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Effect of different sources of water on water quality and growth performance of growing bull

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Abstract

The experiment was conducted to investigate the effect of different sources of water on feed intake and growth performance of growing bull. For this study, sixteen indigenous bulls *(Bos indicus*), around two years age (132.5±20.5 kg of LW), were divided into four groups having four animals in each treatment group. The animals were supplied with four different sources of water viz. Deep Tube Well Water (DTW =T_1), Supply Water from reserve tank (SW = T_2), Pond water (PW = T_3) and River water (RW = T_4). All the animals were fed German Grass (*Echinochloa polystachya* L.) and concentrate mixture. All the animals were free access to water. Live weight was recorded initially and week interval till end of the feeding trial (12 weeks). The results revealed that animal belonging T_1 treatment group showed best growth performance was better in comparison to other treatment groups. Dry matter intake (DMI) was highest for T_1 group (3.08 ± 0.08 kg/d) and lowest for T_4 group (2.81 ± 0.18 kg/d). The digestible nitrogen free extract (DNFE) and total digestible nutrient (TDN) were higher ($P<0.05$)in T_1 group compared to other groups. The highest daily body weight gain (336.49±59.40 g/d) was observed in T_1 group. Based on the results, it is concluded that deep tube well water (T_1) is suitable for cattle for its quality which showed positive impact on intake and growth of animals. Further study might be needed to compare the cost involvement for different sources of water and economy of growth of animals.

Key words: water source, water quality, water intake**,** bull, growth performance

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Introduction

Water accounts for 50–80% of an animal's live weight, depending on age and degree of fat cover, and is involved directly or indirectly in every physiological process occurring within the animal. Water acts as a media for transportation of nutrients, waste products, hormones, and other chemical messengers, and aids in the movement of food through the gastrointestinal tract. Water helps to regulate blood osmotic pressure and is a major component of secretions such as saliva and milk. Body temperature is also regulated through the evaporation of water from the respiratory tract and the skin's surface (Roubicek, 1969). The water supply in ruminant animals comes from voluntarily drinking water, water in the feed, and metabolic water. Environmental factors affect water intake in cattle. Animal factors include body size (Pandey *et al.,* 1989), dry matter intake (Hicks *et al.,* 1988), and stage of production. Beaver (1989) and Holechek (1980) reported that decrease water consumption and animal weight gain from drinking water source contaminated by feces and urine. Water and forage intake are closely related (Hyder *et al*., 1968). It has been estimated that cattle requires approximately 2–4 kg of water for every 1 kg of feed consumed (Utley *et al*., 1970). The water supply for feedlots can come from a number of sources with different water quality. Furthermore, according to Sultana *et al.* (2016), socio-economic factors affecting milk production and water use are highly linked with adoption of efficient management decision tools that will guide the farme rs to allocate water resources effectively for increasing milk production.

Water sources include surface water (dams, rivers, creeks, and channels), groundwater (bores, wells) or municipal supply. In evaluating a feedlot water source, emphasis is generally placed on the chemical and physical characteristics of the water as they relate to cattle drinking water. Cattle are sensitive to water taste and odor and may drink less if the water is unpalatable (Ali *et al*., 1994). Newly arrived cattle may be reluctant to drink water that has an unusual odor or taste, causing short-

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term stress. Contaminated water sources can affect the animal's water intake and animal performance or health. Problems with water quality may have a chemical basis (e.g. pH or concentrations of certain elements) or may be due to physical causes (e.g. turbidity when the water is cloudy with suspended solids) or biological (algae). Some problems may be obvious while others may require more extensive analysis and treatment.Good quality water is clean, clear, odorless, palatable, and free from toxins and has a low mineral content. An indication of poor quality water includes; high level of soluble salt, algae, bacterial contamination, or is turbid which has resulted from clay suspension. Pollution in water which includes chemicals, dead animals, bird droppings and debris can also cause problems.

Based on background information and problem statement as mentioned above, the proposed research objective is to investigate the effect of different sources of water on quality, feed intake and growth performance of growing bull.

Materials and Methods

The experiment was conducted for 80 days and data collected from middle 75 days was used in the analysis. A total of 16 local growing bulls which were assigned a numerical number from 1 to 16 and each treatment group consist of 4 animals.

Experimental location

For conducting the experiment, the feeding trial was conducted in the Shahjalal Animal Nutrition Field Laboratory under the Department of Animal Nutrition, Bangladesh Agricultural University (BAU), Mymensingh. German grass was cultivated at Shahjalal Animal Nutrition Field Laboratory.

Experimental design

Table 1. Layout of the Experimental design showing distribution of Cattle

Replication Animal No.	Treatments				Total Animals
	T_1	T_2	T_3	T_4	
R1	1	2	3	4	4
R2	5	6	7	8	4
R3	9	10	11	12	4
R4	13	14	15	16	4
Total no. of animals	4	4	4	4	Grand total=16

T_1 =DTW-Deep Tube-well water; T_2 = SW-Supply Water; T_3 =PW-Pond Water; T_4 =RW-River Water; R1=Replication 1; R2 = Replication 2; R3 =Replication 3; R4 = Replication 4; under treatments, the number represents the Animal Identification (Tag No) starting from 1 and end up to 16.

Sixteen local cattle (*Bos Taurus* L), aged around two years and weighing average 132.50±20.49 kg of body weight were used to conduct the experiment. The animals were assigned into four groups with each group having four animals which was selected randomly and experiment was conducted using randomized block design. Chronologically the groups ware supplied with deep tube well water, supply water, pond water, river water and common feeding system was maintained for all the 16 animals.

Experimental diet

The experimental diet consists of the fixed amount of roughage particularly green grass, concentrate mixtures and salt. The water was provided as *ad libitum* to each of the animal. German grass diet was supplied to each group of animals. German grass was collected from Shahjalal Animal Nutrition Field Laboratory under the Department of Animal Nutrition, Bangladesh Agricultural University (BAU), Mymensingh. The German grass was chopped in 4mm long before supplying to the animals. Cattle were fed 5±2 kg twice in a day according to their body weight. Daily required amount of total German grass was divided in two parts, one part was supplied in morning (8.00h) and another part was supplied in afternoon (16.00h).

Concentrate mixer preparation

All the ingredients required for concentrate mixture preparation were collected from local market and were grinded. After grinding oil cake, maize, wheat bran and all other ingredients were mixed well using mixer machine. Finally 2% common salt was added with the mixture).

Table 2. Composition of (Kg/100kg) and nutrient content (g/100gm)

Ingredients	Amounts (100kg)
Maize	32
Wheat bran	12
Rice polish	20
Mustard oil cake	36
Dry matter	89.65±0.21
Crude protein	16.23±0.21
Crude fiber	8.035±0.12
Ether extract	3.57±0.10
Ash	9.67±0.035
Nitrogen free extract	61.54±0.22

Maintenance and managerial operation

Temperature and ventilation

The side wall of the shed was exposed to grill. So that air and light could have passed uninterruptedly. The normal atmospheric temperature was (about 25 ± 4^0C) present in the house. The temperature of the water was measured recurrently with the clinical thermometer. The range of water temperature was about $(75\text{-}95)^0$F. There was also facility for curtain by which it can protect the animals at heavy rain or excessive heat.

Feed and water supply

The concentrate feed 0.5kg was supplied to the animals once in a day. Daily required amount of total concentrate was supplied in the morning. Clean and fresh water from different sources were provided by measuring in weighing balance. No growth promoter, antibiotics or feed additives was provided to the cattle. Four treatment groups were four different sources of water such as Deep Tube Well (DTW $=T_1$), Ordinary Supply Water coming via reserve tank (SW $= T_2$), Pond Water (PW $= T_3$) and River Water (RW $= T_4$). Each group has given the same feed such as German Grass (*Echinochloa polystachya* L.) and concentrate feed.

Data collection

Animals were weighed at the onset of trial and then after every one week interval throughout the experimental period. The average body weight gain of animals was calculated by deducting initial body weight from the final body weight. The final body weight gain was measured just prior to stop the feeding trial.

Collection of feces sample

Feces samples were collected during last 7 days of the experimental period. Feces were collected on the polythene bag. After collection, feces samples were dried at 105^o C in hot air oven for 24 hours. Then the feces sample were ground to 1 mm mesh and stored at -20^o C for analysis.

Analysis of feeds and feces sample

Proximate components of feces and feed sample ware analyzed by Khjeldhal method (AOAC, 2010.

Determination of Water Quality

Water quality parameters include PH, Salinity, Biologically Oxygen Demand (B.O.D), Hardness, Sulphate, and Nitrate, each quality parameter was tested by using specific chemical kit applicable to that parameters such as for pH(HI3817, Hanna's pHep®) test kit, hardness (HI3817, Hanna's pHep®) test kit, Sulphate (HI38000, Hanna's pHep®, using turbidimetric method) test kit, Salinity (HI3835, Hanna's instrument®, using mercuric nitrate titration) test kit, Nitrate (HI38050, Hanna's pHep®, uses the cadmium reduction method to measure nitrate) test kit. Phosphorous (HI96706, Hanna's pHep®, portable photometer is for the measurement of phosphorus) Test kit. B.O.D (HQ40D, Hanna's instrument®, followed by using luminescent DO Sensor) test kit.

Statistical analysis

Data were represented as the mean ± SD (standard deviation). All data were subjected to one-way ANOVA using Complete Randomized Design (CRD), and the significance of difference among means was determined using Tukey's HSD test (1953). All analyses were conducted in SPSS (2002). Differences at $P < 0.05$ were considered statistically significant.

Results and Discussion

Determination of Water Quality

The water quality parameters are stated in **Table 4**. There was a significant effect ($P<0.05$) among the different treatment groups for different parameters that was analyzed for water quality. But there was no significant effect (<0.005) among the different treatment groups for temperature. However, in case of the pH parameters, there has significant effect among the different groups. The highest pH value was found in (DTW $=T_1$), groups followed by (SW$=T_2$),(PW$=T_3$) and(RW$=T_4$) group. The highest salinity was found in the SW group that was 224±6.0 followed by DTW, RW and PW group. In the Biological Oxygen Demand (B.O.D) parameter, the highest B.O.D was found in PW group that was 6.26±0.03 and followed by (SW$=T_2$), (PW$=T_3$) and (RW$=T_4$) group. The hardness parameter the highest value was found in T_1 group compared to T_4, T_3 and T_2 group. In case of nitrate test, the highest result was found in T_4 group followed by T_3, T_2 and T_1 group. In the Phosphate group, there was no significant effect on different treatment group and the largest value was found in T_4 and T_2 group compared to T_1 and T_2 group. For the determination of water quality in sulphate the highest significant was found in RW group, followed by T_2, T_3 and T_1 groups (**Table 4**).

Table: 3. Water Quality Parameters

Parameters	Sources of water for drinking				SEM	*P*-value
	DTW	SW	PW	RW		
Temperature	25.27±0.13	25.47±0.25	25.41±0.10	25.50±0.36	0.063	0.645
PH	6.75^{a}±0.21	6.71^{a}±0.32	6.37^{ab}±0.14	6.22^{b}±0.10	0.085	0.040
Salinity	185.0^{b}±5.0	224.0^{a}±6.0	72.20^{d}±0.20	157.0^{c}±3.0	16.84	<0.001
B.O.D	5.51^{c}±0.11	5.75^{b}±0.10	6.26^{a}±0.03	4.93^{d}±0.027	0.15	<0.001
Hardness	300.0^{a}±50.0	140.37^{b}±2.1	185.33^{b}±5.03	195.35^{b}±26.1	18.96	0.001
NO_3	1.41^{c}±0.25	17.84^{b}±1.60	78.57^{a}±10.79	88.21^{a}±0.64	11.38	<0.001
PO_4	0.076±.012	0.08±0.01	0.07±0.02	0.08±0.01	0.003	0.620
SO_4	5.57^{d}±0.93	45.33^{b}±4.16	15.21^{c}±0.66	833.29^{a}±6.33	106.01	<0.001

T_1 =DTW-Deep Tube-well water; T_2 = SW-Supply Water; T_3 =PW-Pond Water; T_4 =RW-River Water; R1=Replication 1; R2 = Replication 2; R3 =Replication 3; R4 = Replication 4;B.O.D-Biological Oxygen Demand

Water quality measurements usually include readings of different water properties, such as the salinity, hardness, pH, microbiological quality, Sulphate, phosphate and nitrate levels (Ittner *et al.,* 1951; Ittner *et al.,* 1954; Lofgreen *et al.,* 1975) had been reported that clean low temperature (10°C vs. 27-28°C) drinking water has been shown to increase live weight gain in beef cattle and (Milam *et al.,* 1986; Wilks *et al.,* 1990) also found feed intake and milk production increase in dairy cattle, compared to supply of pond water and river water. Andersson (1985) found that under thermoneutral conditions (mean temperature was 15.3°C and the range was 10 to 24°C), water consumption of lactating Swedish cows was lower when the water was offered at 24°C than for 3, 10 or 17°C to cows. This study results in **table 4** were supported to the preceding findings.

Willms *et al.* (2002) reported that high salt contents can influence water, feed intake and subsequent growth rates of the beef cattle. Graf & Holdaway (1952) and Allen *et al.* (1958) had been shown that the potential effects of the hardness of the water were investigated in the 50's, but these studies showed no effect of hardness (190 and 290 ppm compared to 0 ppm) on dairy cow's milk production, weight gain or water consumption. High concentrations of sulfate in drinking water can reduce water consumption. Weeth and Hunter (1971) found that 3493 ppm sulfate as sodium sulfate reduced water intake, weight gain, and DMI of heifers. In another research Digesti and Weeth (1976) reported that heifers rejected high sulfate water compared to low sulphate containing water. These findings Kahler *et al.* (1974) reported that beef drinking with high-nitrate water had low growth rate for beef cattle and also had more services per conception, lower first service conception rates, and longer calving intervals for dairy cows.

Different sources of water intake by the growing bull

There was a significant impact on water intake among different treatment groups. The average water intake was higher in (DTW =T_1) group than other group. In the deep tube-well water supplying group, the daily average water intake was 6.73±0.09 and the nearest water intake was T_2(Supply water) group which was 5.76±0.09 litter per day. The other treatment group T_3 (Pond water) and T_4(River water) intake was 4.96±0.04 and 4.80d±0.07 that was comparatively lower than T_1 and T_2 group.

Olson *et al.* (1995) found lowest water intake for contaminated source compared to clean water in beef cattle and stated that fecal contamination in pond water was one of the main reason for lower water intake by beef cattle. Willms *et al.* (2002) also found similar result with dairy cattle. Similar findings were demonstrated by Holechek (1980) who reported a decrease in water consumption and weight gain of cattle drinking from a water source contaminated with feces and urine which was most predominant in river and pond water. All of these results justify this finding.

Relationship between water source and DM intake

The Relation between water intake and DM intake are stated in **table 5.** Supplementation of different sources of water with German grass and concentrate feed had significant (<0.05) effect on different treatment groups. The significant effect was found in water intake and dry matter intake.

The highest water intake for per kg dry matter intake was DTW (T_1=Deep Tube-well water) group followed by T_2, T_3 and T_4 group. But the daily body weight gain for per kg water intake had no significant effect on different treatment groups. Among the different treatment groups for per kg body weight gain the highest water intake was in RT (T_4=River Water) group followed by T_3, T_2 and T_1 group.

Table 4. Effect of different sources of water intake in growing bulls

Parameters	Diet				SEM	*P*-value
	DTW	SW	PW	RW		
1st week	6.20^{a}±0.27	5.56^{ab}±0.70	4.80^{b}±0.76	4.69^{b}±0.42	0.20	0.009
2nd week	6.19^{a}±0.50	5.85^{ab}±0.47	5.00^{bc}±0.66	4.56^{c}±1.06	0.23	0.026
3rd week	6.41^{a}±0.35	5.51^{b}±0.50	4.65^{b}±0.73	4.89^{c}±0.61	0.22	0.004
4th week	6.37^{a}±0.58	5.59^{ab}±0.47	4.69^{bc}±0.59	4.54^{c}±0.89	0.24	0.005
5th week	6.81^{a}±0.38	5.90^{b}±0.44	5.21^{bc}±0.54	4.81^{c}±0.52	0.22	<0.001
6th week	6.55^{a}±0.30	5.63^{b}±0.43	4.71^{c}±0.33	4.64^{c}±0.27	0.07	0.027
7th week	6.75^{a}±0.41	5.71^{b}±0.37	4.92^{c}±0.24	4.71^{d}±0.28	0.06	0.026
8th week	6.88^{a}±0.21	5.83^{b}±0.28	5.01^{c}±0.16	4.77^{d}±0.28	0.04	<0.001
9th week	6.91^{a}±0.34	5.92^{b}±0.32	5.15^{c}±0.18	5.01^{c}±0.25	0.05	0.005
10th week	6.93^{a}±0.30	5.95^{b}±0.22	5.17^{c}±0.23	4.99^{d}±0.22	0.04	<0.001
AWI/day	6.73^{a}±0.09	5.76^{b}±0.09	4.96^{c}±0.04	4.80^{d}±0.07	0.03	<0.001

AWI- Average Water Intake; T_1 =DTW-Deep Tube-well Water; T_2 = SW-Supply Water; T_3 =PW-Pond Water; T_4 =RW-River Water; R1=Replication 1; R2 = Replication 2; R3 =Replication 3; R4 = Replication 4;

Table 5. Relation between water intake from different source and DM intake

Parameters	Diet				SEM	*P*-value
	DTW	SW	PW	RW		
DMI (kg/d)	3.08^{a}±0.08	3.04^{a}±0.18	2.92^{ab}±0.09	2.81^{b}±0.18	0.05	0.055
WI (L/d)	6.73^{a}±0.09	5.76^{b}±0.09	4.87^{c}±0.14	4.67^{c}±0.34	0.03	<0.001
WI /kg DMI	2.18^{a}±0.15	1.90^{b}±0.12	1.70^{c}±0.08	1.71^{c}±0.07	0.05	<0.001
WI/BWG	17.72±6.92	17.93±0.84	23.02±13.15	18.01±2.34	1.82	0.602

T_1 =DTW-Deep Tube-well Water; T_2 = SW-Supply Water; T_3 =PW-Pond Water; T_4 =RW-River Water; R1=Replication 1; R2 = Replication 2; R3 =Replication 3; R4 = Replication 4; DMI = Dry Matter Intake, WI = Water Intake, BWG =Body Weight Gain

Table 6. Effect of different sources of water on nutrients digestibility of bull.

Parameters	Diet				SEM	*P*-value
	DTW	SW	PW	RW		
DCP	7.06±0.10	6.11±0.05	6.14±0.09	6.12±0.045	0.02	0.821
DCF	23.92±0.06	23.96±0.21	23.88±0.10	23.98±0.09	0.04	0.813
DEE	1.81±0.09	1.83±0.10	1.86±0.08	1.78±0.05	0.02	0.682
DNFE	39.06^{a}±0.29	38.12^{b}±0.34	39.01^{a}±0.21	37.03^{c}±0.32	0.32	0.001
TDN	72.05^{a}±0.75	70.31^{b}±1.01	72.01^{a}±0.37	70.26^{b}±0.31	0.32	0.016

T_1 =DTW-Deep Tube-well Water; T_2 = SW-Supply Water; T_3 =PW-Pond Water; T_4 =RW-River Water; R1=Replication 1; R2 = Replication 2; R3 =Replication 3; R4 = Replication 4.

Murphy (1992) found a negative correlation between DM content and total water consumption. Paquay *et al.* (1970) and Stockdale and King (1983) found that as DM content increased, drinking water intake increased while total water consumption decreased. In our experiment we found highest DM and water intake for TW group compared to other group which was similar to finding Schütz k., (2012) and Olson *et al.* (1995) in beef cattle. Schütz k., (2012) found higher DM intake for clean water supplementing group compared to pond water group and Olson *et al.* (1995) found that water intake was lowed in beef when it was contaminated with feces and urine. Preceding's findings are supported in this present study results.

Effects of different sources water on digestibility

The water source and digestibility are stated in **table 6**. Supplementation of different source of water with german grass and concentrate mixture had no significant effect ($P< 0.05$)on digestible crude protein; digestible crude fiber and digestible ether extract (**Table 6**). But digestible nitrogen free extract and total digestible nutrient was significantly higher ($P < 0.05$)in (DTW =T_1), supplying group than other group McDonald *et al.* (2002) could not observe any significant difference in nutrient digestibility by supping clean and pond water in beef cattle. On the other hand, Holechek (1980) observed higher TDN in beef by supplying clean water compared to contaminated water that supported our finding. There are too little review about effect of different sources of water on nutrient digestibility in beef cattle. Probable reason behind getting higher nutrient digestibility in tube water supplementing group in our experiment might be due to lower microbial contamination and higher palatability that promoted higher feed and water intake consequently higher nutrient digestibility.

Effects of different sources water growth parameter of growing bull

There was a significant effect ($P< 0.05$) on final growth performance of growing bull among different treatment groups (**Table 7**). The growth performance of DTW-group ($T_{1=}$Deep Tube-well watering Group) was comparatively better than other group. In the T_1 group the final growth rate was 336.49 gm per day that was nearest to SW group ($T_{2=}$Supply Watering Group). The animal intake PW (T_3=Pond Watering Group) and RW (T_4=River Watering Group) the growth rate was 284.04 and 312.28 gm per day that was lower than T_1 and T_2 group (**Table 7**).

Table 7. Effect of different sources of water on Growth performance of bull

Parameters	Diet				SEM	*P*-value
	DTW	SW	PW	RW		
ILW, kg	120.75±4.37	116.75±10.11	131.0±15.53	141.0±11.9	4.09	0.525
FLW, kg	144.5±10.49	140.50±8.47	150.5±10.41	163.00±8.21	4.00	0.420
LWG, (kg)	23.75^{a}±2.60	23.25^{ab}±0.26	19.5^{b}±1.69	22.0^{b}±.65	0.85	0.068
BWG, g/d	336.49^{a}±59.40	334.1^{ab}±49.22	284.04^{b}±56.31	312.28^{b}±28.7	24.22	0.079

ILW=Initial Live Weight, FLW=Final Live Weight, LWG=Live Weight Gain;T_1 =DTW-Deep Tube-well Water; T_2 = SW-Supply Water; T_3 =PW-Pond Water; T_4 =RW-River Water; R1=Replication 1; R2 = Replication 2; R3 =Replication 3; R4 = Replication 4

Schutz (2012) reported that yearling heifers having access to clean water had 23% higher live weight gain than pond water. In another research Willms *et al. (*2002) found that, it was a tendency for calves with clean water to gain more weight than calves that had direct access to the pond water and river water. Lardner *et al.* (2005) also found positive result on beef cattle by supplying clean water compared to pond water and got 9% more live weight gain, we had also found higher live weight gain in tube well water supplying group compared to supply water, pond water and river water group. The reason of positive impact on growth rate of beef cattle might be by applying tube wall water with lower E. Coli content compared to other water source that justify finding of Porath *et al.* (2002).

Conclusion

This study results has been found that the nutrient digestibility, the digestible nitrogen free extract (DNFE) and total digestible nutrient (TDN) were significantly higher ($P < 0.05$)in DTW(T_1=Deep tube-well water) supplying group compared to other groups. In the growth parameters, the growth performance of bull was better in DTW-group (T_1=Deep tube-well water) that was nearest to SW (T_2=Supply Water) group and comparatively higher than other group. In the T_1 group the daily average water intake was 6.73±0.09 and the nearest water intake was T_2 group which was 5.76±0.09 litter per day. The other treatment group PW ($T_{3=}$Pond water) and RW (T_4=River water) intake was 4.96±0.04 and 4.80±0.07 that was comparatively lower than T_1 and T_2 group. Supplementation of different sources of water with german grass and concentrate, the highest water intake for per kg dry matter intake was DTW (T_1=Deep Tube-well water) group followed by T_2, T_3 and T_4 groups. There have significant (<0.05) effect of water quality, the best quality was found in tube-well water compared to supply water, pond water and river water. Therefore, among all the treatment groups, the tube-well water supplying group performance was better than other treatment groups.

Nowadays, people are more concern about the beef cattle production as well as safe local meat consumption. This is possible to achieve once the plan of nutrition and water supply is well management. Due to climate change and poor knowledge on water management, the availability of the water is decreasing for the beef cattle. The novelty of this study is the first attempt to evaluate the quality of the water from various sources that are commonly used in Bangladesh along with the feed intake and growth performance. A recommendation can be made for future study to compare the cost involved for four different sources of water involved per unit of growth performance and nutrient digestibility of beef cattle.

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