2012

The Odisha Brick Sector
- A baseline study

Development Alternatives

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Executive Summary

The construction sector is an important part of the Indian economy with a contribution of 10% in GDP and registering an annual growth of 9%. Common fired clay brick is one of the important building materials in India. Bricks are used as walling material in most residential and commercial buildings. They are also used for other applications, e.g. road and canal construction. India is the second largest producer of bricks in the world, and is next only to China in terms of brick production. An estimated 140 billion bricks were produced during the year 2000–01. Bricks are generally produced at village and rural enterprise levels. The sizes of brick units are much smaller in the rural areas. However, in peri-urban areas, the size of brick producing units is much larger, and clustering of brick making units is quite common. Regional variations are also observed in the size and scale of the brick production units.

Bull's Trench Kilns (BTKs) and clamps are two prominent firing technologies used for brick making in Odisha. The BTK is a continuous type kiln and has higher production capacities (15,000–50,000 bricks per day). It also has better energy efficiency compared to clamps. There are two types of BTK in operation in Odisha i.e. fixed chimney and movable chimney. Despite its ban by the Supreme Court and enforcement by the Pollution Control Boards of respective State Governments, Movable Chimney BTK flourishes still in many parts or Odisha. BTKs account for 70% of the total brick production in the state. Coal is the main fuel used in BTKs. A variety of fuels such as coal, firewood, various types of agricultural residues and dung cakes are used in clamps. Large variations were observed in the shape, size, stacking of bricks and firing techniques in clamps. Generally, energy efficiencies of clamps are much lower than BTK's in Odisha.

Field study was done in eight districts of Odisha to understand the present scenario of brick industry and to assess the market potential and business viability for clay fired bricks and fly ash bricks in allocated cluster area. An identified key issue in brick sector is that, the brick industry, which is based on widespread production activity, highly pollutes the environment. Problems in this industry have been exacerbated by cheap access to resources such as soil, water, coal, and biomass materials. Even though, the industry is organized regionally and is controlled by powerful brick entrepreneurs, the level of skill development is very poor. Key barriers for improvement of the Odisha Brick Industry are:

1. Lack of knowledge and awareness among entrepreneurs to prepare acceptable and bankable project documents for seeking loan from financial institutions and banks. At present, there is no tailor made financial instrument available to brick kiln entrepreneurs for investing on technology up-gradation.
2. The availability of technology for resource-energy efficient bricks is limited as very few technology providers are available in Odisha.
3. Majority of brick kiln entrepreneurs use traditional method of green brick production, brick firing and marketing. They also lack capacities and modern practices on marketing, business opportunities and kiln management. There is also lack of trained manpower to cope with new technology changes.

4. The existing codes and specifications for building materials are based on traditional brick making and do not meet modern practices and technologies. With the availability of new building materials, these codes and specifications need to be reviewed and modified for large scale production and end use.

5. Present level of awareness of entrepreneurs and end-users on modern technologies (machineries) and building products is low. The benefits of production of resource efficient bricks such as energy savings, reduction in top soil consumption and air pollution are also not well known to the brick kiln entrepreneurs etc.

Odisha is poised to be a major hub for manufacturing industries, which will lead to the generation of enormous quantities of industrial wastes. In Odisha 70,000 acres of land is being used for storage and disposal of pond ash. Fly ash is also freely available in the state. The use of industrial wastes like fly ash, dolochar etc. in brick production can potentially save over 4.6 million tonnes of CO_2 per year. Although technology options exist, evidence of spontaneous adoption of cleaner technologies and practices is lacking. Some barriers for new technology adoption for fly ash brick making are identified as extremely poor quality of bricks being produced, no knowledge about benefit of this new energy efficient and cleaner brick products, less local demand, lack of quality service provider and slightly higher price than normal clay bricks. For sustainability of brick sector four areas of intervention are required as:

- Better building practices using eco friendly bricks
- Energy savings and high quality brick technology
- Reduced loan processing downtime e.g. loan mela etc.
- Innovative financing options
- Large scale training of builders, brick entrepreneurs, and workers.

Thus the following sequence of intervention priorities are proposed for Orissa:

1. **Accelerated service delivery** including awareness to entrepreneurs and Government on the status of environment friendly brick production technologies

2. **Favourable financial regime** including alternate and innovative financing schemes with reduced processing downtime

3. **Enabling policy environment** at the district level and greater awareness only at the State level.

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Chapter 1

Introduction

1.1. Background

The construction sector is an important part of the Indian economy with a contribution of 10% in GDP and registering an annual growth of 9%. The Indian brick industry is the second largest producer of bricks in the world after China. The brick production in India is estimated at 140 billion bricks, consuming 24 million tonnes of coal along with huge quantity of biomass fuels. The total CO2 emissions are estimated at 41.6 million tonnes accounting for 4.5% of total GHG emissions from India. Brick production in India takes place in small units, using manual labour and traditional firing technologies. Large demand for bricks in urban centers has resulted in mushrooming of brick kiln clusters at the outskirts of major towns and cities. These brick clusters are important source of local air pollution (SPM, SO2, fugitive emissions, etc) affecting local population, agriculture and vegetation. Apart from air pollution, brick industry also consumes good quality top soil for brick making. The industry is estimated to consume 350 million tonne of top soil every year. There are several opportunities exist in Indian brick industry to improve resource efficiencies and promote production of resource efficient bricks such as perforated bricks, hollow blocks and fly ash bricks.

1.2. Indian brick sector

Bricks are one of the most important building materials used in India. The Indian brick kiln industry, which is the second largest producer in the world, second only to China, has more than 100,000 operating units, producing about 140 billion bricks annually. Brick making is a traditional, unorganized industry generally confined to rural and peri-urban areas. The Gangetic plain of North India accounts for about 65% of the total brick production. Punjab, Haryana, Uttar Pradesh, Bihar , West Bengal and Odisha are the major brick producing states in this region. The availability of good fertile alluvium soils in North India makes the fringe areas of North Indian cities be dotted with brick kilns and consequently this has become one of the major forces in bringing about land use/land cover changes around cities.

1.3. Baseline study area

The base line survey of Odisha brick sector was conducted in 8 different districts of Orissa. The area covered in this project is mention below. Details are given in Table 1.

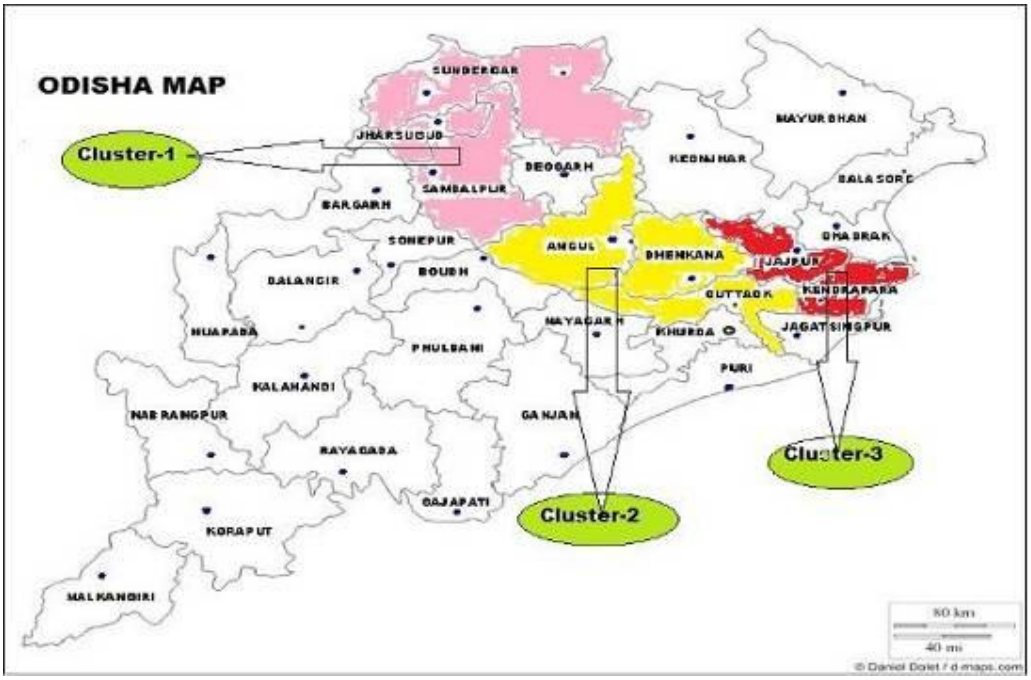


Table 1: Coverage of study area

Districts	Study Area
Cluster-1	
Sundergarh	Sundergarh-Sadar, Bisra and Lathikata
Jharsuguda	Jharsuguda-Sadar and Lakhmanpur
Sambalpur	Sambalpur-Sadar, Rengali and Dhankuda
Cluster-2	
Angul	Anugul-Sadar and Chendipada
Dhenkanal	Dhenkanal-Sadar and Odapada
Cuttack	Salipur, Cuttack-Sadar and Tangi-Choudwar
Cluster-3	
Kendrapara	Aul, Pattamundai, Marsaghai and Mahakalpada
Jajpur	Korei, Jajpur-Sadar and Badchana

1.4. Objectives of the baseline study

- To understand the present scenario of brick industry in Odisha.
- To assess the market potential and business viability for ecofriendly brick production in allocated cluster areas.

1.5. Methodology followed

Phase – 1 (Survey design)

Survey design of the project consisted of the background study about brick sector in Odisha. It includes the following steps:-

- Understanding the Project
- Designing the Questionnaire: A structured Questionnaire was prepared for the collection of primary data.

Phase – 2 (Data collection)

Both quantitative and qualitative data were collected during project period. Quantitative data includes soil and coal quantity in brick making, brick production capacity per day, cost of technology and selling price of final products. Qualitative data includes brick making process, soil and coal type, green and fired brick quality.

The required data was collected from both primary and secondary sources. Primary data was collected from Brick entrepreneurs, Builders and Secondary data collected from District Industry Centre (DIC), Khadi and Village industries Commission (KVIC), Khadi & Village industries Board (KVIB), Directorate of Industries, Odisha as well as from different web sites articles as mentioned in reference part, The Energy and Resources Institute (TERI) and from Development Alternatives (DA) .

Phase-3 (Consolidation and analysis)

Microsoft excel was used as a major tool for analysis of primary data.

- Tabular analysis and Graphical representation

Sampling Technique

In this project the technique of sampling used was **Judgment sampling.** Judgment sampling involves the choice of brick kilns who are most advantageously placed or in the best position to provide the information required.

Sample Design and size

Size of the sample was 78 brick kiln units depending upon the technology used in different locations. Table below gives details of the areas surveyed.

Table 2: Details of survey sampling based on available technologies

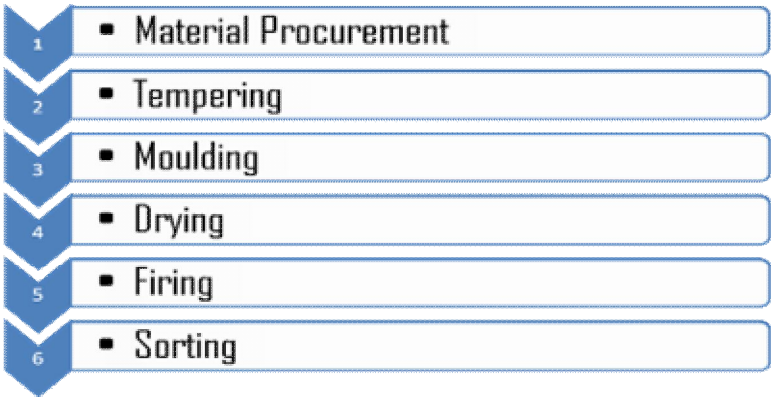
District	FCKBTK	FLY ASH	CLAMP	VSBK	MCBTK
CLUSTER 1					
Sambalpur	5	2	5		
Jharsuguda	2	2	5	2	
Sundergarh	5	2	3	1	
Total	12	6	13	3	
CLUSTER 2					
Cuttack	5	5			
Anugul		5			
Dhenkanal	2	4			1
Total	7	14			1
CLUSTER 3					
Jajpur	5	5		1	
Kendrapara	5	1	3	1	
Total	10	6	3	2	

Chapter 2

Technologies being practiced

2.1. Brick making process

The main steps followed to make a brick are given below.



Material procurement:
The clay is mined and stored in the open. This makes the clay soft and removes unwanted oxides.

Tempering:
This clay is then mixed with water to get the right consistency for moulding. Mixing is done manually with hands and feet. Sometimes and in certain areas, animal driven pug mills are used.

Moulding:
A lump of mix is taken, rolled in sand and slapped into the mould. Initially moulds were made of wood, now metal moulds are used. Sand is used so the brick does not stick to the mould.

Drying:
The mould is emptied onto the drying area, where the bricks are arranged in a herring bone pattern to dry in the sun. Every two days they are turned over to facilitate uniform drying and prevent warping. After two weeks they are ready to be burnt.

Firing:
The green bricks are arranged in a kiln and insulation is provided with a mud pack. Fire holes left to ignite the kiln are later sealed to keep the heat inside. This is maintained for a week. Firing like other operations also depends on the knowledge and experience of the brick maker.

Sorting:
After the kiln is disassembled, the bricks are sorted according to colour. Colour is an indication of the level of burning. Over burnt bricks are used for paving or covering the kiln while slightly under burnt bricks are used for building inner walls or burnt once again in the next kiln.

Though the overall method remains the same, there are certain regional variations considering the local edaphic and climatic conditions. In different areas, different soil types are used with respect to local situation. The three general approaches for firing bricks include using a massive fire, a massive volume and insulation

2.2. Common building material products

Red Brick

Common fired clay brick is one of the important building materials in Odisha. Bricks are very traditionally used as walling material in most residential and commercial buildings. They are also used for other applications, e.g. road and canal construction. The brick size is generally 230mm X 110mm X 75mm. In Sundergarh, Jharsuguda, Sambalpur, Dhenkanal and Kendrapara red brick is major walling material.

Laterite

Laterite is one of the traditional building materials used in Jajpur, Cuttack and Dhenkanal district. The strength of this product is so high compared to red brick and fly ash brick. The product is cheaply available.

Fly ash brick

Fly-Ash Bricks are an environment friendly cost saving building product. These bricks are 3 times stronger than conventional bricks with consistent strength. These bricks are ideally suited for internal, external, load bearing and non-load bearing walls. Modern Construction prefers use of fly ash bricks. In Angul and Cuttack fly ash brick is major building material , which cost is less compared to red bricks. Brick Size: 230mm X 108mm X 75mm.

The table given below shows that red brick is used both urban and rural area as major walling material in Sambalpur, Jharsuguda, Sundergarh, and Kendrapara district. Fly ash brick is used in Angul and Cuttack district due to rapid industrialization.

Table 3: Common building material products being used district wise

	Urban				Rural			
District	**Red Brick**	**Fly Ash**	**Laterite**	**Concrete block**	**Red Brick**	**Fly Ash**	**Laterite**	**Adobe**
Cluster-1								
Sambalpur	Major	Minor		Minor	Major	Occasional		Occasional
Jharsuguda	Major	Minor		Minor	Major	Occasional		Occasional
Sundergarh	Major	Minor		Minor	Major	Occasional		Occasional
Cluster-2								
Cuttack	Occasional	Major	Occasional	Occasional	Major	Minor	Minor	Major
Dhenkanal	Major	Minor	Minor	Occasional	Occasional	Occasional	Minor	Occasional
Angul	Minor	Major		Minor	Major	Occasional	Minor	
Cluster-3								
Jajpur	Minor	Major	Occasional	Occasional	Major	Occasional	Major	Minor
Kendrapara	Major	Minor	Occasional	Minor	Minor	Minor	Occasional	Major

Source: Observation during primary survey

In spite of the amount of bricks being produced there is a substantial sourcing and transportation of bricks inter district wise also. The major reasons are the availability of quality materials and demand /availability of a particular type of material.

Table 4: Brick sourcing from adjoining districts

Cluster-1		
Sambalpur	Jharsuguda – 25%	
Jharsuguda	Sundergarh – 20%	
Sundergarh	Jharsuguda – 5%	Keonjhar – 5%
Cluster-2		
Cuttack	Jajpur – 20%	
Dhenkanal	Cuttack – 20%	Jajpur – 10%
Anugul	Dhenkanal – 30%	Sambalpur – 20%
Cluster-3		
Jajpur	Kendrapara – 5%	Cuttack – 5%
Kendrapara	Jagatsinghpur – 15%	Jajpur – 10%

Source: FGD with brick entrepreneur, builders

The above table signifies that Anugul district sources majority brick from other districts due to the poor soil condition for brick making. So there is the opportunity for production of fly ash brick in Angul district and efforts must be made to encash on the same.

2.3. Technology used for brick production

BTKs (Bull's trench kilns) with moving and fixed chimneys and clamps are generally used for firing bricks in India. Emission standards for BTKs were introduced by the CPCB (Central Pollution Control Board) during 1996. The standards also recommend phasing out of moving chimney BTKs. This led to the adoption of improved brick kiln technologies. Under one such initiative, the SDC (Swiss Agency for Development and Cooperation) has introduced the VSBK(vertical shaft brick kiln) technology in India. At present, there are about 50 VSBKs operating indifferent states, for example Madhya Pradesh, Maharashtra, Uttar Pradesh, and Orissa. The main advantages claimed for VSBK are as highest energy efficiency among all types of kilns, lower emissions, small area requirement and uniformity.

Movable chimney BTK

MCBTK is a highly energy intensive and carbon emitting technology. Chimneys, 6 - 10 m high, made of sheet metal, are placed on top of the brick setting. The firing in a Bull's trench kiln is continuous, day and night. Green bricks are loaded and finished bricks are drawn all the time.

Fixed chimney BTK

The FCBTK is a continuous type kiln and has higher production capacities (15,000–50,000 bricks per day). It also has better energy efficiency compared to clamps. BTKs account for 70% of the total brick production in the Odisha. Coal is the main fuel used in BTKs. The specific energy consumption in firing bricks in BTKs ranges between 1.1 and 1.6 MJ/kg of fired brick.

Clamp

Clamps are used for smaller production levels. A variety of fuels such as coal, firewood, various types of agricultural residues and dung cakes are used in clamps. Large variations are observed in the shape, size, stacking of bricks and firing techniques in clamps. Generally, energy efficiencies of clamps are lower. The specific energy consumption of clamps ranges between 1.5 and 3.0 MJ/kg of fired brick.

VSBK

A Vertical Shaft Brick Kiln (VSBK) is an energy efficient technology for fired clay brick production. This technology originated in China and has about10,000 kilns running at present. In India, the VSBK technology has introduced at a pilot scale in 1996and presently 60 kilns are operational. The VSBK technology considerably economizes on fuel cost, with savings of between 30to 50% when compared with other common firing technologies such as clamps or Bull's

Trench Kilns. Pollution levels are extremely reduced compared to other prevalent methods of brick firing.

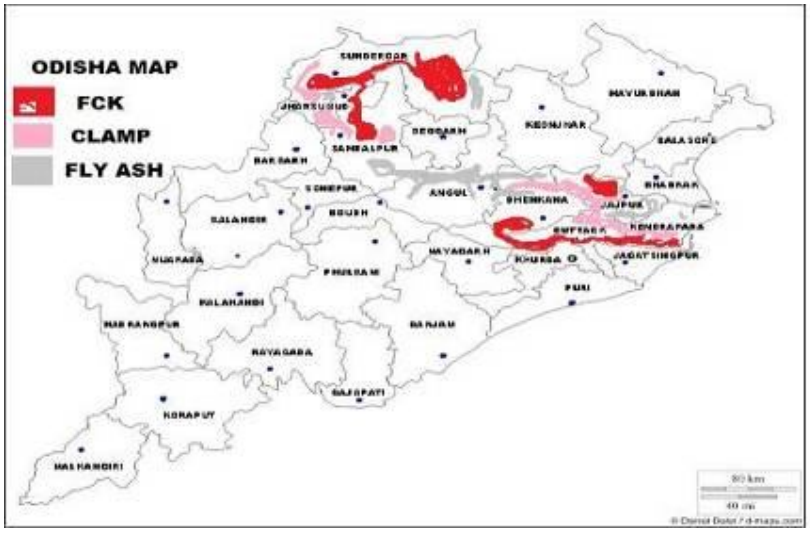
Fly ash brick making

The process comprises of mixing the raw materials using the pan mixer for 4-5 minutes and then transfers the material to press machine with the help of conveyor belt. The compressed blocks are then transferred to a curing yard with the help of wooden pallets on which the blocks are pressed using the press machine. The blocks are then water cured for minimum 14 days. After 14 days of curing bricks are kept for 7 days in dried place, after that it is ready for sale. The composition of a typical Fly Ash Cement bricks is given as below

- Fly ash - 40-50%
- Sand - 40-45%
- Cement/Lime/Gypsum - 8-12%

Technology Mapping

The map given below summarizes the spread of technologies in selected districts of Odisha. The map shows that out of eight districts the concentration of FCK is more in Jharsuguda, Sundergarh, Jajpur and Cuttack district and clamp concentration is high in Kendrapara and Jajpur district. In Angul fly ash technologies has high concentration, but in Dhenkanal and Jajpur district both FCK and fly ash has high concentration.



Source: Observation during primary survey

2.4. Raw materials for brick production

The major raw materials used for brick production are soil and coal for red clay brick production and fly ash for similar blocks. Sources and availability of raw materials are given in Table 5.

Table 5: Raw material source for brick production

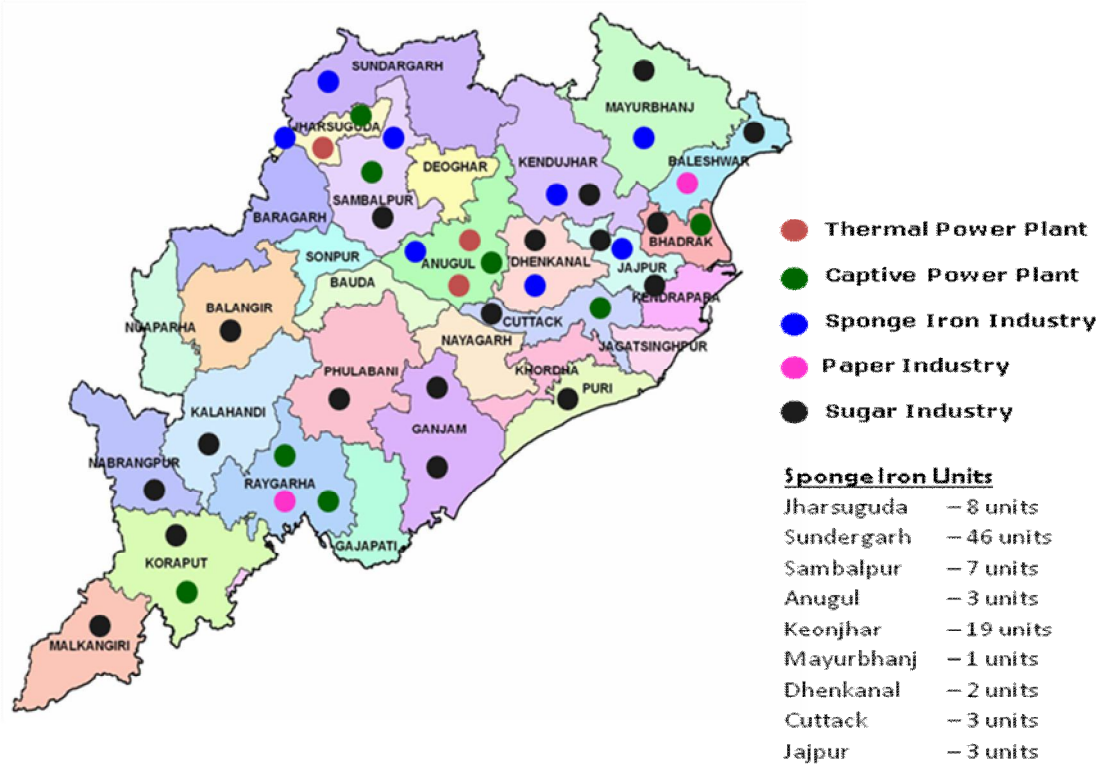
Raw material Source	Cluster-1	Cluster-2	Cluster-3
Coal	Ib Valley Coalfield (MCL)	Talcher Coalfield (MCL)	Talcher Coalfield (MCL)
Rice husk	Bargarh & Sundergarh		
Wood	Local	Local	Local
Sand (river)	Koel, Brahmani	Mahanadi, Brahmani	Brahmani, Baitarani & Kharasrota
Fly Ash	RSP, HINDALCO	NTPC, TTPS, NALCO	JINDAL, NALCO
Black Ash		NavBharat	
Gypsum	PPL	PPL	PPL
Lime	RSP, Rajasthan	RSP, Rajasthan	RSP, Rajasthan

Source: Primary survey

2.5. Mapping of waste material availability

In Odisha 70,000 acres of land is being used for storage and disposal of pond ash. Major power generators are NTPC, NALCO, OPGC, SAIL, RSP, IMFA, HINDALCO, JINDAL among others. Fly ash is freely available in the state. The use of industrial wastes like fly ash, dolochar etc. in brick production can potentially save over 4.6 million tonnes of CO_2 per year.

The map given below shows the waste producing areas in Odisha which are relevant to brick making. Thus it is expected that the Odisha state takes appropriate measures in utilization of waste materials in brick making thereby saving top soil.



Thus the following technologies are recommended to be considered for promotion in various states of Odisha:

Table 6: Technology promotion mapping for important districts in Odisha

District	Fly ash	CEB	Clay brick	HM paper	MCR	Concrete prod.
Malkangiri	√	√			√	√
Koraput	√	√			√	√
Navrangpur	√		√		√	√
Rayagada	√	√		√	√	√
Kalahandi	√	√			√	√
Phulbani	√	√	√		√	√
Bolangir	√	√	√		√	√
Ganjam	√		√		√	√
Puri			√	√		√
Cuttack	√	√	√			√
Khurda	√		√	√	√	√
Dhenkanal	√	√			√	√
Bhadrak	√		√		√	√
Jajpur	√		√		√	√
Kendrapara			√		√	√
Angul	√	√			√	√
Sambalpur	√		√		√	√
Jharsuguda	√		√		√	√
Keonjhar	√	√	√		√	√
Mayurbhanj	√		√		√	√
Balasore	√		√	√	√	√
Sundergarh	√		√		√	√

As far as thermal power sectors in Orissa are concerned about 22.6% of fly ash is being utilized. Institutes like IITS and TERI, Government agencies like CPWD, HUDCO and some of private agencies like Development Alternatives (DA) have accepted to use of fly ash bricks in construction. Institutional acceptance of fly ash bricks as a result of confidence building activities of fly ash mission has triggered the acceptance of fly ash bricks by more and more user agencies.

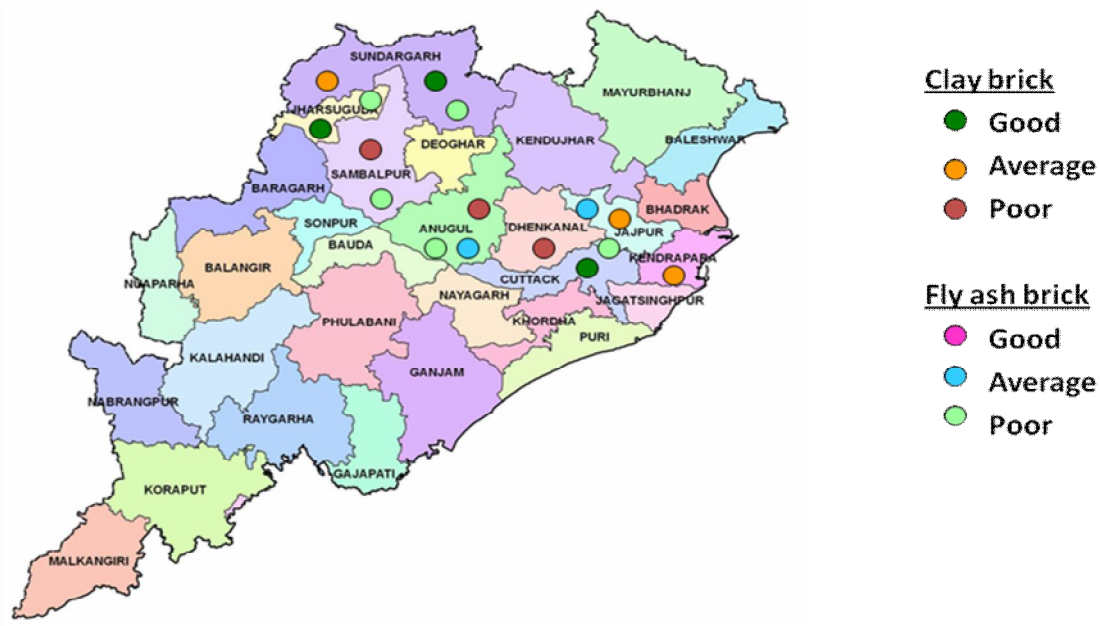
Table 7: Utilization of fly ash by brick sector

Name of the plant	Quantity ash generated (million tonne)	Utilization in brick (tonne)
NALCO, Angul	214	1200
IB Thermal power	0.876	617
INDAL, Hirakud	0.189	7562
ICCL, Cuttack	0.31	Nil
NTPC, Angul	4.62	28735
TTPS, Angul	0.977	5476
RSP, Rourkela	0.21	Wet disposal

Source: Forest and Environment Department, Government of Odisha

2.6. Brick quality mapping

It is desirable that a brick kiln provides a high percentage of high-quality bricks and the number of rejects and breakages is as low a percentage as possible. The ability of a kiln to produce good-quality bricks from a variety of raw materials (clay) generally depends on the rate of heating and cooling, as well as the operator ' s control over the fi ring process ; generally, a slow fi ring kiln or a kiln with better control is able to handle much wider variety of clays. Another important property is the kiln's ability to fi re a variety of products (solid bricks, hollow bricks, tiles and so on).



Source: FGD with builders, brick entrepreneurs

The above map shows that quality of the clay brick is good in Jharsuguda, Sundergarh and Cuttack district and poor in Sambalpur, Dhenkanal and Jajpur district. The quality of the fly ash brick is between average to poor in all the district.

2.7. Mechanization used

The table given below shows the presence of mechanization in the surveyed areas. It signifies that in Sambalpur, Sundergarh and Cuttack there is presence of mechanization but in Kendrapara and Jajpur the presence of mechanization is very low. Thus from marketing angle mechanization needs to be intensified in the areas of Sambalpur, Cuttack and Jharsuguda. In other areas a more promotional introductory campaign needs to be taken up. This is necessary in the long run to create a market for the same since there is a strong demand of mechanization due to very low availability of labour in almost all the districts.

Table 8: Mechanization status in various areas

Districts	Pugmill	Moulding machine	Fly ash	Others
Jharsuguda	No	Yes	Yes	No
Sambalpur	Yes	Yes	Yes	No
Sundergarh	Yes	Yes	Yes	No
Anugul	No	No	Yes	No
Dhenkanal	No	No	Yes	No
Cuttack	Yes	Yes	Yes	Yes
Jajpur	No	No	Yes	No
Kendrapara	No	No	No	No

Source: Primary Survey

Chapter 3

Energy consumption status

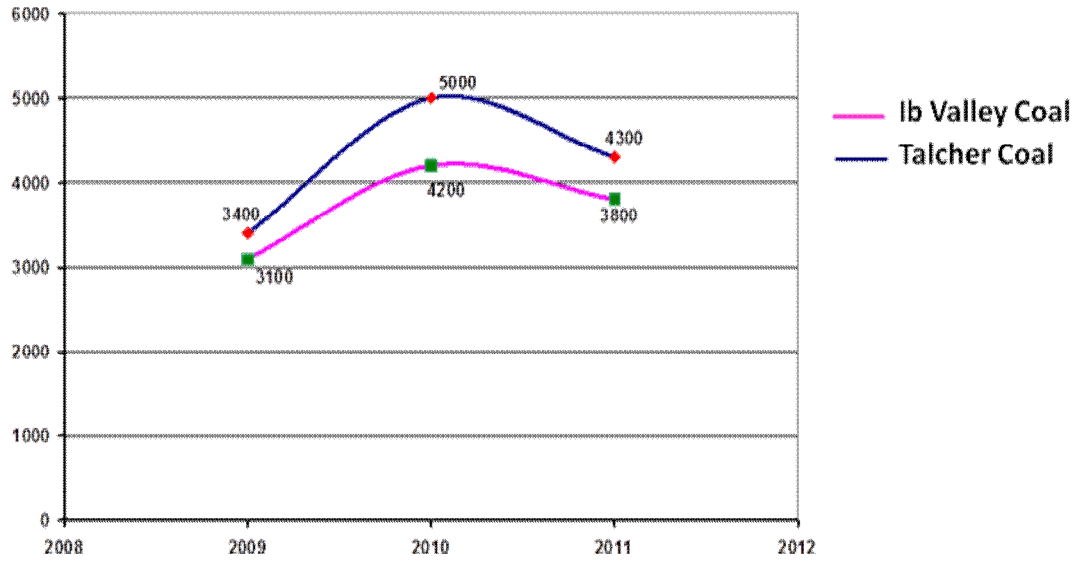
3.1. Energy consumption in the brick sector

Brick firing is an energy intensive process. The annual estimated coal consumption by the brick industry is 24 million tonnes, which represents around 8% of the total coal consumption in India. Besides coal, the brick industry also consumes a large quantity of biomass fuels. The share of fuel in the total production cost of bricks is in the range of 35% to 50%.

In Orissa there are two major coal producing areas belonging to Mahanadi Coal Fields i.e. The IB Valley and Talcher Coal Fields.

For the last 3 years although there has been a general rise in coal throughout the country, the coal prices of Odisha is shown in the graph below.

Trend in energy prices

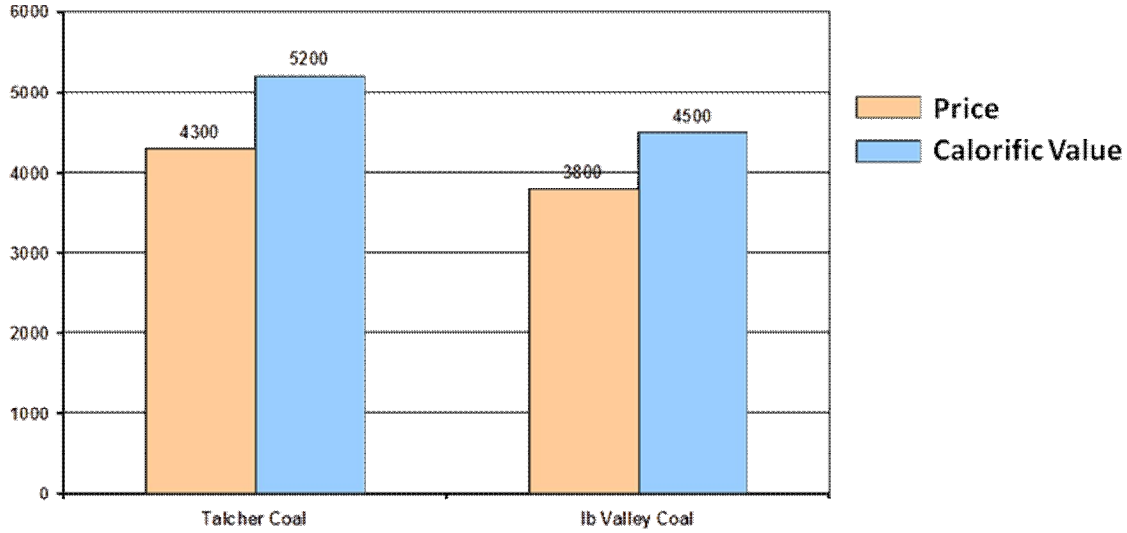


Source: Primary survey

Thus the coal prices over the last year have decreased by more than 10% contrary to the belief that coal price is ever increasing.

It was also observed that there is a considerable variation in coal prices over the two coal fields. However the variation in coal price is not due to the distance of transportation but a matter of quality. The plot of price and quality is shown below in the graph.

Coal quality and price



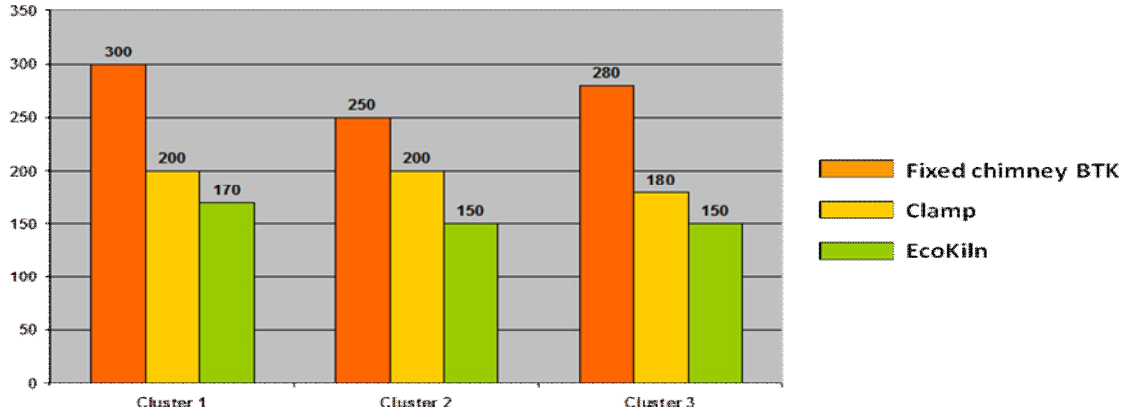
Source: Primary survey

The above bar graph shows that the Talcher coal has high quality and high price compared to Ib valley coal that has low quality and low price.

The coal consumption was plotted based on various technologies. In all the three clusters, the coal consumption in FCK technologies were always much higher that clamp of ecokiln. The considerable low coal consumption in clamp is due to the use of undisclosed amount of biomass in addition to coal. Additionally the quality of the bricks being produced in clamps are also not upto the mark and fully vitrified compared to the fixed chimney kilns.

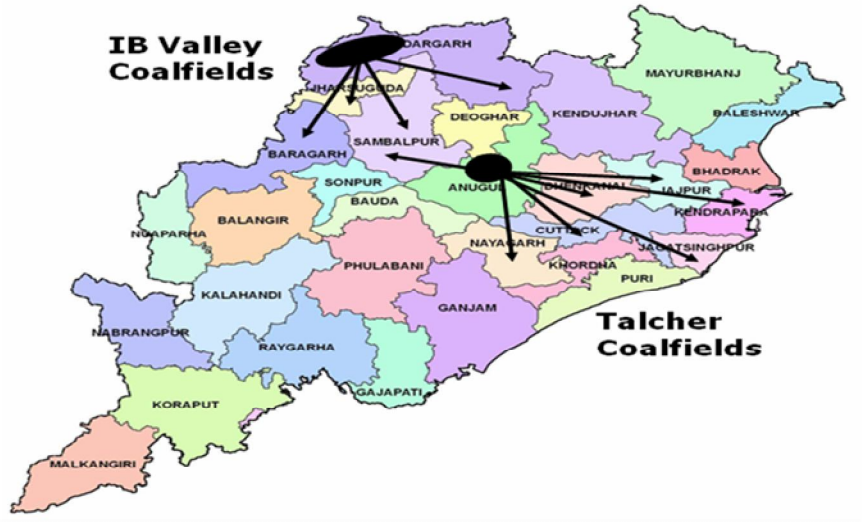
The coal consumption in EcoKiln is almost half that of the fixed chimney. Thus there can be considerable savings in coal consumption and resultant profitability if EcoKiln technology is adopted.

Coal consumption per thousand brick



Source: Primary survey

3.2. Coal distribution for brick production



Source: Primary survey

The above map shows the distribution of coal used in brick making. The IB valley coal field is the energy source for Sambalpur, Bargarh, Jharsuguda and Sundergarh district and the Talcher coal field is the energy source for Sambalpur, Jajpur, Cuttack, Kendrapara and Dhenkanal districts. Thus although the coal price of Talcher is higher, the high calorific value maintains a low fuel consumption compensating the expenses in unit bricks.

Compared to the coal consumption, the energy consumption has also been shown for fly ash brick production in the table given below for various technologies available and practiced in the surveyed areas.

Table 9: Energy consumption (diesel) in fly ash brick production

Technology	Production capacity Brick/hr	Power of motor HP	Diesel consumption Litre/hr
Dash Engineering	650 - 700	43	5.5
Engineer's Enterprises	700 - 750	22	4
TARA Machines & Tech Services	650 - 700	21	4
Ludhiana Tech	600 - 650	32	5

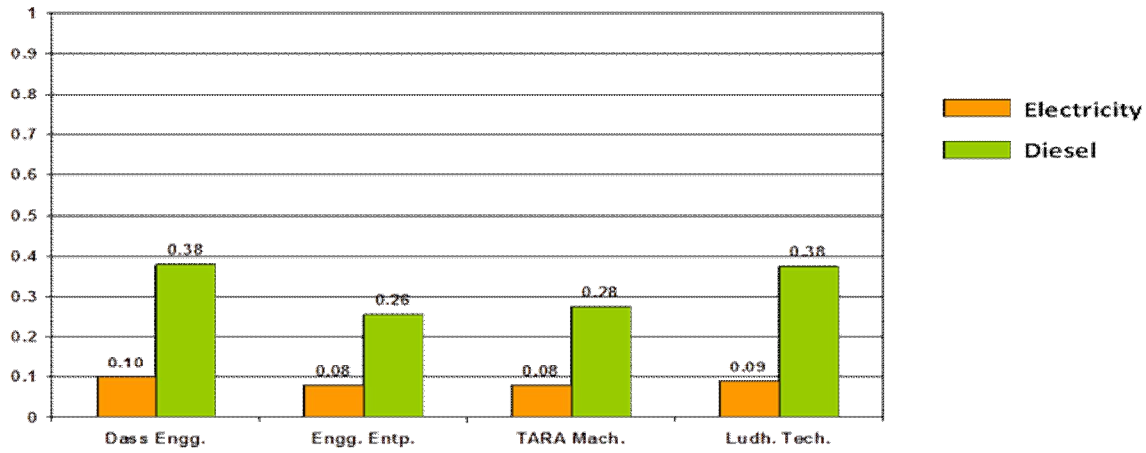
Source: Primary survey

The above table signifies that the energy consumption is also not similar to the technologies being practiced. Out of four technologies surveyed the Engineer's Enterprises is the most energy efficient and high productivity technology. On the other hand Dass Engineering and Ludhiana Tech is the least energy efficient technology amongst all.

Based on the fuel consumption various technologies were also plotted on the average fuel consumption based on surveyed data. Depending upon the present power position in Odisha, the graph shows that electricity cost for fly ash brick production ranges between Rs.0.08 to Rs.0.10 per brick. If machines are operated by diesel for only 4 hours then the energy costs

increases between Rs.0.26 to Rs.0.38 per brick. It can also be seen that power cost for Dass Engineering technology and Ludhiana technology is high compared to other technologies.

Energy cost per fly ash brick production (INR)



Source: Primary survey

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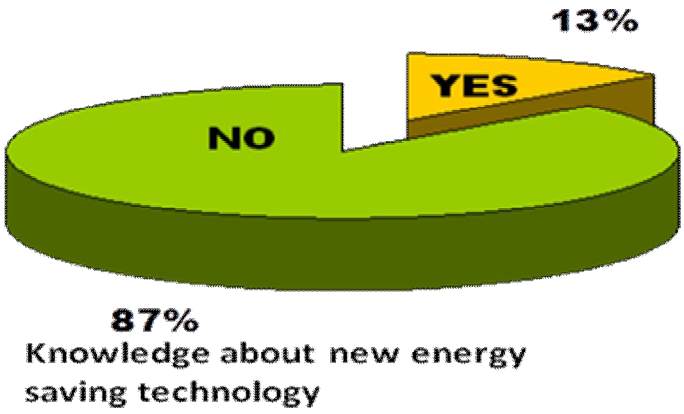
Chapter 4

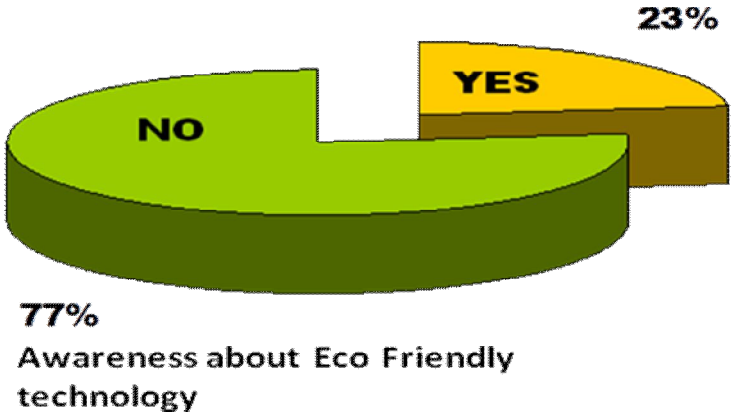
Environmental issues

Brick making has been identified as one of the most polluting industries in small scale sector by the Central Pollution Control Board (CPCB). These brick kiln units are estimated to consume 24 million tons of coal per year along with huge quantity of biomass fuels and emitting 42 million tones of CO_2 every year. Apart from air pollution, brick industry also consumes a large quantity of top soils, which is estimated at 350 million tonnes per every year.



Source: Primary survey

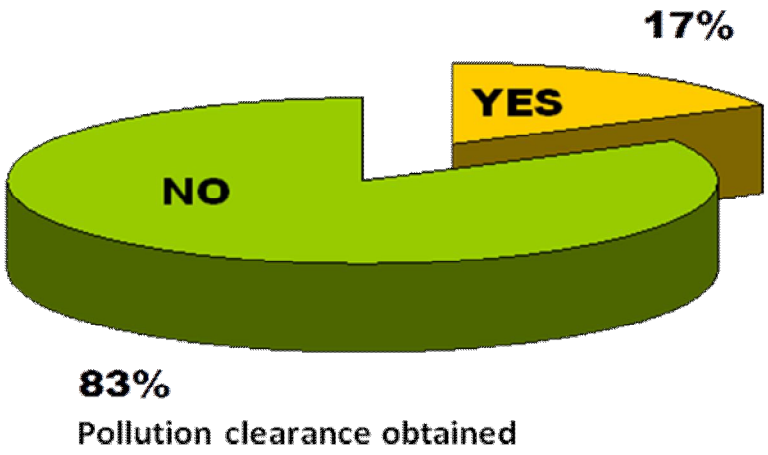
The above pie chart shows that majority (87%) brick kiln owner have no knowledge about new energy saving technology and only 13% entrepreneur have idea about new energy saving technology.



Source: Primary Survey

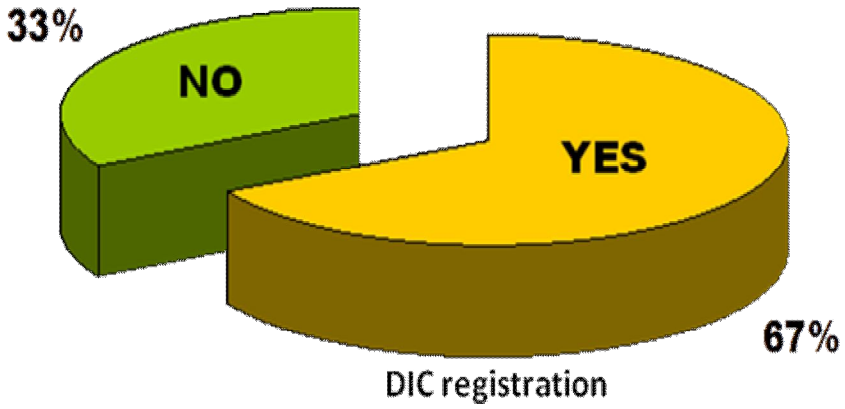
The above pie chart shows that majority (77%) brick kiln owner have no awareness about eco-friendly technology and only 23% entrepreneur have awareness about eco-friendly technology.

Statutory clearances



Source: Primary survey

The above pie chart shows that majority (83%) brick kiln owner have no pollution clearance certificates but still they are operating their brick kiln and only 17% entrepreneur have obtained pollution clearance certificates.



Source: Primary survey

The above pie chart defines that 67% brick kiln owner have registered at DIC and 33% entrepreneurs not registered at DIC.

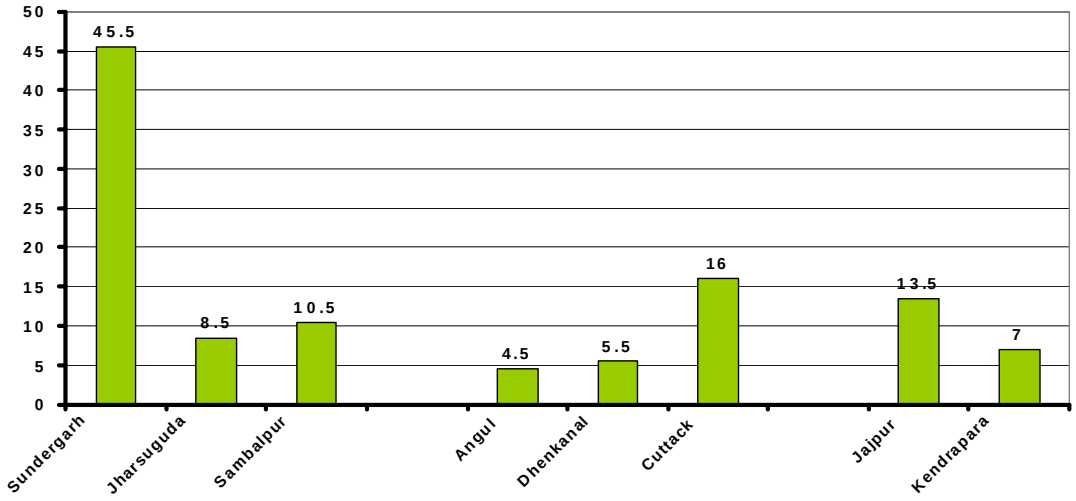
Thus based on the surveyed results it is apparent that even at this modern age, there is a scarcity of information flow amongst brick entrepreneurs. Thus if initiatives can be taken for information flow to all sectors of brick industry, then there might be improved uptake of cleaner brick production technologies. Most of the entrepreneurs have also not taken any pollution clearance maintaining the belief that brick sector is still an unorganized industry inspite of the various initiatives taken by the Government.

Chapter 5

Market trends

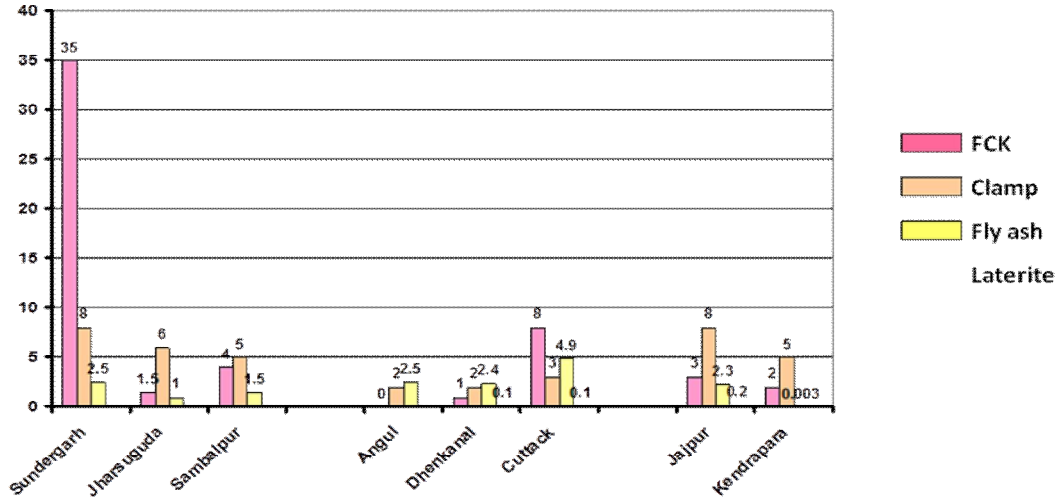
5.1. Brick production per year

The annual brick productions in the surveyed clusters are given in the graph below. Sundergarh district produces the highest bricks out of eight districts annually which accounts for 45.5 crore followed by Cuttack 16 crore, Jajpur 13.5 crore. Angul district has lowest brick production which stands at 4.5 crore per annum. Thus based on the survey it is proposed that all activities be concentrated in Sundergarh district to create impact at the shortest possible time.



Source: FGD with brick entrepreneur and builders

The total brick production has also been segregated based on the available products also. It is surprising that in Sundergarh district FCK has the maximum share of clay bricks. Thus it is proposed that clay brick promotion and use of internal fuel be demonstrated in Sundergarh.



Source: FGD with brick entrepreneur and builders

5.2. Product demand

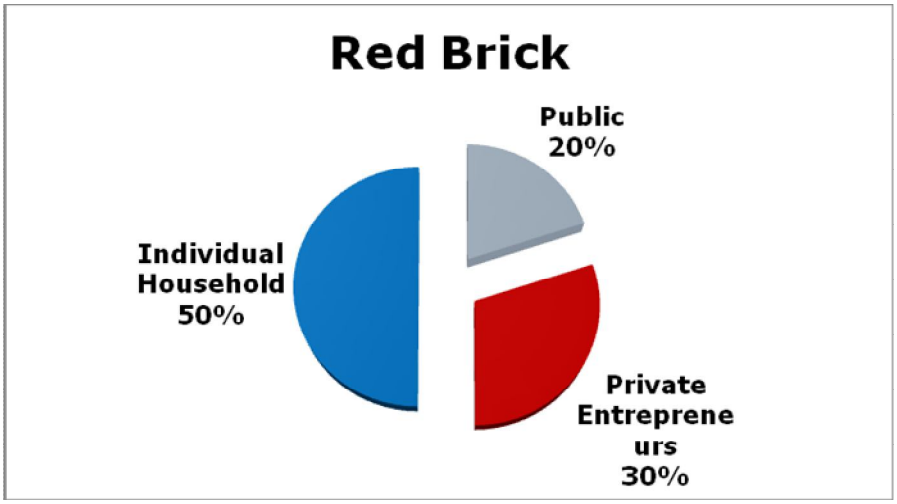
The table below gives an idea of the demand of various types of products both in the urban and the rural market. As expected due to greater purchasing power and availability fly ash bricks are a preferred choice in Cluster 1 of Sundergarh-Sambalpur. Depending on the availability and quality fly ash are also preferred in Angul-Talcher belt. However broadly clamp bricks are not the preferred choice either in urban or rural areas. Although FCK bricks are preferred in rural areas, trend in both rural and urban areas are shifting towards fly ash brick use.

District	Urban			Rural		
	FCK BRICK	CLAMP BRICK	FLY ASH BRICK	FCK BRICK	CLAMP BRICK	FLY ASH BRICK
CLUSTER 1						
CLUSTER 1						
CLUSTER 1						

	High demand		Medium demand		Low demand

Source: FGD with brick entrepreneur and brick consumers

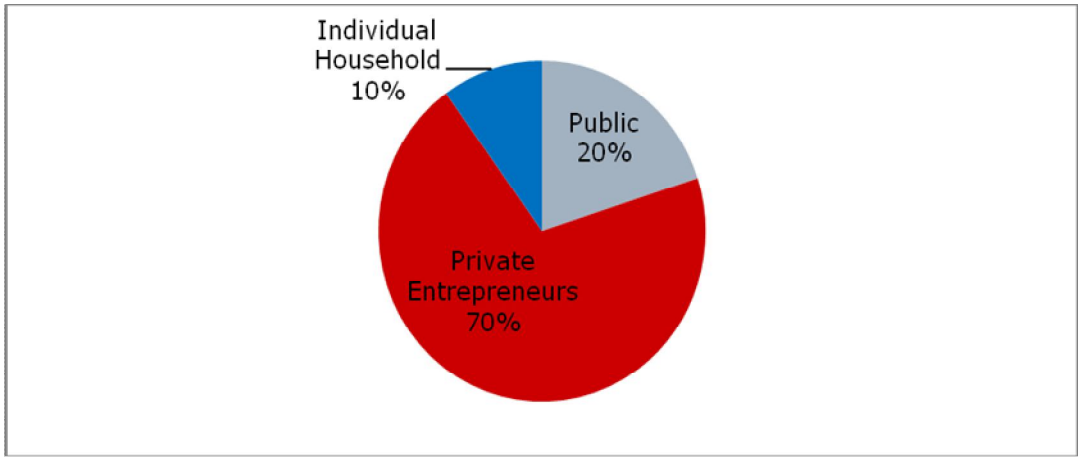
5.3. Consumer profiling



Source: Primary Survey

The above pie chart shows that individual household has highest share of clay brick consumption (50%) followed by private entrepreneur using around 30% and state and other government accounting for around 20% of the total red brick consumption.

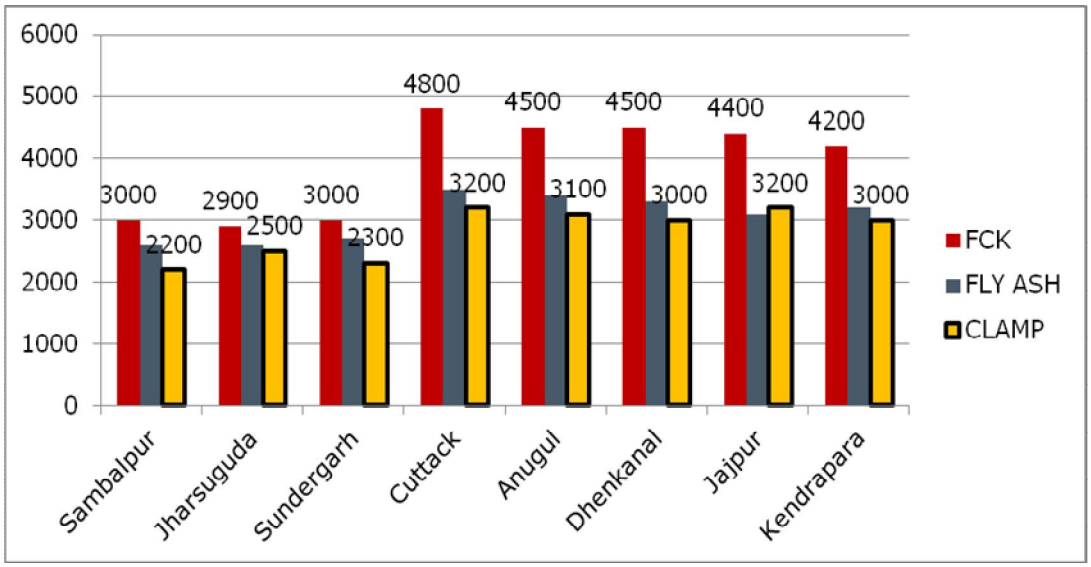
Consumer profiling: Fly Ash Brick



Source-Primary Survey

The above pie chart shows that private entrepreneurs has highest share (70%) of total fly ash brick followed by public (20%) and individual household (10%) out of total fly ash brick consumption.

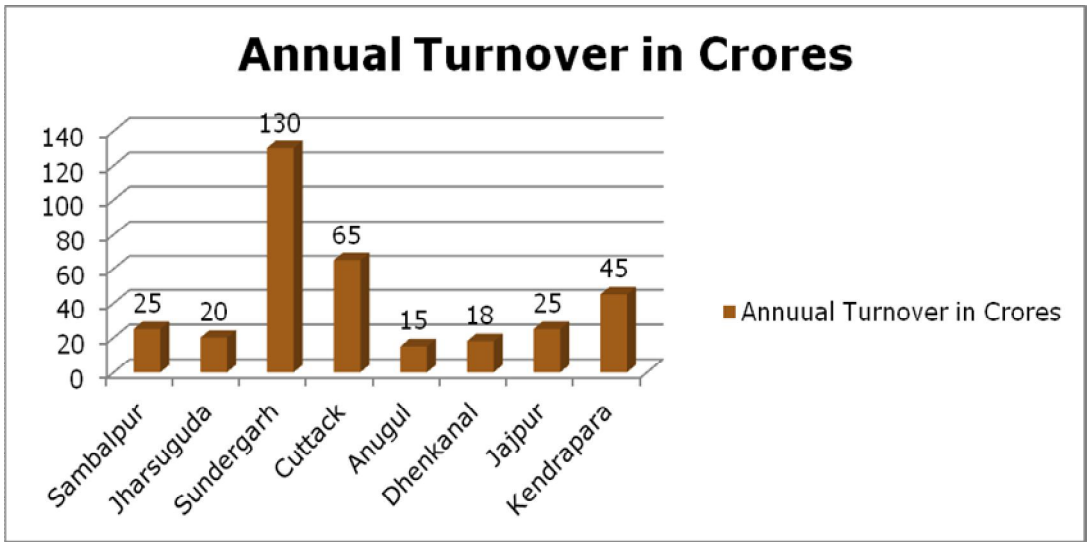
5.4. Product pricing



Source: Primary Survey

According to above bar graph the price of the FCK bricks are highest in Cuttack district followed by Angul, Dhenkanal, Jajpur and Kendrapara. However in Sambalpur, Jharsuguda and Sundergarh the brick prices are comparatively lower than other areas. The price of the fly ash brick is highest in Cuttack district and lowest in Sundergarh district.

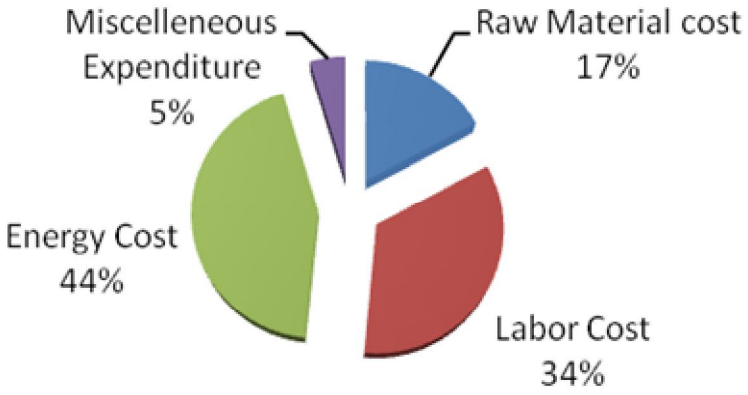
The below bar graph shows that Sundergarh district has annually highest brick turnover which is estimated as Rs.130 crores due to highest brick production. Angul has lowest brick turnover out of the surveyed eight districts.



Source: FGD with entrepreneur

5.5. Profitability analysis and trend

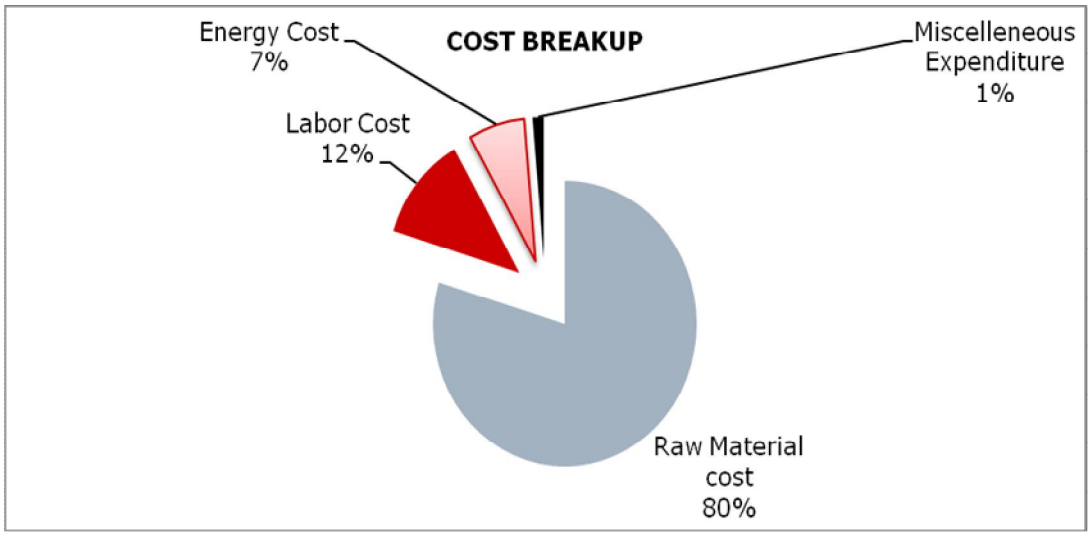
Red brick production



Source: Primary survey

The above pie chart shows that energy cost is the major component of red brick production which comprises 44% of the total production cost.

Fly ash brick production



Source-Primary survey

The above pie chart shows that raw materials cost is the major component of red brick production which comprise 80% of the total production cost.

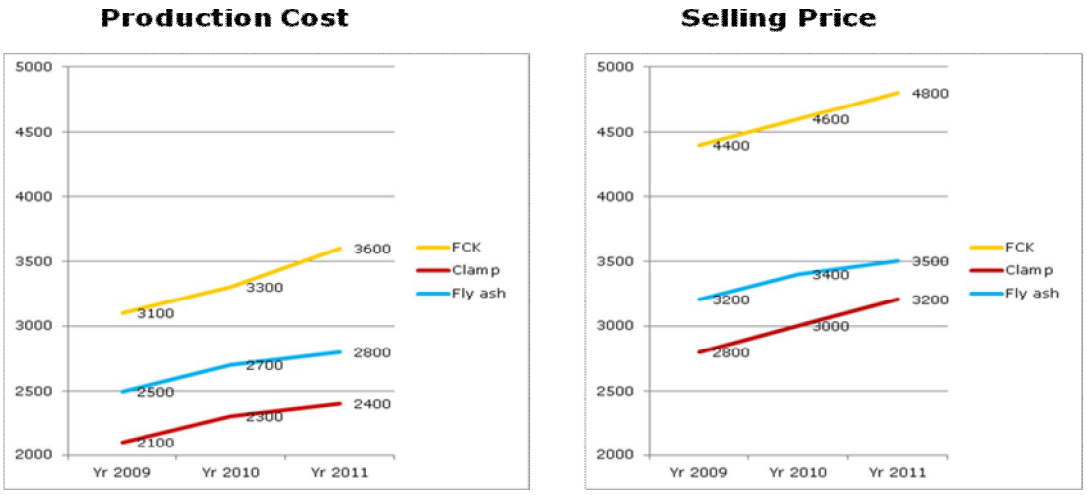
Trend in production cost and selling price

Cluster-1

Source-Primary Survey

Above line graph shows that the production cost trend of FCK brick has increasing at a faster than Clamp and fly ash brick. In another graph selling price of FCK brick is not growing at faster as production cost grows. So it is important information for FCK brick entrepreneur to adopt energy efficient technology.

Cluster-2



Source: Primary survey

Above graph shows that the production cost trend of FCK brick has increasing at a faster than Clamp and fly ash brick but compared to other graph shows selling price of fly ash brick is not growing at faster as production cost grows. So the fly ash entrepreneurs need to reduce the production cost to survive in the market.

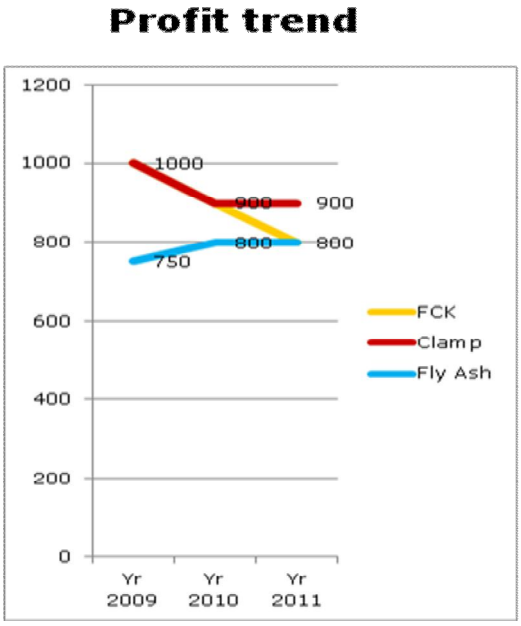
Cluster-3

Source: Primary Survey

Above line graph shows that the production cost trend of FCK bricks has been increasing at a faster rate than Clamp and fly ash brick. However the selling price trend of FCK is not growing compared to fly ash. Thus Cluster-3 has more potential for fly ash bricks.

Profitability trend

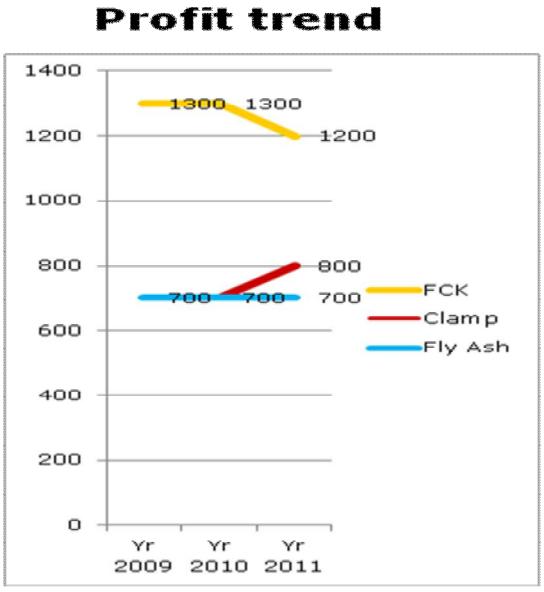
Cluster 1



Source: Primary Survey

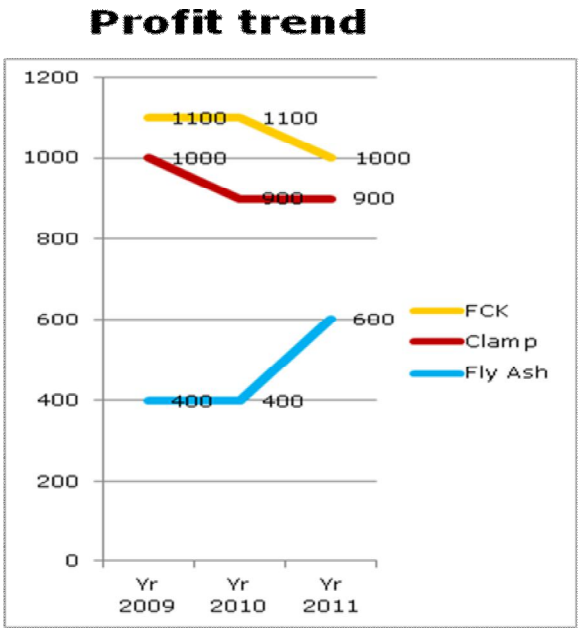
Above graph signifies that profit margin in both FCK and clamp is gradually decreasing but profit margin is increasing in fly ash brick.

Cluster-2



Above graph signifies that profit margin in fly ash brick is also stagnant over last three years. Margin in FCK is gradually decreasing but profit in clamp is increasing.

Cluster-3



Source: Primary survey

Above graph signifies that profit margin in fly ash brick is more compared to FCK and clamp bricks so here are the opportunity for fly ash brick entrepreneurs.

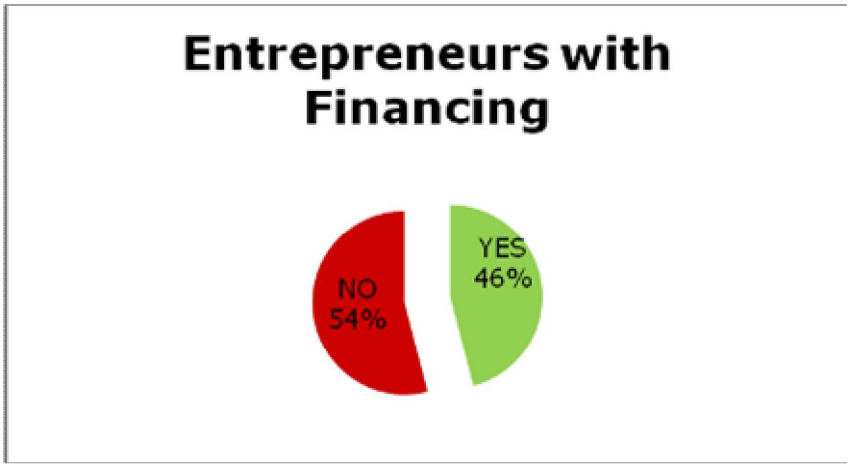
Thus it has been a general trend that production costs of clay bricks is increasing with lower price realization. Thus profit margins in clay bricks are decreasing whereas those in fly ash bricks show an increasing trend. Thus the trend shows clearly that fly ash bricks are going to be the most preferred choice in terms of price in all types of construction activities.

Chapter 6

Financial regime of the brick sector

There is lack of awareness and knowledge among brick kiln entrepreneurs necessary to prepare project reports/documents for seeking loans from financial institutions/banks. The credit-worthiness of brick kiln entrepreneurs is also not very favourably viewed by banks. At present, there is no tailor-made financial instrument available to brick kiln entrepreneurs for investing in technology up gradation. Higher transaction costs are envisaged by individual brick kiln entrepreneurs for developing markets for resource efficient bricks. These financial barriers are responsible for brick kiln entrepreneurs not investing in technology up gradation and by banks related activities.

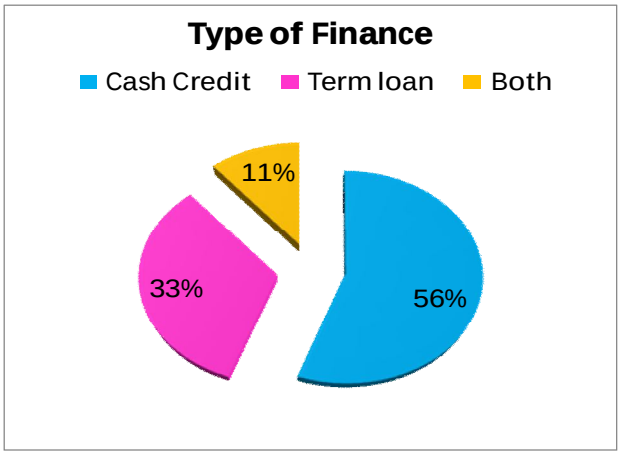
6.1. Finance mapping



Source: Primary survey

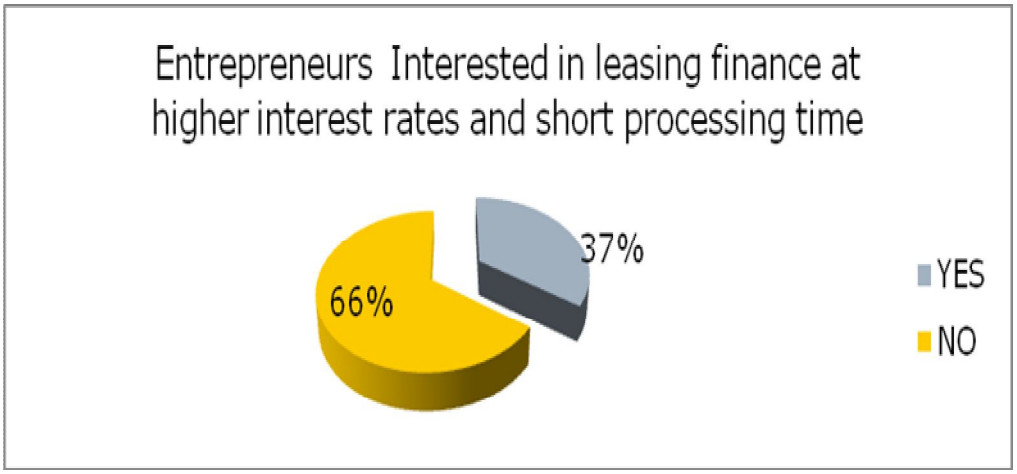
Above pie chart shows that majority of brick kiln entrepreneurs do not take any sort of bank financing. They borrow money from informal sources like friend, relatives and money lender at higher interest rates. Some of them also start business by selling their own land and jewellery.

Type of Bank Finance



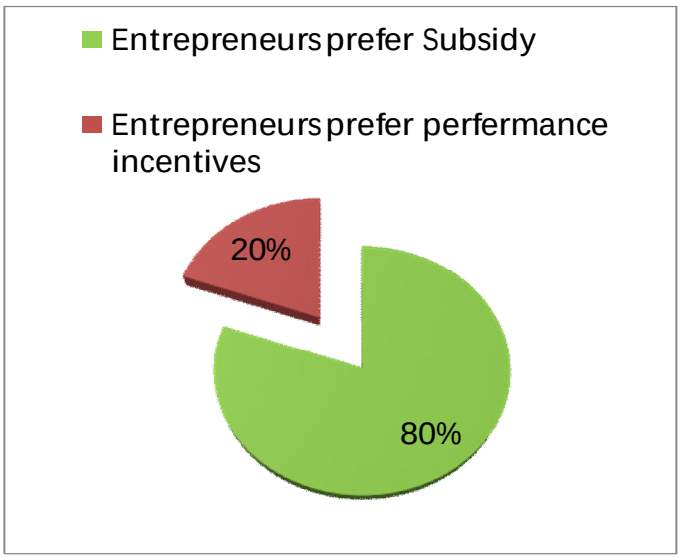
Source: Primary survey

According to above pie chart majority (56%) of entrepreneurs have taken cash credit (working capital) loan.



Source: Primary survey

Above pie chart shows that majority of entrepreneurs are not interested in leasing finance at higher interest rates and short processing time.



Source: Primary survey

Above pie chart shows that majority of entrepreneurs have a preference over subsidy and does not prefer performance incentives. This is obvious of the mentality of work less and get more.

6.2. Subsidy mapping

Generally the State and Central Government promote cleaner brick production technologies by providing subsidies to entrepreneurs. Prime Minister's Employment Generation Programme (PMEGP) is one of the scheme which is promoted by MSME, Govt. of India.

Implementing agency for PMEGP scheme are given below:

- Khadi and Village Industries Commission (KVIC)
- Khadi and Village Industries Board (KVIB)
- District Industry Centre (DIC)

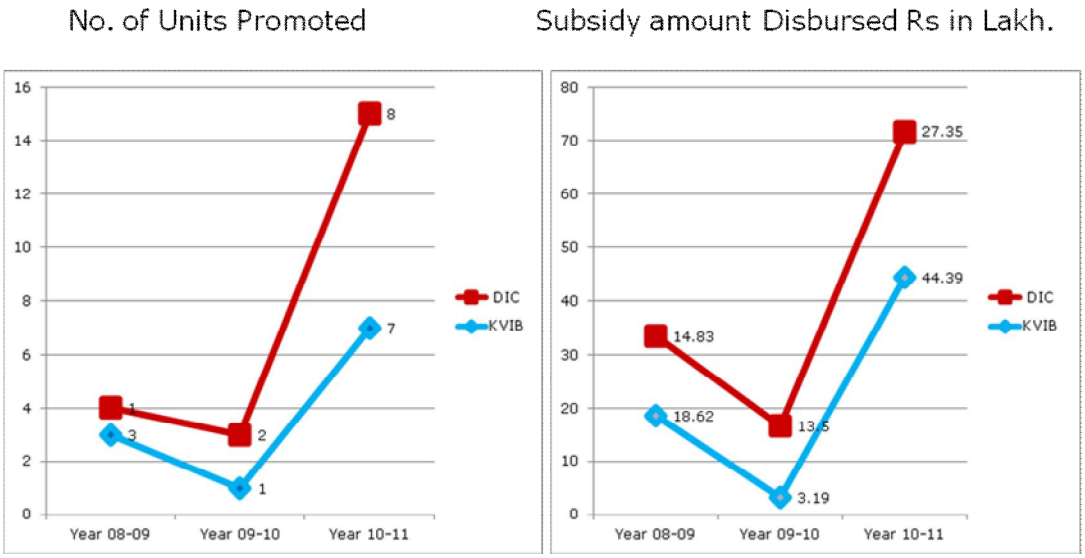
KVIC and KVIB are the implementing agency for only rural area and DIC for both urban and rural area.

Govt. subsidy under the PMEGP scheme

Categories of beneficiaries	Owner's contribution	Rate of subsidy	
		Urban	Rural
General	10%	15%	25%
Special (including SC/ STs/ OBCs/ Minorities/ Women, Ex-servicemen, Physically handicapped)	05%	25%	35%

Govt. subsidy under PMEGP scheme in defined clusters

The graph below shows the subsidies provided under the PMEGP scheme in the surveyed clusters by the Directorate of Industries and KVIB. Thus over the last year the amount of subsidy has increased mainly due to investment in fly ash brick making.



Source: Directorate of Industries and KVIB

Chapter 7

Delivery mechanisms

Technology providers for fly ash brick production

Following are the technology providers of fly ash technology in Odisha.

- Das Engineering
- Engineer's Enterprises
- TARA Machines & Tech Services
- Ludhiana Tech.
- Sakar Engineering

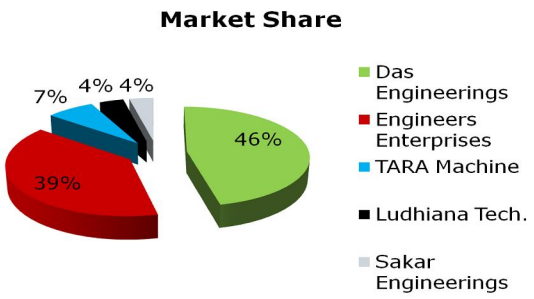
However for EcoKiln technology only TARA Machines and Gram Vikas have been providing the same for the last couple of years.

Service offered by technology providers

Technology provides	Material testing	Design	Material selection	Training	Post prod. support
Das Engineering	NO	YES	YES	NO	YES
Engineer's Enterprises	YES		YES	NO	YES
TARA Machines & Tech Services	YES	YES	YES	YES	YES
Ludhiana Tech.	NO	YES	YES	NO	NO
Sakar Engineering	NO		YES	NO	NO

Source: Primary survey

Market share of various technology providers



Source: Primary survey

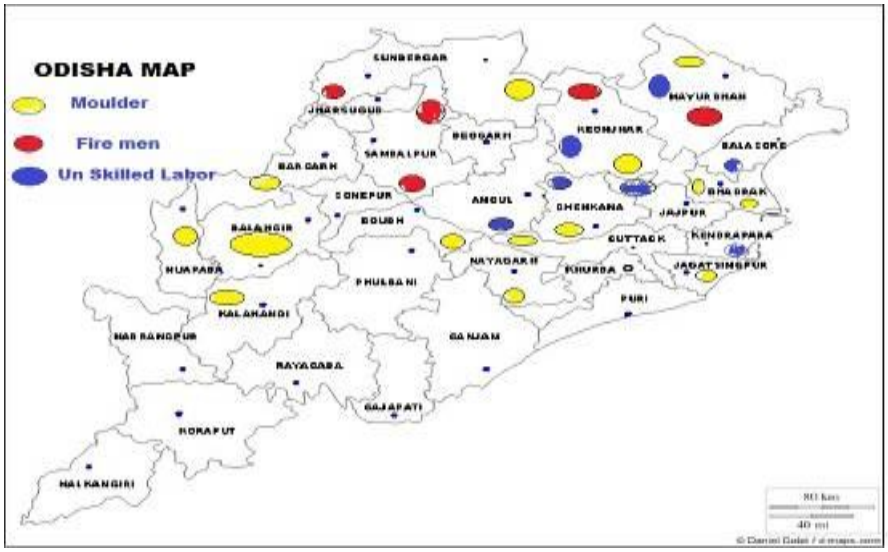
Above pie chart signifies that Dass Engineering have the highest market share compared to all other technology providers due to their base in Cuttack.

Chapter 8

Social issues

The industry is generally clustered and provides employment to approximately 10 million workers nationally. In Orissa also due to lack of industrialization it has been the major hub of brick workers migration both inter and intra state. Good quality moulders from Bhadrak have been traditionally moving all over the country for brick moulding. Kiln labourers are from traditional places like Bolangir, Kalahandi. There are various categories of workers working on brick kilns, moulder, the firemen, unloaders and workers which handle ash (rabish).

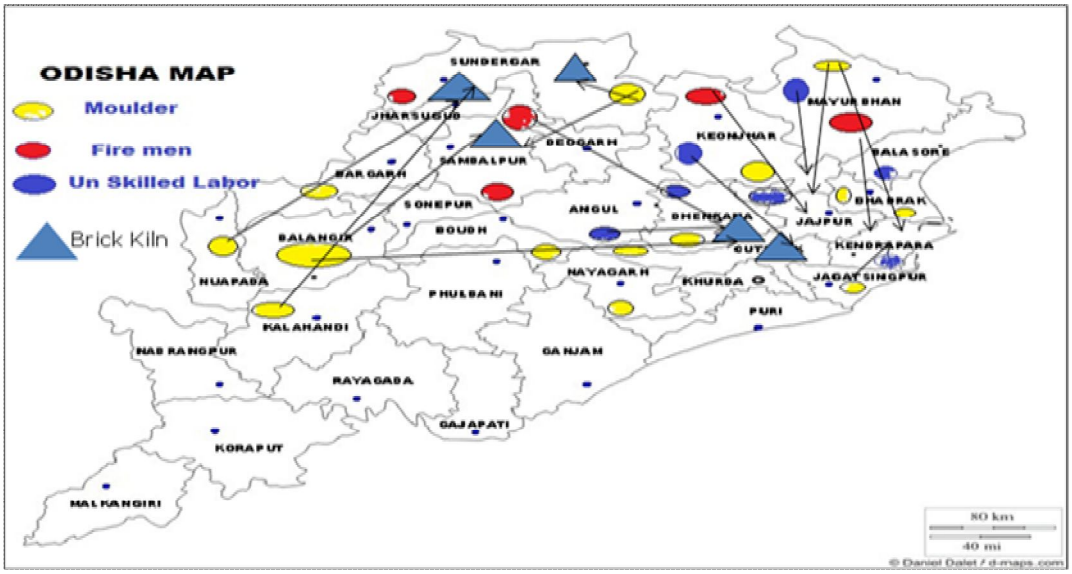
Labour source mapping



Source: Primary Survey

Majority of the migrant workers were young in age, illiterate or having low level of education and belonged to SC/ST, large number of whom came from big families. They have been living in extremely dusty and unhygienic accommodation without water and electricity supply arrangements. The brick kiln workers were not at all aware of the inter-state migrant workmen Act 1979, and other labor laws. A better employment opportunity is the first and most significant factor with maximum percentage of variance, which motivates the workers to migrate.

Labour migration mapping



Source: Primary Survey

Causes of migration

Economic factors

Low agricultural income, agricultural unemployment and under unemployment are considered basic factors pushing the migrants towards prosperous or dynamic areas with grater job opportunities. Even the pressure of population resulting in a high man-land ratio has been widely recognized as one of the important reasons poverty and rural out migration.

Demographic factors

Differences in the rates of population increase between the different regions of a nation have been found to be a determinant in the internal migration. Fertility and the natural increase in population are generally higher in rural areas which drift the rural population towards the city.

Socio-Cultural factors

Social and cultural factors also play an important role in migration. Sometimes family conflicts, family conflicts, the quest for independence also cause migration especially, of those in the younger generation

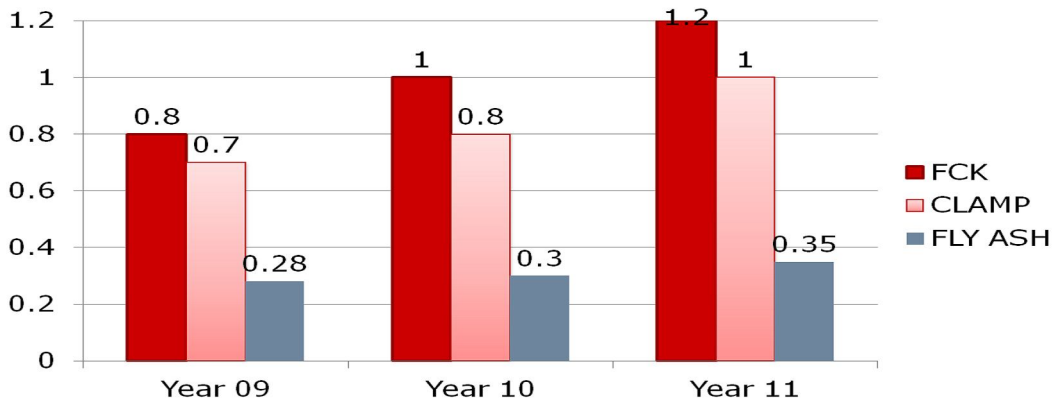
Political factors

Sometimes even political factors encourage or discourage migration from region to another. For instance, in our country the reservation of the jobs for “sons of the soil policy” by the state government will certainly discourage the migration from other states.

Miscellaneous factors

In addition, a number of other factors, such as the presence of relatives and friends in urban areas who mostly provide help factor also responsible for migration

Technology wise labour cost growth



Source: Primary Survey

Above bar graph shows that FCK and Clamp are high labour intensive technologies. However due to increased mechanization and requirement of unskilled workers, the growth of labour costs in fly ash technology is not very high.

Thus it is predicted that in coming years those technologies will be preferred which are less labour intensive and does not require very skilled work force.

Chapter 9

Key issues in brick sector

Government regulations and various promotional efforts by different agencies have so far had limited impacts on Indian brick industry both at the technology used for producing bricks and the types of bricks produced. There are several barriers for adoption of environmentally friendly technologies and practices which include:

- Lack of a comprehensive modernization program with associated support measures from the government.
- Lack of knowledge and access to the energy efficient technologies
- Lack of access and tailor made financial instruments to finance the modernization and up gradation of the brick industry.
- Lack of awareness of energy-environmental issues among the brick manufacturers and consumers.
- Currently poor markets for new types of bricks (resource efficient bricks such as fly ash bricks, concrete blocks).

Held together the discussed barriers have resulted in a continuation of inefficient production processes with high product costs as well as little end product development. Although market exists with higher value addition these are left to the high end brick makers concentrated in the North Indian belt. Under such conditions, there is a need for a holistic perspective that promotes Indian brick sector.

Some of the key issues in the brick sector are as follows:

Air pollution

Air pollution and particulate emission from brick drying and firing are major concern in today's scenario. The largest air pollutants in brick plants are the particulate emissions, which consist of carbonates, silicates, fluorides, etc. The air pollution in the brick kiln affected areas is about three times higher than the normal. These particulate have direct effect on human health causing serious problems such as asthma and bronchitis.

Beside dust emission, gases are also emitted from brick kilns. The nature and quantity depend on the raw materials, fuel, burning condition, kiln dimension, technology used. SO_2, CO_2, H_2O, NOx, CO, and other volatile organic compounds are emitted from brick kilns. When fuels are burned, most carbon is emitted as CO_2 during the combustion process. Some carbon is released as Carbon monoxide (CO), Methane (CH4) or non-methane hydrocarbons. SO_2 is emitted during the firing process of coal in the kiln. SO2 causes harmful effects on vegetation, living beings and monuments. A small quantity of NOx is generated, when fossil fuel is burnt at high temperature in the kiln. Nitrous oxide (N2O) is produced directly from the combustion of fossil fuels.

In another side Odisha is poised to be a major hub for manufacturing industries, which will lead to the generation of enormous quantities of industrial wastes. In Odisha 70,000 acres of land is being used for storage and disposal of pond ash. Fly ash is freely available in the state. The use of industrial wastes like fly ash, dolochar etc. in brick production can potentially save over 4.6 million tonnes of CO_2 per year.

By concerning the present key issues as mentioned above the fly ash brick production should be adopted for cleaner brick production.

High energy consumption

The building material industry is regarded as a big energy consumer. In India brick sector is the third largest consumer of coal after power plants and steel industry. It consumes 24 million tons of coal per year along with huge quantity of biomass fuels .The fuel costs alone account for almost 30-40% of the production cost of brick making.

The largest energy consumption process in brick making is in the firing process, where the formed clay body is subjected to high temperature. However, the energy consumption during the firing process in the kiln depends greatly on the technology applied.

Loss of agricultural lands

Clay for brick making is obtained from land, which also has an agricultural value, such as rice fields, etc. Minimal impact on agricultural land is possible, if the topsoil removed is returned back to the site after clay removal. But, generally this is often not practiced. More often, once the clay has been removed, the pits and land are abandoned. Occasionally, these pits are used as fishponds. But for practical agricultural purposes, the land is lost forever.

Loss of soil fertility

Loss of soil fertility is another environmental cost borne by the brick units. Essential nutrients like nitrogen, phosphorus and potassium are very low in the fields that have been exploited by the brick industries.

Soil erosion

The soil erosion is caused from the loss of topsoil, which supports the vegetation cover and trees. The excavated soil becomes exposed to the wind and rainfall. Under such circumstances, Raindrops erode the soil upon impact with the ground. The main effects from soil erosion are as removal of nutrients and humus from soil and acceleration in declination of soil fertility.

Chapter 10

Key barriers for acceleration

The barriers that are responsible for stagnation of the brick sector are also inhibiting technology up gradation. The major barriers identified in the Indian brick sector are as follows:

Policy

The existing codes and specifications for building materials are based on traditional brick making and do not meet modern practices and technologies. With the availability of new building materials, these codes and specifications need to be reviewed and modified for large scale production and end-use.

Financial

There is lack of awareness and knowledge among brick kiln entrepreneurs necessary to prepare project reports/ documents for seeking loans from financial institutions/ banks. The credit-worthiness of brick kiln entrepreneurs is also not very favorably viewed by banks. At present, there is no tailor-made financial instrument available to brick kiln entrepreneurs for investing in technology up gradation. Higher transaction costs are envisaged by individual brick kiln entrepreneurs for developing markets for resource efficient bricks. These financial barriers are responsible for brick kiln entrepreneurs not investing in technology up gradation and by banks related activities.

Business skills

The majority of the brick kiln entrepreneurs use traditional methods of green brick production, brick firing and marketing. They lack capacities in regard to modern practices in marketing, business opportunities and kiln management. There is also lack of trained manpower to cope with new technology changes.

Technology

There is limited availability of technology know-how for resource efficient bricks, as very few technology providers are available in the country. With brick kiln operations in India generally being carried out at the small scale level, individual brick kiln entrepreneurs find it difficult to access such know-how.

Awareness barrier

The present level of awareness of entrepreneurs and end-users on modern technologies (machineries) and building products is low. The benefits from the production of resource efficient bricks - such as energy savings, reduction in top soil consumption and air pollution - are also not well known to brick entrepreneurs.

Chapter 11

Role of key stakeholders

A large number of stakeholders will be involved to carry out the objectives of policy through various actions oriented initiatives. The stakeholders include individual brick manufacturer / entrepreneur, brick industry associations at regional and national levels, financial institutions, technology and equipment suppliers, market and policy enforcement agencies, government (both state and central), NGOs, private and corporate agency, research laboratories, international funding agency as well as the building industry and other end users of the brick products.

Brick kiln manufacturer/entrepreneur

- Individual brick kiln units are expected to take an active role in widespread technology adoption, which would lead to the introduction of new and resource efficient products in the market.
- Implementation of improved firing technology as VSBK for reduction of CO_2 emissions.
- Use of Internal fuel such as fly ash, coal dust, rice husk in the process of brick making for consumption of less fuel in firing practices.
- Produce resource efficient brick to reduce the quantity of soil usage.
- Improve the kiln operation, particularly by increasing the draught, improving air control and improving fuel feeding practices, the unburnt can be reduced to a large extent.
- Make small improvement in kiln design, construction and operation which would helps in reduced energy consumption.

Brick industry associations

- District level industry associations will facilitate identification of potential brick kiln units who can adopt technologies for production of resource efficient products through accessing finance from commercial banks/ financial institutions.
- Create awareness among brick kiln units on resource efficient products, and interact with policy makers to influencing relevant policies to promote resource efficient products on large scale.

Banks and financial institutions

- Banks and financial institutions would be involved for providing suitable financing mechanisms for technology up gradation.
- Facilitate new and improve technology by offering financial incentives for application of these practices.
- Develop flexible, customized finance products that address the needs of the entrepreneur and facilitate easy repayment.
- Adopt a more flexible and innovative approach in their credit appraisal norms and encourage entrepreneur to take insurance cover.

Policy enforcement agencies

- Policy enforcement agencies can greatly influence the market transformation process by providing support for resource efficient products, which would help in conserving resources and reducing pollution loads.
- Effectively enforce regulatory measures for planned development.

Technology and equipment suppliers

- Technology and equipment suppliers should help for up gradation of traditional technology and adoption of new technology.
- Share information and technologies with the other stake holders and facilitate awareness creation on new, innovative and sustainable methods of brick making.
- Customize alternate technologies for larger application in locally.
- Promote use of resource efficient brick as far as possible and reduced the use of scarce resource, so that the stress on the natural environment is reduced.

State Government

- Prepare policy guidelines related to energy, environment, natural resource and employment.
- Plan long term programmes and short term strategies to tackle problems in brick sector.
- Review the legal and regulatory regime to encourage increasing or improving technology in brick sector.
- State government should take initiative for utilization of energy efficient brick in government sector through govt. agency.
- Encourage partnership between NGOs/CBOs, private sector, PRIs and Microfinance institution.
- Facilitate training programmes for entrepreneur and workers.
- Facilitates research and development activities through appropriate capacity building programmes.
- Ensure large scale dissemination of government schemes and set up structure for accessing them.
- States should ensure availability of their share in schemes sponsored by central govt.
- If required, State government should make efforts to mobilize resources from exclusively for brick sector development.

Central Government

- Take steps to bring in planning, financial, regulatory, institutional and legal reforms.
- Evolve plans, strategies and parameters for optimal use of available resources including land for sustainable development.
- Develop and enforce appropriate ecological standards to protect the environment and provide a better quality of life.
- Promote research and development on innovative building materials, transfer of technology for energy efficient brick sector.

Civil society

- Facilitate exposure and access of innovative technological and institutional solution for brick sector development.
- A very important role of NGOs is to provide Capacity building and training programmes.
- Facilitate Panchayat to access foreign funds /grants and wherever required, provide services for increased effectiveness and greater work efficiency.

Building industry

- Building industry should use resource efficient brick in their construction work.
- Building industry should help for promotion of resource efficient brick, fly ash brick, and also create awareness among all users.

Chapter 12

Conclusions

Bricks are the main building materials and are used in the construction of residential houses, commercial buildings, canals, dams, etc. The demand for bricks is mainly derived from building construction Indian brick industry is highly unorganized with small scale production units, the numbers in the range of more than 100,000 clusters spread across rural and peri-urban areas in the country. Traditional method of brick making is predominant in this country. The technology used for brick making is stagnant for several decades.

Field study was done in eight districts of Odisha to understand the present scenario of brick industry. The study focus on both potential of clay fired brick and fly ash brick production and usage potential. Odisha is poised to be a major hub for manufacturing industries, which will lead to the generation of enormous quantities of industrial wastes. In Odisha 70,000 acres of land is being used for storage and disposal of pond ash, Fly ash is freely available in the state. The use of industrial wastes like fly ash, dolochar etc. in brick production can potentially save over 4.6 million tonnes of CO2 per year. Although technology options exist, evidence of spontaneous adaption of cleaner technologies and practices is lacking. Some barriers for new technology adoption for fly ash brick making are identified as requirement of high investment, no indigenous technology, no knowledge about benefit of this new energy efficient and cleaner brick products, less local demand and slightly higher price than normal clay bricks.

Hence to solve these barriers State and Central government should take immediate steps for promoting production and usage of energy as well as resource efficient bricks at a large scale. The purpose of policy formulation in brick sector is to suggest improvement and inclusion of other concern action point in the existing policy. For replication of traditional technology, demonstration of modern technology and other market transformation activities such as removal of barriers, stakeholder interaction, awareness generation, capacity building, and implementing best management practices are required.

Chapter 13

Recommendations

1. Brick sector should adopt methods and clean technologies which would lead to improvements in quality and fulfilment of need of good quality construction material market.

2. There should be review of existing policies and formulation of new policies related to energy-resource efficient brick production.

3. State and Central government should give more attention in technology adoption as well as in energy efficient brick production.

4. Active initiatives should be taken by brick entrepreneurs, brick association, State and Central Government to promote fly ash brick making.

5. Financial institutions should support financial related problem for brick kiln entrepreneurs.

6. Different steps should be taken for enhancing public sector awareness on cleaner bricks usage.

7. There should be a monitoring committee to monitor brick sector.

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- http://www.forest.mtu.edu.com

Annexure 1

Survey Questionnaire

Questionnaire (Brick Kilns/ Fly ash units)				
1	Name of the District-		Name of the Block-	
1.11	Name of the Proprietor			
1.12	Address & Mobile no.			
1.13	Years of Establishment-		Years of Operation-	
1.2	**Operation Hours**			
1.21	Hour per day		Operation days in month	
1.22	Months per year		Reason for variation	
1.3	**Technology Specification**			
1.31	Firing technology			
1.32	Per Day Capacity		Yearly Capacity	
1.33	% of breakages		No .of Shafts/chimneys/machines	
1.34	Single pan/double pan mixer with capacity(FA)			
1.35	Ease of use			
1.36	Process followed-mixing,moulding,drying,firing			
1.37	Per day Diesel Consumption			
1.38	Rated power of motor in KVA or HP			
1.39	Monthly electricity consumption in units			
1.4	Equipment used			
1.41	Technology Supplier			
1.42	How do you know about Technology?			
1.43	Costs of the tech.?			
1.44	Service provided by Technology supplier			
1.45	How much charge by tech. supplier in major machinery Problem ?			
1.46	Why you prefer this technology?			
1.47	Any Suggestions regarding Delivery?			
2.1	**Brick**			
2.11	Dimension		Weight	
2.12	Strength		Brand	

3	**Market & Economics(Costs involved)**			
3.11	No. of brick units in District			
3.12	Total brick production in District P.A			
3.13	Which have greater Demand fly ash/ red brick			
3.14	Majority supply in which location ?			
3.15	How far?			
3.16	% of consumers bricks? Public Urban_____ and Public Rural			
	Pvt. Small EPs_____, Med EPs_____,Large EPs _____, Individuals For House Construction			
3.17	What is the increase of sales of your bricks compared to last year ?			
3.18	What is the projected growth of sales for next YR.			
3.19	Production Cost Per brick		Selling price Per brick	
3.2	Marketing Strategy adopted(sold through supplier or direct)			
4	**Finance**			
4.11	Total investment		Own investment/ loan	
4.12	If own investment , from whom with amount?			
4.13	Amount of Capital exp.		Own equity amount_____, Debt amount	
4.14	Amount of Working Capital		Own equity amount _____ , Debt amount	
4.15	If bank loan , how much amount ?			
4.16	Bank interest rate		Bank branch/Distance	
4.17	Repayment years		Duration	
4.18	Documents submitted			
4.19	Issues faced			
	If you take Debt from informal source what is the interest rate ?			
	What do you prefer financing or own investment			
	Reasons for financing/own investment			
4.2	**Subsidy**			
4.21	If subsidy, why you prefer subsidy?			
4.22	Name of the Scheme		Agency	
4.23	Amount			
4.24	Duration		Process	
4.25	Issues			
5	**Environment & Policy**			
5.11	Do you Know about new technology for savings of energy ?			**YES/NO**
5.12	Do you know about eco-friendly Technology?		**YES/NO**	
5.13	Do you want to Modification Of your existing technology ?			**YES/NO**
5.14	Pollution clearance obtained?		**YES/NO**	
5.15	EM1 Obtained	**YES/NO**	EM2 Obtained	**YES/NO**
5.16	Is the unit registered at DIC-Reasons			
5.17	Any other clearance/ Documents			
5.18	Tax to be paid ?	**YES/NO**	If yes how much ?	
5.19	Service tax or VAT ?			
5.2	Difficulties Faced			

6	**Situation Analysis(past , present, future)**	
6.11	Situation on start	
6.12	situation now	
6.13	Challenges faced in social ,technical & financial aspects	
6.14	Failures	
6.15	Solutions for the failure	
6.16	Future plans	
6.17	Benefits of using clean Tech(VSBK/Fly ash)	
	Employment	
	Better social condition	
	Environment	
	Financial saving	
7.11	Whether you have joined in any brick association or not	YES/NO
7.12	What type of benefit do You get after joined in association-	

Annexure 2

List of entrepreneurs surveyed

Sl.	District	Name of Unit	Address	Contact No
Details of MCBTK Entrepreneur				
1	Jajpur	North Way Infra Tech. Pvt. Ltd.	Arat Pradhan, At/PO - Janha, Korei	9437041550
2	Jajpur	Narayan Fly Ash Brick	Arun Singh,At/PO - Benapur, Korei	7377097531
3	Jajpur	Maa Tarini Fly Ash Bricks	Santosh Ku. Behera, At- Panikoili	9437277291
4	Jajpur	Raghunath Fly ash Bricks	Pramod Khuntia, At Chotraypur, Sankh chilla	9338430918
5	Jajpur	Avisek Bricks	Tapan Karmkar, At Dhala, Sankhichila road	9439939057
6	Kendrapara	Maa Gayatri fly Ash brick	K Sahani, Badpalgada, Masaghai	9090228991
7	Cuttack	Gopal fly ash Brick	Patitapaban Swain, At Balikuda, PO. Gopalpur	9238447730
8	Cuttack	ABS Bricks	Manas Ranjan Mohanty, At Imam Nagar, PO Bhairabpur	9437365914
9	Cuttack	M/S Prabha fly ash Bricks	Kanhu ch. Parida, At Trisulia, Near IOC Petrol pump	9861884227
10	Cuttack	Utkal Udyag	Pradipta Biswal, At-Kajalkana, Choudwar	9040875905
11	Cuttack	Mohali fly Ash Bricks	Hemant Mahalik, Bhairabpur, Cuttack	9937070345
12	Dhenkanal	Binayak building centre	Renubala sahoo, AT-Korian, PO-Dhenkanal	06762-228352
13	Dhenkanal	Uday fly ash brick	Prasant ku.Rout, At Panch kana chouk, Dhenkanal	9438394377
14	Dhenkanal	Maa fly ash brick	Ramchandra Nath, At ITAP, PO-Kusupanga	9438773001
15	Dhenkanal	S.K fly ash bricks	Satrughna Jena, Balijhati	9437360982
16	Angul	Sabitri fly ash brick industries	Chendipada, Angul	9776037555
17	Angul	Konark fly ash brick	Dharnidhar Sahoo, At-Banpal, Chendipada	9937794328
18	Angul	Sony ash Bricks	Ashok ku. Mohapatra, At-Sabalvanga, Kumrisingha	9437290689
19	Angul	RFAB Ash bricks	Sukanti Badmali, At/po-Panchmahala, Angul	9853539891
20	Angul	Laxminarayan fly ash brick	Chendipada, Angul	9439870742
21	Sambalpur	Maata Ji fly ash brick	Sanjib Mohapatra, At/PO-Sasan, Rengali	9437059658
22	Sambalpur	Utkal fly ash	At-Majhi palli, Sambalpur	9853159486

23	Jharsuguda	K.P Ash Construction	Anil kumar, At- Boxy Chawk, Jharsuguda	9776452035
24	Jharsuguda	Siddhi Binayak bricks Industries	S.N Pradhan, At-Budhipadar, Po-H.Kaapalli	9338056123
25	Sundergarh	S.K Industry	S.K Tripathy,At-Nua toli, po-old jalda, Lathikata	9437502672
26	Sundergarh	OMM Enterprises	M.Sahoo, At-Bedvyas, Rourkela	9861362082
Details of FCBTK Entrepreneurs				
1	Kendrapara	Durga bricks	Kabindra behera, At-Kenal Bridge, Po-Marshaghai	9937464974
2	Kendrapara	Srikrishna Bricks	Sandipta Biswal,At/po-Balisuan, Via-Kujang	8908254623
3	Kendrapara	Sadguru Bricks	Manoranjan Bstia,At/po-Garjanga, Marsaghai	9437020854
4	Kendrapara	OMM MAA Bricks	Arun ku. Samal,At-Badgan, po-Ashrambalikuda	9439489077
5	Kendrapara	Radha bricks	Ashok ku. Rout,At/Po- Marsaghai	9583942817
6	Jajpur	Jagnnath Bricks	Rabindra Nath Mohanty,At- Madh pur, Po-Rudhia	9937290955
7	Jajpur	DKD Bricks	Dillip ku. Dhal,At/po-Baliposi, via-Jajpur	9938331453
8	Jajpur	Mahaveer Bricks	At- Mulapal, po-Rudhia	9437314592
9	Jajpur	BBD Chimny Bricks	Narayan ch. Dhal,At/Po- Rudhia, Via-Jajpur	9437040557
10	Jajpur	BCB Bricks	Niranjan Samal,At/po-Baliposi, via-Jajpur	9238577873
11	Cuttack	Gopal Bricks	Patitapaban Swain,Balikuda, Po-Gopalpur	9938906987
12	Cuttack	Metro Bricks	Bibekananda Swain,At- Jhanjiri mangala, Cuttack	8270151279
13	Cuttack	KBI Bricks	P.C Sahoo,At- Naranpur, Po-Baligachhia	8658923249
14	Cuttack	Sita Bricks	Sukanti sahoo,At- Naranpur, Po-Baligachhia	9338709509
15	Cuttack	Swaraj Bricks	Pabitra mohan swain,At- Trisulia, Cuttack	958356068
16	Dhenkanal	Kalia Bricks	Bidyadhar panda, Khadgpada	9937259481
17	Dhenkanal	S.R.B Bricks	Bibhutibhusan Dhal, Khadgpada	9937266776
18	Sundergarh	BEST Bricks	Tapan kumar Jena, At-Banguurkela, Bisra	9937201958
19	Sundergarh	SUN Bricks	Shibram Sahoo, At-Jambera, Po-Jabaghat, Bisra	9937108456
20	Sundergarh	PNN Bricks	Prema Naik, At-Kainsara, Po- Bhasma, Sundergarh	9178598265
21	Sundergarh	Maa Bricks	Anakar Nayak, At/po-Jabaghat,Bandhmunda	9337215877
22	Sundergarh	LNT Bricks	Sanatan Naik, At-Kainsara, Po-Bhasma, Sundergarh	9178661186

23	Jharsuguda	BPL Bricks	Ghansyam Modi, At/po- H.Katapalli, Jharsuguda	9437059641
24	Jharsuguda	Leo Bricks	Chita ranjan das, At/po-Marakuta,Jharsuguda	9861046890
25	Sambalpur	Iron Bricks	M.B Gopinathan,At-Pandiapalli, Po-Sasan, Dhankauda	9437051514
26	Sambalpur	K.B.M Bricks	Binod Mishra, At/po- Pithampur, Dhankuda	9938107679
27	Sambalpur	Sona Bricks	Visnu Agarwal, At-Titheipalli, Po-Vishal Khenda	9437121505
28	Sambalpur	R.K Bricks	Raju Agarwal, At/po- Pithampur, Dhankuda	9437050515
29	Sambalpur	B.B Bricks	Mishra Babu, At/po- Pithampur, Dhankuda	9437252642
Details of VSBK Entrepreneurs				
1	Jajpur	BBI Bricks	Sharat Baral	8763104345
2	Kendrapara	Das bricks	Dhrub Charan Das,At- belarpur, Laxminarayan pur	9853104554
3	Jharsuguda	Leo Bricks	Chita ranjan das, At/po-Marakuta,Jharsuguda	9861046890
4	Jharsuguda	Sriya bricks	P.N Parida, pipli mal, po-Belpahar	8984553050
5	Sundergarh	LNT Bricks	Sanatan Naik, At-Kainsara, Po-Bhasma, Sundergarh	9178661186
Details of MCBTK Entrepreneurs				
1	Dhenkanal	S.M Bricks	Bidyadhar panda, Khadgpada	9937622205
Details of Clamp Entrepreneurs				
1	Kendrapara	Rabindra Kumar Rout	At/po-Kasan Anta, Via- Pattamunda	9938473828
2	Kendrapara	Khageswar samal	AT-Balkati, po-Aul	9938128893
3	Kendrapara	Keshab chandra patra	At- Aul Raj bati, Po-Aul	
4	Kendrapara	Abhiram Barik	At-Nagpada, via-Aul	9937496770
5	Sambalpur	Jagnath Mihir	AT-Ramchandra nagar, PO- Rengali	9437136927
6	Sambalpur	Daya sagar	At-Keudi,Po-Rengali	9668202185
7	Sambalpur	Durgarohit Das	At-Ganes nagar,Po-Rengali	9437432478
8	Sambalpur	Kailash Agarwala	At-Jangla, Po-Rengali	
9	Jharsuguda	Amit Kumar patel	At- Ganthiabud, Po-H.Katapalli	9861876172
10	Jharsuguda	Ashok kumar patel	At- Ganthiabud, Po-H.Katapalli	9668255054
11	Jharsuguda	Ramesh Prajapati	At-Gaurpara, Belpahar	
12	Jharsuguda	Rajbhan Prajapat	At-Gaurpara, Belpahar	9583890448
13	Jharsuguda	Rasmi S-H-G	At-Tangarpalli, Jharsuguda	8018656582
14	Sundergarh	Debjani patel	At-Vasma, Sundergrh	
15	Sundergarh	Kailash prajapat	At-Vasma, Sundergrh	9178900109