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DAIRYING IN KWAZULU-NATAL

Fodder Production Planning for the Dairy Herd

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INTRODUCTION

The dominant variable on any livestock farm is the supply of feed. Frequently, because of poor planning aggravated by inefficient production practices and adverse weather conditions, basic feed supplies are erratic and inadequate. It is not economic to plug these gaps with concentrates. With the price ratio of milk:concentrate currently near 1:1, it is more important than ever to realize that concentrates are supplementary feeds and not staples. A constant supply of roughage of good quality is the solid foundation of profitable dairy farming. This leaflet on fodder production planning is based on a larger publication `Fodder Production Planning' by Jones, Arnott & Klug (1987).

Fodder includes grazing, hay, silage, and roots. The objective of fodder production planning is to match the production capabilities of the farm with the animals' requirements in order to obtain the greatest margin over feed costs, within safe limits of natural resource utilization. The carrying capacity of the property, not the owner's target income, must determine the size of the herd: specifically, how much suitable fodder can be produced annually for the use of the dairy herd. The annual fodder requirements of every 100 cows and their associated replacement heifers must be known. From this total requirement, and from the assessment of the farm's fodder production capacity, the potential herd size can be calculated. It is neither profitable nor wise to exceed that herd size.

When herd size and farm carrying capacity have been reconciled (and not before), one must consider the costs and returns. The scheme must show an adequate margin over feed costs to cover overheads, and a return to management. If that test is passed, then one should examine the required feed flow, that is the amount of feed required each month of the year (usually fairly constant in a fresh-milk herd). The monthly forage flow is also forecast, with due regard to the kinds and areas of pastures and fodder crops being considered.

Fodder planning requires some crystal ball gazing, because we cannot predict future weather and, even if we could, we can hardly claim to know exactly how our pastures would respond to it. The manager must regard the plan as a statement of intent and not as the ultimate truth. Unforeseen circumstances and opportunities will arise and it is essential for him to respond properly to these, regardless of (but surely the wiser for) the provisions of the plan.

Some points to note:

- Fodder planning maps out a programme of development which has a time scale of years. Do not get confused by problems that have time scales of days or even months: ration balancing is a common red herring.
- Do not confuse the future with the present nor the proposed with the existing; especially do not be shackled by present thinking or practices on the farm. Development must strive to identify and then remove, ameliorate, or sidestep constraints and obstacles.
- Make sure that the plan can be economically implemented with the existing situation as a starting point. Intermediate stages of development may have to be worked out before the plan can be accepted; the first stage of development has to be worked out, in any event.
- The farmer is very much a part of the farm. The plan must take account of his strengths and weaknesses, his interests and dislikes, and especially his financial position.
- Clarify the objectives of planning before starting the exercise.
- Don't split hairs, and don't refine the final answers to several decimal places: the future is not that predictable. If a computer is used it is for rapid and error-free calculation, not to substitute precise arithmetic for imprecise ignorance.
- Round off the results of calculations in such a way that estimates of fodder requirements are increased rather than decreased; that is the cheaper error to make and will lead to the more profitable decision.
- Although the farmer is concerned primarily with the average year in his forward outlook, he should not forget that non-average, but not impossible, conditions once every few years could ruin everything. The best insurance against such disaster is a bulging fodder bank balance.

Planning and managing the fodder flow is not only one of the most critical of all management functions. It can also be one of the most satisfying - financially, psychologically, and aesthetically. Not only does a good fodder flow provide the soundest basis of a profitable operation but also, there for anyone to see at any time, is highly visible proof, pleasing to look at, of a good job well done. Conversely, a poor fodder flow causes trouble on the grazing, in the cowbyre, at the bank, probably even in the home, and usually it offers ugly evidence of incompetence for all the world to see and scorn.

Fodder production planning can be divided into three major sections, namely, the principles of fodder production planning, planning in practice, and implementing the plan.

PRINCIPLES OF FODDER PRODUCTION PLANNING

The soundness of any system, existing or proposed, may be evaluated against the following four criteria in very strict order of precedence:

- safe use of resources;
- meeting the animals' requirements at all times, even when food production falls too low either on a seasonal cycle or due to unpredictable causes;
- margin over all feed costs;
- the system's realism and manageability.

SAFE USE OF RESOURCES

The resources available for producing fodder are land (including veld and water), labour, management, and capital. If each part of the farm has been developed to produce as much forage as it can, and there is no weakening of its soil and water resources, then the fodder flow rates well under this criterion. This is not to say that all veld must be replaced by pastures, nor that all pastures must be irrigated. Resources could be used too intensively (*e.g*. monoculture of erodible soil, irrigation with saline water) or they may be undersupplied (*e.g*. arable land, credit, or managerial time or competence). Far too many farmers undertake too many enterprises, do none of them properly, and end up in a worse position than if they did only two really well. A system which misuses or misjudges the resources available will fail sooner or later, and is unacceptable from the outset.

A careful assessment of the land and water resources is needed. Determine the areas of land suitable for annual cultivation or for planted pastures, because that largely limits the quantity of high-quality forage that can be produced. Identify steep slopes, erodible soils, wet lands, shallow soils, and rocky areas, all of which have limited or no value for forage crops although they could be suitable for pastures. Considering soils and water, the area of land that can be irrigated is of vital importance, since it determines how much green grazing will be available to the herd in the dry season.

Resource planning will frequently involve a critical look at the location of waterways, fences, roads and buildings. A sound run-off control plan is fundamental to the safe use of resources. Do not be too much influenced by existing developments, since fences and roads can be relocated, and even buildings do not last forever. Farm owners may need outside help for this task as it is psychologically very difficult to be objective.

MEETING THE ANIMALS' REQUIREMENTS

Adequate feed must be produced, stored, or bought to feed all animals present on the farm at any given time. As a first step, enough food must be available over an average year to meet the annual total dry matter requirement plus the average input to the fodder bank.

The fodder bank

The fodder bank is a store of conserved fodder (hay or silage) which is deliberately accumulated over and above the normal seasonal requirements, for use in unpredictable, lean times such as an unseasonal dry period, a severe hail storm, or an army worm outbreak. A fodder bank is not a permanent or separate store in the sense that a particular silo or hayshed is "the" fodder bank. Rather, the total store of conserved fodder is built up year by year, part being for dry-season feed and part for reserve, the division being merely a book entry. The oldest stored fodder is always fed first, whether for normal use or for emergency, and any fodder actually in store will seldom be more than two or three years old. This is especially important in the case of hay, which deteriorates far more rapidly than silage does.

Stock flow and required feed flow

The herd structure, and hence the feed demand, of the livestock on a given farm is not always static. It normally changes from month to month, giving rise to a stock flow and its corresponding required feed flow. Herds producing fresh milk, however, usually do have a fairly constant herd structure, because of the tendency to calve the year round; the required feed flow is therefore also fairly constant.

Fodder flow

The fodder flow is the sum of fodder available from each source (veld, pasture, stover, *etc*.) month by month. Ideally, it would exactly match the required feed flow. Rarely does this happen naturally, however, so the match must be forced, by:

(a) purposely altering the stock flow, *e.g*. by strategic culling and calving, and/or

(b) producing more food at particular times, and/or

(c) transferring excess fodder from one time of the year to another as hay, silage, or foggage.

If the match is not achieved by the farmer it will be forced on him by Nature, firstly as a loss in production and reproduction (low fertility), then as a loss in live-mass (thin animals), and ultimately as a loss of animals either by forced selling or, in extreme cases, by death due to starvation. Fortunately, dairy farms rarely retrogress that far downhill, nevertheless, the fodder flow often leaves much to be desired; in fact, it is probably one of the major limiting factors to dairy production in South Africa. The problem, usually one of "subclinical overstocking", manifests itself in the following syndrome:

- an average milk yield below 5000 l per Holstein-Friesland cow's lactation (herd average of 17 l per cow in milk per day), even with generous levels of concentrates;
- concentrate usage exceeding 400 g/l of milk, average over all cows over the year, often associated with low butterfat levels;
- large seasonal fluctuations in milk yield, if these are not caused by the calving pattern;

- thin heifers; underweight first-calvers (mean mass less than 90% of mature mass) and poor first lactation results (under 4000 l);

- a disproportionate number of thin cows in the herd (more than 15% of the herd thinner than 2 on Mulvany's scale);

- low fertility, even among young animals.

Individually, of course, these problems often arise from causes other than feeding, but if three or more of them occur together, the first place to look for the trouble is in the fodder flow. Remember that cows may show the effects of previous underfeeding at a time when forage supplies are good; for instance, a high incidence of repeat inseminations in Spring may be a result of poor winter nutrition.

Underfeeding can be blamed, at least partly, on poor quality of roughage. Quality of forage is more important in dairying than in many other enterprises. A high proportion of cows in the herd need a diet rich in energy (dry matter containing more than, say, 10.5 MJ ME/kg or 70 TDN) and good-quality protein. While it is true that cows are better off with lots of poor roughage than with inadequate amounts of good roughage, the aim must always be to produce **enough roughage** of the **best possible** quality. To some extent, the quality of the diet can be improved by feeding concentrates, but that strategy has limits, and it is much more expensive than providing good fodder as a basis.

A common fallacy is that protein is the only consideration in assessing roughage quality. In fact, energy is more critical since it constitutes by far the greater part of the cost of feeding cows. Protein, while more expensive per kg, is needed in smaller amounts (10 to 15% of the energy expressed as kg of digestible organic matter, DOM). One should worry primarily about providing enough cheap energy; then worry about providing enough protein. Good pastures provide both, the latter usually in excess.

Note that the obvious signs of a bad fodder flow (hungry and unhappy animals, chronic shortage of grazing, overgrazed pastures in poor condition) have not been included in the above list of problems. These are the signs of "clinical overstocking", immediately obvious to mere humans, and by the time that they have appeared much damage has already been done to the dairy enterprise. Don't rely only on your own assessment of the feeding regime: ask the cows if they have been getting enough to eat. Their answer is to be found in the list given above.

The second property of a good fodder flow is, therefore, that the herd is properly fed all year round.

MARGIN OVER ALL FEED COSTS

With a good, well-managed fodder flow the livestock enterprise will show a positive margin over feed costs, if not over all costs. Provided that the afore-mentioned two criteria (care of natural resources, adequate feeding of the herd) continue to be met, numbers and kinds of animals, as well as sources of feed can be manipulated to improve the overall margin, whether expressed as total profit or as return-to-costs. Remember always that profits are not ensured by having many cows, only by having well-fed cows. Pushing up the number of animals to improve the gross margin is a futile exercise if food is the limiting factor, as it almost invariably is. Indeed, reducing cow numbers is sometimes the route to increased profits.

Since feed costs make up about 70% of all variable costs on a typical dairy farm, it makes sense to devote much attention to planning feed supplies, and to managing them efficiently. By integrating other enterprises with the dairy, wastage can be reduced and residues can be profitably utilized, with a positive effect on the farm's economics. The major impact of roughages on economics is that they provide the cheapest way of supplying the cows with their energy and protein requirements. It sometimes happens that one has to trade off roughage quantity against quality, to choose between producing large quantities of poor roughage or a small quantity of good food. The optimum lies somewhere between the two extremes, since deficiencies in forage quality can be profitably rectified with concentrates, within definite limits. Do not think that there is no need to bother about roughages, that concentrates will make up for anything, and then wonder why dairying doesn't pay. This in no way implies that reducing concentrates will always increase overall profitability, even if it does improve margin per litre, because margin per cow or margin per ha could suffer severely as a result of reduced milk production. While money spent on supplementary feeds can be money well spent, that condones neither wasteful practices nor poor fodder flows.

Aspects of management other than feeding may limit the profitability of the dairy enterprise, of course. There are farmers who fiddle with breeding rather than improving management in general and feeding in particular, and blame local semen for their poor results. Milking parlour routine can be critical, as can fertility control, labour management, and overall financial discipline.

A biologically sound, economical feeding system is the goal; its basis is quality forage.

MANAGEABILITY

The fact that a given production plan will (probably) provide for sufficient total feed over the year, does not necessarily mean that the flow of fodder will be satisfactory. For instance, an all-kikuyu system may look good in terms of resource protection, total tonnage of food available, and margin over feed costs, but nowhere with a cold, dry winter could such a system be a practical basis for an intensive dairy farm: winter feeding would not be economical, probably not even practicable without large purchases of feed.

A good fodder flow will allow the livestock enterprise to run smoothly (from a feeding point of view) throughout the year, and will mesh in well with other activities on the farm. For instance, it will be managed so that unexpected surplus forage can be put to good use. It will provide a reliable reserve of fodder so that the animals will continue to be well-fed when normal seasonal shortages occur, and even when unexpected (but **statistically predictable**) unseasonal shortages are experienced, whether caused by drought, flood, fire, or pests. The fodder conservation programme will not call for silage or hay to be made at times when it is difficult to provide the needed labour, supervision, or machinery.

The farmer should draw up your own list of points that will make for a manageable fodder flow on his farm.

PLANNING IN PRACTICE

Although it takes time, a good fodder flow must be planned. Tackle the job by applying the above principles in a logical sequence of steps.

RESOURCE ASSESSMENT

The natural resources of most concern are land, water, and veld.

Veld

There is, in present economic conditions, not much of a role for veld in a dairy enterprise. This is therefore not the place to deal with it, other than to warn that sound principles of veld management, especially as regards stocking rate, are critically important. Bad veld management will cause economic disaster in a dairy operation sooner rather than later.

Water

Irrigation water is often limited: one needs 10 m^3 to apply 1 mm to one ha, whereas to apply an average of, say, 25 mm per week over a dry season of 26 weeks one will use 6500 m^3. Making some allowance for wastage and evaporation, it is safer to allow 7500 m^3 per ha. Ensure that the quality of the water available is sufficient for your purposes. The soils chosen for irrigation should have a sufficient rooting depth for the crop (*e.g*. at least 250 mm for pastures, 500 mm for cereals, 750 mm for lucerne), be subject neither to waterlogging nor to excessive drainage (heavy clays and coarse sands are not soils of choice), and with a low content of soluble salts.

Land

The principal concerns in determining how to use any land revolve around its workability and its susceptibility to erosion; this may be a task for a specialist. Other concerns include distance, accessibility, security, and availability of stock water. The following simple procedure may be used to determine the capability class of any piece of land, whether still veld or already under cultivation. Each area must be demarcated on the farm map, classified as shown below, and its size (ha) recorded, so that the total available area of each class of land can be calculated.

Land capability classes

The idea is to define five land capability classes, and to grade each of the five natural limiting factors into five levels (see Table 1). The capability class of an area of land is then equal to the highest numerical rating accorded over all five factors. The recommended maximum proportion of land under annual cropping follows directly. The suitability of the land for irrigation does not necessarily follow from its capability classification, as a class IV land could be used for irrigated kikuyu if the soil is suitable. In detail:

(a)
Demarcate each area of land so that for cropping purposes it is fairly uniform in terms of the limiting factors tabulated in Table 1.

(b)
Give the land a rating under each limiting factor, see Table 1.

Table 1. Five land capability classes, in terms of their limiting factors

Rating	Rockiness	Slope %	Depth (mm)	Erodibility	Drainage
1	< 10%	< 5	> 900	Very stable	Good
2	10 - 20%	5 - 10	500 - 900	Stable	Fair
3	20 - 30%	11 - 15	300 - 500	Erodible	Marginal
4	30 - 40%	16 - 25	150 - 300	Fragile	Bad
5	> 40%	> 25	< 150	Unstable	Nil

Highly erodible soils have the following properties: sandy texture; low organic status; weak structure; poor infiltration capacity; low permeability of subsoil; poor drainage; high base status, aggravated if Na is present; lack of redness (iron oxides).

Drainage is good if the soil is never waterlogged (red and yellow-brown soils), and nil if it is always waterlogged (blue clay). If the soil is infrequently waterlogged below a depth of 500 mm for short periods, drainage is fair; the topsoil shows no sign of mottling and the subsoil only slight signs. Poorly drained soil is often waterlogged within 600 mm of the surface; slight mottling occurs in the topsoil; such soils are common in bottom lands or vlei margins. Badly drained soil is saturated within 150 mm of the surface for most of the wet season; red mottles in a blue/grey matrix occur at the same depth.

For example, the ratings under the respective headings might be 1,2,3,1,1. Tabulate the ratings for all your lands/camps; a suitable layout for such a table is given in Table 2.

(c)
If you have proved beyond all doubt that you are, in practice, most conservation conscious, then the rating accorded under slope may be upgraded one level. Example: if ALL your waterways and contour banks are well built and ALWAYS well maintained, (in the opinion of your Soil Conservation Committee) a land of slope 13% may be rated 2 for slope, rather than 3. Be conservative rather than optimistic.

(d)
The capability class is given by the highest rating over all factors; the example given in (b) would fall in class 3.

Table 2. Example of a suitable layout for land capability ratings

#	Land/camp name/no.	Area (ha)	CLASSIFICATION OF LAND CAPACILITY						Irrigable
			Rock	Slope	Dept	Erosion	Wetness	CLASS	
0	Example	9	1	2	3	4	4	III	Yes

(e)
The recommended use for each class of land can be expressed as the number of years out of every nine that the land may be under row crops; in the remaining years it should be under no-till cover crops. Class 1 land may be cropped continuously, Class 2 land may be cropped for six years followed by three years under a perennial cover crop (ley), Class 3 should be kept under a ley for at least six years after which it may be cropped for three years, and Class 4 land should be under a permanent cover crop such as Kikuyu, sugarcane, or timber. These figures are offered as a guide only, not a prescription, and are summarized in Table 3.

Table 3. Recommended land class useage

Class	Maximum row-crop years	Minimum cover crop years
1	9	0
2	6	3
3	3	6
4	0	9
5	To remain under natural vegetation	

In each case, the farmer must adopt the appropriate conservation measures where required, as well as choosing the crop along the above lines.

(f)
Add up the total area available under each class. Then calculate the guideline area available each year for various purposes, thus:

(i)
Maximum area under row crops = total class 1 area + _ of class 2 area + _ of class 3 area;

(ii)
Area under ley pastures = _ of class 2 area + _ of class 2 area;

(iii)
Permanent pastures = class 4 area;

(iv)
Veld = class 5.

These results indicate the area of land that can be used to produce forages of various kinds. The fact that area is available does not mean that it must be used.

DAIRY HERD FEED REQUIREMENTS

Fundamental to the whole fodder production plan is an estimate of the amount of food that is needed. Herd requirements are a function of the herd structure, which means taking into account the average number of cows in the herd, size of cow, average butterfat production, cow replacement rate, intercalving period, heifer retention policy (sell surplus heifers as calves, or rear them all and sell the surplus animals when heavy in calf), and age of heifers at first calving. Each of these factors affects either the number of animals to be fed or the requirement of an average animal for dry matter, energy, and protein. Other major factors affecting the amount of forage to be produced are roughage quality and wastage of forages.

Cow size and butterfat production are primarily breed effects, given a level of milk production which is largely a function of management (not of breeding). Other management effects include all the variables listed above, so the farmer is actually the principal determinant of herd structure. Many of the variables, such as breed, herd size, heifer retention policy, are set as conscious management decisions, and the manager needs information to help him evaluate the various options open to him. As a start, Appendix Table 1 itemizes the monthly requirements of an average cow, according to breed and production. It is more difficult to determine the effects of the various options concerning the requirements of heifers. The number of cows, the heifer retention policy, the mean age at parturition and, to a lesser extent, the mean intercalving period of the cows, govern the number of heifers to be fed and the daily dry matter intake of the average heifer.

The approximate number of heifers on the farm may be estimated from one of two formulae. The minimum number, which holds if the surplus heifers are sold as calves, is given by:

Min**H** = **AFC** x **N** x **R**/1000 [Equation 1]
where: **AFC** is age at first calving, in months;

N is the number of cows in the herd;
R is the annual rate of replacement per 100 cows (usually 20 to 30).

A herd of 100 cows, with AFC = 33 months and a replacement rate of 25%, must have at least 82 (33 x 100 x 25/1000) heifers of all ages, including calves, to maintain itself. The maximum number of heifers, supposing all calves are reared and the surplus sold when nearly due to calve, is given by:

$$\text{Max}\mathbf{H} = \mathbf{AFC} \times \mathbf{N} \times (52 + \mathbf{R}/100 \times (\mathbf{ICW} - 52)) /24\mathbf{ICW} \quad \text{[Equation 2]}$$

where: **ICW** is the mean intercalving period in weeks.

The same herd quoted above, assuming an ICW of 56 weeks, will have at most 130 heifers [33 x 100 x (52 + 0.25(56-52)) / (24 x 56)], excluding purchases.

The average mass of the heifers in each age group may be estimated from Appendix Table 2. If the cows weigh 500 kg and AFC is 33 months, then heifers 15 months old should weigh about 255 kg (500 x 0,51); three months later they should weigh 290 kg (500 x 0.58); their average daily gain (ADG) is thus 0,4 kg [(290-255)/90] approximately. For them to calve down at an AFC of 24 months, weighing 85% of mature mass, the ADG from 6 months of age would have to be 0,5 kg [500 x (0,85-0,30) / (730-180)].

The dry matter requirements of each group of animals can now be determined. The energy and protein requirements could also be estimated, to ensure that they will be met. Experience has taught that, provided one keeps in mind the nature of the forage being considered to meet a particular group's needs, it is almost always sufficient to ensure simply that enough dry matter will be supplied. For instance, one would not consider putting the cows on veld in the Highland Sourveld in winter. Their needs would be met by pastures and silage instead, and one would aim to produce enough dry matter from those sources.

The approximate demands of individual dairy animals are given in Appendix Tables 1 (cows) and 3 (heifers). When these demands are related to the structure of the herd, as explained above, an estimate of the herd's total requirements will be obtained. Appendix Table 4 brings together the effects most influential on heifer requirements; the cows' demands, also given in the table, must be added. The cows' requirements must be met from two sources: roughages and concentrates. Since the two types in combination must supply the total nutritional requirement within a fixed dry matter package, it follows that the amount of concentrate needed depends on the quality of the roughage. Appendix Table 5 shows the approximate proportion of roughage in the cows' diet, according to breed, production, and roughage quality. Note how roughage usage increases as the quality rises. (As with all other information given in this chapter, this table must **never** be applied to individual animals.)

Appendix Table 6 presents the annual bulk requirements of 100-cow herds, given various combinations of the major factors mentioned above, and including an allowance for wastage. The examples given in the table assume that all heifer calves will be reared, that 25% of the cows are replaced each year (which is normal unless the herd is expanding), and that the intercalving period is 52 weeks for the Jerseys and 56 weeks for the Holstein-Frieslands (normal in KwaZulu-Natal). Further, the herd structures are assumed to be fairly static, so the fodder flows required in the examples will be simply one twelfth of the annual total per month.

Equations 1 and 2, and Appendix Tables 4 and 6, prove that the number of cows (N) and the age of heifers at first calving (AFC) have a major impact on

the amount of food eaten by heifers. If AFC is reduced, considerable savings in feed costs are possible, or more animals can be carried. Also, heifers come into production sooner. There is therefore a strong temptation to mate heifers early, which can turn out to be a very expensive mistake! Heifers which calve down when they are too small produce less, and often have long intercalving periods; they may catch up only in their fifth lactation. Results from Holstein-Friesland herds in KwaZulu-Natal have shown that the herds with heavier first-calvers produce more milk: every ten kg increase in live-mass causes an increase of 120 kg of milk in the average first lactation, and 105 kg in the third lactation. By all means strive to breed heifers younger (within limits), but breed them on a criterion of growth, not age. Grow them out faster so that they reach 63% of mature mass at a younger age, then mate them. It is a most costly error to grow them out as cheaply as possible and then mate them at 15 months. Remember, reduce AFC by improving ADG.

The second criterion of a good fodder production program is that the animals must be adequately fed. To this end, the first step is to produce sufficient dry matter. Second, the dry matter must contain the required amount of energy, for which purpose some roughage may be replaced by concentrate; the roughage so replaced is then available for additional cows. Large amounts of concentrate might have to be used to try to meet the energy demand, which will make feeding expensive, and it may still not entirely satisfy the cow's needs.

Third, the dry matter must contain sufficient protein. Usually only moderate amounts of protein are required and the cow's requirements can always be met, but it is relatively expensive; by far the cheapest source of protein is green grazing. The quality of the protein is also important: legumes are better sources than grasses, temperate grasses are almost always better than tropicals; crop residues and veld are very poor sources. Beware of grazing (other than clover) which is claimed to have crude protein levels over 20% of dry matter: that is not protein, but forms of nitrogen that are mildly to severely toxic. The best protein supplements are animal byproducts, oilseed cakes, and commercial urea-free HPC. Urea and chicken litter have a very limited use on a dairy farm, mostly for heifers over a year old and dry cows.

PLANNING

The farmer now has a classification of the farm's natural resources, and he knows how to postulate a dairy herd structure with its particular feed requirement - summarized under feed-need. The farmer is ready to start planning, and will need either a computer spreadsheet, or a pocket calculator and a large piece of squared paper, a soft pencil, and a large eraser.

Calculate stock flow and feed required (feedneed)

Define the basic herd structure(s) of the livestock enterprise(s). Remember that, in dairying, this means specifying the number of cows in the herd, the average cow mass, the level and cycle of milk production (seasonal or continuous milk flow), average age of heifers at parturition, and whether surplus heifers will be sold before weaning or in calf. Each of these factors strongly affects the amount and quality of food required on the farm. There is no one "correct" herd structure, despite what certain textbooks state, although some structures are bad, and some will match the possible fodder flows better than others and will therefore be more profitable.

The herd structure usually changes seasonally, giving rise to the stock flow. For a continuous milk flow (*i.e.* year-round calving), however, the dairy herd structure changes little over the year and can, for planning purposes, be regarded as static. For a seasonal milk flow, for example with the entire herd calving in spring, the dairy stock flow resembles that of a beef herd. For the herd structure(s) selected, tabulate the stock flow(s) in time steps of one month.

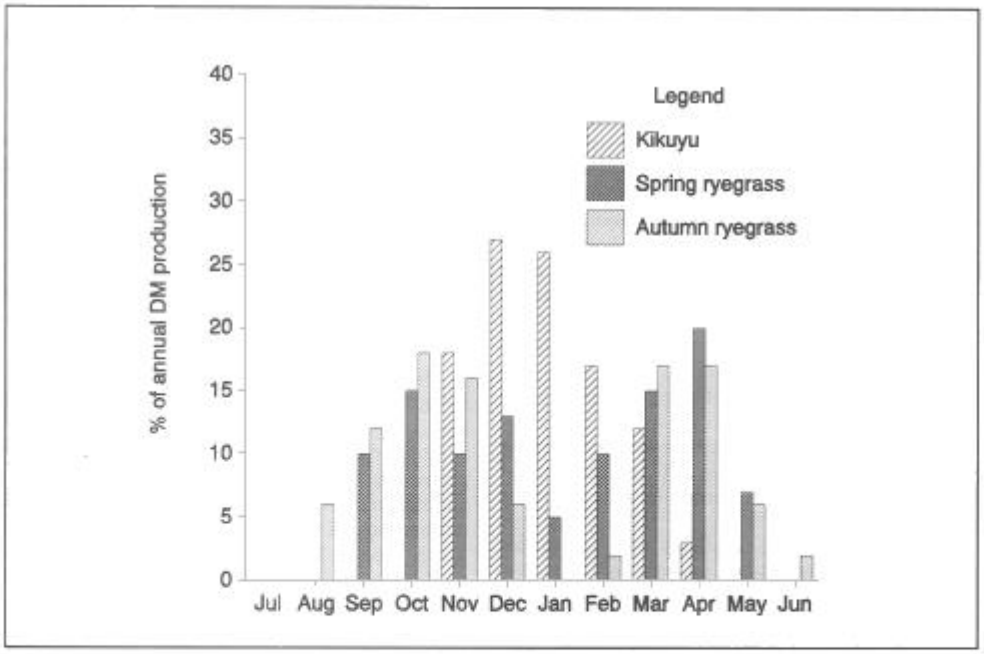
Calculate the required fodder flow corresponding to each possible stock flow (see the section of this leaflet on "Dairy herd feed requirements"). Add at least 10% to the total annual requirement, for the fodder bank. If irrigation is limited, severe hail is frequent, rainfall averages under 900 mm/year, there is no fodder bank to start with, there is heavy reliance on veld grazing, then add 15% for fodder reserve. A statistical method is available to determine the required fodder reserve (Jones, 1983).

Determine fodder supply

Make a list of the various forages (veld, pastures, fodder crops) which will do well, or which must necessarily be placed, on the different parts of the farm. Each part of the country has its own list of suitable forages, dictated by climate and soils. Local knowledge is invaluable in compiling a list of the real possibilities. The farmer should consult his extension officer, seed merchant, fertilizer rep. and neighbours. Do not waste time looking for something different: the tried and trusted species such as Kikuyu, ryegrass and lucerne must form the basis of the programme, although he can always experiment in a small way with outside possibilities - you may strike it lucky, as happened with Coastcross II. The problem with the outside chance is that there are rarely any sound data that can be used to do reliable management sums, upon which a lot of money depends. Even the common forages are difficult in this respect, but at least there usually is some experience to serve as a guide.

Show the expected yield and the cost of production per ha of each forage on the list; the extension officer or nearest research station should be able to give some help here (ask for the latest COMBUD enterprise budgets compiled for your Region by the Directorate of Agricultural Production Economics in the Department of Agricultural Development). The farmer also needs to have an idea of the monthly distribution of dry matter production of each forage - what is called its production curve (see Figure 1) - or, if the forage is grown solely for silage or hay, the time of harvest.

Figure 1. Approximate production curves of dryland Kikuyu and autumn-sown and spring-sown irrigated annual ryegrass pastures in Natal.



Arising from the fodder supply determined and (f) of "Resource assessment", tabulate the minimum and maximum areas of each forage that will be allowed, and the total areas available for annual crops, pastures, and veld. Observing these limits, choose any sensible combination of forages, and calculate the expected total annual fodder production. Ensure that the scheme will satisfy the total feed requirements calculated (feedneed), plus the fodder bank input. The following example illustrates (Table 4):

Table 4. An example determining fodder supply

Forage type	DM (t/ha)	R/ha	Area (ha)	Total DM	Total cost (R)
Kikuyu	10	520	25	250	5200
Eragrostis	9	1043	0	0	0
Spring ryegrass	12	1030	15	180	15 450
Autumn	14	1030	10	140	10 300
ryegrass	14	900	10	140	9000
Maize silage			----	-----	----------
			60	710	39950
TOTAL					
Row crops			10	Compare these with figures derived from Resource assessment (f)	
Leys (include ryegrass)			25		
Permanent cover			25		
Herd requirement (see App Table 6)				875	
Concentrates (see App Table 6)				175	70000
Surplus before input to fodder bank				10	= 710-
Required fogger bank (15% of 710)				105	

		875+175 : 95 ton short

While working out your plans, bear in mind that the fodder programme must aim to produce a sufficient bulk of **high-energy** roughage, at least some of which is rich in protein but still cheap to produce. This is why veld is a poor basis for intensive dairying and why ryegrass is so valuable. Farms which have sufficient irrigable land can get their dry matter, energy, and protein requirements largely from ryegrass; farms with no irrigation have to rely on kikuyu/Coastcross pastures and maize silage plus bought protein or homegrown soya beans.

Margins over feed costs

Calculate the total cost, using the costs listed under fodder supply. On the basis of the stock flow calculated under feedneed and, allowing for mortalities, calculate the expected income from the enterprise, month by month and hence for the year. Estimate the annual margin over feed costs by subtracting the costs from the income.

Repeat the above procedure several times, until a system is found which best meets the FIRST THREE criteria (Safe use of resources, Animal requirements and Margin over all feed costs) discussed earlier in this leaflet under "Principles of fodder flow planning". The farmer should not blame the milk price if he cannot work out a profitable plan for his farm. Probably it is not suited to dairying, which should be left to those able to produce economical, high quality roughages.

Fodder flows

So far, the emphasis is on total annual feed requirements and supplies. When those have been satisfactorily matched, compute the required FLOWS (*i.e.* monthly amounts) of feed required and produced. The flow is calculated by considering the production curves (see Fig. 1) of the selected forages, multiplied by the total production (yield/ha times area) of each forage. Consider the system's need for fodder transfers between months and how practicable it will be to make and feed the quantities involved. If the scheme fails this test (the fourth criterion of a good plan), go back to the steps for calculating fodder supply (Table 4), or even stockflows and feedneed. You will come up with a suitable plan eventually. It is better to bear the labour of doing this on paper than to press blindly on in the hope that things will work themselves out.

Next, fill in the details. Exactly where will each forage be placed on the farm? Show it all on a map. How much forage, of what kind, will have to be conserved for winter feed, and when? Are there the facilities to do that, or must a contractor be engaged or equipment bought?

Finally, work out the annual stages of development of the plan, allowing for expansion of animal numbers, pasture areas, and other necessary capital improvements in a logical sequence. Each stage can be planned as above (do not let pasture development

outstrip the herd's requirements; even worse would be to let herd increases outstrip pasture development). You will then be in a position to draw up a budget and can even outline an itemized five-year cash flow which the bank manager will be happy to consider.

EXAMPLES OF FODDER PRODUCTION PLANS

The typical dairy farm in KwaZulu-Natal gets 800 mm (or more) rain per year. It has a significant area of arable land, and some irrigation for winter pastures. Summer feeding is based on Kikuyu or Coastcross pastures, winter feeding on maize silage and ryegrass (the ratio depending on irrigated area) plus hay, roots, and Kikuyu foggage. It is usual to dispose of bull calves and to rear all heifer calves; replacements (25% of the cow herd) are selected from pregnant heifers and the surplus heifers are sold "heavy in calf". Milk production varies widely; for present purposes the cowbyre mean of a Holstein-Friesland herd is taken to be 17 l per day and that of a Jersey herd 14 l per day.

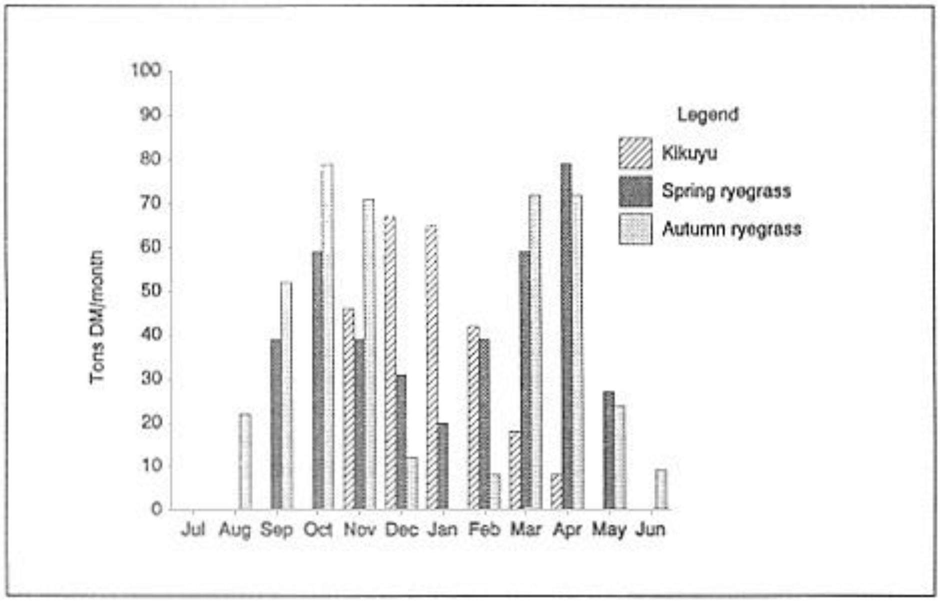
Appendix Table 7 illustrates several possible fodder production systems for 100-cow herds of Holstein-Frieslands or Jerseys. The needs of the milking cows, dry cows, and heifers over six months old are all included. These systems assume that more than half of the available area is arable, and the rest is suitable for permanent pastures, with system (a) having a large proportion of irrigable, arable land, system (b) a small irrigable area, and system (c) no irrigation at all. Note that the examples need about 9 ha for every 10 Holstein-Frieslands, or 6 to 7 ha for every 10 Jerseys, including followers. Note also the big drop in margin when no ryegrass is available, caused by the cost of purchased protein.

The assumptions about yields and costs are, of course, critical in weighing up the relative merits of the various systems. It is also obvious that a great variety of systems is possible, depending on each farm's resources and production limitations. For example, whereas a farm in the Tsitsikama may be able to produce pastures all year round without irrigation, this is most unlikely in KwaZulu-Natal.

The flow of fodder is as important as the total annual amount. Figure 2 shows the fodder flow for the Holstein-Friesland system (a) which is summarised in Appendix Table 7. Note the deficit of forage supply over demand in August, and the excess in spring and autumn. The spring excess of ryegrass must be made into hay or silage for feeding dry stock in winter, when the growth of the ryegrass is too slow to support the whole herd. The monthly surpluses in autumn are defered (kept over) for grazing in winter, which is why there is a small surplus of DM in July, even with no significant grass growth in that month.

The final criterion that the fodder plan must meet is that this flow of fodder must be satisfactory. In the example, it evidently is, except that making good grass, hay or silage in October and November could be problematical. Should this obstacle be serious, system (a) would fail the fourth test listed under "Principles of fodder production planning" and system (b) may be preferred.

Figure 2. Expected fodder flow for Holstein-Friesland system (a) in Appendix Table 7



IMPLEMENTING THE PLAN

Management includes at least four distinct operations: planning, organisation, control, and evaluation. So far we have been discussing planning, to ensure that we do the right thing. It is of little use if we do not do it right, which means organisation and control. And it is essential to measure the returns from our time and money.

From theory to practice (mostly organisation)

There now is a plan, and an outline of how it will unfold, *i.e.* the stages of development. Next, work out the details of implementation. This may take the form of a timetable, in which the farmer will show actions required against dates (month/year), *e.g*. ha of Kikuyu to plant this year, soil samples to be taken in June, bunker silos to be built by the end of next summer, and so on. Also specify the results expected against dates, *e.g*. area of ryegrass needed by next winter, herd size at the end of next year. This is not an inflexible schedule; its main function is to help implement that plan which has been worked out, not some other plan of unknown origin. The plan can be modified at any time, but it is useful to have a reference point that enables the farmer to know what is being changed, with what expected results.

It is also useful to have a second timetable, within the first, that is prepared for six to eight weeks ahead. This will give details of, say, machinery to be overhauled, land preparation, pasture establishment, hay/silage making, vet's visits, stock sales, and other operations which can be planned to within a week.

Managing the fodder flow (part organisation, part control)

It is beyond the scope of this manual to go into detail about the establishment and management of pastures and forage crops, but some important general points can be made.

- Do everything in good time: the difference between a good farmer and a mediocre one is 10 days.

- See that watering points and permanent fences are in really good order. Temporary electric fences are almost essential to good dairy pasture management, and the fencing system must be properly designed and well maintained.

- A badly designed or badly managed irrigation system can do more harm than good. It is better to irrigate a small area well than a large area badly, so do not be over-ambitious.

- If steep lands must be cultivated annually, a reversible plough is advisable for the maintenance of contours. Remember that contours are structures for the control of runoff water, not strips of rough grass to hamper farm operations and provide a habitat for wildlife and weeds. Please do provide refuges for wildlife and indigenous plants, but as part of the overall farm plan, not as part of a chaotic mess.

- Prepare seedbeds well, to get rid of weeds, ensure good germination, and to create a surface upon which modern machinery can operate efficiently. Roll the land several times.

- Buy good quality seed. The cost of pasture establishment is high, but the price of failure is even higher; cheap seed could cost you dearly. Don't buy "uncertified Midmar" ryegrass seed: if it is not certified it is NOT Midmar. Inoculate legume seeds immediately before planting, and keep exposure to the sun to the absolute minimum.

- Have soil samples taken properly to check P and K levels in every paddock before planting, and then every year. Both the pasture and the cows can be adversely affected by mineral deficiencies before the herbage shows any visible signs of shortage. Potash excess, or deficiency, can develop over a very short period, especially on sandy soils. Give the pastures regular dressings of nitrogen, say 50 to 75 kg N/ha at a time (not more). Keep the cows off the pasture for three weeks after topdressing (longer in cold weather) to avoid nitrate toxicity problems.

- Never expect cows in milk to perform well on grazing that is either too short or too rank. Put them in when the grass is 300 to 350 mm tall. Take them off when they have grazed the grass, other than dung patches, down to 100 mm: a cow in milk loses valuable intake time walking from one mouthful to the next. Let dry cows, heifers, sheep, beef cattle and horses clean up the leftovers. Tumblewheel fences must be managed very judiciously, at all times; on most farms they are more of a liability than an asset, because farmers lose milk in trying to avoid wasting grass. Remember, each kg of dry matter that a cow fails to take in can reduce her yield by up to 2 kg. Aim to give the cows in milk "serial continuous" grazing, with a new area of lush grass every day. The followers can be subjected to more stringent rotational grazing, in which they are made to graze the pasture down more cleanly after the milking cows have moved on.

- Organize the grazing rotation so that paddocks can be closed at times of rapid growth, in order to accumulate sufficient herbage for economical hay making, or ensiling, and to maintain the quality of the grazing. The alternative is to waste grass and to have it drop in quality. Not only is that a direct loss, but the day will come when the farmer will regret not having put that material into the fodder bank. Increased concentrate use will also follow the decline in pasture quality, or the milk flow will drop: either way, money is lost.

- Cut hay and grass silage early, before the grass starts flowering, NOT when it is in seed. To allow for bad weather, plan to start cutting even sooner. This is important for dairy cows which, unlike beef cows, cannot perform on hay that is not of the highest quality. Believe it or not, it may be better to have hay rained on after cutting than to let the grass mature while waiting for better weather! Hay of very different qualities should not be put in one stack; keep them apart so that the inferior stuff is not given to cows in milk.

Records (for control and evaluation)

Monitoring progress is a vital aspect of implementation. Only by keeping appropriate records is it possible to know whether the plan is developing as expected, and the cash flow going as the bank manager expected. Everybody keeps milk production records. Every serious dairyman also keeps health and reproduction records. All the animals in the herd should be weighed monthly and their condition scored fortnightly. Hay, silage, and concentrate usage should be monitored, and crop yields should be measured accurately by weighing loads on a portable weighbridge. More difficult is to keep a record of grazing days achieved on the various pastures, together with data on irrigation and fertilization, and to calculate costs of production. It is perfectly feasible to assess pasture yields and to record production curves (as in Fig. 1) by means of a pasture disk meter; sooner rather than later this exercise will become essential for the dairy farmer who means to farm profitably. With feed costs accounting for 70% of all costs in dairying, it follows that feed management deserves a corresponding share of the farmer's time.

SUMMARY

- The essence of fodder production planning is to match the herd, the farm, and the farmer to one another.

- Determine how much food the farm can produce.

- Determine the requirements of your herd.
- Make the two amounts agree by re-arranging the fodder supply or by modifying the herd's needs, usually by reducing numbers, but also by reconsidering your heifer retention and rearing practices.
- Purchased feeds are important for rounding off rough edges, but not as the basis of the feed supply.
- Decide by careful calculation what fodder sources to plant where on the farm.
- Manage fodder sources so that plenty of high quality herbage will always be on offer to the cows.
- Do everything properly and in good time.
- Keep useful records; use them.
- Do get expert assistance and be prepared to pay for it, directly or indirectly: farm planning is a skill requiring experience, and good, free extension services are likely to become even rarer than they are now.
- Do join a study group. Your peers can be an invaluable source of advice and encouragement.

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