Common Pool Resource Issues in Managing Herbicide Resistant Weeds

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USDA ERS and Farm Foundation Conference "Public and Private Sector Policy Implications of Research on the Economics of Herbicide Resistance Management."

November 8, 2013

Outline

- Problem context of herbicide resistance (HR)
- Common pool resource (CPR) complications
- Lessons from other CPR situations
- Implications for developing private and public collective institutions

Problem Context

- Escalating herbicide resistance poses serious economic and environmental risks (NRC).
- Potential economic impacts include lower yields and increased costs.
- Potential environmental impacts include soil erosion, water quality, human health, etc.
- Public and private programs to control HR weeds have not slowed its spread overall.

Problem Context cont'd

- No silver bullet technology on horizon
- Mobile herbicide resistance traits move across farm boundaries
- Solutions require collective action by heterogeneous growers in varying settings.
- This complexity requires interdisciplinary research by natural and social scientists working with growers.

Working Hypothesis

Sustainable HR management will require private and/or public collective institutions to address CPR issues via adaptive management strategies.

Common Pool Resource Complications

- Grower actions affect the welfare of other growers via weed gene movement.
- Hence, strategies to promote individual HR BMPs are insufficient to optimize the welfare of the farm community as a whole.
- Some form of private and/or public collective action is necessary.

Design Principles for CPR Mgmt (Ostrom)

1. **Clearly defined resource boundaries**
2. **Rules adapted to local conditions**
3. **Broad participation by “appropriators”**
4. **Monitoring accountable to the appropriators with sanctions**

Design Principles for CPR Mgmt (Ostrom)

5. **Scale of graduated sanctions**
6. **Cheap and easy conflict resolution mechanisms**
7. **Self-determination of the community recognized by higher authorities**
8. **Larger issues may need “polycentric” governance with multiple layers.**

Lessons from other CPR programs

- **Invasive and noxious weed control**
  - **State regulatory approach**
  - **Formation of weed management areas recognizes need for community-wide effort**
  - **WMAs can define problem boundaries as watersheds, land use areas, etc.**
  - **Non-compliance procedures defined**

Lessons from other CPR programs

- **Boll weevil eradication**
  - **Caused by mobile insect that affected common pool of regional resources**
  - **Three agencies in polycentric approach**
    - **State DoAs – regulatory**
    - **APHIS – technical advice**
    - **CSREES – info dissemination & education**
  - **Required 2/3 vote on referendum to expand into new areas**

Lessons from other CPR programs

- **Irrigation (Ostrom, Stern and Dietz)**
  - **Common pool of regional water resources**
  - **Collective approaches were alternatives to privatization or government programs**
  - **Spain, California and Nepal examples**
  - **Recognition of need for adaptive management**

But CPR programs are complex….

- **Agrawal (2003) – meta review**
- **Factors affecting formation do not have unequivocal effects, e.g., size of group**
- **Higher group heterogeneity not always a disadvantage**
- **Need to account for resource, social/political contexts and personal values**

Concluding observations

1. **HR results from the interplay of biophysical, technological, economic and social factors. Leave any out at your peril!**
2. **Research on the roles of human and social capital in causing and arresting HR has been neglected.**
3. **Reliance on individual farmer approaches will fail with mobile HR traits.**

Concluding observations

4. **Private and public collective approaches are necessary but will impose cost.**
5. **Ostrom's design principles can help guide their development.**
6. **Success likely will come from participatory research using local knowledge that minimizes transaction costs.**

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Socio-Economic Drivers of HR

- Crop prices
- Costs of alternative herbicide technologies
- Company HR BMP incentives
- Farm household income
- Grower personal values about environmental stewardship

Socio-Economic Drivers of HR

- Farm program provisions, e.g., conservation compliance
- Community social network (support and peer pressure)
- Grower education
- Other?

HR Environmental Assessment

- **Resistance management depends on gene mobility, BMP use and pesticide market structure (Miranowski & Carlson).**
- **Environmental assessments of HR therefore must integrate human behavior.**
- **Altering spatial and dynamic patterns of HR environmental impacts requires more interdisciplinary science.**

HR Environmental Assessment

- **Voluntary ag conservation programs, e.g., education, without incentives have limited effect (Ervin).**
- **Knowledge of socioeconomic factors with large HR management leverage under CPR conditions is needed.**
- **The challenge is to design programs for local conditions that integrate learning and adaptive management.**

Salient Questions

1. **How does the interplay of biophysical, economic and social factors affect growers' herbicide management?**
2. **Can we identify different types of growers that are influenced by different sets of factors?**
3. **What variables influence the efficacy of private or public collective management institutions?**