THE ECONOMIC COSTS OF A MAJOR RAIN STORM EVENT – FINDINGS FROM A SURVEY OF AFFECTED FARMERS

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Abstract
Heavy rain which hit Hawke's Bay on 26 and 27 of April, 2011 was described as one of the worst storms to hit the region in decades. The storm event generated significant erosion and flooding in coastal southern Hawke's Bay and a coastal area just east (worst area) and south of Wairoa. The event affected 110 farm properties.

Information on stock losses, stock movements, infrastructure damage and repairs, effectiveness of mitigation measures to combat erosion, and future planned mitigation measures was collected using a questionnaire. Questionnaires were distributed to farmers by post or e-mail in August 2012, and the interviews were done face to face on the farm.

Stock losses were reported on half the farms, with four farms reporting 63% of losses averaging over 400 animals. The other properties reporting stock losses averaged 33 animals lost. Stock losses were valued at ~$495,000.

Almost 75% of all properties affected by the storm had to destock immediately, either to grazing or to forced sale, at a mean cost/farm of $94,600.

All affected farmers identified a loss of grazing immediately following the storm. Recovery measures varied from doing nothing, to aerial reseeding on slopes, to cultivation, cropping and reseeding on the flats. Costs varied from nothing to $64,000 with a mean cost of recovery at the time of interview of $20, 100.

Damage to infrastructure resulted from slippage (fences, dams, tracks), silt (dams, culverts, flats, drains, yards, swimming pool), forest debris (damming streams) and water (bridges, water tanks). The total costs to repair infrastructure damage due to the storm event up to the time data were collected were $5.05M. All farms had to restore infrastructure at a mean cost of $84,250.

Farmers were asked to gauge the effectiveness of their tree conservation plantings (pines, poplars, willows, eucalyptus) in preventing or reducing slippage. Assessment descriptions were not listed so farmers had to choose their own description. Of the 60 famers interviewed, 7 gave no assessment and 6 had no tree protection measures. Effectiveness ratings of excellent or good were given for 94% of pine plantations, 76% of poplar plantings and 73% of willow plantings.

Of the mitigation expenditure since the storm event, 73% was spent on retiring land and planting pine plantations and 21% was spent on planting poplar and willow poles. Of those farmers planting poles, the mean number of poles planted was 227 at a cost of between $3000 and $4000. Of mitigation outcomes offered, soil stabilisation was considered more important than water quality.

The commitment to further mitigation expenditure in the future was similar to that since the storm. Just over half (32) of the farmers expressed a plan to plant trees for soil stabilisation or to improve water quality in future, at an annual cost of $1540/year excluding planting costs.

The development of a decision support tool to assist farmers in identifying erosion-prone sites on their farm and provide planting and management recommendations (spacing, tree species, tree clone) for increasing soil stability on the site is warranted.

The Economic Costs of a Storm event – findings from a survey of affected farmers following a major storm event.

Questionnaires were completed with 60 farmers adversely affected by the storm of April 2011 which impacted on southern Hawke's Bay and an area east and south of Wairoa. Of the 60 farmers interviewed, 39 were in southern Hawke's Bay and 21 in Wairoa. All of the farmers in southern Hawke's Bay had previously been contacted through the Rural Support Trust in the weeks following the storm event which provided the database for this project. The Wairoa farmers adversely affected by the storm were collated by Wairoa District Council into a database, which was accessed for this project.

A letter was sent to all the farmers listed on the two databases introducing the project as a possibility in April 2012 and requesting their support. A second more detailed letter introducing the project team and the aims of the project together with the first questionnaire was distributed to farmers by post or e-mail and the interviews were done face to face on the farm in the following six months. John Ross visited with and interviewed the Wairoa farmers and Mike Barham the southern Hawke's Bay farmers.

A collation and analysis of the data collected through the questionnaires and interviews is reported below under headings corresponding to questions in the questionnaire. Of the 60 farmers who completed questionnaires, 52 were revisited a year later and completed a second questionnaire covering stocking practices following the storm, further infrastructure repairs, additional mitigation works and knowledge and practice of land environment plans for their farm.

The mean property size for the properties covered by the questionnaires was 670 ha, with property sizes ranging from 48 ha to 2228 ha (Figure 1).

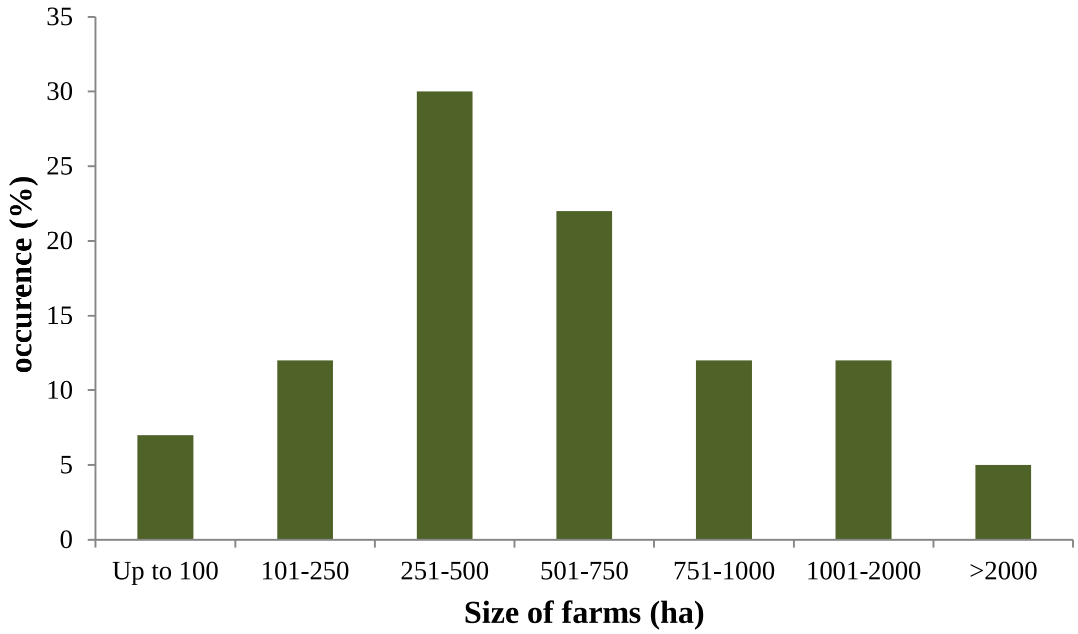

Figure 1 Distribution in size of farms surveyed.

A Stock Information

Stock losses

Total stock losses reported were 2725 animals by 36 of the 60 farmers, representing a financial loss of $495,000. Of these, 1730 animals (950 ewes and 780 lambs) were lost from four properties. For the remaining 32 farms which lost stock, mean losses were 33 stock animals with a value of $9090.

Table 1 Reported stock losses separated into stock classes. Except where the farmer specified the value of lost stock a unit value was applied (last column).

Stock class	**Number lost**	**Value $**	**Unit value $**
bulls	22	16200	900
calves	2	400	200
cows	101	100480	1000
dairy grazers	27	40500	1500
ewes	1404	194680	150
goats	20	1000	50
hinds	4	2000	500
horses	4	15500	
lambs	1045	75150	120
ram hogget	50	20000	400
steers	3	3600	1200
weaners	43	25372	550
	2725	**494882**	

Stock movements

Of more significance were the forced movements of stock off affected properties because of loss of grazing and fences. Farmers fortunate to have available grazing on another property transferred their stock without declared financial cost. Stock numbers moved off the property were 31,362 at a grazing cost of $2,445,920 (10,104 animals) or a trading loss of $1,242,441 (21,258 animals). Stock moved included 400 dairy grazers, 1283 beef cows, 319 steers, 990 weaners, 40 bulls and 45 hinds. These accounted for ~10% of movements. The remaining movements were ewes and lambs to early sale (Table 2). Transport is not included in these costs and losses.

Of properties not included in the 39 identified in table 2, 6 destocked to other properties under the same ownership. Almost 75% of all properties affected by the storm had to destock immediately.

Table 2 Financial costs / losses through grazing and forced sale of stock

Stock moved	Stock sold	Grazing costs $000	Losses from forced sale $000	Farms affected /60	Mean farm cost $000
10,104	21,258	2446	1242	39	94.6

Stock replacement and reduction

Four farmers reported buying in replacement stock. These included ewes (1100), cows (35) and steers (333). Stocking rates were generally back to pre storm levels suggesting that the ongoing loss of grazing resulting from the storm is not affecting stocking rate. Fourteen of the 60 farmers reported a reduction in stocking rate of from 3% – 35%. This suggests that while some farms were affected significantly, for most affected farms the land where slippage occurred did not add a great deal of value to the grazing. Some of the 14 properties have planted affected land with pine trees which would account for some stock reduction.

B Grazing loss

All affected farmers identified a loss of grazing immediately following the storm. Areas varied considerably, with a mean loss of 67 ha (55 ha of sloped land, 12 ha of flat land) per property. This represented an immediate mean grazing loss of 407 stock units. Not all farmers were able to supply a value for SU loss. Recovery measures varied from doing nothing, to aerial reseeding on slopes, to cultivation, cropping and reseeding on the flats. Costs varied from nothing to $64,000 with a mean cost of recovery at the time of interview of $20, 100. Estimated extent of recovery of slopes was from 5 -100%, with mean recovery ~30%. Recovery of flats was higher at 20-100%, mean ~85%. Slope recovery was slower than flats recovery. The costs associated with recovery of flats were very high, warranted by their economic value. Farmer opinion on the value of reseeding eroded slopes immediately following the storm was mixed.

Questions dealing with effectiveness of trees in reducing slippage did not yield accurate data. It is difficult for the landowner to accurately estimate slippage, so we have erred on the side of caution and used the map measure, even though this was considered an underestimate by many farmers, and fails to capture slippage within treed areas. Without actually venturing into the treed areas it is difficult to see the slippage within treed areas.

In our observation most slips occurred on slopes steeper than 30°, and grazing on these slopes was limited. The slip tails had re-grassed (naturally) quite well but grazing from the tails must be less than before the event. Following stock reduction natural production of grass seed was considerable, with significant natural reseeding of slippage areas. Artificial reseeding was carried out by a number of farmers. Though the production benefits of this were questionable, the activity was (in their words) therapeutic for farmers.

Carrying capacity (stocking rate) for slipped areas was not usually separated from overall farm stocking rate, yet the amount of available grazing on steep slopes where slippage occurred is much less so there are possibly errors in discussions of restocking because of overestimation of grazing losses. The recovery of grazing on slipped areas (including tails) is minimal yet many farmers reported stocking rates back to pre-storm levels. However, stocking rates on slipped areas had not recovered to pre-storm levels and other areas of the farm tended to be stocked at a higher stocking rate/ha to compensate.

C Infrastructure

Infrastructure refers to tracks, fences, dams, water reticulation, buildings, yards, bridges and roadways. Questions dealing with damage to, and repair of, infrastructure were quite precise, largely because they were determined by payments and so easily measureable. These give a reasonably accurate picture of costs associated with repairs following storm events such as this. Activities include; clearing tracks, removing silt from flats, restoring water supply, replacing/repairing bridges, repairing sheds and yards, restoring fencing. Of all the activities listed, restoring fences is the most common activity where work remains incomplete. Many sheep destocking decisions were made because of destroyed fences, including boundary fences. Costs were not carefully separated into materials and labour in some questionnaires.

Table 3 Mean costs of repairing infrastructure up to a period 18-24 months following the storm event.

Farms affected /60	Materials $	Labour – self $	Labour – volunteer $	Contractor $	Mean cost $	% complete
60	6814	17779	2891	56763	84247	80

Work still to be completed included fencing, bridge replacement, track repair, desilting dams. The mean costs per farm to restore infrastructure on this basis will exceed $105,000. The total costs to repair infrastructure damage due to the storm event (at the time the questionnaires were completed) was $5.05M, of which $0.17M was volunteer labour and machinery and $1.07M was time contributed by the farm owner or manager, additional to their other roles. Additional infrastructure repair costs identified in the second questionnaire were $21,622 per farm giving a mean cost for those 56 farms of $105,869 in line with the prediction above.

Damage to infrastructure resulted from slippage (fences, dams, tracks), silt deposition (dams, culverts, flats, drains, yards, swimming pool), forest debris (damming streams) and water (bridges, water tanks). Some farmers reported a reduction in water storage of 50-60% from silt in dams that cannot be reached to remove.

D Reduction of storm damage

Farmers were asked about the extent of tree plantings on their properties for soil and water conservation, and stream bank protection. Tree plantings were of poplar, willow or pine; and on one property, eucalyptus. Pines were in plantations and used where land was retired from grazing. Nineteen properties reported having pine plantations, varying in size from 3 ha to 96 ha (mean 30 ha). Poplars and willows were spaced planted across slopes or on earth flows, and willows were also planted in gullies. Gully planting was more extensive than spaced planting across slopes. Extent of poplar and willow planting was difficult for farmers to define, unlike pine plantation size. Various terms were used (extensive, large, small, spaced, gully, riverbank) or specific area given (24 ha, 15 ha, 100 ha). Information on age of plantings was not requested.

Farmers were asked to gauge the effectiveness of their conservation plantings in preventing or reducing slippage (Table 4). Assessment descriptions were not listed so farmers had to choose their own description. Of the 60 famers interviewed, 7 gave no assessment and 6 had no tree protection measures. Effectiveness ratings of excellent or good were given for 94% of pine plantations, 76% of poplar plantings and 73% of willow plantings. While the planting density of pine was known at 400 - 1200 stems per hectare (sph), planting density of poplar and willow would be much lower at 25 – 70 sph and not easily known. The assessments of limited effectiveness for poplar and willow trees were qualified in several cases by identifying them as young plantings. We visited one property where poplars and willows were described as having limited effectiveness. There was no slippage among these trees that we saw, so we considered the comment on effectiveness was due to the limited plantings, not the capacity to prevent slippage. Our visits on farms revealed that slippage was almost nil among mature treed areas of poplar and/or willow (trees over 30 cm diameter at breast height). For two sites only were trees with diameter at breast height (DBH) >30 cm carried downhill by slippage. At one site several trees were toppled, at the other site only one. Farmer comments during the interviews confirmed that trees younger than 6 yr old went with slips or were non-effective in preventing slippage

Table 4 How farmers assessed the effectiveness of their conservation plantings in protecting against slippage. Numbers are of individual farmers.

Descriptive term	**Pine**	**Poplar**	**Willow**
Excellent	12	22	14
Good	4	12	8
Average	0	1	0
Variable	1	0	0
Limited	0	8	7
Poor	0	1	1
Nil	0	1	0
	17	**45**	**30**

E Mitigation

Since the storm

At the time of the storm average annual expenditure per farm on mitigation was $1540, primarily on pole planting but including retiring in to pines also. Farmers were asked what mitigation activities they had carried out since the storm to stabilise soil and improve water quality (Table 5). Of the mitigation expenditure, 73% was spent on retiring land and planting pine plantations and 21% was spent on planting poplar and willow poles. Of those farmers planting poles, the mean number of poles planted was 227 (range 40 – 800). The most common numbers being planted were 150 or 200 poles per year at a cost of $3000 or $4000. Both pole planting and pine plantation planting were activities subsidised by the Hawke's Bay Regional Council.

Table 5 Mitigation activities carried out since the storm event

Mitigation activity	**Number of farmers**	**Location**	**Soil stabilisation**	**Water quality**	**Cost $000**
Retirement to pines	7	Hill slope	5	5	260.4
Pole planting	29	Hill slope, gully	26	10	76.3
Reseeding	2	Hill Slope, Flat	1	0	20
Nil	26				
	60		**32**	**15**	**356.7**

In the future

Farmers were then asked what mitigation measures they would carry out in future. For pole planting an annual commitment was targeted. Of the 60 farmers, 32 said they would plant poles at a mean rate of 140/year (range 40 – 250). At $11/pole this represents an investment of $1540/year excluding planting costs which are roughly equivalent to pole costs. Two of these were also planning to plant 80 ha and 600 ha respectively in pines. The commitment to the future was similar to that since the storm.

Future mitigation activities were variously described. Some comments made by farmers who were not committed to definite mitigation measures were 'will look at planting more poles in the future where required', 'more well thought out planting to be done in the future, but fencing more urgent', 'feels most of planting done', 'fencing off waterways in hill country', 'will plant poles as required' (several responses in this vein), 'as farm held up well no plans to plant any more of the farm', 'plans to plant one paddock at a time instead of random planting – uncertain of numbers yet', 'more blocks of pines planned for the future', 'leased property and owner not interested'.

F. Summary of $ Costs

The mean cost per farm resulting from a storm that lasted less than 24 hours was $228,260. How much of these costs were covered by insurance was not specified but was likely to be small. Many farms still had not competed fencing at the time of the second questionnaire, probably the greatest infrastructure repair cost for many farms.

Table 6 Summary of mean costs on a per farm basis

Storm Cost category	Mean reported cost per farm
Stock deaths	8,250
Destocking	94,600
Pasture restoration	20,100
Infrastructure damage	105,312
TOTAL	**228,260**

Lessons learnt and advice shared

Lessons reported by farmers through this storm event included ‘don’t underestimate where damage can occur’, ‘don’t regrass’, ‘wait for the ground to settle before attempting repairs’, maintain stopbanks’, ‘fence on ridges, don’t spend too much on permanent fencing’, ‘don’t panic but do the essentials’, ‘keep planting trees’, ‘plant trees to protect infrastructure, need to be serious and strategic about tree planting’, ‘the neighbour’s trees reduced erosion on their property’, ‘keep creeks clear of debris, maintain tracks’.

Advice given included ‘be prepared for the worst, don’t overstock’, ‘keep creeks clear of debris, maintain tracks’, ‘trees keep the soil intact’, ‘silt depth of more than 500 mm takes more than three years to support good grass growth’, ‘get a plan going quickly, talk to neighbours, realign fences, plant trees’, ‘ask for and accept help and advice’, ‘farm to be proactive for the future, improve stability of erosion-prone areas’, ‘don’t put off necessary maintenance’.

G. How do the costs of this storm relate to costs of previous storm events?

Following the 2004 storm and floods in the Manawatu a report was compiled (Litherland, 2006) on the impact of slips on a farm’s total pasture production. The report discussed the long term effectiveness of re-vegetating slips and identified a loss in DM production on eroded slips of 80% compared with non-eroded sites after 5 years of re-vegetation with no remedial action. However, no data were gathered on the actual costs in the immediate aftermath of the storm, and the report states that ‘the effect of oversowing on long-term slip recovery is based on assumptions without any data on which to base the assumption. Despite that, the report does add information to the current report. Likewise following the 2005 storm in Wairarapa, a similar localised ‘weather bomb’, no data were collected that are comparable with the costs data collected in the present exercise.

Summary

The empathy with which affected farmers co-operated in this study cannot be emphasised too much. For the southern Hawke’s Bay farmers the foundations for this empathy laid previously in support provided by the Rural Support Trust in both an earlier drought and this storm event. The Rural Support Trust interviewer had until recently been farming in the district, and had visited most of the affected farmers immediately following the storm in

April 2011. For the affected farmers in Wairoa the farmer-interviewer was himself one of the affected farmers and understood their situation fully. Because of these relationships we have confidence that the data presented here are well founded.

The storm event of April 2011 was a localised, very severe rainstorm which generated a huge erosion event in coastal southern Hawke's Bay and a coastal area just east (worst area) and south of Wairoa. The event affected 120 farm properties of which data have been collected on the 60 most affected properties.

Stock losses were reported on half the farms, with four farms reporting 63% of losses averaging over 400 animals. The other properties reporting stock losses averaged 33 animals lost. Stock losses were valued at ~$495,000.

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The commitment to further mitigation expenditure in the future was similar to that since the storm. Just over half (32) of the farmers expressed a plan to plant trees for soil stabilisation or to improve water quality in future, at an annual cost of $1540/year excluding planting costs.
Mean costs per farm resulting from the storm event were $207,200, with just over 80% of infrastructure repairs completed. Only half of farms had mitigation practices in place or planned at an annual cost of $1540/year.

The benefits of mitigation of either soil loss or water deterioration are not focal to farmer thinking or activities. Farmers are very tuned to actions that have direct economic links, such as loss of grazing for fattening lambs, and can get immediate feedback on stock condition by putting them over the scales. It is harder to determine the effects of re-grassing slopes or planting to retain soil on slopes, or prevent erosion of gullies. Hence the need for a model that links economic benefit with soil retention on slopes.

Only the easily measured costs are identified as economic costs. The questionnaire did not explore with the farmers the economic value that they put on stabilised soil or improved water quality. Other studies have reported some cynicism from farmers to the loss of soil, even topsoil. Their attitude was explained by their confidence that nutrients can be readily replaced with fertiliser and that water storage capacity can be managed with irrigation. This could be accepted for an intensive operation on flat land but needs to be challenged for pastoral hill country where fertiliser and water are more difficult to retain in the place where they are needed when topsoil is lost.

Farmer awareness of the Land & Environment Planning Toolkit was low and few had formal environmental management plans in place and operating. Those farmers with Land & Environment Plans (LEPs) or other environmental plans (e.g. erosion control plan ECP) affirmed their value and acknowledged their contribution towards mitigating the damaging effects of this particular storm. Many farmers were reluctant to enter into a plan that was of a regulatory nature, but were more ready to engage in a co-operative venture of which both LEP and ECP are examples.

There is much scope for interaction of farm advisors, regional council staff, extension agencies with farmers in the development of LEPs and co-operating in strategies to strengthen resilience against storm events such as reported here.

Farmers in other regions can expect similar consequences to their farm operation and additional costs following a similar storm in their area. A planned sequence of mitigation measures to protect against soil erosion would seem a no-brainer, particularly as soil once lost is not recovered and the frequency of these events is predicted to increase.

The development of a decision support tool to assist farmers in identifying erosion-prone sites on their farm and provide planting and management recommendations (spacing, tree species, tree clone) for increasing soil stability on the site is warranted.

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