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Multiple-use grasslands : integrating forage , biofuel , and carbon/ phosphorus sinks

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Introduction Crop-livestock integration has declined in North America over the last century but economic and environmental priorities may reverse that trend (Russelle et al . , 2007) . Landowners , especially in drier climates ill suited to row crops , can reduce risks by integrating crops such as biofuels with their current livestock priorities (Allen et al . , 2007) . If biofuel cropping is to succeed in sub-humid and semi-arid climates and on a wide scale , it must integrate into existing systems , initially as a secondary crop until biofuel feedstock markets become stable . Landowner culture (Esterchild and Stanley-Stevens , 2005) and unpredictable climate leave no other choice . In drought years , keeping herds and flocks alive will take priority for socio-cultural and economic reasons while excess forage in high rainfall years can provide inexpensive biofuel stocks . Our challenge will be to design biofuel cropping systems that can best integrate into entrenched animal farming systems while still providing constant fuel supplies to future conversion plants .

Environmental applications may also add value to multiple-use forage biofuel systems . In many grassland regions of the world , concentrated animal feeding operations (CAFO) produce copious quantities of manure , compost , and manure bio-digester solids that pose environmental concerns to water quality (Sharpley and Withers , 1994) . Biofuel cropping systems are ideally suited to mitigate these concerns (Lee et al . , 2007) . Grass swards reduce surface water runoff , have stable soil environments for phosphorus (P) , sequester N and C (Bronson et al . , 2004) , and can recycle manure nutrients because , by definition , biofuel and forage cropping systems are extractive (Pierzynski and Withers , 1994) . This presents a fortuitous opportunity to regions worldwide where beef , dairy and poultry operations can safely apply wastes to biofuel crops not only as nutrient sources (N) but also as nutrient sinks (P) .

Materials and methods Multi-use cellulosic biofuel production systems are currently being studied in south-central North America . Applications include : 1) cellulosic biofuel feedstocks ; 2) pasture grazing for cattle , goats and sheep ; 3) hay and haylage production ; 4) bio-diversification of fauna and flora in high-diversity , low-input native grasslands ; 5) poultry and dairy CAFO manure P sequestration ; 6) C sequestration for carbon credits ; 7) soil conservation under perennial grasslands .

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