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RESEARCH ARTICLE

Factors limiting the availability of native seed for reconstructing Minnesota's prairies: stakeholder perspectives

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Views about sourcing plant material for restoration, habitat reconstruction, and revegetation have developed substantially in recent years. In particular, recognition of the prevalence of local adaptation has been incorporated into guidelines that now often recommend local sourcing of germplasm. Demand for these materials frequently outstrips supply, and land management professionals repeatedly report inadequate availability of plant materials at appropriate geographic scale and affordable price. Here, we use focus group interviews to investigate the obstacles impeding production and use of source-identified native seeds in Minnesota prairie. Focus groups included both producers and users of locally sourced seeds and allowed for open-ended conversations among professionals within each group. Participants emphasized that unpredictability in demand severely restricts supply. To increase use of locally sourced seeds in restorations, participants identified key priorities: working toward more consistent standards and policies, including revising those of agencies that manage lands; promoting awareness of large ramifications from small changes to relevant laws; increasing communication and education; and increasing the number of seed producers.

Key words: climate change, demand, local adaptation, seed sourcing, source-identified seed, supply

Implications for Practice

- Uncertainty in demand for locally sourced native seeds hinders the long-term planning that producers require and aggravates their risks, compromising availability of locally sourced seeds. Processes that reduce uncertainty in demand or that reduce risks undertaken by producers would aid in increasing supplies of these materials.
- Buyers of native seeds face challenges in predicting their needs due to variation in funding requirements and timelines. Across funding agencies, project planning that recognizes the lead time required for commercial production would improve predictability of demand, producers' ability to meet demand, and, thus, availability of seeds as needed.
- Harmonization of seed-sourcing requirements across funding agencies and programs may increase predictability of demand for producers by clarifying where specific seed lot origins are most likely to be utilized.

Introduction

Habitat destruction and fragmentation are among the largest anthropogenic changes across the planet. The effects of this habitat loss range from pollen limitation that reduces reproduction (Wagenius 2006) to extinction of species (Seabloom et al. 2002). These impacts have prompted an increased focus on prairie conservation and reestablishment of prairie habitat. We use the term restoration to encompass varied revegetation and reconstruction practices that entail planting native species on the landscape.

As restoration practices have developed, recognition of the importance of local sourcing of native plant materials has also grown (Richards et al. 1998; Peppin et al. 2010; De Vitis et al. 2017). Across the globe, there is concern that using plant materials originating far from a restoration site could compromise adaptation of the restored population to the local environment, such that survival and reproduction of individuals would be inadequate to maintain a robust population, or that nearby remnant populations could be at risk of genetic admixture (McKay et al. 2005; Bucharova et al. 2019; Hamilton et al. 2020). While adaptation of populations to their local environment has been amply documented (reviewed in Kawecki & Ebert 2004; Leimu & Fisher 2008; Hereford 2009), the geographic scale of local adaptation is poorly understood (McKay et al. 2005). As a result, land managers have justified concerns about the

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genetic consequences of introducing novel populations to a restoration site.

Awareness of the benefits of using local plant materials is now keen, but demand for such materials outstrips supply (Broadhurst et al. 2015; Camhi et al. 2019; Elzenga et al. 2019). High cost and scarcity of suitable seeds frequently confront land managers, motivating efforts to augment availability and affordability of native plant materials at an appropriately fine spatial scale (Peppin et al. 2010; Tishew et al. 2011; Camhi et al. 2019; Elzenga et al. 2019). Efforts to augment native plant production, or increase availability of native plant materials through public funding, have been under way in various countries, including Australia (Broadhurst et al. 2015), Brazil (Schmidt et al. 2019), Germany (Mainz & Wieden 2019), and the United States (BLM 2009). The state of Minnesota, U.S.A., where prairies once occupied 7.3 million hectares, of which approximately 1% remain (MnDNR 2018*a*, Fig. 1), funded market research concerning native seeds in the 1990s (Dale 1993). More recently, the state has supported seed collection from populations throughout the state's prairie region as a basis for expanding native plant production (Minnesota Law 2014, 2017). Despite these national and regional efforts, multiple obstacles impede the use of locally sourced plant materials.

Previous research on supply and demand of source-identified seed has been most prevalent in the western United States and employed surveys of practitioners. This research identified constraints, including market uncertainty, policy inconsistencies, and technical challenges (Richards et al. 1998; Hooper 2003; Peppin et al. 2010; White et al. 2018; Camhi et al. 2019). For example, in the western United States, the yearly need for plant materials varies depending on extent and severity of wildfires (Richards et al. 1998; Peppin et al. 2010). In the Chicago, IL region, seed sourcing policies ranged from strictly on-site collection to a set radius from the county containing the restoration site (Saari & Glisson 2012). This inconsistency is due to uncertainties about the scale of local adaptation (McKay et al. 2005; Peppin et al. 2010; Hamilton et al. 2020), practical considerations, and the distinct goals of the varied organizations involved (Hooper 2003; Peppin et al. 2010). Additionally, technical challenges have been identified, including the need for more information on propagating, growing, and harvesting species (Dale 1993; BLM 2009; Peppin et al. 2010). Impediments to local seed sourcing are not restricted to the United States; similar obstacles are observed in other countries (Tishew et al. 2011; Broadhurst et al. 2015; Elzenga et al. 2019; Mainz & Wieden 2019; Schmidt et al. 2019).

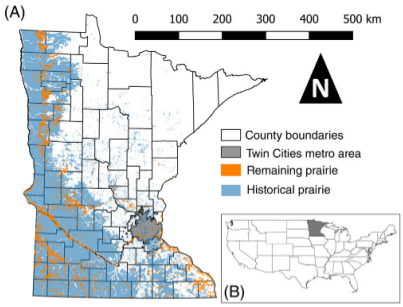

Figure 1. (A) Map of Minnesota showing extent of prairie around 1870 and present. Orange shapes represent remnant prairies as identified by the Minnesota Biological Survey (not restricted to public land). The blue regions represent the native prairie distribution before European settlement. (B) Map of the contiguous United States with the state of Minnesota shaded gray. Geographic Information System (GIS) layers are from the Minnesota Geospatial Commons (MnDNR 1895; 2013; 2018*b*; MDA 2014).

We present research on obstacles to the production and use of locally sourced, native seeds for prairie restoration, focusing on Minnesota. In this state, there is strong public interest in conservation as demonstrated by the electorate's passage of constitutional amendments dedicating funds to natural resources (Noe et al. 2017) and by the aforementioned governmental support for native seed production. Additionally, policy, practice, and seed purchasers have changed during the 27 years since the previous study, a report to the state legislature, on this topic in Minnesota (Dale 1993), necessitating an update. We report on the results of interviews using focus groups. Participants included producers and users of native seeds sourced in the Minnesota prairie. Our methods differ from previous studies, which used surveys (e.g. Dale 1993; Hooper 2003; Smith et al. 2007; Peppin et al. 2010; Saari & Glisson 2012; De Vitis et al. 2017), databases of available seeds (e.g. White et al. 2018), or records of seed purchases (Camhi et al. 2019). We posed open-ended questions, allowing participants to steer the conversation and insights to arise through interactions among participants (Krueger & Casey 2015).

Methods

Rationale

Our goal was to characterize impediments to the production and use of locally sourced native seed, using Minnesota as an example. Rather few people lead efforts to either produce locally sourced native seed or use it to restore Minnesota prairies. Consequently, our conversations could include nearly all key decision-makers. Because this small number of actors restricts sample sizes appropriate for techniques such as surveys, we chose to use focus group interviews. Such interviews capture individual responses to open-ended questions and additional insights from interactions among participants (Krueger & Casey 2015). Our focus groups were exempt from institutional review, because individuals were asked to discuss their expertise and organizational processes, not personal information (UMN 2015).

Focus Group Participants

We invited participants based on their roles in restoring Minnesota prairies: either the production of source-identified native seeds, or the acquisition and use of such seeds (Table 1). Producers involved in a regional trade group, the Minnesota Crop Improvement Association's (MNCIA's) Native Plant Committee, were selected as participants. Additionally, we identified potential participants from the Minnesota Department of Natural Resources plant supplier list (MnDNR 2016) and through nominations. We included individuals at the major governmental, nonprofit, and for-profit organizations that acquire large quantities of native seed to restore Minnesota prairie. Smaller-scale users were nominated by individuals familiar with Minnesota prairie restorations.

Focus Group Sessions

We followed the focus group methods of Krueger and Casey (2015). The approximately 2-hour focus group interviews occurred in person and by conference call. Sessions included three to nine participants from similar institutions plus the authors (Table 1), began with the same introduction (Supplement S1), and followed the same questions (Supplement S2); for convenience, these questions are given in each Results subsection. The session involving members of the MNCIA Native Plant Committee immediately followed and frequently referenced a scheduled committee meeting; consequently, meeting notes were included in the analysis as if part of that focus group. Sessions were recorded with a Zoom H2N device (Zoom North America: Hauppauge, NY, U.S.A.).

Analysis

Audio recordings of the sessions were transcribed using Express Scribe Transcription Software (NCH Software: Greenwood Village, CO, U.S.A.) or by High Fidelity Transcription (Minneapolis, MN, U.S.A.). We analyzed the focus group sessions qualitatively. While quantitative metrics for analyzing focus group interviews exist, our sessions focused on eliciting the variety of experiences and opinions rather than assessing the frequency of certain experiences. During analysis, we merged questions 1 and 2, which addressed predicting and meeting needs, and questions 5 and 6, which addressed demand for species. We then grouped similar responses to each question, reassigning comments to different questions as appropriate, and distilled responses into the following results. Results, including anecdotes, are from participants' comments during the focus group sessions (Supplement S3).

Table 1. Number of participants in each focus group, totaling 33, exclusive of the researchers. Large-scale users represent the major government and nonprofit entities that use large volumes of seeds for restoration. Users were selected based on entities that perform large restorations and snowball sampling. Producers were identified based on the MNCIA, DNR producer list, and snowball sampling.

Session	*Participants*
Users	
Large-scale users	5
Regional users	7
Other users	4
Producers	
Minnesota Crop Improvement Association	9
Hand collectors	3
Other producers	5

Results

Predicting and Meeting Needs

How do you predict your needs for plant materials? What is the timeline of steps you need to take to be able to meet your needs?

Both users and producers of source-identified seeds repeatedly emphasized that unpredictability of needs seriously undermines the reliability of supply (Supplement S3). Users of native seeds reported that they cannot predict their needs more than a year in advance, due to variable funding and guidelines. Variation in acquisition methods—which include purchase of commercially produced material, hand collecting, and bulk harvesting from wildlands—also affect planning timelines.

Uncertainty in demand compromises the availability of commercially produced seeds. Producers and users attributed the limited availability of source-identified seeds to the challenges of planning and implementing production. These arise from varying policies, changing consumer demands, and the biology of particular species. Demand volatility most constrains production, due to the financial risks. Producers report that they start with species they can reliably produce and sell. Depending on available resources and anticipated financial return, they may expand production into other species. For some species, these efforts are constrained by insufficient knowledge of germination and propagation methods. Overall, unpredictability can obstruct entry into and expansion of the seed production business.

Demand for and the Definitions of "Local"

What geographic scale do you consider local?

Definitions of "local" vary among agencies and funding sources. Sourcing guidelines, which are periodically revised, range from restricting to seed originating within 24 km (15 miles) of a restoration site to having no restriction. For example, sourcing guidelines from Minnesota governmental agency programs range from specifying a 40-km (25-mile) radius (Department of Natural Resources, MnDNR), to allowing seeds originating from anywhere in Minnesota and bordering counties of neighboring states (Department of Transportation, details in MacDonagh & Hallyn 2010), to using predefined ecological regions (details in BWSR 2017). Individuals also expressed their opinions regarding the definition of "local." These included preference for sourcing from the same county and surrounding counties; from within 320 km (200 miles); and from an oval 480 km (300 miles) east–west and 320 km (200 miles) north–south, reflecting climatic variables.

Producers and users of native seed recommended considering local sourcing within the context of nearby conditions, intended use of the seeds, and species. The extent and quality of prairie remnants vary throughout the state; local sourcing may obviate the risk of genetically contaminating nearby remnants. Conversely, if a species no longer grows in the area, there is no risk of genetic contamination of populations. Seed collection from wildlands may compromise prairie remnants, and some land managers strictly limit harvesting. Producers viewed local sourcing as more important to long-term than potentially shorter-term restorations, such as those funded under the Conservation Reserve Program (CRP). Producers and users also stated that the definition of "local" should vary among species, given differences in pollination and seed dispersal distances.

Native seed users discussed potential effects on their practice of climate change, adaptive potential, and production location. Climate change may profoundly influence seed sourcing. Practitioners want plant materials that are adapted to both initial and future environmental conditions. However, they also noted the planning required to respond to climate change and acknowledged the risks that assisted migration may impose on extant populations. Users and producers expressed concern that populations' genetic variation declines due to genetic bottlenecks and unconscious selection during collection and propagation. They also questioned whether production site should be considered, in addition to material origin, when sourcing seeds.

Demand and Location

Are there particular parts of the state you anticipate demand changing for?

When asked about geographical change in demand, participants stressed the unpredictability. Some producers and users were unprepared for intensified concern for pollinators and demand for seeds of associated plants, including for revegetation around solar panel arrays. One user speculated that ongoing tree loss due to invasive pathogens and insects may increase demand for savanna species. Some users anticipate that climate change may shift demand indirectly via managed relocation (sensu Richardson et al. 2009). In general, participants expect demand for native seed to increase, though this may depend on marketing, state programs, and large Federal programs such as CRP.

Demand and Species

Are there particular species you anticipate demand changing for?

What seeds or plant materials are you interested in acquiring for use or production but do not have access to?

Participants noted that prairie restorations often include relatively few of the species historically present in tallgrass prairie and identified contributing factors (Supplement S3). Producers reported needing about 5 years to bring seeds of a new species to market. The corresponding delay in recovering their investment means that producers must balance risks and rewards when choosing species to produce (Supplement S4). Producers reported that, for some species, the selling price required to recover their investments is prohibitive for many purchasers. Thus, desirable species that must be sold at higher cost may be harder to sell. Moreover, idiosyncratic biology of individual prairie species can present challenges to commercial-scale production (Supplement S4), due to insufficient information on methods for effective collection, germination, growth, and harvest. Producers and users both noted low availability of species that flower early in the season, have small stature, or occupy wet prairies. Furthermore, seed yield varies interannually, and phenology, weather, and other phenomena affect harvests.

Increasing species diversity in restorations will involve decisions and actions by both producers and users of native seed. These include overseeding and efforts to support pollinators and other invertebrates, such as bulk harvesting via haying, which can collect invertebrates along with the plant materials. Demand for greater species diversity will depend on the resources available to restoration projects, especially for species that have high production costs. Currently, some users of native seeds address this by harvesting expensive species that grow on their own land and distributing them to other areas.

Current Strengths

What is currently working well in the processes for producing and using source-identified seed?

Seed sourcing is improving; more seeds, species, and populations are available, and at higher quality. Participants appreciate Minnesota's system of standards and certifications. While not all seeds meet current guidelines, users stated that seed is now regularly sourced closer to the restoration site than in the past. Demand is also strong in the broader region; producers can often sell seeds outside of Minnesota when unable to sell them within Minnesota.

Users emphasized the employment opportunities associated with grassland conservation and the increased demand for restoration work, due partly to Minnesota's state programs (e.g. Outdoor Heritage Fund). Producers were concerned, however, that increased government involvement in production could harm their business; their consensus was that private entities will grow to meet demand if not challenged by government competition. Additionally, producers voiced concern that potential government-run seed storage facilities, though intended to reduce annual variation in demand, could harm private seed brokering businesses.

Partnerships and cooperation within the restoration sector were viewed positively. Examples included the Glacial Ridge Project, a joint effort of The Nature Conservancy, government agencies, and a commercial seed producer. Users reported valuing relationships with trusted producers, volunteer seed collectors, and nonprofit organizations (e.g. Conservation Corps). Producers also reported cooperative efforts to fill orders.

Current Weaknesses

What would you change about the current source-identified seed system?

Users are often unable to obtain seeds in the quantities they need, while producers face uncertain demand. One user reported receiving bids for seed purchases that lacked some requested species (Supplement S3). Users discussed establishing guidelines to influence production choices. Producers noted the limited incentive to produce species for which demand is uncertain.

Both users and producers expressed concern over staffing (Supplement S3). Users have insufficient staff to harvest multiple times annually; this limits availability of species that are difficult to produce due to unusual phenologies or explosive seed dispersal. Users also need staff to maintain conditions that support robust, reproductive plants and discussed losing sites and genetic resources due to inadequate maintenance. Producers report difficulty retaining experienced employees, who can find higher-paying jobs elsewhere. Producing multiple genetic sources of the same species requires isolating production fields, which complicates production logistics.

Legal and bureaucratic factors also restrain expansion of supply; these include restricted seed collection on public land and varied sourcing guidelines. Participants recognized that standardizing sourcing regulations would be a complex process, especially because of the sparse data available for many species. In Minnesota, commercial producers are currently barred from obtaining foundation seed from state-owned land; whether nonprofits may collect seeds from public land for use in restoration is unclear. Producers also expressed concern that some populations or species, which could be used as a source for production, may be lost despite conservation efforts. However, some users also expressed concerns about overcollecting from wild populations. Focus group participants implicitly recognized that maintaining the genetic variation of natural populations—through avoiding genetic contamination and overharvesting—is an important part of natural resource conservation. Sourcing guidelines can create barriers. One restoration project was reportedly canceled due to inability to meet a 40-km (25-mile) sourcing restriction. Some programs may also restrict management practices that would support prairie species (e.g. restrictions to burning CRP land).

Insufficient technical information is an obstacle to use of locally sourced native seed (Supplement S3). Practitioners hold strongly differing opinions about seeding density and the sequence and timing of steps for restoring prairies. Seed testing is a further concern; results often differ among laboratories, and for many species, tests are unavailable. Producers, having noticed that certain species sometimes fail to establish, discussed the role of microorganisms in restoration and whether they should be included in production. Native seed users, being unsure of the scale of local adaptation, use rough guidelines that they suggested may be unnecessarily narrow.

Participants were concerned about the introduction of nonnative species and genotypes. There are multiple vectors for unintentional introduction, including restoration equipment and contaminated seed supplies. One user discussed "seed bombing," the well-intentioned practice of introducing plants via hurling lumps of substrate and potentially non-native seeds, that highlights the need for public education about risks of indiscriminate introduction. One producer was concerned that unscrupulous producers may include non-native species in seed mixes, to reduce costs.

Possible Solutions

What should someone focus their energy on if they want to improve the source-identified seed market?

Participants suggested the following as high-priority actions: developing more consistent standards, being aware of ramifications from changes to certain laws, revising internal agency policies, increasing communication and education, and promoting increased numbers of producers.

Greater consistency and feasibility of standards would help producers meet them and reduce risks of contamination. Greater investment in the standards is also needed—absent financial benefits from certification programs (see MNCIA 2017), producers may not commit resources to produce source-certified seeds.

Changes in two particular laws could have large ramifications (Supplement S3). One is CRP, a Federal program that pays farmers to keep land out of agricultural production. Existing and future CRP rules have broad impact on demand; e.g. producers were concerned that demand for seed will severely decrease if the cap on the amount of CRP land stays constant. The other is noxious weed law, which can potentially have large impacts because production fields may contain weeds. For example, the presence of *Cirsium arvense* (Canada thistle) in a bulk-harvested field could cause the seed lot to fail inspection and not be sold.

Native seed users recognized that agency rules, such as the restriction on private entities collecting seeds from public lands, can result in reduced seed availability. Concerns about privatizing public goods and favoritism underlie these policies, but some users find the policies counterproductive for restoration. Users speculated on contracts and easements that could alleviate these restrictions.

Improved communication was raised in two contexts: availability of research and increased dialogue between native seed producers and users. Communication between practitioners and researchers about research needs could promote development of germination, production, and tissue culture protocols. Users anticipate benefiting from research on the scale of local adaptation and the long-term effects of sourcing decisions, while researchers could benefit from conducting experiments at restorations. Producers envisioned collaboratively developing methods for producing recalcitrant species. Communication between producers and users was viewed as one way to mitigate risk. Producers discussed the value of having greater advance notice of planned projects, and users discussed sharing seeds or cooperatively harvesting their own lands.

Participants identified a need for public education about the importance of native species and locally sourced populations in neighborhood and roadside projects. Increased installation of rain gardens and pollinator gardens may increase the planting of non-native species. There is a need to stimulate landowners' interest in their prairie remnants and help them realize the potential of the seeds from them. Although the expense of planting

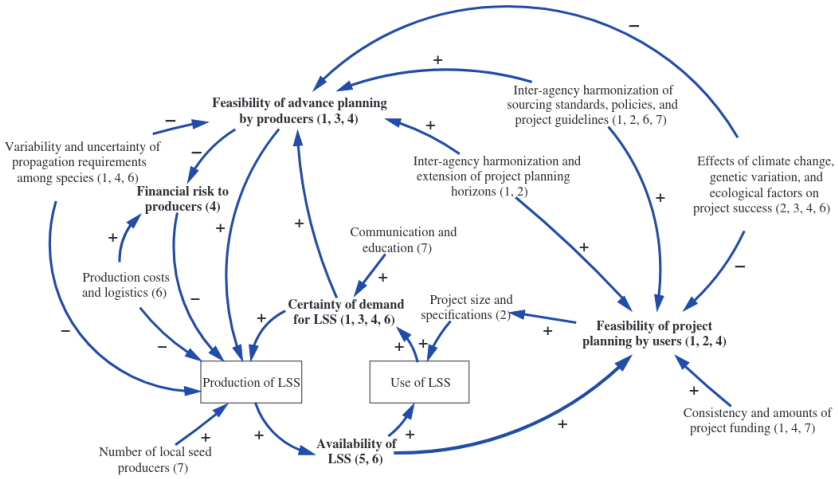

Figure 2. Conceptual model of major factors affecting production and use of locally sourced seeds (LSS) in restoration, and their interrelationships, as identified by expert focus groups (see text for details). Bolding indicates factors of particularly strong effect. Arrows and plus/minus signs indicate the direction and polarity of relationships between factors. Parenthetical numerals denote corresponding sections in Results section of the text: (1) predicting and meeting needs; (2) demand for and definitions of "local"; (3) demand and location; (4) demand and species; (5) current strengths; (6) current weaknesses; (7) insights for possible solutions.

native species on roadsides is considerable, it is small compared to the total cost of a transportation project and to the importance of maintaining native biodiversity.

Participants emphasized the need for more producers, who could increase seed availability and, thus, reduce prices. Increasing the number of producers may facilitate the production of populations sourced on finer geographic scales. Some participants opined that producers of various sizes and scales could coexist. (Fig. 2)

Discussion

Focus group participants acknowledged that increased interest in local sourcing of native seeds for prairie restorations is spurring production and use of these materials, but several issues limit seed availability. Producers emphasized that market unpredictability constrains production, while users discussed inability to obtain requisite quantities of seeds. Conversations encompassed the definition of "local," importance of key laws, role of internal policies, research needs, and importance of education, communication, and partnerships. Many of these topics have also been identified in other parts of the world (e.g. Broadhurst et al. 2015; Mainz & Wieden 2019; Schmidt et al. 2019).

Unpredictability in demand affects supply and is a barrier to launching new commercial entities. This persistent challenge was noted in the survey by Dale (1993) and is not unique to Minnesota prairie, having been identified in Australia (Broadhurst et al. 2015), Brazil (Schmidt et al. 2019), and the western United States (Richards et al. 1998; Peppin et al. 2010; Camhi et al. 2019). Mitigating this volatility may require consistent project funding and much longer planning horizons. The results of efforts elsewhere will be informative. The Seeds of Success program is increasing seed warehousing efforts (BLM 2009; Tishew et al. 2011). Federal agencies are implementing new agreements, such as indefinite-delivery/indefinite-quantity contracts, stewardship contracts, and buy-back options (Peppin et al. 2010).

Restoration goals, definitions of "local," and sourcing decisions vary considerably among agencies and organizations that fund or implement projects. Improved consistency would ameliorate unpredictability of demand. The U.S. National Seed Strategy promotes development of seed transfer zones, whether empirically, for commonly used species, or through modeling (PCA 2015). Kramer et al. (2015) suggested using provisional seed zones that incorporate the U.S. Environmental Protection Agency's level III ecoregions when seed transfer zones have not been established empirically. In Germany, regional admixture provenancing is being implemented, which uses both seed transfer zones and mixing seeds from multiple populations in these zones (Bucharova et al. 2019). For Minnesota, participants called for sourcing guidelines that are compatible, realistic, and

scientifically sound, a goal that will require cooperation among diverse stakeholders.

Changes to certain laws, such as CRP and the noxious weed law, may have an outsized effect on practices. Since its establishment, CRP has varied in its size, peaking in 2007 at 14.9 million hectares (Hellerstein 2015). The program's purpose, eligibility criteria, and enrollment and reimbursement mechanisms have been altered, all of which impact large areas. In other jurisdictions, laws having an outsized impact on native seed production have been identified. For example, regulations concerning fodder in the European Union may not be consistent with restoration goals (Abbandonato et al. 2018). The variability that is important in native seeds for restoration may conflict with regulations designed for agricultural species and may need to be considered in regulations and testing (Pedrini & Dixon 2020).

Participants suggested addressing agency policies; a salient policy in Minnesota is the restriction on sourcing commercial foundation populations from public land. Relevant concerns include risk of overharvesting, privatizing public goods, and inequitable benefit from public resources. The Iowa (U.S.) Ecotype Project addressed some of these concerns by sourcing seed from sites that included public land, developing ecotypes from those seeds, and licensing ecotype foundation seed to private producers (Houseal & Smith 2000). Alternatively, some U.S. Federal agencies permit public harvest for commercial use (Robertson 2013). Overall, reconciling internal policies will depend on policymakers and stakeholders from nonprofit organizations.

The need for increased communication and education on topics concerning locally sourced seeds could be partially met by trade and producer associations, such as the MNCIA, which could communicate, educate, and help producers meet requirements (Abbandonato et al. 2018; Mainz & Wieden 2019). Additional actions, elaborated in the communication plans of the U.S. National Seed Strategy (PCA 2015), are aimed at both internal and external audiences. These include creating an electronic toolbox for briefings and presentations, utilizing social media, creating an expert speaker's bureau, and reaching out to local stakeholders through extension offices, botanic gardens, and relevant special interest organizations (PCA 2016).

Expanded research, scientific communication, and collaboration are needed. The need for more research on seed production and testing, was identified by Dale (1993) regarding Minnesota and subsequently across the globe (Broadhurst et al. 2015; Elzenga et al. 2019; Pedrini & Dixon 2020). A survey of European seed producers found that 75% of the producers who lack active collaboration with a researcher would be interested in forming a collaboration (De Vitis et al. 2017). Scientists studying the effects of climate change, seed sourcing decisions, local adaptation, seed viability tests, and germination protocols should communicate their research to a range of stakeholders through various media including focus groups, such as those used here; this is one advantage of focus groups over conventional surveys. The local knowledge that is available for some species should be valued (Schmidt et al. 2019).

There is strong interest in the production and use of locally sourced native seeds. Users of native seeds generally prioritize purchasing based on immediate funding, which they cannot accurately predict. Producers operate based on reliability of production and sales and reduction of risk. Prairie restoration will benefit from the experience of programs such as Seeds of Success, just as other systems have looked to prairie restoration in the Midwestern United States (White et al. 2018) and the United States as a whole (Tishew et al. 2011). Ultimately, citizens, subnational, and national governments, through funding and policy decisions, will have profound impacts on the future of seed production and sourcing systems.

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Supporting Information

The following information may be found in the online version of this article:

Supplement S1. Introductory statement at the beginning of each focus group session.
Supplement S2. The questioning routine.
Supplement S3. Selected quotes.
Supplement S4. Notable species from the discussion.

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