FARM RESOURCE PLANNING IN NATAL, SOUTH AFRICA - THE PRACTICE AND THE PROBLEMS.

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Abstract

Resources that are assessed in Natal are documented, and include that of climate, soils, vegetation, markets, labour, management and finances. Their assessment enables the planner to then determine land capability, management units and crop suitabilities. Unfortunately, problems pertaining to data retrieval, subjective and unfinished classifications and insufficient knowledge limit the planner in his ability to plan farms accurately. Limitations of these systems are identified and discussed.

Introduction

To create a viable farm plan, it is essential that the farming operation is accepted as a business proposition. Planning should, therefore, attempt to co-ordinate all the actions involved in running the operation, to the maximum benefit of the natural resources, the environment and management. Farm planning is a powerful decision making process that allows one logically, sequentially, and in a series of steps to identify, collect and digest information; analyze alternative options; implement decisions; accept responsibility, and evaluate the results of these actions (Anon., 1987a; Van Zyl, 1988).

From a farm planner's point of view, there are three courses of action by which a farming operation could be improved, viz:

a) making better use of existing resources;
b) adjusting the balance of enterprises in favour of those giving the best returns; and/or
c) reducing input costs (Papenfus, 1990).

The best course of action would be determined by producing a plan, in which all factors on the farm are assessed and analyzed with a view to establishing the most favourable combination of enterprises. To assist planners in Natal, various methodologies, options, assessments and analytical tools have been devised. The techniques are not without their flaws, and therefore in this paper, certain selected techniques, applicable to Natal, are evaluated. Hopefully questions pertaining to these, and other farm planning procedural problems will be raised which will then act as a base from which future improvements and developments can be made to benefit farmers and the natural resources of Natal.

Resource assessment

Climate

South Africa exhibits a very large diversity in climatic conditions, ranging from the tropical eastern seaboard through a mediterranean regime in the south, moving inland to the savanna and desert climes in the west. Much of the country is undulating and covers an area of 1 275 881 km^2. Of this area, Natal constitutes 96 967km^2 and covers 7.67% of South Africa (Schulze, 1982). As an agricultural entity, Natal is the most intensively farmed region in South Africa and has the highest investment and return per unit of area in the country. Unlike much of the rest of South Africa, Natal is noted for its varied physiography, ranging from temperate mountains and plateaux at elevations in excess of 3000m, through plains and deeply incised river valleys to tropical coastlands (Phillips, 1973). Rainfall statistics range from an average of 550mm in the northeast of Natal to 1500mm in the west along the Drakensberg range (Schulze, 1982). In Natal, and certainly South Africa, rainfall is the factor most limiting agricultural production. However, other climatic considerations such as temperature, evaporation, sunshine, wind and frost are also important as they too influence the choice and form of land use.

Analysis of on-farm data is the ideal, and for this, climatic data assessment programmes are available to planners, in both spreadsheet and geographical information system (GIS) formats to facilitate the identification and presentation of pertinent and accurate information. Programmes that aid in this function assess, from the climatic data inputed, heat units for particular crops, rainfall probabilities, the percentage early summer, late summer and winter rain (rainfall regions of Natal) (Schulze, 1982), drought indices and coefficients of variation, amongst other things (Klug, 1993). Reluctance by farmers to keep records is a major problem, and planners invariably have to resort to using more generalised information.

A number of reports summarising climatic parameters have been published specifically for the Natal region. These include climatic data for various weather stations and farms (Erasmus, 1987); risk analyses (Clemence, 1985; Anon., 1987b; Clemence et al. 1987); irrigation water requirements; estimation formulae and/or tables for coefficients of variation and probabilities of occurrence; evaporation; heat units; and agricultural productivity potentials (Clemence, 1982; Schulze, 1982). Shortcomings associated with these include the often relatively small data bases (i.e insufficient records to adequately measure variability); the broken terrain in Natal which makes extrapolation from even a neighbouring farm unreliable; and the lack of climatic information pertaining to specific crops, such as heat units.

Climatic zones have also been delineated on land type maps (1:250 000) in which all agriculturally important climatic parameters display either a narrow range of variation, or a marked regularity in pattern of variation (Anon., 1986). Apart from standard precipitation data, evaporation and frost prevalence, figures are available to estimate the precipitation threshold that can be expected to be exceeded, on a monthly basis, for 60% and 80% of all years. Memoirs dealing with land types provide climatic zone data, and soils and terrain form of each land type with detailed descriptions and analyses for a number of representative samples. These appear in memoirs for each area, and can be related to the land type maps via a climatic zone number. Shortcomings of this system are that not all areas of the country have been covered by the land type survey and, where data were unavailable or unreliable, estimates were made, based upon local observations and knowledge.

Reasonably homogenous farming areas (RHFAs) are areas which are also mapped at a scale of 1:250 000. They are based upon the land type system, but are adjusted for climate and possess less detail (Camp, 1993a). They serve a similar function to Phillips' (1973) eleven bioclimatic regions of Natal.

Ecotopes are another method utilised by planners to determine climatic and other information for a farm. An ecotope is defined as a unit of land within which the yield potential and agricultural production techniques used for a particular enterprise would be uniform and significantly different from adjoining ecotopes (Camp, 1993). Resources, apart from climate (mainly rainfall and temperature), that would be used in the identification of an ecotope would include slope, aspect, soil and vegetation.

Techniques involving regression analyses have been largely inadequate in formulating response functions because farm planning has so many variables, both known and unknown, associated with it that not all of them are able to be included within the equations. Also, different farms have different variables which result in unrealistic extrapolations. Thus an incomplete picture is observed for the farm. However, a sophisticated agrohydrological model has been developed by Schulze (1980) to model the daily water balance in a catchment, from which it is possible to make predictions about pasture management and production, dryland crop production potential, water requirements for irrigation and the delimitation of optimal areas for commercial timber production (Schulze, 1980). Climatic data from the Computing Centre for Water Research, based at the University of Natal in Pietermaritzburg are the primary inputs for this model. This centre has used multiple regression techniques to simulate climatic data at minute by minute intervals from reliable weather stations having daily records for more than 35 years and, on the basis of physiographic changes, identified 712 homogenous climatic zones (HCZ) for South Africa (Dent et al. 1987). These data are proving to be most useful in cases where climatic data are not available for the farm being planned. Advantages of this system are that it covers the whole of the country, and the generated data can be used in tandem with Klug's (1993) computer programmes to obtain the best source of information for the farm. One major drawback is that micro-relief is ignored in the HCZ's, and often the data are still too crude for accurate planning at the farm level. Planners have tended, therefore, to use iterative processes, in association with experience, to formulate answers to the climatic assessment in Natal.

In southern Natal, Transkei and Ciskei, temperature data are sometimes used to assess crop adaptation to local conditions, using the Ehlers system (Ehlers, 1974). This system divides the country up into relatively homogenous temperature zones, termed agro-ecological regions. The temperature regime of each zone is characterised by a code consisting of two numbers and a letter (Papenfus, 1990).

eg: <u>number characterising summer temperature</u> letter (characterising frost incidence)
temperature

eg: $\frac{77}{25}$ A

This method is suitable for appraising the suitability of an area for the production of a wide variety of crops, and is a useful tool for inexperienced land use planners (eg students). However, it is crude and should not be regarded as definitive because the local climate of the farm under consideration may not be typical of the region as a whole. Another factor to bear in mind is that temperature requirements of different cultivars of the same crop may vary making objective interpretations difficult.

A useful method of presenting climatic data is via the climatogram. This was proposed by Walter (1971), and subsequently modified by Wolstenholme (1977). It offers an alternative to data filled tables which might be difficult to interpret, and are often useful for rapid comparisons between farms and areas. Parameters used by Wolstenholme (1977) are considered to be ideal for the requirements of a planner in assessing climate on a farm, but a lack of data to construct a climatogram is often a limitation.

Soils

Soil identification and assessment is an effective means of determining land capability, and thus agricultural potential of the farm. Due to the variation in soils resulting from the influences of climate, physiography, vegetation, soil age and parent material in Natal, soil classifications are essential to ensure that the correct intensity of land use is determined.

All of the soil classification systems in use in South Africa are derived from the USDA system (Anon., 1975). However, on a national scale, the most widely utilised classification is Macvicar's (1991) taxonomic soil classification system for South Africa. The USDA system is not employed in South Africa because it was found to be incapable of accommodating all the soils of the country satisfactorily. The South African system is based upon the soil form and its associated soil families, which, after their identification according to certain criteria, are subdivided down the profile. Each soil is described by a form and family name, identified by means of a code which is easily mapped.

Whilst this system enables planners to adequately identify and determine a general capability of the soils for the whole country, doubt as to the applicability and practicality of the soil families to land use planning has, in some instances, been levelled at the system.

There is no map depicting soils of South Africa, although a number of publications, based on the taxonomic system for South Africa, cover specific localised regions. These include:

a) A survey of soils of the Tugela basin (Van Der Eyk et al. 1969), wherein soils, and land capability as a result, were determined for this area in Natal. This survey laid the foundation for the current national taxonomic system and supplies a broad overview of the soils to be found. However this survey acts only as a guide for a more detailed study.

b) Soils of the sugar industry. This classification lists soil physical and chemical properties and its susceptibility to nematode infestation (Papenfus, 1990). It is crop specific and preempts a crop suitability classification for sugar in Natal, and is thus of limited use for planners investigating general land capabilities.

c) Land type surveys delineate areas into land types, with each land type displaying uniformity with regard to terrain form, soil pattern and climate. This survey provides reliable information to planners in that it may be used as a basis for predicting the most suitable crops, as well as providing an insight to the soil forms that may be found within a particular area. Disadvantages of this system are that it is, as yet incomplete; soil forms and families have changed since the survey was introduced; and the scale of 1:250 000 works against its use at a farm level (Papenfus, 1990).

Other factors that affect the proficiency of soil data collection and assessment in Natal and South Africa, in general include the lack of a simple standardised soil code that is applicable to the rugged physiography of the country, and a system which is able to produce soil units with a high degree of purity.

Veld condition assessment (VCA)

Approximately 80% (7 000 000 ha) of Natal is under veld (range or natural vegetation) (Zeeman, 1974), making it the most important forage source in the province. Because of the diversity of veld types, the productivity, and the importance of veld management to reducing soil loss and improving water quality, a great deal of research has been conducted on monitoring methods to determine the state of health of the veld (Foran, 1976; Foran et al. 1978; Tainton et al. 1980).

Apart from monitoring vegetation changes and trends over time, the assessments aim to determine the grazing capacity of the veld (Heard et al. 1986). With this knowledge, veld management programmes can be implemented.

The modified Foran or benchmark method of assessment is most commonly used in Natal (Foran et al. 1978; Tainton, 1981; Mentis, 1983). In this method, researchers are required to define a benchmark site for each veld type (or bioclimatic group). Planners then use species composition, topography and soil erodability, to determine a comparative current grazing capacity in Animal Units per hectare for a site. A number of sites representing homogeneous units of veld are assessed to determine the total carrying capacity of a property. Although widely used as a planning tool by researchers and planners, a number of problems exist. These include:

a) the average farmer is too busy or not knowledgeable enough to perform the assessment even with the aid of computer programmes (Klug, 1993);

b) the assessment is confined mainly to Natal because of a lack of benchmark data;

c) the categorisation of species in the system is empirical, and therefore the subject of continuous debate between researchers;

d) relatively minor physiographic changes can induce changes to the species composition which are not sufficiently accommodated in the benchmarks; and

e) the estimate of basal cover and grazing capacities do not adequately account for the influences of climatic and user variability upon them (Barnes et al. 1984).

Other methods of VCA in Natal include those of the weighted ecological index method (Tainton et al. Undated; Vorster, 1982), whereby sites are compared on the basis of species composition score with the value of a specie being determined by its ecological group; the weighted key species method (Foran, 1976; Foran et al. 1978), where the proportion of selected key species in a sward is related to a benchmark; and a simplified version of the Modified Foran method as described by Camp, (1993b) in Anon, (1993).

Problems common to all methods are that:

a) individuals are required to know and identify grass and or tree species, albeit a limited number in the case of the key species method;

b) benchmarks and or ecological groupings of grass species need to be identified by experts and are often subjective; and

c) key species have not been identified for the majority of veld types in Natal, let alone South Africa.

In their favour, the weighted ecological method provides a very practical method of VCA especially for monitoring relative change, whilst the key species method is quick and reliable in those areas where key species have been identified and where benchmark relationships have been established.

Other resources

Markets, labour, management and finances are also resources which need to be investigated and assessed, but the methods used are extremely subjective - even for finances. It is perhaps because farmers show so little interest in record keeping and financial performance data that true assessment of markets, management and labour are virtually impossible.

Planners assess markets by considering distances from market, fresh produce markets and abattoirs, marketing boards and handling and storage facilities in an attempt to rationally select best cropping and livestock enterprises for a farm. In most cases the final selection is based on farmer preference. This information is usually obtained from relevant maps and/or Department of Agriculture information centres.

The assessment of labour and management is very difficult. Only attendance records are kept and labour allocation records, machinery usage and time and motion studies are non existent. Although varying from region to region, formal education levels amongst farmers tend to be low and there is a high degree of resistance to change, especially with management styles which are often inherited.

Most forecasts of managerial competence are entirely subjective, often based on impressions of the day. With the recent passing of new labour laws for the farm worker and his conditions of employment, farm labour record keeping will almost certainly improve. This will enable the planner to then utilise these data, to the benefit of both farmer and researcher.

The complete farm plan is dependent upon accurate and thorough financial evaluation, requiring a knowledge of present and future financial requirements. A financial evaluation would help to identify viable or marginally viable operations and would result in the equitable disbursement of capital on the farm. Gross margin analyses and even financial statements are non existent for most farms in Natal and often planners have to rely on generalised budgets published annually for the province by the Department of Agriculture (Anon., 1993a). Occasionally balance sheets are available and with the aid of financial ratios, the financial status of the farm can be evaluated. These financial ratios may be used to conduct either "time series" analyses, in which comparisons are made over time, or as "cross sectional" analyses, in which an attempt is made to gauge financial performance by comparing certain ratio values with those of similar operations (Papenfus, 1990). Unfortunately, limitations to successful planning arise from the age of records in a rapidly changing economy; a lack of a standardised system of defining allocatable costs; and data which may not be sufficiently specific for the farm or enterprise under investigation (Anon., 1993b). Historically, financial ratios were suited to commerce and industry, and analysis of farm finances, using these norms, tends to be inaccurate. It is then incumbent on the planner to modify any available data to suite the particular needs of the farm being planned.

Classification systems

Land capability

Copeland (1987) stated that land use capability concerned the equilibrium potential of land for agricultural production. Therefore, once all the resources of a farm have been evaluated, land should be apportioned into classes based on their most productive capability, and to plan for a level of land use that is consistent with the constraints imposed by capability classes (Scotney, 1971). All land capability classification systems used in South Africa have been based on the USDA system designed by Klingebiel & Montgomery (1961). Scotney (1971) published a system which subsequently became widely used throughout Natal, but serious limitations, such as the lack of cognisance of soil forms to help rate potential; its overriding bias towards arable land; and the inclusion of important parameters by inference rather than by quantifiable units prompted the development of a number of other land capability systems for different regions of the country. This situation is sometimes difficult to reconcile, as comparisons between different regions then becomes difficult to interpret (Scotney et al. 1987). One such system is that of Smith (1993) which is based on the Zimbabwean system developed by Ivy (1977). Because it is based on characteristics which are easily quantifiable in the field, it is easy to use. Although developed primarily for Natal conditions it is applicable elsewhere in the country. The major limitation is that it is new and, as yet, relatively unknown.

Management units

Land capability classes, because of their irregular shape and size, are sometimes difficult to manage in a practical context. To accommodate management, land capability boundaries are adjusted to create management units, which are areas of relatively uniform potential; are a practical size and shape; and represent actual lands or grazing camps. The recommended intensity of use of a management unit should be dictated by the most limiting land capability class but discretion may be used. One major limitation to the continued use of the concept of land capability is that farmers have a poor soil conservation ethic and ignore the recommended restrictions. Inclusion of leys to reduce soil loss is uneconomic and there are insufficient fertility benefits to justify the inconvenience to management.

Suitability classifications

Suitability classifications are utilised where applicable. Very little specific information relating to crop requirements in South African conditions exists. This poses a major limitation for the planner in his evaluation of specific crops for different areas of the farm. The problem is remedied to a minor extent by the use of classifications by Wolstenholme (1977), Sys (1985) and Smith (1993) but these still fall short of an overall suitability classification for the whole province.

Conclusions

A successful plan is dependent upon the accurate retrieval, collation and analysis of data pertaining to all the resources on a farm, because it is from this information that the second phase of planning arises. Unfortunately, in Natal, systems to aid these functions are sometimes limiting, and planning is difficult. Hopefully, the problems which have been highlighted to some extent in this paper will elicit useful discussions to assist us in their resolution.

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