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EMBRAPA

CENTRO DE PESQUISA AGROPECUÁRIA DO TRÓPICO SEMI-ÁRIDO

NEEDS AND PRIORITIES FOR RESEARCH
INTO MANAGEMENT OF THE CAATINGA
REGION OF NORTHEASTERN BRAZIL

I.F. BEALE

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IICA/EMBRAPA
CPATSA



NEEDS AND PRIORITIES FOR RESEARCH INTO MANAGEMENT OF THE CAATINGA
REGION OF NORTHEASTERN BRAZIL

by

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Consultant to: IICA/EMBRAPA

CPATSA

May, 1980

NEEDS AND PRIORITIES FOR RESEARCH INTO MANAGEMENT OF THE CAATINGA
REGION OF NORTHEASTERN BRAZIL

FINAL REPORT

1. Submitted to:

General Coordinator
IICA/EMBRAPA Contract
Brasília-DF.

Chefe
Centro de Pesquisa
Agropecuária do
Trópico Semi-Árido,
Petrolina, PE.

2. Submitted by:

Dr. Ian Francis Beale,
Senior Agrostologist,
Pastoral Laboratory
Department of Primary Industries,
Charleville, Queensland, 4470,
Australia

3. Project:

Strengthening Natural Resource Research in Brazil

4. Activity:

III.SB.I3II. Consultant on Semi-arid Pasture Production
and Utilization.

5. Objectives:

To participate, together with the Chefe of the Semi-arid Research Centre of EMBRAPA in activities to strengthen ^{with the} the Natural Resource Research Programme (pasture production and utilization) by planning, training, evaluating and advising on research of the use of semi-arid pasture resources.

6. Duty Period

3rd March 1980 to 28th May 1980

7. Duty Station

Centro de Pesquisa Agropecuária do Trópico Semi-Árido
Petrolina, PE.

8. Institutions assisted:

Most time was spent assisting staff at CPATSA involved in the Caatinga management project. Time was spent assisting and advising staff working on pasture production and animal nutrition at Centro Nacional de Pesquisa de Caprinos, Sobral. Research activities were inspected at:

- Iguatu(CE), Sertanejo project
Regina Helena Pereira Nobre
- Quixadá(CE), Empresa de Pesquisa Agropecuária do Ceará (EPACE).
Francisco Hélio Ferreira Machado - Chefe
Milton Alves Gurgel
Antonio Amauri Oirã Fernandes

- Quixeramobim(CE), Propasto project
Milton Gurgel
- Canindé(CE) Propasto project
Milton Gurgel
- Irauçuba(CE) Propasto project
Milton Gurgel
- Sobral(CE), Centro Nacional de Pesquisa de Caprinos
Elino Alves de Moraes - Chefe
Claúdio Bellaver
Ederlon Ribeiro de Oliveira
Roberto C.M. Mesquita
Luiz Vieira Vale
Augmar Drumond Ramos
João Andrade
José Gerardo B. Oliveira
- Campo Maior(PI), Research Station and Propasto project
Hoston Nascimento
- Teresina(PI), Unidade de Execução de Pesquisa de
Âmbito Estadual (UEPAE/EMBRAPA)
Elamno Ferrer - Chefe
Antonio Matias
Hoston Nascimento
Herculano Carvalho
Alcímar Leal
- Valencia do Piauí(PI), Propasto project
Hoston Nascimento
- Jaicós(PI), Sertanejo project
Valderi Vieira

- Pedra(PE), Propasto project
Nelson Chaves Filho
- Pesqueira(PE), Propasto project
Nelson Chaves Filho
- Riberião(PE), Propasto project
Nelson Chaves Filho
- Carira(SE), Propasto project
Lafayette Franco Sobral
Wilson Meneses Aragão
- Arauã(SE), Propasto project
Lafayette Franco Sobral
Wilson Meneses Aragão

9. Cooperating staff:

NAME	POSITION	SPECIALIZATION
Renival Alves de Souza	Chefe	Soils
Manoel Abílio de Queiróz	Adjunto Técnico	Plant breeding
Severino Gonzaga de Albuquerque	Pesquisador	Pastures
Luíz Maurício Cavalcante Salviano	Pesquisador	Pastures
Martiniano Cavalcante de Oliveira	Pesquisador	Pastures
Terezinha Nogueira Padilha	Pesquisador	Parasitology
Orlando Monteiro de Carvalho Filho	Pesquisador	Nutrition
Célia Maria Maganhoto de Souza Silva	Pesquisador	Plant Introduction
Jorge Ribaski	Pesquisador	Agroforestry
Gildo Freiras de Almeida	Pesquisador	Animal Prod.

10. Personnel Interviewed

Ederlon Ribeiro de Oliveira(Sobral)	Pesquisador	Nutrition
Roberto C.M. Mesquita (Sobral)	Pesquisador	Pastures
João Andrade (Sobral)	Pesquisador	Pastures
Milcíades Gadelha de Lima	Pesquisador	Agrometeorology
Josias Cavalcanti	Pesquisador	Agronomy
Everaldo Rocha Porto	Pesquisador	Irrigation

11. Activities Developed

I arrived in Petrolina, PE on the afternoon of 3rd March, 1980, to take up duty. The rest of the week was spent in meeting the staff of CPATSA that are involved with the Caatinga management project. A meeting was held to outline the requirements of the centre and to discuss how these could be met. The experimental work in progress was inspected, and progress and problems outlined. Several fazendas were visited to outline the levels of management encountered in the Caatinga region.

Meetings were held with the coordinators of Sertanejo and Propasto projects and the aims and methods of these explained. Visits were made to associated CPATSA programmes on shallow-water storage, irrigated cropping and energy cropping and production. A knowledge of the animal-drawn implements programme was gained by contact with Harbans Lal and Vincent Baron (consultants) and their associates.

Tours were undertaken of pasture research in the northeast. Propasto and Sertanejo project sites were inspected, as were experimental stations and fazendas. The list of site is given in Section 8. A second visit of 3 days was made to CNPC-Sobral where advice on research into animal dietary work was given.

Discussions were held with the researchers working in Caatinga management on research techniques and problems encountered by them. Future work was discussed and methodologies suggested, particularly in the fields of animal dietary studies and vegetation sampling. The procedure for developing relations between tree foliage production, stem production and basal diameter was demonstrated.

I also spent some time in discussions with Drs Brian Norton and John Malachuk, Utah State University, when they visited CPATSA in connection with the United States Title XII programme. (See section 14. Technical Recommendations, and Appendix I).

I participated in a two-day seminar on "Animal Production in Areas of the Caatinga" at Petrolina on 21st and 22nd of May. My tour of duty ended there on 28th May.

12. Results of activities

The activities undertaken during my time in the northeast of Brazil have given a broad view of the problems and potentials of the region, and of some of the needs for research there. The following discussion is largely restricted to the field of natural resources and Caatinga management.

12.1. Research programme

The research programme laid out in "Project for establishing a centre for agricultural and livestock research for the semi-arid tropics" follows well-established lines of investigation. This is further discussed under Technical recommendations (Section 14).

12.2. Research facilities

The area available at the CPATSA field station is already close to being fully utilized. Grazing studies in semi-arid areas require large areas of land, and thought should be given to expanding the station while areas are available adjacent to it. This will reduce operating costs and aid management of project work.

New office and laboratory facilities are at present in the early stages of construction, at the field station. Australian experience suggests that a better choice may have been to keep the existing arrangement of research facilities near an urban centre, with field station areas for research. It is to be hoped that the new facilities add to the research effort and does not detract from it by creating personnel problems.

The research work already done in animal productivity suggests that there will be a need to conduct investigations into animal nutrition, for example mineral deficiencies and supplementation. Provision for housing and handling animals for these trials need to be considered, though for cattle the feedlot facilities at Bebedouro could be utilized.

12.3. Equipment

In general the equipment available appears adequate for most of the research. Facilities for laboratory work are good, though some equipment is required for in vitro digestion and other nutritional analyses. This has been ordered.

There is a need for organization like CPATSA to have much better access to catalogues of scientific equipment. It is little use having a foreign equipment catalogue when purchase of

Brazilian-made equipment is required. It seems that a need exists for a catalogue of scientific equipment made in Brazil which lists the manufacturers, the suppliers and the equipment available.

On the other hand access to such catalogues should not generate a feeling of need to have the latest sophisticated products. These need sophisticated technicians and facilities to maintain them, and where this is not readily available simpler equipment will produce more results. And results are the aim of research.

Thought should also be given to the provision of computer facilities at centres like CPATSA. An working example of this is CSIRONET, the computer link provided by CSIRO in Australia. Now that EMBRATEL is providing data links such networks are becoming possible in Brazil. This is mentioned again under section 12.4 Personnel.

12.4. Personnel

The research personnel in the Caatinga management project are well trained and hardworking. Very importantly they operate well as a team.

They would very much benefit from access to a full-time statistician for planning and analysis of their research projects. I understand that obtaining the services of these is a problem. Access to computer facilities could be a job inducement, as in this age such access is as much part of a statistician's resources as a pen is of a writer's.

Collection and identification of the plants native to the Caatinga is an important phase of the work here. Access to a botanist to help in the collection and identification of specimens would be very helpful.

More assistance is also required at the level of technical assistant. The aim should be at least one per researcher. The researchers with commitments to the Sertanejo and Propasto projects would be much more effective if research with such technical assistance.

12.5. Training

Research staff should be encouraged to undertake higher degree training to the level of Ph.D. Many benefits can be gained from doing some of this training overseas. Probably an ideal combination would be for field-work to be done in Brasil and course-work and thesis writing at the training institution. This reduces the cost and the time absent from duty and ensures that the results are of benefit to Brazil. Means of guaranteeing supervision suitable to the training institution would have to be established. Also the data would have to be processed and known to be sufficient before commencing to write a thesis overseas, as it is difficult to conduct experiments from half a world away.

Research workers tend to become "stale" when left in the one area. This can be alleviated by undertaking short periods (6-12 months) of study leave every 5-7 years at other research organizations. There they can see new techniques and be exposed to different ideas. Attendance at technical conferences (including international) also aids in this.

Overcoming the feeling of isolation of researchers in centres like CPATSA is important. But centres like this can also make a valuable contribution to the education of students from the local school of agronomy. They are as isolated as the researchers without the previous experience.

12.6. Research

It is unfortunate that the need and value of range research is usually realized long after the use of the range resources was initiated. And when research is initiated, answers are often expected "immediately", which really need years to provide. This is particularly so with arid and semi-arid regions, where the vegetation and other range resource tend to change slowly. They can be declining well before the animal production shows this. Thus trial work in these regions, of necessity, must be of longer term than may be the case in more favourable regions. Often the performance of a treatment or management strategy in a drought can be of more importance (in terms of stability) than what it does in more favoured seasons.

Where resources are declining it is initially better to think of increasing production by preventing further decline in output through the "mining" of resources than to aim at increased animal numbers. In fact increased production and resource stability will often be achieved with fewer animals. This is a difficult concept to extend in a world that associates more with better.

The need to have long term research projects emphasises the need for a low turnover of researchers. It is very desirable that projects be well documented in terms of aims and methods for record purposes. In practice it seems that the person who has to conduct an experiment without having been in the planning of that experiment has less interest in the project and the project suffers. Thus a high staff turnover is more detrimental to long-term research.

Research stations should not be the sole site of experimental work. This can create a "research station outlook", where the problems to be solved are partly due to the residual effects of previous research. On-farm co-operative research should

be encouraged. The Propasto project is a good example of this. Problems can be encountered with ranchers when it is their animals that are used in the experiment. For instance they often do not look kindly on treatments that cause loss of weight and possibly loss of animals. One solution to this is for the research organization to provide the animals. More independence of action can be obtained by arranging to lease the experimental area or to otherwise compensate the rancher for the production that he lost from the area.

The increased contact of ranchers and researchers that results is very important. Ranchers often have a sceptical view of researchers, and researchers the same of ranchers: like many generalizations neither view is entirely correct. And in the northeast it seems that the most important part of the research and management effort may be the training and education of ranchers in the improved management systems developed. Technology mis-applied may well be worse than no technology.

Planning of research should be in consultation with a statistician. This should result in the best uses of experimental resources, and prevent the use of confounded designs that has sometimes occurred. I saw several of these in use here. But the statistician must also be aware that there is more to statistics today than the tradition of Fisher and Yates and be aware of these more modern techniques.

12.7. Library

The library is reasonably equipped with references in the field of range management. I would suggest that the amount of material on tropical grasses and legumes published in "Tropical Grasslands" and "Australian Journal of Experimental Agriculture and Animal Husbandry" would justify more complete

collections than are available at present. The circulation of "Current Contents" and other such publications does much to keep researchers abreast of their fields.

12.8. Consultants

Consultants are use^d by research organizations world-wide and provide many benefits to them. It is to the advantage of the host organization to maximize the contribution made by each consultant. This should include notifying interested scientists of the fields of work of the consultant and arrival time and duration of stay. Planning of a detailed itinerary and assembling the available information (research papers, annual reports etc) for the centre. Preparation of a list of staff and their speciality for the centre will help people unfamiliar with Brazilian names.

On arrival the consultant should be given a briefing on the expectations of his visit and meet the personnel with whom he will work. Visits to research projects, farms, etc. should be conducted to give an orientation of the area. Briefings are important here also. Visits to other research centres should be itimized, listing personnel, and research projects, with descriptions of their aims and methods. Lack of this informing reduces the contribution that the consultant can make.

Many of these points were observed by the staff of CPATSA with whom I worked. But remember that often overseas people tend to think in terms of: - What am I doing; Why am I doing it; When am I doing it; and appreciate enough information to do this.

12.9. Transport

The researchers that are involved with the Propasto and Sertanejo programmes have to cover a large area of the northeast. This is going to apply to any other similar programmes based at CPATSA. A lot of the researchers' time in these instances is spent driving - in terms of research driving time is wasted time. Thought should be given to the use of air transport; with Petrolina's present rather inconvenient connections this will have to include the use of charter aircraft. Ideally centres such as CPATSA should have access to its own aeroplane and pilot, for this purpose.

13. Conclusions

The outline of research into Caatinga management, as laid down in the "Project for establishing a centre for agricultural and livestock research for the semi-arid tropics", is along sound lines.

The centre should consider adding to the area of its field station while land is available nearby.

Facilities and laboratory equipment are mostly adequate. Equipment for in vitro digestibility is required and is on order. Facilities will be required for conducting animal nutrition experiments in the future.

More technical assistants are needed to better utilize the time of the research staff.

Opportunity and encouragement to undertake higher degree studies should be available to all research staff.

Provision for study leave for research staff should be made every 5-7 years, to refresh their knowledge and techniques.

Research projects should be planned in consultation with a statician, and make maximum use of facilities and staff.

Researchers require better access to botanical and statistical services.

Thought should be given to the use of aircraft to transport researchers involved in coordinating projects with centres over the northeast.

Some investigation that need to be undertaken are listed in the next section.

14. Technical recommendations

With large areas and few researchers - a common problem in arid and semi-arid research - there is a need to maximize the applicability of research results. This means research sites should be selected that are typical of large areas. It would seem that the choice of the site for the field station is reasonable in this. On the other hand range work should not be done on areas that will be utilized for other enterprises - in this Fazenda Periperi was probably not a good choice. Care will be needed in extending the results of research from Petrolina to more distant areas and, for example, from CNPC-Sobral to Petrolina.

Resource mapping

The soils maps available at the moment are an aid to selection of representative research sites that will maximize the application of the information gained. The scale is too

broad, however, to be of much use in ranch management. Thus smaller scale maps, along the lines of the Australian land unit maps, will be required. These will also pinpoint areas where degradation, eg. erosion, is occurring, and areas that could cause problems if developed for a particular land use. The task is probably best undertaken by a mobile team, but the project proposed by Dr Brian Norton on "Characterization of the vegetation of the Caatinga with respect to climate, soil type and history of use" (Appendix I) would be a start.

Though it is not really in my sphere of consultation, it seems to me that soil management in cropping requires an education programme urgently. Ploughing up and down very steep slopes is well known for its effect on erosion and is not economical of either soil fertility or water. X

Ecological research

a. Vegetation present

Characterizing the vegetation present is an important part of understanding an area. This includes its species, its pattern and its changes with use. A reasonable start has been made here. A reference collection of the native species of the area needs to be collected and identified. Seed supplies of the major species should also be preserved. If this had been done about 300 years ago there would be many fewer questions about the original composition of the Caatinga vegetation. Part of the project of Dr Norton (outlined above) covers work in this category.

Rancher cooperation can play a part in understanding the changes in vegetation with use. Where fence-line

contrasts exist, opportunity exists for eliciting the management that caused them.

Preservation of areas from grazing for the study of long-term changes is important. This has been done at the CPATSA field station. Ideally it needs to be done for the major soil (or vegetation) types. These areas should have their vegetation composition recorded in relocatable sample areas to allow any long-term changes to be followed. Measurements should include species, stem size and number for woody plants, and species and density (or frequency) for grasses and broad-leaf plants.

Vegetation sampling in the Caatinga area presents a large problem. The extensive areas in grazing trials require a very large number of samples for randomly distributed quadrats, and locating these sampling sites is also very difficult. The compromise adopted in the work here, of using fixed, relocatable sampling areas is reasonable in that it is changes in the vegetation over the long term are of most interest. It is suggested that after the initial sampling areas are established and characterised that they not be sampled every year. Instead these fixed points should be photographed annually and the photographs examined for signs of long term change, eg death or increase in the woody vegetation. If such signs appear, then the area should be remeasured in detail. Sampling of extensive areas of pasture for above-ground production requires many samples and much work when traditional methods are used. Systems of double sampling, using both measured and estimated parameters, can be used to reduce this workload. These are already being used by researchers here. X

Research into the productivity of the natural community can be helpful in suggesting the upper limit to its biological productivity. Use beyond that capability will result

in degradation. The aim of research in arid and semi-arid areas should be to maximize productivity with resource stability. Characterization of litter decomposition rates, nutrient cycling and water utilization can be done in conjunction with productivity studies. A start has been made to estimating the standing-crop of grass and broad-leaf species, and of the wood vegetation of the Caatinga. Dr. Norton's second project was "Annual water budgets and soil-water relations for natural Caatinga, cleared with natural regrowth, cleared with perennial grass cover and zero vegetation treatments" (Appendix I). Productivity and nutrient studies could also be done on these treatments.

Part of the study of vegetation movements involves a knowledge of the seed production, germination and survival of the seedlings. Growth rates also play an important part in the survival of species in arid regions.

The role of fire should not be overlooked in management of vegetation. Control of fire is among the managements allowing invasion of wood vegetation into grassland. Thus it would be interesting to see whether excluding livestock will allow enough buildup of litter to carry fires, and the effect of this on the vegetation. It is possible that the density of wood species could be reduced in this manner.

A knowledge of the nutrient status of the major soil types needs to be obtained. Pot trials in glasshouses, followed by field trials are needed. This information is necessary for the testing of introduced species. Some work has been started on this but more needs to be done. Unless this information is available, any field application of fertilizer is a haphazard guess. And any response obtained may well have been obtained at less cost if the full plant nutrition picture was available. It should be remembered that the MOST DEFICIENT

element controls the response obtained. Where several elements are deficient, application of only one will not show a response if it is not the most deficient. This also applies with animal nutrition.

Plant introduction.

Plant introduction is well underway in the northeast. The rate of testing is governed by the workers available, as this is a slow process. It is pleasing to see that introductions are being tested against native species. Collection of more native plants will enable this to be carried out on a wider scale. As mentioned above, knowledge of the soil nutritional status is required. Research on seed production, seedling germination and establishment can be used to investigate cases of poor establishment and to suggest other approaches.

Grazing management practices need to be established for introduced species. There is an active programme in this. Again maximized production with resource stability needs to be heeded. The search for legume species compatible with the grass species needs to continue, but unfortunately leguminous species suitable for use in semi-arid and arid regions are rare. ~~Woody~~ ones are available, but cause problems of management.

Where grasses are planted alone, their initial productivity may decline after the nutrients, concentrated in the wood vegetation and released by burning, are dissipated. The need to monitor grazing trials for long terms is indicated.

With the lack of timber reserves in the northeast, work on the provision of trees suitable for area is important. The initial plantings are showing much promise. Plant introduction could also provide more species for testing.

Animal production.

Problems associated with the present management

practices need to be characterised. These can include husbandry and nutrition of the animals. Work on this in progress and has shown the value of control of internal parasites and the potential of supplementation, fencing and provision of additional water points.

Studies of the diets of animals grazing the vegetation types available can be used to show the species that are utilized and the times of the year that they are grazed. Oesophageal fistula work is planned for cattle. A similar study is proposed by Dr. John Malachek (Appendix I) for goats and sheep. These samples also help in the definition of the nutrient status of the diets. This can lead to further work, for example on mineral nutrition. There is already information suggesting a need for studies in this field, for which facilities will be needed.

In a region of marked summer rainfall such as this, the dry season vegetation is the major limit to animal nutrition. Methods of overcoming this and of providing drought reserves include pasture legumes, fodder trees, fodder crops and fodder conservation. The use of crop residues from farmlands is under consideration. Nutritional values and costs of these sources need to be considered. One cost of the use of crop residues may be removal of organic matter and nutrients creating a need for better soil management.

If increased production is feasible, consideration needs to be given to marketing this product. It is good that CPATSA has the services of an economist.

Multiple use of rangelands.

The research effort at CPATSA involves farming and rangelands, and combinations of these enterprises. Further work on cattle, sheep and goats will show the amount of dietary overlap of these species and hence the competition between them. Existing research points to the need for goats to

control wood weed regrowth in introduced pasture.

Experience in other parts of the world has shown the value of simulation in multiple use resource management. This should not be overlooked in the northeast of Brazil.

Extension and education.

This may not exactly be CPATSA's charter, but I feel that it is very much involved in the success of programmes to improve management. If the concepts of management are not understood and traditional methods are continued then the success of improved methods is very doubtful. How to get this message across is the problem. Perhaps demonstrations comparing traditional useage and improved methods will be useful. And these may also give experience in the handling of problems created by the misuse of this technology.

The aim must be to have production and resource stability.

Work of lower priority.

For the moment I would suggest that plant and animal breeding not be considered for this centre. Both are specialized disciplines and would better be practiced in existing institutions. Field testing of developed plant lines along with introduced and native species could be undertaken in conjunction with established centres.

Application of the knowledge now available on improving animals would probably increase production per animal markedly. This should be encouraged at rancher level.

Implementation of research.

This will depend on the manpower, training and facilities available. A lot of the work suggested is in "streams" that can be undertaken when researchers with those skills are available. Often experimental areas can be used for more than one piece of research to conserve facilities. As an

example a researcher in seedling physiology can provide knowledge of both native and introduced species.

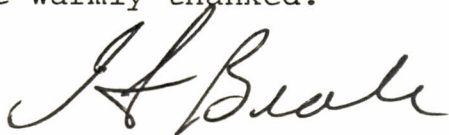
Work on productivity of communities could be handled by a consultancy or in conjunction with the work proposed by Dr. Norton. Results of animal dietary work underway or proposed (Dr. John Malachek) may show the need for more work on animal nutrition in mineral supplementation.

The present staff are about fully committed, particularly during the wet season when sampling work occurs frequently. More technical assistance would enable them to undertake more projects. For example when access to glasshouses can be obtained, soil nutrition pot trials can be conducted year-round.

15. Occurrences which affected my performance.

I would like to acknowledge the assistance of those who filled the role of interpreter for me during me stay in Brazil. Severino Gonzaga de Albuquerque, Martiniano Cavalcante de Oliveira and Luiz Mauricio Cavalcante Salviano were the principals; they and all the others who assisted in any way at all are warmly thanked.

16. Signed.



17. Dated.

28-05-1980

Appendix I.

Attached is a summary of projects suggested by Drs Brian Norton and John Malachek as part of the contribution of Utah State University to the United States Title XII programme.

Possible projects and personnel - B.E. Norton

1. Characterization of the vegetation of the caatinga with respect to

- Climate, especially precipitation and dry season stress
 - Soil type (major parent materials: laterite, limestone, basalt)
 - History of use. Including enquiries into the nature of the caatinga in the last century and earlier.
- Vegetation survey at scale of 5 x 5 km

Possibly utilizing satellite imagery combined with ground truth analysis. (Satellite imagery could also be used to characterize standing green biomass in wet season and dry season and in terms of year-to-year variability).

Collaboration with Severino Albuquerque and Martiniano Oliveira

2. Annual water budget and soil-water relations

a. A study of precipitation input in relation to evapotranspiration over an annual wet/dry cycle with the following treatments:

- Natural caatinga
- Cleared caatinga, natural regrowth
- Cleared caatinga, *perennial grass cover*
- Zero vegetation

These treatments to be applied to major soil types.

Equipment: either gypsum block or neutron probe technique

soil water content; evaporation pans; climate stations (possibly already in place).

- b. A study of soil-water characteristics of major soil types, including infiltration rates under various soil surface treatments (vegetation cleared by hand, bulldozer scraping off topsoil, caatinga shrub cover vs. annuals or perennial grass at end of dry season) and hydraulic conductivity, and relation between soil water potential and water content.

Equipment: infiltrometer, soil psychrometers, microvoltmeter

Doctoral project for João Quiroz, collaboration with EMBRAPA staff (Augmar Ramos and Petrolina hydrologists).

3. Plant introductions and performance testing

- a. Collaboration with Sra Célia Silva on testing introduced species for palatability, tolerance of dry season, regeneration under natural conditions, longevity. Assessment under different precipitation regimes and for different soil types.

Emphasis on herbaceous species

- b. Explore potential for introducing desirable woody species to replace some of the caatinga.

For example, Acacia albida grows in Africa under climate similar to NE Brazil, but it retains its leaves throughout the dry season and loses its leaves in the wet season. Foliage is very palatable.

Collaboration between Sra Silva and Robert Kiermse (A. albida expert) Jorge Ribaski BS (Agrofor).

2. Plant-animal relationship and animal nutrition

Design: In the three major types of plant communities

- . native caatinga
- . cleared caatinga with no artificial seeding
- . buffegrass pastures

grazed at stocking rates representative of "moderate" levels

Objectives: Determine the following attributes and relationships seasonally:

- seasonal diets of goats and sheep by use of oesophageally - fistulated animals (or fecal analysis)
- nutritional quality of diets, including crude protein, in vitro digestibility, phosphorus
- forage intake
- amounts of plant species available for consumption.

Personnel and collaboration:

John C. Malechek - leader
James Pfister - USA Ph.D. student
Orlando M. de Carvalho F. - EMBRAPA nutritionist
Ederlon Oliveira - EMBRAPA nutritionist-Sobral
Luiz Mauricio C. Salviano - EMBRAPA nutritionist-Petrolina
Ian Beale - IICA consultant

Appendix II.

Attached is the programme for the seminar on "Animal Production in Areas of the Caatinga", 21st and 22nd May, 1980 at CPATSA, Petrolina, PE.

SEMINÁRIO SOBRE PRODUÇÃO ANIMAL EM ÁREAS DE CAATINGA

AGENDADIA 21/05/80Manhã

- 08:45 às 09:00 - Abertura
- 09:00 às 10:00 - CPATSA - Apresentação de resultados
- 10:00 às 11:00 - Palestra - Alguns comentários sobre preparação e apresentação de dados experimentais.
Dr. Ian Francis Beale
- 11:00 às 12:00 - EMAPA e UEPAE/Teresina - Apresentação de resultados.

Tarde

- 14:00 às 15:00 - EPACE - Apresentação de resultados
- 15:00 às 16:00 - Palestra - Introdução e coleta de plantas
Dr. Ian Francis Beale
- 16:00 às 17:00 - IPA - Apresentação de resultados
- 17:00 às 18:00 - Palestra - Potencial das pastagens naturais da Zona de Mimoso do Piauí.
Dr. José Herculano de Carvalho

DIA 22/05/80Manhã

- 08:00 às 09:00 - Palestra - Uso de modelos na solução de

pesquisas

Dr. Ian Francis Beale

- 09:00 às 10:00 - EPABA - Apresentação de resultados
10:00 às 11:00 - Palestra - O Solo como um fator na avaliação de pastagens nativas.

Dr. Augmar Drumond Ramos

- 11:00 às 12:00 - Aracaju/Penedo - Apresentação de resultados.

Tarde

- 14:00 às 15:00 - CNPC/EMEPA - Apresentação de resultados
15:00 às 16:00 - Palestra - Identificação de unidade de manejo de terra.

Dr. José Gerardo B. Oliveira

- 16:00 às 17:00 - Palestra - Uma visão geral do programa de pesquisa de Charleville Pastoral Laboratory, Charleville, Australia.

- 17:00 às 18:00 - Livre - Encerramento