

## Carbon sequestration in irrigated pastures

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**Introduction** Carbon sequestration potential for irrigated grazing lands is significant. We measured organic and inorganic C stored in southern Idaho soils having long-term land use histories that supported native sagebrush vegetation (NSB), irrigated pasture systems (IP), irrigated conservation tillage sites (ICT), and irrigated moldboard plowing systems (IMP). This study estimates the amount of possible organic, inorganic and total C sequestration if irrigated pasture land was expanded by 10%.

**Materials and methods** The study area is the Snake River Plain between 42°30' and 43°30' N and 114°20' and 116°30' W, 860 to 1300 m elevation. The climate is temperate semi-desert with cool, moist winters and hot, dry summers. Annual precipitation is 175 to 305 mm. Average annual temperature is 9 to 10°C and soils are typically well-drained loams and silt loams (Aridisols) derived from loess deposits overlying basalt. Soil samples were taken from 3 NSB, 3 IP, 3 ICT (past 8 years), and 3 IMP sites. Ten random 2.4-cm diameter replicate soil cores were taken from each site and partitioned into 0-5, 5-15, 15-30 and 30-100 cm depths. Roots greater than 1.0-cm diameter were measured separately. Inorganic C in each sample of mineral soil was determined by titration (Loeppert & Suarez 1996). Concentration of organic C in each sample of mineral soil was determined by the Walkley-Black procedure (Nelson & Sommers 1996). Total C ha<sup>-1</sup> to a 100-cm depth of mineral soil was calculated assuming 0.44 g C g<sup>-1</sup> organic matter with correction for soil bulk density.

**Results** Inorganic C and total C (inorganic + organic C) in soil were higher in IP than NSB (Table 1). If irrigated pasture land was expanded by 10%--meaning NSB land was converted to IP--a possible gain of 9.6 x 10<sup>8</sup> Mg total C (1.7 % of the total C emitted in the next 30 year) could be sequestered in soils worldwide. If irrigated agricultural land was expanded worldwide and NSB was converted to IP, while an equal amount of less-productive rain fed agricultural land was returned to native grassland, a possible gain of 9.3 x 10<sup>9</sup> Mg total C (11.9 % of the total C emitted in the next 30 yr) could be sequestered in soils. The following figures formed the basis of the calculations: Land area in irrigated crop land in the Western United States is 2.43 x 10<sup>7</sup> ha and worldwide is 2.60 x 10<sup>8</sup> ha. % C<sub>s</sub>/C<sub>EW</sub> = C sequestered (C<sub>s</sub>) divided by the amount of C projected to be emitted worldwide during the next 30 years, which is 5.7 x 10<sup>10</sup> Mg C (C<sub>EW</sub>) multiplied by 100.

**Table 1** Total C sequestered in soils during a 30-year period by a 10% conversion from NSB to irrigated conservation tillage and irrigated pasture lands; and 10% conversion from irrigated moldboard plow to IP

Vegetation conversion	Mg C ha <sup>-1</sup>	Western United States		Worldwide	
		Mg C	% C <sub>s</sub> /C <sub>EW</sub>	Mg C	% C <sub>s</sub> /C <sub>EW</sub>
NSB to irrigated conservation tillage	8.0	1.9 x 10 <sup>7</sup>	0.03	2.1 x 10 <sup>8</sup>	0.37
NSB to IP	35.6	8.7 x 10 <sup>8</sup>	1.53	9.3 x 10 <sup>9</sup>	16.32
10% of irrigated moldboard plow to IP	37.1	9.0 x 10 <sup>7</sup>	0.16	9.6 x 10 <sup>8</sup>	1.68

**Conclusions** The expansion of irrigated pasture land would significantly increase C sequestration in soils worldwide. Land use shift from relatively low productivity rain fed agricultural land to temperate forest or native grassland could also cause meaningful reductions in atmospheric CO<sub>2</sub>.

## References

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