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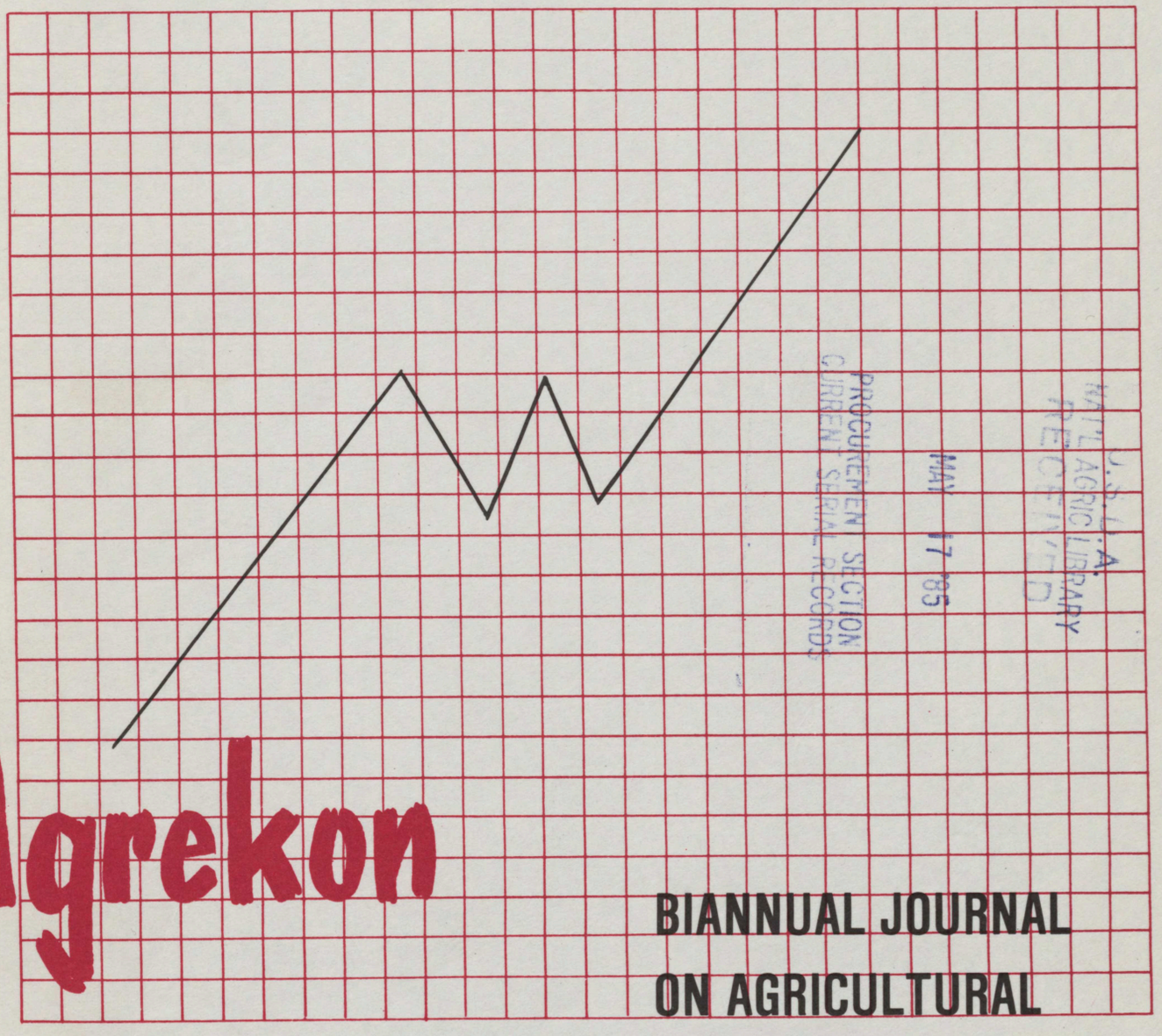

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FARM SIZE AND FLOOD DAMAGE PRONENESS: JOINT EFFECTS ON CASH FLOW*

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1. ASPECTS OF ECONOMIES OF SIZE

The detrimental effects of flood damage as indeed of every other risk factor in agriculture, work mainly *via* cash flow to potential problems with liquidity, solvency and profitability of farms. In a recent study in die Lower Umfolozi Flats potential financial losses because of floods were quantified and probabilities were allocated thereto (van Zyl, 1983).

Cash flow phenomena associated with flood damage, can be expected to differ between larger and smaller farm units. One important reason for this is differences in the relative importance of fixed and variable cost items. Economies of scale are achieved by spreading fixed costs over a larger output. Tables 1 and 2 show for example that labour costs per ton sugar-cane are lower with larger than at smaller producers.

On the Umfolozi Flats, the settlement farmers have an average farm size of 50 ha, a capital investment of R7 233 per ha and operating expenses of R1 266 per ha. The other farmers in the valley, with an average farm size of 196 ha, have a capital investment of R3 890 per ha and operating expenses of R633 per ha. For farmers with such a small enterprise there are probably considerable potential advantages in enlarging their farming enterprises, thereby using their working capital (vehicles and implements and fixed improvements) more efficiently. In recent surveys (Cane Growers Association, 1980) at Pongola it was found that there is little difference in the investment in working capital of sugar-cane farms between 40 and 100 ha.

Management of larger units also demands more than that of smaller units and higher yields per ha are sometimes encountered on smaller units. The sugar industry presents an example. According to Table 3, higher yields are obtained on areas smaller than 80 ha. Once this size has been reached, there is no indication of a relation between area and yield per ha.

Regression analysis was applied to relationships between area, yield per unit of area and labour units per 1 000 ton sugar-cane. The results were as follows:

(a) Yields per unit area decrease as farm size increases according to the regression equation:

$Y_1 = 91{,}638\ (0{,}997^X)$ or
$\ln Y_1 = 0{,}997 \ln X + \ln 91{,}638$
Correlation (r) = 0,932
t-value = 2,46 ($p<0{,}025$)
Standard error = 4,385

(b) Labour units per 1 000 ton sugar-cane cut decrease as farm size increases according to the regression equation:

$Y_2 = 8{,}419\ (0{,}998^X)$ or
$\ln Y_2 = 0{,}998 \ln X + \ln 8{,}419$
Correlation (r) = 0,912
t-value = 3,30 ($p<0{,}01$)
Standard error = 0,630
where Y_1 = Yield (t/ha)
Y_2 = Labour units per 1 000 ton sugar-cane
X = Area under sugar-cane (ha)

*Based on M.Sc. (Agric.) thesis by J. van Zyl, University of Pretoria. The Department of Agriculture bore all research expenses

TABLE 1 - Labour costs per ton sugar-cane produced according to ha or sugar-cane (R/t)

Stratum (ha)	Years					
	1974/75	1976/77	1977/78	1978/79	1979/80	1980/81
0 - 40	2,36	3,31	2,89	3,14	6,66	3,67
41 - 80	2,00	2,56	3,26	3,30	3,01	3,62
81 - 120	2,00	2,31	2,83	2,88	3,17	4,23
121 - 160	1,71	2,45	2,59	2,93	2,95	4,87
161 - 200	1,73	2,29	2,62	3,00	3,22	4,83
201 - 280	1,55	2,26	2,30	2,87	3,02	4,40
281 - 480	1,54	2,20	2,53	2,43	2,76	3,90
over 480	1,45	2,40	2,02	2,50	2,84	2,56
Average	**1,75**	**2,34**	**2,59**	**2,82**	**3,00**	**4,08**

Source: S.A.S.A. (1975; 1976; 1977; 1978; 1979; 1980; 1981)

TABLE 2 - Labour costs per ha under sugar-cane according to ha of sug

Stratum (ha)	1974/75	1976/77	197
0 - 40	175	238	1
41 - 80	127	193	2
81 - 120	105	134	1
121 - 160	94	130	1
161 - 200	87	125	1
201 - 280	89	126	1
281 - 480	85	113	1
over 480	99	109	1
Average	**99**	**131**	**1**

Source: S.A.S.A. (1975; 1976; 1977; 1978; 1979; 1980; 1981)

TABLE 3 - Average yield per ha of the South African Sugar Industry fo

Years	Stratum (ha)				
	0 to 40	41 to 80	81 to 120	121 to 160	161 to 200
1974/75	74	64	52	55	50
1975/76	82	68	46	50	46
1976/77	72	75	58	53	54
1977/78	68	64	52	58	55
1978/79	88	68	50	52	47
1979/80	53	77	53	51	47
1980/81	72	74	46	39	30
Average	**73**	**70**	**51**	**51**	**47**
standard deviation (n-1)	**11,1**	**5,3**	**4,2**	**6,0**	**8,3**
C.V.	**15,3**	**7,3**	**8,2**	**11,7**	**17,7**

TABLE 4 - Labour costs and yields per unit with varying sizes, Umfolozi

	40 ha	50 ha	60
Labour units per 1 000 ton sugar-cane	7,77	7,62	
Total labour costs (R)	22 424	26 681	30 45
Yield per ha (t/ha)	82,26	78,86	7
Total yield (t)	**3 250**	**3 943**	**4 59**

*According to regressions

2. THE EFFECT OF FARM SIZE ON CASH FLOW IN THE LOWER UMFOLOZI FLATS

2.1 Assumptions

The effect of farm size on cash flow can now be determined for the Umfolozi Flats. The probability of a flood, with the expected flood damage and burden of debt of the small farmers were determined and reported in an ealier article (Van Zyl and Groenewald, 1984). It is also known that yield per ha and labour costs per ha decreases as farm size increases.

It is assumed that the equations above will hold, and Table 4 was derived therefrom.

The 1980/81 production season is used as the point of departure with respect to prices and capital investment.

Only cash inflow and outflow related to the farm enterprise itself were included in the calculations. This excludes all living costs and other personal expenditures. Income tax was however included and was calculated by assuming tax deductions as R500 and total deductions to be R1 000.

2.2 Net cash flow per unit under varying circumstances

Average net cash flow per year for a normal year, that is without flood damages appears in Table 5. If, however, an expected annual flood damage of R59 per ha and R94 per ha respectively is taken into consideration (Van Zyl and Groenewald, 1984), the situation changes as is shown in Table 6*. Against this, Table 7 shows the net cash flow per year if the recorded flood damage per year for the period 1951 to 1976 is used as a starting point.

The average net cash flow per year ($\bar{x}$) in Table 7 is lower than the net cash flow per year if, as in Table 6, it is assumed that an average annual flood damage of R94 per ha will occur each year. This is due both to the progressive income tax system, and the non-normal distribution of flood damage.

The situation as shown in Table 7 makes no provision for the financing of a negative net cash flow. In such cases additional capital must be required (at a cost) to maintain liquidity.

For this purpose it was assumed that a negative cash flow will be financed by a Land Bank loan.

*Expected average annual flood damage of R59 per ha and R94 per ha are used, because the first is the average for a simulated period of 25 years, whilst the latter represents the recorded average for the period 1951 to 1976

TABLE 5 - Average annual cash flow for varying farm sizes in a normal

Item	
Gross revenue	
minus	
Farm expenses	
minus	
Interest	
minus	
Capital repayment	
minus	
Tax	
Net cash flow	

TABLE 6 - Average annual net cash flow for varying farm sizes with ex respectively, Umfolozi Flats

Expected average annual flood damage (R/ha)	
59	
94	

TABLE 7 - Net cash flow per year for varying farm sizes, Umfolozi Flats* (R)

Years	Farm size					
	40 ha	50 ha	60 ha	70 ha	80 ha	90 ha
1	7 502	11 229	14 104	16 313	17 975	19 230
2	4 608	7 636	10 216	12 693	14 155	15 140
3	7 502	11 229	14 104	16 313	17 975	19 230
4	7 502	11 229	14 104	16 313	17 975	19 230
5	5 052	8 611	11 231	13 225	14 575	15 763
6	(-18 581)	(-19 707)	(-21 304)	(-23 441)	(-26 012)	(-29 089)
7	7 502	11 229	14 104	16 313	17 975	19 230
8	7 502	11 229	14 104	16 313	17 975	19 230
9	7 502	11 229	14 104	16 313	17 975	19 230
10	7 502	11 229	14 104	16 313	17 975	19 230
11	7 502	11 229	14 104	16 313	17 975	19 230
12	(-43 261)	(-50 557)	(-58 360)	(-66 631)	(-75 372)	(-84 619)
13	7 502	11 229	14 104	16 313	17 975	19 230
14	7 502	11 229	14 104	16 313	17 975	19 230
15	7 502	11 229	14 104	16 313	17 975	19 230
16	7 502	11 229	14 104	16 313	17 975	19 230
17	7 502	11 229	14 104	16 313	17 975	19 230
18	7 502	11 229	14 104	16 313	17 975	19 230
19	7 502	11 229	14 104	16 313	17 975	19 230
20	7 502	11 229	14 104	16 313	17 975	19 230
21	7 502	11 229	14 104	16 313	17 975	19 230
22	2 899	6 263	8 700	10 689	12 039	12 741
23	7 502	11 229	14 104	16 313	17 975	19 230
24	4 195	7 703	10 040	12 289	13 908	14 861
25	6 998	10 685	13 509	15 686	17 303	18 011
Total	**96 946**	**172 756**	**227 904**	**268 144**	**294 146**	**308 948**
($\bar{x}$)	**3 878**	**6 910**	**9 116**	**10 726**	**11 766**	**12 358**
S.D.	**11 135**	**13 487**	**15 748**	**17 970**	**20 169**	**22 389**
Number of years < 10 000	**25**	**6**	**3**	**2**	**2**	**2**

*In this Table no provision was made for financing of negative cash flows

TABLE 8 - Net cash flow for varying farm sizes, Umfolozi Flats (R)

Year	Farm size					
	40 ha	50 ha	60 ha	70 ha	80 ha	90 ha
1	7 502	11 229	14 104	16 313	17 975	19 230
2	4 608	7 636	10 216	12 693	14 155	15 140
3	7 502	11 229	14 104	16 313	17 975	19 230
4	7 502	11 229	14 104	16 313	17 975	19 230
5	5 052	8 611	11 231	13 225	14 575	15 763
6	0	0	0	0	0	0
7	2 849	6 294	8 769	10 443	11 462	11 946
8	2 849	6 294	8 769	10 443	11 462	11 946
9	2 849	6 294	8 769	10 443	11 462	11 946
10	2 849	6 294	8 769	10 443	11 462	11 946
11	2 849	6 294	8 769	10 443	11 462	11 946
12	0	0	0	0	0	0
13	3 418	5 456	8 595	10 023	10 860	11 242
14	3 418	5 456	8 595	10 023	10 860	11 242
15	3 418	5 456	8 595	10 023	10 860	11 242
16	3 418	5 456	8 595	10 023	10 860	11 242
17	3 418	5 456	8 595	10 023	10 860	11 242
18	3 418	5 456	8 595	10 023	10 860	11 242
19	3 418	5 456	8 595	10 023	10 860	11 242
20	3 418	5 456	8 595	10 023	10 860	11 242
21	3 418	5 456	8 595	10 023	10 860	11 242
22	0	1 490	3 191	4 399	4 924	4 753
23	2 233	6 456	8 595	10 023	10 860	11 242
24	111	2 930	4 531	5 999	6 793	6 873
25	2 914	5 912	8 000	9 396	10 188	10 023
Total	**82 431**	**156 296**	**209 276**	**247 096**	**270 470**	**282 392**
($\bar{x}$)	**3 297**	**6 252**	**8 371**	**9 884**	**10 819**	**11 296**
S.D.	**2 072**	**2 845**	**3 496**	**4 008**	**4 408**	**4 765**
C.V.	**62,8**	**45,5**	**41,8**	**40,6**	**40,7**	**42,2**
Number of years < 10 000	**25**	**22**	**20**	**5**	**4**	**4**

TABLE 9 - Net cash flow per year for varying farm sizes, Umfolozi Flats (R)

Year	Farm size (ha)					
	40 ha	50 ha	60 ha	70 ha	80 ha	90 ha
1	7 502	11 229	14 104	16 313	17 975	19 230
2	4 608	7 636	10 216	12 693	14 155	15 140
3	7 502	11 229	14 104	16 313	17 975	19 230
4	7 502	11 229	14 104	16 313	17 975	19 230
5	5 052	8 611	11 231	13 225	14 575	15 763
6	0	0	0	0	0	0
7	2 348	5 762	8 194	9 810	10 759	11 161
8	2 348	5 762	8 194	9 810	10 759	11 161
9	2 348	5 762	8 194	9 810	10 759	11 161
10	2 348	5 762	8 194	9 810	10 759	11 161
11	2 348	5 762	8 194	9 810	10 759	11 161
12	0	0	0	0	0	0
13	2 067	4 879	6 774	7 944	8 508	8 602
14	2 067	4 879	6 774	7 944	8 508	8 602
15	2 067	4 879	6 744	7 944	8 508	8 602
16	2 067	4 879	6 774	7 944	8 508	8 602
17	2 067	4 879	6 774	7 944	8 508	8 602
18	2 067	4 879	6 774	7 944	8 508	8 602
19	2 067	4 879	6 774	7 944	8 508	8 602
20	2 067	4 879	6 774	7 944	8 508	8 602
21	2 067	4 879	6 774	7 944	8 508	8 602
22	0	1 490	3 191	4 399	4 924	4 753
23	110	4 792	6 774	7 944	8 508	8 602
24	0	1 353	2 710	3 920	4 441	4 233
25	14	4 335	6 790	7 317	7 836	7 383
Total	**62 633**	**133 135**	**182 728**	**216 904**	**236 379**	**243 533**
($\bar{x}$)	**2 502**	**5 325**	**7 309**	**8 676**	**9 455**	**9 741**
S.D.	**2 280**	**3 066**	**3 729**	**4 277**	**4 732**	**5 213**
C.V.	**91,1**	**57,6**	**51,0**	**49,3**	**50,0**	**53,5**
Number of years < 10 000	**25**	**22**	**20**	**20**	**15**	**15**

4. CONCLUSION

In this analyses the Lower Umfolozi Valley was used as a case study of flood damage. Flood damage are periodically experienced in several river-basins in South Africa, for example in the Sundays, Fish and Gamtoos Valleys. Some of these areas more-over also have to cope with other of nature's disasters such as drought.

Farm size appears to be a factor that has an influence on the effect of flood on net cash flow and thus eventually also on liquidity, solvency and profitability. Basically, small units are subject to more severe risks than larger units. Higher interest rates emphasise riskiness.

Authorities should, when deciding on sizes of settlement holdings, take the effect of farm size on cash flow and risk more seriously than has historically been the case.

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