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Consultant Final Report
IICA/EMBRAPA-PROCENSUL II

TICK AND TICK BORNE DISEASE CONTROL

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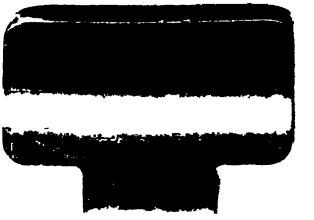

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IICA/EMBRAPA-PROCENSUL II

Geoffrey A. Norton

Brasília, fevereiro de 1989

INSTITUTO INTERAMERICANO DE COOPERAÇÃO PARA A AGRICULTURA
EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA

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APRESENTAÇÃO

A reprodução e difusão dos Relatórios de Consultores, no âmbito restrito das Diretorias das Unidades do Sistema Nacional de Pesquisa Agropecuária, vinculado à EMBRAPA, tem como objetivo principal o de divulgar as atividades desenvolvidas pelos consultores e as opiniões e recomendações geradas sobre os problemas de interesse para a pesquisa agropecuária.

As atividades de consultoría são realizadas no âmbito do Projeto de Desenvolvimento da Pesquisa Agrtopecuária e Difusão de Tecnologia na Região Centro-Sul do Brasil - PROCENSUL II, financiado parcialmente pelo Banco Interamericano de Desenvolvimento - BID e a EMBRAPA conforme os contratos de Empréstimo 139/IC-BR e 760/SF-BR, assinados em 14 de março de 1985 entre o Governo Brasileiro e o BID.

As opiniões dos consultores são inteiramente pessoais e não refletem, necessariamente, o ponto de vista do IICA ou da EMBRAPA.

A coordenação dos Contratos IICA/EMBRAPA agradeceria receber comentários sobre estes relatórios.

Horacio H. Stagno
Coordenador Contratos IICA/EMBRAPA

INSTITUTO INTERAMERICANO DE COOPERAÇÃO PARA A AGRICULTURA
CONVÊNIO IICA/EMBRAPA

RELATÓRIO FINAL DE CONSULTORIA

1. Nome do consultor: *Geoffrey A. Norton*

2. Especialista em: *Análise de Sistemas e "Sistemas Especialistas" em controle de carrapatos de gado bovino*

3. Nome do Projeto do IICA: *2.SB.3*

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23 de novembro até 22 de dezembro/1988	*CNPGL/EMBRAPA, Coronel Pacheco*
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5. Fonte financiadora: *PROCENSUL II*

REPORT ON A SERIES OF WORKSHOPS ON TICK AND TICK BORNE DISEASE CONTROL HELD IN BRAZIL : 1 - 22 DECEMBER, 1988

CONTENTS

1.SUMMARY

A series of three workshops on tick and tick borne disease control in Brazil were conducted over the period 1 - 22 December, 1988. The three sites at which the workshops took place were -

EMBRAPA National Research Centre for Dairy Cattle (CNPGL), Juiz de Fora, Minas Gerais

EMBRAPA National Research Centre for Sheep (CNPO), Bage, Rio Grande do Sul.

EMBRAPA National Research Centre for Beef Cattle (CNPGC), Campo Grande, Mato Grosso do Sul.

The aim of these workshops has been to provide participants with experience in the use of a range of systems analysis techniques by focussing on the particular problems of the area. At the same time, the workshops have produced a 'statement' of the problems associated with ticks and tick borne diseases in each area, and in some cases tentative implications have been drawn on research and extension needs.

A feature of the first two workshops was that several 'case study' farmers were interviewed by the group. Subsequently, structured discussion sessions were held with invited Centre research specialists, advisers and farmers to obtain their views on general and specific aspects of the problem. As well as being of value in its own right, this information also provided

material for analytical sessions. With the shorter time available for the third workshop (Campo Grande), analytical and discussion sessionms were combined. The details of each workshop can be found in the body of the report.

A final 'round-up' session was held in Brasilia, when the results of the workshops were presented and possibilities for future developments were discussed.

Recommendations (see section 8)

2.ACKNOWLEDGEMENTS

The success of the series of workshops described in this report is due to the enthusiasm and effort shown by a number of people. In particular, we wish to express our gratitude to the following -

The Directorate of the CNPGL for promoting and assisting in the design of the whole series of workshops.

The Directorates of the CNPO and CNPGC, and the Assessory Department (DTC) at EMBRAPA Headquarters, for their help and cooperation in realising the objectives of the project.

Colleagues from EMBRAPA and other collaborating institutions who participated in the workshops, for the time and effort they devoted to the various sessions and for freely sharing their expertise with us. The final outcome is as much due to their effort as it is to ours. We hope they benefited from the experience as much as we did.

Those farmers and advisers who gave of their time and expertise during the interview and discussion sessions. They provided a valuable contribution in keeping us aware of the real problems of tick and tick borne disease control.

Finally, IICA for its administrative support to facilitate Dr.Norton's visit to Brazil as a consultant to EMBRAPA under technical cooperation arrangements with the Intra-American Development Bank (BID).

BACKGROUND TO THE PROJECT

EMBRAPA National Animal Health Research Programme (PNPSA) is developing key components for an integrated pest management approach to tick and tick borne disease control. The aim is to provide the beef and dairy industry with more cost effective means of dealing with these problems.

Much of this work is based on the transfer of technology originally developed in Australia - especially the highly efficient 'strategic dipping' strategy against the cattle tick, Boophilus microplus, which can result in far less acaricide use, and the development of a live vaccine for use against bovine

results becoming available.

Decision rules for tick borne disease control could not be developed in the time available. However, the group did discuss the factors that would need to be taken into account in arriving at a recommendation. A list of 15 factors were proposed, as shown in Table ?. The order of these factors is according to the priority put on them by the group - the most important factor being first, the least important last.

CONCLUSION

SYSTEMS ANALYSIS AND DECISION TOOLS FOR TICKS AND TICK CONTROL

PHILOSOPHY, CONCEPTS AND TECHNIQUES

G.A.Norton, Centre for Pest Management, Imperial College
Silwood Park, Ascot, SL5 7PY, U.K.

PHILOSOPHY

Research and development in pest management does not always lead to practical improvements. There are two reasons for this :

1. R and D is aimed at the wrong questions or at developing inappropriate practices
2. Research results are not getting through to pest managers and their advisers.

A range of systems analysis and decision tools can be used to improve this situation. As implied in Fig. 1, there are two major roles that these techniques can play -

1. To help define the pest management problem and identify those key questions on which the research strategy should be based to maximise the chance of successful implementation
2. To pull together research findings, interpret them in the context of the farmers' problems, determine recommendations, and provide a tool for training and disseminating information.

Fig.1. The role of systems analysis and decision tools in pest management

PEST MANAGEMENT RESEARCH AND DEVELOPMENT	SYSTEMS ANALYSIS AND DECISION TOOLS	PEST MANAGEMENT PROBLEMS

Before looking at these techniques in more detail, let us first consider three concepts that I believe to be crucial to this approach.

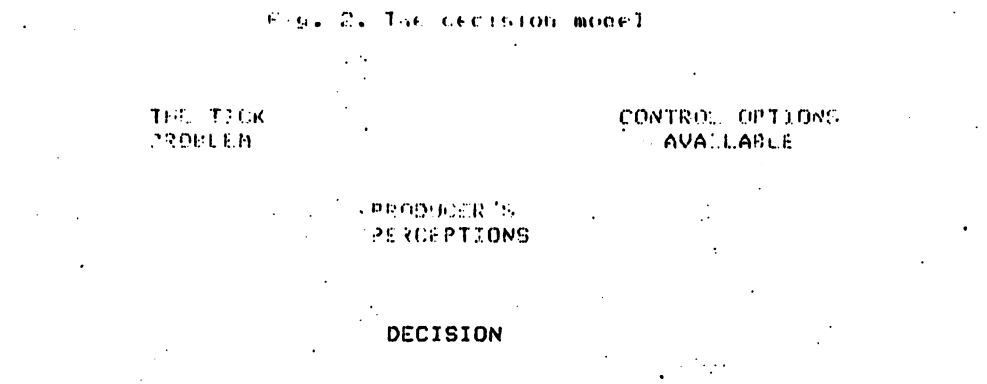
CONCEPTS

1. Decision model

The decisions made by cattle producers regarding tick control are determined by four factors (Fig. 2) :

(i) **the problem**, in terms of tick and tick borne disease challenge,
(ii) **the options** available to the producer, such as resistant breeds and acaricides,
(iii) **the producer's perceptions** of the problem and of the availability and effectiveness of the options, and
(iv) **the producer's objectives**, including financial goals and attitude to risk.

Fig. 2. The decision model



We need to understand how the variables in this model influence the actual tick control decisions made by producers if our research and extension effort is most likely to succeed. For instance, producers may be constrained from implementing particular control actions by lack of finance or their perception that certain options will increase risk.

Another possible constraint is lack of knowledge or information, which brings us to the second concept.

2. Information gaps

If producers are to manage ticks in the best way, there is a certain set of knowledge and information they need to be aware of, such as the tick life cycle, the importance of breed in determining the potential tick challenge, and how to use acaricides effectively and safely. In practice, farmers are likely to be aware of far less than this. The difference between the information that farmers have and that which they should have, to make good decisions, is the information gap.

Where there is an information gap, the important question that then arises is – what is the cause of this gap? There are several possibilities (Fig. 4) :

1. **Research gap**: Some of the required information is just unavailable. Therefore, if the gap is to be closed, appropriate research needs to be carried out.

2. **Synthesis/interpretation gap**: Research has been carried out

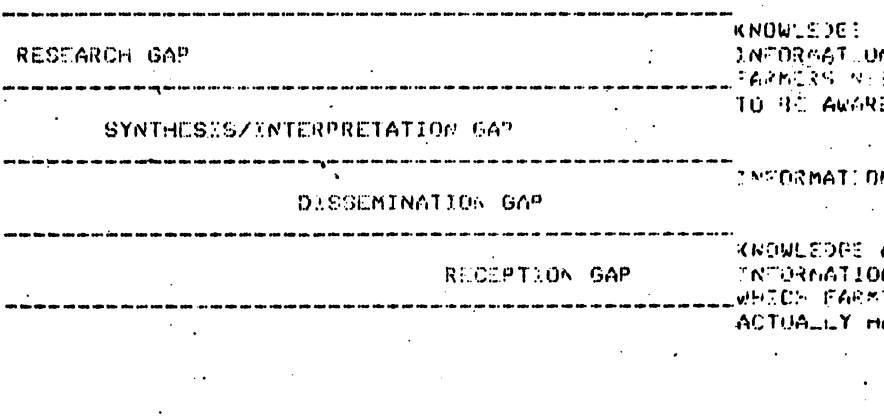
on the topic of concern but this information has not been pulled together, analysed and interpreted in the context of the farmers problem. In this case, appropriate systems and decision analysis tools should be of value.

3. **Dissemination gap**: Part of the reason for an information gap at the farm level may be that relevant information is just not reaching the farmer. This implies that extension services may need to be improved or that the form in which information is relayed to the farmer needs to be changed.

4. **Reception gap**: Although information gets through to the farmer, he may not be able to utilise it properly because he lacks the necessary background knowledge. If this is the case, more effort devoted to farmer training is implicated.

Clearly, if decision making at the farm level is to be improved, effort needs to be devoted to these four activities according to their contribution to the overall information gap.

Fig. 4. Information gaps associated with tick control



3. Development pathways.

Agricultural development can be viewed as a dynamic process, its direction being determined by political processes, economic forces, technological change and adoption, and so on. With changing livestock management practices, the need for information and knowledge on ticks and tick control at the farm level (the information gap) will also change. Since there are time lags between the initiation of research and the implementation of its results, scientists have to try to predict the direction of these changes to ensure that their research is directed towards producing relevant information and appropriate technology.

An example that will give some idea of the importance of attempting to portray this development process is given later in the form of an historical profile for cattle tick related

developments in Rio Grande do Sul (Fig 2).

TECHNIQUES

The two roles of systems and decision analysis techniques were described earlier, in relation to Fig. 1. They concern the 'targetting' of research and the synthesis / interpretation / dissemination of its results to pest managers.

The range of techniques that can be employed for these purposes can be grouped into two classes - 'soft' or descriptive techniques and 'hard' or quantitative techniques.

1. 'Soft' / descriptive techniques

These techniques are mainly concerned with helping to identify the best research strategy, providing a systematic means of inter-disciplinary problem definition. Such techniques as flow charts, historical and seasonal profiles, interaction matrices, and decision trees can be used to help identify the key components and relationships associated with tick problems and so determine the key questions that relate to their improvement. Two examples are given below to illustrate the nature of these techniques.

Historical profile

The 'historical profile', shown in Fig. 2, indicates the changes in major factors affecting ticks and tick related problems at a regional level in Rio Grande do Sul, Brazil. Information on each of the factors shown in Fig. 2 was obtained during a workshop involving scientists and administrators of the Secretariat of Agricultura, Rio Grande do Sul, in 1986. Possible or likely trends in each of these factors could then be discussed in the context of this 'profile', and implications drawn for ticks, tick control, and tick related research. This profile was re-investigated, up-dated and modified during the Bage workshop.

Interaction matrix

This second example concerns systems more directly related to ticks, namely the paddock, cattle and management systems. The 'model' shown in Fig. 3 indicates the possible relationships and interactions between components in these systems. The convention used is that a dot indicates a <u>direct</u> relationship between the column component (which affects) the row component. This type of technique allows workshop participants to systematically work through the possible relationships in the system. It can then provide -

a) a basis for identifying research gaps,
b) reveal interactions to consider in planning field and laboratory experiments, and
c) a rigorous means of simplifying a complex system as a preliminary stage in constructing a 'hard' simulation model, for example.

2. 'Hard' / Quantitative techniques

These techniques, which usually involve computers, can be concerned largely with research questions and priorities (like 'soft' techniques). However, they can also be more concerned with

advisory questions, and it is on this aspect that we will focus our attention. Two examples/techniques, concerning tick problems, are described below to illustrate the nature and function of the techniques available.

Simulation modelling

A simulation model of cattle tick populations has allowed the performance of a whole range of control measures, including cattle breed, pasture spelling, culling and dipping, to be assessed for a variety of climatic situations. This model, developed by CSIRO Division of Entomology in Australia and the Centre for Pest Management of Imperial College, U.K., has been of value in a number of ways: -

i) it has helped us appreciate the importance of host resistance in determining potential tick challenge,

ii) the model has enabled us to investigate how very specific changes in control strategies can affect their performance. For instance, we can assess the effect of level of efficacy of acaricide treatment, as may be associated with different treatment methods, on the performance of different control strategies, such as strategic (3 week) dipping or threshold dipping.

iii) from numerous model runs assessing different combinations of control methods over a range of climatic situations, overall recommendations have been derived for the best strategy in S.E.Queensland, given the level of host resistance to ticks and an estimate of climatic favourability.

iv) finally, the model has enabled us to suggest a novel single spelling strategy - for 50% Zebu-European cross animals - that can effectively control ticks without resort to acaricides.

Expert systems

Expert systems are programs that can mimic how human experts solve problems. They can be used together with other knowledge based systems, such as data base management systems, browsing (for information) programs, simulation models and pest management simulation games, to perform four main roles in pest management -

1. Practical problem solving - e.g. diagnosing pest problems and recommending appropriate treatment,
2. Information provision - e.g. how to manage a plunge dip correctly,
3. Problem structuring - in building an expert system, relevant disciplines are integrated, problem components are related, and key research and extension needs for improved management are defined.
4. Training - Using an expert system, particularly with respect to 1. and 2. above, the user gains 'experience' in how to tackle particular problems.

Fig. ? illustrates the general idea of how an expert system operates.

Fig. ? A simple decision chart and decision rule

COMPUTERISED DECISION RULE

IF Cattle breed is European
and Climate is favourable

THEN Routine dip 5 times per year

The top section of Fig. 2 is a decision chart, that leads the user, through a series of questions, to a recommendation. The lower section of the figure shows how the sequence linked by bold lines can be represented in the form of a computerised decision rule. Two expert systems for tick control and disease diagnosis, developed in workshops, can be found in the Bage workshop report.

CONCLUSION

Systems analysis and decision analysis tools can be of value to research and extension activities in pest management. They can be of help in -

* precisely defining the problem of ticks and tick borne diseases,
* assessing the feasibility of potential control methods and practices,
* identifying key research and advisory questions,
* generating hypotheses about the reasons for pest outbreaks or increases in pest status.
* evaluating the technical and economic performance of control options,
* determining recommendations for specific situations, etc..

As shown in the subsequent workshop reports, this approach can be particularly stimulating, and generate many ideas and proposals when used in an inter-disciplinary workshop.

DESCRIPTIVE ANALYSIS OF THE TICK PROBLEMATIQUE ASSOCIATED WITH BEEF CATTLE IN CAMPO GRANDE, MATO GROSSO DO SUL

Core workshop participants:

G.A.Norton - IICA consultant to EMBRAPA/CNPGL
D.E.Evans - IICA consultant to EMBRAPA - PNPSA/CNPGL
J.Furlong - Parasitologist, EMBRAPA/CNPGL
M.R.Honer -

Timetable:

	Morning	Afternoon	Evening
Mon.19/12	Analysis session I	Analysis session II	Write-up
Tue.20/12	Discussion with		

INTRODUCTION

In the short time available for this workshop, the main purpose has been to obtain a quick overview of the ptoblem in the vicinity of Campo Grande to allow comparison with the previous two workshops. The expertise available at CNPGC has also enabled us to become acquainted with current 'modelling' activity associated with ticks and to investigate further the idea of a rule based diagnostic system.

REGIONAL LEVEL ANALYSIS

CONCLUSIONS AND RECOMMENDATIONS

This project has been a first step in the use of a range of soft' (descriptive) systems analysis techniques applied to tick and tick borne disease problems in Brazil. It has -

* provided participants with experience of how particular techniques can be used to help understand something of the complexity involved in tick and tick borne disease problems,

* enabled them to assess the value of the approach, and

* allowed conclusions to be reached on the nature of the problems and the specific research and implementation needs in three regions:-

Mixed breed dairy cattle - South East Region (Juiz de Fora)
European and mixed breed beef cattle - South Region (Bage)
Zebu and mixed breed beef cattle - Central West Region (Campo Grande)

The following recommendations are made:

1.Detailed follow-up of workshops

A more detailed follow up of this series of preliminary workshops is rquired to confirm or modify its findings and to undertake a more intensive investigation of research and implementation needs. It is envisaged that this would be carried out by EMBRAPA staff and other colleagues who participated in the original workshop.

2. Research projects

These follow-up workshops should also attempt to design research and implementation projects aimed at meeting identified needs. In the Juiz de Fora workshop, for example, a training course for farmers and their advisers was recommended, while an intensive on-farm case study was recommended in the Bage workshop, to monitor tick numbers and disease incidence, assess the effectiveness of acaricide treatments, and investigate the economic aspects of tick control.

3. Training

To maintain the impetus of this project, at least one suitable candidate within EMBRAPA should be chosen for short term training with the Knowledge Based Systems Group at Imperial College (details of current projects are given in Appendix I). If possible, the period for this training should be arranged to allow the candidate to attend the course 'Decision Tools for Pest Management' to be held at Imperial College, University of London, 11-22 September, 1989.

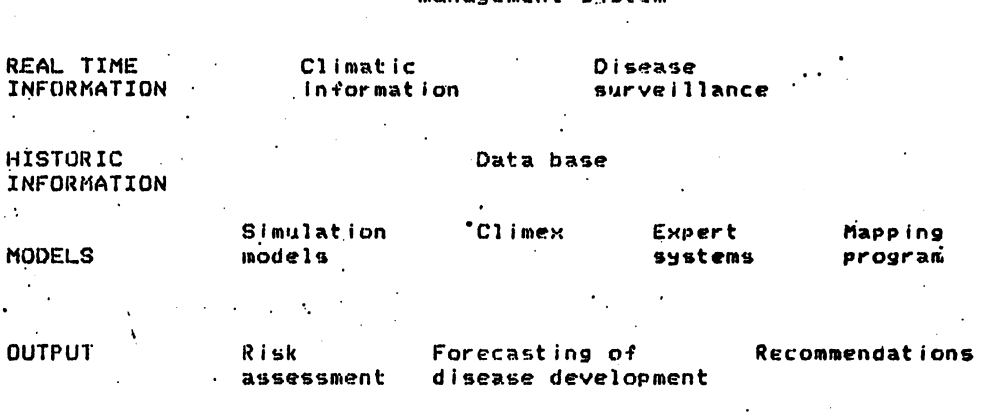
4. Computer systems

A number of personnel at various institutions are currently developing and adapting computer models and systems for use in tick tick borne disease research and control. It is envisaged, in the longer term, that these various components could be

incorporated in an overall system, as shown in Fig. 1. The form of each system will depend on the intended use, such as surveillance, research, implementation of control programmes, assessing tick and disease risk, designing recommendations, and providing training and information services.

Encouragement should be given to those involved in developing these components to coordinate their activities and, wherever possible, to ensure that the components are mutually compatible.

Fig. 1. Suggested livestock disease knowledge-based management system



5. Expert systems

Expert systems, that can mimic the way in which tick and tick borne diseases are diagnosed and recommendations made, could be particularly worth developing in the future. They would not only contribute to a general computer system (see 4. above) but also facilitate greater links between research and extension, and provide a framework for a manual of tick and tick borne disease control, aimed at extension officers and farmers.

6. Workshop 1990 or 1991

Prior to the anticipated 3rd. International Conference on cattle ticks and tick borne diseases, Southern Cone countries of South America, scheduled to be held in 1990 or 1991, it is recommended that a two-week intensive workshop be organised for participants from Brazil and from Argentina, Uruguay, and Paraguay.

The objectives of this workshop would be -

1. to provide participants with experience in the use of 'soft' systems analysis techniques to analyse the tick and tick borne disease problems in the immediate vicinity of the workshop location (yet to be determined).
2. to acquaint participants with 'hard' systems analysis techniques, including 'Climex', simulation modelling, expert systems, and other computer techniques that have been applied to tick and tick borne disease problems in Brazil.
3. to identify research and implementation needs in the study area.
4. to determine how both 'soft' and 'hard' systems analysis techniques can be used in the future to assist in research and

management programmes associated with ticks and tick borne diseases.

It is also recommended that the workshop be based in an area where -

* there are challenging problems associated with ticks and where access to farms is relatively convenient,
* workshop facilities and accommodation can be provided at one site,
* local scientists and advisers would be willing to collect relevant information in the area prior to the workshop.

Summary results of this workshop would then be presented to a wider audience by devoting one day of the International Conference to this subject.

DESCRIPTIVE ANALYSIS OF THE TICK PROBLEMATIQUE ASSOCIATED WITH BEEF CATTLE IN BAGE REGION, RIO GRANDE DO SUL

Core workshop participants:

G.A.Norton - IICA consultant to EMBRAPA/CNPGL
D.E.Evans - IICA consultant to EMBRAPA - PNPSA/CNPGL
J.Furlong - Parasitologist, EMBRAPA/CNPGL
A.da Cunha Pinheiro - Parasitologist, EMBRAPA/CNPO
F.P.Alves.Branco - Parasitologist, EMBRAPA/CNPO
A.M.Sacco - Haemoparasitologist, EMBRAPA/CNPGC
J.Machado da Silva - Ministry of Agriculture - DFA/RS
D.Radley - Technical Cooperation Officer, ODA;SAA-RS/IPVDF
C.C.P.Arteche - Technical Adviser, Lanifício Albornoz - RS

Timetable

	Morning	Afternoon	Evening
Mon.12/12		Introductory lecture	Orientation session
Tue.13/12	Visits to 3 "case study" farms		Write-up
Wed.14/12	Analysis session I	Discussion with farmers, advisers, CNPO staff	Write-up
Thu.15/12	Analysis session II	Final analysis	Write-up
Fri.16/12	Write-up	Discussion with IPVDF staff	

INTRODUCTION

The purpose of this workshop, as with the Juiz de Fora workshop, was to provide experience for the participants in a range of analysis techniques, to obtain at least a preliminary statement of the tick problematique asociated with beef cattle in the Bage area, and to identify key research / implementation needs. The same qualification applies to this report as to the previous one. Since the "results" were obtained in 3 days, they should be regarded as very preliminary, leading hopefully to a more rigorous description and appraisal of the problem.

Tick problems in the Bage region, as in Juiz de Fora, are influenced by such factors as stocking rate, cattle breed, pasture improvement and climatic favourability (see Fig. 1 in the Juiz de Fora report). However, a significant difference in the Bage region is degree of concern for Tristeza (Babesia/Anaplasma) problems. Accordingly, much more attention has been given to this problem.

In view of the interest and expertise of the Bag

participants, it was decided to initiate the farm level analysis with a seasonal profile and an expert system exercise. Both of these had not been possible in the time available in the Juiz de Fora workshop, and therefore extended the range of techniques employed by the core group.

An outline of the overall analysis is provided in Fig. 1.

REGIONAL LEVEL ANALYSIS

An historical profile, portraying the changes in important factors associated with tick problems in Rio Grande do Sul over the period 1940 to 1986, has already been described (Section I, Fig. ?). This profile provided the basis for a sub-group of participants to correct, up-date, and add additional information. Further inputs to this analysis were also obtained from staff at IPVDF, Secretariat of Agriculture, Porto Alegre.

Historical profile - amendments

The major modifications to the original historical profile are as follows -

1. Land allocation:

At present, approximately 30% of the total land area in the region is arable, 5% is improved pasture, and 65% is native pasture. However, it is common practice to crop for 2 years and leave a fallow for 3 years, providing grazing for cattle during this period. An increase in cattle density therefore may be exaggerated.

2. Regional cattle numbers:

In recent years there has been a slight decline in the regional herd - from 13 to 12 million head.

3. Breed changes:

The proportion of Zebu-cross cattle was over-estimated in the original profile. In 1986, the figure for cross-bred cattle should have been 40%, having increased now (1988) to 60%. However, this figure does not just include Zebu crosses but also European x European crosses.

The current estimate for Zebu cross cattle is 30 to 40% of all cattle in Rio Grande do Sul: it is expected to remain around this level. Cross-bred European cattle now account for approximately 20% of the regional herd: this figure is expected to increase at the expense of the pure-bred European stock.

Pure-bred Zebu cattle are not expected to increase to any degree, cold winters and the wide availability of A.I. reducing the attraction of pure Zebu.

4. Tick numbers:

Participants agreed with the original estimate of number of ticks per head per year and expect the downward trend to continue to extremely low levels of ticks, and to virtual eradication on some properties. However, in view of the suspicion of pyrethroid resistance in some areas, there may well be an increase in tick numbers on some properties if resistance does in fact occur.

5. Acaricides:

Synthetic Pyrethroids remain the predominant acaricides, although there has been some resurgence in the use of Amitraz: it is expected to remain at the current level of use. Major reasons for the increase in Amitraz use include:
the reduced necessity to protect against Berne (Dermatobia), which allows the cheaper Amitraz to be used, and
the rotational use of chemicals in some areas as a possible means of delaying the onset of acaricide resistance.

6. Number of dippings:

The average number of 5 dippings per year, ranging from 2 to 10 dippings, is not expected to change significantly in the near future.

7. Babesiosis/Anaplasmosis:

The incidence of both diseases, identified in the original analysis, has continued to increase. It is expected to increase even further, being the major preoccupation of many producers. The possibility of a vaccine becoming available is seen as the chief means of reducing this problem.

8. Berne (Dermatobia):

Dermatobia continues to remain at the low levels suggested in 1986 although, as pointed out in 5 above, a change in the type of acaricide used may permit local resurgence of the pest. For instance, if pesticide resistance occurs in ticks, the first reaction is likely to be an increase in pyrethroid use, giving greater control of Dermatobia. However, the longer term response to pyrethroid resistance will be a switch to other chemicals. Since Amitraz is the most obvious substitute at present, this will result in an increase in Dermatobia.

In addition, four further items have been added to those originally identified in 1986 -

9. Dairy industry:

Since there are 2 million dairy cattle in Rio Grande do Sul, out of a total of 12 million cattle, they constitute an important and high risk section of the cattle industry in the region. It was commented that the dairy industry traditionally has received little attention and technical support in the State.

10. Improved pasture:

As well as changes in pasture area, as determined in 1986, it is important to recognise changes in the area of improved pasture. This has continued to increase since the 1970's, currently accounting for approximately 5% of the total land area.

11. Adoption of animal health practices:

A series of animal health practices have been adopted in the region over the past 20 years. In the 1960's, antihelminthics were adopted. Since 1965 it has been obligatory to vaccinate against Foot and Mouth disease. This involved (initially) mustering animals every 4 months, which initiated producers in having much greater and frequent contact with their cattle. Also, being used to the idea of vaccination, there is unlikely to be any producer resistance to the adoption of a Babesia vaccine, if and when it becomes locally available. As already noted, the high rate of adoption of synthetic pyrethroids in the late 70's and early 80's, and the consequent decline in tick numbers and increase in Babesiosis problems, will reinforce the propensity to adopt the vaccine.

12.Climatic favourability:

Recent average temperatures in Rio Grande do Sul have increased, possibly associated with the global increase in temperature. This has resulted in higher winter temperatures and greater tick survival. If this trend continues, the distribution and status of the pest is likely to increase.

FARM LEVEL ANALYSIS

To obtain some indication of the practical problems associated with ticks, three case studies were carried out in the Bage region. The major points obtained from each of these interviews with producers are reported in Table 1. As in Juiz de Fora, a discussion session was also held subsequently with producers, advisers and scientists from the Centre, providing an additional means of assessing how tick related problems are perceived. Table 2 presents the salient points raised during this session.

More detailed analysis of the tick and tick borne disease problem took two forms. First, as a means of viewing tick problems within the context of the overall beef production system, a seasonal profile has been constructed. Despite the range of farm types in the region, it was felt that a typical seasonal pattern could be recognised over this range.

The second form of analysis, concerned with decision making in tick and tick borne disease control, employed an expert system format. In addition, when tick borne disease was discussed, a simple life cycle was used to elicit ideas, and provide a check-list, for control options.

Seasonal profile

The seasonal profile, shown in Fig. ?, includes climatic factors, grass biomass, cattle biomass and numbers, ticks, tick diseases and control measures. Further analysis of this profile could include an attempt to obtain more quantitative information on each component, an analysis of the possible interactions between the various components over time (including the use of an interaction matrix, as in the Juiz de Fora workshop - Fig. ?), and consideration of the best time at which to recommend particular practices. For instance, this profile can provide a useful framework for discussion of the best time at which to apply a Babesia vaccine, taking into account livestock movement, labour availability, tick numbers, nutritional stress of the cattle, etc..

Decision rules/expert system

To investigate the problem of deriving recommendations for tick and tick borne disease control, three exercises were conducted: one on tick control and two on disease control.

Tick control recommendations

The factors which potentially might be taken into account in making recommendations for tick control were outlined in the Juiz de Fora workshop (Fig. ?). In the Bage workshop, a decision chart was constructed for a specific problem, to illustrate the potential of the approach.

To keep the task manageable, a very specific problem was considered - "High tick numbers have been detected". The questions that would need to be answered in arriving at a recommendation for this problem were discussed within the group, and several of the paths were completed, as shown in the decision chart in Fig. ?.

Where treatment with acaricide has been carried out, and yet there is still a high tick number problem, a whole series of "trouble-shooting" questions need to be asked to try to identify why dipping is not effective. A number of possibilities exist:

a) kill per dipping is not adequate. This could result from incorrect charging/recharging of the dip, a leaking dipping tank, dilution of the dip through rain or run-off, failure to agitate the dip or run the first 50 or so animals through the dip a second time, a low mustering %, and so on.

b) dipping strategy is not adequate. For the breed of animals the producer has, the climatic favourability of the paddocks, the previous history of ticks, the method of acaricide treatment, and other relevant factors, questions could be asked that would determine whether the overall strategy the producer is using could be expected to cope with the tick challenge he might expect.

c) reduced host resistance. The high tick number may be the result of host resistance being lower than might be expected. For instance, cross-bred cattle may have less Zebu content than supposed or the animals may be under extra stress.

d) highly favourable micro-climate. Grazing the cattle on improved pasture or the incidence of weather conditions that are particularly favourable to ticks, may also account for high tick numbers.

As well as the decision chart (Fig. ?), which concerns a very small proportion of the overall decision rule approach, an expert system, based on Fig. ?, has been produced using "EXSYS PROFESSIONAL", an expert system software shell.

Tick borne disease control

Decision making rules were also explored for two tick borne disease problems - disease diagnosis and control recommendations.

Before attempting to develop these decision rules however, a life-cycle diagram, illustrating the process of infection, was used to identify and provide a checklist of the options for control (cf. the tick life-cycle diagram used for tick control in the Juiz de Fora workshop, Fig. ?). A summary of the options listed is shown in Fig. ?.

To recommend options for tick borne disease control it is first necessary to identify the disease involved. The decision chart, shown in Fig. ?, indicates the factors that need to be considered in diagnosing tick borne diseases. Clearly, this is a very preliminary attempt.Further development of this approach might include a more general livestock diagnosis system that would operate at various levels of information and of user (veterinary) experience of livestock pests.

For instance, it might be useful to develop a system that enables the risk of particular diseases to be assessed in situations where laboratory diagnosis facilities are unavailable or not immediately accessible. Such a system would rely on indirect "clues" that a veterinary adviser could use to assess the likely cause of a particular problem, prior to laboratory

Babesia and Anaplasmosis.

For this technology to be successfully implemented however, it needs to be adapted to suit Brazilian conditions. As part of the process of producing this appropriate technology, it is argued that a rigorous analysis is required of the tick and tick borne disease problem, including its biological, technical, economic, cultural and political dimensions. The realistic evaluation of specific R & D projects, such as improved tick control options and vaccines, can only be undertaken within this broad analytical framework. Similarly, the greater appreciation of the problem obtained through this approach can be crucial in determining how best to implement research results via Government planners, extension workers, and the cattle producers themselves.

Systems analysis techniques provide a means of undertaking this broad and rigorous analysis of livestock pest problems. Following the "Second International Workshop on Tick and Tick Borne Diseases and Insect Pests of Cattle - Southern Cone Countries, S. America", held in Porto Alegre, April/May, 1986, EMBRAPA decided to initiate developments in this field.

One aspect of this has been the organisation of a series of workshops, involving key EMBRAPA personnel concerned with tick and tick borne disease control, as well as other scientists from collaborating institutions.

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DESCRIPTIVE ANALYSIS OF THE TICK PROMLEMATIQUE ASSOCIATED WITH DAIRY CATTLE IN JUIZ DE FORA

Core workshop participants:

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D.E.Evans - IICA consultant to EMBRAPA - PNPSA/CNPGL
J.Furlong - Parasitologist, EMBRAPA/CNPGL
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T.M.Saueressig - Parasitologist, EMBRAPA/CPAC
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R.Leite - Parasitologist, UFMG
A.H.de Fonseca - Parasitologist, UFV

Timetable:

	Morning	Afternoon	Evening
Sun.4/12			Orientation session
Mon.5/12	Introductory lecture	Analysis session I	Questionnaire design
Tue.6/12	Visits to 5 "case study" farms		Write-up
Wed.7/12	Analysis session II	Discussion with CNPGL specialists	Write-up
Thu.8/12	Analysis session III	Discussion with farmers and advisers	Write-up
Fri.9/12	Final analysis	Group seminar to CNPGL staff	

INTRODUCTION

The purpose in carrying out this analysis was threefold :
1.to provide experience for the group in applying a variety of descriptive and decision analysis techniques to the problem of ticks in dairy cattle,
2.to produce a preliminary statement of the problematique in the Juiz de Fora area,
3.to identify key research and implementation needs in ticks and tick control.

Since the analysis has been completed within 4 days,the details it contains and the conclusions drawn should be regarded with caution. Nevertheless, this report does represent at least a "first shot" or preliminary statement of the problem, providing a basis for further development. We also believe that the conclusions drawn merit further attention.

An outline of the analysis is provided in Fig. 1; further details on each component can be found on the page indicated.

The tick and tick control problem

Tick challenge and the consequent reduction in milk yield is influenced by a range of factors, including climatic effects and the impact of such management related factors as breed, stocking rate and acaricide treatment (Fig. 2). The latter, in turn, are influenced by other variables, particularly the price of milk and the cost of labour and other inputs. One aim of the descriptive analysis is to identify and portray in more detail the key components of this system, their relationships, interactions and trends.

The analysis is divided into two main sections, dealing with the regional and farm systems seperately (Fig. 1).

REGIONAL LEVEL ANALYSIS

Our main concern here is with the changes that have taken place over time in the key components, and how they are likely to change in the future. Our impression of the overall trends are indicated in Fig. 3. This historical profile has been based on expertise within the group, from discussion with farmers, advisers and staff of the Dairy Centre. The major points raised during the meeting with the latter are given in Table 1.

FARM LEVEL ANALYSIS

To gain some indication of the tick and tick control problems faced by farmers in the Juiz de Fora region, a series of case studies were undertaken by visiting 5 farms, representing a range of farming types. The key information obtained from these visits is set out in Table 2. In addition, a discussion was held with invited farmers and advisers: the main features of this session are given in Table 3.

With this appreciation of the problem, further analysis was carried out to identify, in more detail, the options for tick control and the relationships and interactions affecting tick challenge (Fig. 1).

"Brainstorming"

Using the life-cycle of the tick as a means of stimulating ideas, the group identified 25 options for tick control in a "brainstorming" session lasting an hour or so (Fig. 4). This list, which has been compiled without regard to the feasibility of each option, provides a checklist of options on which further research might be undertaken. However, before being used in this way, a further analysis of each option would need to be undertaken, to explore the possibility of modifying the option to make it more effective and/or more feasible.

Interaction matrix

This technique also provides a kind of checklist, although in this case, we are concerned with identifying the relationships and interactions that can occur between climatic, management, pasture and herd features (Fig. 1). The interaction matrix, shown in Fig. 5, portrays the linkages between the various components. A dot indicates that the respective column component is thought

to have a direct effect on the row component.

Secondary and subsequent linkages can be traced through the system via horizontal and vertical connections. For instance, pasture improvement can have a direct effect on grass species, grass structure, grass quality, and cattle density and movement (as shown in column 5). Moving horizontally along row 1, to column 10, and moving down column 10, we can see that grass species can affect larval survival directly (due to stickiness for example) and also affect grass structure and grass quality. These in turn can affect micro-climate and nutrition, which affect egg and larval survival and the tick resistance of the animals.

As well as providing a means for systematically thinking about relationships in the system, the interaction matrix also serves as a descriptive model, allowing detailed studies on particular components of the system to be related to other components, albeit in a simple way.

The next two sections are more concerned with implementation aspects, and how tick management might be improved.

Information and knowledge need

One conclusion that arose from discussion with advisers and farmers was the need for a short training course. For such a course to have maximum impact, it must cover those topics which advisers and farmers need to be aware of if they are to make sound tick control decisions. A short group session was spent in listing these key information and knowledge needs. This list, which is not necessarily complete, is given in Table 3.

Designing tick control recommendations

A longer term objective of this project is to develop an expert system for tick control. This would not only provide the opportunity for advisers to have access to computer information, problem solving and training programs, but would also provide a rigorous means of designing an extension manual.

It was not possible to make much progress in the development of this expert system in the time available in this initial workshop. However, as a preliminary stage in this process, attention was given to the steps that would seem to be necessary in reaching a recommendation on acaricide use. This model for the design of recommendations for acaricide use is set out in Fig. 6.

CONCLUSION

In the course of this workshop, a number of questions have been raised and implications drawn about future research and extension. Some key conclusions are listed below under three major headings -

Research gaps

There is an urgent need for investigations into on-farm acaricide application, concentrating particularly on :

1. the effectiveness of on-farm equipment and treatment, including the practice of only treating areas of the cattle where ticks are seen.

2. the effectiveness of commercially available acaricides.
3. the reasons for 'poor' treatment, such as cost saving, poorly maintained equipment, and lack of 'know-how'.

Implementation gaps

A one-day training course on ticks and tick control should be conducted for advisers and farmers, the course content being based on information needs (Table 2).

Further systems analysis work

Two topics merit further attention :
1. the development of an expert system for tick control in Brazil
2. the use of the Australian simulation model to provide a means of assessing the economic performance of different control methods and strategies, including questions relating to 'pour-on' and 'spot' treatment of ticks.

INSTITUTO INTERAMERICANO DE COOPERAÇÃO PARA A AGRICULTURA

O Instituto Interamericano de Cooperação para a Agricultura (IICA) é o organismo especializado em agricultura do Sistema Interamericano. Suas origens datam de 7 outubro de 1942, quando o Conselho Diretor da União Pan-Americana aprovou a criação do Instituto Interamericano de Ciências Agrícolas.

Fundado como uma instituição de pesquisa agronômica e de ensino, de pós-graduação para os trópicos, o IICA, respondendo às mudanças e novas necessidades do Hemisfério, converteu-se progressivamente em um organismo de cooperação técnica e fortalecimento institucional no campo da agropecuária. Essas transformações foram reconhecidas oficialmente com a ratificação, em 8 de dezembro de 1980, de uma nova convenção, que estabeleceu como fins do IICA estimular, promover e apoiar os laços de cooperação entre seus 31 Estados membros para a obtenção do desenvolvimento agrícola e do bem-estar rural.

Com um mandato amplo e flexível e com uma estrutura que permite a participação direta dos Estados membros na Junta Interamericana de Agricultura e em seu Comitê Executivo, o IICA conta com ampla presença geográfica em todos os países membros para responder a suas necessidades de cooperação técnica.

As contribuições dos Estados membros e as relações que o IICA mantém com 12 Países Observadores, e com vários organismos internacionais, lhe permitem canalizar importantes recursos humanos e financeiros em prol do desenvolvimento agrícola do Hemisfério.

O Plano de Médio Prazo 1987-1991, documento normativo que assinala as prioridades do Instituto, enfatiza ações voltadas para a reativação do setor agropecuário como elemento central do crescimento econômico. Em vista disso, o Instituto atribui especial importância ao apoio e promoção de ações tendentes à modernização tecnológica do campo e ao fortalecimento dos processos de integração regional e sub-regional.

Para alcançar tais objetivos o IICA concentra suas atividades em cinco áreas fundamentais, a saber: Análise e Planejamento da Política Agrária; Geração e Transferência de Tecnologia; Organização e Administração para o Desenvolvimento Rural; Comercialização e Agroindústria, e Saúde Animal e Sanidade Vegetal.

Essas áreas de ação expressam, simultaneamente, as necessidades e prioridades determinadas pelos próprios Estados membros e o âmbito de trabalho em que o IICA concentra seus esforços e sua capacidade técnica, tanto sob o ponto de vista de seus recursos humanos e financeiros, como de sua relação com outros organismos internacionais.

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O Programa de Geração e Transferência de Tecnologia é a resposta do IICA a dois aspectos fundamentais: (i) o reconhecimento, por parte dos países e da comunidade técnico-financeira internacional, da importância da tecnologia para o desenvolvimento produtivo do setor agropecuário; (ii) a convicção generalizada de que, para aproveitar plenamente o potencial da ciência e da tecnologia, é necessário que existam infra-estruturas institucionais capazes de desenvolver as respostas tecnológicas adequadas ás condições específicas de cada país, bem como um lineamento de políticas que promova e possibilite que tais infra-estruturas sejam incorporadas aos processos produtivos.

Nesse contexto, o Programa II visa a promover e apoiar as ações dos Estados membros destinadas a aprimorar a configuração de suas políticas tecnológicas, fortalecer a organização e administração de seus sistemas de geração e transferência de tecnologia e facilitar a transferência tecnológica internacional. Desse modo será possível fazer melhor aproveitamento de todos os recursos disponíveis e uma contribuição mais eficiente e efetiva para a solução dos problemas tecnológicos da produção agropecuária, num âmbito de igualdade na distribuição dos benefícios e de conservação dos recursos naturais.

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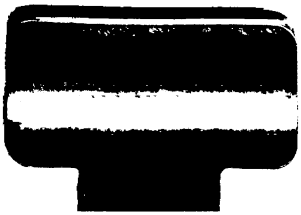

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