

Issues related to livestock returns in Bangladesh

(Why Do Bangladeshi Cattle Yield High Positive Return?)

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Context and the debate

- Anagol et al. (2017): Indian cows earn negative return
- Median rate of return is -7% without labor cost
- Median rate of return is -38% with labor cost
- Measurement error leading to underestimates of returns, preference for illiquid savings insurance, variation of returns over years, labour market failures, milk market failures and social, cultural, and religious values.

Context and the debate (contd.)

- Attanasio and Augsburg (2018): Returns are negative in drought year and positive in normal years.
- Gehrke and Grimm (2018): Returns are largely negative but it may vary by quality of the cattle and size of the stock.

Context and the debate (contd.)

- Returns from livestock rearing in Bangladesh have mostly found profitable.
- Only two studies out of eight estimated negative returns (Gisby 2010 and Halim et al. 2010).
- Most of the studies ignored labor cost, some ignored app/dep of asset.
- Profitability changed less when labour costs are incorporated in Gisby (2010).

Results in brief

- The apparent paradox of widespread cattle rearing despite negative return in India does not hold in Bangladesh.
- We find that the average and marginal returns of cow and bullock are positive and high in Bangladesh.
- Appreciation of the value of cattle is the major contributing factor for positive returns.
- The existence of meat market that is based on trading of cattle for slaughtering, which is missing in most states of India, is the key to high positive return in Bangladesh.
- Despite lower return, the poorer are more likely to raise cattle.

Importance of the study

- Debate over returns to investment in livestock is extremely relevant to livestock development in Bangladesh. Because--
- **First**, the livestock sector is growing slowly in Bangladesh. Livestock sector has grown by 3.2% in 2016.
- Livestock's contribution to GDP has fallen from 2.2% in 2008 to 1.7% in 2016
- Livestock's contribution to agriculture sector has been almost static at around 13% during the same period.
- Beef consumption has steadily fallen, from 8.3 gms/p/d in 2000 to 6.8 gms/p/d in 2010.
- Per capita milk consumption in Bangladesh is 18 kg per year. (90 kg in India and 190 kg in Pakistan)
- **Second**, a firm knowledge about the rate of returns of the cattle raised by small holders is essential for designing livestock development policies as well as anti-poverty programs in Bangladesh.

Data

- We used Bangladesh Integrated Household Survey (BIHS of International Food Policy Research Institute (IFPRI)).
- This is a nationally representative data of rural Bangladesh.
- BIHS conducted two rounds of survey in 2011 and 2015 on the same households. We combined them to create a household level panel data

	BIHS 2011	BIHS 2015
Full sample (households)	6503	7036
Nationally representative sample	4423	4419
Livestock HHs (among nat. rep sample)	1823	1645

Descriptive statistics

- About 91 percent and 92 percent of the cattle owning households are male-headed in 2015 and 2011 respectively as opposed to 73 percent and 74 percent for non-cattle owning households.
- The average sizes of the households with cattle are 4.68 and 4.59 in 2015 and 2011 respectively compared to 4.12 and 3.98 for the households without cattle, with statistically significant difference.
- Male-female ratio is also significantly higher for the cattle-owning households.
- Households who raises cattle have higher amount of land than those who do not.
- Cattle owning HHs are more likely to be poor than their counterpart.
- Interestingly, households which raise cattle are closer to shops than the households which do not .

Descriptive statistics (contd.)

	2011			2015		
	Mean	SD	Observation	Mean	SD	Observation
Cattle value and herd size						
Total value of stock of cattle	34910.47	30464.29	1079	40087.96	31124.72	947
Average cattle value	15702.01	7906.84	1079	18362.57	9928.11	947
Herd size: Cattle	2.32	1.48	1079	2.3	1.45	947
Herd size: Only Bullock	1.6	0.92	263	1.67	1.19	200
Herd size: Only Milk Cow	1.45	0.71	272	1.48	0.78	232
Herd size: Both Milk cow and bullock	2.82	0.95	85	2.91	1.57	86
Herd size: Calf household	3.42	1.61	333	3.22	1.43	296
Herd size: Sales household	2.46	1.57	126	2.25	1.35	133
Revenue and costs						
Milk	5936.17	18420.8	827	9229.02	19338.18	779
Manure	1911.75	2156.76	1079	1604.32	1994.68	947
Calf	8564.95	3201.99	333	10503.83	3411.61	296
Fodder	3994.41	9945.34	1079	4655.44	7447.25	947
Wage labor (taka)	176.15	2420.96	1079	32.41	479.13	947
Family labor (male, no of hours on livestock)	306.22	410.02	1079	369.07	273.66	947
Family labor (female, no of hours on livestock)	341.46	244.59	1079	410.64	274.55	947

Descriptive statistics (contd.)

- Mean of the total value of the stock were about 35,000 BDT in 2011 and 40,000 BDT in 2015 while the average cattle value were about 16,000 BDT and 18,000 BDT in nominal terms.
- Size of the herd has remained constant at about 2.3 during this time.
- The share of milk revenue has increased sharply during 2011 and 2015; an increase by about 65 percent.
- Female family members worked more hours on cattle rearing than the male members.

Profits from raising livestock in BD

(Sample size)

	HH type (by herd size)	BIHS 2011	BIHS 2015
HHs with only bullock	Constant	263	200
HHs with only milk cow	Constant	272	232
HHs with both milk cow and bullock	Constant	85	86
HHs with a calf at the end period	Non constant	333	296
HHs sold cattle at the end period	Non constant	126	133
Working sample	--	1079	947

- We have dropped HHs with (i) purchase of a new cattle, (ii) giving/receiving of cattle as gift, (iii) leasing in cattle, (iv) own consumption of cattle and (v) cattle lost (i.e. stolen/burnt/spoilt/died).
- 744 and 698 such HHs in 2011 and 2015 respectively.

Profits from raising livestock in BD (contd.)

(Methodology)

- Let the household level aggregate production function of milk cow be-
- $Q = Af(K, L, X, F)$
- Where, Q= milk, calves, cattle sold, manure; K = value of cows; L= labour; X = land; F = fodder, A= household and region-specific characteristics that influence the TFP of inputs.
- The profit function-
- $\pi = P \cdot Q - cK - wL - gF - rX + \delta K$
- Where, P = price vector of outputs; w= wage rate (both market and imputed); g= price of fodder; r= rent of land; c=other costs associated with K; δ =rate of appreciation/depreciation. Price of capital is assumed to be zero, following Gehrke and Grimm, (2018), We also set r=0.
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Profits from raising livestock in BD (contd.)

(Components of profits: 2011)

Constant herd size (sample size=620)											
		Revenue				Cost				Profit with family L	Profit without family L
	Appreciation/Depreciation (appreciation gross income ratio)	Milk	Manure	Value of calf	Value of the cattle sold	Wage labor	Family labor	Fodder	Medicine and other cost		
Households with only Bullock	0.68 (0.77)	0	1352	0	0	86.80	7479	2877.33	255.62	-2226	5252
Households with only Milk cow	0.71 (0.57)	3557	1541	0	0	33.80	7514	2707	339	1509	9023
Households with both Bullock and Milk cow	0.61 (0.77)	6383	2383	0	0	188	8806	5654	549	4208	13015
Non-constant herd size (sample size=459)											
Households with a calf at the end period	0.43 (0.04)	8728	2331	8564	0	360	9278	5540	518	9646	18925
Households sold cattle at the end period	0.12 (0.31)	3416	2357	0	27798	153	9580	4457	426	31953	41534

Profits from raising livestock in BD (contd.)

(Components of profits: 2015)

Constant herd size (sample size= 518)											
	Revenue					Cost				Profit with family L	Profit without family L
	Appreciation/ Depreciation (appreciation gross income ratio)	Milk	Manure	Value of calf	Value of the cattle sold	Wage labor	Family labor	Fodder	Medicine and other cost		
Households with only Bullock	0.68 (0.78)	0	1432	0	0	0	5537	3996	305	2437	7974
Households with only Milk cow	0.42 (0.56)	6624	1226	0	0	43	5772	4298	473	4595	10368
Households with both Bullock and Milk cow	0.43 (0.56)	16198	1757	0	0	55	7080	5824	475	17612	24693
Non-constant herd size (sample size=429)											
Households with a calf at the end period	0.19 (0.04)	10052	2031	10503	0	53	6111	4019	491	18305	24417
Households sold cattle at the end period	0.15 (0.18)	7045	1487	0	32002	0	6108	6888	707	40615	46724

Profits from raising livestock in BD (contd.)

(Components of profits: 2011 & 2015)

- Appreciation is high for constant herd size HHs, and low for non-constant herd size HHs.
- Appreciation is a major source of gross income for constant herd size HHs and minor for non-constant herd size HHs.
- We also observe that bullocks appreciated more than milk cows in 2015 but in 2011 it appreciated 3 percentage point less.
- As expected, the share of milk revenue is the highest for the households with a calf.
- Profit from raising livestock is found positive (excluding family labor cost) in all categories.
- Once family labor is valued at market price, the profit reduces considerably and even becomes negative for the households with only bullock.

Average and marginal returns

- Average return of raising livestock is given by,
- $\frac{\pi}{K} = P \cdot \frac{Q}{K} - c - \frac{wL}{K} - \frac{gF}{K} + \delta$
- We estimate marginal returns in two different ways. First, using a linear production function-
- $\pi_i = \alpha_0 + \alpha_1 K_i + \alpha_2 X_i + e_i$
- Second, we use a CES production technology to estimate marginal return.
- $\pi'(K) = P \cdot Q'(K) - c + \delta$
- Or $\pi'(K) = P \cdot \alpha_1 \cdot \frac{Q}{K} - c + \delta$ -----(1)
- $\text{Log}(PQ) = \alpha_0 + \alpha_1 \log K + \alpha_2 \log L + \alpha_3 \log X + \alpha_4 \log F + \alpha_5 A + \epsilon$ -----(2)
- We get alpha from equation (2) and plug in to equation (1) to get marginal return.

Average and marginal returns (contd.)

(Results: 2011 & 2015)

BIHS 2011: Constant Herd Size (sample size= 620)				
	Average return		Marginal return (with CES fn)	
	With family L	Without family L	With L	Without L
Households with only Bullock	-15.68	19.13	.73	.70
Households with only Milk cow	-4.4	28.54	.82	.82
Households with both Bullock and Milk cow	-2.13	8.8	.67	.63
BIHS 2011: Non-constant herd size (sample size=459)				
Households with a calf at the end period	12.85	37.07	.96	.96
Households sold cattle at the end period	22.48	30.37	.71	.72
BIHS 2011: All (sample size =1079)	1.38	27.43	.82	.81

BIHS 2015: Constant Herd Size (sample size=518)				
	Average return		Marginal return (with CES fn)	
	With family L	Without family L	With L	Without L
Households with only Bullock	-0.67	21.92	.74	.73
Households with only Milk cow	6.46	27.88	.57	.57
Households with both Bullock and Milk cow	11.80	18.65	.51	.50
BIHS 2015: Non-constant herd size (sample size=429)				
Households with a calf at the end period	38.01	59.92	.73	.73
Households sold cattle at the end period	24.30	29.61	.37	.37
BIHS 2015: All (sample size =947)	17.69	35.71	.62	.62

Average and marginal returns (contd.)

(Linear pro fun results: 2011 & 2015)

	OLS		RE	FE
	(1)	(2)	(3)	(4)
Value of the cattle	0.584***	0.559***	0.601***	0.674***
	(0.018)	(0.028)	(0.018)	(0.035)
Value of the cattle(squared)		0.000		
		(0.000)		
Labor cost	-1.069***	-1.078***	-1.113***	-1.252***
	(0.102)	(0.102)	(0.101)	(0.197)
Homestead land owned	151.273***	154.172***	155.448***	168.174
	(40.761)	(40.836)	(44.966)	(209.049)
Fodder cost	-0.330***	-0.360***	-0.342***	-0.382**
	(0.066)	(0.071)	(0.067)	(0.161)
Distance to local shop	76.055	55.082	-215.206	-1,005.700
	(778.174)	(778.327)	(762.720)	(1,236.430)
Year	3,022.551***	3,085.597***	2,949.262***	2,504.362*
	(1,058.697)	(1,060.038)	(926.548)	(1,295.739)
Constant	-4,122.871***	-3,388.365**	-4,019.691***	-5,088.151*
	(1,289.884)	(1,439.938)	(1,303.365)	(3,082.050)
Observations	2,008	2,008	2,008	2,008
R-squared	0.388	0.388		0.512

Note: Linear production function assumed. Dependent variable is profit (with labor cost). Standard errors (clustered at household level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Average and marginal returns (contd.)

(CES pro fun results: 2011 & 2015)

	OLS (1)	RE (2)	FE (3)
Total asset value (log)	0.784*** (0.051)	0.776*** (0.051)	0.504*** (0.117)
Labor cost (log)	0.083 (0.060)	0.067 (0.060)	-0.113 (0.121)
Homestead land (log)	0.090*** (0.029)	0.097*** (0.029)	0.180* (0.102)
Fodder cost	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Distance to local shop	0.081 (0.050)	0.079 (0.050)	0.014 (0.097)
Year	0.235*** (0.070)	0.213*** (0.067)	0.005 (0.110)
Constant	-1.416* (0.733)	-1.266* (0.737)	2.171 (1.921)
Marginal returns to cattle at:			
Median	0.56	0.56	0.46
Mean	0.83	0.82	0.71
Observations	1,843	1,843	1,843
R-squared	0.192		0.089

Note: CES production function is assumed. Dependent variable is the log of sales revenue from dairy products, calves (if any) and revenue from cattle sales (if any). Standard errors in parentheses (clustered at household level). *** p<0.01, ** p<0.05, * p<0.1

Average and marginal returns (contd.)

(Results: 2011 & 2015)

- In Bangladesh, both average and marginal returns are positive for the full sample.
- The average return (without family labor) from holding cattle for a year is 27.4 and 35.7 percent in 2011 and 2015 respectively.
- However, average return is sensitive to the inclusion and exclusion of family labor cost.
- The marginal return is positive and very high in Bangladesh which is more than 80 percent and 60 percent per year in 2011 and 2015 respectively. Intuitively, annual return from investing additional one dollar to the existing stock is 82 cents in 2011 and 62 cents in 2015.
- Among constant herd size households, those who have only milk cows, earns the highest average return in both years.

Heterogeneity in returns

(Is there any economies of scale?)

Herd size	average value of total stock(BDT)	average return (with family L)	average return (without family L)	marginal return (with L)	marginal return (without L)	Observation
1	17826	-8.68	34.46	0.84	0.83	373
2	15277	7.97	33.12	0.79	0.78	349
3	13666	6.19	18.52	0.81	0.80	183
4	14667	6.80	15.50	1.03	1.03	108
>4	13679	5.46	9.97	0.56	0.56	80

BIHS 2011

Herd size	average value of total stock(BDT)	average return (with family L)	average return (without family L)	marginal return (with L)	marginal return (without L)	Observation
1	21158	11.42	43.98	0.73	0.73	322
2	17360	29.50	45.39	0.60	0.60	301
3	16584	15.28	22.60	0.61	0.61	176
4	17233	10.79	15.25	0.50	0.50	75
>4	15612	9.18	11.91	0.42	0.43	73

BIHS 2015

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Heterogeneity in returns (contd.)

(Is there any economies of scale?)

- Average return tends to decrease with the herd size; the average return is maximum for herd size of one or two.
- When family labor is not priced, average return was as high as 45% for the herd size two in 2015. For the herd size three and above, the average return decline sharply – 23%, 15% and 11% respectively for herd size 3,4 and 5 in 2015.
- In case of marginal return, we observe such pattern for 2015, but not for 2011.

Heterogeneity in returns (contd.)

(Who raises livestock more?)

Per capita food exp quintiles	% of HHs with livestock	Average herd size (full sample)	Average herd size (livestock sample)	Average value of total stock (BDT)	Avg. value of stock bull only (BDT)	Avg. value of stock cow only (BDT)	Average return (without family L)	Marginal return (without L)
Q1	61.81	1.5	2.5	33058	21815	29316	20.3	0.62
Q2	45.08	1.04	2.31	31315	22454	28163	22.38	0.7
Q3	36.43	0.87	2.32	32718	22202	27958	19.13	0.81
Q4	32.32	0.73	2.37	35317	21026	34858	24.9	0.88
Q5	30.43	0.75	2.44	39174	22069	35251	22.55	0.73
BIHS 2011								

Per capita food exp quintiles	% of HHs with livestock	Average herd size (full sample)	Average herd size (livestock sample)	Average value of total stock (BDT)	Avg. value of stock bull only (BDT)	Avg. value of stock cow only (BDT)	Average return (without family L)	Marginal return (without L)
Q1	52.04	1.18	2.29	35161	26139	29145	20.9	0.58
Q2	42.76	0.91	2.22	36879	25928	32537	23.8	0.6
Q3	35.52	0.79	2.14	34682	24218	31122	19.1	0.61
Q4	31.45	0.68	2.22	37476	27275	31611	31.3	0.69
Q5	24.35	0.57	2.29	44195	26684	40050	24.48	0.64
BIHS 2015								

Heterogeneity in returns (contd.)

(Who raises livestock more?)

	Dep. Var = Livestock incidence	Dep. Var = Herd size	Dep. Var = Livestock incidence	Dep. Var = Herd size
	2011		2015	
Expenditure dummy:Q1	0.077*** (0.002)	-0.465*** (0.000)	0.087*** (0.001)	-0.286*** (0.018)
Expenditure dummy:Q2	-0.005 (0.824)	-0.418*** (0.000)	0.040* (0.096)	-0.191* (0.102)
Expenditure dummy:Q3	0.003 (0.876)	-0.339*** (0.002)	0.056*** (0.017)	-0.027 (0.807)
Expenditure dummy:Q4	-0.001 (0.957)	-0.242** (0.026)	0.019 (0.391)	-0.093 (0.405)
Female male ratio	-0.025*** (0.001)	--	-0.023*** (0.002)	--
Female labor*Male labor	--	1.79e-06*** (0.000)	--	2.23e-06*** (0.000)
HH size	0.054*** (0.000)	0.144*** (0.000)	0.041*** (0.000)	0.138*** (0.000)
Education of HH head	0.0001 (0.295)	-0.0001 (0.855)	0.0003** (0.033)	-0.0004 (0.537)
Homestead land	0.005*** (0.000)	0.012*** (0.000)	0.004*** (0.000)	0.005* (0.064)
Distance to local shop	0.012 (0.311)	-0.051 (0.307)	0.024* (0.071)	0.005 (0.930)
No. of observation	4,134	1,773	4,145	1,620
R-squared	0.1499	0.1646	0.1371	0.1865

Heterogeneity in returns (contd.)

(Who raises livestock more?)

- Poorer households raise livestock more.
- in both years, the incidence of livestock raising of the households in bottom 20th quintile is more than twice than the households in top 20th quintile.
- Among the households who raises livestock, herd size and average value of the stock does not vary much over the food expenditure quintiles. In both years, the average rate of return is found lowest in third food expenditure quintile.

Robustness check

(Returns with non-cash fodder)

- Due to lack of data, we rely on secondary information on non-purchased fodder.
- We assume that home produced and collected fodder is about 20% of total purchased fodder, when priced at market price (Halim et al. 2010).
- Even if we consider non-market fodder, the average return is still very high – about 34% when we do not consider family labour in 2015. If we price family labour at market rate, this return turns out to be about 16% in 2015.

Discussion on the debate

(Role of appreciation and the meat market)

- Existence of market for buying and selling of cattle for meat consumption (explained by high appreciation) is the key to high positive return in Bangladesh.
- Due to the absence of a proper meat market (i.e. cattle slaughter is prohibited), appreciation of a cattle is solely determined by the biological age of a cattle in India.
- In Bangladesh, due to the existence of a competitive meat market, appreciation (as measured by the reported market price of cattle) reflects not only the age of the cattle but also the value or meat or other factors like cattle's breed, cattle's overall health, consumer preference, condition of the market etc.

Discussion on the debate (contd.)

(Role of appreciation and the meat market)

- We have found appreciation to be very high in Bangladesh. Appreciation of value of bullock was found higher than cows and rates of returns similar for 2015. This shows that the market considers many factors other than age for valuing livestock.
- This difference between the definition of appreciation (arising from the absence or presence of meat market) makes the cattle rearing non-profitable in India and highly profitable in Bangladesh.

Conclusion

- Unlike India, the rates of returns from raising cattle in Bangladesh, are high and positive.
- We have argued that positive/high rates of returns in Bangladesh is explained by the existence of market for cattle in a social setup where there is no moral or religious stigma attached to meat consumption.
- Higher rates of return for livestock rearing indicate that there is a scope for further development of the livestock sector.
- Since rates of return are higher for poorer households, the possibility to reduce poverty through livestock transfers still remains.

Thank you