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INFLUENCE OF THE ENVIRONMENT, RESEARCH AND EXTENSION
SERVICE ON BEEF CATTLE PRODUCTION IN THE GULF PRAIRIE
OF TEXAS

Term paper

by

Cristo Barbosa do Nascimento

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Embrapa

INTRODUCTION

The Coast Prairie of Texas is an almost level, slowly drained area 20-80 mile wide along the Gulf of Mexico. The area covers about 8 million acres of land (1). This well-watered, grassy part of Texas is one of the most important cattle producing areas of the state (2). Unfortunately, the environmental factors of warm, humid climate, low altitude, prevalence of parasites and diseases, poor quality of native forage, have constituted tremendous obstacles for beef cattle production.

Research has been one of the most prominent factors of production in such an area. Crossbreeding program, animal disease research, fertilizer studies, introduction of new species of grasses and other many studies have decisively contributed to increase productivity in the Coast Prairie of Texas. However, it is necessary to point out that the inestimable importance of research would decrease a great unpredicted extent without the outstanding task of the Extension Service as a link between research and beef cattle producers.

The scope of this paper is to study these aspects as a background for the future work that I will have to develop in a region which to a certain extent shows similar conditions to the Gulf Prairie of Texas.

ENVIRONMENTAL FACTORS AND THEIR INFLUENCES ON BEEF CATTLE PRODUCTION

Environment includes everything that may affect an organism in any way. It is, therefore, a complex of factors (3). These factors, non-living and living (4), interact upon each other. It is possible and appropriate to think of environment as a whole that, together with the animals forms an energy system of forces and conditions, an ecosystem. However, our knowledge of the system is so incomplete and its complexities are so great that a discussion on this basis is, as yet, somewhat impractical. There appears, therefore, no alternative but to segregate the principal factors of the environment and to consider their independent as well as when possible integrated, direct or indirect effects on beef cattle production in the area.

DIRECT EFFECTS

Weather records at the station that is located in the Gulf Prairie of Texas, for 50 years, 1914-1963 (1), indicate the following figures for temperature averages: Mean annual temperature was 69.7° F (20.9° C), with a maximum daily average of 79.0° F (26.1° C) and a minimum daily average of 58.7° F (14.8° C). The January mean maximum was 65.1° F (18.4° C), the mean minimum 43.9° F (6.6° C). The August mean maximum was 92.2° F (33.4° C), the mean minimum 72.1° F (22.3° C). Temperature varied from a record high of 105° F (40.5° C) in July 1932 to a record low of 10° F (-12.2° C) in January 1918 and 1940. As we notice there are considerable deviations from temperature averages being therefore an important matter affecting beef cattle production. Since the comfort zone (environmental temperature range in which no apparent demands are made upon the physiological thermoregulatory mechanisms) for European

cattle is between 35° and 70° F (1.7° and 21.1° C), whereas for Zebu cattle is between 50° and 80° F (10° and 26.7° C) (5), the mean temperature records are considerable more undesirable for European breeds during the summer season, than for Zebu cattle. Even when temperature is above 80° F, European cattle are forced to adjust quantitatively more than Zebu cattle. Increased respiratory rate, drooling, sweating, and increased water consumption characterize the adjustments by cattle under above comfort zone conditions (5).

Increased temperatures during the summer may result in sufficient heat stress upon the animal so as to be reflected in lowered feed intake (6). Existence of thermosensitive areas in the hypothalamus have been demonstrated. Thus, we are justified in concluding that thermostatic mechanisms may dominate regulation of feed intake independently of other factors (7). Lowered feed intake results in reduction of milk production and/or growth rate (6).

The coefficient of digestibility may be also reduced by high air temperatures during the summer (8). High atmospheric temperatures, reduce the opportunity that the animal has for losing heat to its surroundings (6). When the opportunities for heat loss are restricted, undesirable effects are brought about which result in reduced metabolic efficiency, and as a consequence, decreased productive performance occurs (9). The animal in order to dissipate heat increases its expended energy, particularly through increased respiration rate. This with reduced voluntary feed intake are apparently responsible for reduction or cessation of weight increase. Temperature stress is followed by metabolic changes in the animal including modification of ruminal volatile fatty acid ratios, decline in thyroid activity, reduction of ascorbic acid,

and CO₂ combining power of blood serum (10).

In most areas having high summer temperatures, the summer months have the lowest reproductive efficiency. Innumerable variables could potentially affect calf crop from a given area, but it is perhaps more than coincidental that the areas in the U.S.A., by states, with lowest rates are nearly the same as those with the highest summer temperatures (12). Therefore, it seems that in the Gulf Prairie of Texas reproductive performance has been greatly affected by the high summer temperatures once it is located within the lowest calf crop percentage (80 or less) area of Texas.

Temperatures below comfort zone of breeds principally for Zebu cattle are found in winter season, mainly in January. Cold has deleterious effects on the efficiency of the production whenever heat loss exceeds the metabolic heat production resulting from a feeding regime normal for the type of production being aimed for.

The critical temperature that is the temperature of the air below which the oxidations in the body must be increased to keep an animal warm will be lower for European cattle than for Zebu cattle (11). Since below this temperature beef cattle will be using energy from feed to maintain body temperature rather than for productive purposes, it seems that below critical temperatures for both, European cattle will be using less energy from feed to body temperature rather than for productive purposes than Indian cattle.

Evaporation during the 50 years, was highest during the drier years. Evaporation from a free water surface averaged 45.10 inches (1,145.54 mm) per year, ranging from a low of 33.71 inches (856.23 mm) in 1949 to a

high of 58.79 inches (1,493.27 mm) in 1954.

Evaporation and temperature affect the relative humidity (1). The mean annual humidity at the station was 81.4 percent for the 50 years. The relative humidity has constituted a critical factor in determining how well the animal is able to dissipate excess body heat at high temperatures (6). As the water vapor content of atmospheric air rises, the capacity of the air to absorb water vapor rising from the animal body decreases. This has a considerable importance with increasing environmental temperature once the opportunities of heat loss by the animal through evaporation are more restricted, therefore, more undesirable effects are brought about which result in more reduced metabolic efficiency decreasing more its productive performance.

Air movement increases heat loss by the cattle. Therefore, the winds blown from the Gulf of Mexico, have a dual effect on the cattle depending upon the time of the year. During summer they are beneficial for the cattle, since they increase heat loss by cattle through evaporation. However, this is not an advantage during the winter time, when the animals seek the shelter of windbreaks or artificial shelters to protect them against the cold winds.

Light greatly influences, at least in European breeds, shedding and hair growth (13). Light rays cause an impulse or stimulus on the pituitary gland and hence, a reaction by which the animal sheds its hair (8) as well as through the same way hair growth is regulated. So, in the Gulf Prairie as the days become shorter and the nights longer cattle begin growing longer hair and develop winter coats. Conversely, as the nights shorten and the days lengthen, they shed their winter coats and become

relative smooth coated. Therefore, this is an important factor in heat tolerance in the summer as well as in cold tolerance in the winter and thus, presumably in weight gain of the animals.

Heat is another important factor in the area during the summer, because as we know it is absorbed greatly by the animal directly or indirectly. Therefore, dissipation of the additional heat load puts added strain on the animal.

INDIRECT CLIMATE EFFECTS¹⁰

Indirect effects of climate, in the area, on beef cattle production are expressed mainly by prevalence of disease and parasites, and changes in nutritive value of forages (1,10,14).

Pinkeye (keratoconjunctivitis) is the term commonly applied to an infectious inflammation of the eye (15), which may occur at any season, however, it is most often during the summer months in the area, when flying insects and dust conditions are most prevalent (16). The disease is characterized by an intense inflammation of the mucous membrane of the eyes and tears mixed with pus which flow down the side of the face. In its most aggravated form it causes a large grayish-yellow ulcer to appear on the cornea, making the eye temporarily blind (15).

Cancer eye (epitheoma) is another disease I have observed in the area. It is a malignant tumor on the eyeball or eyelid of cattle that develops into a badly infected sore. It is found principally during the summer season, when intense sunlight and irritating dust are believed to be at least indirect causes (15).

Brucellosis which is a infectious disease caused by bacteria, Brucella abortus (16), has been found in the studying area. Female

animals are specially affected by this disease which may occur at any age. The pathogenic agents are located specially in the organs of reproduction from where the dissimination occurs (17). The disease is characterized by abortion of fetuses through all stages of pregnancy and with placentas commonly retained (16).

Foot rot may occur in the wet pasture during the summer (16). It is an inflammation of the foot caused by Actinomyces necrophorus, which gains access through the skin hurt by stones, sticks or other similar objects.

Certainly, other diseases are found in the studying area, however, through the literature available these are the most important ones.

As far as parasites are concerned, the following have been found most commonly in the Southern part of U.S.A., which includes the studying area (2,15): Screwworms, hornflies, lice, grubs, blowflies, stableflies and intestinal worms. These parasites have been responsible for rather serious monetary losses. Transmission of diseases, sucking of blood of the afflicted animal which experiences annoyance and disturbance along with loss in vitality and poor performance due to loss of blood have been consequences of them.

Particularly, mosquitoes have been responsible for tremendous losses among beef cattle in the area, acting as disease transmitters, mechanically and as intermediate hosts of disease organisms. They also damage beef cattle directly by causing loss of blood or destruction of tissue, and they irritate and worry the animals by their presences or bites. Beef cattle losses take the form of increased mortality, lowered vitality, slower growth, lowered work output, and reduced quality and quantity of markable products (18).

The climate of the Gulf Prairie markedly affects quality and nutritive

value of feedstuffs produced within the area.

The mean rainfall for 50 years, 19-14-1963, was 48.03 inches (1,216.96 mm). But, the highest annual rainfall during this period was 83.40 inches (2,118.36 mm) in 1949 and the lowest only 21.76 inches (552.704 mm) in 1954. Average monthly rainfall for the 50 years was distributed fairly evenly through the year with slight peaks in July and September. Tropical storms account for years with unusually high rainfall and for the rather uniform long-time average monthly distribution of rainfall. Years without hurricanes tend to have dry summers. Hurricanes that come inland usually cause much damage by the accompanying high torrential rainfall and in some cases tidal waves (1). Salt damage in the soil reached by hurricane is limited mainly because of excessive rainfall during this storm saturates the soil prior the action of it (19). However, this excessive or whenever relative high rainfall occurs, leach out soluble minerals (9) and take them into the deeper layers of the soils where they become less available to the forages. They undergo rapid growth, but increase in fiber and water content, and decrease in protein and more digestible carbohydrates content, decreasing consequently their qualities and nutritive values (9,11).

In the soils of the Gulf Prairie of Texas (Lake Charles clay and Edna clay loam mainly), moisture deficiencies often occur during the late spring and summer period since evaporation is usually high relative to rainfall (1). As a consequence, forage growth is handicapped (9) decreasing its nutritive value, and quality, as well as its yield.

RESEARCH AS A FACTOR OF BEEF CATTLE PRODUCTION

Gulf Coast Pasture-Beef Cattle Research Station serves as a main

research to the beef cattle industry of the Coast Prairie of Texas. Since 1909, when it was established, it has been a factor of great important in the increase of beef cattle production under adverse environmental conditions of the region.

BEEF CATTLE RESEARCH

A rotational beef cattle crossbreeding program involving 5 breeds of cattle, Hereford, Brahman, Santa Gertrudis, Angus and Charolais, have been carried out since 1957 with the following objectives: (1) to measure the productivity of cattle in a five breed rotational crossbred herd compared with that of cattle in a high grade Hereford or Brahman herd; (2) to evaluate the carcass of multi-cross calves and cattle from the standpoints of yield, of preferred whole sale cuts and consumer satisfaction of the meat; and (3) to determine the influence of heterosis in the dam and in the calf upon weaning weight of calves and growth rate to maturity in breeding females (20).

According to the literature available at the station (21,22,23), the program can be summarized as follows:

It has involved until 1965, the following breedings: HxB, BxH, BxB, HxH, BxBH, HxBH, AxBH, Ax^AA²B¹H¹ and SGxA^AA²B¹H¹.*

Since 1959, the Brahman cows have been mated to registered Brahman bulls for comparative purposes. The Hereford cows also have been mated to Hereford bulls for continued comparative purposes. Percent cows diagnosed pregnant, percent cow which calved, weaning percentages, birth weights, weaning weights adjusted to 205 days, and milk yields were used in this study.

*H, B, A, SG and BH denote respectively Hereford, Brahman, Angus, Santa Gertrudis and Brahman-Hereford first-cross. The superscripts indicate the fractional part of each breed in a crossbred animal. The breed of the sire is shown first and the breed or cross of the dam is shown second.

Differences among breeds and crosses in percent of cows pregnant, percent of calves born and percent of calves weaned were highly significant. Brahman matings produced results 10.4, 10.9 and 22.0 percent, and Hereford matings 8.3, 6.0 and 3.8 percent, respectively, for the traits below the average for all matings. Also, first-cross Brahman-Hereford cows mated to Angus bulls showed below average percent of pregnancy (6.1 percent), however, their calving percent was average and weaning percent above average (3.1 percent).

Cross mating Brahman and Hereford cows to bulls of the other breed increased 12.8, 19.3 and 31.6 percent for Brahman cows and 11.9, 15.6 and 15.2 percent for Hereford cows, respectively for the traits as compared with purebred matings for the two breeds. Backcrossing Brahman-Hereford first-cross cows to Hereford bulls gave better results than to Brahman bulls for the mentioned traits. Second-cross $A^2B^1H^1$ cows mated to Angus bulls in one year only were 100.0 in all the three percentages. The same cows mated to Santa Gertrudis bulls were 87.1 percent for all the three percentages*. Approximately 15.3 percent more calves were raised by hybrid females than by purebred females for all matings.

The majority of calf losses occurred post-partum. The pre-partum losses from pregnant cows amounted to 3.0 percent for Brahman matings and 2.1 percent for Hereford matings. However, cross mating these two breeds reduced the loss to zero. Losses from all hybrid females were also essentially zero. The post-partum losses amounted to 20.5 percent

*Percent of calves born and percent of calves weaned are unpublished results, therefore they are not included for other results.

for Brahmans and 2.2 percent for Hereford, but cross mating the two breeds gave losses of 4.7 and 4.0 percent, respectively. Total calf losses from hybrid females were zero except for Brahman-Hereford females mated to Angus bulls (1.8 percent).

Adjusted 205-day weaning weights of calves were significantly influenced by breed of cross. Calves from Hereford matings were the lightest (319 pounds) followed by Brahman matings (370 pounds). First-cross calves from Hereford and Brahman cows weighed 378 and 390 pounds, respectively. Calves from first-cross cows by Angus bulls averaged 435 pounds.

Sex also significantly influenced weaning weight. Steer calves and heifers averaged 392 and 365 pounds, respectively.

Purebred calves were exceeded by all first-cross calves by 11.4 percent. Calves from first-cross cows exceed Hereford and Brahman calves as well as the average for purebred calves by 36.4, 17.4 and 26.2 percent, respectively.

Breed or cross and age of cow significantly influenced cow weight. Hereford cows were the lightest (866 pounds) followed by Brahmans (900 pounds), first-cross (947 pounds) and second-cross (985 pounds).

In limited data on 24-hour milk production of cows of different breedings, Hereford cows were exceeded by Brahmans, first-crosses and second-crosses by 32, 62 and 40 percent, respectively. It seems there is a close relationship between milk production of the cows and weaning weight of their calves.

A study on the economic effects of salt-marsh mosquitoes on beef cattle production has started and it can be summarized this way (18):

The study has the following objectives: (1) to determine the nature and extent of loss in beef of cattle from high infestations of salt-marsh mosquitoes; (2) ascertain the feasibility of chemical control of mosquitoes for beef cattle production; (3) determine the effectiveness of physical methods of mosquito abatement (water management) in salt-marsh pasture; and (4) determine the effect of physical control practices on soil structure and productivity, on plant species, and on estuarine animals.

Four 75-acre pastures will be used and each pasture stocked with three breeds of cow. Two of these pastures will be treated with insecticide and the other two left as control. The animals will be individually sprayed in one treated pasture and one control pasture. Periodic weights, calving percentage, weaning percentage and milk production records will be maintained on the cows. Periodic and weaning weight and carcass quality will be recorded on the calves. Mosquito counts will be made on both light trap collections and selected animals from each group to measure mosquito population.

A test site adjacent to an inland ^{bay} will be surveyed for elevation and a main lateral ditch cut from the lowest depression into the bay. Feeder laterals will be cut from the minor depressions to the main lateral ditch or into the bay to permit free water movement by tidal action. Pasture fertilizer, weed control and pasture management, mosquito population, plant and soil studies, estuarine animal studies will be evaluated in the program.

The station also, at least, until 1960 had been contributing with investigations on pinkeye (keratoconjunctivitis) and parasites (2).

The primary concern of investigations on pinkeye was the bare facts ^{basic} surrounding the disease and its causative organism in order to develop a

vaccine for the disease.

Parasite research at the station involved both treatment and prevention. Various compounds were tested in an effort to develop efficient ^Nanthelmintics with relatively non-toxic effects to the animal. Stomach and intestinal worms were included in the study. The worms were treated with X-rays and the sterile larvae were used to infect parasite-free calves to evaluate the immunity produced by the worms with the final objective of developing a vaccine.

Freeze-branding tests and demonstrations have been done on cattle by the station (24). It has been done with dry ice-alcohol mixture, copper irons of 1/4 to 1/2 inch in thickness and two inches in depth and brandings at different times and lengths of hair. This new discussed matter continues being under study by the animal nutritionist of the station (25).

FORAGE RESEARCH

In an effort to get grasses capable of producing large yields of high [?]quality forage, the station has introduced new species of grasses. Native grasses, hybrids such as Coastal Bermudagrass, and numerous legumes have been also grown for this scope by the station (2).

Basically, the selecting research is divided into 4 phases: (1) adaptation; (2) yield potential, water and fertilizer requirements, resistance to disease and insects, and establishment and maintenance requirements are studied more closely; (3) surviving forages are subjected to exhaustive tests to determine their yields under practical grazing conditions; and (4) in the newly initiated phase of the forage research program, an effort is made to discover what factors in a grass

or legume control its ability to produce beef or milk which is, in this phase, measured.

Among the more important introductions are Angleton grass from India, Dallisgrass and Bahia grass from South America being the latter native of Brazil (26), Buffelgrass from Africa and Hardinggrass from Australia. The most promising legume and hybrid grass have been Louisiana Sl white clover and Coastal bermudagrass, respectively.

Research to determine cultural and fertilizer treatments necessary for the satisfactory establishment of Dallisgrass, Bermudagrass and clover (warm-season perennial pastures),^{has} the following major steps as minimum requirements: (1) elimination of competing vegetation prior to seeding; (2) provision for adequate surface drainage; and (3) application of at least 60 pounds of available phosphoric acid per acre (2).

The station has studied temporary winter pastures since they continue to be an important consideration in year-round grazing programs because no fully satisfactory cool-season perennial grass is presently available. Gulf ryegrass planted on well prepared seedbeds or in rice stubble has provided maximum cool-season grazing.

Pasture management has been one of the main concerns of the station. The proper utilization of forage during periods of peak production is the key to realization of maximum profit from fertilized tame pastures.

Two systems of grazing management, continuous and rotational, on Dallisgrass-white clover pastures, with three stocking rates, 1, 1.5 and 2.0 animals per acre, have shown high significant to slight difference for continuous grazing, in weight gains, from the lowest to the highest stocking rates (27). This is, at least, probably due to two factors:

(1) shading of the legume by the grass, and (2) photosynthesis problem (28).

Fertilizer studies and variety testing of corn and grain sorghum have been revealing that a ratio of 3-1-0 (90#N, 30#P₂O₅ and 0#K₂O) and 1-0-0 (90#N, 0#P₂O₅ and 0#K₂O) will give the best result on corn (Texas 34, the recommended over all other testing individuals), and it seems to be the most practical for sorghum grain respectively, for the following hybrids: RS 610, RS 608, RS 620, RS 650, DeKalb C44a and E56a (2).

Digestibility of ryegrass and bur clover mixture in chopped and pelleted form by cattle and sheep has been started.

The objective of the study is to determine differences in dry matter digestibility and volatile fatty acid ratio of cattle and sheep consuming the chopped or pelleted mixture (25).

EXTENSION SERVICE AS A LINK BETWEEN RESEARCH AND BEEF CATTLE PRODUCERS

Research, mainly represented in the area, by the Gulf Coast Pasture-Beef Cattle Research Station can not be able alone of transmitting what it has found to the beef cattle producers, since researchers' background is not appropriate for such a task, and their products, represented by scientific publications cannot be understood by a relative great part of the producers, due to their degree of complexity. And, as to the structural point of view, it would be almost unpracticable, since research requires an almost exclusive working time. Therefore, the task of transmitting knowledges is given mainly to the Extension Service of Brazoria County.

The Extension Service of Brazoria County which serves a considerable part of the studying area, works in a cooperative system of Texas A&M University, the United States Department of Agriculture and Brazoria County government; from where it gets monetary and/or technical support.

Basically, the objective of the Extension Service is the development of people themselves to the need that they, through their own initiative, may effectively identify and solve the various problems directly affecting the welfare (29). Therefore, specifically, the Extension Service has as an objective the development of the beef cattle producers in such a way that, they may effectively identify and solve the various problems directly affecting their welfare, particularly their businesses, by their own initiative.

How does this development take place in the studying area?

The instruction of the producers on the economical discoveries for increasing beef cattle productivity has been the main concern of the Extension Service of Brazoria County.

The county agent and his assistants are the main people in charge of transmitting what research has found through many methods such as group meetings, demonstrations, individual visits, group tours, circular letters, leaflets, bulletins, radio, television and newspapers, and community leaders (29,30).

In group meetings with the producers many problems are discussed, points of view are heard and steps are established to get their solutions.

Demonstrations are, as I had the opportunity to see, generally carried out in the fields, with the objective to show the producers who are widely invited through many means, such as television, radio and leaders; how to get more production with less costs. In those demonstrations the producers

have the opportunity to see in loco, the applied findings of research. Such as suitable fertilized Dallisgrass-~~white~~ clover pastures for the warm season. These demonstrations are usually done on producers' ranches or as it has happened every year in the field, at the Station.

Individual visits are done daily by the county agent, in order to transmit what is necessary, as well as to know the producers' problems in order to find the ways to help them to solve the problems. Here, in accordance with the complexity and quality of the problems, the county agent can orientate them without help by the station, or he applies for the personnel of the station to find the solutions for the problems.

Group tours take place periodically, participating the majority of the producers. In these tours several important points of commercial cow and calf program which is the main program of beef production in the studying area, are visited. In these places, many questions are asked of the manager of the ranches by the other visiting producers. Generally, the distinguished producers where their ranches serve as a point of convergence during tours, are people who have been constantly aware of production news. Being, therefore, their successes a partial consequence of the work of county agent and his collaborators.

During the tours also incorporations connected with beef cattle production are visited, such as Red Barn Chemicals Incorporation where Mactram (granulated fertilizer) and PMS Bull Shipper (balanced nutritional liquid supplement) are made. The objective of the visits is obviously also informative.

Circular letters, leaflets and bulletins have been the result of a laborious work of summarization and easy understandable reading made by the extension service in order to put the producers aware of the constant

findings of the researchers.

Radio, television and newspaper have been too, the means of spreading beef cattle production news. For this scope the Extension Service of Brazoria County has maintained special programs in the radio and television stations nearest the studying region. On the newspaper pages many digested articles concerning beef cattle production have been also propagated.

Usually, among the producers served by Brazoria County, there are people whom their neighbors trust the most and as a consequence, accept more easily their advice. These people after very careful observations are chosen by the county agent to be the leaders of communities; through whom the Extension Service can spread many of its programs, to the other producers.

There is also a particular way of reaching the producers through their sons who, in the future, tend to be at least, to a relative great extent beef cattle producers. The 4-H Club of Brazoria County is it.

The 4-H Club of Brazoria County constituted of youngsters between 10 and 19 years old, has as a motto "to make the best better" (11) that can express clearly its objectives. In the club, individual project programs, meetings, demonstrations, orientations, parties and other sorts of program, have been the ways of reaching the producers and building beef cattle producers of the Gulf Prairie of Texas.

SUMMARY

Influence of the environment, research and Extension Service on beef cattle production in the Gulf Prairie of Texas were studied.

The study showed that beef cattle production has been markedly

affected by environmental factors, directly and indirectly.

Research, mainly represented by Gulf Coast Pasture-Beef Cattle Research Station, has contributed decisively to increase beef cattle *productivity* production under the adverse environmental conditions of the area, through *principally* mainly, beef cattle and forage research.

In the beef cattle research, a rotational crossbreeding program has been of special importance in the increase of beef cattle performance.

In the forage research, introduction of new species of forage, fertilizer studies and pasture management have been of considerable importance.

The Extension Service of Brazoria County has constituted a link between research, principally represented by the station, and a great part of the beef cattle producers. This integration is mainly carried out by instruction of the producers about those economical findings of the research, through the following methods: group meetings, demonstrations, individual visits, group tours, circular letters, leaflets, bulletings, radio, television, newspaper and community leaders.

The 4-H Club has contributed reaching the producers indirectly and building beef cattle producers.

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