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Department of Agricultural and Consumer Economics, University of Illinois Urbana-Champaign

New Approaches to Weed Management: Public-Private Partnerships

Lisa Schlessinger, Natalie West, and A. Bryan Endres

Department of Agricultural and Consumer Economics
University of Illinois

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Introduction

Large scale management of weed populations is vital to decreasing propagule pressure and reducing weed seedbanks, two of the principle process targets in integrated weed management strategies.[1] Unfortunately, demands for improved management techniques will escalate in many areas as herbicide resistance (HR) expands. One strategy—cooperative weed management areas (CWMAs)—have been a fixture in western rangeland systems, and are increasingly being adopted to manage invasive plant populations in the eastern U.S. CWMAs are defined loosely as coalitions of neighboring landowners, natural resource agencies, and conservation organizations that pool and distribute public and private resources to optimize regional weed control.[2] As plant dispersal is not restricted by land ownership boundaries, and both the direct and indirect movement of weed seeds is facilitated by the agricultural infrastructure, whether through contaminated feeds or manure, use of non-certified seed, or weed seeds carried on farm equipment transported or used across broad areas, a more regional or landscape approach to weed management may be an important innovation in traditional Midwestern row cropping environments.[3]

[1] *E.g.,* L. Bastiaans et al., *Focus on ecological weed management: what is hindering adoption?* 48 WEED RES. 481 (2008); F.D. Menalled et al., *Weed aboveground and seedbank community responses to agricultural management systems*, 11 Ecological Applications 1586 (2001).

[2] Center for Invasive Plant Management 2002. "*Weed Management Areas"* adapted from *BLM Guidelines for Coordinated Management of Noxious Weeds*, Chapter 11 in *Invasive Plant Management: CIPM Online Textbook*, CENTER FOR INVASIVE PLANT MANAGEMENT, http://www.weedcenter.org/textbook/index.html (last visited Apr. 21, 2015).

[3] J.K. Norsworthy et al., *Weed Seed Contamination of Cotton Gin Trash*, 23 WEED TECH. 574 (2009); C.L. Mohle, *Weed Life History: Identifying Vulnerabilities, in* ECOLOGICAL MANAGEMENT OF AGRICULTURAL WEEDS. (M. Liebman et al. eds. 2001); S. Benvenuti, *Weed Seed Movement and Dispersal Strategies in the Agricultural Environment*, 7 WEED BIO AND MGMT. 141 (2007); S. Weller et al., *The Need for Speed: Timely Prevention of the Dispersal of Noxious Weeds in Relief Fodder Using Efficient Sampling Procedures*, 70 CROPS PROTECTION 21 (2015): J.K. Norsworthy et al., *Reducing the Risks of Herbicide Resistance: Best Management Practices and Recommendations*, 60 WEED SCI. 2 (2012). For example, problems with Palmer Amaranth are thought to have originated with cattle feed transported from southern regions of the US. https://www.extension.purdue.edu/extmedia/WS/WS-51-W.pdf.

Why Public Lands Have Adopted CWMAs?

CWMAs have been effective across the West in managing infestations that cross boundary lines or require expensive or intensive treatments. For instance, Montana[4] and Nevada[5] have ongoing and active programs to develop and coordinate Cooperative Weed Management efforts. In cropping systems, successful regional cooperative efforts have been implemented to reduce the prevalence of cotton boll weevil and stem the spread of citrus diseases.[6] However, these types of cooperative arrangements have been rare in cropping systems, particularly in the eastern U.S., and have been primarily system or problem specific.

Why Private Landowners Will Benefit from Working Cooperatively?

A problem such as weed herbicide resistance gives rise to a situation in which individual, on-farm, practices affect common pool resources (i.e., resistance susceptibility), resulting in a tradeoff between the immediate benefits of highly effective weed control through herbicide application coupled with HR crops, and the long term efficacy of these management tools (i.e., herbicides and HR crops), and system productivity (quality of ecosystem services).[7] Long term investments in sustainable practices can improve system health and management efficacy over time, but experience has shown that the net benefit of these investments cannot be optimized piecemeal, with no coordination at the landscape-scale of weed populations and control of post-harvest transport.[8]

In rangeland systems and other invasive plant management efforts, control strategies and knowledge dissemination has benefited from cooperative networks of landowners, managers, and researchers involved in the development and implementation of pest control technology. Multiple studies have suggested coordinated management above the farm-scale is necessary to reduce regional weed populations, and increase the sustainability of weed control options; however, this represents just as much of a social dilemma as ecological one.[9] Practices that are optimal at the farm-scale do not necessarily result in landscape-scale benefits, and implementation of alternative management strategies necessitates both agronomic and cultural changes.[10]

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[4] MONTANA WEED CONTROL ASSOCIATION, *Weed Control and Management*, http://mtweed.org/weed-control-management/ (last visited Apr. 21, 2015).

[5] NEVADA DEPARTMENT OF AGRICULTURE, *Nevada's Cooperative Weed Management Areas (CWMAS)*, http://agri.nv.gov/Plant/Noxious_Weeds/Programs__CWMA_Overview/ (last visited Apr. 21, 2015).

[6] APHIS, *Plant Protection and Quarantine: Questions and Answers Boll Weevil Eradication*, http://www.aphis.usda.gov/publications/plant_health/2013/faq_boll_weevil_erad.pdf (last visited Apr. 21, 2015); NATIONAL COTTON COUNCIL OF AMERICA, *History of the Eradication Program*, http://www.cotton.org/tech/pest/bollweevil/eradication2.cfm (last visited Apr. 21, 2015); USDA/APHIS, *Citrus Health Response Plan State of Florida*, http://www.aphis.usda.gov/plant_health/plant_pest_info/citrus/downloads/chrp.pdf (last visited Apr. 21, 2015).

[7] David Ervin and Ray Jussaume, *Integrating Social Science Into Managing Herbicide-Resistant Weeds and Associated Environmental Impacts*, 62 WEED SCIENCE 403 (2014); A. Agrawal, *Sustainable Governance of Common-Pool Resources: Context, Methods, and Politics*, 32 ANN. REV. OF ANTHROPOLOGY 243(2003); M.D.K. Owen, *Weed Species Shifts in Glyphosate-Resistant Crops*, 64 PEST MGMT. SCI. 377 (2008).

[8] *E.g.*, D. A. Mortensen et al., *The Role of Ecology in the Development of Weed Management Systems: An Outlook*, 40 WEED RES. 49 (2000); M.D.K. Owen et al., *Integrated Pest Management and Weed Management in the United States and Canada*, 71 PEST MGMT. SCI. 357 (2014); C. Shennan, *Biotic Interactions, Ecological Knowledge and Agriculture*, 363 PHIL. TRANSACTIONS OF THE ROYAL SOC'Y B 717 (2008); L. Bastiaans et al., *Focus on Ecological Weed Management: What is Hindering Adoption?* 48 WEED RES. 481 (2008).

[9] David Ervin, *supra* note 6; R.S. Epanchin-Niell & A. Hastings, *Controlling Established Invaders: Integrating Economics and Spread Dynamics to Determine Optimal Management*, 13 ECOLOGY LETTERS 528 (2010); P. Neve et al., *Evolutionary-Thinking in Agricultural Weed Management*, 184 NEW PHYTOLOGIST 783 (2009). C.J. Swanton & S.D. Murphy, *Weed Science Beyond the Weeds: the Role of Integrated Weed Management in Agroecosystem Health*, 44 WEED SCI. 437 (1996).

[10] D.D. Buhler et al., *Theoretical and Practical Challenges to an IPM Approach to Weed Management*, 48 WEED SCI. 274 (2000); R.S. Epanchin-Niell et al., *Controlling Invasive Species in Complex Social Landscapes*, 8 FRONTIERS IN ECOLOGY AND THE ENV'T. 210 (2010); J.K. Norsworthy et al., *Reducing the Risks of Herbicide Resistance: Best*

What Are Legal Tools for Encouraging and Facilitating Private Cooperative Weed Management Areas?

As mentioned in the previous section, a coordinated management scheme is needed for successful invasive management as a tool for farmers to fight herbicide resistance. While the science is clear, the social dilemma of how to facilitate cooperative work between neighboring farmers over a certain geographic boundary is a hurdle to CWMA formation and long-term success.[11] Existing state-level laws that attempt to solve the issue generally fail to regulate invasive plants. These weak rules cover, on average, only 20% of the species considered invasive by scientific authorities.[12] When regulatory systems fail to cover disputed topics, it falls upon individual farmers and landowners to develop alternative strategies. There are several possible solutions with varying governmental involvement to promote the use of private CWMAs; including private action, state regulation, or a hybrid model of public-private engagement whereby the state creates supporting structures for private CWMAs. All options require individuals to contract with each other to ensure long term success and establish roles and responsibilities of the members.[13]

Private action requires private individuals and business to contract with each other to reach a desired outcome. Much like the CWMAs for public lands, a private CWMA should contain clauses that clearly define the purpose of the agreement, specify the boundaries of the CWMA and adapt the rules to local conditions, specify who the members are, decide how accountability and monitoring of progress will work, impose sanctions for violations of the agreement, contain conflict resolution mechanisms, and detail the governance structure.[14] Future work by the authors will develop model private agreements for the establishment of voluntary CWMAs.

In addition to private contracts, policymakers may find that state regulations would help increase the likelihood and willingness of farmers to adopt CWMAs. Model statues can clarify the terms of each clause discussed in the section above, while giving more teeth to the legitimacy of the CWMA through state endorsement of incentives and enforcement clauses. Another regulatory option is to craft statutes that govern the formation, governance and conflict resolution of a farmer's association that would resemble the already existing framework of homeowner's associations.

There is no clear answer as to which option—private action, state regulation or a hybrid model—is the most effective for encouraging the adoption of private CWMAs. However, the current uncoordinated practices by landowners and farmers demonstrate a need for a more nuanced and comprehensive framework to promote establishment of CWMAs in order to better manage invasive species and slow the rate of herbicide resistance.

Management Practices and Recommendations, 60 WEED SCI. 31 (2012);D.A. Mortensen et al., *Navigating a Critical Juncture for Sustainable Weed Management*, 62 Bio. Sci. 75 (2012).

[11] David Ervin, *supra* note 6.

[12] Lauren D. Quinn et al, *Navigating the "Noxious" and "Invasive" Regulatory Landscape: Suggestions for Improved Regulation*, 63 BIOSCIENCE 124 (2013).

[13] Midwest Invasive Plant Network, *CWMA Cookbook: A Recipe for Success*, http://www.mipn.org/CWMACookbook2011.pdf (last visited Apr. 17, 2015).

[14] David Ervin, *supra* note 6.