

A financial analysis of the impact of sheep on the risks and returns associated with mixed enterprise dryland farming in south-eastern Australia: Part II

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Abstract. This paper extends the long-term cash-flow simulations reported in Part I (Hutchings 2009) to include a range of seasonal scenarios at four representative dryland sites in south-eastern Australia. The effect of varying the proportion of sheep and cropping in the enterprise mix at each site on cash surpluses is discussed. The analysis shows that, for most sites, the cropping enterprises require better than average seasons, prices and water-use efficiencies to generate a positive cash flow and are subject to substantial variability and risk of loss. In contrast, the sheep enterprises show small but stable cash flows in all but extreme drought conditions.

This paper emphasises the need to include site-specific, long-term variability and whole-farm costs in analyses of farming returns. Attempts to define optimum or best-bet management systems which exclude these factors are likely to provide misleading information to farmers.

Keywords: Whole-farm planning, cash flow, sheep, crops, risk.

Introduction

Part I of the study (Hutchings 2009) showed that sheep enterprises reduce the variability of cash flow, and so reduce the exposure of a farm to the risks associated with cropping in average seasons. This stabilising effect was more important for the low rainfall farms, which are exposed to higher production risk (due to lower and more variable rainfall) and lower overall operating margins. Any form of diversification of these farm businesses into low-cost, low-risk enterprises or investments would similarly reduce the variability of cash flow. This analysis further showed the importance of including site-specific variability and whole farm costs in the analysis of the cash flows for different enterprise mixes for any farm.

The Part I analysis was limited to the effect of one year of drought on the performance of farms across these four regions in average (decile 5) years only. This second part of the study extends the first part across a more complete range of seasonal scenarios and enterprise mixes to provide a comprehensive risk profile for a range of enterprise mixes in each region.

Method

Two representative farms used in the analysis were located in the high rainfall zone (South West Slopes of NSW and Western Victoria) and two were in the low rainfall zone (Riverina, NSW and Mallee, Victoria). The farms selected were chosen to represent the largest areas which local consultants felt could be efficiently operated by one family. A description of the four farms is contained in Hutchings (2009).

Simulations involving the cropping of 30 percent, 60 percent and 90 percent of the area of each farm were run for three years, with and without a drought in the second year to simulate climatic variability and over a range of growing season rainfall decile sequences.

These simulations were performed using the MS&A Farm Wizard—an Excel spreadsheet developed by MS&A (Mike Stephens & Associates) to prepare 36-month financial analyses for their clients' farm businesses. The Farm Wizard was designed to model the long-term, whole-farm, financial impact of management decisions in a risky environment. Input data are drawn from physical and financial records for the subject farm, together with current prices and costs. For further details of the model see Hutchings (2009).

To understand the full risk profile of the different enterprise combinations requires the analysis of a range of seasonal effects on cumulative cash flow over the 36-month period analysed in the model. For this reason the analysis shown in the previous paper (Hutchings 2009) for decile-5 years with and without a drought, was repeated for growing season rainfall deciles 1, 3, and 7 (seasons in the lowest 10%, 30%, and 70% of growing season rainfall) for each of the three seasons for each site. Hence, eight 36-month scenarios were developed, with the second four having a drought in year 2.

Because a decile by definition is the growing season rainfall occurring in 10% of all seasons, each seasonal scenario has an equal probability of occurring. The full seasonal risk profile for each enterprise mix can be viewed as the balance of the positive and negative cash flows for all seasons. The optimum enterprise mix will then depend on the farmer's subjective assessment of an acceptable balance of gain or loss (Boehlje et al. 2000). These seasonal scenarios are run with and without a drought; the inclusion of a year-2 drought can be viewed as an internal test of business resilience, as well as adding to the range of seasonal scenarios modelled. Although a one-in-three incidence of drought (defined as a season with decile-1 growing season rainfall) may over-estimate the long-term drought frequency, it is less than the 70 percent incidence of drought suffered by many farmers in southern NSW this decade.

Results

The 36-month cash flow for a range of seasonal scenarios is shown in Figure 1, and clearly indicates the serious effect of the failure of the second harvest on the cash flow on a high-rainfall farm in the South West Slopes.

The effect of the drought on this enterprise mix at this site was to move the break-even season from a sequence of decile-3 years (3,3,3) to a decile-5 sequence when a year-2 drought was included (5,1,5). Cash surplus increased with rainfall in all sequences, while the risk of loss (indicated by the peak debt) was more than halved as rainfall increased from decile 1 to decile 7, both with and without a year-2 drought. The difference between the two continuous drought sequences is due to the assumption that the farmer in the sequences that included the year-2 drought made pro-active reductions in variable cost inputs amounting to approximately $40,000 over the three-year period.

The accumulated net cash flow for seasonal scenarios was calculated for all sites.

South West Slopes cash flow scenarios

The three-year accumulated cash flows, represented by the bar graph in Figure 2, show that, for the SW Slopes farm, the 100% crop option is the most profitable in all seasons, except in continuous drought (1,1,1 deciles). The cash deficits in this continuous drought scenario would be recovered in the 5,1,5 and 7,1,7 scenarios. The optimum enterprise combination for the SW Slopes farm would include as high a proportion of cropping as possible, given the topographical constraints (steep slopes and other non-arable areas) in the region.

Riverina cash flow scenarios

In contrast to the SW Slopes, the risk profile for the Riverina farm is more evenly balanced between upside and downside risk. The accumulated 36-month cash flow scenarios in Figure 3 show that, even in average (decile 5) years, the Riverina cash flow was more sensitive to drought than any other farm. This pattern shows that large losses can accumulate quickly in drought (decile 1,1,1). Conversely equally large surpluses can accumulate in a run of good seasons (decile 7,7,7), although the sizes of these surpluses are approximately halved by the inclusion of a drought in year 2 (decile 7,1,7).

For the Riverina site, enterprise mixes with a higher proportion of sheep perform better than continuous cropping in poor seasons, while enterprises mixes with a higher proportion of crops do better in average and above average seasons.

The Riverina farm manager faces a dilemma in choosing his best-bet enterprise mix; on this farm, risk and reward are finely balanced. This analysis shows the high level of risk, both upside and downside, attached to continuous cropping. Sheep should be included on at least 30% of the farm area (the 60% crop mix), and this simulation suggests that including more sheep substantially reduces the downside risk, whilst at the same time reducing the cash surpluses in the higher rainfall years. The extent of the reduction depends on the number of sheep carried, and the relative price of sheep and grain. The ideal system for this farm would encompass more flexibility and diversity than the relatively rigid model used in this simulation, including the ability to trade rather than breed livestock, or the possibility of investing off-farm.

Western Victorian cash flow scenarios

The Western Victorian cumulative cash flow shows little risk of loss in any seasonal scenario (Figure 4). Farms in this area have a higher growing season rainfall in drought years than the other sites and this reduces the risk of loss, especially when coupled with the 50% drought loading on grain prices.

The Western Victorian farm used in the simulation also showed lower fixed costs, which contribute to a lower cost of production than the South West Slopes farm for a similar growing season (Hutchings 2009). For these reasons this Western Victorian farm can afford to maximise the area sown to crop, and do so with little risk.

Mallee cash flow scenarios

Figure 5 shows that the Mallee farm operates with considerable downside risk. It is the least viable of the four farms studied, due to the fact that it has the lowest growing season rainfall profile. As a result it has the lowest yields, coupled with a slightly higher cost of production for each enterprise mix, than the Riverina farm.

The outstanding feature of the cash flow simulations is the large downside risk associated with cropping, at both the 60% and 100% level. The accumulated losses in the 1,1,1 scenario would take approximately 30 years of continuous drought-free decile 5 years to repay, which is clearly not viable.

Including a sheep enterprise markedly reduces the scale of these losses, and therefore the downside risk, both with and without a drought in the second year. However, the upside is also reduced. At 60% crop the break-even cash flow occurs at or near the 5,5,5 and 5,1,5 scenarios. This enterprise mix could be viable, but it is still marginal. The downside is further reduced at 30% crop, but at a marked, and probably unacceptable, cost to the upside.

This simulation suggests that the optimum enterprise mix for the Mallee area should be based on sheep, although the simulated margins are so fine and variable that this farm will need a return to more favourable seasons to survive. However, many Mallee farms have removed the fences and other infrastructure that are essential for grazing sheep, so that alternative enterprises (on or off-farm) need to be found to reduce the downside risks associated with cropping. Mallee farmers removed the grazing infrastructure in the belief that cropping is more profitable than grazing. This belief may be based on gross margin analysis for average years, and ignores both the whole-farm costs and risk associated with cropping. This analysis contradicts current practice in the area, and demonstrates the inherent inaccuracies in partial analysis, and the danger of ignoring risk.

Effect of price on enterprise cash flow

The effect of output price on cash flow is presented in Figure 6, and can be assessed by its impact on the break-even point for each scenario. Only analyses for the SW Slopes and Riverina farms are presented, because these farms demonstrate the effects over a large range of growing season rainfalls, and including the Victorian results from the other two farms would not add substantially to the conclusions. Similarly the analysis is limited to the most typical 60% crop enterprise mix, with the non-subject enterprise price being held at the 60th price percentile. That is, crop prices are held at the 60th percentile as sheep price is varied, and sheep price is held at the 60th percentile as crop prices are varied.

Figure 6 can best be understood by looking at the break-even point for each scenario, which is defined as the point at which the 36-month cash flow becomes positive. The break-even point for the SW Slopes site is moved approximately one full seasonal scenario (5,1,5 to 3,1,3) as the result of increasing the sheep prices from the 20th percentile (ewes $45/head) to the 90th percentile (ewes $90/head). Increasing the crop price by a similar percentile range ($166/tonne to $307/tonne) has a greater effect on cash flow; the cash flow remains negative in all seasons for the 20th percentile price, and is strongly positive at the 90th percentile price in all seasons except continuous drought. At average prices (50th percentile, $242/tonne), break-even occurs at slightly above the 5,1,5 scenario. Consequently price is critical to the viability of the crop enterprise at this site.

At the Riverina site increasing the sheep price from the 20th percentile to the 90th percentile moves the break-even point from the 5,1,5 seasonal scenario to less than the 3,1,3 scenario. Increasing the crop price percentile from the 20th percentile to the 90th percentile also moves the break-even season from above the 5,1,5 scenario to less than the 3,1,3 scenario, with break-even at average prices occurring in a 5,1,5 scenario. Price is important but less critical to the viability of the cropping enterprise in the Riverina than in the SW Slopes. This difference between sites is due to the lower costs, and increased scale of the Riverina farm.

The effect of water-use efficiency on individual enterprise performance

The previous results show the whole-farm cash flow effects of different enterprise mixes for each site. The whole-farm performance is driven by the performance of the sheep and crop enterprises, which will differ in each scenario modelled. For any given dryland management system the performance of these enterprises will be driven by the water-use efficiency and the output prices received.

Productivity at these dryland sites is water-limited (French and Schultz 1984; Passioura 2004), so that gross income and net cash flow will respond positively to management practices which increase the efficiency of enterprise water use. Because all cash costs are allocated by enterprise, the resulting effects of increasing water-use efficiency (WUE) on enterprise profitability and cash flow can be calculated.

Figure 7 shows the effect of increasing the WUE on the cash surplus generated by each enterprise in various seasonal scenarios. The general pattern of enterprise performance is similar across the two sites. As would be expected, cash flow increases with rainfall and WUE in all scenarios at both sites; both sheep and crop enterprises are more responsive in the higher rainfall SW Slopes site than in the Riverina. The Riverina farm compensated for the lower return per hectare by more than doubling its scale of operation (2000 ha) compared with the SW Slopes (800 ha).

At both sites the sheep enterprise was relatively unresponsive to increasing rainfall scenarios, due to the fact that the stocking rate, and therefore breeding ewe numbers, was set at 75% of water-limited potential under a constant decile 5 environment. This closely follows normal strategic farming practice, but does not capture the tactical flexibility shown by some farmers who may chose to vary livestock numbers, or conserve fodder in some seasons. As a result the only response to different seasonal scenarios in these simulations was to change the amount and cost of supplementary feed. The model assumed that the flock would be fed grain for a maximum of 30% of any year in any scenario, and that grazing would be available from pastures or crops at other times. While this may under-estimate the time on feed, it may be partially countered by the assumption that, during drought periods, the cost of grain was assumed to be 50% higher than in other years.

In contrast the yield of all crops in the simulation increased linearly with rainfall, using the WUE factors defined by French and Schultz (1984). Costs were relatively constant in all seasons except drought (decile 1) where fertiliser and weedicide costs were reduced by approximately $40/ha, although this varied with the rotation used at each site. Thus the crop enterprise showed greater variation in net revenue across seasons than the sheep enterprise.

Figure 7 can be analysed by looking at the break-even point for each scenario, which is defined as the point at which the cash flow becomes positive. In most scenarios the sheep enterprise showed a small cash surplus at 75% WUE in all seasons except continuous drought (1,1,1). The exception is the 30% crop enterprise mix for the SW Slopes, where a stocking rate greater than the 75% level was required for break-even, because in this enterprise mix the sheep enterprise carried a greater allocation of fixed costs.

In contrast the break-even point for the crop enterprise at both sites with 75% WUE occurred at a higher rainfall than given by the 5,1,5 scenario. The 60% enterprise mix in the SW Slopes broke-even close to the 7,1,7 scenario. Because 75% WUE seems a realistic benchmark for most cropping farms (Hutchings 2009), this suggests that this enterprise is barely viable in average seasons which include a one-in-three drought and prices in the 60th percentile. This conclusion can be drawn because each seasonal scenario is equally likely, so that enterprises with break-even points above 5,1,5 have a better than even chance of loss.

Conclusion

These simulations illustrate the complexity of the business decisions faced by dryland farmers in south-eastern Australia. The cash surpluses, which are essential for the viability of their farm businesses, are variable and subject to the influence of season, enterprise mix, water-use efficiency and price. These influences can mask the effects of management decisions and make it difficult if not impossible to define best practice for any one site, let alone design farming systems with more general applicability.

This analysis also shows that the current cropping systems in south-western NSW and the Mallee need above-average prices and seasonal scenarios to generate reliable cash surpluses in seasonal scenarios that include a one-in-three drought frequency. Only the Western Victorian site has the climatic stability needed to make the cropping enterprise viable in the long-term. These analyses clearly show that decision-making based on partial (gross margin) and short-term analysis for average seasons can be misleading, especially given the forecast increase in climatic variability due to climate change in the region. Attempts to define optimal farming systems, which ignore site-specific risk and which do not include all costs, including living expenses, also fail to provide a realistic basis for advice to farmers.

It must be stressed that these simulations describe systems that are unrealistically inflexible, and that in reality farmers continuously adjust their operations to capture tactical opportunities. However, these simulations do capture the important effects of risk, and attempt to define the risk profile for each site and enterprise mix. The choice of the best-bet management system depends on the skills, experience and risk tolerance of individual farmers and will evolve in response to changes in the operating environment (Boehlje et al. 2000).

Part III of this series will further define the risk profiles of these enterprise mixes using long-run analysis based on historical rainfall records for all sites. Risk in this case will be defined as the probability of loss during this period (Richardson et al. 2000).

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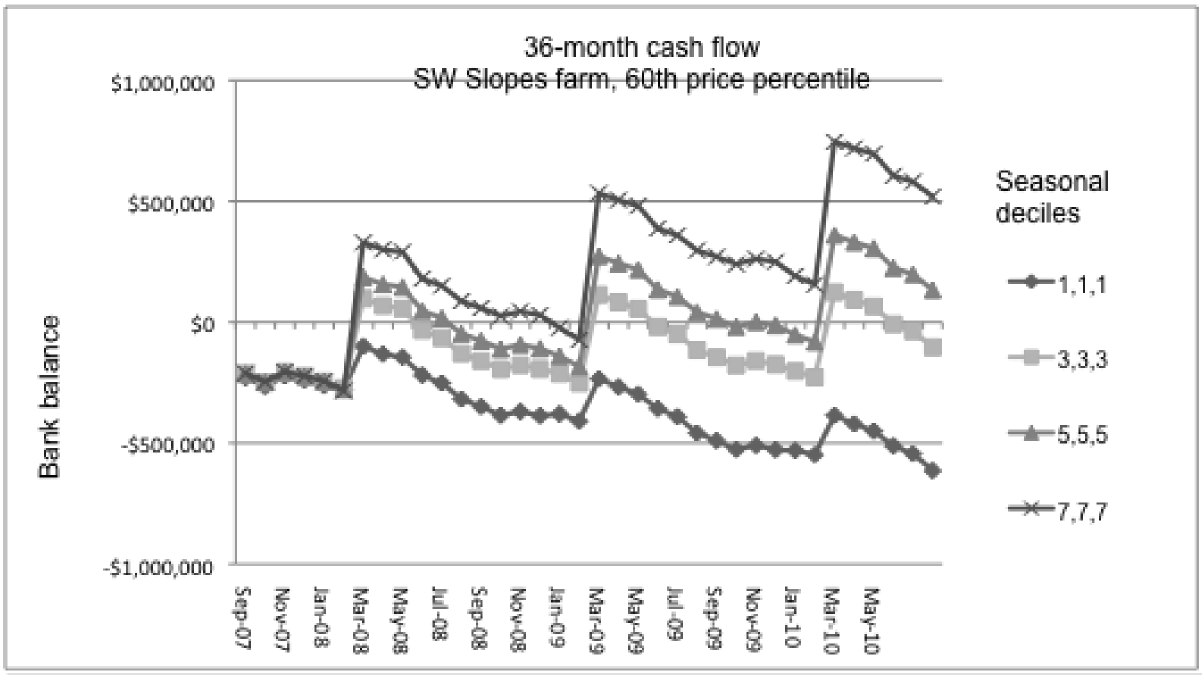
Figure 1. 36-month cash flow for the SW Slopes farm, 60% crop, 75% water-use efficiency, 60th price percentile



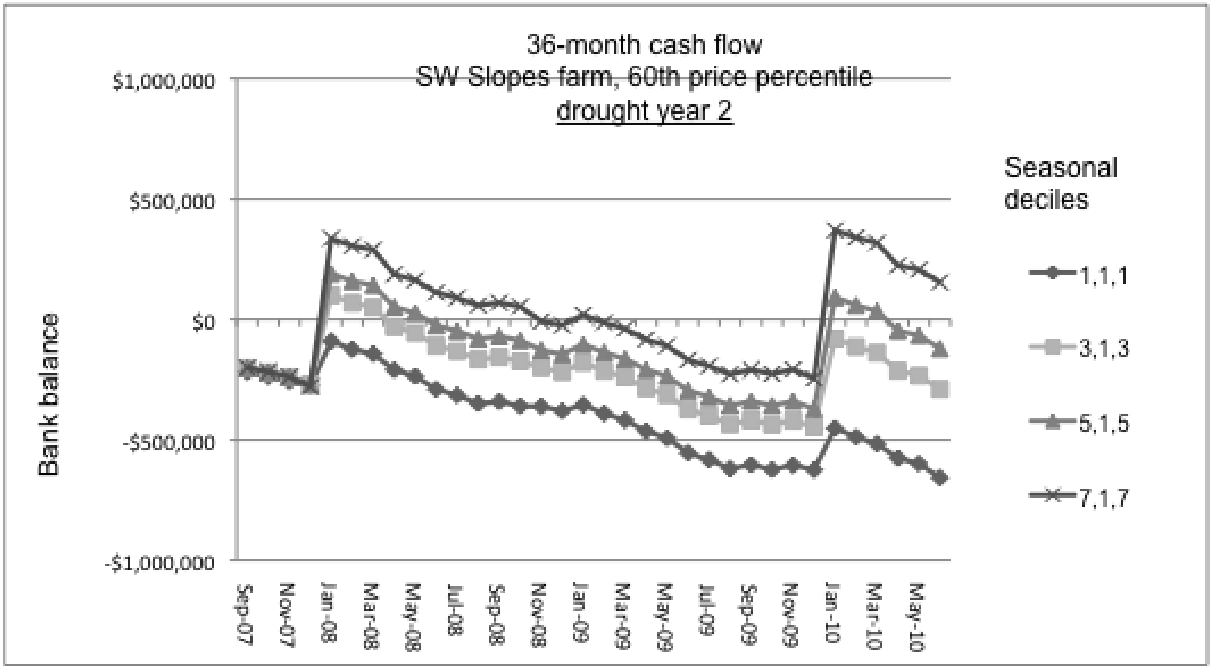
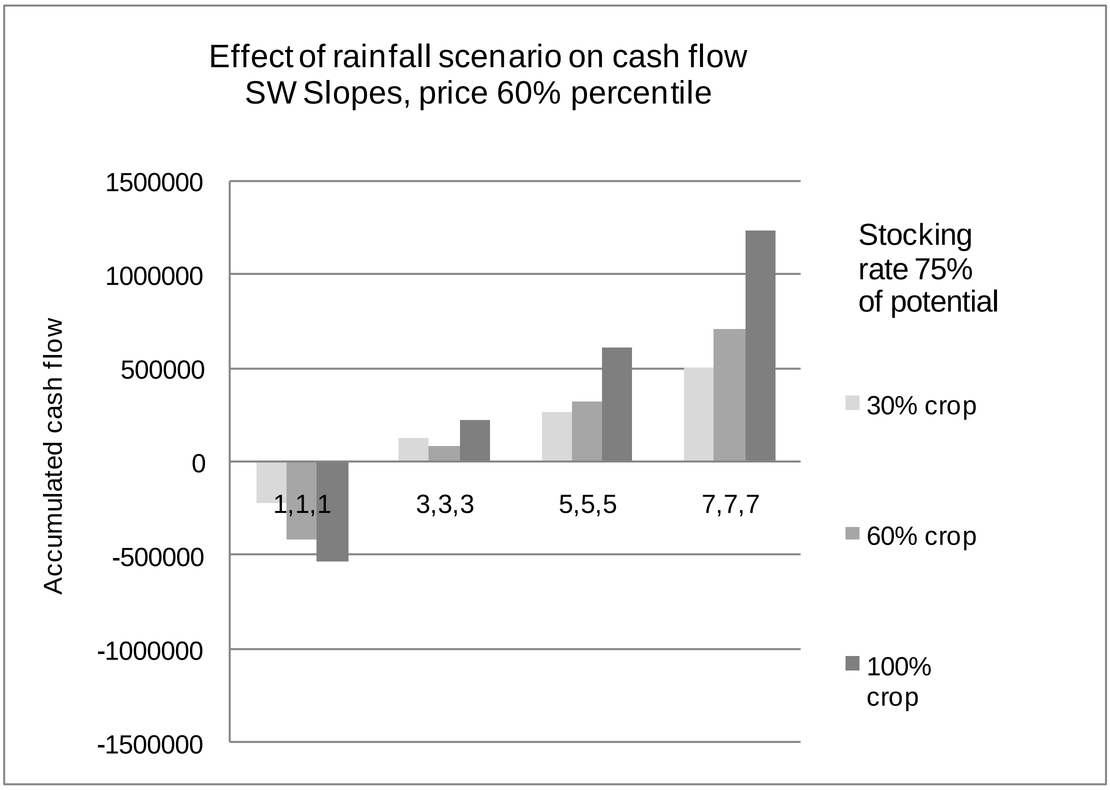


Figure 2. SW Slopes seasonal cash flow scenarios, 60th percentile prices



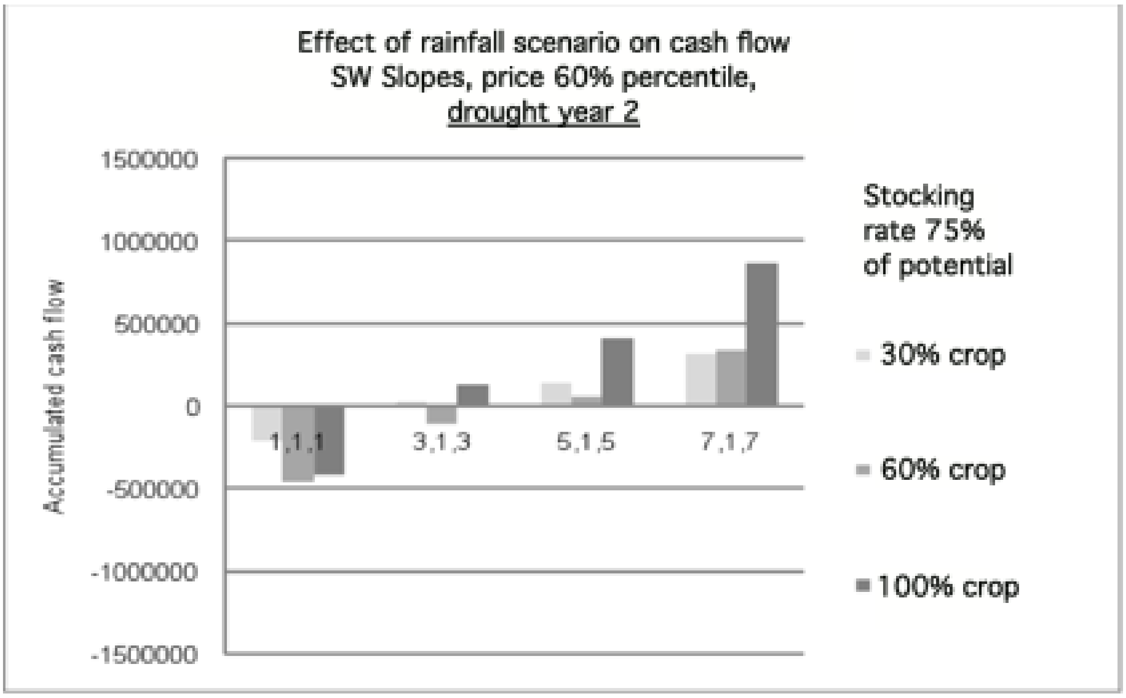
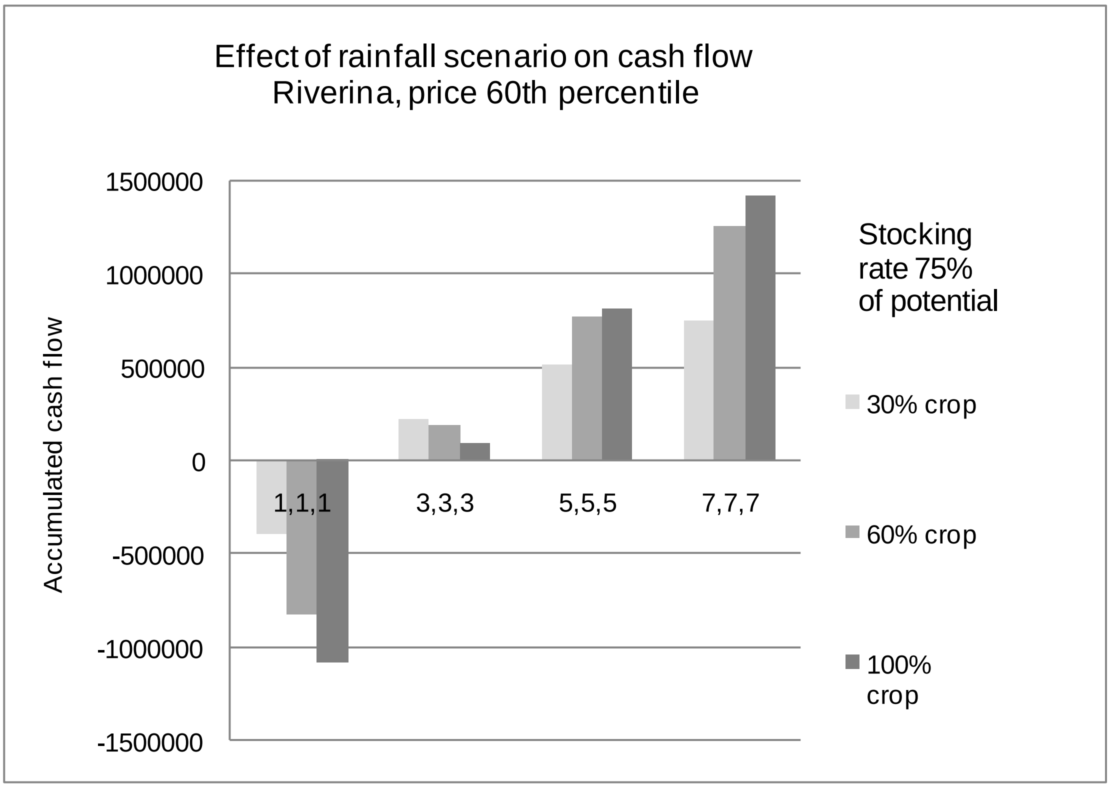


Figure 3. Riverina seasonal cash flow scenarios



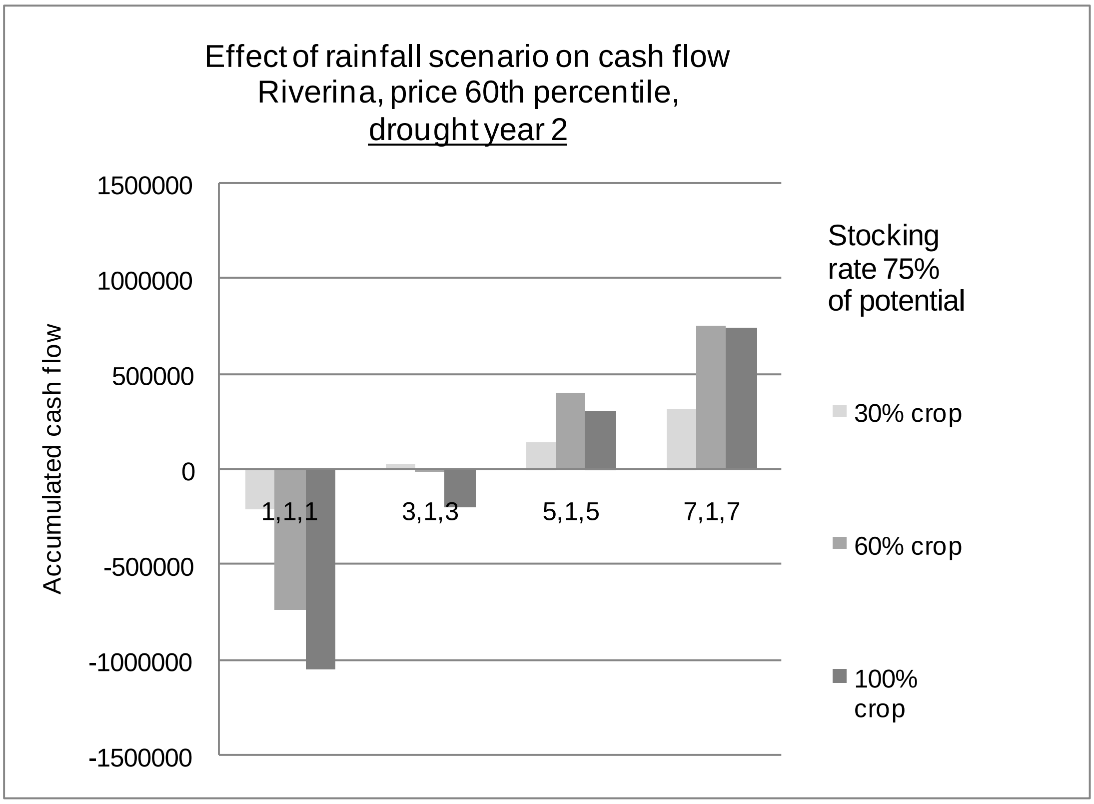
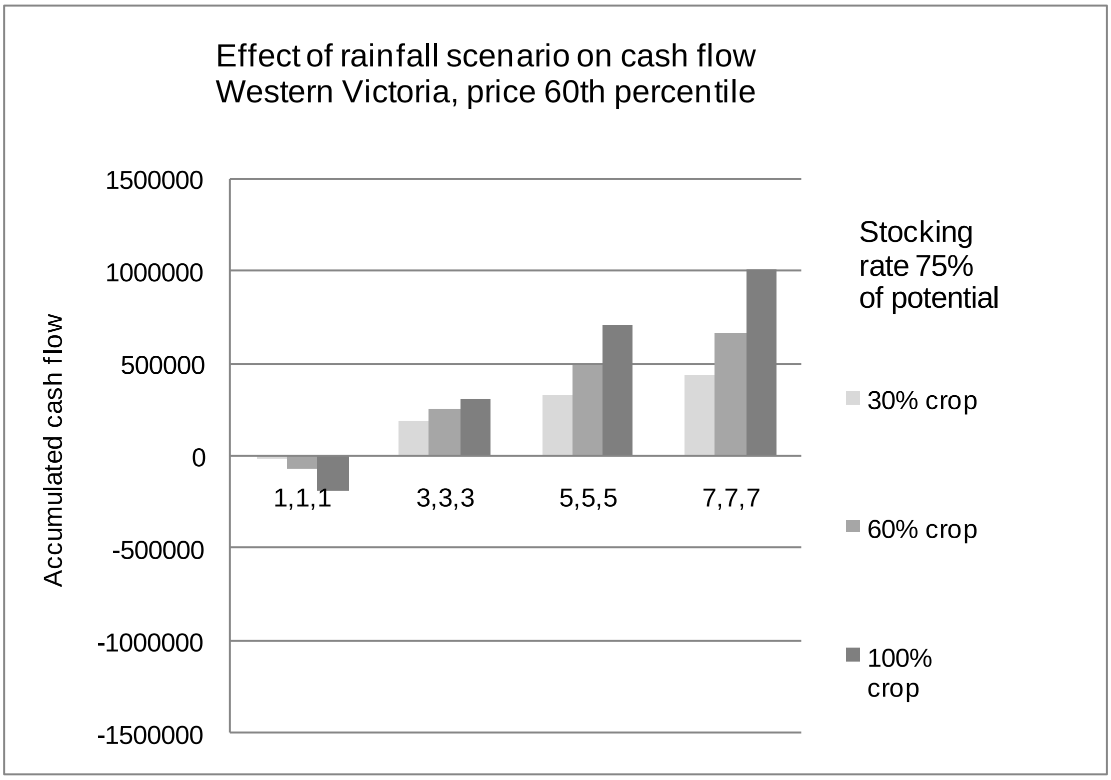


Figure 4. Western Victorian seasonal scenarios, 60th percentile prices



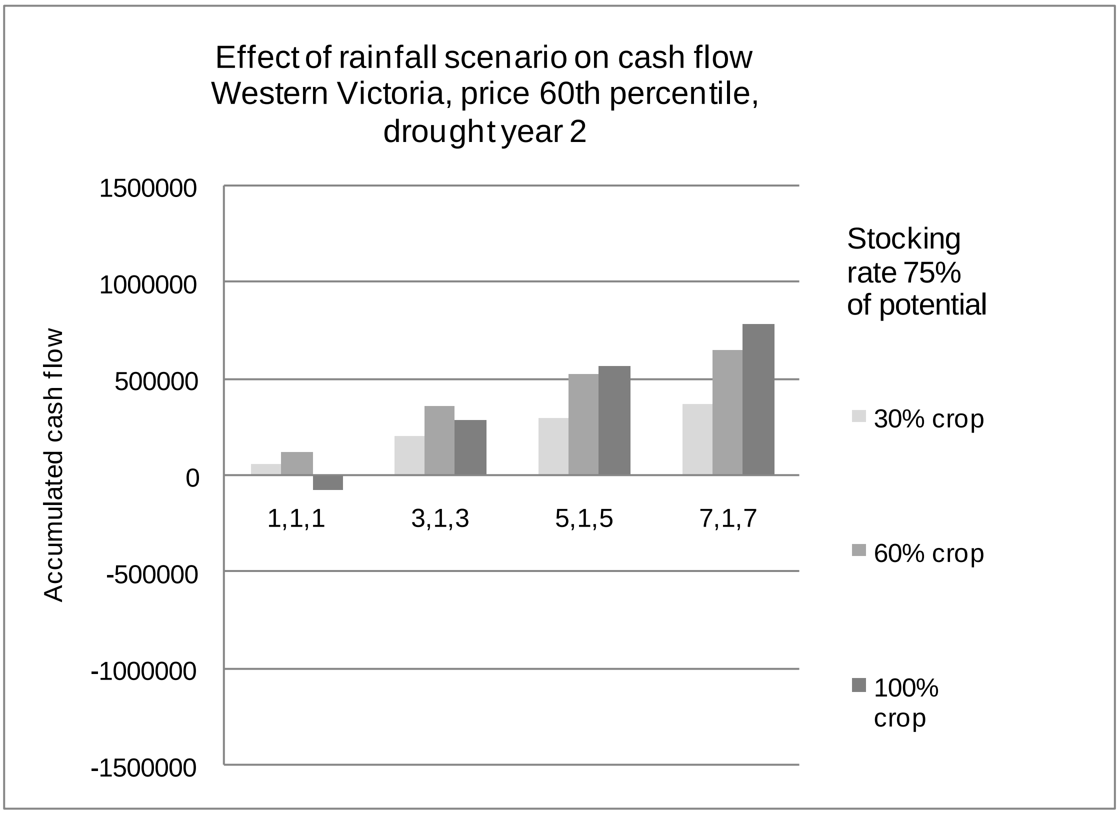
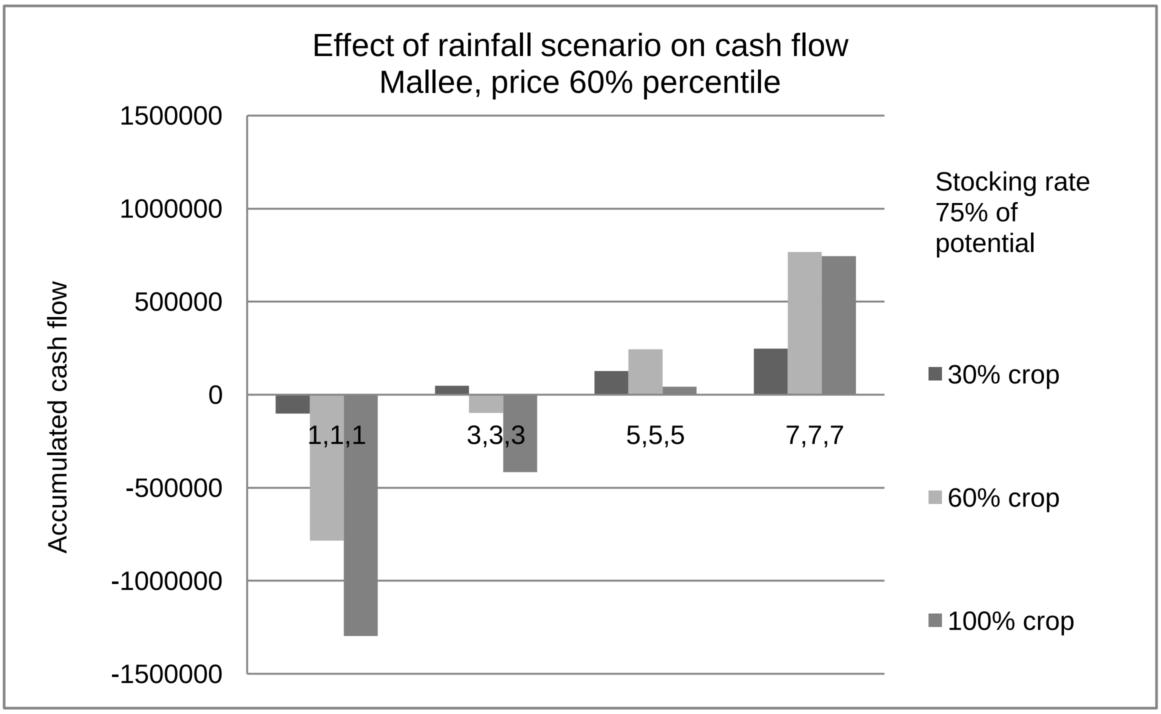


Figure 5. Mallee seasonal cash flow scenarios, 60th percentile prices



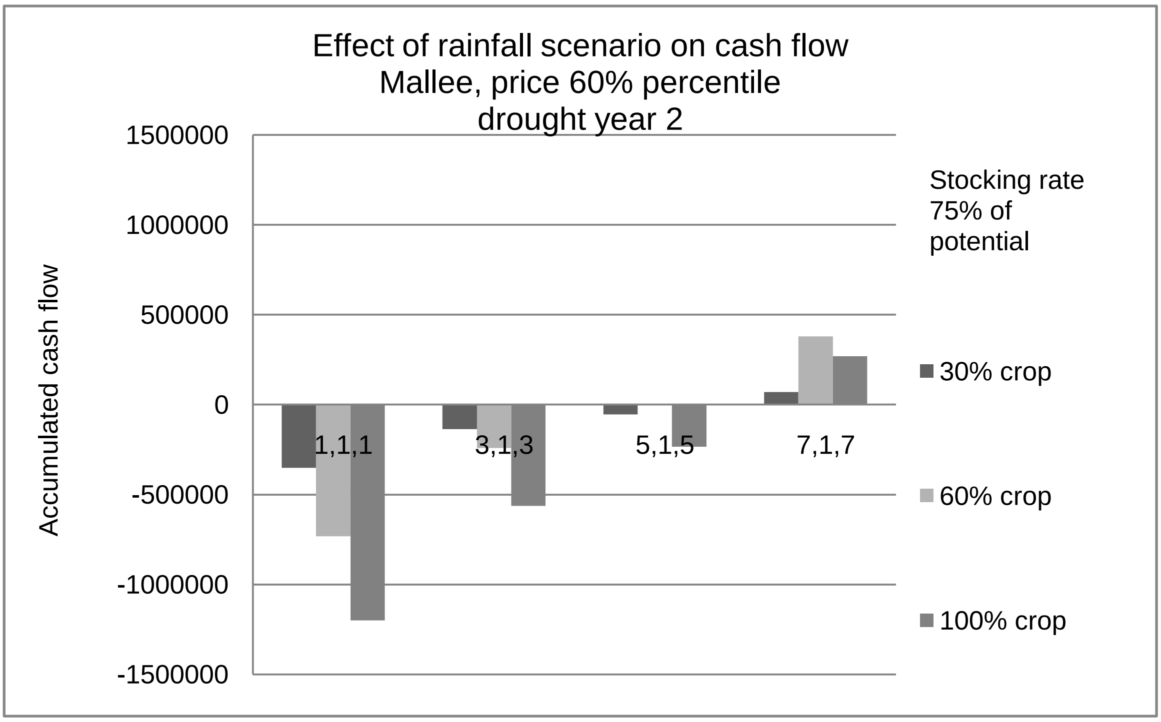
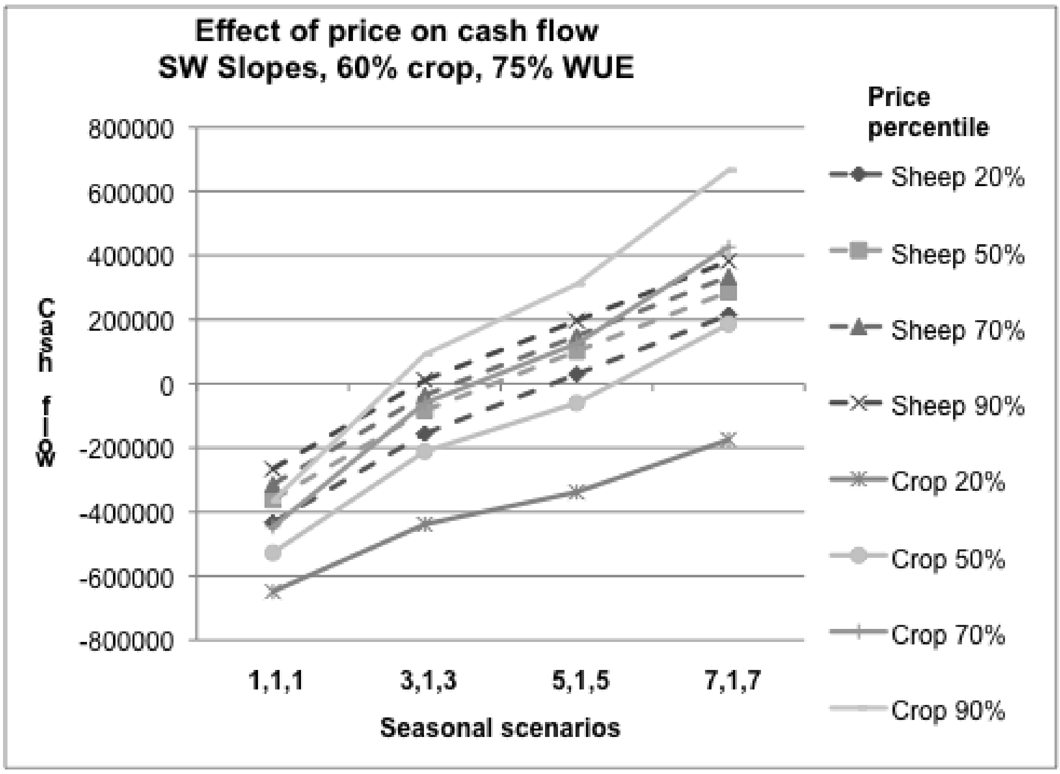


Figure 6. The effect of price and season on enterprise cash flows



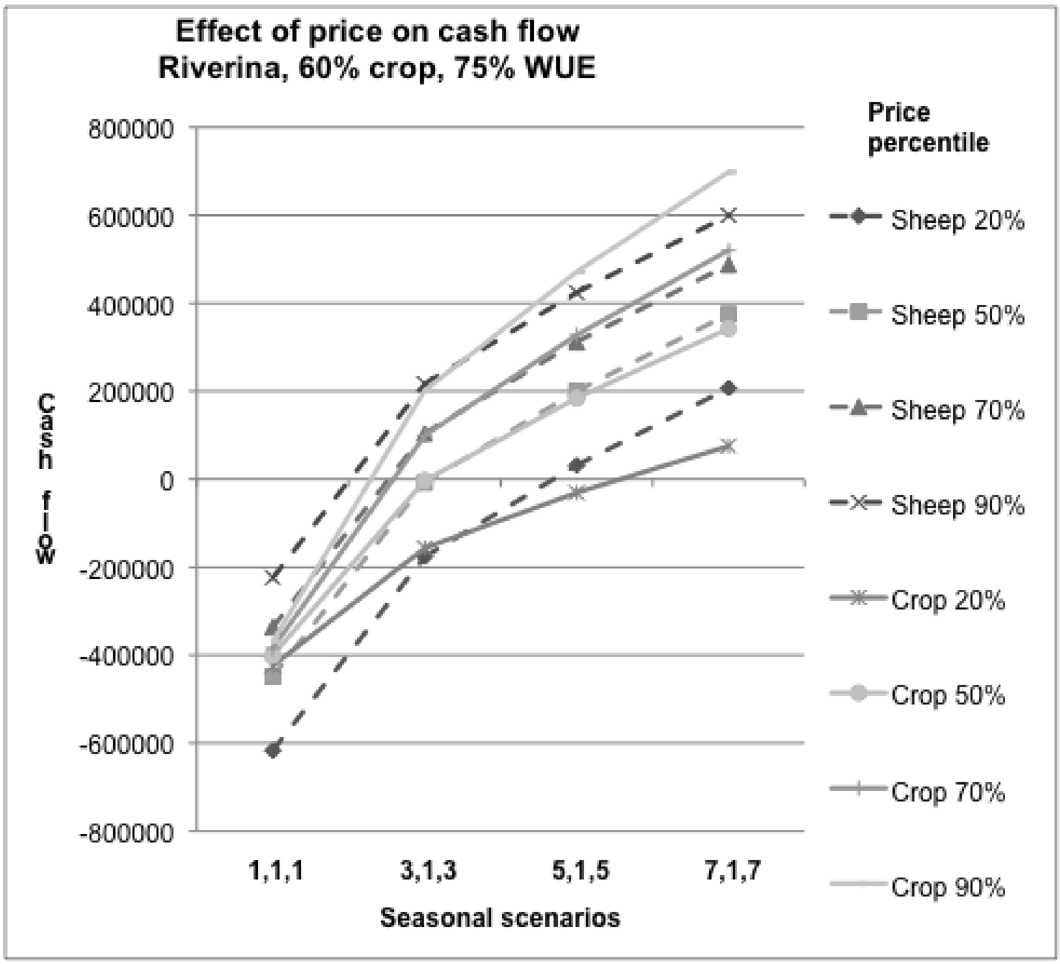


Figure 7. The effect of enterprise mix and water use efficiency on enterprise cash margins