

A Preliminary Examination of the Environmental Use of Plants in Oregon

Final Project Report

Submitted to

The Sustainable Plant Research and Outreach (SPROut) Center

by

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List of Abbreviations

BEST	Oregon Bioeconomy and Sustainable Technology Research Center
DEQ	Department of Environmental Quality
ES	Environmental Services
INR	Institute for Natural Resources
NGO	Non-governmental Organization
ONAMI	Oregon Nanoscience and Microtechnologies Institute
OWEB	Oregon Watershed Enhancement Board
PCP	Pentachlorophenol
SPROut	Sustainable Plant Research and Outreach
SWCD	Soil and Water Conservation Districts

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A Preliminary Examination of the Environmental Use of Plants in Oregon

1.0 INTRODUCTION

The environmental use of plants can be broadly defined as applications that use plants to provide sustainable ecosystem services in managed landscapes. Over the last several years our understanding of the environmental use of plants has been expanding and affecting the relevance and use of plant-based solutions to address environmental challenges.

In a 2004 workshop that convened academic and industry leaders in environmental plant fields, the Sustainable Plant Research and Outreach (SPROut) Center identified five major areas of priority for the environmental use of plants—wetlands and wastewater treatment, phytoremediation, urban water management and eco-scaping, riparian restoration, and native plant restoration and invasive species control. Though there have been developments in these areas over the last few years, there continues to be a lack of a clearinghouse or an inventory of what is going on, who is doing it, how cooperative project efforts can be leveraged, and what else could be done to both enhance environmental sustainability and promote economic development.

The purpose of this project was to conduct a preliminary examination of the environmental use of plants in Oregon by gauging the breadth of opportunities and challenges faced by growers, users, and researchers who are involved in the general area of the environmental uses of plants. More specifically, the project set out to learn about grower, user, and researcher interests and expertise; identify opportunities and barriers to participating in this sector; and, identify applied research needs.

1.1 Structure of Report

The report is structured in the following way:

- Section 2 describes the approach to the study and the study participants;
- Section 3 outlines a general profile of the respondents;
- Section 4 presents respondent views of the opportunities, challenges, and research gaps in the environmental use of plants sector; and,
- Section 5 highlights a series of key issues and recommendations regarding how to build awareness about the environmental use of plants, and the opportunities for linking growers, users, and researchers. The recommendations listed in this section are summaries of what respondents stated. They are meant to stimulate conversation and not meant to be taken as definitive.

This document is a preliminary description of the environmental use of plants in Oregon. It should be regarded as a living document to be refined and updated through further information gathering, expanded stakeholder linkages, and applied research.

2.0 APPROACH

In summer 2007, the Sustainable Plant Research and Outreach (SPROut) Center asked the Institute for Natural Resources (INR) at Oregon State University to conduct a preliminary examination of the environmental use of plants in the state of Oregon. The goal of the project was to help set the groundwork to develop an agenda that focuses on potential research and market opportunities; and, to find opportunities to link growers, users, and researchers who are interested in the environmental use of plants.

To identify the interests, opportunities, and challenges of participating in an environmental use of plants sector, a series of telephone interviews was conducted. An initial list of approximately 130 individuals—growers (i.e., nursery managers or owners), users (local, state, and federal agencies), and researchers—who participated in the 2004 SPROut workshop served as the initial key informants. These individuals were chosen as study participants because they had expressed some interest in the environmental use of plants, and were believed to be able to provide current perspectives and up-to-date knowledge that can not be found in other sources of information.

Through purposive sampling, those on the abovementioned list were recruited to participate in the study. As appropriate, participants were asked to identify other individuals who might be willing to participate in the study. In all, 152 people were contacted for the study. Non-probability sampling was appropriate for this study because the objective was to become more informed about each individual or organization's experience and perspectives about the environmental use of plants in the state of Oregon.

Telephone interviews were conducted between September and December 2007. If respondents were available to interview at the time of the initial call, an interview was conducted. If they were not, an interview time was scheduled. Up to three calls were attempted with each person in the sample with whom phone messages were left. Those with wrong or disconnected phone numbers were eliminated from the study. Seventy-six interviews were conducted (a response rate of 50%). Each interview lasted between 10 and 25 minutes.

In order to solicit more information and continue a dialogue, all individuals that were on the list, whether respondents or not, were given the opportunity to add substantive comments about the environmental use of plants in Oregon and suggestions about how to move this sector ahead through applied research, and improved grower, user, and research linkages. All substantive comments were added to Appendix C of this report.

3.0 RESPONDENT PROFILES

Seventy-six people representing growers, private industry, consulting firms, local government, state government, federal government, and public research institutions were interviewed (Figure 1).

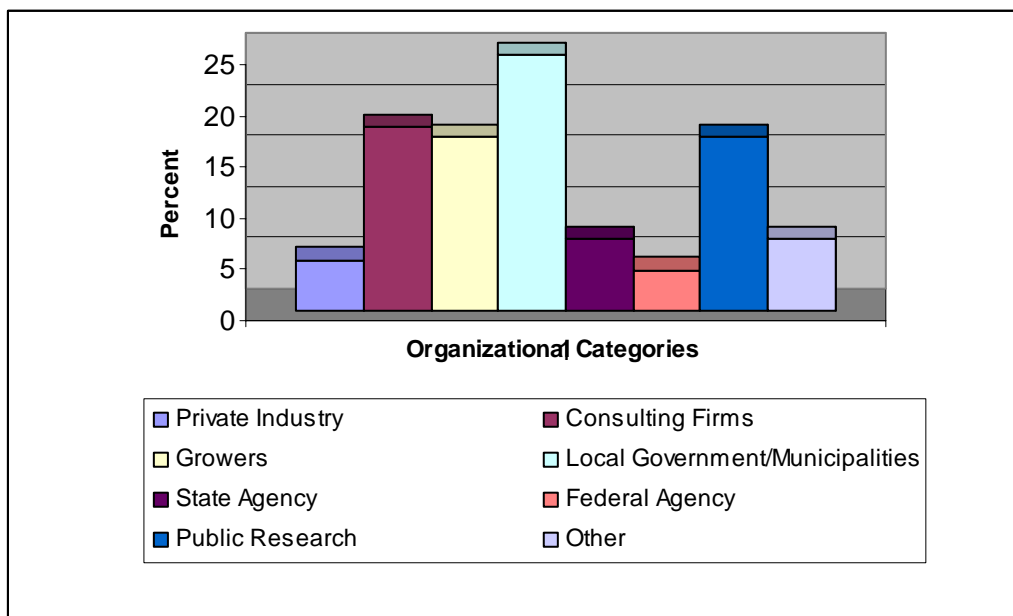


Figure 1. Percentage of Respondents per Organizational Category

Two organizational types engaged in restoration work that are missing from this study are non-governmental organizations (NGOs) and community groups (i.e., watershed councils and soil and water conservation districts). Watershed councils and soil and water conservation districts (SWCD) engage in voluntary restoration work with private landowners in urban and rural communities and are users of plants for environmental purposes in some of their restoration activities.

These groups are largely excluded from this study as they did not participate in large numbers at the 2004 SPROut workshop from which study participants were drawn. More information about the restoration issues, investments, and the activities of watershed councils, SWCDs, and others, on a basin-by-basin basis, can be found in the Oregon Watershed Enhancement Board’s (OWEB) [Oregon Plan Biennial Report 2005 – 2007](#). The exclusion of these groups may influence the general understanding of the environmental use of plants in Oregon as presented in this preliminary examination.

3.1 About the Users

Sixty-six percent the respondents categorized themselves as “users” of plants for environmental purposes. Of the users, most represented local government, primarily municipalities. Municipality respondents were located in different departments within

their municipalities, including parks and open space, public works, facilities and landscaping, natural resources, and planning. Municipality respondents were careful to note that their interests and projects may differ from other departments within their municipality (i.e., parks, planning, public works, facilities, etc.) and at times suggested others within their municipality to speak with. Other users interviewed were environmental consultants, engineers, and landscape architects.

3.1.1 General Interest and Types of Projects

The majority of the respondents (79 percent) stated that their interest in plants for environmental purposes is increasing. Respondents cited four general reasons for their increased interest – changes in their organization’s leadership to those who are more supportive of the environmental use of plants; the positive influence of policy, city requirements, incentive programs, and regulations; more “green” public perceptions; and, a general increase in plant-related projects due to, for instance, more public demand for such projects, the organization’s acquisition of more land for restoration and mitigation, and the integration native plants into street sites and parks. In some cases, respondents mentioned that this increased interest is reflected in an increase in the number and/or type of projects (Figure 2) in which they are involved. Only in two cases did the respondent say that their organization’s interest was decreasing, and in four cases respondents said that their interest has remained the same.

- | | |
|--|---|
| <ul style="list-style-type: none">• Bioengineering• Bio-swales• Detention ponds• Enhancement of natural areas• Erosion and sediment control• Green buildings and roofs• Infiltration basins• Native landscapes• Native plant plantings and invasive plant removal• Phytoremediation | <ul style="list-style-type: none">• Restoration (<i>riparian, wetland, upland, oak savanna, oak woodland, prairie habitat</i>)• Riparian and stream enhancement• Stormwater mitigation• Stream enhancement• Urban landscapes• Wastewater treatment• Water quality and conservation• Wetlands (<i>mitigation, restoration, construction</i>)• Wildlife habitat |
|--|---|

Figure 2. Types of Projects in which Users are Engaged

Over the last five years respondents have been engaged in numerous new and on-going environmental use of plants projects. The number of projects respondents are involved in ranged from one new project per year to over 100 projects per year, with the average among the respondents being 20-25 new projects per year.

3.1.2 Interest in SPROut Identified Research Priorities

Through extensive research and interviewing of professionals in environmental and horticultural fields, in 2004 SPROut identified five areas as priorities for Oregon and the Northwest (Figure 3).

Wetlands / Wastewater Remediation: Wetlands are productive ecosystems, improving the quality of water that flows through them by filtering out impurities, actively degrading waste, and removing pollutants through plant uptake. The root systems of wetland plants such as reeds, bulrushes, and cattails do much of the work; providing surface area for beneficial bacterial growth, filtration of solids, nutrient uptake, and oxygen infiltration. There is growing interest in the use of engineered or constructed wetlands that utilize the natural wetland processes of vegetation, soils, and microbial activity to assist in treating wastewater. These wetland treatment options can be quite cost effective while reducing the water quality impacts on the local watershed.

Phytoremediation: Phytoremediation is the emerging technology of using plants to extract, degrade, contain or immobilize contaminants in soil, groundwater, or surface water. Some plants are particularly good at uptake or processing of certain kinds of contaminants. Specific mechanisms of phytoremediation include: (1) Extraction of contaminants from soil or groundwater, through their uptake and storage in the plant's shoots, leaves, or roots; (2) Degradation of contaminants, particularly organic compounds such as pentachlorophenol (PCP), through uptake and metabolism by the plant; and, (3) Containment or Immobilization of contaminants, through their uptake into the root zone, even if the plant or tree is itself not removed.

Urban Water Management and Ecoscaping: In recent years, this has become an increasing area of interest in the Pacific Northwest, with the tremendous population growth in the Puget Sound and Portland metro areas, and with the growing recognition of urban growth impacts on salmon and stream restoration. The new field of "low impact development" uses engineered green space to intercept, store, or transport stormwater—particularly important for the recharge of our groundwater resources; to sequester air pollutants such as excess carbon; or to filter industrial run-off contaminants. Techniques used in stormwater management include raingardens planted close to downspouts or other outlets of concentrated stormwater run-off; green roofs which greatly reduce an urban development's impervious surface area while slowing down the run-off that is left; and vegetated swales that act as biofilters for pollutants washing off buildings and streets. Other plants for green spaces have the ability to withstand drought and provide an attractive and functional urban landscape without intensive use of water, fertilizers, or pesticides, further reducing the impacts of urban development on water/ air quality and stream habitat.

Native Plant Restoration and Invasive Species Control: Restoring native plant communities can be an environmental end in itself—the creation of fundamental habitat for native wildlife. Also, the use of native plants in managed landscapes can reduce the need for extensive resource input, such as fertilizer, pesticides, water, etc., because native plants are often better adapted to the climate of the area. One major challenge with native plant restoration is competition from invasive species. Invasive plants are usually non-native species, can grow and spread very quickly to crowd or kill other plant populations, often have negative impacts on local resources (by drying up water sources or poisoning animal herds), and are often difficult to control with conventional methods.

Riparian Area Restoration: The importance of riparian corridors in protecting water quantities and qualities is quickly being learned. Vegetated corridors keep temperatures in streams cool for fish health and minimal evaporation loss of water; filter or contain run-off pollutants; provide erosion control of stream banks; help minimize the easy transport/ spread of invasive plant seeds and fragments to other areas; and link together habitat conservation fragments.

Source: http://www.oregonqarden.org/SPROUT/SPROUT_Research.html

Figure 3. SPROut's 2004 Research Priorities

Interview respondents were asked to rank their top three interests of the SPROut identified priorities (Figure 4). Thirty-four percent of respondents ranked “urban water management and ecoscaping” as their number one interest of the abovementioned SPROut research priorities, followed by 28 percent of respondents ranking “native plants and invasive species control” as their first interest. “Riparian restoration” and “native plants and invasive species control” surfaced to the top of the second-ranked interest list for 35 percent and 25 percent of the respondents, respectively; and, for 29 percent and 25 percent of the respondents, respectively; and, for 29 percent and

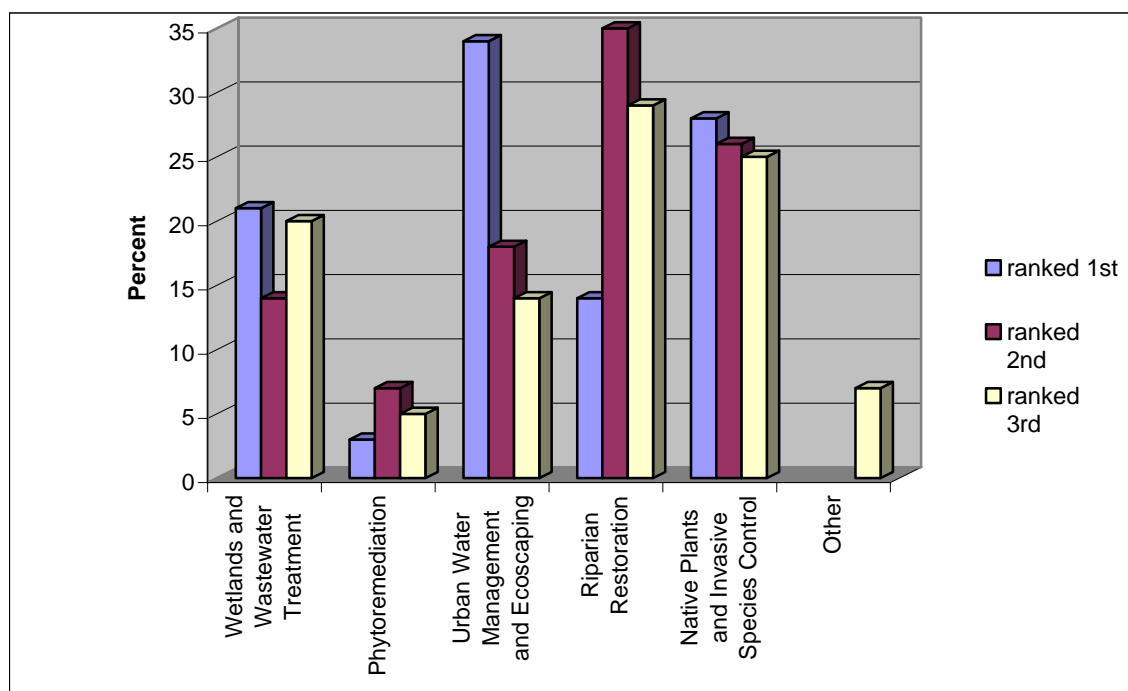


Figure 4. Percentage of Respondents Ranking their Top Three Interests in SPROut’s Research Priorities

25 percent of the respondents, respectively, for the third-ranked interest list. Two of the SPROut research priorities— “riparian restoration” and “native plants and invasive species control”—ranked somewhere in the top-three interest list of 26 percent of all respondents, followed by “urban water management and ecoscaping” (22 percent of all respondents). Of the overall, combined top three interests, “native plants and invasive species control” ranked first, the second-ranked interest was “riparian restoration”, and “urban water management and ecoscaping” was third.

3.2 About Growers and Researchers

3.2.1 Growers

Growers made up 17 percent of the overall respondents. In addition to answering questions related to challenges, opportunities, and research gaps (Section 4 of this report), growers were also asked non-confidential questions about their business experience.

More than half of the growers interviewed predominantly sell to the restoration market. In some cases the interviewed growers grew “restoration” plants strictly for themselves

while selling other plant products in retail garden centers and for commercial and residential landscapes. When asked if they had been approached by buyers to grow crops that were new to them, 77 percent of the growers said yes; and, when asked if buyers have approached them to grow higher quantities of crops than they usually grow, 62 percent said yes. The majority of the growers have had clients wait one to two years for special orders. In some cases that wait was due to propagation needs, but in other cases, as explained by one grower, the wait was due to contract delays for restoration projects, particularly delays in projects receiving grant funds.

When asked what factors inspire growers to trust enough in a particular plant market that they would be willing to enter that market by growing a new crop or expanding quantities of current crops, the majority of the respondents, as was expected, said that demand was the motivating factor. Recognizing that lead time is necessary to propagate a new crop before it is ready to sell, when asked how far ahead of the market they were comfortable going, most responded that they were comfortable with and willing to go either 1-2 years or 3-5 years ahead of the market. Finally, most of the growers said that it did not matter if their clients were local or national, but the few who said it did matter pointed to the high cost of transporting goods as a main deterrent to having national customers.

3.2.2 Researchers

Individuals conducting research related to the environmental use of plants represent many disciplines, including horticulture, landscape architecture, forest science, botany and plant pathology, civil engineering, and fish and wildlife. Though researchers in this area work in the private and public sector, all of the researchers interviewed for this study were from public research institutions or universities. Researchers interviewed are engaged in a variety of research projects including invasive species removal, restoration, green streets, green roofs, bio-retention, rain garden swales, phytoremediation, and climate change, among others.

In all cases but one, researchers said that their interest in the environmental use of plants is increasing. The one respondent that said that their interest is remaining the same noted that his research team's interest has shifted from restoration to alternatives to invasive species.

4.0 CHALLENGES, OPPORTUNITIES, AND RESEARCH GAPS

4.1 Challenges

Respondents had many perspectives regarding the challenges to participating in the environmental use of plants sector. While some respondents saw using plants as cost-effective and capable of “achieving multiple environmental objectives”, others thought that it was too “expensive to be sustainable”. Several general challenges to participating in the environmental use of plants sector did emerge, including challenges with standards, policies, and regulations; project costs; and production and availability, among others.

4.1.1 Standards, Policies, and Regulations

Several respondents felt that policies and regulations are generally not keeping up with “green” options. In particular, respondents mentioned engineering standards, design and land-use approvals, permitting processes, and conflicting natural resource agency policies and regulations as being particularly challenging. For instance, one respondent stated that since decision-makers perceive that the use of plants for environmental purposes is new and unproven, they tend to “shy away from anything that can not be quantified and tend to favor ‘hard’ engineering”. Respondents also concurred that from a decision-maker’s point-of-view there is the challenge of enforcement, and as one respondent stated “it is much easier to enforce flow out of a pipe than a wetland.”

Some respondents thought that it was the municipalities themselves that make it more difficult to use green treatments. Others, however, noted that in some cases, city governments have goals for using green treatments and endorse the use of them, but that permitting offices are “not up to speed”. Still others noted that at the state level some agencies, such as the [Department of Environmental Quality](#) (DEQ), are beginning to notice the benefits of green design and technologies, and are recognizing the benefits of reclaimed water.

A few respondents said that they do not know of any standards or guidelines for the environmental use of plants and that they would like to see Oregon-specific ones established. Though not Oregon-specific, one respondent did provide two websites of organizations that have or are developing such guidelines – the [Sustainable Sites Initiative](#) and the [America Society of Landscape Architects](#) . (See Appendix C for more comments).

4.1.2 Cost of Projects and Lack of Funding

Across the board, respondents mentioned the cost of projects and the lack of funding to implement projects as major challenges. Whether they were talking about the lack of funding (via grants programs) for small acreage projects or the high price of seeds for large-scale projects, one respondent said, “It’s always about the money. The higher the cost, the less likely people are to participate.”

“Though most of the costs are upfront,” stated one respondent, “a return on invest does happen.” Several respondents agreed that most of what is happening with the environmental use of plants is taking place in the private sector—those who believe in the idea, and can afford the installations and plant materials are the ones doing it. And, at least one respondent questioned whether this benefits public spaces.

It is not only the cost of the projects, but having a consistent source of funding that respondents find challenging. Most funding occurs on an annual basis and not on long-term bases. Thus, monitoring falls by the wayside, which in turn impedes the ability to not only understand if the plants are doing what they were intended to do, but also does not allow for establishing a track-record that could positively influence policies and standards to support the environmental use of plants.

4.1.3 Production and Availability

Users mentioned that they often encounter difficulties in finding certain native plant and seed materials at specific sizes and quantities for restoration and urban landscape projects. This is particularly so when they are involved in large-scale projects and do not want to go out-of-state to purchase plant materials.

Since plants are not generally mass produced, they tend to be expensive and the variety of native plants is limited, respondents said. One respondent stated that unless particular plants are promoted by the nursery industry, they are not going to be used. Another respondent also stated that the lack accessible information on the characteristics of how to grow and maintain the plants and about their invasive potential makes choosing a good mix of plants very challenging

On the supply-side of the market, commercial growers face the challenge of upfront costs, the varying care requirements for plants (i.e., specialized harvest, chilling requirements, among other requirements), and shipping costs.

4.1.4 Education and Public Perception

Several respondents spoke to the general challenge of public perception and the need for more education about the benefits of using plants for environmental purposes. Some respondents felt that the environmental use of plants is perceived as a “high risk” effort. Since it is seen as “new and trendy”, people tend to look at it skeptically and are more hesitant to invest in it. In one case, a respondent said that the developers his department works with do not want to be the first to try using plants for environmental purposes. The same respondent suggested that if smaller municipalities had examples of what larger municipalities are doing, and they could share these successes with developers, they could possibly change developer perceptions about the use of plants for environmental purposes.

This education and awareness-building effort is not aimed at one population. As a few respondents said there needs to be a “re-education of the entire field” – municipalities, developers, designers, growers, landowners, clients, the general public, and policy-makers”, and that it needs to be a full effort, “not just brochures”. Areas of education suggested by respondents include the benefits and aesthetic beauty of the native plants as typical ornamental plants; biodiversity; understanding the differences between native, exotic, and invasive species; and, learning the invasive potential of various plants. As one example of education, one respondent said that in their education efforts, they are getting more public interest in sites and the environmental use of plants, when they show they are working toward reintroducing natural diversity.

In addition to the perceptions and education challenges, information access is a challenge that needs to be remedied in order to support education efforts. Though respondents said that information about the environmental use of plants is available to the general public, the challenge is that people do not know where to go or how to tap into it.

4.2 Economic Development Opportunities

Several respondents referred to Oregon as a “strong nursery state”. According to the 2006 Oregon Nursery and Greenhouse Survey (USDA-NASS, 2006), the horticulture industry ranked highest in the state for total value of agricultural production, followed by the cattle industry (with nearly have the total value), then by grass seeds and all hay industries. In 2006, Oregon’s nursery and greenhouse sales rose to \$966 million—a 10 percent increase from the year before. Considered a key generator of revenue for Oregon, more than 75 percent of it sales (\$730 million) come from outside the State (USDA-NASS, 2006). Despite the overall industry’s ability to generate income, when asked about the economic development opportunities of the environmental uses of plants, respondents had the most difficulty answering this question.

Between the many responses of “I don’t know”, some respondents listed opportunities to use plants for environmental purposes in biofuels, green building, new developments, and Brownfield sites. The most mentioned economic development opportunities were in the areas of native seed and plant production and ecosystem services marketplaces. A few respondents also thought that Oregon has the potential to be the hub for advancing education in and technology for working plants.

4.2.1 Education and Technology for Working Plants

A few respondents thought that Oregon has the characteristics to be a national leader in the use of plants for environmental purposes, particularly in promoting such plants through education and technology. One respondent said that based on what he learned from attending national landscape architecture conferences the Pacific Northwest is much more progressive in this field than other parts of the U.S.

Oregon could not only be a national producer and distributor of improved plant products, but also a producer of patentable intellectual property, technologies, and equipment needed for the sector. With the millions of acres of forests and farmland streambanks within Oregon, Oregon has its own need to expand the use of working plants. Through the production, selection, evaluation, and matching of plants that work better for specific environmental purposes, this sector, as one respondent stated, has the ability to “reinvent [Oregon’s] natural resources industry”.

4.2.2 Native Seeds and Plants

The most mentioned economic development opportunity by respondents was that of native seed and plant production. Several respondents stated that the demand for native seeds is growing, particularly as the number of organizations doing restoration throughout the State is increasing. Some respondents felt that the market has not yet been saturated with regard to quality seed sources. For instance, one respondent mentioned that his organization fields many complaints that “good seed sources” are difficult to find. Another respondent commented that native seeds could be profitable to growers and qualified this by stating that while rye grass sells at approximately \$3 per pound, his organization pays between \$30 per pound and \$100 per pound for native seeds, depending on the seed’s rarity. However, while acknowledging an increase in the demand for native seeds and plants, another respondent questioned how gradually or exponential such a market could grow.

- Collect and grow native plants on an ecoregion basis
 - Quality seed sources and plants for riparian restoration
 - Quality seed sources and plants for ornamental landscapes
 - Native plants development for stormwater and urban wastewater treatment
 - Creating new local markets for plants.
- Figure 5. List of Native Seed and Plant Economic Development Opportunities**

4.2.3 Ecosystem Services Marketplaces

By building capacity and infrastructure, several respondents thought that Oregon could serve as a market for ecosystem services. In short, an ecosystem services marketplace is an established structure for buying and selling environmental services. Ecosystem services (ES) is the name given to the benefits people obtain from ecosystems, which include clean water and air, carbon sequestration, biodiversity, habitat and species protection, and others. Through restoration, conservation, tree planting, using green building practices, etc., people can increase the services provided by an ecosystem. The resulting ecosystem services can then be measured, valued, and sold, and the right to use them (*credits*) can be bought altruistically or bought to offset unavoidable environmental impacts.

The wide-ranging importance of ecosystem services, and their potential for helping landowners to gain revenue from their lands while providing benefits to society as good land stewards, is drawing attention around the country and in Oregon. The specific ecosystem services markets that

To make these exchanges happen, a market needs a limit on the use of an ecosystem service, a way to measure increases and decreases in the service provided, and rules governing the transfer and monitoring of ecosystem service credits. To date, these markets have grown up in isolated contexts, or *silos*, that have generated the same fractured regulatory structure we have today.

For an ecosystem services marketplace to thrive, we need to move past the theory of creating markets and build a transparent, fungible, and vibrant global trading infrastructure. Within five years we need to have created this market, this “ecosystem NASDAQ”, which recognizes a suite of ecosystem service offsets. At the same time, we also need to have devised a credible way to integrate the standards, technology, and institutions of ecosystem service markets.

Source: Gaffi, Bill and Allen Alley, 2006. Creating an Ecosystem Services Marketplace Initiative Proposal – Oregon Business Plan 2007. p.2.

Figure 6. Making an Ecosystem Services Marketplace Work

respondents thought were economic opportunities include water temperature, runoff mitigation, wetlands, carbon sequestration, and biomass production.

Oregon is making progress in developing an ecosystem services market. For example, aimed at making Oregon a leader in sustainable development, business leaders presented four new proposals at the [Oregon Business Plan](#) Oregon Leadership Summit in January 2008 and one of those proposals was *Creating an Ecosystem Services Marketplace*. Also, recently the Ecosystem Services Council—comprised of Oregon businesses, agencies, and non-profit organizations—has been developing the tools, standards, and institutions for such a marketplace.

Among those actively involved in the development of an Oregon's ecosystem services marketplace is the widely-shared objective to develop integrated, conservation-driven markets for ecosystem services, through which markets for such services as carbon sequestration, water quality, and wetlands are integrated into land management plans. Current markets for these services are operated as separate plans, each with their own set of regulations. The Institute for Natural Resources (INR) is working with a number of groups to help phase out the fragmented approach that generates competition among resources and failure to manage holistically.

4.3 Information Sources and Research Gaps

During the interviews, users were asked where (from what sources) they sought information about the environmental use of plants and what type of information they sought. As was expected, all of the users stated that they used the internet as a primary source of information about the environmental use of plants. Other sources of information used by the respondents included other local organizations, OSU Extension, and workshops/conferences. Users mostly sought on-the-ground implementation information (i.e., project design and installation, etc.) and case studies. However, in no instance did users say they looked in peer-reviewed journals for information or that they were specifically looking for the latest research and science regarding the environmental use of plants.

Public and private institutions across the state are involved in various aspects of environmental use of plants research. Such research has expanded our understanding of the role that plants can play in resolving or mitigating environmental problems, and has also explored the potential for using, modifying, and enhancing plants to work better. However, when asked to identify what they thought were the largest research gaps regarding the environmental use of plants, responses varied and many had difficulty answering the question. While one respondent stated that this was a difficult question to answer because the environmental use of plants is not a well-established field and that there is not a broad set of literature that identifies gaps, other respondents thought that there is quite a bit of information, but that it is not brought together in an accessible way.

The research gaps stated by respondents are categorized as follows:

Socioeconomic Research

- Assess the economic viability of the sector.
- Examine and assess changes in practices that would be necessary to make this sector work.
- Determine the market potential for particular plants.
- Conduct risk assessments.
- Stimulate research on understanding public preferences for improvements in natural systems of both short- and long-term significance to society.
- Develop policy instruments that would encourage the development of beneficial new technologies and use of plants in a cost-effective manner.

Applied Research and On-the-Ground Experiments

- Conduct research about the density of water treatment (*i.e., What and how much can be used in the smallest area? What are the mechanics? What is the efficiency of energy and area?*).
- Conduct research on the control of invasive species in wetland environments.
- Identify and evaluate the right mix of plants for particular condition sets.
- Conduct research in the use and function of native plants in cities (*i.e., seed dispersal, location of plants within the community, water use/needs, etc.*).

Green Roofs

- Develop technologies that address leak issues.
- Identify native plant mixes to meet specific environmental needs.
- Identify plants that work for the long-term.
- Assess and evaluate green roof efforts and techniques.
- Expand green roof research in general.

Plant Understanding, Development, and Improvement

- Identifying which plants are invasive.
- Develop responses to and demand for new technologies that could offer improved environmental performance.
- Improve the understanding of disease resistant cultivars (*i.e., Oregon Ash*).
- Expand research on the true capability of plants (*i.e., Which plants fulfill the intended roles? Which plants are best at taking up pollutants from stormwater runoff?*).
- Understand the fate and transport of herbicides in plants.
- Improve and/or develop drought resistant plants.
- Improve and/or develop bio-resistant plants – plants that are resistant to more toxic pathogens and allergens that result from climate change.
- Expand research efforts on plants that are aesthetically pleasing and functional for residential and commercial landscape design (*i.e., how to grow native plants of size and quality for residential and commercial landscape design*).

- Develop responses to and demand for new technologies that could improve how plants work.
- Identifying plants are resilient to encroachment and genetically crossing with other exotic plants.

Climate Change

- Develop models about the local effects of climate change.
- Conduct impact studies on plant species that have sensitivities to climate change.
- Assess the impacts of climate change on invasive species management techniques.

Monitoring

- Conduct more effectiveness monitoring for phytoremediation and bio-retention.
- Improve understanding of the effectiveness of techniques such as riparian buffers, remediation, etc. and their relationship with the stream channel from headwaters to the confluence (*What is needed to be effective?*).
- Study the effectiveness of the best practice management and restoration to achieve ecological functioning.
- Assess the effectiveness of wetlands in urban settings.
- Conduct further research on different technologies impact on plants (*i.e., maintenance for overtime after application of the plants or wastewater swale, etc.; maintenance requirements; how to maintain water effectively; what are the maintenance implications; performance overtime*).

5.0 CONCLUSION: KEY ISSUES AND RECOMMENDATIONS

Key issues presented by the respondents fell into four categories: building a network within the environmental use of plants community; policies and incentives; public education; and funding. These recommendations are presented as a list to stimulate discussion and input from stakeholders. They are not listed in order of priority. In some cases, where recommendations are quite distinct, the ideas are bulleted.

5.1 Key Issue: Building a Network within an Environmental Use of Plants Community (Linking Growers, Users, and Researchers)

Recommendation: Focus on what Oregon is doing well

Focus on what Oregon is doing successfully with regard to the environmental use of plants and green technologies. Nursery production in Oregon is among the best in the country and Oregon has a reputation for environmental leadership. This reputation could be built upon and is reinforced by [Oregon InC](#) and the [Oregon Bioeconomy & Sustainable Technologies Center](#) (BEST). Once what Oregon is doing well is identified,

determine why, and who is benefiting from it. Then concentrate efforts on its capacity to add value to the environmental use of plants sector.

Recommendation: Foster private-public research collaboration

There is a lack of collaboration between private and public research. In some cases they do not know what the other is doing, and in other cases they are in direct competition for research dollars.

Recommendation: Provide channels for communication and coordination to link growers, users, and researchers

Currently there is a lack of coordination and communication between growers, users, and researchers. What is needed to improve communication are:

- More workshops and forums.
- Central, one-stop website for information.
- Demonstration project field visits.
- More marketing from growers and researchers.

Recommendation: Consider developing a sector business plan and market the sector

- The business plan needs to show that an environmental use of plants sector can be part of a larger plan leading to economic viability.
- “Build the buzz” for the sector.

Recommendation: Follow the ONAMI model

The [Oregon Nanoscience and Microtechnologies Institute](#) (ONAMI) is Oregon's first "Signature Research Center". Together with other academic and industrial partners, ONAMI performs research and applies it to short- and long-term commercial opportunities ranging from computers to healthcare, and energy systems to environmental remediation. ONAMI was created to cultivate research and commercialization to advance the leading economic sector in Oregon, and expand the benefits of technology innovation to traditional and natural resource industries. ONAMI is a cooperative venture among government and nanoscience and microtechnology research and development institutions and industry in the Northwest. Oregon should consider applying the model to the environmental use of plants sector.

5.2 Key Issue: Standards, Policies, and Regulations

Recommendation: Develop Oregon-specific standards and guidelines for the environmental use of plants

Recommendation: Work toward improving policies and regulations

- Lobby the government to change policy to promote the environmental use of plants.
- Promote a policy agenda that directs federal money to help state to use plant in environmental way.
- State should encourage biofuels use.
- Include phytoremediation in agencies requirement.
- Have policies that discourage the selling of invasive species.

- Need federal-level policy to protect upland habitats.
- Work with agencies to streamline permitting processes for restoration and other uses of plants for environmental purposes.

Recommendation: Document the incentive programs and policies throughout the state that support the environmental use of plants

Larger municipalities, such as Portland, have incentive programs that encourage the use of green technologies, including the use of plants for environmental purposes. Often smaller municipalities do not have the time to network with others to see the pros and cons of such incentive programs and policies, and whether they could be adapted to suit their needs.

5.3 Key Issue: Sector-wide Education

Recommendation: Invest in a statewide education effort

Implement an education/“re-education” effort aimed at the entire sector—from growers to landscape architects to consumers/clients to the general public to policy-makers.

- Educate consumers how to grow plants in environmentally friendly ways and use for restoration.
- Educate on native vs. exotic vs. invasive species.
- Educate about the importance of the environmental use of plants, green design and technologies.
- Re-educate of the entire landscape industry to promote the environmental benefits of plants for all their projects.
- Promote changes in what to grow and why.

5.4 Key Issue: Funding to engage in projects

Recommendation: Promote public-private research collaborations

Recommendation: Link researchers with communities willing to have on-the-ground experiments

- Coordinate with others in advance of requests for proposals to help form project teams.
- Host a database of expertise for request for proposals and other activities.

Recommendation: Track requests for proposals (RFP) and general information relevant to the environmental use of plants

- Local, state, and federal government opportunities.
- Solicited and unsolicited proposals.
- Private foundations.

REFERENCES

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APPENDIX A: USERS QUESTIONNAIRE

**Environmental Uses of Plants:
A Preliminary Examination of the Oregon's
Research and Economic Development Opportunities**

USER QUESTIONNAIRE
Interview code # MA-XXX

If I come to any question that you would prefer not to answer, just let me know and I'll skip over it. Ok?

Section I: Interviewee Background, Area of Expertise, Interest

First I'd like to ask you several questions about your background and area of expertise.

Q1. Which category best describes your organization?

Organization Type	
<input type="checkbox"/>	1 Private industry (retail, wholesale)
<input type="checkbox"/>	2 Consulting firm
<input type="checkbox"/>	3 Public research institute or university
<input type="checkbox"/>	4 Private research organization
<input type="checkbox"/>	5 Local government/Municipality
<input type="checkbox"/>	6 State government
<input type="checkbox"/>	7 Tribal government
<input type="checkbox"/>	8 Federal government
<input type="checkbox"/>	9 Other (<i>please specify</i>):
<input type="checkbox"/>	99 Decline to respond/no answer

Q2. Over the last 5 years, approximately how many new or on-going “environmental use of plants” projects has your organization (or you) been involved in?

Q3. In what general “environmental use” areas have those projects been (*i.e., wastewater treatment, phytoremediation, green buildings, etc.*)?

Q4. Over the last 5 years, how would you describe your organization’s interest in pursuing “environmental use of plants” projects?

Organization’s Interest	
<input type="checkbox"/>	1 Increasing
<input type="checkbox"/>	2 Remaining the same
<input type="checkbox"/>	3 Decreasing
<input type="checkbox"/>	0 Don’t know
<input type="checkbox"/>	99 Decline to respond/no answer

Q4a. Why do you think your organization’s interest is increasing/remaining the same/decreasing?

Q5. In a 2004 workshop that convened academic and industry leaders in environmental plant fields, the Sustainable Plant Research and Outreach (SPROut) Center identified 5 major areas of priority for environmental uses of plants. I will read you the names of the five areas. Please rank the top three that you/your organization has or might have an interest in – with 1 being your first interest choice.

General Interest					
	Rank 1	Rank 2	Rank 3	Decline to respond/no answer 99	
Wetlands and Wastewater Treatment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Phytoremediation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Urban Water Management and Ecoscaping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Riparian Restoration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Native Plants and Invasive Species Control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other(s)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other(s) (please specify):					

Section II: Information Sources and Professional Networks

Q6. Where (from what sources) do you mainly seek information on the environmental use of plants? (*i.e., websites, industry/trade association newsletters, Local organizations, peer reviewed journals, conferences, OSU Extension, workshops/trainings*)

Q7. When looking for information regarding the environmental use of plants, what type of information are you most frequently looking for? (*i.e., latest research and*

science; on-the-ground implementation/case studies; growing plants; project design; project installation)

Section III: Needs and Opportunities

- Q8.** For the State of Oregon, what are the greatest **economic development** opportunities for developing an environmental use of plants “sector”?
- Q9.** What are the **challenges/barriers** to participating in the environmental use of plants “sector”?
- Q10.** In what areas are there the largest gaps in **research** for the environmental use of plants?
- Q11.** What recommendations do you have to better link users, growers, and researchers, in this field?
- Q12.** What other persons would you recommend that we contact to participate in this study?
- Q13.** As a final question, is there anything we’ve not asked you or you think we should know, from your perspective, about the environmental use of plants?

Thank you for your time. If you are interested in the results of this survey and other documents resulting from this project, we will have the report available at the Institute for Natural Resources <http://inr.oregonstate.edu/> and the SPROut http://www.oregongarden.org/SPROUT/SPROUT_Research.html websites.

APPENDIX B: GROWERS QUESTIONNAIRE

**Environmental Uses of Plants:
A Preliminary Examination of the Oregon's
Research and Economic Development Opportunities**

GROWER QUESTIONNAIRE

Interview code # MA-XXX

If I come to any question that you would prefer not to answer, just let me know and I'll skip over it. Ok?

Section I: Background and Area of Expertise

- Q1.** What plant markets do you predominantly sell to right now? (i.e., *retail garden center, ornamental landscape use, environmental restoration*)
- Q2.** Have you had buyers approach you about growing crops that are new for you?
- 1 YES** **2 NO** **99 Decline to respond/no answer**
- Q3.** Have you had buyers approach you about growing higher quantities of crops than you usually grow?
- 1 YES** **2 NO** **99 Decline to respond/no answer**
- ↓
→ If YES, what crops and for what uses?
 99 Decline to respond/no answer
- Q4.** What **factors** inspire you to trust enough in a particular plant market that you are willing to enter a new market by growing a new crop or expanding quantities of current crops?
- Does it matter whether the clients are local or national?
- 1 YES** **2 NO** **99 Decline to respond/no answer**

Q5. We understand that lead time is necessary to propagate a new crop before it is ready for sale. How far ahead of the market are you willing or comfortable in going? Please choose one of the following:

New Area of Research	
<input type="checkbox"/>	1 1-6 months
<input type="checkbox"/>	2 7 months- 11 months
<input type="checkbox"/>	3 1-2 years
<input type="checkbox"/>	4 3-5 years
<input type="checkbox"/>	5 More than 5 years
<input type="checkbox"/>	6 Not willing or comfortable
<input type="checkbox"/>	0 Don't know
<input type="checkbox"/>	99 Decline to respond/no answer

Q6. In your experience (or that of your organization), have you had clients willing to wait a year or two for special orders that are not in your “ready-to-go” inventory?

1 YES **2 NO** **99 Decline to respond/no answer**

Section II: Needs, Opportunities, and Interest

Q7. For the State of Oregon, what are the greatest **economic development** opportunities for developing an environmental use of plants “sector”

Q8. What are the **challenges/barriers** to participating in the environmental use of plants “sector”

Q9. Have you ever **researched** (looked into) new markets or clients for non-retail garden center or non-ornamental landscape use (*i.e., restoration, remediation, energy biomass, biofuels, green roofs, paper pulp, chips, etc*)?

1 YES **2 NO** **99 Decline to respond/no answer**

↓
→ If YES, what have you found?

99 Decline to respond/no answer

Q10. What plant research are you (your organization) doing on your own?

Q11. What questions do you have about your plants that you can't answer or would like to see researched?

Q12. Would you be interested in linking with new project partners (other growers, users, and researchers)?

New Project Partners	
<input type="checkbox"/>	1 Yes
<input type="checkbox"/>	2 No
<input type="checkbox"/>	0 Don't know
<input type="checkbox"/>	99 Decline to respond/no answer

Q13. What recommendations do you have to better link researchers, users, and growers in this field?

Q14. What other persons would you recommend that we contact to participate in this study?

Q15. As a final question, is there anything we've not asked you or you think we should know, from your perspective, about the environmental use of plants?

Thank you for your time. If you are interested in the results of this survey and other documents resulting from this project, we will have the report available at the Institute for Natural Resources <http://inr.oregonstate.edu/> and the SPROut http://www.oregongarden.org/SPROUT/SPROUT_Research.html websites.

APPENDIX C: STAKEHOLDER COMMENTS

The report was sent to 161 people for comment. In addition to 5 comments stating that they found the report interesting and encouraging, one comment adding additional information for the report was submitted.

Stakeholder Comment

1. **Section 4.1.** Available and proposed protocols for reporting and certifying ecosystem services are inconsistent, cumbersome, and expensive to implement. Ecosystems are inherently difficult to measure, especially the measurement of additional ecosystem services that result from management. Inconsistencies make the protocols difficult to apply across geographic boundaries and reduce market valuation. Some ecosystem accounting techniques have intrinsic measurement costs that may exceed the current value of the reportable ecosystem benefits. One example of the problem is the application of forest sector protocols for reporting and certifying carbon sequestration by forests and forest products.
2. **Section 4.1.1.** Although Standards, Policies, and Regulations may be challenges to some, they are responsible for most environmental uses of plants, and for the consistency and quality of applications. There are many available standards and guidelines for environmental uses of plants. Some of those used in Oregon include:
 - ODOT's Oregon Standard Specifications for Construction (2008)
 - City of Portland's Stormwater Management Manual (2004)
 - ODEQ's Erosion and Sediment Control Manual (2005)
 - USDA – NRCS, Oregon & Washington Guide For Conservation Seedings and Plantings (2000)
 - Washington State Aquatic Habitat Guidelines Program's Integrated Streambank Protection Guidelines (2002)
 - National Transportation Research Board's Environmentally Sensitive Channel- and Bank-Protection Measures (NCRHP Project 24-19) (2005)
 - USDA Forest Service, SOIL BIOENGINEERING: An Alternative for Roadside Management; A Practical Guide (0077 1801—SDTDC) (2000)
 - Center for Watershed Protection's Urban Watershed Forestry Manual (2005)
3. **Section 4.2.** One sure-fire way to stimulate economic development of environmental uses of plants is to require licensing or certification of practitioners. For example, registration of foresters in California has led to increases in restoration standards, quality, and education. USDA has Technical Service Providers. The Ecological Society of America certifies ecologists.

4. **Section 4.2.3.** An economic opportunity for ecosystem services is planned urban development. New communities being brought into the Urban Growth Boundary need economic incentives for conserving natural resources, open spaces, and habitats. Tools are needed to recognize ecological value and consider the environmental uses of plants in financing plans.

APPENDIX D: SPROUT'S PHYTOTECHNOLOGY RESOURCE BOOK

As a follow-up to the SPROut Survey you have participated in this summer, we are producing a reference guide called "SPROut's Phytotechnology Resource Book: an Oregon User's Guide to Plant-Based Solutions". **We are hoping to list your contact information (name, organization, phone, email, address) in the book as a networking tool.** The book is largely designed for the user who needs to implement a project to solve an environmental problem, such as a city planner/manager constructing a wetland or greenroof to handle stormwater. The book will contain references and descriptions of useful organizations, laws and regulations, and current research. This book will be equally useful to the consultant or landscape architect who ends up doing the design or construction work for the project. Relevant education, training, and certification programs will be profiled. For all those who may be new to the concepts of phytotechnology, this Resource Book will offer a 'primer' on terms, concepts, significance, pollutants, and methods and mechanisms for environmental solutions in three major media- water, soil, air. And for growers who want to learn more about marketing their plants for particular environmental uses, there will be some special profiles for you. We hope you want to be listed in this first edition book (due out in spring, 2008), which will be updated annually as an on-going and invaluable resource for environmental uses of plants in Oregon. **Please fill out the following permission form and send it back to Renee Stoops, SPROut Coordinator at The Oregon Garden, PO Box 155; Silverton, OR 97381. Any questions? Please contact Renee Stoops, SPROut Coordinator @ 503-584-7252.**

Name:

Organization:

Email:

Website:

Phone:

Mailing Address:

Please list the above contact information in the publication titled "SPROut's Phytotechnology Resource Book: an Oregon User's Guide for Plant-Based Solutions". I understand the contact listings may be categorized (grower, user, researcher, water, soil, air, etc) for easier networking/reference.

Signature_____

