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# PASTURE RESEARCH AND TECHNOLOGY TRANSFER IN TWO LATIN AMERICAN CATTLE DEVELOPMENT PROGRAMS ECUADOR AND PANAMA

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## ABSTRACT

Experimental results on pasture and forage production and utilization show that it is possible to obtain about 450 g/animal daily liveweight gains in steers in relatively fertile soils with good water retention capacity which is the case in the Coastal area in Ecuador between Quevedo and Santo Domingo With stocking rates up to 3 animals/ha it is possible to obtain gains of 1 5 kg/ha/day or 500 kg/ha/yr enabling animals to reach slaughter weight before 2 5 years of age Adequate reproductive levels with 80% effective weaning is possible both for adult cows and first calving heifers before the age of 3 years On the other hand test results in acid infertile soils with low moisture retention capacity such as those prevalent in the Pacific Region of Panama do not seem promising at this time This justifies the need for further research on these soils The comparative advantages of using fertile soils for the more profitable crop production must be considered as well With respect to technology transfer to cattlemen although it is true that there is no adequate model that can be applied to all possible circumstances in Latin America experiences in Ecuador and Panama suggest the need to develop research with practical well-defined goals related to livestock development programs supported by credit projects Furthermore validation of technology and demostrations at the producer s level should form an integral part of research activities as should training young professionals and designing techniques for evaluating adapting and adopting new technology in light of socio economic conditions of the livestock industry


Pasture and forage production capacity has been considered one of the advantages of the Tropics for economical beef cattle production However the present use of these resources under grazing conditions is far from being efficient mainly due to production restrictions during the dry periods and variations in forage quality on offer in the humid dry regions with acid infertile soils

Results reported during this seminar have shown the production potential of these areas and how nutritional problems of livestock production under grazing con ditions could be solved despite the above mentioned deficiencies However a number of unsuccessful attempts on technology transfer in Latin America have also been mentioned (24) especially those related to introducing new forage species with higher potential than native species in which due to higher costs of establishment and management a change in the existing

Agronomist Beef Product on Program Centro Inter nacional de Agr cultura Tropical Cali Colombia

pasture structure was not justified In relation to that it has also been pointed out (4) that some forage species especially grasses have been introduced by ranchers themselves On the other hand it must be recognized that the existing technology is far from being applied at the farm level at a sufficient rate to cause impact on beef production promising a serious delay in tropical livestock development

Even though the importance of research on pasture and forage production and utilization in tropical acid infertile soils must be recognized because of the possible impact of the results on economical beef production it has been suggested (19) that perhaps it is also important first to adapt and to test results at the regional level before transferring technology to the producers

Nevertheless in the case of livestock production we still do not have a technological package similar to that for crop production in the Green Revolution which could be applicable to livestock production Basic to any beef production program in Latin America efforts must be made to develop a methodology to facilitate technology flow from researcher to producer

The objectives of this paper are to present results of research in tropical forage and pasture production and utilization based on the experience of livestock development programs in the tropical coastal regions of Ecuador and the Pacific Coast of Panama and to discuss the possibilities for develop ing technology transfer models at the farm level

## CHARACTERISTICS OF THE TROPICAL REGIONS OF COASTAL ECUADOR AND THE PACIFIC COAST OF PANAMA

These are two typical regions in Latin America where beef production plays an important role in the agricultural develop ment of each country not only because of its importance in food production but also because of its contribution to the economics of the region Available natural resources for beef production present certain marked differences which are reflected in the production and utilization of pastures and forages the approach to research and the technology transfer methodology applicable to each region

### Climate

Annual rainfall and distribution throughout the year do not seem to differ in the two regions (Fig 1) Approximately 80 to 90% of the annual rainfall occurs during the rainy season and affects seasonal forage production Due to the difference in latitudes the rainy and dry seasons occur at different times of the year in each region

### Soils

Differences between both regions are being determined by this natural resource In Ecuador only 23% of the soils are classified as Oxisols or Ultisols (2) and most of the estimated 8 6 million ha are located in the eastern humid tropical region and the northern part of the Coast In Panama 3 6

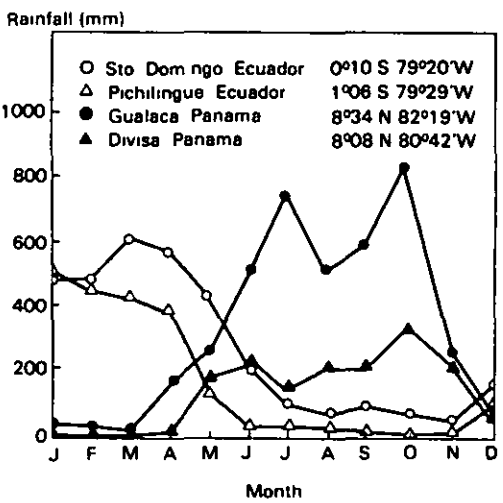



Figure 1 Rainfall distribution in representative sites of the Ecuadorian coast and the Pacific Region of Panama (Servicio Nacional de Meteorologia e Hidráulica of Ecuador and Servicio Interamericano de Cooperación Agrícola of Panama)

million ha comprising 63% of the country are found throughout the nation both in humid and humid dry regions

Table 1 shows soil chemical characteristics of each region In general the Ecuadorian coastal soils especially from Pichilingue to Santo Domingo are highly fertile which allows high yields of annual food crops such as rice maize soybean etc (5) On the other hand low soil fertility has been considered the main limiting factor in Panama for forage production hence food crops

The moisture retention capacity of coastal Ecuadorian soils—mostly Inceptisols Alfisols and Vertisols—is generally good with moisture equivalents of 30 to 40% which allows continued forage growth for some time after the end of the rainy season On the other hand ocean currents greatly influence prevailing winds and air temperatures in the region leading to lower evapotranspiration rates during the dry season (12) In Panama water holding capacity of most Ultisols and Oxisols is relatively low independent of texture and OM content During the dry season actual evapotranspiration is 80 to 90% higher than rainfall (18) Therefore low soil moisture content in addition to low natural fertility levels are more critical for pasture and forage production and utilization in the Pacific Coast of Panama than in the Ecuadorian coast

## Forage species

*Panicum maximum* Jacq (31) is the most common grass in the Ecuadorian coast where it has been naturally adapted to soil and climatic conditions ranging from sea level to an altitude of approximately 1100 m This forage species has been recognized as excellent (32) because of its yield and adaptation to all climatic and soil conditions in the Tropics and it is considered (37) the highest yielding grass under grazing con ditions in Puerto Rico In Panama 84% of the pastures are established with *Hyparrhenia rufa* (Nees) Stapf (27) hence livestock production mainly during the dry season is limited due to its low yield and nutritional value even after N application near the end of the rainy season (35)

## METHODOLOGY

The first activities in Ecuador and Panama were related to ecological survey of the tar get area within the beef development pro grams to get acquainted with the available resources for pasture and forage production and above al to identify limiting factors which should be emphasized in the study (33 34) The scheduled visits to many beef ranches representing different types and levels of productivity helped in analyzing animal production factors directly related to nutritional and socio economic aspects involved in technology development and transfer to producers

Table 1 **Characteristics of representative soils from the Ecuadorian coast and Pacific region of Panama**

| | | | | Exchangeable cations | | | | |
|---|---|---|---|---|---|---|---|---|
| | pH | OM | P (Bray II) | Ca | Mg | K | Al | Source |
| | — % — | | ppm | ——— meq/100 g ——— | | | | |
| Santo Domingo Ecuador | 5 7 | 5 3 | 5 | 3 0 | 0 6 | 0 3 | 0 0 | Tergas |
| Pichilingue Ecuador | 6 1 | 5 6 | 28 | 13 0 | 2 4 | 1 6 | 0 0 | (12) |
| Gualaca Panama | 5 1 | 7 5 | 1 | 1 3 | 0 5 | 0 3 | 1 8 | (8) |
| Coclé Panama | 5 4 | 4 6 | 2 | 8 6 | 2 1 | 0 3 | 1 3 | (8) |

Unpublished data

As to finding practical and economical solutions to the problems of pasture and forage utilization and production the follow ing methodology was adopted (a) screening of forage species adapted to the prevalent ecological conditions (soils and climate) in the area (b) development of acceptable pasture establishment and maintenance practices for the specific socio economical conditions of the beef industry in each country and (c) personnel training within the program in validation and technology transfer techniques

Research work in Ecuador was conducted directly with a technical assistance program of the University of Florida (U S A ) in association with the Instituto Nacional de Investigaciones Agropecuarias (INIAP) with headquarters at the Estación Experimental Tropical de Pichilingue (EETP) in Quevedo (financed by the Central Bank s Livestock Development Program ECU 222 through a loan from the International Bank for Reconstruction and Development (World Bank)) A research program was set up including conventional agronomy studies of forage plants under cutting and grazing conditions on the Ecuadorian coast Technology transfer carried out through the Centro de Capacitación Ganadera (Livestock Training Center) in the experimental station where theoretical practical courses on basic animal production aspects are offered to extension and credit agents and selected producers

The Panama study was carried out directly with the Panama National Bank s Livestock Development Program PAN 901 financed through a World Bank loan Activities of testing on adaptation and validation of technology at a farm level were supported by the pasture and forage research program of the Instituto de Investigaciones Agropecuarias de Panama (IDIAP) with headquarters at the Gualaca s Experimental Station which is technically assisted by the Animal Husbandry Department of the Cen tro Agronómico Tropical de Investigación y Enseñanza (CATIE) of Costa Rica The mechanisms used for technology transfer involved direct technical assistance to producers and field demonstrations

The training of technological personnel assigned to these programs was designed to provide (a) knowledge for identification of forage utilization and production problems related to nutritional needs of the herds (b) technical skills in validation and adaptation of new technology according to the available natural and financial resources and ad ministrative capacity of the enterprise and (c) communication and agricultural exten sion methods In Ecuador greater attention was placed on the research aspects and in Panama to the financial ones for obvious reasons

## RESULTS AND DISCUSSION

Most of the research and technical assistance efforts were focused on the dry season due to the fact that most restraints concerning pasture and forage utilization and production in terms of dry matter (DM) production and nutritive value are found during this critical period

### Research

#### Dry matter

Screening results on *P maximum* accessions which were adapted to the ecological conditions of the Ecuadorian coast showed no ecotype with better DM production during the dry season (Table 2) There were also no significant differences among the best varieties introduced and common ecotypes in terms of DM digestibili ty and crude protein content (CPC) (36)

Table 3 summarizes dry season average DM yields of pasture species and varieties adapted to the Ecuadorian coast under cutting conditions every 21 and 35 days In general common *P maximum* was outyield ed only by species of *Brachiaria* varieties of *Pennisetum purpureum* Schumach varieties of *Glycine wightii* (R Grah ex Wight and Arn ) Verdcourt especially Malawi and *P maximum* variety EETP 307

Accession number from the Estación Experimental Tropical de Pichilingue INIAP Ecuador

Table 2 **DM yields of naturalized *P maximum* and introduced well adapted varieties under grazing conditions (15 16)**

| Varieties | 1975 Dry season | 1976 Rainy season | 1976 Dry season | Total 18 months |
|---|---|---|---|---|
| | t/ha | | | |
| Common | 3 15 | 10 19 | 5 37 | 18 72 |
| Improved | 2 62 | 6 99 | 3 74 | 13 35 |
| EETP 307 | 3 64 | 8 84 | 4 49 | 16 97 |
| Introduced | 4 28 | 8 78 | 4 76 | 16 83 |
| Average | 3 42 | 8 70 | 4 53 | 16 72 |

Dry weight bas s 45°C 24 ho s
G azed at 21 and 42 day ntervals d ng the a ny and dry seaso espectively
Ave age of 10 best nt oduced va et es

however performance of the latter variety under grazing conditions was not consistent as shown in earlier tables

Dry season production of non fertilized *H rufa* in Panama (27) was 1 05 t/ha representing 14 6% of the total annual production meanwhile the average yield of improved species without fertilizer applications was 1 16 t/ha and 2 97 t/ha when fertilized annually with 900 kg N 400 kg $P_2O_5$ and 120 kg $K_2O$/ha However dry season yields represented only 12% of the total annual production *H rufa* is considered suitable only for extensive production systems due to its poor response to N application during the rainy season Among the grasses selecteu and recommended for intensive use they considered *Digitaria dec\ mbens* Stent *Brachiaria ruziziensis* Germain & Evrad *Brachiaria decumbens* Stapf *Brachiaria radicans* Napper *Hemarthria altissima* (Poir ) Stapf & Hub bard var Tetraploid and some *Axonopus Cynodon* and *Pennisetum* species and varieties The following legumes were considered promising *Pueraria phaseoloides* (Roxb ) Benth var Javanica (Benth ) Bak *Desmodium ovalifolium* Vahl *Desmodium intortum* (Mill ) Urb *Centrosema* spp *Stylosanthes guianensis* (Aubl ) Sw and *Macroptyloma axillare* (E Mey ) Verdc although dry season yields were only recorded for the most productive species (*B decumbens Cynodon* sp var Estrella and *B ruziziensis*)

Table 3 **DM yields of naturalized species and varieties and introduced well adapted pasture species under cutting conditions during the 1975 dry season at INIAP (34)**

| Species and varieties | Cutting intervals 21 days | 35 days |
|---|---|---|
| | t/ha | |
| Common *P maximum* | 2 63 | 3 34 |
| Improved *P maximum* | 2 91 | 3 61 |
| *P maximum* EETP 307 | 8 05 | 11 93 |
| *Cynodon* spp | 3 83 | 3 96 |
| *Brachiaria* spp | 7 05 | 8 36 |
| *C ciliaris* | 3 56 | 4 34 |
| *Setaria* spp | 3 01 | 5 64 |
| *P purpureum* | 8 42 | 16 84 |
| *C wightii* | 7 75 | 5 66 |
| *G wightii* var Malawi | 10 59 | 8 12 |
| Average | 5 78 | 7 18 |

Dry weight ba 45 C 24 hou

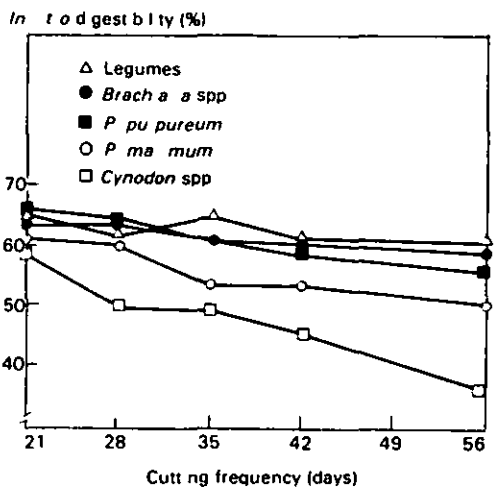
*P purpureum* yield levels of DM obtained in Panama (18) towards the end of the rainy season ranged from 6 3 to 10 3 t/ha using up to 1 400 kg N/ha/year and from 4 5 to 8 0 t/ha when grown in association with *P phaseoloides* with P K and gypsum applications DM yields ranging from 58 to

66 kg/ha/day were recorded by IDIAP (14) for non fertilized *Saccharum sinense* Roxb and 68 to 82 kg/ha/day when fertilized with 100 kg N/ha/yr This grass has shown good drought resistance and response to low P levels in P deficient soils

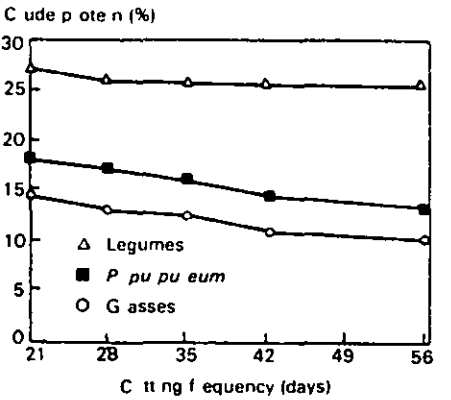
### Nutritive value

DM *in vitro* digestibility averages of the best adapted *P maximum* varieties in the Ecuadorian coast taken at 21 and 56 days during the dry season decreased from approximately 61 to 52% as the plant matured (Fig 2) There were no significant varietal differences when compared with common *P maximum* (36) Among the grasses only *Brachiaria* species and *P purpureum* varieties proved of any importance regarding DM digestibility and were slightly better than *P maximum* varieties Legume species maintained digestibility levels above 60% despite the plants stage of maturity

Average CPC in grass species and varieties in Ecuador decreased with maturity (between 21 and 56 days of growth) whereas CPC remained over 25% in legume species (Fig 3) Furthermore the performance of *P purpureum* varieties was slightly better however in all cases overall CPC was above 10% an adequate level for growing ruminants and for beef production No significant CPC differences were found during the rainy season (36)




Fgu e 2 **Effect of cutt ng f equency o n t o digestibility of tropical pasture species and varieties adapted to the coast of Ecuador INIAP Pichilingue dry season 1975 (34)**




Fg re 3 **Average crude protein content of tropical pasture species and va eties adapted to the coast of Ecuador INIAP Pichilingue dry season 1975 (34)**

In Panama (27) average CPC of samples from 13 species and varieties of grasses was 13 7% Materials were selected according to environmental adaptability cut at three day intervals between 12 and 42 days of growth and fertilized with 360 kg N 240 kg $P_2O_5$ and 60 kg $K_2O$/ha In comparison maximum CPC was 9 to 10% for *H rufa* fertilized with 600 kg N/ha/yr during the rainy season and 4 to 6% during the dry season

Crude protein levels of almost 11% (18) were found in *P purpureum* towards the end of the rainy season without N application while *S sinense* levels fluctuated between 8 and 11 5% (14) when N was applied at a rate of 200 kg/ha/yr

Digestibility and nutritional level parameters for the selected grasses were not reported except for P content in P treated soils

### Animal production

Tables 4 and 5 show daily liveweight gain/animal and per area in Ecuadorian

Table 4 **Liveweight gains per animal with several grass species and varieties under different treatments in the Ecuadorian coastal Plains**

| Species and varieties | Treatment | Liveweight gains | | | | Source |
|---|---|---|---|---|---|---|
| | | No of days | Dry season | Rainy season | Annual average | |
| | | g/animal/day | | | | |
| Common *P maximum* | Non fertilized | 180 | | 423 | | (15) |
| | Non fertilized | 491 | 307 | 411 | 359 | (15) |
| | In association with *P phaseoloides* | 491 | 331 | 468 | 399 | (15) |
| Improved *P maximum* | Non fertilized | 280 | 317 | 597 | 457 | (25) |
| | Non fertilized | 180 | | 353 | | (15) |
| | 100 kg N/ha/yr | 336 | 485 | 674 | 579 | (28) |
| | In association with *C pubescens* | 224 | 243 | 744 | 493 | (7) |
| *B dictyoneura* | Non fertilized | 180 | | 394 | | (15) |
| *G wightii* var Tinaroo | Non fertilized | 180 | | 607 | | (15) |
| Average | | 282 | 336 | 519 | 457 | |

Pichilingue
Santo Domingo

coast tests with different grass species and varieties mainly common and improved *P maximum* varieties under different treatments Despite the short duration of these trials in general animal production averages of 457 g/animal/day and 1 46 kg/ha/day throughout the year are very good This provides liveweight gains of over 500 kg/ha/yr and enables steers to reach slaughter weight (450 kg) before 25 months of age when weaned at not less than 180 kg (1) These results are 52% higher than averages found in an economic survey of farms within the Livestock Development Program in the Area of Santo Domingo and Quevedo (19) This production rate is comparable to that presented in a summary on animal performance on N fertilized tropical grasses and pasture and legume associations (23) and higher than that recorded in Mexico for *D decumbens* and *H rufa* when fertilized with 100 kg N/ha during the rainy season (11) and in Venezuela (6) for *Cynodon* sp var Estrella *D decumbens* and *P maximum* receiving N applications However results from Pichilingue show that average daily gains per animal during the dry season are only 65% of those obtained during the rainy season This is due to the effect of lower quality grasses which leads to a 50% reduction in beef production/ha/day even despite high stocking rates over the entire year

In Panama in trials (18) with stocking rates of nearly 2 5 animals/ha the highest daily gain per animal on non fertilized *H rufa* under rotational grazing conditions was 200 g while 310 to 450 g gains were obtained with complete fertilization of *Brachiaria* spp and *D decumbens* In another trial in Gualaca (14) daily animal gains of up to 838 g were obtained in 180 days on N fertilized *H rufa* pastures However economic evaluations showed the system to be economically unfeasible due to current beef and fertilizer prices The same study shows that *H altissima* var Tetraploid fertilized with 300 kg N/ha/yr produced weight gains of up to 502 kg/ha during the initial stage of the study compared with 417 407 and 390 kg/ha for *D decumbens Cynodon* sp var Estrella and *B radicans* respectively These production rates are

Table 5 **Liveweight gains per unit area with several grass species and varieties under different treatments in the Ecuadorian Coast**

| Species and varieties | Treatment | No of days | Stocking rate | Liveweight gains | | | Source |
|---|---|---|---|---|---|---|---|
| | | | | Dry season | Rainy season | Annual average | |
| | | | an/ha | kg/ha/day | | | |
| Common *P maximum* | Non fertilized | 180 | /3 1 | | 3 20 | | (15) |
| | Non fertilized | 491 | 3 8/3 3 | 1 22 | 1 17 | 1 20 | (15) |
| | In association with *P phaseoloides* | 491 | 4 8/3 4 | 1 40 | 1 38 | 1 39 | (15) |
| Improved *P maximum* | Non fertilized | 280 | 1 4/1 7 | 0 65 | 1 65 | 1 15 | (25) |
| | Non fertilized | 180 | /2 8 | | 2 68 | | (15) |
| | 100 kg N/ha/year | 336 | 3 3/3 3 | 1 60 | 2 22 | 1 91 | (28) |
| | In association with *C pubescens* | 224 | 1 7/3 3 | 0 95 | 2 33 | 1 64 | (7) |
| *B dictyoneura* | Non fertilized | 180 | /3 6 | | 2 90 | | (15) |
| *G wightii* var Tinaroo | Non fertilized | 180 | /2 6 | | 2 81 | | (15) |
| Average | | 282 | 3 0 | 1 16 | 2 26 | 1 46 | |

Pich l ng e
Sa to Dom ngo
Dry/ ny seaso ave age

relatively low compared to production rates resulting from *H rufa* experiments in non fertilized but more naturally fertile soils in Ecuador (29) and from *H rufa* and *S guianensis* associations in acid infertile soils in Pucallpa very similar to those in Panama (20)

### Animal reproduction

Results obtained in Ecuadorian coast trials show that effective weaning averages of over 80% are possible with average 160 kg weights (adjusted to 205 days of age) for males and females by utilizing mineral supplementation and breeding herd management without changing the common *P maximum* pastures in the region (Table 6) These averages are much higher than those found on Ecuadorian Livestock Development Program ECU 222 farms in Santo Domingo and Quevedo where the maximum average growth rate of the herd is only 1 2% (9) Regarding development and reproduction performance results show that it is possible to obtain a 36% higher calf crop when first calving heifers graze separately from the adult herd (15)

In Panama calving rates increased from 62 to 73% when P was supplemented to the animals or by fertilizing *H rufa* at a rate of about 80 kg $P_2O_5$/ha (14) On the other hand in studies conducted in the humid tropics of Peru (30) mineral supplementation was found to have a greater effect on reproductive performance of heifers than superphosphate applications of up to 500 kg/ha on *H rufa* and *P phaseoloides* associations These results suggest that mineral supplementation with P could have a greater effect on reproductive performance than pasture improvement as has been found in the Llanos Orientales in Colombia (2)

## Technology transfer

### Centro de Capacitación Ganadera

Table 7 shows the number of participants in the pasture and beef cattle management courses offered at Pichilingue from 1975 to the present A total of 376 trainees including a balanced number of producers from the Coastal region and technical research and assistant staff members from the Livestock Development Program have received training The information provided during the courses is based on research results Field demonstrations are carried out at the experimental station followed by regional trials on selected farms owned by participating ranchers Up to now these experiments have been concentrated on reproductive improvement in a region of low animal population rates and high grassland availability

Table 8 shows the alternatives offered to cattlemen and participants in the improved pasture establishment and management courses for increasing beef production during the dry season It is interesting to note that the option with the best expected

Table 6 **Reproductive performance of beef herd grazing on common and improved *P maximum* varieties (15 16 17)**

| | 1975 | | 1976 | | 1977 | | |
|---|---|---|---|---|---|---|---|
| | Common | Improved | Common | Improved | Common | Improved | Average |
| Calving (%) | 92 | 95 | 80 | 80 | 80 | 80 | 84 |
| Birth weight (kg) | 28 | 29 | 28 | 29 | 29 | 29 | 28 |
| Weaning (%) | 92 | 95 | 80 | 80 | 80 | 80 | 84 |
| Weaning weight (kg) (205 days) | 159 | 160 | 159 | 168 | 156 | 166 | 162 |

Table 7 **Number of participants by levels in the beef and pasture management courses at the Centro de Capacitación Ganadera (15 16 17)**

| Level | 1975 | 1976 | 1977 | Total |
|---|---|---|---|---|
| Technicians | 65 | 90 | 47 | 202 |
| Producers | 45 | 49 | 80 | 174 |
| Total | 110 | 139 | 127 | 376 |

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benefit ratio when compared with es tablishment and management costs is the use of common *P maximum* complemented with *Eriochloa polystachya* H B K and another species well adapted to the many floodable low land coastal areas and *P purpureum* from cutting and grazing under extreme drought conditions

Associations of common *P maximum* and *P phaseoloides* in established pastures seem to be a promising option for low fertility soils or areas where soil fertility is declining These data are available (15) and results could be transferred to cattlemen in a relatively short period of time First however the persistence of the species under present management systems in the area must be validated and the need of whether to modify or not the present sys tems which include burning and continuous grazing must also be studied Furthermore it is important to consider the possibility of reducing establishment costs especially availability and seed price and to define P and S fertilizer maintenance requirements The other option substituting common *P maximum* for some *Brachiaria* species is

Table 8 **Analysis of possible alternatives based on research carried out on improved pasture management and establishment to increase dry season beef production in common *P maximum* pastures of the Ecuadorian Coast**

| Alternatives offered (management) | E B | E E [b] | M D [c] | E M C [d] | E B / E M C |
|---|---|---|---|---|---|
| *P purpureum* *E polystachya* (Supplemented) | > | $\overline{\overline{<}}$ | | $\overline{\overline{>}}$ | > |
| *P phaseoloides* *G wightii* (In association) | > | ? | ? | ? | ? |
| *B decumbens* *B dictyoneura* (Replacement) | = | < | = | > | < |

E pected be f t
[b] E se f est bl shm t
M nagem t d ff c lt es
[d] E t bl shm t nd ma g m t cos s

not promising in the long run because although these species seem to be better adapted to low fertility soils and compete better with weeds under these conditions their productivity gradually decreases due to soil N deficiencies and a legume grass association would be much more difficult to establish

### Technical assistance and demonstrations

A total of 311 visits were made to cattle ranches in Panama between the end of the rainy season in 1975 and the first semester of 1977 Table 9 shows the objectives number and distribution of calls At the beginning of the study several non participating ranches were visited so as to diagnose pasture and forage production and utilization problems in the area and to observe some of the better managed holdings Later most activities were con centrated on ranches associated with the credit program

Technical assistance at the farm level focused on improved forage establishment and management mainly to increase the nutritional level of feed provided during the dry season As a result of these visits almost 1000 ha of improved pastures and seed plots of the recommended species were esta blished on almost every participating ranch Field demonstrations were used to train the program s technical staff on improved pasture establishment and management practices (i e species identification and screening forage utilization and preserva tion etc ) so that through the learning process the communication methodology and agricultural extension work could be more effective Toward the end of the second year the sub projects were evaluated ac cording to the new technology s effective ness economic impact and acceptance Eva luation was extended to the training of the technical personnel The evaluations were concentrated on farms selected as models within the sub region the majority of which were less than 300 ha in size and with so called dual purpose dairy beef operations Economic evaluations of these farms are in progress at the present time

Specific technical recommendations are based on the analysis of the options presented in Table 10 These options would be presented to cattlemen according to the study results and socio economic aspects of the beef industry It is not feasible to increase production during the dry period by improving *H rufa* management although the relative importance and productivity of this grass during the rainy season was noted A promising short range option that solves some nutritional problems is the establishment of relatively small areas at the beginning of *B decumbens* or *B radicans* in low fertility soils *E polystachya* in lowland floodable areas and *S sinense* as cut grass for supplementing *H rufa* during the dry period The gradual substitution of *H rufa* by *Brachiaria* species and the establish ment of *Cynodon* in higher fertility areas were considered feasible yet there is no

Table 9 **Number and distribution of visits to cattle ranches in different regions in the Pacific Coast of Panama Livestock Development Program PAN 901 Banco Nacional**

| Objectives | 1975 | 1976 | 1977 | Total |
|---|---|---|---|---|
| Problem diagnosis | 69 | 10 | 0 | 79 |
| Technical assistance | 8 | 111 | 19 | 138 |
| Demonstrations and training | 0 | 13 | 0 | 13 |
| Sub project evaluation | 0 | 25 | 56 | 81 |
| Total | 77 | 159 | 75 | 311 |

Table 10 **Analysis of possible alternatives based on research carried out on improved pasture management and establishment to increase dry season beef production in *H rufa* pastures of the Pacific Coast of Panama**

| Alternatives offered (management) | EB | EE [b] | MD [c] | EMC [d] | EB/EMC |
|---|---|---|---|---|---|
| *Brachiaria* spp<br>*S sinense*<br>*E polystachya*<br>(Supplemented) | > | ≷ | = | > | > |
| *P phaseoloides*<br>*S guianensis*<br>(In association) | > | ? | ? | ? | ? |
| *Brachiaria* spp<br>*cynodon* spp<br>(Replacement) | > | < | = | > | ? |
| *P purpureum*<br>*S sinense*<br>(Silage) | ? | < | > | > | ? |
| *D decumbens*<br>*Cynodon* spp<br>(Hay) | = | ≷ | > | > | < |
| By products<br>Molasses + urea<br>(Supplemented) | > | = | > | > | ? |

[a] Expected benefits
[b] Establishment
[c] Management difficulties
[d] Establishment and management costs

information on expected benefit ratios compared to additional establishment and management costs On the other hand both systems tend to degrade with time due to decreases in soil fertility leading to reductions in animal production Another possibility would be to include forage legumes such as *P phaseoloides* and *Stylosanthes* spp native to the area in *H rufa* pastures since this seems to have been effective in certain tropical areas including some isolated areas in Panama However experimental results have not been tested sufficiently in commercial operations and lack of seeds of adapted species and varieties limits the work on technical adaptation at the regional level

The preservation and use of forage as silage or hay for beef production was not found to be economically feasible due to high production costs (34) and losses during storage (21) Finally the use of agricultural by products such as sugar cane and bagasses rice hulls etc was considered with some good biological results (14) Their

use depends on the availability of a commercial molasses mix with 2% urea content at localized subsidized prices much lower than in the international market which can be justified only to maintain animals under extreme drought conditions or high pasture and forage scantiness

## CONCLUSIONS

Test results on pasture and forage production and utilization in the Tropical Coastal area of Ecuador between Quevedo and Santo Domingo on fertile soils with adequate moisture indicate that there is enough information available to improve livestock production which is based on acceptable and ready to transfer technology on improved forage establishment consisting mainly of management of the available natural resources with minimum investment costs However the situation varies in low soil fertility areas with moisture retention problems as is the case of the Pacif Coast of Panama where forage production is low during most of the year On the other hand any livestock development program must consider the comparative advantages of higher soil fertility areas for the more profitable crop production

Though it is true that based on these experiences from Ecuador and Panama an ideal technology transfer model for cattlemen can not be designed we can however confirm the important role of research as a source of new technology as long as it is related to well-defined goals in the livestock development programs

A common error in Latin America (4) is the lack of relevance of the work carried out at experimental stations to the cattleman s problems in the region Recommended therefore is the establishment of a livestock training center within the experimental station such as that at INIAP in Pichilingue Ecuador

Frequent contact among producers extension agents and research workers—with the support of development and credit agencies—is essential if research results are to be applied at the producer level This contact does not necessarily guarantee results but does serve as a stimulus which is the case of Australia and other tropical countries throughout the world (13)

Training in economical production and efficient utilization of pastures and forages and in communication and technology transfer techniques is important in order to maintain a good flow of information between research workers and the beef industry due to the limited number of persons in the developing countries in Latin America capable of interpreting and transmitting the technology developed at research stations (22) Research projects related to any Latin American livestock development program should include training for technical personnel especially young college graduates

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