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CHANGING FARMING SYSTEMS – CASE STUDIES ASSESSING THE FINANCIAL IMPLICATIONS

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Abstract

The ability to adapt to changing circumstance is a determinant of future farm prosperity. Managers need to assess the performance of their current farming system and alternative farming options to identify possible profitable management changes.

This paper uses the STEP (Simulated Transitional Economic Planning) model to provide case study analyses of the financial implications of changing a farming system. STEP simulates the process of transition allowing the user to assess the financial costs and benefits of transition.

The case studies examined in this paper use financial data from farms at Wickepin, and Meckering in Western Australia.

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Introduction

Pressures of decreasing terms of trade, environmental degradation and changes in climate variability are encouraging farmers to consider new technologies, including new crop varieties and changing their management practices. Assessing the potential financial implications on a farm of making the transition is as important as undertaking the initial gross margin analysis. The period over which the transition is made can affect the long term profitability of the farm.

The profitability of the new system, and its costs of implementation are the main drivers determining the optimal period of time for maximum profits.

This analysis uses the STEP (Simulated Transitional Economic Planning) model to assess the transitional costs of changing the farming system. STEP is a user-friendly tool, integrating paddock scale decisions with the whole farm, developed for undertaking whole farm analysis of changing from one enterprise mix to another.

Before undertaking an analysis using STEP it is useful to undertake a comparative analysis of the new and existing enterprises. The additional skills, capital and technology required for the new enterprise need to be identified as do its sources of failure or success. The area of the farm devoted to the new system also needs to be identified as does the transition process of incorporating the new enterprise.

In this paper the two case study farms are analysed to reveal the financial consequences of including lucerne in the farming system, with the transition occurring over a period of four, six and eight years.

This paper comprises two sections; the first briefly describes the STEP model, the second provides a case study analyses for the Wickepin and Meckering properties and discusses both income distribution and environmental effects.

A Description of the STEP Model

Using the STEP spreadsheet tool a user can simulate over time the financial consequences of changing from one enterprise mix to another. The user can assess and compare different production possibilities and different enterprise options to get a strong indication of the viability of a new system compared to the old. The following description of the model draws heavily on the paper presented by Bennett et al. at the 47th AARES conference in Fremantle 2003.

STEP fills the gap between generating information from conventional financial tools such as gross margins, partial budgets and cost benefit information and practical implementation of a new system. Using STEP to assess the financial consequences of making a transition gives the user a guide as to the possible outcomes of incorporating the new system on their farm.

Microsoft Visual Basic automation reduces data input time. After entering a few parameter values STEP automatically generates information over a number of years. Given the data links within the spreadsheet, sensitivity analysis of variables is easy and increases the user's overall understanding of the new system.

Although STEP is most suited to broadacre cropping enterprises, its flexibility and generic characteristics mean it is applicable to a number of other industries.

STEP has been tested with a number of farmers, the majority of whom have given favourable reviews.

As with all tools there are a number of limitations. Those identified are listed below.

- The user is required to be knowledgeable about the farming system being tested. No prices or biological interactions are preset in the model. Lack of familiarity with the system interactions can result in incorrect and misleading results. Or said another way – rubbish in, rubbish out.
- Requires Microsoft Excel 97 or later to run.
- Making changes to the STEP framework will require some knowledge of Excel and depending on the extent of the changes, possibly Microsoft Visual Basic.
- Planning of what is going to be tested is essential before starting the analysis. If a farm is represented incorrectly in the model it can inhibit extensive analysis. Consequently time spent planning how the analysis is undertaken is time worth spending.
- STEP does not link into other farm management tools that are currently on the market such as PAM™ and Pinpoint™. This means that information existing in other computer programs needs to be re-entered into STEP.
- STEP is a simulation not an optimisation model.
- Climatic risk and inter-year price variation assessment is not easily accommodated by the model due to the complexity of relationships. However if this is desired, all figures can be altered on a yearly basis.

Users of STEP will not be confined to farmers assessing system options for themselves. Financial consultants are considered to be the biggest group expected to use this tool for individual property assessment. STEP provides financial consultants will an automated tool to test the comparative profitability of different options their clients are considering.

Researchers could use the tool to evaluate the difference their research may make to an average farmer's profitability in the long term.

Development officers may use the tool as a way of testing different systems for their area, as a workshop tool with farmers as well as an educational tool for themselves.

Finally universities could use the tool as a teaching aid for students. As it does not hide system interactions, it will force students to think about the farm as a system and consider the interactions of enterprises.

A conceptual overview of STEP is shown in Error! Reference source not found.. The spreadsheet is separated broadly into modules that 'dock' onto the budget.

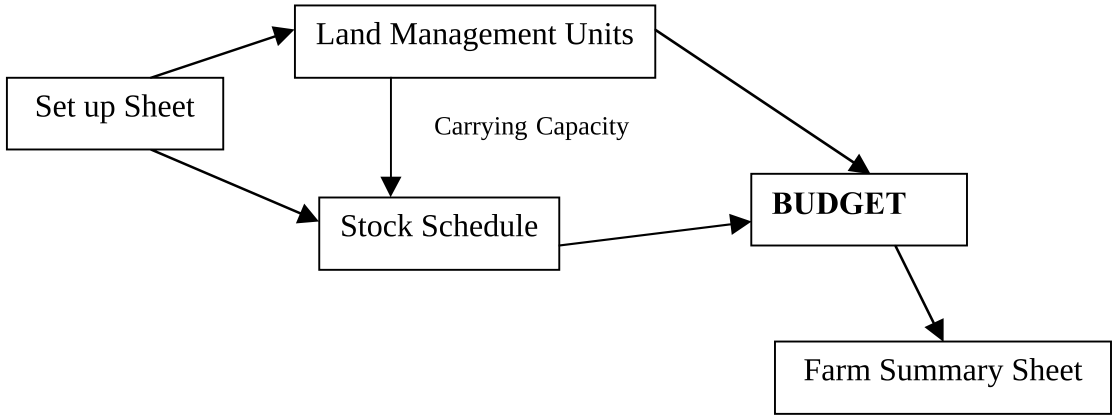

Figure 1: Conceptual representation of the STEP model

Case Study – Wickepin

The case study farm is located near the town of Wickepin in a region of Western Australia that has an annual rainfall of 380 mm.

Prior to the introduction of lucerne this farm engaged in production of annual pastures, lupin, wheat and oaten hay. Following the introduction of lucerne as a rotational, barley and canola were also introduced. Whilst this farmer had not grown barley or canola in the past, they are crops commonly grown in the area.

The farmer introduced lucerne to one third of his property through a phase farming approach. The paddocks changed from a wheat: sub. clover rotation to a phase rotation of three years of lucerne followed by annual phases of wheat, canola, wheat and barley. In the year of transition, lucerne followed a wheat crop from the wheat: sub. clover rotation. A cover crop of barley was sown over the lucerne in the establishment year and then the lucerne was managed as a pasture until it was sprayed out at the end of the third year. It is expected that the wheat crop following lucerne will have an increased protein content (this is reflected in the analysis by a $5/t premium) and slightly reduced fertilizer costs of $2/hectare due to the increased nitrogen availability after lucerne.

shows the sequence of crops for both rotations.

Table 1: Sequence of crops for both rotations

Rotation	Sequence Year 1	2	3	4	5	6	7
Wheat: sub clover	wheat	sub.clover	wheat	sub.clover	wheat	sub.clover	wheat
Lucerne	Lucerne / barley	lucerne	lucerne	wheat	canola	wheat	barley

In this analysis lucerne is introduced over various periods of four, six and eight years. The shorter the transition the more rapidly lucerne is introduced across paddocks to replace the wheat:sub. clover rotation. The annual surplus/deficit of each of these transition strategies is shown in Figure 2, with the net present value at a discount rate of 10% shown next to each strategy. The calculation of these profit measures initially excludes any environmental benefits of the greater water use of lucerne.

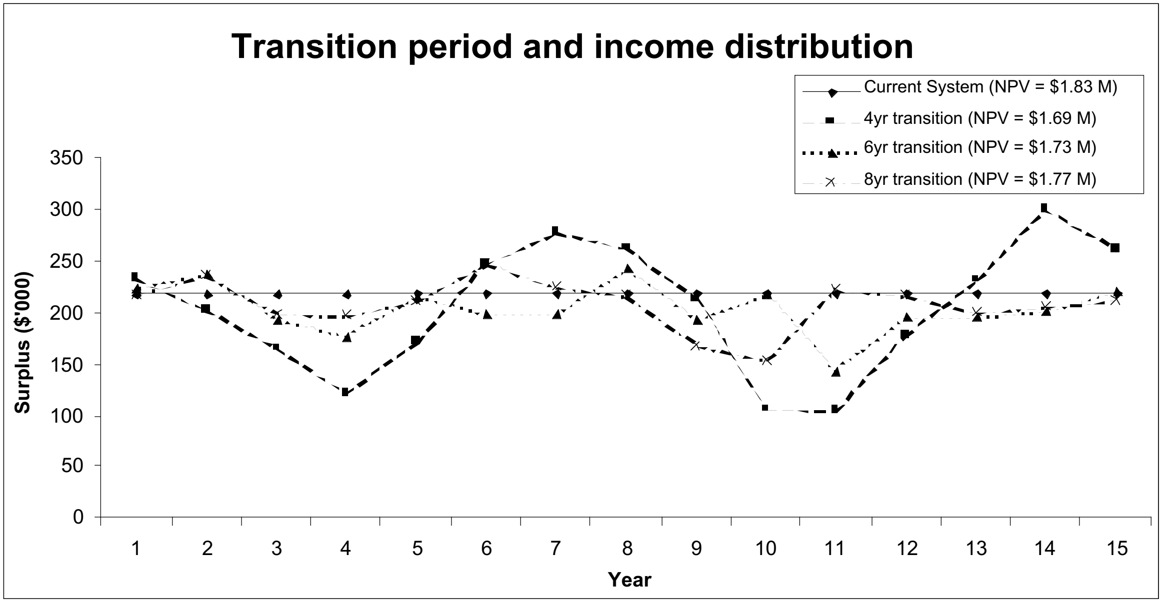

Figure 2: Transition period effects upon income distribution – Wickepin case study

Figure 2 illustrates that for this example a shorter transition generates a greater fluctuation in income across time. For instance in year 4 all of the strategies experience a dip in income, yet the four year strategy displays the greatest dip, followed the 6 year and finally the 8 year strategy. By year 5 the four year transition is complete yet the new system continues to provide fluctuations in income. These fluctuations are caused by shifts in the pasture:crop ratio due to the number of years in the new rotation being seven which is longer than the four year transition.

The eight year strategy has fewer fluctuations in income. By year 9 this strategy is fully incorporated, but again due to the odd length of the new rotation fluctuations in income continue.

The net present value (NPV) of each transition strategy also fluctuates. The current system has the highest NPV, followed by the 8 year strategy through to the four year strategy. This is because the new strategy is less profitable than the current strategy and therefore not changing into lucerne is the preferred strategy.

A main impediment to adopting the lucerne system is the impact of the lucerne establishment year and the greater emphasis on cropping associated with the new lucerne:crop rotation. One third of the property changes to the new crop dominant rotation, resutling in a reduction of 1360 DSE/ha in carrying capacity per year. Such a reduction in stock numbers and a shift toward cropping, with its higher input requirements and greater variability of returns, is a disincentive for adoption.

Inclusion of Environmental Benefits

The farmer wished to plant lucerne as a way of slowing the onset of salinity. An analysis was undertaken to simulate the loss of income from encroaching salinity. Annual production losses of 1%, 3% and 5% of continuing in the current system were simulated to show the production losses due to salinity. For each transition strategy, a production penalty was incurred for each year the land was not planted to lucerne. This is demonstrated in Table 2 where an eight year transition occurs on eight paddocks with a 3% production penalty for each year the introduction of lucerne is delayed.

Table 2: *Cumulative yield penalties of delaying the introduction of lucerne*

Table 3: Cumulative yield penalties of delaying the introduction of lucerne

Paddock	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
1	Lucerne							
2	3%	Lucerne						
3	3%	6%	Lucerne					
4	3%	6%	9%	Lucerne				
5	3%	6%	9%	12%	Lucerne			
6	3%	6%	9%	12%	15%	Lucerne		
7	3%	6%	9%	12%	15%	18%	Lucerne	
8	3%	6%	9%	12%	15%	18%	21%	Lucerne

Including a yield penalty of delaying the introduction of lucerne has the effect of increasing the profitability of including lucerne in the farming system as shown in Table 3.

Table 4: Net Present Values at a discount rate of 10% of including lucerne into the farming system over 4, 6 or 8 years with production penalties incurred for delaying its inclusion.

Production penalty	4 year transition	6 year transition	8 year transition	No transition
No penalty	$1.68 M	$1.73 M	$1.77 M	$1.83 M
1% penalty	$1.68 M	$1.71 M	$1.70 M	$1.68 M
3% penalty	$1.66 M	$1.68 M	$1.65 M	$1.38 M
5% penalty	$1.65 M	$1.65 M	$1.60 M	$1.09 M

Where no production penalty is incurred the current system is more profitable than the lucerne system. However with a production penalty as low as 1% the 6 and 8 year transition strategies are more profitable than the current system and the 4 year transition is only slightly less profitable. As the penalty increases all the strategies become less profitable. Table 3 also shows that as the penalty increases the optimal transition shifts towards the shorter transition period, but in all cases the 6 year transition has the highest net present value. This is due to a trade-off between losing the profitability of the current system by making a transition too quickly, and the loss of production due to salinity from delaying the transition.

Figure 2 shows the eight year transition has a more evenly distributed income than the six year transition strategy. Determining the best transition length will depend on the risk preferences and goals of the farmer. Having greater fluctuations in income exposes the farmer to greater risks.

There are other possible production outcomes of introducing lucerne that this analysis has not covered including:

1. Increases in sheep reproductive percentage (Latta and Matthews, 2003)
2. Improved wool quality (Latta and Matthews, 2003)
3. Increased price of sheep grazing lucerne (Latta and Matthews, 2003)
4. Increasing stocking rates on lucerne above those of sub. clover stocking rates (Latta and Matthews, 2003)
5. Decreased yields in crops following lucerne due to soil water deficiencies (Latta, Cocks, and Matthews, 2002) and

6. Soil health benefits such as increased soil structure and stability.

Most of these factors will increase the competitiveness of lucerne compared to the current system and may lead to a further shift towards a shorter transition period.

Case Study – Meckering

The farm is located in Meckering, in a region of Western Australia that has a mean annual rainfall of 360mm. The property is a combination of livestock and cropping enterprises. The farmer has light and medium heavy soil types and grows wheat, lupins, field peas, cadiz serradella and volunteer pasture.

The farmer chose to change the rotation on his low yielding wheat: pasture areas to include a three-year lucerne pasture phase. On the particular paddocks targeted there was a change from a wheat: pasture rotation to 3 years of lucerne followed by wheat, wheat, field pea, wheat and wheat phases. The areas that the farmer targeted had been experiencing 80 percent of the yield of the average wheat crop. Lucerne was used to reduce the water table in an area subject to waterlogging. After the lucerne phase the farmer expected an increase in wheat yields to between 84% to 93% of the farm average. Part of the yield boost was anticipated to come from the nitrogen benefits of the lucerne and field peas.

The long-term profitability of the lucerne system is greater than the wheat pasture rotation, as illustrated in Figure 3.

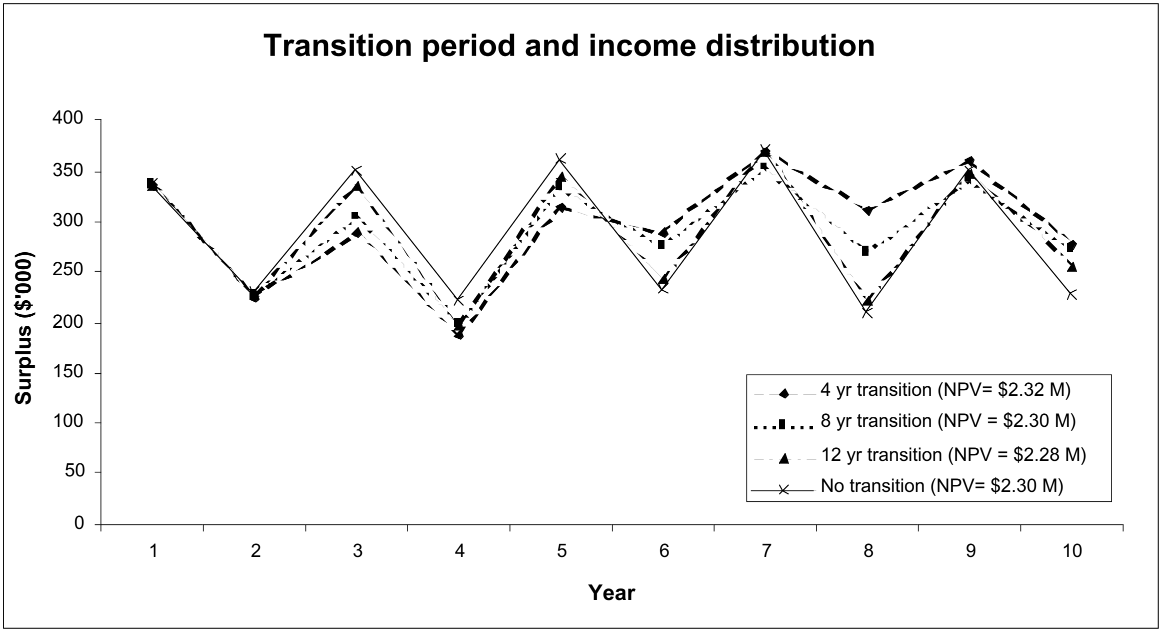

Figure 3: Transition period effects on income distribution – Meckering case study

This is due to the improved crop yields and the greater number of crop years, 5 out of 8 years compared to 4 out of 8 years in the previous system. However Figure 3 also shows the length of transition affects the overall productivity of the system. A transition over a greater period of time can reduce the NPV. However the difference between the different transition strategies is slight. For this case study farm the lucerne phase system is more productive and profitable than the former system, so it is better to adopt the lucerne system sooner. The distribution of income over time for the new system is greater in all years except 3, 4 and 5. So although income variability may be higher with the faster transition, the variability is only an increase in income, suggesting staggering the transition over a greater period of time is unnecessary.

The lucerne phase system is targeted to small areas of the farm and comprises only 14% of the farm area and as a result the up front costs are small.

Conclusion

Both case studies in this paper investigate replacing a wheat:sub. clover rotation with a lucerne based rotation. Approximately one third of the farm is replaced with lucerne in the Wickepin case study, whilst just over one tenth was replaced in the Meckering case study.

For the Wickepin case study the major cost and impediment of the lucerne system is the impact of a reduced flock size and the introduction of new crops whose profitability does not match that of the wheat crops they replace. However, as shown in Table 3, if production levels are maintained as a result of the inclusion of lucerne rather than being reduced due to salinity, the new lucerne system becomes more profitable. Other Improvements in production as a result of lucerne can be expected to further boost lucerne profitability.

The transition strategy chosen affects the income distribution over time. When salinity benefits are included in the analysis, a transition period of six years provides the most benefits although the income distribution may expose the farmer to higher levels of risk than an eight year transition.

For the Meckering case study, the new system is more profitable than the existing system causing a shorter transition period to be preferable, even when income distribution is considered.

References

Bennett, A., Edward, A., Herbert, A., Kingwell, R., Peek, C., Rogers, D. (2003) Changing farming systems - Financial implications for farm businesses. Paper presented at the 47th Annual Conference of the Australian Agricultural and Resource Economics Society, 11 February, 2003, Esplanade Hotel, Fremantle.

Latta, R.A., Cocks, P.S. and Matthews, C. (2002). Lucerne pastures to sustain agricultural production in south-western Australia. *Agricultural water management* 53, 99-109.

Latta, R.A. and Matthews, C. (2003). Sheep production from lucerne. Paper presented at the 2003 Agribusiness Sheep Updates, 12-13 August, 2003, Hyatt Regency Hotel, Perth, Western Australia.