Bibliography

Prepared for the Transition Advisory Group (TAG)

By Mike Marden

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- Many of the earlier published articles are not available in electronic form. If they're available, you can find them on the links provided.
- Some publications address more than one theme so are listed more than once.
- Each publication will also contain a list of references some of which will be of relevance to this TAG.
- This bibliography is by no means complete. Please feel free to suggest/provide additional references of relevance and suggest the addition of further themes of interest.

Themes

1. Previous reviews into impacts of erosion and floods on pastoral and forestry land pre-and post-Bola.

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Abstract: Recent studies of continental margins suggest that small, high-yield rivers can generate shelf sediment-gravity flows, an idea that fundamentally alters our understanding of material flux from the continents to the ocean. Discharge measurements indicate that the Waiapu River, North Island, New Zealand reaches hyperpycnal concentrations (> 36 kg m^{-2}) on a yearly basis. This study contrasts shelf-edge basins with a broad trough along the shelf-edge off the Waiapu River, testing whether there is evidence that shelf sediment-gravity flows propagate to topographic lows. Observations and measurements through geochemical and sedimentological analyses of sediment cores, EM1002 swath bathymetry, and Chirp sub-bottom profiles suggest differing transport modalities on the outer shelf. In general, a southern trough-shaped region exhibits high terrigenous inputs and non-steady-state ^{210}Pb profiles, whereas the northern basins contain steady-state ^{210}Pb profiles and increased marine influence. Sediment-gravity flows dominate accumulation in the southern region, whereas within the northern portion, surface plume sedimentation is indicated. Overall, this study suggests that sediment-gravity flows could be bypassing the northern basins, perhaps a result of oceanographic influences and bathymetric steering as they seek a more direct route across the shelf.
Keywords: sedimentation; sediment-gravity flow; hyperpycnal flow; Waiapu River; New Zealand

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The results provide a high-resolution description of gully behaviour over a short time period, and also demonstrate that mass movement (slumping and debris flows) accounted for almost 90 per cent (4660 ± 200 m^3) of the sediment generated. This erosional response is described in terms of gully evolution by comparing the gully complex to other systems

in the region in various stages of development. The effect of gully evolution on geomorphic coupling between the gully complex and channel system is described, and coupling is also shown to vary with the magnitude and frequency of rainfall events. From a land management perspective the success of strategies, such as tree planting, to mitigate against gully erosion depends on the stage of gully development - particularly on whether or not mass movement erosion has begun. In contrast to gully rehabilitation efforts elsewhere, basin-wide afforestation in the early stages of gully incision is favoured over riparian planting, given that mass movement assisted by excessive groundwater pressure is the main process leading to uncontrollable gully expansion. To protect land effectively against continuing gully erosion of headwater catchments and resulting downstream aggradation, it is necessary for land managers to understand the spatial and temporal variability of gully development fully so that mitigation efforts can be targeted appropriately.

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Abstract: Steepland rivers draining small, coastal watersheds often have very high suspended sediment loads, but the event characteristics of suspended sediment concentration and yield in this class of river is not well documented. Continuous monitoring at four sites in the Waipaoa River basin, New Zealand, demonstrates that during individual and composite events, suspended sediment concentration versus water discharge relations typically shows clockwise hysteresis and that event maximum concentration is poorly related to event peak discharge. The signature of different erosion processes is also imprinted on the event yield magnitude frequency distributions. Gully-dominated tributary basins produce relatively high yields at all frequencies, reflecting greater sediment availability, whereas in tributary basins, where shallow landsliding is the dominant erosion process, there is a steep increase in yields in relation to return period. We estimate that flood discharges from the Waipaoa River approach or exceed the critical suspended sediment concentration (~40,000 mg L-1) for hyperpycnal plume generation (because of negative buoyancy) at the river mouth once every ~ 40 yr, but in the neighbouring Waiapu and Uawa Rivers, the threshold concentration may be exceeded once a year and two to three times a year, respectively.

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Abstract: The sediment delivery ratio was estimated for two periods (28 years and eight years) following reforestation of seven tributary catchments (0·33 to 0·49 km^2) in the headwaters of the Waipaoa River basin, North Island, New Zealand. In these catchments, gully erosion, which largely resulted from clearance of the natural forest between 1880 and 1920, is the main source of sediment to streams. Reforestation commenced in the early 1960s to stabilize hillslopes and reduce sediment supply. Efforts have been partially successful, and channels are now degrading, though gully erosion continues to supply sediment at accelerated rates in parts of the catchment.

Data from the area indicate that the sediment delivery ratio (SDR) can be estimated as a function of two variables, Ψ(the product of catchment area and channel slope) and A_g (the temporally averaged gully area for the period). Sediment input from gullies was determined from a well-defined relationship between sediment yield and gully area. Sediment scoured from channels was estimated from dated terrace remnants and the current channel bed. Terrace remnants represent aggradation during major floods. This technique provides estimates of SDR averaged over periods between large magnitude terrace-forming events and with the present channel bed. The technique averages out short-term variability in sediment flux.

Comparison of gully area and sediment transport between two periods (1960-1988 and 1988-1996) indicates that the annual rate of sediment yield from gullies for the later period has decreased by 77 per cent, sediment scouring in channels has increased by 124 per cent, and sediment delivered from catchments has decreased by 78 per cent. However,

average SDR for the tributaries was found to be not significantly different between these periods. This may reflect the small number of catchments examined. It is also because the volume of sediment scoured from channels was very small relative to that produced by gullies.
According to the equation for SDR determined for the Waipaoa headwaters, SDR increases with increasing catchment area in the case where A_g and channel slope are fixed. This is because the amount of sediment produced from a channel by scouring increases with increasing catchment area. However, this relationship does not hold for the main stem of the study catchments, because sediment delivered from its tributaries continues to accumulate in the channel. Higher order channels are, in effect, at a different stage in the aggradation/degradation cycle and it will take some time until a main channel reflects the effects of reforestation, and its bed adjusts to net degradation.
Results demonstrate significant differences among even low order catchments, and such differences will need to be taken into consideration when using SDR to estimate sediment yields.

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Keywords: Steep headwater catchment; Hillslope erosion; Storm events; Sediment budget; Coupling; Channel morphology; Land-use change

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Abstract: Sequential aerial photographs of a small headwater catchment in the **Waiapu** basin, East Coast Region, North Island, New Zealand, were interpreted to measure and analyse temporal changes in active area of gullies and gully complexes for a longer time

span (1939-2003) and with higher temporal resolution compared to previous studies. We focus on the conditions leading to the development of gullies and gully complexes under pasture and forest by using topographic thresholds (slope-area relationships) of catchments for the initiation of gullies and gully complexes. In addition, the influence of two different lithologies as well as the occurrence of major rainfall events was related to gully activity.

Twenty gullies and four gully complexes (occupying 62·5 ha or 12·5 per cent of the catchment area) occurred in the study catchment between 1939 and 2003. However, the majority of these were not active at all the dates studied. Gullies developed in the sandstone-dominated Tapuwaeroa Formation tended to attain their maximum size by 1957 with a mean catchment area of 2·1 ha. Gullies developed in mudstone of the Whangai Formation attained their maximum size in 1939 with a mean catchment area of 4·31 ha. Exceptions are gullies which developed into mass movement deposits or into an earth flow deposit as well as gullies developed under indigenous forest. Topographic threshold values for gullies under pasture and indigenous forest show that values for gullies under forest plot far above the threshold line of gullies under pasture, indicating that the topographical threshold for gully development under forest is higher compared to under pasture. A threshold value of 9·4 ha in catchment area is needed for the development of gully complexes under pasture, all located in the Whangai Formation and with the same orientation as the strike of the mudstones. Gully-complex area and dominance of mass-movement erosion increased with larger catchment area. A decreasing distance to the threshold line for gullies under pasture indicates a later development for gully complexes. No gully complexes developed under indigenous forest, indicating that the threshold value for gully-complex development is higher than for gully complexes under pasture and was not reached in the study area. A model of shifting topographical threshold for gully development for a given catchment is developed which depends on land use. When a catchment has an indigenous forest cover the topographical threshold is very high. After conversion to pasture, threshold values decrease drastically. With the invasion of scrub, the threshold slowly increases and returns to a similar level to that under indigenous forest after reforestation. Development of gullies and gully complexes is a highly dynamic phenomenon, and phases of expansion and inactivity indicate that models describing only unidirectional advancing stages without periods of inactivity are not suitable. Therefore, this study adds more phases to models of gully and gully-complex development in the East Coast Region. The threshold line for gully initiation under pasture and a value of 9·4 ha in catchment area for gully-complex initiation permits one to predict which catchments, under similar environmental settings, develop gullies and gully complexes on a physical basis. This enables land managers to implement sustainable land-use strategies to reduce erosion rates of gullies and gully complexes.

Keywords: gully erosion, gully complex, topographic threshold, land-use change

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Keywords: Fluid mud; Sediment transport; Turbidity currents; Subaqueous delta

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