतु गठित राज्य स्तरीय समिति दिनांक–11.01.18 की बैठक की कार्यवाही संलग्न करते हुये कार्यवाही की कंडिका–4 में फ्लाई ऐश ईंट का 100% उपयोगिता की बाध्यता को शिथिल किये जाने के निर्णय के अनुरूप कार्रवाई किये जाने की सहमति प्रदान की गयी। उक्त के आलोक में विभागीय पत्रांक 1567 (भ0) दिनांक 19.02.2018 द्वारा संबंधित को निदेश दिया गया कि निर्माण कार्य योजनाओं में न्यूनतम 50% तक फ्लाई ऐश ईंट का उपयोग किया जाय।

पुनः पर्यावरण एवं वन विभाग ने अपने ज्ञापांक 499(ई0) दिनांक–04.05.2018 द्वारा राज्य में फ्लाई ऐश के उपयोग के अनुश्रवण हेतु गठित राज्य स्तरीय समिति की दिनांक–19.04.2018 की बैठक में लिये गये निर्णय में संसूचित किया है कि पर्यावरण वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार के एस0ओ0–254(ई0) दिनांक 25.01.2016 के आलोक में कार्रवाई की जाय।

तदआलोक में निर्णय लिया गया कि निर्माण कार्य योजनाओं में 100% फ्लाई ऐश ईंट का उपयोग किया जाय।

संबंधित को निदेश दिया जाता है कि सभी निर्माण कार्य योजनाओं में 100% फ्लाई ऐश ईंट का उपयोग दृढ़ता से किया जाना सुनिश्चित किया जाय।

अनु0–यथोक्त

विश्वासभाजन
(हस्ताक्षर) 29/5/18
— (लक्ष्मी नारायण दास)
अभियंता प्रमुख–सह–अपर आयुक्त–सह–विशेष सचिव

Annexure 2: 100% utilisation notification issued by Urban Development and Housing Department

Annexure-R-4
182

पत्रांक– 11 न0वि0 अभि0 (को0) ट्रिब्यु0 232/2017 875 न0वि0 एवं आ0वि0

बिहार सरकार
नगर विकास एवं आवास विभाग

प्रेषक,

विशेष सचिव,
नगर विकास एवं आवास विभाग,
बिहार, पटना।

सेवा में,

प्रबंध निदेशक,
बिहार राज्य जल पर्षद, पटना।
प्रबंध निदेशक,
बुडको, पटना।
प्रबंध निदेशक,
बिहार राज्य आवास बोर्ड, पटना।
मुख्य अभियंता
नगर विकास एवं आवास विभाग,
बिहार, पटना।
नगर आयुक्त,
सभी नगर निगम, बिहार।
सभी कार्यपालक अभियंता,
जिला शहरी विकास अभिकरण, बिहार।
कार्यपालक पदाधिकारी,
सभी नगर परिषद/सभी नगर पंचायत, बिहार।

पटना, दिनांक– 13/07/18

विषयः– राज्य में संचालित किए जा रहे योजनाओं में 100% फ्लाई ऐश ईंट के उपयोग के संबंध में।

प्रसंगः– (1) पर्यावरण एवं वन विभाग, बिहार का ज्ञापांक– 499(ई0) पटना, दिनांक–04.05.2018
(2) भवन निर्माण विभाग, बिहार का पत्रांक–5274(भ0) पटना, दिनांक–31.05.2018

महाशय,

उपुर्यक्त विषय के संबंध में कहना है कि पर्यावरण एवं वन विभाग, बिहार के ज्ञापांक–499(ई0) दिनांक–04.05.2018 द्वारा राज्य में फ्लाई ऐश के उपयोग के अनुश्रवण हेतु गठित राज्य स्तरीय समिति की दिनांक–19.04.2018 की बैठक में लिये गये निर्णय में संसूचित किया गया है कि पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार के एस0ओ0–254(ई0) दिनांक– 25.01.2016 के आलोक में कार्रवाई की जाय।

उपर्युक्त निर्णय के आलोक में भवन निर्माण विभाग, बिहार के पत्रांक– 5274(भ0) पटना, दिनांक–31.05.2018 द्वारा निर्माण कार्य योजनाओं में 100% फ्लाई ऐश ईंट का उपयोग करने का निर्णय लिया गया है।

तदनुसार पर्यावरण एवं वन विभाग एवं भवन निर्माण विभाग, बिहार के प्रासंगिक पत्रों के आलोक में नगर विकास एवं आवास विभाग, बिहार अन्तर्गत निर्माण कार्य योजनाओं में भी 100% फ्लाई ऐश ईंट के उपयोग का निर्णय लिया गया है।

अतः निदेश दिया जाता है कि सभी निर्माण कार्य योजनाओं में 100% फ्लाई ऐश ईंट का उपयोग दृढ़ता से किया जाना सुनिश्चित किया जाय।

विश्वासभाजन

अनु0:–यथोक्त।

13.07.18
विशेष सचिव
नगर विकास एवं आवास विभाग
बिहार, पटना।

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SHAKTI
SUSTAINABLE ENERGY
FOUNDATION

Shakti Sustainable Energy Foundation (SSEF) was established in 2009 to support India's developmental and energy security objectives. SSEF works to facilitate India's transition to a sustainable energy future by aiding the design and implementation of policies in the following sectors: clean power, energy efficiency, sustainable urban transport, climate policy and clean energy finance.

Development Alternatives

Development Alternatives (DA) is a premier social enterprise with a global presence in the fields of green economic development, social equity and environmental management. It is credited with numerous technology and delivery system innovations that help create sustainable livelihoods in the developing world. DA focuses on empowering communities through strengthening people's institutions and facilitating their access to basic needs; enabling economic opportunities through skill development for green jobs and enterprise creation; and promoting low carbon pathways for development through natural resource management models and clean technology solutions.

Development Alternatives

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