Vegetation Buffers, Water Quality & Land Use

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Introduction

Agricultural activities have substantially disturbed the natural balance in watersheds by altering vegetative cover, accelerating erosion, and introducing pollutants (Lant, 1995). Agricultural chemicals bind to clay particles, including pesticides, herbicides and synthetic fertilizers.

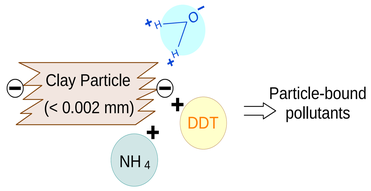

Figure 1. Clay particle with active negative charge, attracts chemicals; forms particulate bound pollution

When sediments are displaced and transported, the pollutants bound to them are deposited into receiving water bodies, where they degrade water quality.

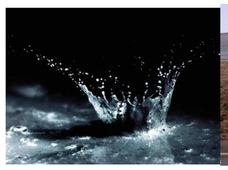

Figure 2. Rain splash impact mobilizing soil

Figure 3. Runoff with high concentration of sediment

Once deposited into water, they eventually end up in harbors, rivers or lakes, where they impair water quality. Typical erosion rates in Elkhorn Slough are estimated at 13,376 kg/ha/yr from strawberry lands. Damage estimated at $3 mill/yr, without environmental costs (USDA, 1984).

Materials and methods

Three vegetative treatments were planted to test the efficacy of vegetation buffers: native perennial grasses, annual barley and unseeded weeds. Sediment transport was measured in sediment loss (gully number and volume) and sediment capture (depositional fans and suspended sediment in runoff). There were hydrology and plant components of this study, but sediment transport is the focus of this poster.

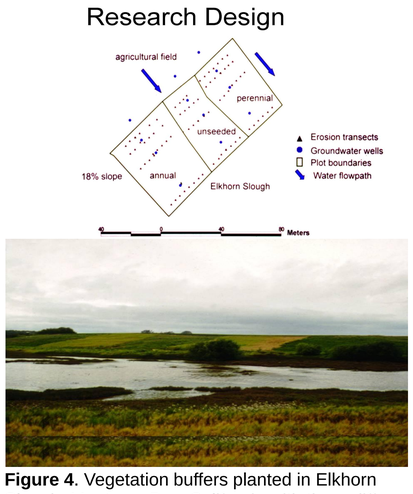

Figure 4. Vegetation buffers planted in Elkhorn Slough, Monterey Bay, California with three different species composition, three replicates of each treatment. Agricultural runoff enters each plot. Design is in top drawing and photo of established buffers is shown above.

Research Questions

Are Vegetation Buffers effective at:

- Preventing erosion (gully development)
- Trapping suspended sediment & insoluble chemicals
- Protecting water quality in a sensitive estuary
- Reducing exposure to environmental contaminants
- Restoring native grasses while reducing pollution

Results

Figure 5. Gullies formed after first storm event in perennial & unseeded treatments, as sufficient vegetation was not yet established

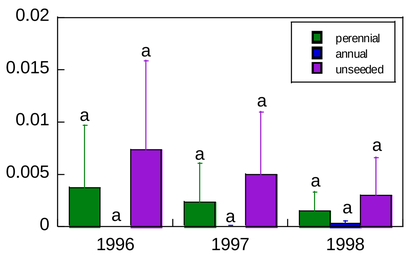

Figure 6. Gully volume (m^3/m) measured in cross sectional analysis.

Gully erosion rates were significantly lower in the non-native annual grass plots in the first year. Gullies developed in plots with insufficient cover (perennial & unseeded) but none developed in barley, which had dense cover. By second year, sediment capture filled in some gullies, reducing gully volume. Differences in accumulated gully volume in the three treatments decreased in the second and third years. Native perennial grasses were most effective by the second year at trapping sediments originating from the agricultural field, measured as deposition.

Figure 7. I am measuring gully cross section, showing decreased gully volume, due to vegetation buffers ability to capture sediment

Figure 8. Sediment Capture Units designed to capture overland flow carrying sediments

We measured sediment concentration in runoff leaving a conventional strawberry farm by capturing water samples during storm events. In the lab, I used vacuum filtration to filter, bake and weigh clay particles.

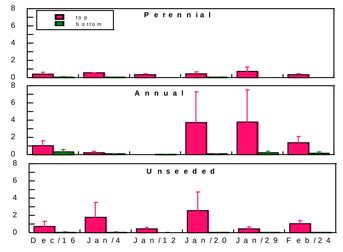

Figure 9. Vegetation buffers reduced suspended sediment concentration of effluent runoff by 93%, compared to runoff entering the VBS; trapping capacities were similar in all treatments

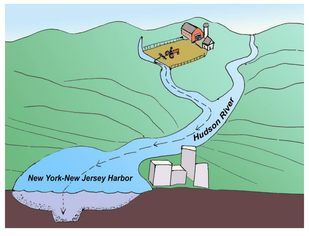

Figure 10. When the sediment is on the farm, it is a valuable resource; when it leaves the farm through erosion, it becomes pollution. Sediments eventually flush into a receiving water, ie. ports.

Dredging of ports and navigation routes is required to maintain vessel access. Contaminated sediments have high disposal costs and environmental impacts to wildlife and water supplies. Finding innovative, marketable products for dredged material is an important need.

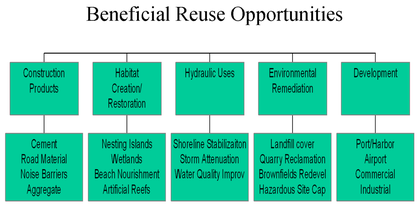

Figure 11. Dredged material framework for potential uses, including those with high levels of contamination.

Conclusions

Vegetation buffers **were** effective at:

- Preventing erosion (gully development)

No new gullies developed after vegetation established

- Trapping suspended sediment & insoluble chemicals

Gullies filled in, suspended sediment had 93% capture

- Protecting water quality in a sensitive estuary

Agricultural chemicals remained on farm, out of water

- Reducing exposure to environmental contaminants

Reduced wildlife impacts in nurse habitat

- Restoring native grasses while reducing pollution

Native perennial grasses most effective by second year

After establishment, all vegetation buffer treatments showed a net capture of sediment. Timing of vegetation establishment, rainfall intensity and slope steepness were important factors influencing sediment loss. Potential management strategies to increase buffer strip efficiency include 1) irrigation to catalyze plant establishment before the onset of the rainy season and 2) use of a nurse annual crop in a perennial system to provide initial soil protection while perennial grasses establish.

Agricultural chemicals impair water quality in many watersheds. Restoring landscapes with native grasses can effectively provide source control for reducing topsoil reduction and protecting water quality, yielding multiple benefits. Removing contaminants from water is a costly and challenging effort. Effective source control reduces dredging expenses and environmental exposure to pollutants.

Policy implications include targeting sensitive waters and eroding fields to change land use. Converting productive land to include vegetation buffers will reduce erosion, protect water quality and reducing dredging needs.

Literature cited

Lant, C., S. Kraft, and K. Gillman. 1995. Enrollment of filter strips and recharge areas in the CRP and USDA Easement Programs. Journal of Soil and Water Conservation 50:169-200.

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For further information

Please contact rein@scientist.com or go to *www.effectivewatershedsolutions.com* to view this poster and request information on water quality or ecological restoration projects. Watershed solutions is a Florida and PBC certified woman owned small business.