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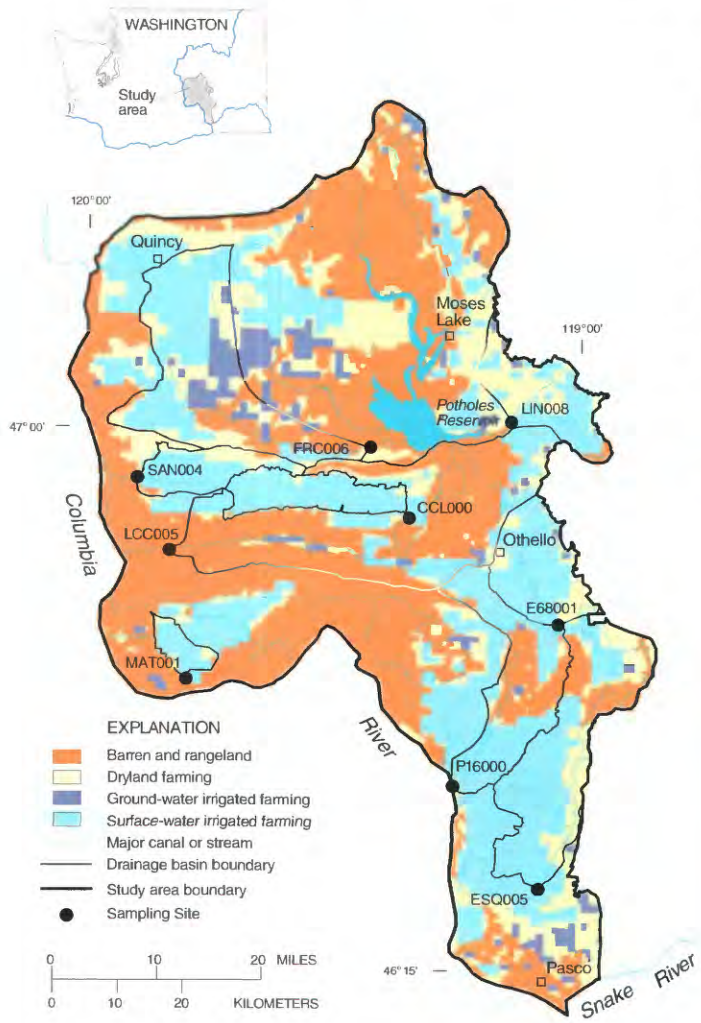
Irrigation and Surface-Water Quality in the Quincy and Pasco Basins, Washington

USGS Fact Sheet 080-97

- **The transition from furrow to sprinkler irrigation has reduced the transport of soil from irrigated cropland to surface waters.**
- **Both current conditions and historical trends reveal that decreasing use of furrow irrigation reduces the soil loss.**
- **Lower concentrations of DDT in streambed sediment and fish tissue were detected in drainage basins with lower percentages of furrow irrigation.**
- **Decreasing use of furrow irrigation may reduce runoff losses of other pesticides and nitrogen from irrigated cropland.**

During 1993-94, scientists with the U.S. Geological Survey National Water Quality Assessment (NAWQA) Program collected samples of surface-water discharges at the outflows of nine drainage basins containing irrigated cropland. All or parts of the drainage basins lie within the Quincy and Pasco Basins of Washington State. The study area is defined by the boundaries of the Columbia Basin Irrigation Project where irrigation water is diverted from the Columbia River and distributed to cropland through an extensive network of canals and laterals. Samples were analyzed for concentrations of suspended sediment, pesticides and nutrients.



Land use in study area and location of sampling sites.
See table for explanation of site abbreviations.

Usually, the effectiveness of an irrigation method in reducing surface runoff is assessed with small-scale studies on plots and fields. The data from this NAWQA study provided an opportunity to assess the effects of the two dominant methods of irrigation, furrow and sprinkler, on the runoff of soil, pesticides and nitrogen from irrigated cropland to surface waters at a drainage-basin scale. Using historical data, the relation between changes in methods of irrigation and changes in soil loss over time was also evaluated.

How Does Irrigation Affect Surface-Water Quality?

Surface-water quality is degraded by the runoff of soil, pesticides and nutrients from cropland to streams. Runoff of soil and associated compounds from cropland typically increases when surface runoff increases as a result of precipitation or irrigation. Sprinkler irrigation usually produces less surface runoff than furrow irrigation. Therefore the use of sprinkler irrigation reduces the runoff of soil and may reduce the runoff of pesticides and nutrients from irrigated cropland and their transport to surface waters.

Irrigated agricultural drainage basins sampled in the Quincy and Pasco Basins

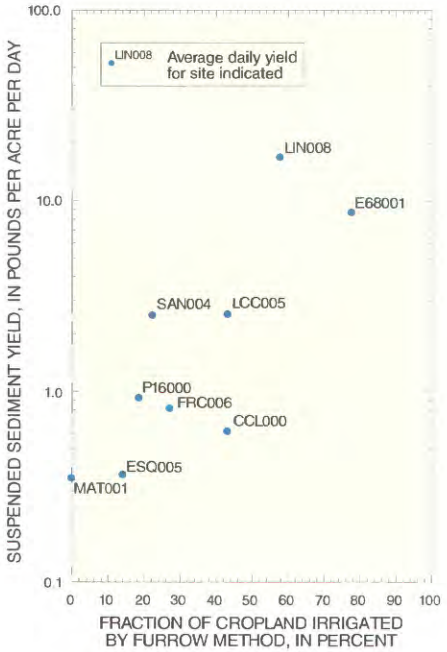
[mi^2, square mile]

Site abbreviation	Sampling site	Drainage area (mi^2)	Irrigated area (mi^2)	Furrow irrigation (percent)
CCL000	Crab Creek Lateral	56.2	39	44
E68001	EL68D Wasteway	[a]146	52	78
ESQ005	Esquatzel Wasteway	[a]475	72	14
FRC006	Frenchman Hills Wasteway	202	80	27
LCC005	Crab Creek near Beverly	386	93	43
LIN008	Lind Coulee Wasteway	[a]703	35	58
MAT001	Mattawa Drain	18.1	13	0
P16000	PE16.4 Wasteway	118	44	19
SAN004	Sand Hollow Wasteway	46.5	31	22

[a] Parts of drainage areas extend outside the study area.

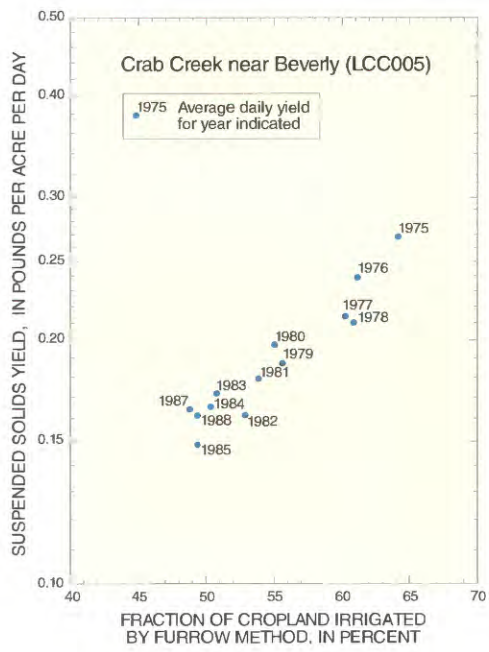
Decreasing Use of Furrow Irrigation Results in Less Soil Loss

Analyses of samples collected from nine drainage basins during April and May 1994 at the beginning of the irrigation season indicate that yields (amount discharged divided by acre of irrigated cropland) of suspended sediment, an indicator of soil loss, are closely related to the percentage of cropland irrigated by the furrow method.



Downward Trend in Use of Furrow Irrigation Over Time Has Decreased Soil Loss

Analysis of long-term data for one site, Crab Creek near Beverly (LCC005), shows a strong relation between yields of suspended solids and the percentage of cropland irrigated by the furrow method. (Suspended solids and suspended sediments are differentiated by the techniques used to collect and analyze the samples. The concentration of suspended solids are usually less than suspended sediment.)



Decreasing Use of Furrow Irrigation Provides Additional Benefits to Surface-Water Quality

In a related study in the Quincy and Pasco Basins, Gruber and Munn (1996) found that drainage basins with lower percentage of cropland irrigated by the furrow method had lower concentrations of DDT in streambed sediment and fish tissue.

To determine if runoff losses (amount discharged divided by amount applied) of other pesticides and nitrogen also relate to the irrigation method, samples were collected and analyzed at two sites during the 1993 irrigation season. Results indicate that runoff losses of most pesticides and nitrogen in the Crab Creek Lateral drainage basin (CCL000), with a lower percentage of cropland irrigated by the furrow method, were less than losses from the EL68D Wasteway drainage basin (E68001) (see following table).

Comparison of runoff losses from two basins sampled in 1993

Sampling site	Furrow irrigation (percent)	Runoff Losses Pesticides (percent)	Runoff Losses Nitrogen (percent)
Crab Creek Lateral (CCL000)	44	[a] 0.04	5.6
EL68D Wasteway (E68001)	78	[a] 0.31	8.4

[a] Median value of 13 pesticides.

Other Management Practices Can Reduce Soil Loss

Although this fact sheet showed the effects of irrigation method on soil loss and runoff losses of compounds, other management practices can also influence soil loss from irrigated cropland. For example, adding polyacrylamide (PAM) to irrigation water increases the cohesiveness of soil particles, making the soil less subject to erosion (Raloff, 1993). Since 1995, PAM has been used extensively on cropland irrigated by the furrow method in the study area.

References

Gruber, S.J. and Munn. M.D., 1996, Organochlorine pesticides and PCBs in aquatic ecosystems of the Central Columbia Plateau: U.S. Geological Survey Fact Sheet 170-96, 4 p.

Raloff, J., 1993, Holding on to the Earth: Science News, v. 144, p. 280-281.

This fact sheet is based on the journal article by Ebbert, J.C. and Kim, M.H., in press, Relation between irrigation method, sediment yields, and losses of pesticides and nitrogen: Journal of Environmental Quality, [about 8p.]

For further technical information contact:
Project Chief
Central Columbia Plateau NAWQA
1201 Pacific Ave., Suite 600
Tacoma, WA 98402
Phone: (253) 593-6530 x235
Email: nawqa_ccpt_wa@usgs.gov
WWW: http://wwwdwatcm.wr.usgs.gov/ccpt/

By Moon H. Kim and James C. Ebbert

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