DAIRY PRODUCTION SYSTEMS RELEVANT TO THE TROPICAL REGIONS OF AUSTRALIA
2. REVIEW OF FARMING PRACTICE

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INTRODUCTION

This review is an attempt to collate and interpret information derived from practical experience—as distinct from research—with dairy production systems in tropical Australia. Because of the limitations of such information it has been possible only to classify existing systems according to their sources of feed supply and provide subjective estimates of their frequency of occurrence and performance levels.

Some factors—appropriate to the study of farming systems in different contexts—have been specifically excluded from consideration:—

1) Socio-economic factors were defined as outside the scope of this conference and this appears justified. They are obviously of major importance in determining production systems in practice, but may be very inefficient guides unless performance parameters are first reliably defined in physical terms.

2) Wider considerations of whole farm systems or enterprise combinations have also been excluded. The major relationships of the dairying system to other farm systems are economic, and technical interrelations are not directly important to the study of dairying systems *per se*.

3) Considerations of animal health and milking procedures have also been excluded. These have important effects on performance which are related to the system within which they operate, i.e. both the incidence and quantitative effects of variations in these factors differ between dairying systems. There is, however, no evidence to suggest that the effects of similar variations differ between tropical and temperate environments.

With these exclusions the factors remaining for study are variations in the level and composition of feed supply in relation to number of milking cows. However, the conclusions of workers who have examined dairying systems in the region —e.g. Swain *et al.* (1970), Rayner and Young (1962)—suggest that these are, in fact, the important variables.

Dairy production systems have been categorised according to—

a) Forage supply—Types of pastures and crops and major agronomic practices, particularly fertilizer and irrigation usage.

b) Forage utilisation methods—The whole range from uncontrolled grazing to green soiling occurs in the region.

c) Supplementary feeding—Only consideration of variations in gross levels has been possible.

d) Herd management, involving variation in animal numbers and calving time in order to relate variations in nutritional requirements over time to varying feed supply.

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Variations within these factors and their combinations define a large number of alternative production systems, most of which are used on farms in tropical Australia. This paper is restricted to those which occur on a substantial number of farms or appear to have wider potential application.

Performance levels of systems have been estimated in terms of butterfat production per milking cow per annum. This measure has obvious and well known deficiencies, but its use was dictated by lack of alternative information.

DAIRY PRODUCTION SYSTEMS

1. Raingrown unimproved pastures

The term "unimproved" is used to include both native and introduced species which persist under heavy grazing without fertilizer applications.

As an arbitrary definition, this system includes situations where 90% or more of dry matter intake is obtained from these pastures. The remainder may be from supplementary feed, crops and/or improved pastures, sometimes with a small amount of irrigation. These small additions to the feed supply may be important for animal survival, but usually produce little production response in a situation of chronic under-nutrition.

Lack of herd management is also a characteristic of this system, but calving of the 70% of animals which re-calve annually tends to be concentrated in the spring. Production averages approximately 100 lb B.F. per cow, but ranges widely from less than 50 lb to 150 lb per lactation.

Up to 16% of dairy farmers in coastal northern New South Wales and southern Queensland may be in this category. No reliable information exists, but it is suspected that the rate of change from this system—to more intensive systems or out of dairying—has not been higher than the 8%-10% of farms annually which has occurred throughout the industry.

2. Improved pastures

The term "improved" in this context refers to sown and/or fertilized swards. Generally the system involves sown, fertilized pastures, but sown pastures are not necessarily adequately fertilized and fertilizer is not uncommonly used without introduction of new species. Field evidence is insufficient to assess the relative responses of sown and existing pastures to appropriate fertilizer regimes, but conclusions emerging from a survey (Minson, personal communication) indicate the need for a closer examination of the simpler procedure.

Useful manipulation of animal requirements seldom occurs. Breeding may be controlled, but this does not necessarily mean an effective relationship of calving time to feed supply pattern. Pasture subdivision and grazing management are usually related to requirements for maintenance of the sward rather than of the animal.

To avoid excessive subdivision, this system is taken to include situations with from 10% to 100% of feed supplied by improved pastures. (In practice few farms go beyond 60%.) Again, by definition, no more than 10% of total feed supply comes from supplementary feeding, crops or irrigated forage.

These definitions are not, however, very limiting. A system in which 50% of feed is obtained from fertilized pastures—including tropical and temperate varieties —and 10% from strategic supplementary feeding and/or forage cropping may allow production up to 250 lb B.F. per lactation and satisfactory breeding performance. Alternatively a situation with 10% or even 20% of dry matter from fertilized tropical pastures, but the remainder almost entirely from unimproved

pastures may be little better than the totally unimproved situation for eight months of the year. The lower level of performance for this system is accordingly less than 100 lb B.F. per lactation.

Approximately 20% of dairyfarmers may be using this system, with an increase of up to 4% annually as farms move to this system from unimproved pastures and annual crop systems.

3. *Unimproved pasture plus crop grazing*

This is defined as a system in which up to 40% of dry matter is provided by forage crops and up to 10% by supplementary feeding.

The important factor of this system is the opportunity—not always realised—to provide a reasonably satisfactory feed supply (other than during droughts) by strategic use of crop varieties and agronomic practices and appropriate selection and use of supplementary feed. The system suffers from self imposed problems due, for example, to inappropriate selection of crops (what is the value of forage sorghum which makes the same contribution to feed supply as available pasture?), poor cultural practices and ineffective herd management.

Performance levels from 100 to 250 lb B.F. per lactation are achieved. Approximately 20% of farmers may be using this system, but the number is declining.

4. *Improved pasture plus crop grazing*

This is as the foregoing system but with improved pasture replacing native pasture to a varying extent and providing up to 10% of dry matter intake.

With appropriate selection of pasture and crop varieties, agronomic practices, utilisation methods, supplementary feed use and herd management this system gives good results on many farms. Its technical limitation under these conditions is exposure to seasonal variations, but this may be largely mitigated (perhaps even to the economic optimum extent) by use of the supplementary feed allowance on an average rather than annual basis.

Because of the same problems of execution as occur with the foregoing system, performance is not universally satisfactory, ranging from 120 to 300 lb B.F. per lactation. Fifteen percent of farms may be using this system and the number is increasing.

5. *Annual crops*

A system in which more than 40% of dry matter intake is obtained from forage crops.

More than half of the forage crop area is commonly planted to oats with sorghum the other main grazing crop. During recent years there has been an increase in the use of leguminous crops for late summer grazing and in strategic planting of later winter or early summer crops to attempt to fill a spring feed gap. Most farms using this system feed relatively large amounts (10 to 15% of dry matter intake) of grain and supplement strategically with roughage.

In the areas where it is used this system is technically satisfactory in comparison with presently available alternatives—perhaps because of a delay in development of pastures for these localities.

Performance levels range from 150 to 300 lb B.F. per lactation. The system is considered to be used by 25% of farms and use is probably static.

6. *Limited irrigation*

This system is defined as use of irrigation to produce less than 20% of utilised dry matter in situations otherwise falling into systems 2 to 5. It thus covers a wide variety of situations and its diversity is multiplied by the effectiveness of irrigation usage—varying from virtually useless to being the most important factor in a fully satisfactory and dependable system. Major apparent failings in irrigation use are restriction to a small relatively ineffective area (e.g. high water usage to maintain permanent temperature pastures which contribute effectively to the feed supply only during autumn and spring) and too infrequent use—during droughts and then often too late.

Performance levels range from 100 to 400 lb B.F. per lactation. It is considered that 40% of the farms in systems 2 to 5 (i.e. more than 30% of the total) make limited use of irrigation. The number increases during droughts.

7. *Extensive irrigation*

A system in which irrigation is used to produce more than 20% of dry matter intake. By appropriate use in situations where other feed components are satisfactory, use of irrigation to produce 20% of fodder (on average) can provide a fully effective feeding system.

Performance levels probably range from 200 to 450 lb B.F. per lactation, but only about 2% of farms use this system.

8. *Green soiling*

The distinguishing aspect of this system is that lot feeding of freshly harvested material is used for more than six months each year. In practice, when the method is used to this extent the herd is usually lot fed continuously, using other fodders when fresh forage is not available. Queensland observations suggest that per acre productivity may be approximately doubled when green soiling is used with a sequence of rain grown forage crops. Pertinent considerations appear to be—

a) With cows confined and totally hand fed the operator is virtually forced to plan to supply their known feed requirements.

b) For large increases in per acre production the system depends on the use of forages giving much higher dry matter yields than swards suitable for grazing.

Performance of 220 to 400 lb B.F. per cow is obtained, but per acre production may be higher at the lower per cow figure. Less than 1% of farms use this system and the number may be declining.

9. *Hand feeding*

More than 50% of dry matter intake from hand feeding.

This system is variable, ranging from full lot feeding (with or without some green soiling) through heavily supplemented grazing situations to effectively full hand feeding although the animals have access to pasture.

Little need be said—the performance of animals whose nutritive requirements are increasingly met by hand feeding becomes increasingly predictable and high production per cow is normally aimed for in these situations. Less than 1% of farms use this system and the number is static.

DISCUSSION

On the basis of evidence available from field observations nothing can be said regarding the comparative performance of dairy production systems or their

apparent suitability to the tropical Australian situation which could not be predicted from the principles established in temperate situations. Increasing increments of fertilizer, water, appropriate plant varieties, animals, and herd management applied to existing dairy farms give rise (at least over a considerable range) to increased production.

This study has been too superficial to give any indications of the quantitative inter-relations between the few factors considered in dairy farming systems. It has also overlooked important factors such as climate and method of use of inputs. The range of climatic conditions between the dairying areas of tropical Australia (in annual rainfall alone) may dictate major differences in optimum systems. Details of factor use have been briefly referred to (e.g. "strategic" use of supplementary feeding and "appropriate" crop varieties), but it is apparent that the way in which such factors are used (as distinct from their quantity) will substantially modify their effects and the performance of the systems in which they occur.

It is apparent that a considerable amount of systematic data collection and interpretation is necessary if dairy production systems in this region are to be sufficiently understood to enable farmers and their advisers to predictably modify systems, rather than manipulate their components on an *ad hoc* basis. That extension officers working in this field do not have this information is not surprising and is in no way a criticism in view of the lack of a generally accepted framework for systematic observation.

CONCLUSION

With existing land, plant and animal resources very substantial increases in dairy production are possible using predominantly grazing systems. A technically (and economically) satisfactory system seems possible using a variety of pasture components and strategic fertilizer practices which would meet the needs of an appropriately managed milking herd for nine months of the year on average. (Because of seasonal variability these would not be the same nine months each year.) If dairy production is to be continuous (and this may be a question of social behaviour, rather than technology or economics) a moving feed gap of approximately three months' duration each year has to be filled. It may be met by forage crops (grown on conserved moisture) plus supplementary feed, supplementary feed alone, or use of irrigation. Given the biological and technical parameters the answer is in the field of economics.

As already discussed, these parameters are not known. We are, of course, not concerned with only one environmental situation or one set of parameters, but with a set of parameters for each of the situations in which dairying is to continue.

There appears no satisfactory solution other than—

a) Definition of the systems likely to be useful on the basis of the informed opinions of research and extension workers in the region.

b) Analysis of these selected systems to identify the most important points of deficiency in knowledge.

c) Research by specific experiments, multi-factorial studies of those factors for which interactions are likely to be important, and computer simulation to use the new data to define the best systems and further biological research needs.

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