| Research Article |

Cost Benefit Analysis of North Sindh's traditional red brick kilns

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Abstract: *Cost Benefit Analysis is economic evaluation with aim to make strategic decisions for kilns. There are two types of the costs i.e. fixed and variable costs Variable cost is 27%, 16% and 12 % of total cost of goods sold(COGS) for small, medium and large kilns. COGS is the final kiln cost. Largest cost for all small and medium kilns is labour cost (36-40%) of the COGS. For large kilns it is fuel cost (39%).Second largest cost for small kilns is FOH (17%), for medium kilns fuel(34%) and for large kilns labour costs(36%). . Least cost for small kilns is clay (3%), for medium kilns water cost (0.9%) and for large kilns water cost (0.4%).*

On the average Direct Labour is 45 % of the prime cost.

It takes a lot of cost to convert clay into bricks for small kilns i.e. 63% of total cost. On the average cost of goods available for sale (COGAS) is 3.3% more than final cost (COGS) for large kilns, 9.3% for medium kilns and 14.1 % for small kilns. Some difference results between COGAS and final cost results are in negative percentage because final cost is higher than COGAS. Some kilns have zero difference between COGS and COGAS.

Cost of one brick is largest for small kilns i.e. 4.84 Rs, for medium it is 4.86 Rs and 4.52 Rs for large kilns . Cost of one brick is highest in sukkur (4.9Rs) but least in Larkana (4.4Rs). Brick price is highest in Khairpur (7.05Rs) and least price in sukkur(6.9Rs).

There is positive and significant relationship between cost and price of a brick made at an average kiln at adjusted R^2 value of 0.083. Y Intercept tells that if the cost of making one brick falls to zero the brick price will remain 6.186Rs.

Unit Contribution Margin(CM) ratio is 41%,45% and 51% for large, medium and small kilns respectively. For every rupee sales only 41% goes to covering FC and profit generation for large kilns. Higher the ratio better it is. It means more money available to cover FC.

Breakeven Point Sales (BEP) is 150841 bricks (1043289Rs), 1338155 bricks (9374469 Rs) and 3839411 bricks (27279716Rs) sale for small , medium and large kilns respectively.

On the average operating expenses are 2.9 times non operating expenses for brick kiln industry.

When non operating expenses are subtracted from EBIT we get Net Profit for a kiln. Net profit is 281808, 3647403 and 14908971 Rs for small , medium and large kilns calculated in income statement. Net profit , as percentage of gross profit, is highest for large kilns (80%). It is 50%, 68% for small and medium kilns. Kiln size determines Net profit. Net profit is least for small kilns i.e. 50% of Gross profit. Net profit is less than gross profit because of operating expenses and non operating expenses.
Benefit Cost Ratio is 0.27 for small kilns, 0.35 for medium kilns, and 0.52 for large kilns.
Finding the biggest impact of a cost type on kiln's net profit is important. Multiple linear regression is performed with five variables ie. Prime Cost, conversion cost , cost of goods manufacturing (COGM), COGAS and COGS. Y variable is Net Profit. All the variables are significant except for intercept. COGM and COGAS are both inversely related to net profit. If they decrease net profit will increase. But COGS is positively related to Net Profit. The strongest relation is that of COGM with Net Profit. Adjusted R^2 is 0.863.
***Key words** : Benefit Cost Ratio , kiln , Cost Of Goods Sold, cost, benefit, Breakeven Point , brick, Factory Overhead , Net Profit, contribution margin, North Sindh*

Introduction:

Cost Benefit Analysis is economic evaluation with aim to make strategic decisions for kilns. kilns change cost breakup and go for newer investing opportunities to better cost benefit ratio. It tells about positive and negative consequences of economic decisions. It is seen from short term and long term perspective. Cost is spent money to get benefit out of a business. Benefit is profit got from business of brick making Following indicators are part of CBA.

- Present value of costs (PVC): Total cost value for the kiln. It is COGS.
- Present value of benefits (PVB): profit for a kiln.
- BCR (Benefit Cost) Ratio= PVB/PVC
- Net Benefit= PVB-PVC
- Income statement

Literature Review:

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 Naveen et al, 2016)
Construction agencies and individual consumer (Siriman Naveen et al , 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,

Rural kilns are usually clamp kilns with energy usage of 1.5-3.0 MJ/kg usually in form of coal) (Rizwan Khan et al., 2007). Kilns don t work during monsoon time i.e. June to September. (Sushmita Dey et al., 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 et al, 2012)

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 et al., 2015) Brick is ceramic in nature formed inside fire temperature range of 900-1200^{o}C. Bricks are not burnt properly. Some are highly burnt while some are burnt at low temperature. Thus bricks are categorized on the basis of their burning in kiln. Bricks may differ because of the clay/soil used inside it. They conducted test to check quality of bricks made in Punjab on the basis of absorption of water and strength of brick. Water absorption quality of a brick was performed by dipping a brick in water for 24 hours at 27^{o}Cand re-measuring it weight. The brick is said to be durable if it does not absorb lot of water. More it is durable less it absorbs water. Including Boron rich materials cause bricks to be more durable with this respect. (Attiqur Rehman Tariq et al., 2014)

Making bricks is a continuous process (Rizwan Khan et al., 2007) involving following steps

First of all mixing of husk, soil, fly ash and sand with water takes place.

This mixture is further processed and mixed again and again by labour to get desired level and quality

Then it is kept unattended for 12 hours covered with something. This completes the process of mixing and further it is ready for moulding.

- Bricks are moulded and put on ground.
- Bricks are ready for putting into kilns for baking.
- Bricks are baked continuously for 1 month.
- Bricks are ready for use.

Mr. Xu (2003) has calculated Gini coefficient and Lorenz curve to show income inequality at kilns and Abdella et al, 2012, have used Xu's approach in this research.

Profit = Total return – Total cost

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

Table1: cost and revenue for farms and kilns (in SDG currency) (Abdalla et al, 2012).

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 (Palash Patra et al., 2015).

Kiln industry belongs to informal economic sector of Pakistan. (Muhammad Sohail et al., 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. (Muhammad Sohail et al., 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. (Muhammad Sohail et al., 2020)

Research Methodology:

This article is part of PhD research. Questionnaire form I was got filled from 90 kilns of North Sindh an area of Pakistan. It is non random purposive sampling with aim to collect and survey data from three target districts i.e. Khairpur , Larkana, Sukkur.

There are two types of the cost fixed and variable costs. Fixed costs include rent (Land cost), Interest payment on Accounts payable/Short term debt (capital cost), FOH cost (Factory Overhead) and maintenance cost. While variable cost includes Labour Cost, Clay cost, transport cost, fuel cost (special and normal fuel) and water cost.

Direct material is sum of purchases, transport cost and water cost

Direct Labour is cost of labour procured.

Factory overhead (FOH) includes *chokidaar* (security man) cost, waste cost, advertising cost, marketing cost, utilities cost, tax cost, depreciation cost, insurance cost, theft cost, legal fees, maintenance and land cost.

Ambiguous or Unimportant FOH costs include advertising, marketing, tax, insurance and legal costs. During survey the *Munshis* at kilns either gave ambiguous answers to avoid real answers or they did not mention these cost heads at all.

Here only active cost heads are maintenance cost, land cost , chokidaar cost (security cost) , waste cost , utilities and Depreciation cost(on PPE).

Prime cost is sum of Direct Material and Direct Labour.
Maintenance cost includes, Tractor trolley maintenance cost, Office petty cash cost, Solar system maintenance cost, Cleanliness cost, Generator maintenance cost and Vehicle maintenance cost.
Land Cost is cost of land (i.e. Rent) on which kiln operate. Kilns have ROL (rent/ownership/lease) status.
Depreciation is FOH cost on the PPE (Property Plant Equipment). It is part of Balance Sheet. It decreases taxation.
Prime cost is sum of DM and DL.
Conversion cost is sum of direct labour and FOH cost.
Cost Of Goods Manufactured is sum of DM, DL and FOH
Beginning Inventory (Finished goods) is remaining product (red bricks) from previous year production cycle. B.I of bricks could not be sold in the last year.
Cost of Goods Available for Sale is sum of COGM and Cost of Beginning Inventory of finished goods.
Ending Inventory (Finished goods) is product (Bricks) which is not at the end of year cycle.
Cost Of Goods Sold (PVC= Present Value of costs) is final annual kiln cost. It is cost of goods available minus cost of ending Inventory of finished goods. Some kilns have zero difference between COGS and COGAS.
Weighted average unit cost is one average brick cost.
Variable and fixed cost analysis: There are two types of the cost fixed and variable costs. Fixed costs include rent (Land cost), Interest payment on Accounts payable/Short term debt (capital cost), FOH cost (Factory Overhead) and maintenance cost. While variable cost includes Labour Cost, Clay cost, transport cost, fuel cost (special and normal fuel) and water cost.
Overall sales: price of each type of brick order is multiplied with quantity of orders sold for that type of brick. And thus overall sales price is calculated by adding all values. There are four types of bricks each having superior and *bhelli* (inferior) qualities. Brick types are *Qisti, Roof, Dhero and Diplo.*
Contribution Margin (CM) is sales minus variable costs. When CM is equal to fixed costs then profit is zero and kiln reaches BEP sales.
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.
Gross Profit is "overall sales" minus "cost of goods sold".
Operating expenses is opposite of capital expenses. It is cost of normal business operations for kilns. Opex includes land cost (Rent) , maintenance cost and following costs
Non Operating expenses are not related directly to the main business of brick making. It includes interest, taxes, depreciation and waste cost.
Net Profit (PVB= present value of benefit): When non operating expenses are subtracted from EBIT we get Net Profit for a kiln.
Benefit Cost Ratio (BCR) = Net profit/Cost of Goods sold
Income Statement (or profit and loss statement) summarizes profit and loss for a kiln for a specific duration of time.
Final regression model tells about impact of different costs on the overall net profit. It is simple multiple

regression.

Results:

Results about costs are as,

Depreciation is 94441Rs for large kiln, 64880Rs for medium kilns and 16428Rs for small kilns per annum.

On the average Direct Labour is 45 % of the prime cost.

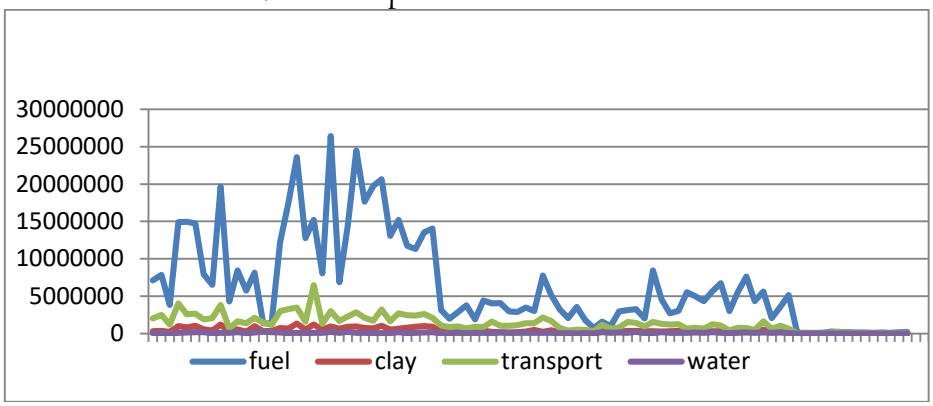

Figure1: Prime cost constituents

Conversion cost is sum of direct labour and FOH cost.

Kiln Type	Total FOH	Total labour cost	Total Cost @Kiln	Conversion Cost	Conversion Cost as % of Total Cost
Large	2988437	11133882	30405386	14122320	47.9764
Medium	1470612	3976744	10876667	5447356	51.48016
Small	225817.5	394310	984965.6	620127.5	63.1993

Table2: Conversion Cost analysis

It takes a lot of cost to convert clay into bricks for small kilns i.e. 63% of total cost.

Cost Of Goods Manufactured is sum of DM, DL and FOH

Kiln Type	COGM	Conversion Cost	final cost	COGM as % of Final Cost
Large	29890415	14122319.65	30405386	98.06972
Medium	10656620	5447356.099	10876667	98.04826
Small	937129.9	620127.4517	984965.6	95.27658

Table3: COGM Analysis

Beginning Inventory (Finished goods) is remaining product (red bricks) from previous year production cycle. B.I of bricks could not be sold in the last year.

Cost of Goods Available for Sale is sum of COGM and Cost of Beginning Inventory of finished goods.

On the average COGAS is 3.3% more than Final cost for large kilns, 9.3% for medium kilns and 14.1 % for small kilns. Some difference results between COGAS and final cost results are in negative percentage because final cost is higher than COGAS.

Ending Inventory (Finished goods) is product (Bricks) which is not at the end of year cycle.

Cost Of Goods Sold (PVC= Present Value of costs) is final annual kiln cost. It is cost of goods available minus cost of ending Inventory of finished goods. Some kilns have zero difference between COGS and COGAS.

Cost head	Large	Medium	Small
Conversion Cost (CC)	14122320	5447356	620127.5
Cost Of Goods Manufactured (COGM)	29890415	10656620	937129.9
COGM % of CC	109.2433	95.64252	51.14417
Cost Of Goods Available for Sale (COGAS)	31328412	11856830	1106209
COGAS as % of COGM	5.376783	11.40207	19.87519
Cost Of Goods Sold (COGS)	31002069	11735851	1076622
COGS as % of COGAS	-1.08534	-1.08509	-2.58025

Table3: Relation of different Cost heads

	Small kiln	Medium kiln	Large kiln
Labour cost	1.932622	1.775174	1.649771
Capital cost	0.220727	0.093475	0.089153
land cost	0.162335	0.070423	0.03747
maintenance Cost	0.163372	0.06659	0.044176
clay cost	0.152513	0.129637	0.107269
Total Fuel cost	0.778202	1.694588	1.805679
Transport cost	0.55544	0.442083	0.370204
water cost	0.066695	0.045819	0.021772
FOH Cost	0.820709	0.544526	0.395438
Sum(Average Cost of a brick)	4.84	4.86	4.52

Table4: COGS cost break up for a brick

Weighted average unit cost is one average brick cost. cost of one brick is largest for small kilns i.e. 4.84 Rs, for medium it is 4.86 Rs and 4.52 Rs for large kilns . Cost of one brick is highest in sukkur (4.9Rs) but least in Larkana (4.4Rs). Brick price is highest in Khairpur (7.05Rs) and least price in sukkur(6.9Rs).

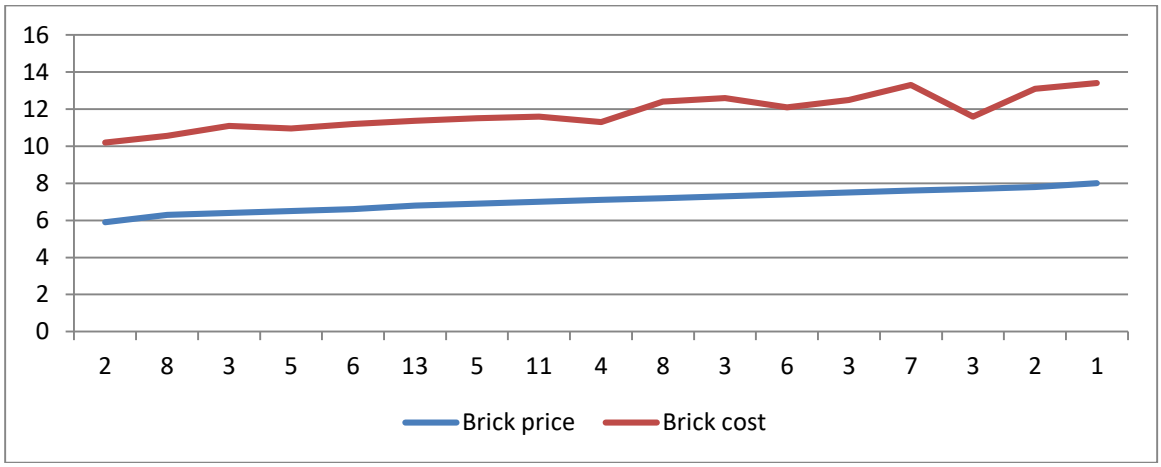

Figure2: Relation between cost and price of a brick(Y axis P and c of brick, X axis Number of kilns)

Relationship between cost and price of a brick made at kiln is as follows,

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
I	.305[a]	.093	.083	.44208

a. Predictors: (Constant), CostBrick

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
I	Regression	1.760	I	1.760	9.006	.004[b]
	Residual	17.198	88	.195		
	Total	18.958	89			

a. Dependent Variable: PriceBrck

b. Predictors: (Constant), CostBrick

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
I	(Constant)	6.186	.285		21.692	.000
	Cost Brick	.178	.059	.305	3.001	.004

a. Dependent Variable: Price of Brick

Table 5 Model summary, ANOVA and coefficients of the regression model

There is positive and significant relationship between cost and price of a brick made at an average kiln at adjusted R^2 value of 0.083. Intercept tell that if the cost of making one brick falls to zero the brick price will remain 6.186Rs.

Variable and fixed cost analysis: There are two types of the cost fixed and variable costs. Fixed costs include rent (Land cost), Interest payment on Accounts payable/Short term debt (capital cost), FOH

cost (Factory Overhead) and maintenance cost. While variable cost includes Labour Cost, Clay cost, transport cost, fuel cost (special and normal fuel) and water cost.

	VC %	FC %	sum	COGS
Large	87.26087	12.73913	100	31002069
Medium	83.97297	16.02703	100	11735851
Small	72.09312	27.90688	100	1076622

Table6: Cost fixing for a kiln into variable and fixed categories

Overall sales: price of each type of brick order is multiplied with quantity of orders sold for that type of brick. And thus overall sales price is calculated by adding all values. There are four types of bricks each having superior and *bhelli* (inferior) qualities. Brick types are *Qisti, Roof, Dhero and Diplo.*

Kilns sell bricks for revenue. Bricks of different type, quality fetch different price for them. Usually each brick type has different order size and price. Average Order price for good Qisti bricks is 27466Rs, Roof 57744Rs, Dhelo/Dhero 60866Rs and for Nav Sha/ Sha Nav 26700Rs. Average Order price for bhelli/inferior Qisti bricks is 15277Rs, Roof 32255Rs, Dhelo/Dhero 34555Rs and for Nav Sha/ Sha Nav 17966Rs. Annual orders sold small, medium and large kilns are 45,468 and 1341. Most orders are sold by Sukkur district. On the average bricks are sold in the order size of 5000-5200 bricks. Average order price is highest for the largest kilns. Average order price is highest for the district Khairpur kilns. Average order price remain in the range of 34000-38000Rs. there is inverse relation between orders sold and order size. All kilns sell product on credit too. 17 kilns sell on credit only less than 1% of the total sale. 70 kilns sale on credit between the range of 1-10% of total sale. Only 4 kilns sale on credit up to 34% of the total sale.

Contribution Margin (CM) is sales minus variable costs. When CM is equal to fixed costs then profit is zero and kiln reaches BEP sales. Unit CM ratio is 41%,45% and 51% for large, medium and small kilns respectively. For every rupee sales only 41% goes to covering FC and profit generation for large kilns. Higher the ratio better it is. It means more money available to cover FC. CM in rupees is 21987375, 7167304 and 854397 Rs of sales. Net Profit Margin is also called as "return on sales".

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 (BEP Sales) is 150841 bricks (1043289Rs), 1338155 bricks (9374469 Rs) and 3839411 bricks (27279716Rs) sale for small , medium and large kilns respectively.

Gross Profit is "overall sales" minus "cost of goods sold".

Operating expenses is opposite of capital expenses. It is cost of normal business operations for kilns. Opex includes land cost (Rent) , maintenance cost and following costs

Chokidar	Advertising	Marketing	Utilities	Depreciation	Insurance	Theft	Legal fees

Earning Before Interest and Taxes (EBIT): tells about kiln's ability to make profit. It is revenue minus expenses (without taxes and interest). It refers to operating profit.

	Gross Profit	(EBIT)operating profit	EBIT % of GP	NetProfit	NP % of EBIT	NP as % of GP
Large	18412379	17734848.45	96.32024508	1490897	84.06596	80.97254

Medium	5338063	4887850.735	91.5660077	3647403	74.62181	68.32822
Small	555461.2	398639.3773	71.76727801	281808	70.69247	50.73406

Table7: Relationship of EBIT, Gross Profit and Net profit

Non Operating expenses are not related directly to the main business of brick making. It includes interest, taxes, depreciation and waste cost. On the average operating expenses are 2.9 times non operating expenses for brick kiln industry.

Net Profit (PVB= present value of benefit): When non operating expenses are subtracted from EBIT we get Net Profit for a kiln. Net profit is 281808, 3647403 and 14908971 Rs for small , medium and large kilns calculated in income statement. Net profit , as percentage of gross profit, is highest for large kilns (80%). It is 50%, 68% for small and medium kilns. Kiln size determines Net profit. Net profit is least for small kilns i.e. 50% of Gross profit. Net profit is less than gross profit because of operating expenses and non operating expenses.

Benefit Cost Ratio (BCR) is 0.27 for small kilns, 0.35 for medium kilns, and 0.52 for large kilns.

Income Statement (or profit and loss statement) for three types of the kilns is

Income statement			
	Small Kiln	Medium Kiln	Large Kiln
	Sample 14	Sample 42	Sample 34
Sales	1632083	17073914	49414447
COGM	937129.9	10656620	29890415
Beginning Inventory	23571.43	167714.3	196382.4
COGAS	1106209	11856830	31328412
Ending Inventory	6428.571	25476.19	69558.82
COGS	1076622	11735851	31002069
Gross profit	555461.2	5338063	18412379
Operating expense	156821.8	450211.8	677530.4
EBIT	398639.4	4887851	17734848
non operating expense	116831.4	1240448	2825877
Net profit	281808	3647403	14908971

Table8: Average North Sindh kiln Income Statement, 2021-2022 (Rupees)

Relationship of different costs with net profit: It is regression to find the biggest impact of a cost type on kiln's net profit.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.933[a]	.871	.863	2902736.57090	1.338

a. Predictors: (Constant), COGS, conversioncost, Primecost, COGM, COGAS

b. Dependent Variable: NP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
I	Regression	476502794263540 3.000	5	953005588527080.600	113.105	.000[b]
	Residual	707773886405819.000	84	8425879600069.273		
	Total	547280182904122 2.000	89			

a. Dependent Variable: NP

b. Predictors: (Constant), COGS, conversioncost, Primecost, COGM, COGAS

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
I	(Constant)	-486387.052	594945.054		-.818	.416
	Prime cost	5.092	.886	7.947	5.744	.000
	Conversion cost	3.799	.353	2.872	10.750	.000
	COGM	-5.838	1.133	-9.853	-5.154	.000
	COGAS	-4.583	1.276	-7.950	-3.590	.001
	COGS	4.588	1.245	7.884	3.686	.000

a. Dependent Variable: NP

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1491442.8750	28106436.0000	7378236.0615	7317078.63870	90
Residual	-8260841.00000	7584074.00000	.00000	2820020.49240	90
Std. Predicted Value	-1.212	2.833	.000	1.000	90

Std. Residual	-2.846	2.613	.000	.972	90

a. Dependent Variable: NP

Table9: Model summary, ANOVA, Coefficients and residual statistics for cost model

Finding the biggest impact of a cost type on kiln's net profit is important. Multiple linear regression is performed with five variables ie. Prime Cost, conversion cost , COGM, COGAS and COGS. Y variable is Net Profit. All the variables are significant except for intercept. COGM and COGAS are both inversely related to net profit. If they decrease net profit will increase. But COGS is positively related to Net Profit. The strongest relation is that of COGM with Net Profit. Adjusted $R^2$is 0.863.

Conclusion

When kilns start New Year they buy special fuel which is required to start new fresh fire. After starting fire with special fuel normal/ordinary/primary fuel is used. All the kilns either small or large use special fuel. Tari wood, Devi/Babur wood, date palm trunks, etc were used as special fuel. Mostly Devi/Babur is used. Special fuel is 10.2%, 6% and 5.9% of total fuel used at small, medium and large kilns. Normal primary fuel is used in large quantities at kilns. Local simple firewood, furt, tootar, booh , shena (dung) and bakas were used as normal primary or alternative fuels. Mostly furt and tootar are used. Alternate fuel used mostly is local simple firewood. Per maund of fuel burnt there are 312, 284, 271, 243 and 208 bricks are made for dung, simple local fire wood, tootar, furt and bakas respectively. Special fuel demand is 94, 598 and 2339 maunds for small , medium and large kilns. On average main primary fuel demand is 830 , 11500 and 35988 maunds for small, medium and large kilns. Bhelli bricks produced are 7.3%, 7.1% and 6.9% for small, medium and large kilns. Higher the special fuel used lesser the bhelli bricks produced at a kiln. Bakas produce least bhelli bricks burnt (0.26 bricks),and the least efficient fuel is dung (0.7 bricks).

Kilns operate in cycles / chakars of production. Dried bricks are stacked into chimneys (Khuro) or laid on land in open in case of small kilns. small kilns are called Daas in local language. Bricks laid vary in quantity depending on chimney type or acapacity, and labour or capital utilization. It usually takes one month to complete one production cycle. In winter relatively less bricks are made due to small day time and less availability of sunlight to dry bricks. This is why small kilns don t operate in winter. Kiln operators / managers / munshis calculate profits on basis of number of successful completion of chakars. Each chakar produce superior as well as interior quality of bricks. Ratio changes for each kiln depending on the use of fuel type/quality, duration of fire, etc.

Regularly bricks are made in four types i.e. *Qisti, Roof (12/6), Dhelo/Dhero, Nav Sha (9/6)*. Sometimes brick order with a specific design is receive at a kiln. For this they have to make special moulds. All brick types can be spoiled at kiln in the process. 48 kilns make 4 types of bricks and rest 3 types. Order size for Qisti bricks is 5000 bricks, Roof 5000, Dhelo/Dhero 2500 and Nav Sha/ Sha Nav 4000 bricks per trolley. Nav sha bricks are made by 42%, 38, 94% small, medium and large kilns. Rest are made by all kilns. It is easy to make Qisti brick as compared to Roof and Dhero types of red brick. As kiln size decreases Bhelli brick production, as % of total production, inceases. Kiln size is inversely related to Bhelli production.

There are two types of the bricks made at the kilns i.e Bhelli (Inferior) and Good / Superior quality bricks. Usually out of 1000 bricks made 10 to 30 bricks are spoiled due to operation at kilns. It is

operational waste. Small kiln operational waste is 16 bricks per 1000, medium kiln 17 bricks and large kiln 20 bricks. Bricks are spoiled also due to rain , horse treading, mismanagement during stacking or carrying etc. spoiled quantity (and orders) of such brick waste is collected /asked in/ by questionnaire form. It is natural waste. Large kiln natural waste is 173529 bricks, medium kiln 101071 bricks and small kiln 5857 bricks. Bhelli Bricks of Roof, Dhelo and nav Sha are actually waste cost for the kiln managers and such bhelli bricks are disposed off as waste because those are not in demand in the market. It is assumed waste. Total waste is sum of all three. There is inverse relation between total waste % with Net profit % at a kiln. With increase in level of production there is significant decrease in the total wasted bricks. By using Dung as fuel at kilns 16 % bricks are wasted. Least loss is with tootar (11%).

Kilns sell bricks for revenue. Bricks of different type, quality fetch different price for them. Usually each brick type has different order size and price. Average Order price for good Qisti bricks is 27466Rs, Roof 57744Rs, Dhelo/Dhero 60866Rs and for Nav Sha/ Sha Nav 26700Rs. Average Order price for bhelli/inferior Qisti bricks is 15277Rs, Roof 32255Rs, Dhelo/Dhero 34555Rs and for Nav Sha/ Sha Nav 17966Rs. Annual orders sold small, medium and large kilns are 45,468 and 1341. Most orders are sold by Sukkur district. On the average bricks are sold in the order size of 5000-5200 bricks. Average order price is highest for the largest kilns. Average order price is highest for the district Khairpur kilns. Average order price remain in the range of 34000-38000Rs. there is inverse relation between orders sold and order size. All kilns sell product on credit too. 17 kilns sell on credit only less than 1% of the total sale. 70 kilns sale on credit between the range of 1-10% of total sale. Only 4 kilns sale on credit up to 34% of the total sale.

CBA (Cost Benefit Analysis) is economic evaluation with aim to make strategic decisions for kilns. Cost is the money spent to get benefit out of brick making business. Benefit is profit got from business of brick making. Total cost value for the kiln is COGS (Cost of goods sold).

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. It is highest for district Khairpur 0.42, and least for Sukkur. COGS comprises of many costs.

There are two types of the cost fixed and variable costs. Fixed costs include rent (Land cost), Interest payment on Accounts payable/Short term debt (capital cost), FOH cost (Factory Overhead) and maintenance cost. While variable cost includes Labour Cost, Clay cost, transport cost, fuel cost (special and normal fuel) and water cost. VC is 27, 16, 12 % of total COGS for small, medium and large kilns. Largest cost for all small and medium kilns is labour cost (36-40%) of the COGS. For large kilns it is fuel cost (39%).Second largest cost for small, medium and large kilns is FOH (17%), fuel(34%) and labour costs(36%). . Least cost for small, medium and large kilns is clay (3%), water cost (0.9%) and water cost (0.4%).

One brick cost is 4.84, 4.86 and 4.52 Rupees for small, medium and large kilns. Cost of making a brick increases with increase in kiln size. One brick price 6.96, 6.97 and 7.12Rs for small, medium and large kilns. There is positive and significant relationship between cost and price of a brick made at an average kiln at adjusted R^2 value of 0.083. Price of a brick is highest with *munshi* as kiln s administrator not owner. Munshi is professional player.

Net profit is 281808, 3647403 and 14908971 Rs for small , medium and large kilns calculated in

income statement. Net Profit , as percentage of gross profit, is highest for large kilns (80%). It is 50%, 68% for small and medium kilns. Net profit is less than gross profit because of operating expenses and non operating expenses. Operating Expenses (opex) is opposite of capital expenses. It is cost of normal business operations for kilns. Opex includes land cost (Rent) , maintenance cost and costs of chokidar, advertising, marketing, utilities, insurance, theft and legal fees. Non operating Expenses are not related directly to the main business of brick making. It includes interest, taxes, depreciation and waste cost. On the average operating expenses are 2.9 times non operating expenses.

COGM and COGAS are both inversely related to net profit. If they decrease net profit will increase. But COGS is positively related to Net Profit. The strongest relation is that of COGM with Net Profit. Adjusted $R^2$is 0.863.

References

Lelia, C., & Maria, S. (2012). Benefits and costs of the informal sector: the case of brick kilns in Bangladesh. *Journal of Environmental Protection, 2012*.

Bhattacharjya, S. (2018). BENEFIT-COST ANALYSIS.

Brent, R. J. (2006). *Applied cost-benefit analysis*. Edward Elgar Publishing.

Layard, R., & Glaister, S. (Eds.). (1994). *Cost-benefit analysis*. Cambridge University Press.

Boardman, A. E. (2008). *Cost benefit analysis*. Pearson Education India.