P-ISSN: 2709-6254	Journal of Development and Social Sciences	April-June 2025, Vol. 6, No. 2
O-ISSN:2709-6262	https://doi.org/10.47205/jdss.2025(6-II)15	[165-179]

Journal of Development and Social Sciences
www.jdss.org.pk

RESEARCH PAPER

Logistical Analysis of Traditional Red Brick Kiln Industry of North Sindh, Pakistan

[1]Dr. Siraj Narejo*, [2]Dr. Akram Ali Shah and [3]Dr.Muhammad Qabil Dayo

1. Assistant Professor, Economics, Government Degree Science College, Gambat, Sindh, Pakistan
2. Assistant Professor ,Economics, Government Mumtaz College , Khairpur Mir's, Sindh, Pakistan
3. Assistant Professor, Economics, Government Boys Degree College, Ratodero, Sindh, Pakistan

***Corresponding Author:** Ksks.narejo1987@gmail.com

ABSTRACT

This research paper purpose is to check impact of brick logistical supply chain management on the final house value. There are eight sreps to "finished house" starting with "procurement of clay" at kilns. Model is simple multiple linear regression using SPSS. North Sindh is traditionally and culturally very rich region. For them onstruction is also a fun activity. They want to construct houses , such research is need of time to tell them what factors are responsible for construction of their sweet home. Purposive sample randomly selected is used and only three districts of North Sindh are chosen i.e. Khairpur, Sukkur, and Larkana. Traditional red brick kilns are divided into three categories by scholar based on production level , infrastructure, land area and annual operating time. Sample of random 90 kilns , 100 households , 200 local middlemen , labour and brick sales men were taken. Data is all ordinal and interval. Focus is cross sectional brick industry chain management analysis. Value is added at end of each of the eight steps when clay goes through transformation into shape of final house. House demand is affected by the time, duration, cost, etc at each of eight steps of brick making. 10000 bricks is set as standard at each level. (house made of 10000 bricks). Clay cost is taken as base. Land, fuel, transporter, Jamadaar, kiln management and sales agent add value to clay gradually by making bricks. Highest value is added at stage when house is finally sold. Labour adds least value to 10000 brick house. In the end all costs of players are observed in final house sales price or value. Model is valid as at least two variables are significant at adjusted R^2 value of 0.299. It means there is impact of brick logistical supply chain management on the final house value. It is recommended to increase value of labour that adds least value to 10000 brick house. BCR is least for small kilns so should not be taxed.

KEYWORDS Kiln Industry, Red Brick, Kiln, Clay, Value Addition, Logistics, Kiln BCR, Kiln Value Addition, Kiln BCR

Introduction

The The basic unit of manufacturing in construction industry is kiln. Kiln is place where construction seeds/inputs are prepared in the form of red bricks. Brick Kiln industry needs inputs and further wants to sell final finished product i.e Red Brick.

- Procurement of fuel, transport ,labour, and clay
- Re Order Point,
- Break Even Point sales,
- Role of Transporter
- Role of middlemen in value chain
- Benefit Cost Ratio
- Value added Ratio

Procurement of inputs i.e. clay, fuel and labour, is the start of the value chain. It requires resources (monetary) to procure / purchase these inputs on specific time during production process at kiln. It is time sensitive.

Clay is usually procured from local land owners / farmers. They sell clay of their fertile land to kiln management on fixed terms. Kilns dig (or get dug) clay and transport it on site themselves. But there is carrying cost and holding cost associated with clay input procurement and inventory management.

Fuel is of different types / qualities. The fuel usually burnt at kilns is husk of mustard or rice (locally called *Tootar* and *Furt*). The fuel price also depends on time of crop harvesting (supply and demand of fuel). Fuel is stored for future by Fuel selling middlemen. *Larkana* is the center of kiln fuel procurement.

Labour procurement is the most difficult job for the kilns. Some kilns procure labour not locally. Non local labour travel from Khyber Pakhtunkwa or Baluchistan for a season or specific contract time period. They reside on the kiln site. *Jamadar* is the *theekdar* of all the procured labour. He gets percentage of their wage in return.

After acquiring inputs (LLK) kilns apply management / entrepreneurial skills and bakes final product in the form of bricks. Usually brick making is the main activity at kilns. This is transformation of all inputs into output.

FOH (Factory overhead) is the cost of production other than Direct Material and Direct Labour. it includes costs of chokidaar (security), waste, advertisement, marketing, utilities, tax, depreciation, insurance, theft and legal fees.

Inventory is stored at kiln site until sold. There are costs associated with inventory management, i.e. theft, rain spoilage, Bhelli bricks, etc. there are Carrying and Holding cost associated with inventory (products) made at kilns. Kilns sell by FIFO method.

Production cycle tells about conversion of inputs (raw materials) into products (finished goods). Production at kiln is done in lots/batches.

Operating cycle is about getting inputs , converting them into product, selling them and finally receiving cash. This is all connected. Kilns are organizations having a lot of accounts receivables and accounts payables.

Kilns can earn more revenue by not selling product (bricks) to sales agents (middlemen). They can sell directly to consumer bypassing sales agents. Revenue increases by selling directly to consumers. Kilns can also earn by renting or non operational usage of their tractor trolleys , etc.

Kilns manufacture bricks but don't sell directly to house builders or end consumers. Here middlemen or sales agents are involved. They purchase brick kiln inventory. Purchasing by sales agents is of two types

- On spot contract (locally called *Thado*)
- Advance contract

Kilns are usually at loss because they don't sell directly to consumers. If they sell directly they will earn more profit as well as they can earn from the operation of tractor trolley (i.e. saving from transport cost)

Kiln industry Middlemen: There is greater role of middlemen in brick kiln industry. Main player in the chain is kiln. It acquires raw input in the form of land, labour, capital, fuel, etc, and sale the final product i.e. brick to sales agents. Sales agent is the main

middleman in whole chain. Middlemen of the brick kiln industry include clay, fuel, labour, transport and sales middlemen.

Clay middlemen: They are not farmers who allow kiln management to dig clay from their land through contract. They function as middlemen between kiln management and farmers.

Fuel Middlemen: they buy fuel from local farmers and sale in the time of need to kiln management. In this way they earn money.

Labour middlemen i.eJamadaar: they are responsible to make available labour and get them work too according to work quotas at kilns.

Transporter middlemen: their work is to make available transport i.e. tractor tolley to bringinputs at kilns and sell/deliver bricks to sales agents/consumers. It costs to procure clay and fuel. Kilns pay for transport cost for all the orders they procure. They deliver order to houses being built. Average distance travel for an order's delivery ranges between 25 km to 30 km. there are two *mazdoors* (labourers) per trolley along with one driver. One driver performs daily two such trips on average.

Sales middlemen: Bricks are sold to agents who deliver orders at the doors of consumers. They do this by receiving order at kiln site and transporting that order directly to consumers. It may not involve bringing bricks inventory at the business place of sales agents. Sales agents get order from kiln and load in their own trolley and deliver directly to place of construction. Sales agents only keep samples of bricks to be sold at site of business / office. They also sale related building material to consumer i.e. sand, *Krash*, *Roro*, etc.

Literature Review

Siriman, 2016 has used Michael Porter model of Comparative Analysis at Hyderabad, is. They have analysed how a value chain is created and sustained in brick industry from producer to consumer, and how value is added to product. Value chain includes bringing product from conception and this includes production phases, delivery and disposal after usage

Pakistan is third largest producer in south Asia. Pakistan urbanization has been increasing at the rate of 10% per annum. This has given impetus to make more and more bricks. (Sheikh, 2020)

Brick making is technical process involving many step i.e. procurement, tempering, moulding, drying/loading, firing and sorting. Kilns function at full capacity during December to March. (Palash Patra, 2015)

Soil is dug to acquire clay for brick making and this cause pits formation. Procurement of clay causes floods in the plains of Nile river around Khartoum. Sometimes this prevents cultivated land to have beneficial sediments being deposited. (Ahmed, 2010; Alam, 2006)

Process of brick making has many steps (Mayuree Das, 2018)

1- Raw bricks making: Patheras are involved I making raw bricks by mixing water and clay in right proportions. They work as family unit. Kiln owner fetch clay from nearby places at the cost of 400-500Rs per trolley. This cost depends on the distance and location of kiln. Sun dries bricks for 2-3 days. Green Bricks, which are dried in sun light.

2- Carriers of dried bricks to storage: Kessarejas are involved in taking bricks to storage place.

3- Arrangers of bricks in line: Load mistrys arrange bricks in a position that is best for burning.

4- Covering arranged bricks with sand etc.: Rabbish men cover bricks with sand dust.

5- burning/ firing bricks: Firemen are the most important labourers at kilns who fire the bricks in the chimney.

6- Carrying fried bricks to storage: Nikashi or Pakkareja take fried bricks out of kiln for final storage.

Rural kilns are usually clamp kilns with energy usage of 1.5-3.0 MJ/kg usually in form of coal. (Rizwan Khan , 2007). Kilns don t work during monsoon time i.e. June to September. (Dey, 2015)

BCR, Gini coefficient, profit, change ratio, cash value of cow dung fuel, and ratio of agricultural activities versus brick making activities are calculated. (Abdalla, 2012; Xu, 2003)

The cost benefit ratio of brick making was 1.25 SDG (Sudanese currency) for every 1 SDG invested. Income from land, per capita, averaged 13 Sudanese Pounds per day for kiln owners and 2.4 Sudanese Pound per day for farmers. Gini coefficient of 0.38 was better equally distributed with kiln owners as compared to farmers. (Abdalla, 2012).

Table 1
Cost and revenue for farms and kilns (in SDG currency) (Abdalla , 2012).

Parameter	Red brickKilnOwners(n= 45)	Urban farmers (n = 15)
Average total return	147229.6	8.267.00
Average total cost	116355.3	3718
average net return	30874.3	4626
Gini coefficient	0.38	0.49
B/C	1.27	2.22
Land Share of total cost	6	29

*SDG(New Sudanese Pound)=0.4US Dollars

Main reasons of Brick kiln industry bloom are cheap raw materials, low land rate, availability of labour, low cost of carrying raw material, and proximity of area to brick market. Big towns are connected by highway (PalashPatra, 2015).

Kiln industry belongs to informal economic sector of Pakistan. (Sohail, 2020). ILO has defined informal economy as economic activity that is not covered or not sufficiently covered by formality in agreements either in practice or law. It is also called as unregulated, non-standard, flexible, grey, unobserved, undocumented, unorganized or dark economy which falls not in the realm of sate enacted observation, taxation and regulations. Kilns are not registered to authorities so as to save taxes. Labourers receive income below minimum wage, live sub standard life and have no right to make union. (Sohail, 2020)

Two types of labour work at kilns when it comes to wage, i.e. underpaid and unpaid ones. Women are usually not paid directly but to their husbands, brothers, etc. This unpaid contribution to informal economy is the largest in this sector. Muster rolls do not include women and child labour even though their work is significant for the kilns. 65% businesses

work in informal economy. 45 million out of 70 million labour force of Pakistan work in informal economy. (Sohail, 2020)

There is a theory von Thünen s theory of a land rent gradient (von Thünen, 1930) which predicts conversion of agriculture land into pre urban land. This theory is proved in Sudan. Land on which kiln is rented is input factor for kiln management while same land is resource for its owner. If land value increases owner will sell it. So increase in land value will cause more pre urban areas around a city. (Sazak, 2004).

Abdalla et al., 2012 have concluded that land owners can either rent to kilns for brick making or agriculture purpose (share cropping). In Pakistan this competition is researched by Ishaq, 2010. It involves change in land use pattern based on its opportunity cost. B/C ratio, for land, is higher for agriculture. But constraints for agriculture production are limited land and higher input costs. BM is providing jobs and its Gini coefficient tells a better income distribution. (Sohail, 2020)

Other players in brick making value chain are NGOs, Labour unions, Government, Human Rights Organization, environmental protection agencies, etc (Siriman, 2016)

Pakistan kilns are less energy efficient and use cheap fuel to make bricks thus there is problem of pollution. (Sheikh, 2020)

Red brick is main product and usually cow dung or fire wood is burnt to produce it. Only 2% of the bricks are manufactured by using fossil fuel. This causes urban GHG (Greenhouse gases) problem as low combustion efficiency of used fuels. (Abdalla, 2012)

Dung was dried and then burnt to find ratio of carbon dioxide and other nitrogenous gases released. (Abdalla, 2012)

Cow dung can be used both for agricultural and brick making purposes. But around Khartoum it is utilized in brick making process only because it is cheap. (Abdalla, 2012)

Costs associated with kiln are labour cost, coal cost, mud cost, rent cost and electricity cost. Kilns are being shut because of high interest paid on initial capital, and rent on land, also lack of mud input, unavailability of advance cash for labour and no trust between labour and owner. There is no availability of formal credit for owners so 90% of them resort to informal credit. Because of this they have to pay high interest rate. And in some studies it is found that 30%of the labour is not bound by any contract so labour leaving in the middle is big problem for owners. (Siriman, 2016)

Construction agencies and individual consumer (Siriman, 2016) influence on labour working conditions at kilns by

- Paying kilns late ,
- Forcing to deliver on time,
- Demanding higher quality,
- Paying in instalments,
- Not depending on one kiln for supply,
- Having short term contracts with kilns,
- Paying low price of bricks,

Kiln industry is labour intensive and is place where unskilled; semi skilled and migrant labour is employed. This industry has generated a lot of job opportunities for locals and migrant labour. Potential of kiln industry to generate jobs stands at 3 million for rural seasonal labour. Every season 3 million people are employed by kilns. But there is shortage of skilled labour. (Mayuree Das, 2018)

The focus is on chain level not on the producer or labour level. Real estate sector is resorting to new techniques to get light weight, durable, capital intensive brick making. In developing countries bricks are made by using old traditional labour intensive ways. (Siriman, 2016)

Research Methodology

Nature: Research is applied. It should be noted that research is restricted to a certain area. A fix area is selected for sampling.Research is limited in the sense that it will revolve around the models already created. And research design is rigid in the sense that it will be used to collect formalized or ungrouped data with already designed research strategies. It is part of three years long doctoral thesis.

Population Participants are from kiln, kiln labour, villages , sales agents and houses constructed in North Sindh. Sampling is non random purposive. Data is all ordinal and interval. Focus is cross sectional brick industry chain management analysis.

Sample size and technique Selected sample size is 90 kilns ,200 labourers ,200 villagers / neighbours surrounding kiln and sales agents, 100 households (people who have recently built houses).

Instrument. Sample survey and face to face interviews are conducted from year 2020 to year 2022. Data is collected by employing local methods of communication (Sindh language), transport, etc. Data for brick production (at kilns) and kiln labour may be difficult to acquire simultaneously. As the wages given to labourers may not be the one mentioned by owners/producers of kilns. These both data streams may contradict each other or biased on participant end. Same happens for data about houses constructed and construction labour. This applied research will be based on limited sample of kilns, labourers, villagers and households of North Sindh, etc .Male to female ratio of the participants may be a bit twisted.

Validity reliability

Results are alternately form reliable when seen in literarture (Sheikh 2020), sampling, surveying, results are similar of North Sindh.

Results as given in this paper are reliable internally With overall PhD doctoral thesis results.

Data analysis technique

Simple multiple regression, ANOVA with hypothesis testing. SPSS statistical software is used.

Data is taken from 4 questionnaires. Participants are from kiln, kiln labourvillages , sales agents and houses constructed in North Sindh. Sampling is non random purposive. Data is all ordinal and interval. Focus is cross sectional brick industry chain management analysis. Following formulas are used to calculate x variables value for the model.

Land providers cost

It is part of FOH cost and is cost of land (i.e. Rent) on which kiln operate. ROL (rent/ownership/lease) status is asked in the questionnaire form 1. What land can contribute to value addition of red brick. Land is place where kilns aoperate. Land is costly.

Clay Middlemen cost

Kiln management acquires clay through local means. They procure one/two jaraibs of local land on tender or contract. Clay upto 2 to 3 meters is dug by machines and

transported to kiln for brick making. Clay procure can be either retail wise or based on contract.

Following formulae are used

Total clay trolleys needed= Total Production/Bricks made from 1 trolley

One trolley weight of clay (maunds)= (Average weight of brick*bricks made from 1 trolley) /40

Note: Average weight of one brick is in kilograms. There are 40 kilograms in one maund.

Maund cost= Biomass rate per trolley/one trolley s clay weight

Annual clay demand= total clay trolleys*one trolley s clay weight

Total clay cost= One trolley clay rate*total clay trolleys needed

Fuel middlemen cost

Fuel is the most important cost at kilns specially for small size kilns. Good quality fuel decreases amount of Bhelli bricks. Fuel used at kilns is of two types. Special fuel is required to start initial fire at the kiln at the start of each *Chakar*.

Data collected for each type of fuel (special and normal fuel) includes fuel type, per *Chakar* fuel, maund per trolley, maund cost and procurement mode.

Following formulas are used to calculate Per*Chakar* fuel trolleys, Total fuel trolleys used at kiln, Cost of one trolley, Annual fuel demand, Per Brick Fuel used, Bricks made per maund of fuel and Cost of fuel. These will be calculated for normal fuel. Fuel demand and cost for the special fuel will be calculated.

Per *Chakar* fuel trolleys= per *Chakar* fuel/fuel maunds per trolley

Total fuel trolleys used at kiln = Per*Chakar* fuel trolleys* Number of *Chakar*s

Cost of one trolley= maunds in trolley* maund cost

Annual fuel demand = per fuel *Chakar**total *Chakar*s

It will be calculated in maunds and kilograms.

Per Brick Fuel used = Annual fuel demand/total production

It will be calculated in maunds and kilograms.

Bricks made per maund of fuel= total production/annual fuel demand

Cost of fuel = Number of fuel trolleys * Cost of one trolleys

Total fuel: It includes both normal and special fuel.

Total fuel cost = normal fuel cost + special fuel cost

Total fuel quantity (maunds) = normal fuel demand + special fuel demand

Total fuel orders = normal fuel orders + special fuel orders

Special fuel demand: It is based on the times chimney is burnt. After completion of a production *Chakar*/ cycle chimney is cleaned and special fuel is used to start fire anew for burning bricks. Special fuel which may be expensive is required to start process of initial fire at start of each cycle. Later normal fuel is used until cycle/*Chakar*/batch of production ends

Average maunds of fuel per trolley = ((Normal trolley Fuel Maunds*Trolleys)+(special trolley fuel maunds* Trolleys))/Total fuel quantity in maunds)

Transporter's cost

Total kiln transport orders= fuel orders + clay orders

Average fuel transport = (normal fuel transport cost*orders+sp.fueltrans cost*orders)/fuel total orders

Average transport cost = (nor fuel tran cost*orders+sp. Fuel trans cost*orders + clay transport cost*orders)/ Total kiln transport orders

Total Transport Cost= normal fuel transport cost + sp. F. t. cost+ clay trans. Cost

Jamadaar's cost in whole brick chain:

Jamadar charges 15-30 Rs per 1000 rupees earned from the kiln labour.

Kiln's cost:

Kiln cost includes FOH (Factory Overhead), maintenance, water, labour spending, etc. their sum is divided with total production and finally multiplied with 10000 bricks to get value addition at kiln level.

Some extra calculations were made, but not part of the model.

ROP (Reorder Point) clay/fuel: This indicator tells about level of clay/fuel which decides reorder point for a kiln. It tells kiln to reorder before it is too late. If this is not heeded by kiln there will be loss to kiln. It can be calculated as

ROP = d*L

(d is daily clay/fuel demand) (L tells about time before delivery or order reaches at kiln)

Daily demand of clay or fuel = annual demand /active days

Break Even point Sales: It is point of sales where revenue equals the costs. It helps kiln to decide for the units or bricks to produce to at least cover all costs. Formula for its calculation is

BEP (Rs) = Fixed Cost / (Total unit price-VC per unit)

BEP (Units) = BEP units * Total unit price. (Unit refers to bricks)

Sales agent cost

Kilns sell data to sales agents. They add value to bricksby selling to consumers. Sales agents have many annual cost i.e. electricity/ solar, petty cost, labour cost, and rent.

That sumis divided by their annually processed bricks and finally multiplied with 10000 bricks.

House construction cost

House data is taken from questionnaire form 3. Consumers get bricks either fromkilnoragents. They have to pay for bricks, brick transport, labour, compliments, substitutes, technology/installation, weather cost etc. That house costs' sum is divided by total bricks used at house and finally multiplied by 10000 bricks.

Some additional calculation are made as BCR and VAR

BCR (Benefit cost ratio) is when benefit is divided with cost at a kiln.

VAR (Value added ratio.) value added to 10000 bricks at each of the 8 steps to finalization of value of clay.

Final Regression Model : Kiln logistical chain management model for North Sindh

Description: This model is simple multiple linear regression model with intention to check impact of different levels of brick processing /costs on the sales price of the house. What is the cost of clay? How value is added at different steps when clay goes through transformation into shape of final house. House demand is affected by the time,duration cost etc at each step of the brickmaking. 10000 bricks is set as standard.

In the end all costs of players are observed in final house sales price or value. So we can examine if there is a relationship among these variables .Relevant costs are only for that amount of bricks which are used in houses (sample quantity). Following table will be generated for regression analysis.

Table 2
Variables used in model

Y	x1	X2	X3	X4	X5	X6	X7	X8
House Value or price	Land providers cost	Transport cost (fuel, clay)	Clay providers cost	Fuel providers cost	Labour providers cost	Kiln cost	Sales agents cost	Consumer / house owner

Value is added at end of each of the eight steps when clay goes through transformation into shape of final house. House demand is affected by the time, duration, cost, etc at each of eight steps of brick making. 10000 bricks is set as standard at each level. (house made of 10000 bricks). Clay cost is taken as base. Land, fuel, transporter, Jamadaar, kiln management and sales agent add value to clay gradually by making bricks. Highest value is added at stage when house is finally sold. Labour adds least value to 10000 brick house. In the end all costs of players are observed in final house sales price or value.

Clay providers add value to clay. It is first value addition step after acquiring land for kiln to operate. Questionnaire form1 gives data about annual brick production along with cost.

Clay cost of 10000bricks= (total clay cost/annual production)*10000

Same formula is applied to fuel providers cost,transporter's cost, land providers cost.

Kiln cost includes FOH (Factory Overhead), maintenance, water, labour spending, etc. their sum is divided with total production and finally multiplied with 10000 bricks to get value addition at kiln level.

Labour procurement is job of *jamadar*.he charges 15-35 Rs per 1000 income on daily basis. This data is taken from questionnaire form 2.

Labour cost= (*jamadar* commission paid annually/annual bricks processed)* 10000 Bricks

Kilns sell data to sales agents. They add value to bricksby selling to consumers. Sales agents have many annual cost i.e. electricity/ solar, petty cost, labour cost, and rent. That sumis divided by their annually processed bricks and finally multiplied with 10000 bricks.

House data is taken from questionnaire form 3. Consumers get bricks either from kiln or agents. They have to pay for bricks, brick transport, labour, compliments, substitutes, technology/installation, weather cost etc. That house costs' sum is divided by total bricks used at house and finally multiplied by 10000 bricks.

SPSS is used for regression.

$Y=a+ \beta_1X_1+ \beta_2X_2+ \beta_3X_{3+} \beta_4X_{4+} \beta_5X_5 +\beta_6X_6+ \beta_7X_{7+} \beta_8X_{8+}u$

Y= dependant variable. X1,….X8 = independent variables. $\beta_{1 \text{ to}} \beta_8$ = coefficients. u = error term, a= intercept

Hypotheses Testing at aggregate level:(Regression model's overall significance is tested)

H_0: $\beta_1 = 0,\ldots..,\ \beta_7 =0$ (i.e. there is no relation between x and y variables at all)
H_1: ≠0 (It means at least one of the independent variables shows a relation with dependent variable.)
H0: Value of house is dependent on logistical supply chain cost.
H1: Value of house is dependent on logistical supply chain cost

Hypotheses testing at individual level :(If significance level is less than 0.05 H0 (Null Hypothesis) will be accepted)

H1: $\beta_1 =0$ (Land provider's cost has sufficient impact on House Value)
H2: $\beta_2 =0$ (Clay provider's cost has sufficient impact on House Value)
H3: $\beta_3 =0$ (clay/fuel transporter's cost has sufficient impact on House Value)
H4: $\beta_4 =0$ (Fuel provider's cost has sufficient impact on House Value)
H5: $\beta_5 =0$ (Labour provider's cost has sufficient impact on House Value)
H6: $\beta_6 =0$ (kiln cost has sufficient impact on House Value)
H7: $\beta_7 =0$ (Sales Agent cost has sufficient impact on House Value)
H8: $\beta_8 =0$ (House owner cost has sufficient impact on House Value)

Ethical considerations

This research paper is part of doctoral thesis. Sample has no any female munshi (kiln manager) out of 90 participants. Local language facilitated data transfer from participants to surveyor (Research scholar).

Data from kiln manager and kiln labour is difficult to acquire simultaneously. As the wages given to labourers may not be the one mentioned by owners/producers of kilns. These both data streams contradict on participant end.

While acquiring data from kiln labour at their villages there were people who objected and were afraid of losing their job. They asked participants to avoid telling scholar their real problems and real data.

Results and Discussion

Table 3
Land rent analysis

	Kiln Area (Acres)	Jraib Annual rate	land cost
Large	5.426471	19764.71	204764.7
Medium	3.571429	20535.71	145333.3
Small	1	16857.14	34785.71

Impact of Kiln ROL status on rent is as

Table 4
Impact of Kiln ROL status on rent

ROL Status	Kilns Q	land cost	Kiln Area (Acres)	Jraib Annual rate
Lease	4	352500	7.125	25000
Owned	54	125611.1	3.351852	18481.48
Rent	32	167500	4.34375	21015.63

Clay is main ingredient for the manufacturing of the bricks at kiln. Tractor trolleys are used to bring clay at kiln site. Clay is acquired from local area either via contract or retail. Through *contract procurement of clay* they (kiln managers) procure one/two jaraibs of local land on tender or contract. Clay up to 2 to 3 meters is dug up by machines and transported back to kiln for brick making. Pathan community is involved in digging and providing clay to kilns. It is not local labour. 62 kilns use contract way of clay procurement.

Table 5
Clay Analysis

Item	large	medium	small
Clay trolleys	2257.019	841.71	84.71443
Biomass Rate per trolley	320.5882	341.6667	389.2857
One trolley clay weight (weight)	233.375	216.7083	205.7857
Cost of maund	1.424722	1.668306	1.922244
Clay annual demand (Maund)	511654.4	178256	17016.07
Average brick weight (kg)	2.858824	2.890476	2.942857
Bricks made from 1 trolley	3270.588	2995.238	2800

Clay Procurement Analysis is as,

Table 6
Clay Procurement Analysis

Kiln Type	Contract	retail	Total	Retail %
Large	29	4	33	12.12121
Medium	31	11	42	26.19048
Small	2	12	14	85.71429

Results achieved for fuel cost are as

Fuel is the most important cost at kilns especially for small size kilns. Good quality fuel decreases amount of Bhelli bricks. Fuel used at kilns is of two types. Special fuel is required to start initial fire at the kiln at the start of each *Chakar*.

Table 7
Kiln Fuel usage analysis

Item	Large	Medium	Small
Over all fuel cost	12514832.4	3809524	160075
Quantity	38327.3529	12098.93	924.6429
Avg per maund cost	320	319.2857	167.1429
total fuel orders	112.610411	56.85669	26.18129
avg maund per order	335.882353	313.3333	41.07143
Trolleys	105.875117	54.33288	24.25272
per *Chakar* trolleys	6.9195845	8.229223	7.196939

per *Chakar* fuel	2336.76471	2098.81	243.9286
maund per trolley	335.882353	313.3333	41.07143
Annual fuel demand(Maund)	35988.2353	11500	830.3571
Annual fuel demand(Kg)	1439529.41	460000	33214.29
cost of one trolley	109620.588	103916.7	7064.286
maund fuel per brick	0.00488307	0.004689	0.003804
kg fuel per brick	0.19532267	0.187555	0.152148
bricks per maund	250.175167	262.9234	279.1415
normal fuel cost	11710588.2	3621024	138225

Results achieved for transporter's cost are as

Table 8
clay and fuel transport cost analysis

Item	Large kiln	Medium Kiln	Small Kiln
Total transport cost	2397806.093	1003816	112440.9
clay rate per trolley	855.8823529	869.0476	864.2857
ordinary fuel rate per trolley	5214.705882	7092.857	1478.571
special fuel rate per trolley	6991.176471	7104.762	1714.286
Average fuel transport cost per trolley	5322.193907	6981.621	1496.319

ROP (Re-Order Point):This indicator tells about level of clay/fuel (maunds) on reaching which kilns decide to reorder. It is reorder point. It tells kiln to reorder before it is too late. If this is not heeded by kiln there will be loss to kiln. ROP for clay is400, 3031 and 7328 maunds for small, medium and large kilns ,respectively. ROP for fuel is 22, 196 and 470 maunds for small, medium and large kilns respectively.

BEP (Sales): It is point of sales where revenue equals the costs. It helps kilns to decide for the units or bricks to produce to at least cover all costs.

Table 9
BEP sales Results

Breakeven point			
Sales	**Small**	**Medium**	**Large**
Brick quantity	150841.6	1338155	3839411
Rupees	1043289	9374469	27279716

Benefit Cost Ratio: It is 0.27,0.35 and 0.52 for small, medium and large kilns.

Value added Ratio: value added to 10000 bricks at each step is given in the following table.

Table 10
Value addition at different levels of brick kiln industry (10000bricks)

Per 10000 Bricks, value added at each step				
S.no	**logistical partners**	**Cost added**	**Value added separately (times)**	**value added at each level (times)**
1	Clay	1158.563	1	1
2	transport clay plus fuel	4007.579	3.61423	2.614
3	land	668.8782	4.203212	0.588982
4	Labour	152.8667	4.344935	0.141723
5	Fuel	14814.61	18.4695	14.12457
6	Kiln	23178.17	40.1128	21.6433
7	sales agent	20370.55	59.27065	19.15785
8	House	1339836	1280.526	1221.255
	house value	284084		

Value is added at end of each of the eight steps when clay goes through transformation into shape of final house. House demand is affected by the time, duration, cost, etc at each of eight steps of brick making. 10000 bricks is set as standard at each level. (house made of 10000 bricks). Clay cost is taken as base. Land, fuel, transporter, Jamadaar, kiln management and sales agent add value to clay gradually by making bricks. Highest

value is added at stage when house is finally sold. Labour adds least value to 10000 brick house. In the end all costs of players are observed in final house sales price or value.

Table 11
Logistical chain management SPSS Results

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.601[a]	.362	.299	311015.45016

a. Predictors: (Constant), house, transport, labor, fuel, land, kiln, clay, salesagent

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	4439887043111.940	8	554985880388.992	5.737	.000[b]
	Residual	7835179429134.610	81	96730610236.230		
	Total	12275066472246.500	89			

a. Dependent Variable: HValue

b. Predictors: (Constant), house, transport, labor, fuel, land, kiln, clay, salesagent

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	376223.544	163824.608		2.297	.024
	Clay	190.496	122.944	.197	1.549	.125
	Transport	-13.623	32.435	-.055	-.420	.676
	Land	-7.173	84.707	-.010	-.085	.933
	Labor	-177.339	72.480	-.244	-2.447	.017
	Fuel	12.868	9.404	.168	1.368	.175
	Kiln	2.639	9.204	.036	.287	.775
	Salesagent	24.488	14.082	.233	1.739	.086
	House	.168	.046	.351	3.623	.001

a. Dependent Variable: HValue

Equation generated is

House value = 376223+.197clay -.055transport -.010land -.244labor +.168fuel + .036kiln + .233salesagent +.351house±311015

Brick kiln industry logistical chain Model is valid as at least two variables are significant at adjusted R^2 value of 0.299. It means there is impact of brick logistical supply chain management on the final house value.

Conclusion

Demographically there is no North Sindh officially. It is for the convenience that such demographic distribution is used here in this research. There are many districts of the North Sindh. But for this research only three districts are chosen i.e. Khairpur, Sukkur, and Larkana. North Sindh traditional kilns are divided into three categories by scholar based on production level , infrastructure, land area and annual operating time i.e. small, medium and large kilns. Production of average bricks is 230429, 2465477 and 7147059 bricks for small, medium and large kilns respectively. Large kilns can produce 15 Million bricks in a year. Average acreage is 1, 3.5 and 5.5 acres for small, medium and large kilns. On the average there are 21, 49 and 108 labourers at small, medium and large kilns respectively. 35 kilns don't produce bricks in winter season as it is difficult to dry and demand is also low. Net profit is 281808, 3647403 and 14908971 Rs for small , medium and large kilns calculated in income statement.

Value is added at end of each of the eight steps when clay goes through transformation into shape of final house. House demand is affected by the time, duration, cost, etc at each of eight steps of brick making. 10000 bricks is set as standard at each level. (house made of 10000 bricks). Clay cost is taken as base. Land, fuel, transporter, Jamadaar, kiln management and sales agent add value to clay gradually by making bricks. Highest value is added at stage when house is finally sold. Labour adds least value to 10000 brick house. In the end all costs of players are observed in final house sales price or value.

Clay makes bricks. Clay is usually procured from local land owners / farmers. After that it is transported along with fuel to kiln site where it is further processed. Final product of kiln is sold to sales agents in the form of traditional red brick. Sales agents sell it to houses/consumers. This whole chain is analyzed in this article. Sample of random 90 kilns , 100 households , 200 local middlemen , labour and sales men were taken from North Sindh.

ROP (Re-Order Point) tells about level of clay/fuel (maunds) on reaching which kilns decide to reorder. It is reorder point. It tells kiln to reorder before it is too late. If this is not heeded by kiln there will be loss to kiln. ROP for clay is400, 3031 and 7328 maunds for small, medium and large kilns ,respectively. ROP for fuel is 22, 196 and 470 maunds for small, medium and large kilns respectively.

Breakeven Point Sales (BEP) is point of sales where revenue equals the costs. It helps kilns to decide for the units or bricks to produce to at least cover all costs. It is 150841 bricks (1043289Rs), 1338155 bricks (9374469 Rs) and 3839411 bricks (27279716Rs) sale for small, medium and large kilns respectively.

BCR (Benefit cost ratio) is when benefit is divided with cost at a kiln. It is 0.27 for small kilns, 0.35 for medium kilns, and 0.52 for large kilns. Higher it is better is the investment effectiveness at a kiln.

Value added tells that in the end 10000 bricks will be sold 1280 times initial cost of procuring clay. Clay cost is taken as base. Highest value is added at stage when house is finally sold. Labour adds least value to 10000 brick house.

This final kiln logistics model is simple multiple linear regression model with intention to check impact of different levels of brick processing /costs on the sales price of the house. What is the cost of clay? How value is added at different steps when clay goes through transformation into shape of final house. House demand is affected by the time, duration cost etc at each step of the brick making. 10000 bricks is set as standard.

In the end all costs of players are observed in final house sales price or value. So we can examine if there is a relationship among these variables .Relevant costs are only for that amount of bricks which are used in houses (sample quantity).

Brick kiln industry logistical chain Model is simple regression. It is valid as at least two variables are significant at adjusted R^2 value of 0.299. It means there is impact of brick logistical supply chain management on the final house value.

Labour adds least value to 10000 brick house. It should be given attention by authorities. BCR is least for small kilns. Small kilns should be guided how to improve their benefits.

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