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Development of continuous living cover breeding program to enhance agriculture's contribution to ecosystem services

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Abstract

Over the last half-century, 'Green Revolution' technologies have dramatically enhanced crop yields, but have reduced the production of ecosystem services necessary to maintain global food security. Globally, many fear that agriculture is nearing a tipping point; with concerns that population pressure, declining natural capital, and overall diminished ecosystem service delivery will reduce global food security. As a result, a new green revolution is needed – a 'Forever Green Revolution' – that embraces continuous living cover on working lands through the development of a new suite of perennial grains and winter-annual crops that are high yielding and also produce multiple ecosystem services. By adding perennial and winter-annual crops to agricultural systems, we can: enhance agricultural productivity, support rural economic development, and provide major environmental benefits to all citizens. A strong base of evidence indicates that these new production systems can enhance cropping system yields, produce new high value commodities (food, feed, and high-value biomaterials), enhance soil quality, provide wildlife habitat, enhance species biodiversity, and improve water resources. Perennial and winter-annual crop based agricultural systems should also be more resilient to climate change, and weed, disease and insect pressure. These benefits are possible because perennial and winter-annual crops are alive during a large portion of each year when summer crops are absent. For this reason, perennial and winter-annual crops, working in tandem with summer-annuals, can capture solar energy, water, and nutrients with high efficiency. Currently, perennial grains and cover crops cover only 3 to 7% of cropland in the United States. In order to accomplish a 'Forever Green' landscape, we propose that a paradigm shift in three areas is needed: focus public plant breeding programs on continuous living cover development, diversify and enhance agricultural stakeholder engagement by encompassing landscape optimization planning, and a revaluation of what is considered a highly productive and efficient agricultural system.

Key words: ecosystem service, soil erosion, yield, economic valuation, agroecosystem, Minnesota, tradeoff analysis, optimization