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FACTORS AFFECTING BRICK PRODUCTION AT TRADITIONAL NORTH SINDH RED BRICK KILNS

Siraj Narejo[1], Prof. Dr. Muhammad Saleem Rahpoto[2]

[1]PhD scholar, Assistant Professor (Economics), Government Degree Science College, Gambat, Sindh, Pakistan; [2] Chairman, Economics Department, Shah Abdul Latif University, Khairpur, Sindh

Corresponding Author: ksks.narejo1987@gmail.com

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ABSTRACT

This research is conducted to check impact of inputs (costs of production) on the total brick production at an average kiln using Cobb Douglas Production Function. Overall North Sindh kilns experience IRS (increasing returns to scale) with elasticity of production 1.09. It is sum of coefficients of all factors (costs) of production. Variable Cost is 27%, 16% and 12 % of total COGS for small, medium and large kilns. COGS is the final kiln cost. Largest cost for all small and medium kilns is labour cost as 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 cost(36%) respectively. Least cost for small, medium and large kilns is clay (3%), water cost (0.9%) and water cost (0.4%). R square is.995. Aggregate hypothesis tells there is relation between X variables and Y (no any Beta is 0). Land rent, maintenance and transport cost have negative relation with total production level. Labour is the most powerful variable. Only labour, capital, clay and fuel costs are significant in The Model.

Keywords: Brick Production

INTRODUCTION

Cobb Douglas Production Function is type of production function in which technological relationship among inputs and also between inputs and output is represented. Total production (Y) is dependant variable and input costs to produce production are independent variables, i.e. x1, x2, x3, etc. in this production model. CDPF tells about returns to scale for the kilns, relative share of all the input costs for the kiln. Variables' parameters/ coefficients, beta 1, beta 2…… represent elasticity coefficients. It is used to check factor intensity. It is used to calculate average physical product and MPP of inputs. MRTS can be calculated easily.

2. Literature Review:

Kiln Inputs used were dung, wood, clay and labour. Their costs and benefits were calculated separately. From late July to end of September it was considered off season or dry season. While production season starts from October to July each year. And in both seasons input and output change accordingly. Following was data associated with inputs (Abdalla et al, 2012).

Table 1: prices of inputs for 49 kilns at Khartoum (Abdalla et al, 2012).

Parameters	% of kiln	Mean	Change ratio (%)
Loose dung			
Beginning of season	96	42.6(5.7)	
Middleof season	92	55.1(7.3)	
End of season	100	70.3(7.2)	65
Average Prices	100	55.1(4.6)	
Compacted Dung			
Beginning of season	85	15.8(2.6)	
Middleof season	92	23.7(4.1)	
End of season	92	25.5(5.9)	61.4
Average Prices	100	22.1(4.1)	
Wood	100	343.8(21.3)	
Red Brick			
Beginning of season	100	93.7(6.4)	
Middleof season	100	84(4.8)	
End of season	100	75.2(9.8)	25
Average Prices		84.1(4.5)	

Input prices of dung increase during off season and increase with the start of production season. Wood prices remained stable. (Abdalla et al, 2012)

Table 2: fuel profile (Abdalla et al, 2012).

	Average Product range per t DM
Loose dung	2950–4660 bricks
Compacted dung	2490–4980 bricks
Wood	25710–180000 bricks

Labour, dungfuel,rent and wood fuel costs are 57%, 22%, 6% and 13% of total costs at average kiln.(Abdalla et al, 2012)

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)

Fuel used mostly is coal and bricks are used within 25 km radius of the area. high use of fuel causes fire and flames to affect surrounding fertile lands. According to them fuel cost is the largest cost of brick making i.e. around 30-35%. (Palash Patra et al., 2015)

Pakistan kilns are less energy efficient and use cheap fuel to make bricks thus there is problem of pollution. Kaleemullah sheikh et al., Sindh 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 et al, 2012)

Main fuel used at kilns of Nepal is coal that is imported from India. According to them (SeshanandaSanjel et all, 2016)

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)

2. Research Methodology:

Cobb Douglas production function in non linear simple form can be written as

$Q = \beta_0 X_1^{\beta 1} X_2^{\beta 2} \ldots\ldots\ldots X_9^{\beta 9}$

This function has to be formed in linear form because it will be easy to analyze further. Linear form of CDPF is

$\ln Q = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_2 \ln X_8 + \beta_9 \ln X_9$ (Equation I)

(: ln = natural log) , (: Q= Dependent Variable), (: $\ln\beta_0$ = Y intercept) , (:X1…….X9 =Independent variables), (:β1…… β9 = coefficients) (β_1 = Total labour cost , β_2 = Annual capital cost, β_3 = Annual land cost,β_4 = Annual maintenance cost, β_5 = Annual clay cost, β_6 = Annual fuel cost, β_7 = Annual transport cost, β_8 = Annual water cost, β_9 = Annual Factory Overhead cost.)

Kiln Cost Data for CDPF,90 kilns, is compiled in MS Excel, e.g.

	Y	x1	x2	x3	x4	x5	x6	x7	x8	x9
S. No.	total production	Total labour cost	Capital cost	land cost	maintenance cost	clay cost	total fuel cost	transport cost	water cost	FOH
1	2000000	3320000	60000	420000	113918	320000	3162000	1642000	30000	1027143
2	126000	234840	4500	20000	16936	21000	91000	71580	9333	56339
3	160000	308000	24000	15000	21849	36363.6	117000	111287	11851	114856

Table3: Kiln Cost Data for CDPF regression

This data table is converted into natural log form and then regression in SPSS statistical software is performed. Error term is added to equation I to get statistical CDPF model. e.g.

$\ln Q = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + \beta_9 \ln X_9 + u$ (Equation II)

Regression model's overall significance is tested. (Hypothesis testing)

H_0: $\beta_1 = 0$, $\beta_2 = 0 \ldots \beta_9 = 0$ (i.e. there is no relation between x and y variables at all)

H_1: $\neq 0$ (It means at least one of the independent variables shows a relation with dependent variable.)

Factor / cost significance is tested at individual level.

H1 : Cost of Labour has sufficient impact on total production of bricks

H2:Capital cost has sufficient impact on total production of bricks

H3: Land cost has sufficient impact on total production of bricks

H4:clay cost has sufficient impact on total production of bricks

H5:Fuel cost has sufficient impact on total production of bricks

H6: Cost of transport has sufficient impact on total production of bricks

H7: water cost has sufficient impact on total production of bricks)

H8: FOH Cost has sufficient impact on total production of bricks

H9:Maintenance cost has sufficient impact on total production of bricks

3. Results

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%).

Total Labour Cost: It is cost of labour hired directly involved in brick making. Some labour at kiln is not directly involved. It is vital intangible asset of the kilns. Following results have been achieved.

Safaiwara and trolley labour is not relevant labour. It is my classification based on their small role in main activity at a kiln.

	Labour Not relevant %	Relevant Labour %	Average labour (Total)	Not relevant labour (Q)
Large	4.6	95.4	108	5
medium	10.2	89.8	49	5
Small	13.04	86.96	23	3

Table 4: Total Labour Relevant and Non relevant

	average production	LabourCost	TotalCost	LabourCost %
Large	7147058.8	11133882	30405386	36.61813
medium	2465476.2	3976744	10876667	36.56216
small	230428.57	394310	984965.57	40.03287

Table 5 :Labour cost as percentage of total /final cost

	Total Production	LabourCost	TotalCost	LabourCost%
khairpur	4088273	6403755	17453588	37.46795
larkana	1590000	2533800	6558640	39.12765
sukkur	4575000	7364982	20490675	37.91155

Table 6: Labour cost as percentage of total /final cost (District Profile)

Capital Cost: It is short term loan or accounts payable along with monthly interest rate applied. It is important cost for the kilns especially for small ones.

Kiln Type	Capital Cost	ST loans	Interest rate per month	initial investment	operating years
large	514970.5882	1300000	4.029411765	6697059	12.44118
medium	220047.619	635714.3	4.19047619	1652381	10.38095
small	47835.71429	198571.4	4.071428571	185714.3	6.714286

Table 7: Capital cost analysis

Kiln Type	Capital Cost	Total Cost	Capital Cost %
Large	514970.6	30405386	1.930275
Medium	220047.6	10876667	1.951743
Small	47835.71	984965.6	4.723418

Table 8: Capital cost as percentage of total /final cost

	CC	TC	CC % of TC
khairpur	379071.2	17453588	2.618226
larkana	139000	6558640	3.517831
Sukkur	72285.71	20490675	0.410656

Table 9: capital cost as percentage of total /final cost (District Profile)

Land Cost: It is part of FOH cost but analysed separately because of importance for the kilns. It is cost of land (i.e. Rent) on which kiln operate. ROL (rent/ownership/lease) status is asked in the questionnaire form 1. Further following results have been achieved.

	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

Table 10: land cost analysis

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

Table 11: land ROL status

	land cost	Kiln Area (Acres)	Jraib Annual rate
Khairpur	158500	4.128788	18916.67
Larkana	115000	2.3	25000
Sukkur	138714.3	3.785714	19428.57

Table 12: land cost at district level

land cost is the most expensive in Larkana district.

Maintenance Cost: It is part of FOH cost but analysed separately because of importance for the kilns. It includes, Tractor trolley maintenance cost, Office petty cash cost, Solar system maintenance cost, Cleanliness cost, Generator maintenance cost and Vehicle maintenance cost.

Tractor trolley is the most important part of the operation at the kiln. Small kilns don't own so they hire. It requires maintenance constantly. Tractor trolley delivers bricks two times a day to consumers nearby in same district only. Average distance per chakar ranges from 25-30km. After every two weeks there is cost of Mobil change for the tractor. There are two days' leave in two weeks. 12 days work. Mobile cost is 4500Rs per each time. There is also tyre cost associated.

On the average tractor travels 1900 km before mobil needs changing.

11 kilns have not their own tractor trolleys but they hire along with labour. There is one driver and two labourers per trolley.12 kilns have two tractor trolleys. 67 have 1 tractor trolley and only 12 participants have 2 tractor trolleys.

Office petty cash cost includes tea, lunch for munshi, stationery and phone cost.

Small and large kiln usually both needs *solar systems* at the kiln site. This cost includes cost of battery renew and/or solar maintenance cost. Solar batteries are not renewed each year. Eleven (11) kilns have solar system. Batteries are renewed at 67 kilns. Monthly cost of maintenance of solar system ranges from 300 to 500 Rupees, other than fault.

Total solar maintenance cost per year is 7430 Rs, 6470 Rs and 945 Rs for large , medium and small kilns respectively.

After each chakarMunshi hires *safaeemazdoors* (cleaning labour) to clean Chimney area and rest of the kiln so as to prepare for the next Chakar of production. Cleanliness is one day's work.

*Generator maintenance cost*is based on the hours that generator (s) work on the kiln. Generator cost is based on daily bricks made on the kiln. It is usually 2 to 3 hours per day to pump water for brick moulding purpose. Mobil is change after 60-100 hours generator work. Each time *Mobil* cost ranges between 350 – 500 Rs. In each chakar production there are limited moulding days.

Kiln Munshis usually have *motorcycle* at their disposal to perform day to day work at kiln site. Vehicle maintenance will be asked on monthly basis. Munshis just gave data about monthly maintenance cost of vehicle and did not tell about the distance they travel so *Mobil* and tyre costs could not be calculated.

It usually takes 1000-3000 Rupees to maintain a motorcycle for kiln purpose. All the kilns have it for day to day jobs. Petrol for the bike is not included in the vehicle maintenance cost head.

	small	medium	large		khairpur	larkana	sukkur
T M Cost	33464.67	141711.8	275412.8	T M Cost	176492.2	120954.6	209028.7
Annual tractor trolley maintenance	4178.572	44885.78	91207.88	Annual tractor trolley maintenance	57408.38	22610.07	73551.19
	12.91026	32.96857	32.41709		30.5624	17.17186	34.19766

Office petty cost	24765.71	81069.44	150789.8	Office petty cost	98534.35	87763.33	106970.7
	72.70312	55.46288	55.24883		57.09871	73.94164	51.27239
Solar system m cost	946.4286	6469.048	7430.882	Solar system m cost	5827.273	4100	8000
	2.547719	4.75235	2.894119		3.690213	2.629956	4.558084
cleanliness cost	2164.286	6759.524	24644.12	cleanliness cost	12648.48	4920	19150
	7.058732	4.956308	8.872421		6.590458	4.50448	9.188178
Generator maintenance	409.671	1527.986	340.0652	Generator maintenance	1073.723	561.1941	356.8099
	1.323566	1.1165	0.160743		0.943444	0.558175	0.21708
Vehicle Maintenance	1000	1000	1000	Vehicle Maintenance	1000	1000	1000
	3.456597	0.743399	0.406801		1.114772	1.193893	0.566605

Table 13: Total maintenance cost

Clay Cost: 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.

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

Table 14: Clay Analysis

On the average weight of one brick at large kilns is 2.85kg, medium kilns 2.89kg and 2.94kg for small kilns. Large kilns make 14.11 bricks per maund, medium 13.95 and 13.68 by small kilns.Large kilns make 3.27thousand bricks per trolley, medium 2.99 thousand bricks and 2.8 thousand bricks per trolley by small kilns.

overall average (Bricks made)	Bricks made per maund	efficiency	Kilns Q
13.97	11.11	79.52756	2
13.97	12.12	86.75734	2
13.97	12.5	89.47745	3
13.97	12.9	92.34073	5
13.97	13.33	95.41875	50
13.97	15.38	110.0931	9
13.97	16	114.5311	19

Table 15: Clay usage efficiency

Total Fuel Cost: 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*.

Fuel Quantity/Demand results achieved are

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
avgmaund 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

Table 16: Kiln Fuel usage analysis

Following is the list of different fuel types used at kilns.

S.No	Fuel description	Fuel type
1	Normal	Fire wood (date palm branches and leaves, cotton wood, etc) (for small kilns)
2	Normal	*Dung* or *manure* or *Shena*
3	Normal	Waste (Rubber, plastic shoes etc)
4	Normal	*Tootar (of rice)*
5	Normal	*Furt* (types : mustard /Rai and chickpea/channa)
6	Normal	*Bakas (sugarcane residual from mill)*
7	Normal	Coal
8	Normal	Booro
9	Special	*Hard wood etc*

Table 17: Different kiln fuel types

Fuel is procured in two ways i.e. Contract or Retail. 65 kilns procure via contract

	main fuel	special fuel	total fuel	total production	total bhelli bricks(not wasted bricks)	% of total production
large	35988.23529	2339.117647	38327.35294	7147058.824	496029.4118	6.940329
medium	11500	598.9285714	12098.92857	2465476.19	175321.4286	7.111057
small	830.3571429	94.28571429	924.6428571	230428.5714	16857.14286	7.315561

Table 18: Relationship of fuel with bhelli production

	total production (lakhs)	bhelli production(thousands)	total fuel (tonnes)
large	71.47058824	49.60294118	38.327353
medium	24.6547619	17.53214286	12.098929
small	2.304285714	1.685714286	0.9246429

Table 19: Relationship among brick production, Inferior bricks' quantity and total fuel used at kiln

Fuel	kg of fuel spent to make 1 bhelli brick	bhelli bricks made per kg of fuel burnt
Bakas	3.84(most efficient)	0.260417
Dung	1.28	0.78125
Furt	3.255334	0.399092
Local simple firewood	3.289252	0.393153
Tootar	2.245931	0.527254

Table 20: Kiln fuel efficiency

Transport Cost: It is cost associated with the production inputs of the clay and fuel. Kilns procure fuel and clay via local or non local means. Tractor trolleys are used. Transport of fuel, special fuel and clay is analysed separately.

Clay transport cost is not costly as compare to that of fuel. If the trolley is owned by the kiln transport cost of clay is not high. But it depends on if the kiln management uses tractor trolley for fetching clay from fields. Usually tractor trolleys at the kiln are used to provide /sell bricks to the consumers or sales agents.

Fuel used at the kilns is usually agricultural product being produced locally. *Fuel transport* is expensive as compared to clay transport.

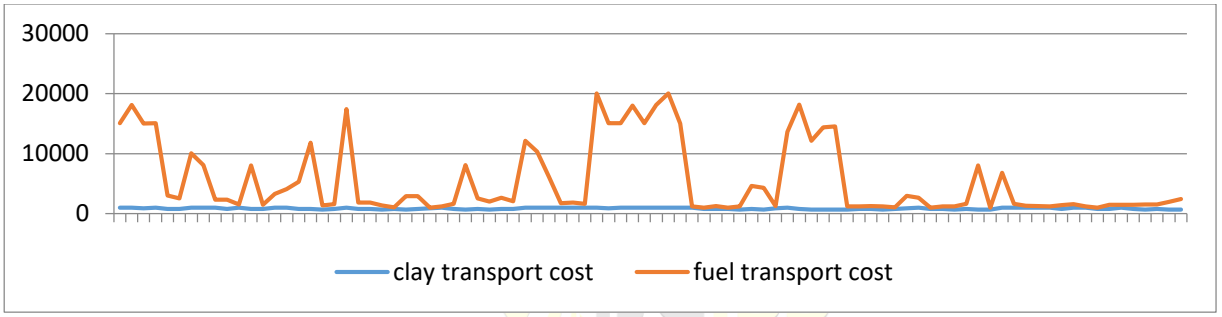

Figure 1: Relation (average fuel transport cost vs average clay transport cost)

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

Table 21: transport cost analysis

Water Cost: Water is needed at the kiln for moulding purpose. Daily bricks are moulded. Water is pumped from underground. Usually generators are used at the site for this purpose. Normally generators operate 3-5 hours in working days depending on the quantity of clay to be moulded into bricks. Fuel used for the generator is petrol. It should be noted that Mobil cost for the generator is included under maintenance cost heading. *Munshis* gave "daily cost of generator" based on the amount of petrol they use, which was asked in the questionnaire form 1. For large kiln per hour generator cost is 3997, for medium kiln 1086 and for small kiln 246. While generator maintenance cost is 340 Rs for large kiln, 1528Rs for medium kiln and 409Rs for small kiln. It is generator Mobil change etc.

Kiln Type	Generator annual work hours	generator fuel per day	total water cost (Thousands)
large	51.009784	541.17647	128.76195
medium	229.19792	469.04762	105.96406
small	61.450643	207.14286	12.685384

Table 22: water cost analysis

Factory Overhead: It includes chokidaar (security man) cost, waste cost, advertisng cost, marketing cost, utilities cost, tax cost, depreciation cost, insurance cost, theft cost and legal fees.

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

Depreciation is FOH cost on the PPE(Property ,Plant Equipment). It is part of Balance Sheet. It decreases taxation. It is 94441Rs for large kiln, 64880Rs for medium kilns and 16428Rs for small kilns per annum.

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.

	FOH (Rs)	chokidaar cost (and its % as FOH)		waste cost(and its % as FOH)		Utilities etc(and its % as FOH)	
Large	2508260	151941.2	6.057633	2310907	92.13188	45411.76	1.810489
Medium	1183567	130571.4	11.03203	1020400	86.21399	32595.24	2.753983
Small	157567.1	78285.71	49.68406	68995.64	43.78811	10285.71	6.527833

Table 23: FOH analysis

Following SPSS results for CDPF have been achieved,

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.998[a]	.995	.995	.08577

a. Predictors: (Constant), FOH, watercost, Capitalcost, totalfuelcost, landcost, claycost, maintenancecost, transportcost, Totallabourcost

Table 24: SPSS Model summary

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	126.404	9	14.045	1909.318	.000[b]
	Residual	.588	80	.007		
	Total	126.992	89			

a. Dependent Variable: LNProduction

b. Predictors: (Constant), FOH, watercost, Capitalcost, totalfuelcost, landcost, claycost, maintenancecost, transportcost, Totallabourcost

Table 25: CDPF ANOVA

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.458	.420		-3.473	.001
	Totallabourcost	.894	.051	.861	17.541	.000
	Capitalcost	.037	.011	.039	3.272	.002
	Landcost	-.005	.017	-.004	-.313	.755
	Maintenancecost	-.010	.037	-.006	-.267	.790
	Claycost	.104	.034	.098	3.053	.003
	Totalfuelcost	.025	.013	.032	1.964	.053
	Transportcost	-.005	.026	-.004	-.185	.854

Watercost	.036	.022	.028	1.672	.099
FOH	.023	.032	.019	.720	.473

a. Dependent Variable: LNProduction

Table 26: Model Coefficients

CDPF equation is generated as,

$\ln Q = -1.4 + .861\ln X_1 + .039\ln X_2 - .004\ln X_3 - .0061\ln X_4 + .098X_5 + .032X_6 - .004\ln X_7 + .028\ln X_8 + .019\ln X_9 \pm 0.086$

CDPF Hypotheses testing and statistical analysis:

R square is.995

Land rent, maintenance and transport cost have negative relation with total production level.

Labour is the most powerful variable.

Aggregate Hypothesis: There is relation between x variables and y. (no any Beta is 0)

H1: ≠0 Alternate hypothesis is accepted (with significance level of 0.000) i.e. Below 0.05

Individual Hypotheses: Only null Hypotheses accepted with significance level below.05.

Only labour, capital, clay and fuel costs are significant.

4. Conclusion and suggestions

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%).

Large kilns operate 24 hours of a day. Large kilns have Chimneys and produce 30000 to 50000 bricks on daily basis depending on the demand / consumption. It is range. Total stacking capacity of the kiln is 4 to 5 lakh bricks. Bricks can be stacked in series or parallel but usually done in sequence/series. I have not observed any kiln with two chimneys or that which operate in two or more shifts. But Mistri who fires bricks usually work for 24 hours alog with Jalaiwalamazdoors. New bricks (30k-50k) are continually stacked inside chimney while prepared /burnt/completed bricks (30k-50k)are rolled /pulled/carried out at large kilns. Small kilns remain active for specific duration. Theirs is no any big stacking capacity. They prepare, dry, sprinkle sand, and burn bricks in open. Usually their cpapacity per chakar (cycle) range from 1 lakh to 20 lakh. Also small kiln use different fuel. Fuel affects the quality of the bricks manufactured. Chimney is the towering part of the kiln visible to all. It is for exhaust purpose. Usually it is of same size but its inside capacity changes. Bhelli Bricks are inferior bricks which are either overly burnt or less burnt in the process.

It is not easy to start a kiln. It requires initial capital / investment. Large kiln need 6108824Rupees, Medium Kiln need 3714286 and small kiln needs 246428Rupees only. It is most expensive to start a kiln at district Sukkur in medium and large kiln categories. On the average it takes kilns to operate 13 months to payback their initial investment cost.

Production of average bricks is 230429, 2465477 and 7147059 bricks for small, medium and large kilns respectively. Large kilns produce can produce 15 Million bricks in a year. Average acreage is 1, 3.5 and 5.5 acres for small, medium and large kilns. There can be six partners in profit at a kiln. Leased kilns have large partner ratio with bigger profits. Kilns that are rented have one owner only.

For brick molding, carrying, stacking and firing manual technology is used at all three types of kiln. Many Punjab large kilns use zigzag technology unlike FCBTK (Fixed Chimney Bulls Trench kiln) kilns of North Sindh.

For logistical purposes kilns are constructed /operated near roads. Average net profit and average production increases because of availability of roads and less operating expenses. Some Kilns sale product directly to consumers but 54 out of 90 kilns sale only to agents.

Kilns were surveyed and 90 questionnaire forms were filled but only 25 kiln participants allowed their private data to be shared. Most of the

participants were owners themselves (42). All participants were experienced except two. Some had experience of 40 years. Some were running three kilns at a time. Only 70 got some sort of training. Highest number of kiln participants age remained in the age interval of 31-40years. As, age of participants increases the number of kilns operated and operating years/ experience at kiln increases too. On the average small kilns operated half (6 years) as less time as large kilns (12 years). Area occupied by kilns ranges from 1 acre to 21 acres. When it is feasible to lease kiln management lease kiln land for 3-10 years. Lease rupees are paid annually. Only large kilns are leased.

Cobb Douglass Production Function isabout relationship of inputs with output at a kiln.Dependent variable is total production and with 9 natural log independent variables. Results are at adjusted R^2 value of 0.995 with significant Model ANOVA. Only 4 variables are significant (labour, capital , clay and fuel) butland, maintenance, transport, water and FOH costs are insignificant variables.

6. References

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