RELEVANCE OF AUSTRALIAN EXPERIENCE IN TROPICAL PASTURES TO DEVELOPING COUNTRIES

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ABSTRACT

Comparisons of environmental features of tropical developing countries with those of tropical Australia indicate many similarities in soils and climate. These similarities have led to a major involvement of Australians in pasture research and development in developing countries. This paper assesses the results of these activities by means of a survey.

The relevance of the Australian germplasm collections, and of the Australian approach to the role of legumes, soil fertility assessment and amelioration, establishment and management of pastures, ley pastures and seed production are discussed. Poor adoption of improved pastures is identified as a major concern in developing countries and suggestions are made to overcome this constraint.

INTRODUCTION

Tropical pasture research in Australia commenced with plant introduction work at Lawes in 1930 (McTaggart 1942), but it was not until the early 1950's that integrated multidisciplinary research programs got underway. However, although research and development in this field covers a relatively short time span, Australia has been a focal point for the transfer of tropical pasture technology to developing countries.

This paper assesses the results and relevance of these activities by means of a survey conducted to canvass views on: (1) the relevance of the various components of Australian tropical pasture technology; (2) the effectiveness of methods of transferring this knowledge; and (3) the degree of adoption by indigenous primary producers. Forty-four questionnaires were sent to personnel involved in pasture work in developing countries. There were 35 replies, 27 from Australians and 8 from non-Australians. This paper is therefore an integration of the opinion of respondents, and their contributions are acknowledged, but the responsibility for emphasis is the authors.

Environmental similarities

In discussing the relevance of such research it is appropriate to briefly put into perspective the relationship of the tropical Australian environment to the rest of the tropics. Tropical Australia is defined as that area north of lat. 30°S, and receiving more than 500 mm mean annual rainfall. It covers the north-west of Western Australia, the top end of the Northern Territory, north and eastern Queensland and a small portion of coastal New South Wales.

In this region, wet (7.5-9 month wet season), dry (4.5-7 months) and arid (<4.5 months) tropical climates are found, and most of the major soil orders are represented (Sanchez and Isbell, 1979; Aubert and Tavernier, 1972), although the area of oxisols, ultisols and very acid soils typical of Latin America and Southeast Asia is small. Environmentally, tropical Australia has a closer similarity to Africa and Central America than to Southeast Asia or South America.

Livestock production systems

In contrast to environmental conditions, livestock production systems and levels of production in developing countries are very different from those in Australia. For instance in Africa's arid zone, migratory pastoralism is the predominant production system while in semi-arid Africa, Asia and the Far East region, the large bovine populations are concentrated with smallholder farmers whose livestock production and cropping systems are closely integrated. Only in Central and South America, are there great expanses of land in the sub-humid and humid zones which can be developed with Australian-type production systems. Because of these differences, it was generally felt that Australian animal production systems were not of direct relevance to developing countries.

RELEVANCE OF AUSTRALIAN PASTURE KNOWLEDGE AND RESOURCES

Plant collection and genetic resources

All respondents stated a need for importation of new genetic material, and since Australia has been involved in major pasture plant collection programs since 1947 (Ralph 1982), developing countries look to Australia for assistance. However, their requirements vary with the quality and productive potential of indigenous flora.

For instance, Africa is well endowed with grass species while Central and South America are rich in indigenous legume species. Respondents from Pacific Island nations, and Southeast and East Asia expressed a need for both grass and legume species although productive legume genera are endemic to equatorial Asia.

The survey showed that as resources and expertise have improved in the developing world, research agencies have begun their own germplasm collection and storage programs. In future, developing countries will look more closely at the value of indigenous germplasm and will make greater use of other international centres, but it is likely that they will continue to use the well organized Australian resource.

Adaptation of species

All respondents indicated an initial reliance on Australian published information on the adaptation of pasture species to assist with choice of suitable species but all emphasized the need for local screening trials. However, the level of reliance on Australian resources and information has decreased with increased availability of expertise and facilities for local research.

Programs with limited research capability, such as livestock development projects (often ADAB supported), which imported only commercial material and tested these for local adaptation by means of pilot plantings have greater reliance on Australian information. Projects in isolated sites such as those in Sarawak, China and Laos were in this category.

Projects with research capability (e.g. those attached to national or international research institutions) were able to import a wider range of germplasm including non-commercial material. This is clearly to their benefit as many well adapted, but non-commercial ecotypes have been identified to suit the different physical and socio-economic environments of developing countries. Examples are the release of Khon Kaen stylo (Stylosanthes humilis) in Northeast Thailand, an accession from the CSIRO collection, and the superiority of CPI 34911A (S. guianensis) over the cultivar Graham in Zimbabwe.

In parts of South America, environmental conditions limit the usefulness of Australian cultivars. For instance, Australian Stylosanthes material is not resistant to local races of anthracnose, and other legume genera are not adapted to the very acidic high aluminium ultisols. These conditions encourage self-reliance which in itself has several advantages for other countries with similar soils, (e.g. Indonesia).

Role and importance of legumes

Respondents recognized the inherent value of legumes for improving infertile soils through nitrogen accretion, and for their positive effects on animal production through improved diet quality and pasture yield. However, most downgraded the relevance of grass/legume pastures to smallholders because of the management expertise necessary to maintain legumes, the lack of appreciation of the value of legumes by smallholders, the high costs of inputs (e.g. seed and fertilizer) and the difficulty in controlling stock grazing on unfenced communal lands. Possible exceptions to the above views are ranch style properties found in South America, the Pacific region, Malaysia and Zimbabwe. In Africa and Asia, the role of legumes is oriented more towards dietary supplementation of herbivores, and maintenance of soil fertility in cropland.

There was concensus that low cost oversowing of legumes into native grasslands was relevant, but again uncontrolled communal stocking and reluctance to use fertilizer mitigated against persistence of legumes (Shelton and Wilaipon 1984) and grasses. The Imperata grasslands of Southeast Asia and the Pennisetum and Themeda grasslands of Papua New Guinea and Fiji, become unstable at the increased stocking rates associated with oversowing and fertilization, and this has led to the replacement of the grass species by unpalatable weeds (Falvey and Andrews 1979).

These experiences underscore the need for hardy and persistent grasses and legumes to underpin the development of stable pastures for communal and smallholder areas. Examples are Nadi blue grass (Dicanthium caricosum) in Fiji and Dicanthium annulatum in Papua New Guinea (Holmes 1981), which form dense, persistent, weed-free swards

under continuous grazing, and fine stem stylo (Stylosanthes guianensis) and Cassia rotundifolia, particularly for use on infertile soils, where there is a reluctance to use fertilizer.

Some respondents expressed the view that shrub legumes warrant further investigation because they have several clear advantages including persistence, adaptation to adverse moisture and low fertility conditions and suitability to cut and carry systems. Naturalized species such as Acacia in Africa, Leucaena in the South Pacific region and Prosopis in South America already play an important role in livestock feeding.

Rhizobium microbiology

With the exception of Zimbabwe, Brazil and Colombia, most developing countries do not have facilities for commercial supply of Rhizobium cultures to farmers, although some microbiological laboratories have been set up in developing countries for supply of inoculum to research groups. Therefore most legume plantings were not inoculated and Rhizobium specificity was seen as a practical disadvantage. Australian research methodology is clearly relevant and the recent initiation of an ACIAR Rhizobium project jointly with Southeast Asian countries is acknowledgment of this.

Soil fertility and plant nutrition

A unanimous conclusion from the survey was that the nutrient status of pasture soils in developing countries requires more attention. Australian methodology for the identification of nutrient deficiencies was viewed as relevant, even for soil types not well represented in Australia. However, the lack of analytical services for farmers and experimental work limits application of this technology. Most respondents felt that fertilizer application is not an economic option in most cases, but that a knowledge of the fertility status of pasture soils would permit rational choice of improvement strategy (e.g. choice of species to suit fertility).

Establishment and management of pastures

Most respondents felt that the Australian concepts of establishment and management of broadacre pastures were not relevant to smallholders and communal livestock graziers in developing countries. Cattle owners in Asia and Africa have no fences making pasture management almost impossible. Again, exceptions were the ranches of South America, Zimbabwe, the Pacific area, and parts of Asia such as state farms in China. However, where oversowing techniques were used for native grasslands, the ecological principles which determine persistence of legumes and native grasses were clearly relevant.

Ley pastures/crop rotations

The survey showed general interest in the concept of ley rotations because of the close association of livestock with crop production in Asia and Africa, and that further research was warranted. Examples of current work were the CSIRO/ACIAR work in Kenya, University of Queensland work with rotation of Stylosanthes hamata with upland crops,

alley cropping of leucaena in Northeast Thailand, and work by Shelton (1980) on the rotation of lowland rice with sunnhemp (Crotalaria juncea). The point was made that smallholders are reluctant to fertilize pastures, even though the subsequent crop will benefit.

Seed production

The Australian pasture seed production technology was viewed as highly relevant to developing countries. This is a specialized high input activity which can, in part, be transferred. Local seed production is a key factor in successful pasture development unless vegetative propagation is used. For countries close to the equator with high and uniform rainfall patterns and small fluctuations in daylength, seed supplies may have to be imported from a third country, perhaps Australia, although the high price of Australian seed is a disincentive.

ADOPTION OF TECHNOLOGY

Level of adoption

Comments indicated little adoption of improved pasture technology (especially legume pastures) by indigenous smallholder livestock producers. However, where ranch style management was possible, such as in South America where the Andropogon gayanus cv. Planaltina is well adapted, pasture development has occurred. Some success has also been achieved with smallholder dairy producers who had better cash flows and a greater awareness of the importance of feeding.

Many reasons were given for the poor adoption of improved pastures, namely:

1. Subsistence farmers are crop orientated, and unaware of the importance of livestock feeding,
2. hierarchical social structures do not encourage innovation,
3. poorly developed infrastructure (e.g. no transport system or commercial markets),
4. lack of funds for inputs such as fertilizer, fences and seeds,
5. presence of communal grazing lands where there is no individual or collective responsibility,
6. ineffective extension services,
7. importance of cattle for non-cash purposes, (e.g. draft, fertilizer, hides and hair),
8. non-commercial attitudes to cattle raising, (e.g., cattle kept for social, religious or ceremonial reasons),
9. shortage of labour for management of pastures,
10. lack of familiarity with cattle and pastures (some Pacific nations),

11. lack of hardy pasture species, particularly legumes, and

12. subsistence farmers were not given time to absorb the skills and develop motivation before commencing commercial cattle production.

Despite these limitations to adoption, there has been sufficient limited success to encourage perseverence. However, research agronomists must attempt to improve adoption because further research cannot be justified without improved rates of adoption.

Extension emphasis

Survey replies suggested a modified extension emphasis to suit the circumstances of farmers in developing countries. Since mass media outlets are often limited more use needs to be made of field day demonstrations using influential or innovative farmers. Mobile extension units with audio-visual displays were used, for example, in Nigeria and Vanuatu. Women and children need to be involved as they are often responsible for day to day tasks.

Exceptions were the centralized economies of China and Burma, where tight control is exercised over agricultural activity and innovations can be directed from above. In Pacific nations, pasture development is often tied to agricultural development bank loans which specify satisfactory completion of pasture improvement, fencing and stockyard construction.

Relevance of research to indigenous biological and socio-economic system

Whilst there has been much useful pasture research conducted in most tropical developing countries, following Australian methodology, respondents felt that much of the work could have been better directed. For research results to be adopted, they must have clear biological, economic and social advantages. In addition, there are many examples where good research has been conducted but never implemented because of failure of some other linkages necessary for the livestock industry to progress (e.g., absence of marketing infrastructure, social restrictions, health limitations).

Reasons given for lack of relevance of research were: (1) aid projects often have a short life span (3-5 years) which encourages hasty activity in order to quickly achieve visible results; and (2) indigenous postgraduate students return to their countries without the advantage of experienced leadership and direction and may simply conduct a variation of their thesis work without proper appreciation of local farmer needs.

There was almost complete agreement that research scientists require a more detailed understanding of the local biological and socio-economic system in order to work effectively. To provide this data surveys of local livestock production systems were recommended. Surveys of the kind suggested are currently being conducted in Ethiopia by ILCA, in Indonesia and in Papua New Guinea. It was suggested the research scientists should work much more closely with the farming community to both improve their understanding of on-farm problems and

to test innovations at a practical level.

One valuable suggestion is that since skills and resources of smallholder farmers are limited, research aims in these countries should be lowered towards a more robust but probably less productive system. Highly productive options are of little value if they cannot be successfully managed. Examples of such strategies are the use of Nadi blue grass (Dicanthium caricosum) in Fiji, buffalo grass (Stenotaphrum secundatum) in Vanuatu, and simple improved grazing management strategies for existing grasslands in Africa.

METHODS OF TRANSFER

There are a number of different mechanisms that have been used to transfer Australian tropical pasture information to developing countries but the long term secondment of Australian personnel to work closely with national staff was the most favoured method. However, the quality of this transfer mechanism depends on the approach adopted which should be collaborative and not dominating. Communicative skills and other non-technical personal resources are paramount. Short term consultancies, unless specifically focussed, were not favoured as expertise was often seen as not locally relevant.

Most respondents recognized the value of postgraduate study in Australia, as formal training enhances understanding of underlying principles. Such training is more effective when made in association with an aid project for two reasons: (1) it provides opportunity for field research work within project goals and therefore improves relevance; and (2) it provides ongoing research programs to absorb returning graduates thus ensuring sound supervision and availability of facilities. Disadvantages are that graduates can be promoted into administration and are therefore lost to field activities, and that over-specialization can bias choice of research priorities leading to imbalanced and non-relevant programs.

There was varied opinion concerning the value of short courses and study tours and where they should be held. Courses for lower level technical staff are probably best held within the region to highlight relevant techniques in similar conditions whilst research staff may benefit from exposure to Australian methods if they are able to appreciate the principles involved. Care should be taken to ensure that training courses are appropriate to the needs of participants.

There was general support for collaborative networks to bring pasture workers together from often isolated situations. Such interaction promotes the cross fertilization of ideas, and improves the focus and relevance of national programs. Recently, a meeting in Zimbabwe resolved to establish a pasture network coordinated by IDRC while in South America CIAT coordinates similar activities. Current plans to establish a network for the Asia and Pacific region under the auspices of ACIAR and ADAB were well supported.

FUTURE DIRECTION OF AUSTRALIAN ASSISTANCE

Australia has made a substantial input of time, expertise and resources into tropical pasture research and development in developing

countries over the past twenty years. Whilst there have been many positive aspects including goodwill, improved qualifications and expertise of third world nationals and improved research capacity of local institutions, overall, the results have been disappointing mainly because of poor adoption of improved pasture technology by indigenous farmers. This situation cannot be ignored.

The survey has highlighted many reasons for the poor adoption and suggestions put forward to address these problems are listed below.

Research emphasis

1. Focus of third world research programs should be improved by social, economic and biological surveys of local production systems to establish more relevant research priorities.

2. Research objectives and improvement expectations should be lowered with more attention on robust and stable systems.

3. Research personnel should work more closely with extension officers and farmers to ensure applicability of recommended strategies by on-farm testing.

4. Pasture agronomists must maintain an overview of the ruminant industry so that research does not outstrip progress in other sectors (e.g. marketing infrastructure, health improvement).

5. Soil fertility and plant nutrition studies should have priority.

6. Hardy persistent grasses and legumes as well as shrub legumes should be transferred quickly from the Australian collections.

7. Australian based research will always be of value to developing countries to provide background information.

8. Future research into the use of ley rotations is recommended.

Training emphasis

1. Training to increase the number and expertise of third world agronomists should be emphasized, particularly postgraduate training which strengthens understanding of basic principles.

2. Collaborative networks to foster workshops and study tours should be encouraged.

3. There should be more collaboration between Australian workers responsible for development projects, and those involved in research and education projects.

In the final analysis, success will be achieved by encouragement of enthusiastic and qualified local staff. Without commitment and motivation of developing country personnel, significant development of improved pastures and forages will not be achieved.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the substantial assistance and contributions of all respondents to our survey: - J. Ayres, J. Brigatti, G.J. Calder, C.P. Chen, J.N. Clatworthy, J.L. Falvey, T.A. Gibson, G.M. Giles, B. Grof, R.C. Gutteridge, R. Harrison, J. Hopkinson, L.R. Humphreys, G. Hunter, D.A. Ivory, J.R. Lazier, D.S. Loch, R.L. McCown, R. Mendoza, Ng Thai Tsiung, B. Norman, M. Osvaldo Paladines, I.J. Partridge, C. Piggin, S. Reynolds, A.D. Robertson, J. Teitzell, D. Thomas, W. Thompson, P. Thurbon, J. Tothill, N. Tulloh, G.J. Tupper, B. Walker, P.C. Whiteman.

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ACRONYMS

ADAB	Australian Development Assistance Bureau
ACIAR	Australian Centre for International Agric. Research
ILCA	International Livestock Centre for Africa (Addis Ababa)
IDRC	International Development Research Centre (Ottawa)
CIAT	International Centre for Tropical Agriculture (Columbia)