Seasonal labour is the most profitable use of labour in broadacre crop dominant farms

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Abstract

Labour scarcity and affordability have encouraged many farmers in Western Australia to focus more on cropping than sheep production. Many farmers are opting to run low input livestock systems. This paper examines labour demand for sheep and cropping during the production year, combined with various scenarios of labour availability and cost. The implications for farm profitability and enterprise selection are examined using the bio-economic farming systems model MIDAS (Model of an Integrated Dryland Agricultural System). Labour requirements for sheep are far greater than those for cropping. Additionally the labour requirements for sheep are high in all production periods whilst the seasonal nature of cropping means more time is required only at certain times of the year, particularly at seeding and harvest. This means that the most profitable labour option is employing casual labour during periods of peak demand for cropping. The lesser relative profitability of the sheep enterprise makes employing a permanent worker the least profitable labour option. By contrast, employing casual labour during busy periods for cropping is more profitable but it is also associated with only small areas of perennial pastures being sown which has environmental implications. The logistics of employing labour at only certain times of the year compared to employing a full time worker means that farmers need to pay more per week to employ these workers or do the extra work themselves.

Keywords: agriculture, labour, farm modelling, cropping, sheep

1. Introduction

Many broadacre farms in Western Australia (WA) experience problems in attracting and retaining farm labour. A survey of WA farmers (Rabobank 2007) reported that of the 69 percent of farmers who required additional labour over the previous 12 months, 14 percent said it was ‘impossible’ to find labour. A further 62 percent said they had experienced some difficultly attracting adequate labour. To overcome this labour shortage, 41% of the survey participants said they had increased their own working hours. The increase in farmer workload is causing many farmers to be time-pressed.

Trewin (2002), for example, reported that 60% of dryland farmers indicated that time pressures on their management limited their adoption of salinity management options. As farmers become timed-pressed the problem of volunteer burn-out in rural communities becomes more apparent and forming and maintaining community and environmental networks becomes problematic (Byron and Curtis 2002)

There are a few reasons for these labour difficulties and time pressures. Firstly, increasing farm sizes and use of labour-saving technologies have reduced employment in agriculture, causing a 9 percent decline in rural labour between 1996 and 2001 (Tonts 2005). It can be difficult to attract workers into an industry in which employment prospects are shrinking. Secondly, rural populations in many inland areas are stagnating or declining, further limiting employment prospects and lessening the social attractiveness of life in the bush. Thirdly, higher wages in metropolitan areas and the resources sector (Barr et al 2005), especially during the boom up until the end of 2008, have attracted skilled labour away from agriculture.

To combat their own time pressures and the expense of labour, farmers are putting less effort into their less important enterprises. In some medium and low rainfall zones farmers are focusing on cropping rather than animal production; as cropping is their most profitable enterprise. In WA over the period 1990 to 2005 sheep numbers fell by over 40 percent while the area sown to cereals increased by over 50 percent. The preference for cropping has been aided by its higher rate of productivity gain (Zhao et al 2008) caused by factors such as new herbicide technology (Gill and Holmes 1997), machinery innovation and improved varieties (Kokic et al 2006). In contrast, the profitability and innovation in wool production has been less. This lack of innovation in combination with the expense and difficulty of attracting sheep labour have led some farmers to run low stocking rate, easy care flocks.

Although farm labour can be a key component in broadacre agricultural production systems, most farm modelling involves a fairly simplistic treatment of labour. Often a range of assumptions are invoked about labour use and availability.

A number of studies have examined broadacre farm production in WA using MIDAS (Model of an Integrated Dryland Agricultural System), a whole-farm bioeconomic model (Kingwell and Pannell 1987, Ewing et al 1992, Kingwell 2002, Flugge and

Schilizzi 2005). This model invokes several assumptions about labour availability and use. Contract labour is used for mulesing and shearing. Casual labour over several weeks is employed for seeding and harvest and for supplementary feeding of sheep. In addition, family labour is used for all other farm tasks. This pool of labour is assumed sufficient and capable to run a diverse range of possible farming systems, from cropping-only through to pasture-dominant, cross-bred prime lamb sheep systems (O'Connell et al 2006, Kopke et al 2008, Gibson et al 2008).

However, a potential weakness of the MIDAS model is its failure to adequately capture the impacts of farmers being time-pressed and the difficulties of securing skilled farm labour, particularly for sheep enterprises that require a high level of sheep husbandry skill. For example, MIDAS studies of sheep systems that produce prime lambs and that draw upon lucerne and saltland pastures (Bathgate and Pannell, 2002; O'Connell et al., 2006) assume that labour supply for sheep management is non limiting. However, farm surveys (Rabobank 2007, Trewin 2002) indicate that farmers are time-pressed and experience difficulties in employing skilled farm workers. Hence, there is a need to represent the availability, expense and use of farm labour in the MIDAS model better, especially regarding sheep management.

This paper introduces a more accurate and detailed description of labour availability and use in the WA broadacre farm environment. A range of farm labour possibilities are investigated, including employing permanent labour units, employing casual labour during the year and the outsourcing of sheep management which involves employing a professional sheep manager.

This paper is structured as follows. Section 2 provides a description of the MIDAS farming system model and the revised treatment of farm labour. Section 3 presents modelling results for the six labour scenarios. Section 4 is a discussion of the results. Section 5 is the conclusion of the paper.

2. Methods

2.1. Farm modelling

This research used a version of MIDAS (Model of an Integrated Dryland Agricultural System), a whole-farm bioeconomic model (Kingwell and Pannell 1987) which includes further revisions (Kingwell 2002; O'Connell et al. 2006; Gibson et al. 2008;

Kopke et al. 2008). MIDAS is a linear programming model that calculates the mix of crop, pasture and sheep that optimises whole farm profit. The model uses an average weather year and calculates net return by subtracting all operating costs, overhead costs, depreciation and opportunity costs associated with farm assets (exclusive of land) from production receipts. The several hundred activities in MIDAS include alternative rotations on each of eight soil classes (S1-S8), crop sowing opportunities, feed supply and feed utilisation by different livestock classes, yield penalties for delays to sowing, cash flow recording, and machinery and overhead expenditures. Constraints include resource restrictions such as availability of land, and capital plus various logical constraints and transfer rows.

The MIDAS model used in this paper represents a typical 2000 hectare farm in the central wheatbelt of Western Australia (see Figure 1). The types and areas of the various land management units that comprise the farm are listed in Table 1.

The farming region (Figure 1) receives medium rainfall, an average of 350-400 mm annually, with the majority of it falling over Winter/Spring (May-October). The weather is characteristic of a Mediterranean climate with long, hot and dry summers and cool, wet winters. In the model the break of season in the region occurs on the 10th May. A typical farm in the central wheatbelt uses a mixture of cropping and livestock enterprises. In MIDAS the crops grown include wheat (Triticum aestivum), barley (Hordeum vulgare), oats (Avena sativa), triticale (Triticale hexaploide), lupins (Lupinus angustifolius), canola (Brassica napus), field peas (Pisum sativum), and faba beans (Vicia faba). These are grown in rotation with lucerne and the pasture specie French serradella cv. Cadiz. Sheep on the farm are produced for wool and meat and are mostly Merino breeds with options to mate ewes to crossbred rams for lamb production. For further detail of the MIDAS model refer to Kingwell and Pannell (1987), who describe the early version of the model. Later versions are described by Kingwell et al. (1995), Kingwell (2002), O'Connell et al. (2006), Kopke et al. (2008) and Gibson et al. (2008).

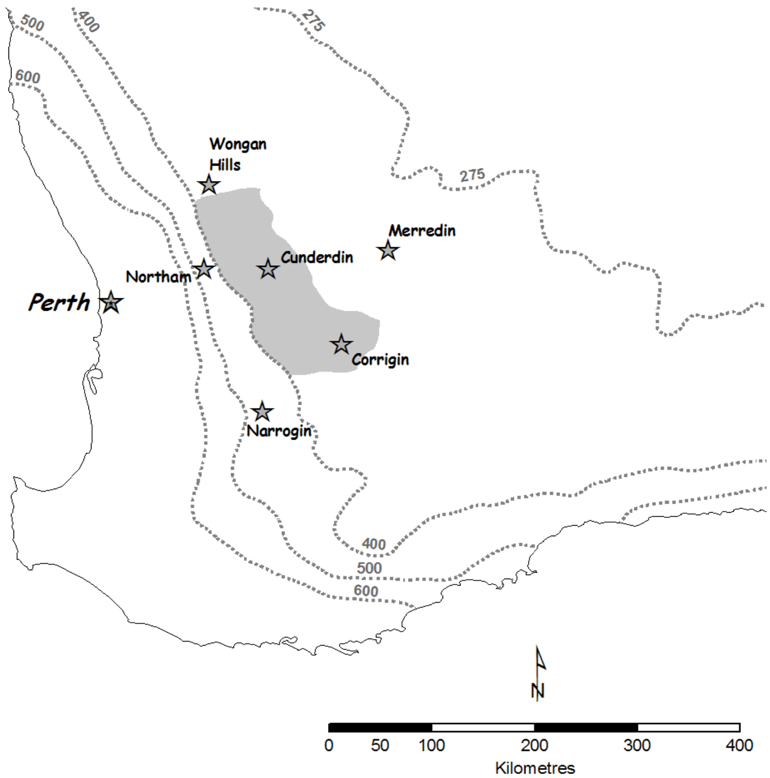

Figure 1 Map of the region represented by the Central Wheatbelt MIDAS model

Table 1 Land management units (LMU) in the MIDAS model

LMU	Name	Dominant soil type	Area (ha)
S1	Poor sands	Deep pale sand	140
S2	Average sandplain	Deep yellow sand	210
S3	Good sandplain	Yellow gradational loamy sand	350
S4	Shallow duplex soil	Sandy loam over clay	210
S5	Medium heavy	Rocky red/brown loamy sand/sandy loam; Brownish grey granitic loamy sand	200
S6	Heavy valley floors	Red/brown sandy loam over clay; Red and grey clay valley floor	200
S7	Sandy surfaced valley	Deep sandy surfaced valley; shallow sandy-surfaced valley floor	300
S8	Deep duplex soils	Loamy sand over clay	390

2.2. Including labour in MIDAS

The most recent version of MIDAS was changed to include labour requirements during the year. Three steps were used to include labour into MIDAS as recommended by Hazell and Norton (1986):

1. Allocate the time required to do each management activity on the farm in each month.

2. Specify the time available to do each management activity in each month by defining the total number of hours provided by the farm owner.

3. Provide for the opportunity to hire casual labour or hire a unit of permanent labour. This adds labour costs in the objective function of the model and increases the hours available for each management activity in each month.

Extra periods were included in addition to each month for seeding periods A, B, C and D. The crop yield for each rotation grown in these time periods decreases the later the crop is sown. There is also a limitation in the amount of days that lupins and canola can be harvested and also the time available to harvest the cereal crops. Table 2 lists the length of each period and the activities that require labour in each period.

Table 2 Amount of days available and the main activities in each time period.

Time period	Start date	Length (days)	Cropping	Sheep
January	1 Jan	31		Take rams out of ewes
February	1 Feb	28		
March	1 Mar	31	Prepare cropping machinery	Vaccinate ewes Crutching Ewes and hoggets drenched
April	1 Apr	30	Prepare cropping machinery Spray to remove lucerne	
May	1 May	7	Spray herbicides for seeding in period A	
Seeding period A	8 May	9	Seeding and spray herbicides for seeding period B and C	
Seeding period B	17 May	5.	Seeding and spray herbicide for seeding period D	
Seeding period C	22 May	5	Seeding	Lambing starts
Seeding period D	27 May	5	Seeding	Lambing
June	1 Jun	30	Spray herbicides for sowing lucerne Sow lucerne	
July	1 Jul	31	Spray herbicides	Mark merino lambs and crossbred lambs
August	1 Aug	31	Spray lucerne in establishment year	Wean crossbred lambs and merino lambs
September	1 Sep	30	Spray for pest and diseases and late herbicides	Shearing Weigh crossbred lambs
October	1 Oct	31	Swath canola Prepare crop machinery	Ewes and hoggets drenched
Harvest lupins and canola	1 Nov	10	Harvest canola and lupins	
Harvest cereals	11 Nov	40	Harvest all crops	
December	21 Dec	11		Class and selenium bullet ewe hoggets Put rams into ewes

2.3. Time required for sheep management

The time requirements for sheep include activities for each sheep (see Tables 3 and Table 4) and activities for each mob of sheep.

Table 3 Time required for each activity (sheep/hour)

Sheep class	Drench	Jet	Shear[1]	Crutch[2]	Vaccinate	Draft ewes	Class ewe hoggets	Selenium pellet
Hoggets	280	400	150	280	250		300	200
Ewes	280	400	140	250	250	500		
Wethers	280	400	120	220				
Merino lambs	300	300	170	320	300			
Crossbred lambs	300	300	180	320	300			

[1] Five shearers used during shearing. [2] Three crutchers used during crutching. [1,2] The farmer musters sheep whilst the sheep are being shorn and crutched

Table 4 Time required for additional activities for lambs (lambs/hour)

Sheep class	Mark	Wean	Weigh
Merino lambs	100	500	300
Crossbred lambs	150	500	

Lambs are weighed three times before they are sold. The first time they are weighed 60% are sold; the second time 30% are sold and after the final weigh all are sold. This is because not all lambs are simultaneously at the required sale weight.

In addition to the time requirements in Table 3, five hours are assumed needed to organise and supervise contractors for shearing, crutching and marking.

All other sheep tasks are done on a mob basis. The maximum number of sheep in each mob is in and the time required for mustering each mob of sheep for each of the jobs in Table 3 and Table 4 is in **Error! Not a valid bookmark self-reference.**.

Table 5 Maximum number of sheep in each mob and time required to muster each mob

Sheep class	Maximum number of sheep in each mob	Time required to muster each mob (hours/mob)
Ewes	700	1.75
Ewes and lambs		2.75
Wethers	700	1.75
Hoggets	700	1.75
Merino lambs	800	2.00
Crossbred lambs	800.	2.00

Each mob of ewes is monitored once a week and this takes half an hour per mob. When ewes are lambing they are monitored an extra time each week which takes 45 minutes per mob. If sheep are supplementary fed in a period then they are fed three times a week. The time required to supplementary feed depends on the amount of grain fed and the number of mobs. The time required driving to and from the silo to the paddock is 30 minutes. The time required to put each tonne of grain in the 100 bushel feed cart and feed the grain once it is in the paddock is listed in Table 6.

Table 6 Time required for filling and emptying the feed trailer

Filling and emptying feed trailer	Rate (bushel/hour)
Filling feed trailer	1000
Emptying feed trainer	2000

If ewes graze lucerne in a time period then the time required to move the sheep on and off the lucerne is 1 hour per mob. The time required to monitor the lucerne whilst sheep are grazing in each period is 15 minutes per 100 ha of lucerne.

The time required for sowing and spraying pastures and lucerne is included in the cropping section because these activities use the machinery used for cropping.

2.4. Time required for cropping

The time required for sowing and harvesting is in Table 7 and 8. Spraying of all herbicides can be done at a rate of 24.4 ha/hour. For every crop type sown, 3 hours are required to clean and modify machinery during seeding period A and harvest late. Additionally 16 hours are required in April to prepare seeding machinery and 16 hours in October to prepare swathing and cropping machinery.

Table 7 Time required to sow one ha of crop for each sowing method. This is the total time including working up and sowing the seed

Sowing method	Sowing rate (ha/hour)
Direct drill	5.9
Work and seed	3.9
Work and seed plus tickle	3.9
Tickle	2.9

Table 8 Time required to harvest crops (ha/hour)

Crop	Harvest rate
Cereals	7.0
Lupins	6.4
Canola	4.8
Field peas, faba beans and chick peas	4.6

2.5. Amount of time available in each period

The amount of time available to work in each period depends on the hours that each worker works each day (see Table 9). The cost of each labour source includes superannuation. Casual labour costs the most because it requires the most supervision. A professional sheep manage is the cheapest labour source because they because they are specialists in sheep management and would require the least supervision.

The farmer and the professional sheep manager have four weeks off each year for holidays during December, January and July. All labour sources take days off for

Christmas, New Year's day and Easter are not included in each off those periods. The farmer must also spend 24 hours in each quarter for office work and tax.

Table 9 Time available to work each day and cost per hour for each labour source.

	Hours available to work each				
Labour source	Weekdays	Weekends	Seeding[1]	Harvest[1]	Cost ($/hour)
Farmer	8	4	10	10	No cost
Permanent	8	0	10	10	27.50
Casual labour[2]	8	0	10	10	28.50
Professional sheep manager	8	0	8	8	25.00

[1] All labour sources work on weekends during seeding and harvest except for the professional sheep manager. [2] All labour sources work on weekends except for the professional sheep manager

2.6. Labour scenarios

To investigate the relationship between optimum land allocation and labour demand and supply a number of labour scenarios were examined. The labour scenarios were:

1. No limitations on farm labour – model run as it has been used before
2. Farmer labour only – no options to employ extra labour
3. Permanent labour – one set of permanent labour available and they must be employed for the whole year.
4. Casual labour available all year – one set of casual labour available to work in each month.
5. Casual labour seeding and harvest – one set of casual labour available during seeding and harvest only
6. Outsourcing sheep management –a professional sheep manager available to work in each month.

The profitability of each of these labour scenarios was at tested low, medium and high grain prices and low, medium and high sheep and wool prices (Table 10 and Table

11). The profitability of each scenario was also tested at different levels of crop. This crop area analysis used medium grain, sheep and wool prices.

Table 10 Price ($/t) for each grain type in each grain price scenario.

Price scenario	Wheat	Barley	Oat	Lupin	Canola	Field peas	Faba bean	Chick peas
Low	256	256	192	224	544	328	384	480
Medium	320	320	240	280	680	410	480	600
High	384	384	288	336	816	492	576	720

Table 11 Price for wool and sheep in each sheep price scenario

Price scenario	Wool ($/kg)	Shipper wether ($/hd)	Lamb ($/kg)	Cast for age ewe ($/hd)
Low	6.9	56	3.32	40
Medium	8.6	70	4.15	50
High	10.4	84	4.98	60

3. Results

3.1. Results

Restrictions on labour availability tend to decrease whole farm profit (see Table 12). At high grain prices the least profitable option was the farmer's labour only. However, at low grain prices the least profitable option was permanent labour. The most profitable option at all price scenarios was hiring casual labour anytime during the year. Outsourcing sheep management was more profitable than hiring casual labour during seeding and harvest only at high sheep and wool prices. Overall whole farm profit was more responsive to increases in grain prices compared to sheep prices.

Table 12 Farm profit ($ per ha) for each sheep and grain price scenario and for labour scenarios 1 (no limitation on farm labour), 2 (farmer labour only), 3 (Permanent labour all year), 4 (Casual labour available all year), 5 (Casual labour available seeding and harvest only) and 6 (Outsource sheep).

Grain price	Sheep price	Labour scenario					
		1	2	3	4	5	6
Low	Low	17,400	-8,800	**-55,000**	**11,900**	4,090	4,680
Low	Med	92,100	38,500	**19,200**	**82,400**	51,200	74,300
Low	High	189,000	**90,800**	110,000	**169,000**	101,000	164,000
Med	Low	121,000	71,300	**48,400**	**115,000**	113,000	100,000
Med	Med	188,000	123,000	**116,000**	**180,000**	155,000	168,000
Med	High	267,000	**175,000**	194,000	**255,000**	199,000	242,000
High	Low	280,000	**170,000**	206,000	**275,000**	275,000	204,000
High	Med	301,000	**218,000**	228,000	**295,000**	293,000	264,000
High	High	362,000	**269,000**	289,000	**352,000**	331,000	334,000

Hiring casual labour was the most profitable labour use at every level of cropping (see Figure 2). Outsourcing sheep management was the next profitable at low levels of cropping whilst employing casual labour for seeding and harvest was more profitable at higher crop levels. Employing permanent labour for the whole year was only more profitable outsourcing sheep labour at high levels of crop. The profitability of outsourcing sheep labour decreased rapidly after about 50% cropping because the capacity for the farmer alone to sow the crop is limited.

If outsourcing sheep labour is a forced selection then its associated optimal farm plans have the lowest area of crop at nearly all price scenarios. By contrast, employing casual labour during seeding and harvest had the highest area of crop (Table 13). The stocking rate increased at high sheep and wool prices in all labour scenarios except when employing casual labour during seeding and harvest (Table 14). Additionally the area planted to lucerne depended on having extra labour available during year. Employing labour during seeding and harvest was associated with selection of the lowest area of lucerne. This reflects the higher labour requirement required for using lucerne.

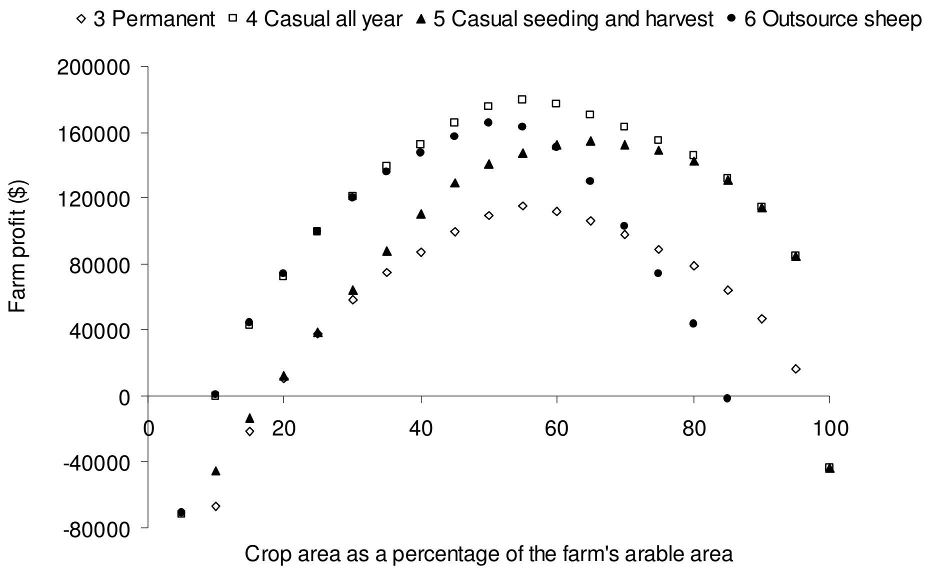

Figure 2 Farm profit at standard sheep, wool and grain prices at different crop area for labour scenarios 3 (Permanent labour all year), 4 (Casual labour available all year), 5 (Casual labour available seeding and harvest only) and 6 (Outsource sheep).

Table 13 Area of crop (ha) for each sheep and grain price scenario and for labour scenarios 3 (Permanent labour all year), 4 (Casual labour available all year), 5 (Casual labour available seeding and harvest only) and 6 (Outsource sheep).

Grain price	Sheep price	3 Permanent	4 Casual all year	5 Casual seeding and harvest	6 Outsource sheep`
Low	Low	**1030**	1040	**1080**	1040
Low	Med	**960**	**1070**	1020	1010
Low	High	950	950	**970**	**880**
Med	Low	1310	1330	**1430**	**1040**
Med	Med	1100	1120	**1260**	**1040**
Med	High	1130	1110	**1260**	**1030**
High	Low	1740	1740	**1740**	**1070**
High	Med	1500	1420	**1430**	**1040**
High	High	1210	1150	**1390**	**1040**

Table 14 Stocking rate (dse per winter grazed ha) for each sheep and grain price scenario and for labour 3 (Permanent labour all year), 4 (Casual labour available all year), 5 (Casual labour available seeding and harvest only) and 6 (Outsource sheep).

Grain price	Sheep price	Permanent	Casual all year	Casual seeding and harvest	Outsource sheep
Low	Low	**7.2**	6.9	**6.4**	6.7
Low	Med	**8.4**	8.2	**6.0**	7.8
Low	High	**9.4**	9.5	**5.5**	8.9
Med	Low	**7.8**	7.5	**6.6**	6.4
Med	Med	**8.7**	8.7	**6.2**	7.3
Med	High	**10.2**	8.7	**6.3**	8.5
High	Low	4.1	2.8	**2.8**	**6.2**
High	Med	**8.7**	7.0	**6.6**	6.9
High	High	**10.0**	8.7	**6.6**	7.7

Table 15 Area of lucerne (ha) for each sheep and grain price scenario and for labour scenarios 3 (Permanent labour all year), 4 (Casual labour available all year), 5 (Casual labour available seeding and harvest only) and 6 (Outsource sheep).

Grain price	Sheep price	3 Permanent	4 Casual all year	5 Casual seeding and harvest	6 Outsource sheep
Low	Low	**234**	134	**8**	148
Low	Med	**358**	234	**0**	288
Low	High	**362**	345	**0**	345
Med	Low	**199**	184	**79**	179
Med	Med	**270**	234	**54**	234
Med	High	**317**	245	**51**	314
High	Low	**35**	7	**7**	166
High	Med	**155**	146	**76**	234
High	High	**282**	234	**55**	245

The labour use for sheep at medium sheep, wool and grain prices was highest for the permanent labour source and lowest for employing casual labour during seeding and harvest (Table 16). The total time required for cropping was highest for employing casual labour during seeding and harvest (Table 17). The labour requirements were much greater for sheep than for cropping in all scenarios.

The labour use for crop was almost the same for all labour scenarios. The labour use for crop reflects the seasonal nature of cropping with many time periods requiring little or no labour.

Table 16 Labour required to manage sheep (hours) in each time period with medium sheep and medium grain prices for each sheep and grain price scenario and for labour scenarios 3 (Permanent labour all year), 4 (Casual labour available all year), 5 (Casual labour available seeding and harvest only) and 6 (Outsource sheep).

Time period	3 Permanent	4 Casual all year	5 Casual seeding and harvest	6 Outsource sheep
January	86	76	181	75
February	16	14	145	14
March	328	109	152	108
April	324	144	153	141
May	13	11	6	11
Seeding period A	22	50	10	29
Seeding period B	16	12	7	40
Seeding period C	61	18	16	8
Seeding period D	17	15	8	9
June	130	116	55	98
July	87	79	30	78
August	108	96	42	94
September	242	206	106	196
October	372	188	17	54
Harvest early	4	14	2	60
Harvest cereals	350	302	149	290
December	59	52	72	52
Total	**2235**	**1502**	**1151**	**1357**

The amount of hours used in each period for each scenario was highest for permanent labour (see Table 18). This is because MIDAS was constrained to employ a permanent worker on a full time basis. For the other labour scenarios MIDAS could choose the optimal use of each labour source in each period. Extra labour was used for seeding in all of the scenarios and during June and September for casual labour all year and outsourcing sheep. June and September are the time periods that crops are sprayed and sheep are shorn.

Table 17 Labour required for cropping (hours) in each time period with medium sheep and medium grain prices for each sheep and grain price scenario and for labour scenarios 3 (Permanent labour all year), 4 (Casual labour available all year), 5 (Casual labour available seeding and harvest only) and 6 (Outsource sheep).

Time period	3 Permanent	4 Casual all year	5 Casual seeding and harvest	6 Outsource sheep
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	60	70	63	56
May	0	0	0	0
Seeding period A	142	140	142	90
Seeding period B	84	77	82	50
Seeding period C	29	32	55	50
Seeding period D	0	0	0	50
June	100	96	88	103
July	21	21	27	20
August	4	3	1	3
September	64	65	70	62
October	16	16	35	16
Harvest early	0	0	48	0
Harvest cereals	207	211	275	196
December	0	0	0	0
Total	**727**	**731**	**886**	**696**

Table 18 Labour used (hours) in addition to farmer's labour in each time period for medium sheep and grain prices for labour scenarios 3 (Permanent labour all year), 4 (Casual labour available all year), 5 (Casual labour available seeding and harvest only) and 6 (Outsource sheep).

Time period	3 Permanent	4 Casual all year	5 Casual seeding and harvest	6 Outsource sheep
January	184	0	0	0
February	160	0	0	0
March	176	0	0	0
April	168	0	0	0
May	40	0	0	0
Seeding period A	90	90	61	29
Seeding period B	50	49	39	40
Seeding period C	50	0	21	8
Seeding period D	50	0	0	9
June	168	32	0	21
July	176	0	0	0
August	184	0	0	0
September	160	95	0	82
October	184	0	0	0
Harvest early	100	0	0	0
Harvest cereals	200	0	0	0
December	200	0	0	0
Labour cost ($)	**70,850**	**7,730**	**3,390**	**4,710**

4. Discussion

The most profitable use of labour was casual labour during busy periods. This enables the farmer to sow crops without penalties for late sowing whilst also maintaining high stocking rates and levels of lucerne. The most viable use of extra labour is during the periods with high labour demand for cropping. Because there is no direct cost of labour for the farmer, MIDAS uses all of the farmers extra time for sheep during the year. . Note, in MIDAS the opportunity cost of farmer's labour is treated as an imputed annual salary. No account is made of the extra hours that might be demanded at various times of the year by certain enterprises or activities Professional sheep managers are only used at critical times for crop dominant enterprises, suggesting that extra profits from sheep from more intensive management and the use of lucerne are not high enough to justify employing extra labour.

These results support the crop dominant nature of broadacre farm businesses in WA. Farmers in these areas are often prepared to outsource cropping tasks Production stages in farming, particularly in cropping, tend to be short, infrequent, and require few distinct tasks, thus facilitating use of casual labour; especially as machinery technology facilitates use of unskilled and semi-skilled labour. (Allen and Lueck 1998). Hence, employing casual labour for cropping activities is the most profitable labour use, although the logistics of employing labour for short periods of the year can be difficult. Moreover, because most farmers require labour for seeding and harvest at the same time of the year, this can make finding adequate casual labour problematic.

This study found that outsourcing sheep management was not profitable compared to many other labour use scenarios, particularly if the farming system was crop dominant. The decision for a firm (in this case a farm) to outsource to another firm (the professional sheep manager) includes consideration of;

1. the cost of producing a product (make or buy decision),
2. the size of the firm and the capacity of the firm to produce the product itself,
3. the complexity of the product,
4. education or knowledge required to make the product,
5. diversity of products within the firm (firms with higher diversity would consider outsourcing so they can become more specialised),
6. control and ownership (separating control can be risky) and
7. the transaction costs (cost of setting up and maintaining contracts) of outsourcing (Ono and Stango, 2005).

In the case of labour, the capacity of the farmer to produce grain and meat is limited by their own working ours. If casual labour is not a practical option then employing permanent labour is currently the next best option. However, the total outsourcing of sheep management would mean that the farmer would then be free to focus on cropping, their main enterprise. Outsourcing of sheep could be done by paying a professional sheep manager, such as used in this study or by leasing sheep or non arable areas of the farm. The latter option would be a low risk option which provides income from sheep in all seasons. However, this type of outsourcing is difficult to model with MIDAS because the profitability of two businesses would need to be optimised. Additionally MIDAS only optimises for an average season and does not investigate profit across a range of types of season.

4 Conclusion

The management of sheep requires more work than cropping and sheep production is generally less profitable than cropping. Therefore the most profitable use of labour is during periods when the farmer does not have enough time properly grow and manage crops. The priority for farmers in the wheatbelt is therefore securing reliable casual labour for cropping during the year.

The implications of this type of labour use are a low input sheep system with little use of perennial pastures, highlighting the low adoption rate of perennial pastures on many WA farms. The greater labour requirements for sheep management suggests that WA farms would benefit from improved efficiency of livestock management, otherwise many broadacre farmers will persist with low input, low stocking rate sheep systems. Examples of improvements in sheep that would ease or reduce their labour requirements include improved genetics to produce ‘easy care’ sheep which require less crutching, jetting and monitoring. Another option that may be viable in the future is ‘Pastures from Space’, a service that uses satellite technology to estimate pasture growth and which could be used to make timely decisions about sheep movements. Cattle could also replace sheep since they have a lower labour requirement than sheep. If the profitability and labour efficiency of sheep production could be improved then many innovations, such as perennial pastures, would become more attractive to farmers and problems with the cost and availability of labour would be less constraining on farm performance.

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