

Feasibility of innovative sharemilking arrangements

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1 **Feasibility of innovative sharemilking arrangements**

2 **Short title: Innovative sharemilking arrangements**

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11 **Summary text for the Table of Contents**

12 Sharemilking is an entry point for new dairy producers in the New Zealand industry, but growing milk price
13 volatility increases the business risks for sharemilkers. We tested the hypothesis that flexible sharemilking
14 arrangements will reduce the income variability of sharemilkers. The results illustrated the feasibility of a
15 flexible model which shifts some of the risk from the sharemilker to the farm owner, while still allowing both
16 to generate a positive ROA and a positive net profit with high probability.

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17 **Abstract.**

18 Sharemilking is an entry point for new dairy producers in the New Zealand industry, and traditionally most
19 sharemilking arrangements have been a 50/50 arrangement. These structures are relatively rigid in the share
20 of milk income and apportionment of operating costs between the land owner and sharemilker. With milk
21 price volatility rising these types of arrangements increase the financial and business risks, particularly for
22 sharemilkers. These risks are further compounded because the value of the primary asset owned by
23 sharemilkers, cows, declines to a much greater extent than land with a fall in milk price, reducing total wealth.
24 We tested the hypothesis that flexible sharemilking arrangements will reduce the variability of income of
25 sharemilkers, making for a sustainable income pattern.

26 A synthesised dairy farm system is used to compare an innovative arrangement where milk revenue is divided
27 based on milk payout price, rather than simply on contribution. Stochasticity is incorporated into the model to
28 capture milk price volatility through the use of a stochastic price simulator. This approach allows decision rules
29 to be built into the model based on revenue sharing to reduce income variability.

30 The identified innovative structures could be used by new entrants, sharemilkers, and land owners to
31 encourage alternative forms of sharemilking revenue sharing, and provide information and education to the
32 dairy industry. These alternative structures could be beneficial to industry sustainability, given that the dairy
33 industry contributes a significant amount to New Zealand's economy and export earnings, and price volatility
34 is expected to continue to increase.

35 **Additional keywords:** Sharemilking, income volatility, dairy, sustainable, risk, net profit, resilience

36 **Introduction**

37 Sharemilking is a widespread structure in New Zealand, where sharemilkers can use the milking plant and land,
38 but provide labour and other specified inputs in return for a specified share of the milk price. The milk price
39 share and inputs depend on the type of sharemilking agreement: 50/50 if they are herd-owning sharemilkers
40 (HOSM), less if they are lower-order or variable order sharemilkers (VOSM). Variable-order sharemilkers are
41 covered by the Sharemilking Agreements Order 2011, based on the Sharemilking Agreements Act of 1937
42 (Parliamentary Counsel Office, 2011), however HOSM are not covered by any specific legislation, but are
43 considered as contractors and as such are covered by contract law. Sharemilking in New Zealand has been

44 viewed as the typical pathway to farm ownership in the past (Gardner and Shadbolt 2005). In the 2016-17
45 production year, there were 8,508 owner operator herds and 3,203 herd owning sharemilker herds in New
46 Zealand (DairyNZ 2018).

47 Previous research has identified that profitability for sharemilkers is highly variable due to milk price
48 fluctuations (Gardner, 2005; Pepper, 2013), this variability can also be observed in Figure 1. With increased
49 volatility in world commodity prices and the New Zealand dairy industry exporting over 90% of its product to
50 world markets (Hemme (ed.), 2016), this structure has increasingly come under pressure and achieving farm
51 ownership more unlikely. New developments, such as *Mycoplasma bovis*, have further intensified the pressure
52 on sharemilkers (Vance, 2018). In periods of low milk prices, sharemilkers, HOSM and VOSM, come under
53 stress to break even financially. Furthermore, the situation for the HOSM is further aggravated as their wealth
54 decreases due to lower livestock values. This is reflected in the number of herds milked by each group: while
55 the average number of dairy herds in the period 2009/10 to 2016/17 was 11,800, the number of herds milked
56 by owner operators increased 13% (7,534 to 8,508) and the number of herds milked by sharemilkers fell by
57 22% (4,125 to 3,203) in the same time period (DairyNZ, various).

58

59 Figure 1 Operating profit for herd-owning sharemilkers (SM) and owner operators (OOP) for production years
60 2007-08 to 2016-17 (data DairyNZ, various)

61 Albeit, or despite, being an omnipresent system in New Zealand, research and publications on sharemilking
62 are scarce. Currently the industry, namely DairyNZ and Federated Farmers, are looking into alternative
63 options, one of them being a 'flexi-rate', where a low milk price triggers a contract/salary option. After
64 realizing that there is a lack of understanding of alternative options, and a fair degree of caution amongst all
65 parties about undertaking these options, DairyNZ and MyFarm began examining the concept of Flexi-Rate
66 sharemilking (DairyNZ, nd). We identified two potential alternatives: First, income insurance similar to the
67 Crop and Revenue insurance (OECD, 2000), or the Livestock Gross Margin Insurance for Dairy Cattle (LGM-
68 Dairy), which "is a risk management tool for protecting milk income over feed cost margins" (Bozic et al.,
69 2014). The main characteristic of income insurance, as with all insurance markets, is a pooling of risk (OECD,
70 2000). Both income insurance types are commonly used in the USA. Second, and potentially more suitable to
71 the sharemilking system prevalent in Australia and New Zealand, is a more flexible arrangement in the split of

4

72 income between sharemilker and farm owner, on a mutually agreeable basis rather than rigidly set as is now
73 common. In contrast to the insurance system, the latter alternative does not change the mean income of any
74 given farm, but instead is flexible in its allocation to the parties involved. The objective of this study was to
75 study the economic feasibility of the second option and to provide quantitative results on its impact on
76 sharemilkers and landowners.

77 **Methods**

78 A cash budget was designed to measure the income and expenses of a HOSM and landowner. The present
79 research uses the software @Risk, which uses Monte Carlo simulation to construct probability distributions of
80 variables of interest (Palisade, 2018). This stochasticity is designed to capture milk price volatility through the
81 use of a stochastic price simulation. A synthesised dairy farm system (base system), was developed. The base
82 system is a 550 cow pasture-based system, reflective of System 2 or System 3 (DairyNZ, 2017). Knowledge of
83 cost and revenue sharing was used to develop financial information for owner operators and sharemilkers
84 under "standard" (50/50) sharemilking agreements. This base system was used to compare to an innovative
85 arrangement where milk revenue is divided based on milk payout price, rather than simply on contribution.
86 The model required inputs and outputs, and the number of iterations set. Stochastic input variables were: milk
87 price, cow price, supplementary feed expenses per cow, and urea expenditure for the enterprise. Historic milk
88 price data (DairyNZ various) was used, and cow price data was from the Inland Revenue Department (IRD,
89 2018). Prices were adjusted to correct for inflation using the agriculture producer price index (PPI) (StatsNZ,
90 2018).

91 For input variables, the distribution used was determined using statistical fit analysis, such as the Akaike
92 Information Criteria (AIC) – normal, lognormal, or triangular – as well as the arithmetic mean and standard
93 deviation, which were drawn from the data (Table 1). A lognormal distribution was identified for the milk price and simulation of the distribution yielded a
94 \$NZ 4.95 to \$NZ 8.93 as the 90th percentile range. The distribution was skewed to the left with a median of
95 \$NZ 5.92 compared to the mean of \$NZ 6.23 and a standard deviation of \$NZ 1.43. Cow price (mixed age) was
96 normally distributed, with a 90% probability range between \$NZ 1,304 and \$NZ 2,282 per cow, mean of \$NZ
97 1,725, and standard deviation of \$NZ 300. Supplementary feed expenses per cow were normally distributed,

99 with a 90 percentile range of \$NZ 159 and \$NZ 259, a mean of \$NZ 209, and a standard deviation of
100 approximately \$NZ 30. Urea expenses for the enterprise were defined by a triangular distribution, with
101 minimum \$NZ 46,000, maximum \$NZ 84,858, and most likely value of \$NZ 53,095. The variation in feed and
102 urea expenses were due to price variation, input levels remained constant. Milk production remained
103 constant.

104

105 Table 1: Specifications of input variables

106 Return on assets (ROA) was identified as a key output, as it reflects the effect of milk price volatility and
107 changing asset value (cows). Other key outputs were cash surplus (or deficit) and net profit (or loss). The
108 @Risk simulation was set to 10,000 iterations.

109 *Flexible model*

110 The base model was then modified to allow for a more flexible allocation of milk revenue between farm owner
111 and HOSM. A constraint was entered into the model to change the 50/50 base-allocation to the following: If
112 milk prices dropped below \$NZ 4.59 per kg milk solid, the HOSM was allocated a larger share (60%) of milk
113 revenues, while the remaining 40% was allocated to the farm owner. If the milk price was above \$NZ 8.93 per
114 kg milk solid, the adjusted shares were reversed, the farm owner receiving 60% and the HOSM 40%. The milk
115 price bounds were set according to ranges shown in

116 Table 1, representing the 90 percentile range. Cost split remained constant in both scenarios.

117 **Results**

118 *Base model*

119

120 Table 2 shows the detailed results for the three output variables according to the standard revenue split
121 between farm owner and HOSM in the base system. It shows that while cash surplus tends to be higher for the
122 HOSM, average net profits are higher for the farm owner, it is skewed with a relatively high probability of
123 being negative for the HOSM (7.2%) and a median of \$NZ 107,682, due to the impact of the log-normally

124 distributed milk price on profit. This is in contrast to a median of \$NZ 186,022 for the farm owner (or 73%
125 higher).

126

127 Table 2: Detailed results for the three output variables, for farm owner and HOSM – Base model

128 The base system, under a standard sharemilking agreement, showed that the HOSM is facing a higher
129 probability of low returns compared to the farm owner (

130 Table 2). The results showed no cash deficits for HOSM, a mean of \$NZ 227,283, and standard deviation of
131 \$NZ 136,928, while farm owners were faced with a 1.5% chance of a cash deficit with a mean of \$NZ 186,390
132 and standard deviation of \$NZ 140,424.

133

134 Table 3: Probability of results being zero or negative – Base model

135 The range of ROA was generally wider for HOSM, with a mean of 8.6% and standard deviation of 5.5%, as
136 HOSM have a lower asset base compared to the farm owner. Farm owners, in comparison, have an average
137 ROA of 4.2% with a standard deviation of 1.9%.

138 Negative net profit occurred in 7.2% of the iterations for the HOSM, in comparison to 0.1% for the farm
139 owner. As can be seen in Figure 2, the HOSM not only faces a higher probability of negative results, but also
140 has a higher probability of low positive net profit compared to the farm owner. For the HOSM, the results
141 showed a mean of \$NZ 137,631 (standard deviation \$NZ 130,040), while results for farm owners were 58%
142 higher with a mean of \$NZ 216,975 (standard deviation \$NZ 140,424).

143

144 Figure 2: Net profit distribution for HOSM and farm owner – Base model

145 *Flexible model*

146 The detailed results in

147 Table 4 show the effect of the flexible sharemilking arrangement in contrast to the 50/50 base model as

148 shown in

149 Table 2. For the HOSM, the probability of low financial results is reduced, while the probability of very high
150 financial returns is also curtailed, indicating a narrower range. In contrast, farm owners have a higher
151 probability of lower results under the flexible arrangement, while also increasing the probability of high
152 results, indicating an increase in the range of returns to farm owners.

153

154 Table 4: Detailed results for the three output variables, for farm owner and HOSM – Flexible model

155 This reallocation of returns and profits was achieved with little impact on the mean (\$NZ -5,850 and +5,838)
156 and median (\$NZ +490 and +4,137). Standard deviation was consistently reduced for the HOSM, while it
157 increased for the farm owner. This is important as the goal of this study was to show that a reallocation of milk
158 income between farm owner and HOSM is possible and feasible, without significantly altering the average
159 total farm milk income per se.

160 **The results showed an increase in the likelihood of a cash deficit for the farm owner (up 3.5 percentage**
161 **points) as well as for a net loss (up 4.3 percentage points). This was contrasted by lower probabilities for**
162 **negative results for the HOSM: down 0.2 percentage points to 0.01% for negative ROA and 4.3 percentage**
163 **points down to 2.9% probability of net loss (**

164 Table 5).

165

166 Table 5: Probability of results being zero or negative – Flexible model

167 Discussion

168 This research identified the impact of a modification to the common New Zealand 50/50 sharemilking model
169 and showed how it reduced the downside risk for HOSM. The current sharemilking model has been in decline
170 in recent years (DairyNZ, various), and while specific reasons for this trend may not be well understood, the
171 high downside risk for HOSM has been discussed (Gardner, 2011; Pepper, 2013). The important factor in the
172 current model was the ability to assess and quantify the risks associated with the current 50/50 and modified
173 flexible sharemilking options (

174 Table 3,

175 Table 5). The results shown are for the most likely outcomes within the imposed changes over 10,000
176 iterations. Net profit is often defined as 'the bottom line', and with over 7.2 % probability of it being negative
177 in the base system, HOSM face considerable risk, especially as they do not have a substantial asset base to
178 allow for sufficient borrowing. An aggravating factor is that frequently in downturn milk price cycles, cow
179 prices also decrease, thus further lowering the asset base of the HOSM. The study has illustrated the
180 possibility and feasibility of a flexible herd-owning sharemilking model which shifts some of the risk (upside as
181 well as downside) from the sharemilker to the farm owner, while still allowing both parties to generate a
182 positive ROA and a positive net profit with 95.6% to 97.1% probability (

183 Table 4,

184 Table 5). The same clarity of results would not be possible if the data from many farms were merged as 50/50
185 sharemilking agreements are negotiated bilaterally and thus do not present a homogenous group with
186 comparable inputs and cash budgets. Figure 3 illustrates how the probabilities for net profit are more compact
187 for HOSM and farm owner in the flexible model compared to the base model (Figure 2).

188

189 Figure 3: Net profit distribution for HOSM and farm owner – Flexible model

190 While the farm owner has additional downside risk in the flexible model in low milk price seasons compared to
191 the base model, the likelihood for high returns is also increased in case of high milk prices, due to the reverse
192 distribution of milk income. The farmer's and sharemilker's attitude to risk, and credit availability will likely be
193 main factors in the choice of such a model, as well as its specifications, especially the milk income distribution
194 and the cut-off milk prices at which the flexible model is activated.

195 Conclusion

196 This approach allows decision rules to be built into the models based on revenue sharing to reduce income
197 variability. While the study showed the general feasibility of flexible sharemilking agreements, we recommend
198 building on the existing research by analyzing a range of 50/50 sharemilking cases as well as monthly cash-flow
199 budgets. This could help to further fine-tune the cut-off milk price at which the allocation of milk income
200 changes from the prescribed 50/50 arrangement as well as the percentages of the flexible arrangement.

201

202 **References**

- 203 Bozic M, Newton J, Thraen C S, Gould B W (2014) Tails Curtailed: Accounting for Nonlinear Dependence in
204 Pricing Margin Insurance for Dairy Farmers. *American Journal of Agricultural Economics* **96**(4): 1117–1135; doi:
205 10.1093/ajae/aau033
- 206 DairyNZ (2017) Facts & Figures – A quick reference guide for New Zealand dairy farmers. 2nd Edition. Hamilton.
- 207 DairyNZ (various) DairyNZ Economic Survey 2009/10 to 2016-17. Hamilton.
- 208 DairyNZ (n.d. – no date). Flexi-Rate Sharemilking agreement (concept). DairyNZ, Hamilton.
- 209 Gardner J W (2005) Lower order sharemilking in New Zealand. In Proceedings of the 15th International Farm
210 Management Conference. Campinas, Brazil.
- 211 Gardner J W (2011) Sharemilking in New Zealand. In Proceedings of the 18th International Farm Management
212 Conference. Methven, New Zealand.
- 213 Gardner J W, Shadbolt N (2005) Wealth creation. In: 'Farm Management in New Zealand' (Eds N. Shadbolt, S.
214 Martin) pp267-304. (Oxford University Press: Melbourne)
- 215 Hemme T (ed.) (2016) IFCN Dairy Report 2016. IFCN, Kiel, Germany.
- 216 IRD (2018) National average market values of specified livestock determinations. Available at
217 <https://www.ird.govt.nz/technical-tax/determinations/livestock/national-averages/livestock-nat-ave->
218 [index.html](https://www.ird.govt.nz/technical-tax/determinations/livestock/national-averages/livestock-nat-ave-index.html) [verified 22 August 2018]
- 219 Parliamentary Counsel Office (2011) Sharemilking Agreements Order 2011. Wellington. Available at
220 <http://www.legislation.govt.nz/regulation/public/2011/0295/7.0/DLM3950706.html> [verified 18 August 2018]
- 221 OECD (2000) Income Risk Management in Agriculture. OECD, Paris.
- 222 Palisade (2018) @Risk – Advanced Risk Analysis for Microsoft Excel and Project.
- 223 Pepper M (2013) What's wrong with the 50/50 Sharemilking contract! 'The decline of the Herd Owning
224 Sharemilker'. Report for the Kellogg Rural Leadership Program. Christchurch.

225 StatsNZ (2018) Producers Price Index – information releases Available at
226 [http://archive.stats.govt.nz/browse_for_stats/economic_indicators/prices_indexes/producers-price-index-
info-releases.aspx](http://archive.stats.govt.nz/browse_for_stats/economic_indicators/prices_indexes/producers-price-index-
227 info-releases.aspx) [verified 22 August 2018]

228 Vance A (2018) Is it the end of sharemilking? Manawatu Standard, 25/05/2018. ISSN: 11763558

229

230 **Conflicts of Interest**

231 The authors declare no conflicts of interest.

232

233 **Acknowledgements**

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235 (DairyNZ) for providing supporting information and data.

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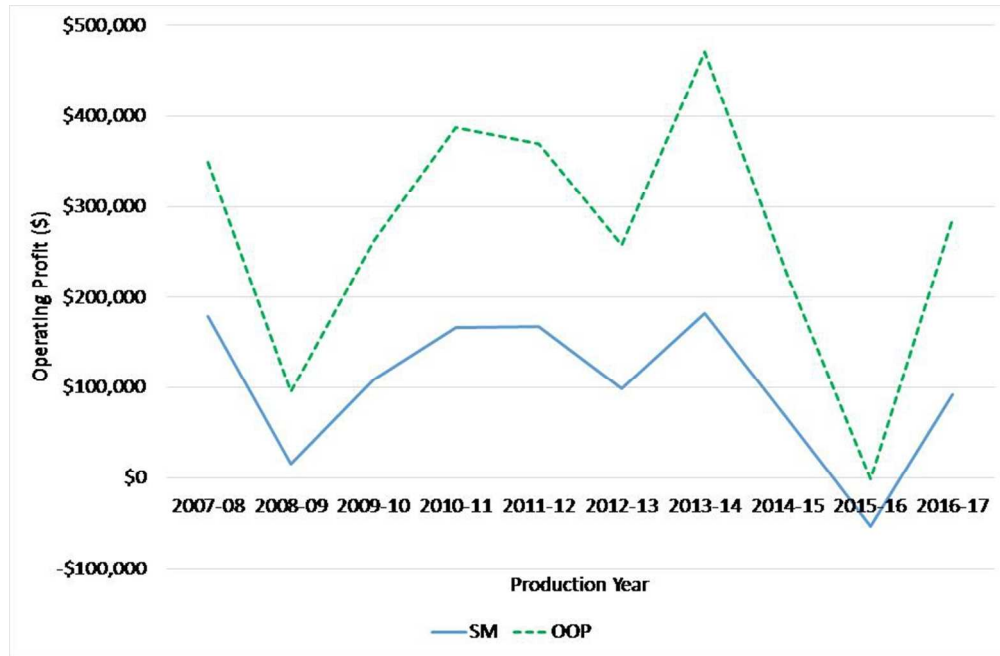


Figure 1 Operating profit for herd-owning sharemilkers (SM) and owner operators (OOP) for production years 2007-08 to 2016-17 (data DairyNZ, various)

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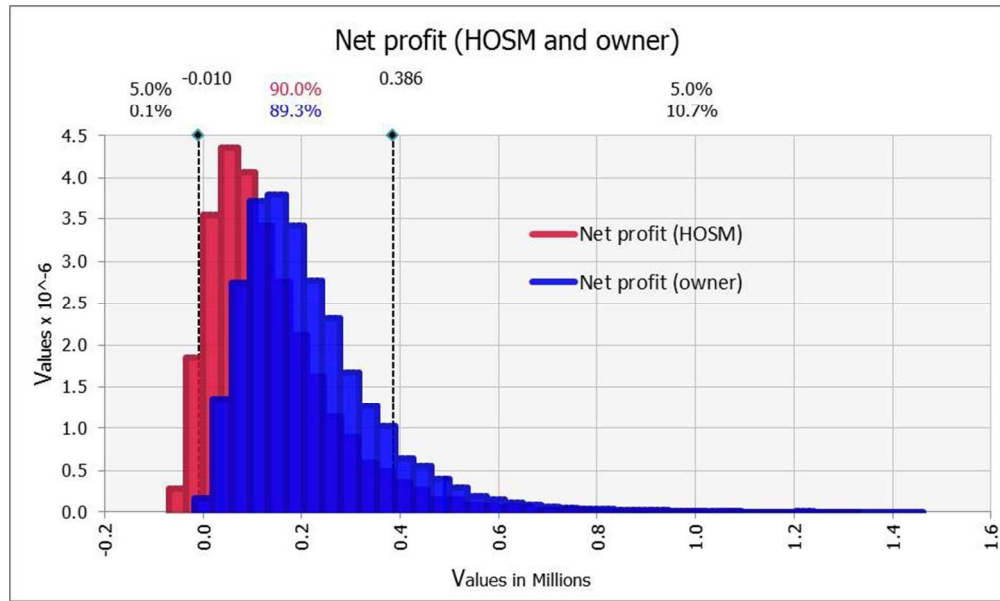


Figure 2 Net profit distribution for HOSM and farm owner – Base model

159x95mm (150 x 150 DPI)

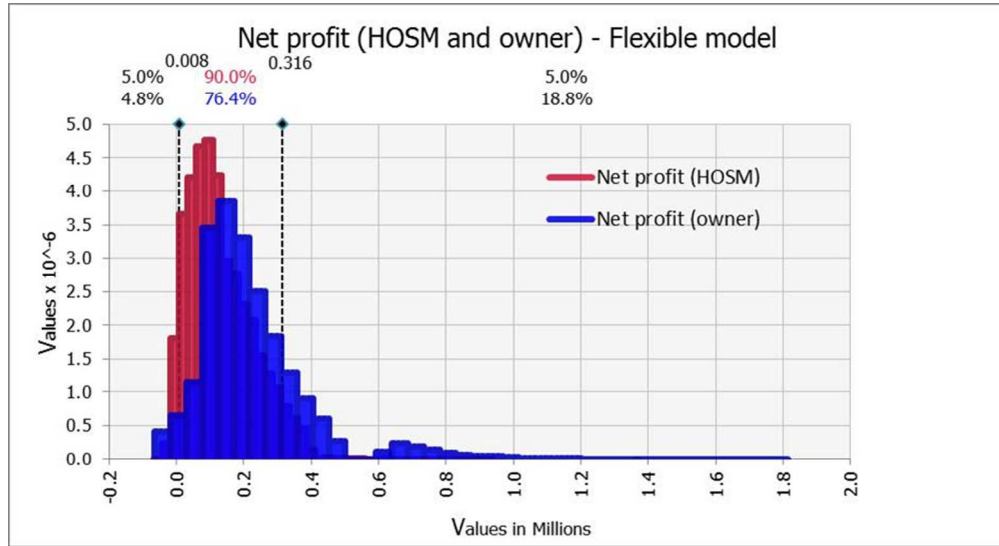


Figure 3 Net profit distribution for HOSM and farm owner – Flexible model

159x87mm (150 x 150 DPI)

view Only

	Distribution	Range (NZ \$), 90% probability	Mean (NZ \$)	Median (NZ \$)	Standard deviation (NZ \$)
Milk price	Lognormal	4.59 - 8.93	6.23	5.92	1.43
Cow price	Normal	1,304 - 2,282	1,750	1,725	300
Supplement expenses per cow	Normal	159 - 259	209	209	31
Urea expenses for the enterprise	Triangular	49,685 - 76,986	61,286	59,977	8,456

Table 1 Specifications of input variables

108x62mm (150 x 150 DPI)

		Range (NZ \$), 90% probability	Mean (NZ \$)	Median (NZ \$)	Standard deviation (NZ \$)
Cash surplus / (deficit)	Farm owner	23,946 – 452,486	186,390	155,438	140,424
	HOSM	70,039 – 486,865	227,283	196,592	136,928
Net profit / (loss)	Farm owner	54,530 – 483,070	216,975	186,022	140,424
	HOSM	(9,530) – 385,682	137,631	107,682	130,040
Return on assets (in %)	Farm owner	1.98 – 7.76	4.17	3.76	1.89
	HOSM	1.90 – 18.9	8.57	7.46	5.45

Table 2 Detailed results for the three output variables, for farm owner and HOSM – Base model

96x71mm (150 x 150 DPI)

Only

	Cash surplus	Return on assets	Net profit
HOSM	0.0%	0.2%	7.2%
Farm owner	1.5%	0.0%	0.1%

Table 3 Probability of results being zero or negative – Base model

81x23mm (150 x 150 DPI)

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		Range (\$NZ), 90% probability	Mean (\$NZ)	Median (\$NZ)	Standard deviation (\$NZ)
Cash surplus / (deficit)	Farm owner	5,772 – 576,266	192,229	155,928	171,336
	HOSM	90,277 – 417,582	221,434	197,965	102,834
Net profit / (loss)	Farm owner	36,356 – 606,850	222,813	186,512	171,336
	HOSM	8,458 – 315,965	131,781	111,819	96,616
Return on assets (in %)	Farm owner	1.76 – 9.47	4.25	3.76	2.31
	HOSM	2.85 – 16.16	8.40	7.76	4.14

Table 4 Detailed results for the three output variables, for farm owner and HOSM – Flexible model

97x75mm (150 x 150 DPI)

	Cash surplus	Return on assets	Net profit
HOSM	0.0%	0.01%	2.9%
Farm owner	5.0%	0.0%	4.4%

Table 5 Probability of results being zero or negative – Flexible model

84x29mm (150 x 150 DPI)

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