Market research for decision support for dryland crop production in central Queensland: a preliminary report

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Summary. During 1992/3, we began to construct ethnographic decision tree models to describe the way in which farmers in Central Queensland (CQ) use various technological components believed to contribute to more sustainable agricultural production. Discrepancies between practice and formal management recommendations provide a potential basis for the design, development and provision of decision support. The use of inorganic fertiliser by ten farmers at two locations in CQ is compared with current fertiliser recommendations. There appears to be little scope or justification for the development of decision support systems for routine fertiliser use in CQ based on current rules. Cropping system simulation models might provide appropriate support for the interpretation and generalisation of farmer-managed on-farm experiments on fertiliser use.

Introduction

The way in which an agricultural production system is managed is mainly the outcome of a series of related decisions about the use of different technological components; it reflects both environmental (physical, social and economic) constraints and characteristics (goals, skills) of the decision-maker. Planned improvements in decision-making behaviour will come from better understanding of the implications of existing decision-making practices. The design and provision of decision support tools will most usefully compensate for demonstrable weaknesses in behaviour. This applies both to the adoption of well-established technologies (perhaps related to weaknesses in our own program content and delivery) as well as facilitating the incorporation of novel practices. We face both situations in dryland crop production in Central Queensland (CQ).

We believe that several technological components potentially contribute to a more sustainable agricultural production system in CQ: purposeful crop sequences (e.g. rotations; the use of legumes; integration of cropping and livestock); conservation tillage (zero tillage, and other forms of reduced tillage; stubble retention); opportunity cropping (planting a crop whenever an opportunity arises cf. the use of rigid crop schedules); and the use of fertiliser (especially nitrogen). These are all used already to a greater or lesser extent. Opportunity cropping is widely practised since rainfall is at best spasmodic. Fertiliser use is increasing. The amount of tillage has decreased over the last decade. The level of integration of crops and livestock is low, although there is growing interest in this. The poor availability of suitable legumes is a limiting technology. Seasonal climate forecasts are a new technology that people only understand in a limited way.

Professional researchers see this uncertain and dynamic situation as an opportunity for improving management practices through the provision of decision support. But, before investing scarce research resources in the development and extension of decision support products. it is sensible to consider the structure, content and social context of decisions that might be supported, and the best way of supporting them. This is a preliminary report of the way we are approaching the analysis of this problem. taking the use of fertiliser as an example. Later work will develop this approach by formalising and generalising alternative models of farmer behaviour.

Dryland cropping in CQ is a risky business because of the uncertain rainfall. Soil fertility is declining to problematic levels (3). Use of inorganic fertiliser is likely to be of increasing value and importance as the response to its application gets bigger. Yet the response is still not well-specified because of the climatic variability and uncertainty about the current state of N and water in the system. There is a potential market for an information product to support decisions about fertiliser use at farm-level.

Methods

Rapid survey methods are widely used in the diagnosis stage of farming systems research (9). They have been used in Australia (6) as a way of re-focusing the research agenda. As a tool for technology design. rapid survey methods have limitations. Two responses to this have been development market research (4) and ethnographic (or hierarchical) decision analysis (5). These approaches emphasise deliberate attention to what farmers say they want, and what they actually do. Ethnographic decision analysis explores, in much greater detail than rapid survey methods, the rules people use (whether consciously or not) when they make a decision. Development market research seeks to get practitioners to specify the outcomes that they want rather than trying to impose solutions. Our approach is a hybrid of these two. Its basis is a recognition that neither descriptive nor normative models of decision-making behaviour are adequate by themselves as prescriptive models (1).

During 1992/3, we began to construct ethnographic decision tree models to describe the way in which farmers in CQ use technological components believed to contribute to more sustainable agricultural production. We did this by interviewing farmers about the way they use these technologies. This report is based on semi-structured interviews with ten farmers (six in Capella. in the Central Highlands; four in Banana near Moura, in the Dawson-Callide) with whom we are working on a program of on-farm research. What they do is the best of current farm practice. The responses were checked in a second round of interviews during which the results of the first'round were fed back to the farmers. Later in the project, we shall look at the way other farmers make the same decisions, and explore alternative representations of farming systems. The way farmers make decisions about each of these component technologies is compared with the structure and content of current recommendations regarding their use. This paper relates just to the use of inorganic fertiliser.

Results and discussion

The recommended rules for fertiliser use on crops in CQ are given succinctly in the Crop Management Notes provided to all farmers by the Queensland Department of Primary Industries (10). They can be divided into three groups: adjustments in relation to the level of soil moisture at planting (Table I); what level of phosphorus (P) to apply (Table 2); and what level of nitrogen (N) to apply (Table 3).

The decision to fertilise or not, with what, and at what level, can hardly be described as complex. The Queensland Department of Primary Industries Crop Management Notes uses 15 rules, sonic of which are redundant as they form partial conditions of more complex rules. An earlier key presented by Leslie and Hart (7) for using nitrogen in grain crops in south-eastern Queensland gives 20 rules. Once the soil type (scrub soil or open downs) and the age of cultivation are set (these change only slowly), the number of relevant rules drops even further.

Table I. Recommended rules for adjustments to fertiliser use in relation to the soil moisture at planting in Central Queensland, after (10).

Rule 1	IF	moist soil > 80cm	THEN	fertilise at planting
Rule 2	IF	moist soil = 60 - 80cm	THEN	reduce N rate by 10 kg/ha
Rule 3	IF	moist soil < 60cm	THEN	do not fertilise or plant yet

Table 2. Recommended rules for the use of phosphorous fertiliser for all (sic) crops in Central Queensland. after (10).

Rule 4	IF	soil P > 10 mg/kg	THEN	no P required
Rule 5	IF	soil P < 5 mg/kg	THEN	apply 10 kg/ha P at sowing
Rule 6	IF	soil P = 5-10 mg/kg AND fallow < 18 months	THEN	apply 5-10 kg/ha P at sowing
Rule 7	IF	soil P = 5-10 mg/kg AND fallow > 18 months	THEN	apply 10 kg/ha P at sowing

Table 3. Recommended rules for the use of nitrogenous fertilisers for non-legumes in Central Queensland. after (10).

Rule 8	IF	new country AND scrub or alluvial soil	THEN	no N required
Rule 9	IF	new country AND open downs soil	THEN	apply 15 kg/ha N
Rule 10	IF	age of cultivation < 10 years AND no N deficiency symptoms	THEN	no N required
Rule 11	IF	age of cultivation > 10 years AND N deficiency symptoms seen AND lots of stubble present	THEN	apply 40 kg/ha N
Rule 12	IF	age of cultivation > 10 years AND N deficiency symptoms seen AND little stubble present	THEN	apply 30 kg/ha N
Rule 13	IF	sulphur deficiency suspected	THEN	use sulphate of ammonia

The number of options the farmer has is small. Building decision support systems (2) for routine fertiliser use in dryland crops in CQ is not justified by our analysis: this is less than a 20-rule problem! The choice between options is hampered by the considerable uncertainty about: the biological relationships involved (e.g. the rate of loss of soil N. the relationship between soil N and yield/protein, and the potential yield as influenced by in-season rainfall); the current state of the system (in the absence of an adequate soil test for plant-available N); and market conditions at harvest (which influence financial returns). A situation characterised by low complexity and high uncertainty is not one where a rule-based decision support system will be of much help: the rules are simple and widely available. The question is more about the extent to which the rules are applicable, and what the pay-off will be. The decision to use fertiliser is difficult not because it is complex but because the outcome is uncertain.

This is reflected in the way farmers told us about what they do. Although many of them (especially in Capella) have had soil tests done at some stage, soil tests are not used as a routine decision-making tool. Typically, farmers see greater value in fertiliser test strips (often done with the help of a local fertiliser distributor) which provide some financial return. There is limited scope for adjusting fertiliser use with the level of moisture available at planting because fertiliser is often put on several weeks or months before planting. Several reasons were given for this: lack of suitable equipment; case of handling; and so not to slow the planting operation which is limited to a narrow window by the evaporation of soil moisture following a planting rain.

Despite uncertainties about returns, the requirement for some form of added N is increasing inexorably. The decision to start using fertiliser was often precipitated by the farmers' own observations of long-term yield or protein decline; by comparison of old and newly-developed country; by discussions with neighbours who are already using fertiliser; and by what happened in their own experiments. These farmers are all active experimenters. It is by trying things out that they get a feel for whether something works or not. But because their experiments are done in real time and are subject to the location-specific vagaries of weather. there is a danger that they will miss opportunities for valuable experience due to the small number of situations sampled.

Farmers usually combine information from different sources in order to decide what to do. The interpretation of the behaviour of soil nutrients and plant response in on-farm experiments is a different matter. We do not know just from the final yield and protein levels whether the outcome is the result of the treatment or not (given the variation in soil N and P over the site; the uneven distribution of rainfall; the unevenness in planting rate or establishment etc.). This level of analysis is one where the complexity of current crop models (8) might be appropriate.

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