NAUFRP Research Chair Report
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Since the last NAUFRP Executive Committee in the spring, we finished up two projects addressing national challenges associated with forest and forest products R&D funding and capacity: 1) Quantifying changes in Ph.D. expertise in forest resources from NAUFRP university programs over the past four decades (1978 to 2017), and 2) Leading a U.S. Forest and Forest Products R&D Capacity Summit). The following progress was made on both projects:

1. Change in Ph.D. dissertation topics in forest resources from U.S. universities over four decades (1978 to 2017)

Results of this study were completed in the summer and a manuscript submitted for publication in the journal Forest Science. Authors of the paper are Robert Wagner, Kristen Bellisario, and Ningning Nicole Kong. Below is the abstract from that paper:

Abstract
Changes in forest resources expertise from 1978 to 2017, as measured by annual number of Ph.D. dissertations published on 20 topics, were examined. Using the ProQuest Dissertations and Theses Global database, titles and abstracts from 11,530 dissertations produced by 56 U.S. land-grant universities were selected. Automated Content Analysis and Latent Dirichlet Allocation were used to identify the optimal number of topic groupings among 7,742 dissertations that met selection criteria. Substantial differences were found in the pattern of publication among the 20 topics over time. The number of dissertations related to forest growth and silviculture; tree seedling propagation, physiology, and regeneration; and forest soil nutrients, ecology, and management declined over the past two decades. Dissertations related to forest wildlife management, including terrestrial wildlife ecology and management; wildlife food and nutrition; and fish ecology and management also declined during the same period. The number of dissertations in the fields of forest policy, politics, and social science; forest modeling, biometrics, and statistics; wood science; forest vegetation ecology; and avian ecology increased during the four decades. Dissertations published in the fields of forest economics, and forest entomology and pathology, remained relatively stable.

Study implications
We found decreasing production of Ph.D. dissertations focused on applied forest and wildlife management problems in recent decades. Declining Ph.D.-level expertise in applied fields after the early 2000s suggest that there is less capacity to address practical problems facing forest and wildlife managers. This decline also suggests that finding university instructors qualified to teach applied forest and wildlife courses may have been more difficult over the past decade and possibly into the future. Our analysis indicated that the number of dissertations in adjacent sciences supporting forest resources have increased capability in these areas.

2. U.S. Forest and Forest Products R&D Capacity Summit

To address the problem of continued erosion of the nation's forest and forest products R&D capacity over the past several decades, we organized a Forest and Forest Products R&D Capacity Summit with leaders from state, federal, private, and university forestry and wood products organizations from across the country. NIFA supported the summit by funding a one-year conference grant during 2020-21. Our research team included Robert Wagner (Purdue U.), Emily Huff (Michigan State U.), Michael Goergen (U.S. Endowment for Forestry and Communities), and Keith Gilless (U.C. Berkeley).

Results from the Forest and Forest Products R&D Capacity Summit are presented in the attached draft report. Next steps call for engaging our established steering committee to seek better national mechanisms and approaches for cooperatively identifying, communicating, coordinating, and advocating for U.S. forest and forest products R&D priorities, capacities, and funding. We are seeking advice from the NAUFRP Executive Committee about next steps for this effort.

U.S. Forest and Forest Products R&D Capacity:

Results from 2020-21 Stakeholder Summit

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Executive Summary

The forest and forest products research and development (R&D) capacity of the U.S. (measured in scientist years and funding) has eroded substantially during the past three decades. Without significant investments and institutional change, there will be continued erosion of the nation's forest and forest products R&D capacity that will reduce global competitiveness of the U.S. forest products sector, as well as threaten the management and sustainability of our nation's forests.

The purpose of the 2020-21 Forest and Forest Products R&D Capacity Summit was to bring leaders from private, state, federal, and university Forest and Forest Products organizations together to strategize a better approach to collectively identify, communicate, coordinate, and advocate for US forest and forest products R&D priorities, capacities, and funding. While the long-term goal of this project is to identify novel methods for strengthening R&D at a national scale, this report synthesizes the perspectives of leading stakeholders of Forests and Forest Products R&D.

Eight stakeholder perspectives (State Foresters, family landowners/managers, large private forest owners/managers, forest products industry leaders, environmental NGOs, USFS National Forest System leaders, USFS Research Station Directors, and University research leaders) were gathered in focus groups to discuss Forest and Forest Products Research & Development (R&D) in the United States, with a focus on declining capacity and proposed solutions. Over 73 individuals participated from a range of organizations and shared their perspective on challenges, opportunities, and priority setting. The transcripts from each focus group (held via Zoom) were analyzed and coded for major themes.

Themes that emerged from the focus group include:

- Strong consensus among the focus groups surveyed on top R&D priority areas.
- Critical areas of growth and opportunity for R&D include mass timber, climate change and forest carbon, and new markets for wood.
- Communications about forest and forest products R&D should focus on fire hazards, keeping forests as forests, and forests as a natural climate solution.
- Partnerships/coordination have become increasingly creative to help fill the gaps in forest and forest products research capacity and funding.
- There is misalignment between the incentives for forest and forest products researchers and the research needs of R&D consumers.
- While all focus groups felt there was an advantage to having a unified national voice for setting forest and forest products R&D priorities, there also was a concern about the potential loss of advocacy for regionally important issues.
- There are existing convening organizations (e.g., AFF, NAFO, SAF, NAUFRP) that should be leveraged in identifying and communicating forest and forest products R&D priorities.
- Communicating the value of forests to the public and policy makers is vital before advocating for specific forest and forest products R&D needs.

Results included broad support to create a new mechanism for national R&D Prioritization. An in-person meeting was identified as a critical next step to bring stakeholder groups together to discuss options for improved advocacy and coalition building, and to create workflows and timelines that coincide with federal and regional budgeting processes.

Background and Motivation

The forest and forest products research and development (R&D) capacity of the U.S. (measured in scientist years and funding) has eroded substantially during the past three decades. Without significant investments and institutional change, there will be continued erosion of the nation's forest and forest products R&D capacity that will reduce global competitiveness of the U.S. forest products sector, as well as threaten the management and sustainability of our nation's forests. The purpose of the Forest and Forest Products R&D Capacity Summit was to bring leaders from private, state, federal, and university forest-based organizations together to strategize a better approach to collectively identify, communicate, coordinate, and advocate for U.S. forest and forest products R&D priorities, capacities, and funding.

Rather than just producing another report on the state of forest and forest products R&D capacity in the U.S., our goal is to develop a new, tangible, and lasting mechanism for private, state, federal, and university organizations involved in forestry and forest products to cooperatively identify, communicate, coordinate, and advocate for forest and forest products R&D priorities, capacities, and funding.

To be successful, this new mechanism, whether it be an entirely new body or a modification of existing bodies, needs to be charged with:

- Jointly identifying national and regional research priorities for forest and forest products R&D in the United States,
- Jointly communicating, coordinating, and collaboratively advocating for forest products and forest R&D funding that addresses top priorities,
- Monitoring and reporting progress in addressing top priorities,
- Maintaining and building the nation's forest and forest products R&D capacity, and
- Identifying long-term and sustainable funding sources to support forest and forest products R&D priorities.

Approach

A broad spectrum of stakeholders involved as consumers and/or producers of forest and forest products R&D were selected from eight categories:

1. State Foresters
2. Family forest landowners/managers
3. Large private forest owners/managers
4. Forest products industry leaders
5. Environmental non-governmental organizations (ENGO) leaders
6. USFS National Forest System leaders
7. USFS Research Station Directors
8. University research leaders

Within these groups, key thought leaders were identified by the organizing committee and steering committee and additional recommendations were made during focus groups. Because in-person meetings were not possible due to the COVID-19 pandemic, we held 17 focus groups

online via Zoom, each with 3-6 members, for a total of 73 participants. Prior to each meeting, each participant was given:

1. A script of questions related to the benefits, outcomes, resources/investments, advocacy, priority setting, collaborations, challenges, and future of forest and forest products R&D;
2. The 2017 U.S. Endowment for Forestry and Communities final report of the Blue Ribbon Commission on Forest and Forest Products Research & Development in the 21st Century; and
3. Zoom instructions.

All sessions were recorded and transcribed for later analysis. Data analysis consisted of qualitative coding techniques (Charmaz 2006), beginning with in vivo codes, grouping of codes into key themes, inter-rater reliability checks, and finally re-coding in vivo codes into consistent codes for tabulation and summaries. Throughout this report, if a code was constructed using the exact wording of the individual, it will be presented in 'italics' whereas thematic and interpretive codes are in normal font. During thematic analysis, some codes (e.g., Top Three Priorities) were re-coded and grouped for clarity. For example, "forest carbon" and "forests as a climate solution" were re-coded to "Climate Change." Names of individuals and other identifying characteristics (geography, gender, position/title) have been removed to protect the anonymity of participants.

The organizing committee consisted of Dr. Robert Wagner (Purdue University), Dr. J. Keith Gilless (UC-Berkeley), Michael Goergen (US Endowment for Forestry and Communities), and Dr. Emily Huff (Michigan State University). The steering committee consisted of Tom Martin (AFF), Alexander Friend (USFS), Susan McCord (NCASI), Dave Tenny (NAFO), and Justin Morrill (AWC). The organizing committee met weekly to plan and draft the focus group script, to review progress, and weigh in on the analysis. At least one organizing committee member was present at each focus group. The steering committee reviewed the focus groups scripts and were debriefed about key results.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. Sage.

Results

Individuals representing stakeholder groups were geographically varied (Figure 1), but the majority represented an organization that worked nationally. Similarly, the scope of work or influence was largely at the national scale (Figure 2). After learning about the R&D capacity of each organization, we were able to determine whether they produced and/or consumed information about forests or forest products R&D as part of their organization's mission:

- **R&D Producers**
  - University research leaders
  - USFS Research Station Directors

- **R&D Consumers**
  - State Foresters
  - Family landowners/managers
  - Large private forest owners/managers
  - USFS National Forest System leaders

- **R&D Producer and Consumer**
  - Forest products industry leaders
  - Environmental non-governmental organizations (ENGOs)

The U.S. regions represented and the geographic scope of the stakeholders in forestry or forest products interviewed are shown in Figs 1 and 2.

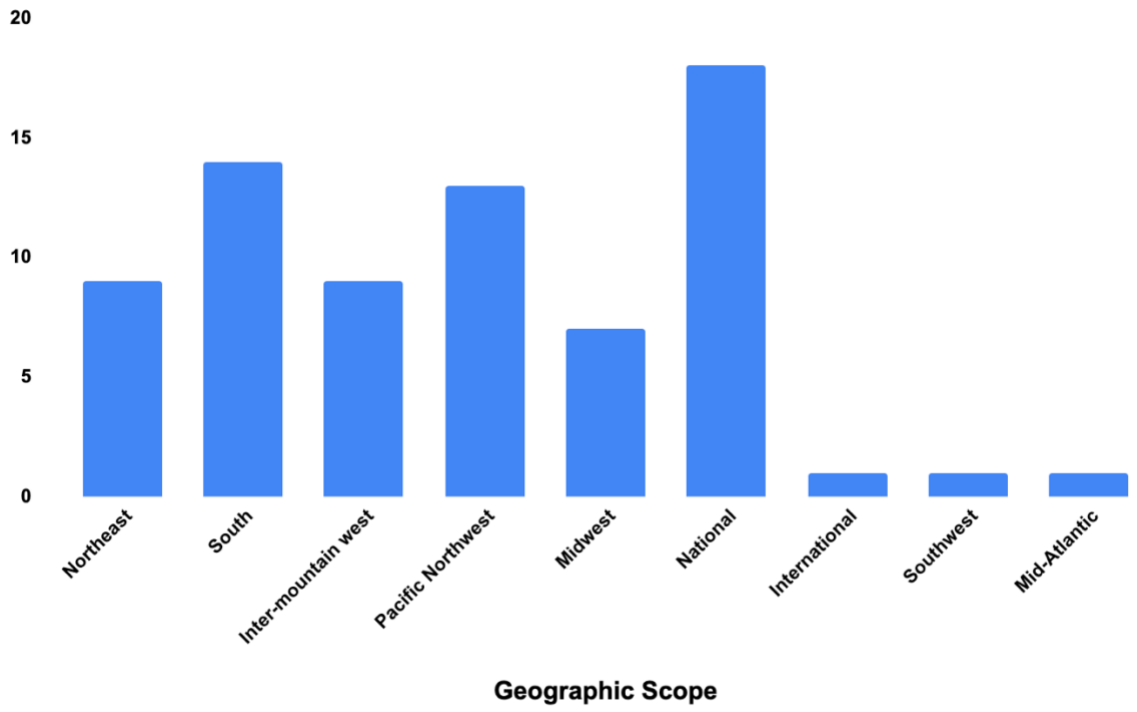

Figure 1: Geographic scope of focus group participants.

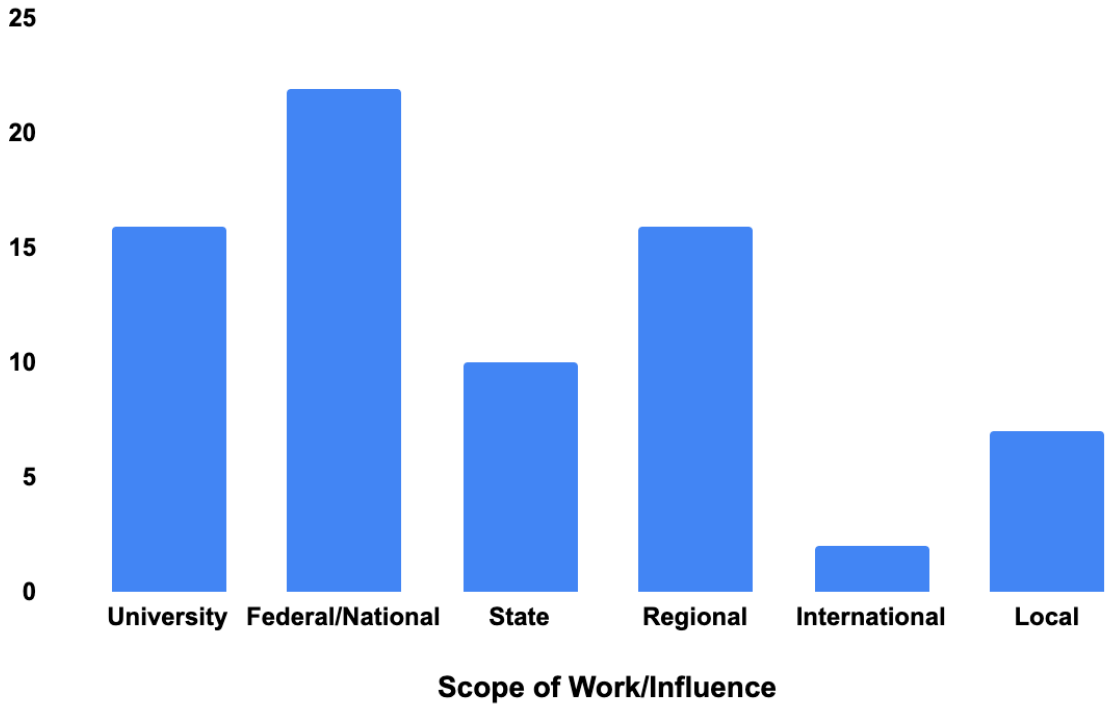

Figure 2: Scope of Influence represented by each focus group participant and their respective organization.

Thematic codes spanned a wide range of perspectives on forest and forest products R&D (Table 1). The conversations were organized to proceed from R&D Benefits to Challenges, Priority Setting, and Actions/Next Steps. There were also specific questions about Advocacy, current organizational capacity and structure, but the conversations often included other topics, inspired by the perspectives of participants.

Table 1: Thematic Codes used (alphabetical order) with their corresponding definitions

Code	Sub-codes	Definition
Actions and Next Steps		Anything a participant described that could be actionable or a tangible idea for what to do next
Advocacy		Examples of advocacy or lobbying done by participants (or their organization)
Challenges and Problems	Broad	Problems or challenges facing the sector more broadly
	R&D Specifically	Problems or challenges inherent to forest and forest products R&D, specifically
Cases for Change		Participants were asked if they had any ideas for Case Studies that could be highlighted for advocacy work
Communication		Issues with science communication, making the case for R&D, outreach, and education
Current R&D		Current R&D activities or pursuits at the organization represented by participants
Forestry Data/Tools		Mention of key forestry data, tools, and technology that has been useful for participants and their organizations
R&D Funding		Funding mechanisms, partnerships, and sources
R&D Prioritization	Broad	Discussion of how the organization sets priorities more generally, and how they believe priorities could/should be set at the national scale
	Specific	How organizations specifically determine R&D priorities (if they are R&D Producers) or how to prioritize R&D information seeking or funding (if they are consumers)
Key Players	Conveners	Entities mentioned as 'important' to Forest and Forest Products R&D
	New Stakeholders	New entities (not previously considered by the organizing team or steering committee) with potential relevance to Forest and Forest Products R&D

Past Trends		Notable issues mentioned that led to today's R&D context
R&D Benefits		How Forest and Forest Products R&D helps the organization, and society more broadly.
R&D Consumers	Perspectives	Perspectives on what it means to be a consumer of Forest and Forest Products R&D
	Sources of Information	Where R&D Consumers obtain information.
R&D Coordination		Discussion of partnerships and strategies for undertaking R&D
R&D Opportunities	Areas of Growth	Noted areas that are likely to grow in the coming years
	Current Gaps	Current gaps (and needs) in Forest and Forest Products knowledge
	General Opportunities	General opportunities for R&D that were not highlighted as areas for growth; often specific to a particular stakeholder group
R&D Producers		Perspectives on what it means to be an R&D Producer
Structure and Mechanisms		Ways in which organizations are undertaking, using, and sharing R&D
Success Stories		Examples where Forest and Forest Products R&D has been successful and led to *R&D Benefits*.
Top Three Priorities		Participants were asked to identify their Top Three R&D Priorities, given limited resources
Unified Voice	Advantages	Participants were asked to discuss what the advantages might be for a nationally-unified voice for setting R&D Priorities
	Disadvantages	Participants were asked to discuss what the disadvantages might be for a nationally-unified voice for setting R&D priorities

R&D Benefits

The benefits of forest and forest products R&D were discussed by every stakeholder group. Industry representatives noted that margins are tight in forestry and forest products; R&D gives industry an essential edge, particularly when people are increasingly turning to renewable resources for product manufacturing and carbon sequestration. Family Forest Owners (FFOs) felt that nearly all research was valuable, but the challenge was making sure that research is properly disseminated and translated to the enormous ownership base of U.S. private forests. FFOs, in particular, highlighted information about water and forest health management as especially beneficial. Large private forest owners/managers pointed to R&D as being critical to fight against or defend state and federal policy/legislation. For example, one participant noted that:

> *"We're fighting a bill in the main legislature that would ban aerial herbicide spraying for forestry purposes, and that's an essential tool for doing what we need to do. Without the research, we'd be in a much tougher spot." – Large Private Forest Manager*

State Foresters noted that R&D is beneficial for the sector because it gives us credibility and builds trust with the public. They also noted that R&D is a tool for soliciting increased funding of forest management. State Foresters noted that forests are being increasingly identified for a broad spectrum of benefits and functions. Therefore, analysis of forest management provides specific guidance as to the acceptability, desirability, and necessity of forest policies and practices - particularly when competing interests are involved. Finally, State Foresters all commented that the link between R&D and forestry practices is critical, as is R&D to inform and support new markets for wood products. U.S. Forest Service National Forest System representatives focus mainly on the benefits of R&D for reducing costs. They also focused on automated tools and new technologies for managing public forest lands. USFS Station Directors also noted that R&D is meant to benefit the public, and to help the country manage both private and public forest resources.

Past Trends

During the framing portion of the focus group, participants noted past trends that brought the sector where it is today. Multiple stakeholder groups noted that the USFS Forest Products Laboratory in Madison, WI has suffered huge losses in expertise and staffing, to the detriment of the sector. Industry groups commented on the drive towards non-renewable packaging materials is starting to reverse, which may be a positive trend for the sector. University leaders were mixed - some described declines in forestry and forest products degree enrollment, while others reported steady or increased numbers. University leaders also reflected that there is a reduction in number of researchers, less connection to industry, and the largest and most monumental change was the shift in forestland ownership to Timber Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs). NGO leaders discussed both contraction in private sector capacity, and an expansion in capacity because of new technology (e.g., LIDAR and GIS). One NGO noted:

"You know maybe the biggest belly flop is liquid fuels from forests. Obviously it's not a panacea, but I feel like we were promised all these different things. Even biomass outside of pellets seems to have kind of disappeared..."

Large private forest landowner/managers described the decline in investment as a result of the lack of coordination across stakeholder groups. State Foresters felt that the areas of forest and forest products R&D that have been left behind are traditional forestry disciplines, like silviculture. They also noted that historically key funders like industry are no longer funding R&D. The USFS Station Directors commented that their units that conducted wood products research have slowly disappeared - key personnel have retired and their positions were not replaced. Their counterparts in the NFS also noted that research personnel turnover and retirement is a persistent issue. They also noted that:

"There was a time when the Forest Service was the go-to person, entity, organization, for scientific information around forests and now people can google whatever and you don't even know sometimes whether or not the information on the internet is factual, but if our public gets ahold of it, it creates really tough situations because we as an agency are supposed to be multiple use and balance all interests."

This shift in knowledge access and availability also was emphasized by ENGOs and forest products industry leader stakeholder groups. It has potential benefits, but also downsides to the R&D process.

Challenges and Problems

Broad Challenges

Within this theme, there were many broad challenges described. Family landowners/managers discussed the disconnect between calls for renewable and green energy, but political opposition to forests as energy sources. They noted that their fellow private forest landowners were often more 'amenity and beauty' landowners, with no interest in working forests. They found this troubling for the future of the sector. Industry leaders discussed competing materials (e.g., steel), excess wood due to mill closures, university and federal funding, and issues '*telling our story well*' (see *Communications* theme). They also mentioned that the fundamental challenge the sector has is helping people understand the link between the forest and the forest products industry. College and University leaders echoed this sentiment, reiterating that the lack of markets for wood products means we are often paying to perform needed vegetation management. There was also recognition that we struggle, as compared to the agricultural sector, to get what we need. One university leader mentioned that we have:

"too many organizations. Even in our state of [removed] we have a separate forest products association and a separate forestry association. We have a logger's association. It's a scale issue."

Finally, College and University leaders noted a chicken-and-egg problem. States won't provide matching funds for forest and forest products R&D unless the industry does, and industry won't provide funds unless there is public support. ENGO leaders also reiterated that we have to communicate the value forests provide before we can advocate for specific R&D priorities. ENGOs and private landowner/managers also brought up the workforce development issues in forestry - how do we attract and retain the brightest minds to the field? ENGOs mentioned the incredible number of user communities in forestry and forest products and the challenge in meeting all of their needs. They also mentioned a 'social license to operate' which was also mentioned broadly across stakeholder groups. Many groups noted that within the sector, there are two distinct 'camps' - preservationists and pro-management - and this fracture contributes to the mixed messaging we see within the sector. State Foresters put their biggest challenge succinctly, "*we have to sell what we grow,*" but also noted that they had trouble recruiting good foresters.

USFS Research Station Directors felt that social science was a broad challenge for the sector, which included public interface issues and communication. They also agreed that hiring people with the right backgrounds was a challenge for the agency going forward. Station Directors felt that strong markets were a broad problem, but unlike others who mentioned markets, they emphasized that non-consumptive markets were important to them - such as payment incentives for ecosystem services. USFS National Forest System leaders discussed the challenges they faced with lack of markets for their wood and a culture of 'localism,' at the expense of the bigger picture (e.g., their forest models don't necessarily line up with regional models). They also were the only group to introduce the concept of 'competing science' whereby litigation can find facts to support many sides of an issue, "*people often have an affinity to "science" that supports their views.*"

Specific R&D Challenges

The group that mentioned R&D Challenges the most were the USFS Research Station Directors and National Forest System leaders. Family forest landowners/managers and ENGOs discussed challenges the least (as measured by time and level of detail). The challenges mentioned by all groups were those related to markets, priority mismatches, funding, and competing information (Figure 3).

Family forest landowners/managers perceived that forest and forest products R&D was more active in Europe than in the U.S. They also perceived a disconnect between the work that's being done and how it can be practically used by them, as potential R&D consumers. They did, however, feel that science translators (e.g., foresters, extension, landowner associations) were effective at getting information to them (*see R&D Sources*).

Forest products industry leaders felt that technology transfer was a particular area of weakness among researchers and further emphasized the need for better research

communication. They also differentiated between the researchers themselves and research managers (e.g., University leaders and federal research managers) - recognizing that it is the research managers who should be responsible for ensuring R&D consumption and production are in alignment, and that innovations make it to market.

College and University research leaders identified the following R&D challenges:

- *Dwindling faculty numbers*
- Competing demands for faculty time (e.g., teaching, mentoring, service)
- Decline in funding support (e.g., lack of grant programs, incentives to focus more on teaching)
- Extension support dwindling
- Lack of integration with other critical companion disciplines (e.g., fisheries)
- *Unclear messaging*
- Industry desires proprietary R&D rather than basic science
- High overhead rates and the price tag for graduate students

There was clear consensus that faculty are not linking with research priorities out of federal agencies and other stakeholders. As one participant states, "*we can go down a rabbit hole and work for a long time on some R and D stuff that isn't really valuable to stakeholders and will not have an impact."* Additionally, some participants were increasingly alarmed about the erosion of expertise within departments and colleges, that '*vegetation ecologists are teaching our Silviculture class*.

ENGO leaders, as both R&D producers and consumers, felt that funding and a common understanding (and interpretation) of science were the major challenges facing R&D. Large private forest owners/managers were most concerned with the mismatch between research production and consumption needs. They also recognized that if we (as a sector) are not setting priorities, someone else is defining what happens in our forest and the wood products manufacturing industry.

State Foresters emphasized market challenges again when discussing R&D challenges, and also described research production/consumption mismatches. To a lesser extent, State Foresters were worried that while there are great research efforts underway, they are disjointed and often duplicate each other because researchers aren't incentivized to share data, methods, and results. They felt frustration that academics are not responding more directly to industry and state agency needs, and emphasized a need to invest in social science research. Although many groups touted the benefits of big data, State Foresters cautioned that there could be a downside:

> *"how do you make sure you're collecting the right data at the right time so you just don't get into this rat race of collecting data all the time whether or not it's for the strict purpose of research, but with this assumption that*

more data is better. I think that collecting the right information in order to not to exceed human bandwidth is going to be something we really need to be thoughtful about increasingly." – State Forester

USFS Research Station Directors had a slightly different perspective. They felt their biggest challenge, as producers of R&D was being subject to political whim - to the extent that they questioned if they were a science-based or a socially based organization. They felt they were undergoing an "identity crisis" and their challenge was to keep enough R&D to "*be prescient about what needs might be while still fulfilling the role of relevance that often times is defined as a rather short-term focus."* Although the USFS is perceived by other stakeholders to be the best place for coordinating and conducting long-term R&D, Research Station Directors felt they were still under pressure to deliver short-term science on congressional cycles and were competing for the same R&D dollars as everyone else. Furthermore, they recognized the limitations imposed by public office to interpret research results and make 'policy recommendations.'
The USFS National Forest System leaders also indicated that the incentives of R&D (within the USFS) do not always align with the goals of National Forest System (actionable and very practical applied research). They perceive that R&D USFS scientists were incentivized to '*shy away*' from applied science.

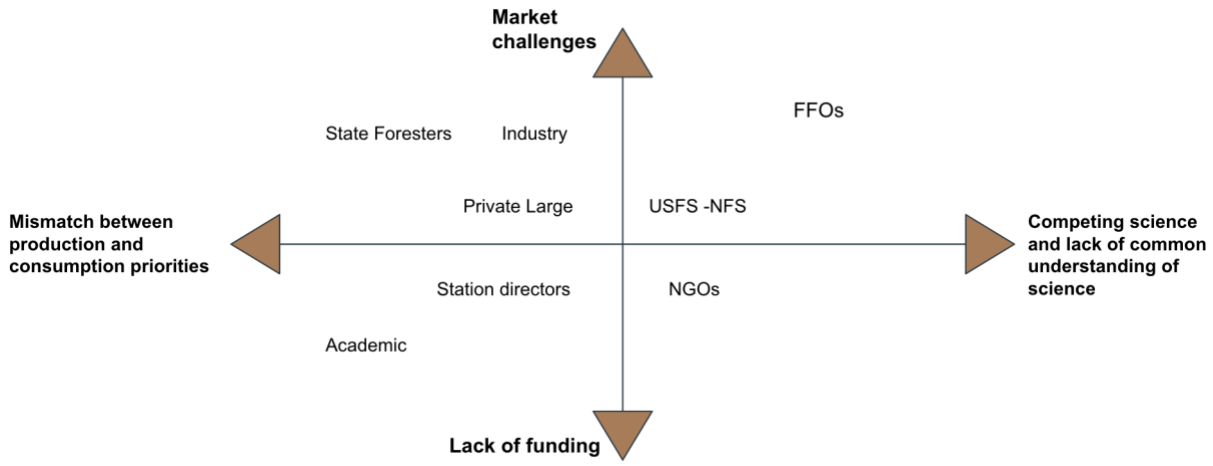

Figure 3: Major challenges noted by more than two groups; groups are placed on the graph by which two challenges were mentioned most, and the extent to which they were mentioned within each group.

R&D Consumer vs. Producer

Consumer vs. producer of forest and forest products R&D captured key perspectives from both ends of the R&D pipeline. Family forest landowners/managers self-identified as R&D consumers and rely heavily on Extension, webinars, short courses, and newsletters. There was recognition by this group that there are owners who want to actively manage, and owners who "*just want to sit here and look at trees.*" They recognized that the latter group may not see the

value of R&D as they are not prone to take action on their land. Some ENGO participants felt they were 'significant' consumers of R&D, and many felt their role could be that of translator and synthesizer. If anything, ENGO participants saw themselves as 'co-producers' of research. State Foresters also self-identified as Consumers, pointing out that they rely on Universities and the USFS Forest Inventory and Analysis program (FIA) as their main source for information. Surprisingly, the USFS Research Station Directors also perceived themselves as Consumers.

Forest products industry leaders were mixed, but those that self-identified as R&D producers remarked that they needed internal R&D capacity to stay competitive, even if they also formed external partnerships to meet their R&D needs. Generally, those who felt they were Producers of research felt that Forest and Forest Products R&D was a 'shared responsibility' and that no one stakeholder group should be solely responsible. There was perception among College and University research leaders, however, that federal agencies and industry have decreased their R&D capacity and that no one has stepped up to fill the void. This was further elaborated in one ENGO group where a participant remarked, "*We shut our door on science if we lose the Forest Service.*" There was sentiment expressed (counter to the perspective of USFS Station Directors, see *Challenges*) that the USFS was uniquely positioned to provide long-term forestry research.

Forestry Data and Tools

The key data, tools, and technologies that have been useful for stakeholders are:

- Forest Inventory and Analysis (NGO, State Foresters, USFS NFS, College and University Leaders)
- National Woodland Owner Survey (NGO, University Leaders)
- Seedlot Selector (NGO)
- Tree Equity Score (NGO)
- I-Tree and related Forest Service tools (NGO, Family Forest Owners)
- ArcGIS and ESRI Suite (NFS, State Foresters, USFS Station Directors)
- LIDAR and Remote Sensing (College and University Leaders, USFS NFS, NGO)

R&D Producers and Consumers mentioned Forest Inventory and Analysis data as the backbone for additional research and for managers. R&D Consumers had additional tools that they found useful, such as i-Tree. R&D Producers found GIS and remote sensing tools useful and likely to have the most potential moving forward. Generally, this topic generated less discussion than other questions in the focus group guide.

Current R&D

Current pursuits by R&D producers varied, and were likely correlated more with the specific participant organizations present than a generalizable set of sector-wide research activities.

Forest products industry leaders

- Lignin properties, toxicological profiles of new wood-based materials

University research leaders

- Environment-health interface, tick-borne diseases, mass timber, restoration ecology, nanocellulose markets, biofuels, urban forestry, climate science, shared stewardship and governance, remote-sensing data for decision-making, adaptive forest management, mill repositioning, glycomaterials, Ecosystem Service markets, AI tools for analyzing forestry data, environmental justice, watershed management, eddy flux tower research, global environmental change, forest carbon policy, forest landowner engagement, biomass supply chain management, genetic tools for tree improvement, endangered species recovery

ENGOs

- Conservation values
- Forest carbon management
- Remote sensing technology for forest inventory
- Ecosystem services
- Grant agreements

Large private forest owners/managers

- Silviculture
- Growth and yield
- Tree genetics and improvement

State Foresters

- Wood products and bioenergy
- Biochar
- Fire management and Rx Fire
- Genetic improvement
- Herbicides

R&D Funding

R&D producers felt that research funding was either declining or staying the same, consumers felt it was generally stable, and those that both produce and consume R&D felt it was either stable or increasing. However, this perception varied greatly by state, region, and participant (Figure 4). Forest products industry leaders remarked that large companies who support innovation with R&D funds were increasingly scarce, and that the best they could hope for was incremental improvements rather than revolutionary changes. Nearly all stakeholder groups said successfully funded projects were partnerships (see R&D Coordination). The major sources of R&D funding across stakeholder groups were government agency funds (e.g., DOE, USDA), internal funds, and university research cooperative dues. Generally, all groups except family forest landowners/managers had some money to fund R&D. The groups who actively sought money for R&D were Universities and ENGOs.

Perspective	Perceived change	Sources/Issues
Academic	↓	Academia sources funding from Grants, Partnerships, and Agreements
Station Directors	↓	Station Directors perceived that their funding has declined and there has been a shift to short-term projects (e.g., Joint Venture Agreements)
National Forest System	→	NFS managers felt they were still receiving the same funding, but were partnering with Universities rather than USFS R&D to meet their research needs
Family Forest Owners	↑	Family Forest Owners recognized that they do not avail themselves of funding available, but felt funding for research had been increasing.
Private Large	→	Private Large Landowners funded R&D through partnerships and sometimes were able to reinvest revenue into R&D
NGOs	→	Some NGOs sponsor research by issuing requests for proposals while others perform research in house
State Foresters	→	Some fund internally, others partner
Industry	→	Some fund internally, others partner

Figure 4: Perspectives on R&D Funding by stakeholder group. Red arrows indicate a decrease in funding, yellow arrows indicate no change in funding, and green arrows indicate an increase in funding.

Key Players

Focus groups mentioned two different categories of organizations: those that convened and translated R&D, and new stakeholders that should be considered in this national prioritization effort. Key convening organizations that could be leveraged in this prioritization project are:

- National Association of Forest Owners (NAFO)
- Society of American Foresters (SAF)
- National Association of University Forest Resource Programs (NAUFRP)
- National Council for Air and Stream Improvement (NCASI)
- National Association of State Foresters (NASF)
- National Woodland Owners Association (NWOA)
- American Wood Council (AWC)
- Forest Climate Working Group (FCWG)
- Sustainable Forestry Initiative (SFI)

The Farm Bureau and APLU were mentioned as a source for learning ‘what works’ for prioritizing and messaging in the agriculture sector. The Nature Conservancy (TNC) was mentioned as an organization that has helped to fill R&D gaps across the country, notably in the area of science communication.

New stakeholders include the U.S. Climate Alliance, minority landowners, epidemiologists, and air/water quality scientists.

R&D Coordination

Academic institutions were broadly recognized by most groups as the hub for forest and forest products R&D coordination (Fig 5). University research leader participants described partnerships with industry, the USFS National Forest System, USFS Research Stations, State forest agencies, and large private forest owners/managers. One partnership between USFS R&D and ENGOs was described. The Forest Climate Working Group is a broad coalition of all stakeholder groups and was mentioned as a platform for building funded partnerships to work on R&D projects. Nearly all the positive outcomes from R&D were attributed to partnerships and coordination across stakeholder groups (see Success Stories), from both consumer and producer perspectives. The only group that was noted to be missing from these partnerships are family forest landowners/managers, although representative organizations (e.g., American Tree Farm System) are sometimes included in partnerships to represent landowners in R&D efforts, to assist in recruiting landowners for R&D projects, or to help disseminate R&D products.

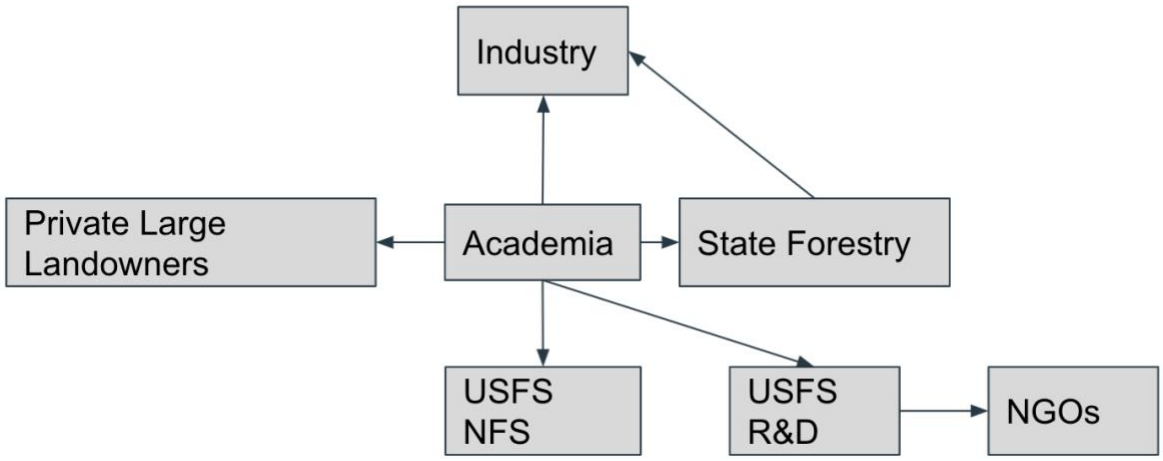

Figure 5: R&D Coordination schematic. Arrows denote a partnership between the two stakeholder groups (not directionality). Academia partnered with the greatest number of stakeholder groups.

The regions in which coordination between universities and industry appeared to still be strong were the northeast, the south, and the pacific northwest. Large private forest owners/managers were also coordinating R&D with universities through research cooperatives in the Pacific Northwest, Southeast, and Northeast, but less so in the Midwest and Lake States. This was the only mention of University/Industry coordination, and the mechanism private large industry entities spend their R&D funding on, other than in-house work. Fire issues were mentioned as a catalyzing force for building R&D partnerships. The USFS participants noted that partnerships between their USFS National Forest System and R&D personnel were strong in the intermountain west but varied widely throughout the agency. State Foresters also had very different inter-group perspectives on partnerships. Some had very strong ties to universities in their states, and others felt that there was a strong mismatch between Universities and State needs for forest and forest products R&D priorities.

Structure and Mechanisms

Throughout the focus groups, there were ideas shared for strengthening the sector: Family Forest Owners indicated that the Farm Bureau provides a real return on investment for its members. The posed the question: *"How can forest landowners be given the same return on investment for joining the many associations and organizations they are pitched?*" They did perceive that associations like the American Tree Farm System provided as much to them as Farm Bureau does for farmers.

Industry participants suggested a tax credit for employees when they move to a rural area to work in the forest sector (biomass given as a specific example), to address workforce development issues. They noted that R&D capacity tends to be centered in places far removed from the resource, and a possible mechanism to improve R&D would be to incentivize researchers to work closer to the resource they are studying. Industry participants also mentioned "FRAC" – the Forest Research Advisory Committee – but noted that it hadn't met for years. They perceived that it was a useful convening body and may serve as an example for future prioritization efforts.

College and University leaders shared that wood science and forestry departments have merged at most universities, or that wood science was subsumed by other departments (e.g., Biosystems Engineering). There was general consensus among stakeholder groups that Academia and the USFS should be the primary producers of R&D, while NGOs and the private sector can inform and focus the research.

NGOs felt that some erosion of R&D was linked to the increasing trend of forest land ownership by TIMOs and REITs. One participant stated, "the nature of their [TIMO and REIT] ownership makes it more difficult for them to be able to invest in that kind of long view with regard to R&D." NGOs also felt that the USFS was a critical R&D partner for multiple stakeholder groups.

The private large landowner/manager groups commented on the relationship between size of organization and ability to fund in-house R&D. The smaller the company, the less likely they were to fund R&D, internally or externally. This group suggested that state forests be used as demonstration forests for R&D. Independently, State Foresters commented that often they do use their land as a resource to offer for research projects. State Foresters had some degree of R&D in house, via Departments of Natural Resources in many states. They also commented that depending on the state, forestry was often in the same department as fisheries and wildlife, and thus competing for increasingly limited resources.

In terms of structures and mechanisms, USFS R&D mentioned that often researchers are not taught project and budget management, which makes coordinating long-term R&D projects cumbersome. They also echoed that research must be translated and made 'usable' to stakeholders, to make the case for future increased investment.

Success Stories and Cases for Change

Although much of the conversation in the focus groups centered on challenges, there were some examples highlighted were R&D has been successful, leading to success within the broader forest and forest products sector. There were also a number of suggestions to elaborate upon to make a "Case for Change" in a prioritization process. The Wood Based

Composite Center was mentioned by forest products industry participants as a success story. It is a collaboration between academia and industry, where M.S. and Ph.D. students are partially funded, and are advised by industry mentors. University leaders highlighted the geospatial arena as particularly successful for the forestry sector. They also pointed to industry / university cooperative models (e.g., Forest Productivity Cooperative at NCState, CFRU at University of Maine, Stand Management Cooperative at U. Washington) as successful vehicles for partnership and leveraging of funds over a number of decades. One university leader also mentioned the importance (and successful attempt) of bringing politicians to the woods or on-site to see R&D impacts. ENGOs pointed towards forestry's efforts in the climate change space, both in terms of predictive modeling and supply-chain management. Private large landowner/managers also described carbon, selling carbon, and growth and yield as success stories for forestry. Genomics and genetics were also mentioned as areas in which forestry has been successful. Multiple groups mentioned the Joint Fire Science Partnership as an example of success.

Cases for Change would serve as a catalyzing topic for production of materials for advocacy work. They would begin with a broad and critical motivating reason for Forest and Forest Product R&D and use specific examples that demonstrate success and point to a critical need.

Ideas for topic that Cases for Change could focus on were:

- Forests as a Water Quality Solution (FFO)
- Forests as a Natural Climate Solution (University)
- Working Forests Reduce Fires (Private Large)
- Forests in a Bioeconomy (State Foresters)
- Long Lived Wood Products (State Foresters)

Communication

At the beginning of the virtual summit, participants were not asked explicitly about communication and R&D translation, outreach, and dissemination. However, the topic was increasingly raised, so later groups were asked to comment on whether and how R&D was being successfully communicated. The consensus among all stakeholder groups was 'no.' R&D communications have been failing in three areas:

- communication with the public,
- communication between R&D producers and consumers,
- communication within stakeholder groups.

Although R&D translating groups (e.g., university Extension, ENGOs) were mentioned, there was a general sentiment that the entire sector lacks clarity and cohesion with messaging. There also was a noted 'divide' in the sector between forest protection and forest management, which contributes to the difficulty with messaging. Some, particularly in the ENGO space, feel that forest stewardship should not be driven by market forces and management objectives, but rather protected for their own intrinsic value. Others feel that forest management is the impetus for keeping forests as forests. This divide was described as potentially watering down

messaging around Forest and Forest Products R&D and weakening the potential for agreement on R&D priorities. There was agreement that the sector has not adequately supported the notion that forest products industries help support forestry and continued longevity of forested lands. Forest products industry leaders self-reflected that they were partly to blame, and suggested resources for people doing outreach so that messages support the overall sector, and not the specific needs of the researcher, or research organization. Another participant commented:

> *"outreach money that ends up kind of skewing towards one political ideology doesn't really get any traction because there's so many people that are against that ideology, so it has to be ideological neutral outreach that still supports the forest industry."*

In addition to the identified issues with organizations communicating with publics, there was a discussion of how researchers do not communicate their science to stakeholders very well. Several groups commented that the organizations best positioned to provide information in the future are those that can repackage the 'state of knowledge' for people the most efficiently and clearly.

There also was recognition that the message should not change for different audiences, but they ways in which it is communicated should change (e.g., language, venue, medium). There was also consensus that messages should be kept simple and short.

> *"We sound like children stomping our feet if we don't make clear that the needs we express actually will ensure the benefit of society and are critical to our ability to be able to greet the future."* - ENGO
>
> *"pro-forestation as the latest kind of iteration of essentially a zero cut call from local groups, NGO's, etcetera and I think we're still having conversations all across the country...about sort of social acceptance and I think that as climate change gets worse and worse and people get a little more panicked about losing trees and loosing other services the idea that cutting trees can be part of a viable solution or viable adaptation to climate change I think will continue to need societal conversations to build trust."* - ENGO
>
> *"Doesn't matter if it's small landowners or groups of them or single large landowners, keeping them convinced they're spending the money for the right reasons is a full-time job."* - Large private forest owners/manager

State Forester also reflected that they did not talk enough with each other. USFS Research Station Directors echoed this, that within the agency there was disjointed communication, but some improvement with the hiring of specific communications staff within R&D. There were also comments from USFS National Forest System leaders that the ability to search for information broadly on the web has led to a steady erosion of support for agency R&D delivery.

R&D Needs, Opportunities, and Priorities

Family Forest Owners mentioned that pests and fire were areas in which they wanted more research and thought continual research was needed, given the changes seen on their lands due to climate change. They mentioned understanding how to thin and reduce fuel loads, properly regenerate following fire, and dealing with pests from insects to white-tailed deer. Industry participants mentioned mass timber and how wood products can be positioned 'environmentally' as areas that needed R&D. Other specific industry opportunities mentioned were cellulose-based materials and product development, and wood energy. The academic community saw the greatest R&D opportunity as one of communicating research, engaging stakeholders, and developing markets - they felt R&D would progress within their institutions regardless, but these other critical R&D supportive elements were the biggest opportunity. As one academic stated, *"I'm less concerned about priorities, because they'll change next year, and the year after, and the year after, but how do we fix the mechanism that supports research in forestry and natural resources in general?"* - NAUFRP member

Several academic participants noted that silviculture was an area that seemed to be suffering, particularly relative to its importance in a Forestry degree program. They noted that the candidate pool for jobs was small and support for hiring new faculty in this area was not strong compared to the noted value of silviculture by the focus group participants. NGO participants remarked that measuring conservation impacts and outcomes was a big opportunity for future R&D. Several organizations brought up drones and remote sensing data opening new opportunities for forestry R&D.

Areas of Growth and Current Gaps

Areas of growth were topics that participants felt were currently growing in need and interest, in addition to being potential R&D opportunities. These were identified across stakeholder groups as mass timber, climate smart forestry/forests as a natural climate solution, relation between forests and water, biochar and biofuels, and pests/disease research.

Gaps were identified as: restoring degraded landscapes, economics of land use decision making, log drying technologies (and other primary processing advancement), stability in supply chains (to prevent mill closures), climate change mitigation strategies, engaging private (family) landowners, markets for small diameter wood, entomology and pathology (generally declining),

There were also several specific, and nuanced, gaps mentioned. For example, one State Forester remarked, "*I think we need more research on the pretty good versus the ideal. In other words, you're never going to grow Ponderosa pine on a three-hundred-year rotation on private lands anyways, what are some of the best management practices on private lands that may not be the ideal for climate change adaptation, but they get the job done and they enable people to stay in business and make a profit, you get more acreage covered*." This led to a discussion of how we best research (and communicate) management scenarios that are site specific, but broadly applicable to many stakeholders.

Multiple stakeholder groups (State Foresters, USFS Station Directors, USFS NFS) commented on the need for more social science research. This was broadly described as encompassing public awareness and engagement, the 'social license to practice,' and understanding landowner management behavior. Specific disciplines (e.g., political science, psychology, sociology) weren't discussed. Rather, participants sought R&D that legitimized a desired outcome rather than R&D that informed what the outcome should be.

Finally, USFS NFS leaders discussed a gap in the research deployment and synthesis realm, *"I think a lot of times we think like a everyone's just going to grab the latest research and be able to figure it out and that's a model that really doesn't work when management folks are so flipping busy. So, that's to me maybe something that research might really be able to help us to do."* This was echoed, in a different way, across other stakeholder groups as they grappled with how research is packaged and accessed so that individuals aren't just gathering the science that best fits their narrative, but rather is balanced and current. Some participants labeled this disconnect as a 'technology transfer' gap while others described a more general lack of science translation in the context of declining support for Extension at land grant universities.

We wanted to map the identified gaps and opportunities/areas of growth to each other to determine if there were matches or mismatches in what stakeholders perceived was needed and where they felt R&D could or should go in the future. Identified gaps could be mapped to related or relevant opportunities and areas of growth. Groups mentioned that *Markets for Small Diameter Materials* was a gap, and *New Market Development* was an opportunity, suggesting a synthetic view on what is lacking and how to meet that need. *Economics of land-use decision making* was the gap and *Multi-Criteria Land Use decision-making* was an identified opportunity. *"The pretty good vs. the ideal"* was a gap discussed by State Foresters and *Using Big Data to understand management opportunities* was noted as an area of growth by all but one stakeholder group. *Social science* was a broad gap noted by half the groups, and a corresponding opportunity was the *social benefits of forests* and the *linkage between forests and human health. Forest health* was a gap and *pests/disease* research were noted as an area of growth, by family forest owners, large private landowners, and the academic community. Remote sensing and agroforestry were noted as potential opportunities, but there was not a specific R&D gap discussed by stakeholders.

R&D Prioritization

The groups all discussed how they prioritize their own R&D pursuits (or consumption) and how an R&D prioritization process might proceed, based on the identified lack of a coordinated approach as the catalyst for these conversations. Broadly, industry recommended road mapping exercises and having clear and simple messages that everyone could agree on, saving additional space for regional priorities and differences of opinion that could be advocated for separately and in other places than the broadly applicable priorities. Academia echoed that a national and perhaps regional priority setting processes were equally important. They also repeated that priorities will change, but having a process in place will allow for all groups to efficiently self-advocate and for convening groups to understand their stakeholders quickly and

effectively. There was also concern that the agricultural commodity model would never work for forestry because of the diverse range of values and services forested lands provide.

NGO groups pointed out that perhaps having existing convening groups for each stakeholder sector (e.g., NAUFRP for academia, NAFO for large private landowners, SAF for NGOs, NASF for State Foresters) could enable a hierarchical assembly of priorities that then makes a national priority setting effort more efficient and 'bottom-up.' Both NGOs and State Foresters commented that the focus must be on applied science. They recognized the importance of basic science in academia (and the associated motivation structure for research faculty) but stressed that applied research was critical to stakeholders and is a part of the land-grant mission that seems to be declining at many universities. NGO's self-identified as 'picking up the slack' where universities weren't able to provide necessary research and research syntheses for practitioners and managers.

State Foresters also had a very practical perspective on prioritization, stating that "*We also are involved with a coalition for ground forestry in DC, advocating for top line R&D numbers but I think that sort of sets up another issue, that the folks who are out advocating for those, everybody is just concerned with their priority program and so that's a problem*." If the 'top-line' numbers aren't there, it does not matter what the R&D priorities may be. All groups admitted that '*we don't talk to each other enough*" (NGO) and discussed the need to have a cross-functional group focused on Forestry R&D that allowed for broad membership, but also was nimble and curated. The Forest Climate Working Group was mentioned as a broad coalition whose general model could be useful for a Forest and Forest Products R&D prioritization effort.

Existing prioritization efforts mentioned by groups were either money-driven, or stakeholder-driven. All groups discussed that it depended greatly on the mission and organizational goals. Industry took a very top-down approach while academia was almost entirely bottom-up. Industry and NGOs mentioned "Innovation Labs" and the private large landowner groups also mentioned internal R&D vetting processes that ensured they were meeting the needs of their managers and leveraging partnerships to build knowledge they needed to manage their timber resources. One NGO group discussed a 'consumer-driven' prioritization perspective, namely that consumers are looking for increased supply-chain transparency. The most formal existing prioritization efforts were that of the USFS, both station directors and USFS NFS. These involved science advisory teams, public commenting, and strategic partnerships and grant-making.

Top Three Priorities

All groups were asked the following question, "Given limited resources, what would you say are your top three R&D priorities right now?" Participants presented results as an unranked list. We collected these responses and re-coded them to create consistent thematic codes (Appendix III). In addition to grouping similar words (e.g., forest carbon and climate change re-coded to **Carbon and Climate**), we tallied the number of times a particular topic was mentioned and used a frequency approach to list numbers 1 - 3, 1 being most frequently mentioned within a

stakeholder group and 3 being the third most identified topic. What emerged were a remarkably consistent set of priorities (Table 2).

Table 2: Top Three Priorities for stakeholder groups, organized by R&D Production and Consumption

	R&D Producers		**R&D Consumers**		**R&D Producers and Consumers**			
Research Priority	***Academic***	***USFS Station Directors***	***USFS National Forest System***	***Family Forest Owners***	***Private Large Forest Owners / Managers***	***NGOs***	***State Foresters***	***Industry***
#1	Carbon and Climate	Fire	Fire	Forest health	Forest Productivity	Carbon and Climate	Mass Timber	Markets for forest products
#2	Forest Health	Water	Water	Carbon and Climate	Carbon and Climate	Fire	Carbon and Climate	Social License to Operate
#3	Fire	Markets for Forest Products	Carbon and Climate	Water	Markets for Forest Products	Social License to Operate	Markets for Forest Products	Wood Energy

The most common priority areas overall (across all three tiers) were:

1. Carbon and Climate (appears 6 times)
2. Fire, Water, and Markets for Forest Products (appear 4 times each)
3. Forest health and the social license (twice each)
4. Wood Energy and Mass Timber (once each)

Actions and Next Steps

Each group had a different perspective on where to go from this initial focus group effort. Family forest owners focused on lobbying and getting money. They put forth a 'plea' as well to engage younger people in forestry, remarking that they perceived landowners to be an older group and the logging industry as having trouble attracting the next generation. Industry groups mentioned potential to access venture capital and other funding sources previously untapped by the forestry sector. Academia pointed to messaging and increasing awareness among University leadership of the importance of forestry. "*We need to be our own best advocates.*" Several participants also remarked on the need for creativity and inspiration. One participant suggested a paper be written on how we got to where we are, to avoid making the same mistake in the

future. Private large landowners felt like smaller landowners needed to be engaged in a more efficient and fruitful manner:

"*Even though the group of us on this call represent a whole lot of trees, the trees don't have voices, they don't have votes, so there are not very many of us advocating. So, there's nothing you can do about it so it's a hard nut to crack but if you can get small landowners engaged, that's a whole different ball game.*" - Private large landowner

State Foresters discussed a "pool of money" but weren't sure who should contribute and how much. The felt this pool should fund long-term research at a local level and guide new researchers (e.g., faculty) towards goals that are needed on the ground, rather than what the researcher is personally interested in. They also felt private industry should be engaged to again fund R&D - either internally, externally, or both.

Advocacy

In the middle of each focus group, stakeholders were asked if they do any advocacy work. Nearly all of them engaged in some form of advocacy, either through direct lobbying efforts (e.g., industry) or by providing 'letters of support' for research grants (e.g., USFS National Forest System). The advocacy work carried out by the stakeholders is as follows.

Family Forest Owners

- Forest Climate Working Group
- Industry Associations
- American Forest Foundation's Impact group
- American Tree Farm System
- Farm Bureaus

Industry (often through a board member role)

- The Association of Pulp and Paper Technology Innovation
- Great Lakes Fire Energy Research Center
- USFS Budget Discussions

Academia

- Industry/University Research Cooperatives
- NAUFRP
- Input to USFS Station Directors
- Input to NCASI and NAFO

Non-governmental Organizations

- Federal Policy Makers
- Letter sign-on through SAF
- Letter sign-on through Rural Voices for Conservation Coalition

Private large forest landowners / managers

- University lobbying/funding
- Trade Organizations

- US and Canadian Forest Service
- Forest Carbon Working Group
- US Fish and Wildlife Service

State Foresters

- Letter of support to the Joint Fire Science Program
- Through NASF
- FIA funding advocacy

USFS National Forest System

- Letters of support for research projects

What does it mean?

All stakeholder groups agreed that increased capacity in Forest and Forest Products R&D was critical, and that the sector is at a turning point. They also agreed that a national prioritization effort was important, if there was still a mechanism for regional priorities to be expressed, and if there was accommodation for multiple viewpoints, and a process for resolving disagreements. The focus groups discussed developing coherent and consistent priorities (allowing for funding advocacy), or funding availability that then drives priorities. All groups acknowledged that each stakeholder category had some resources to bring to the table (e.g., forestland base, funding, expertise), but leveraging each would take a coordinated effort that may or may not be part of national-scale prioritization effort. The research team responsible for running these focus groups and steering committee see potential for the following next steps.

1. **Develop detailed "cases for change" to aid in advocacy work, based on priority topics that emerged from this initial effort.**

These cases for change would ideally represent different U.S. regions, and involve enough detail to be credible, but was presented in a manner suitable for a lawmaker, and as a 'leave behind' at meetings and events. It is important to note that participants were not specifically asked about mediums for knowledge distribution. However, the topic of communication came up frequently, and as a significant shortcoming within Forest and Forest Products R&D. It bears further reflection how researchers continue to stay relevant, while maintaining high quality science, and ensuring that information is presented to policy and law makers in a timely and understandable fashion. Finally, it is also important to evaluate whether or not the transmission of knowledge is effective or ineffective, and to focus additional resources on the effective pathways.

2. **Host an in-person summit to discuss and frame a national prioritization effort.**

This summit would need a representative from each 'convening organization,' representing the stakeholder groups included in this initial effort. Other key thought leaders and funders from forestry should likewise be targeted. The effort would need facilitation and would produce a

guiding document that outlines the prioritization process in detail, including any data collection efforts, future meetings/conversations, and a procedure for resolving disagreements. This summit would mix representatives from stakeholder groups, rather than grouping them (e.g., state foresters in one group). During this engagement, we propose having a more formal conversation about Extension, including technology and knowledge transfer. Triangulating results from different stakeholder groups, there is consensus that some of the work traditionally delivered by Extension has been picked up by NGOs; this could be a starting point for conversation about effective pathways for communicating Forest and Forest Products R&D. We also propose starting with a draft national prioritization mechanism (companion piece to this report) as a point of departure, as it may generate more discussion than asking participants to start from scratch.

3. **Carry out a national prioritization effort.**

Based on the feedback from the summit, and additional meetings with steering committee members, a national Forest and Forest Products R&D prioritization effort may be effective in increasing research capacity.

Appendix I: Focus Group Script Example

U.S. Forest and Forest Products R&D Capacity Summit
Focus Group Guide – USFS Research Station Directors

FACILITATOR INTRODUCTION AND PROJECT PURPOSE

I am an Assistant Professor in Human Dimensions of Forestry from Michigan State University, hired by the organizers and I am here to facilitate the discussion and listen to your answers. The role of facilitator is to make sure all topics are addressed, and all opinions and perspectives are shared. Thus, I will alternate between an open-floor for comments and a round-robin style of opinion sharing. I have a series of topics that I need to cover, so at times I may need to ask someone to wrap-up their thoughts and we'll have to move on. There will be additional opportunities to convey your ideas either in follow-up sessions, as written commentary, or however you wish to submit your thoughts.

This focus group is part of a larger summit process where we hope to understand the forestry community's perspectives on R&D priorities and needs. Forestry R&D needs to remain relevant and meet the needs of various stakeholders. Research funding has been dropping at all scales in the forestry sector. This effort is designed to figure out how we can build back the strength towards an integrated research effort. How do we add value and have impact as a sector? We (project team) believe we can do that together. We're asking you today how we can structure the effort to make those impacts and build back a coordinated research program that draws more investment from decisionmakers. We will build on these focus groups with a larger, hopefully in person meeting, where we can share findings and build on your ideas. At the end of this process, we will compile a final report stating these priorities, as gleaned from this and several other focus groups.

ACKNOWLEDGEMENTS

I would like to acknowledge the National Institute for Agriculture for sponsoring these focus groups. I would also like to say thank you for coming. We really appreciate you taking time out of your schedules to be with us today.

DISCLOSURES

This meeting is being recorded. I am sure there will be many interesting things said here today and we want to make sure we can capture all of it. These recordings are strictly

for ensuring a complete set of recommendations from this process and additional research purposes that may arise from your ideas, they will not go beyond the executive steering team. Individual statements will never be attributed to specific individuals. Please raise your hand (live or via the raise hand button), or type in the chat window your agreement for the session to be recorded. If you wish for your personal statements to be omitted from our summaries and analyses, please indicate that in the chat window. You may send a message to my privately (select just me in the chat window) if you wish.

PERMISSIONS AND ETIQUETTE

We will not take any formal breaks. At any time, please feel free to use the facilities and to grab some food or drink, turning off audio or video as needed. We may be using break-out rooms for smaller conversations. Please use the Chat feature to communicate if you are having any technical difficulties or cannot use audio for any reason. Please also use the 'raise hand' feature of Zoom if you wish to contribute, or you may simply unmute and speak up. The raise hand feature can be found in the Participants window at the bottom right hand side of your screen. I will constantly monitor the chat and hand raise icons.

Section 1: Benefits and Barriers [20 minutes]

1.1. Let's start by having everyone state your name, station and define Research & Development. What does it encompass for your station?

Going forward, we will define R&D very broadly as basic and applied research and experimental development (NSF definition). This includes things like business intelligence, new technologies, new knowledge, and incremental improvements to tools and processes.

1.2. Does your station benefit from R&D in Forestry, or do you primarily produce R&D?

1.3. I would like to know if your station engages in research for the following topics. Please share in the chat window an example of research your station is engaging with currently.

1. *Economics*
2. *Silviculture*
3. *New markets for forest products*
4. *Forest monitoring technologies*
5. *Policy*
6. *Stakeholder engagement and landowner outreach*
7. *International forest issues*
8. *Hydrology/Ecology*
9. *Wood Products*
10. *Pests/Pathogens*

11. *Genetics*

Are there any additional ways in which your station engages in R&D that I haven't yet mentioned?

1.4. In the last decade, which fields of forestry seemed to obtain the tools needed to do their work more effectively and which were left behind?

1.5. What do you see as the biggest challenges to your station over next decade?

Section 2: Resources/Investments

We are now moving on to Section 2 on Resources and Investments.

2.1 Tell us about the R&D capacity of your station? How are you organized internally to conduct R&D? To use R&D? To fund R&D?

2.1.1. What role, if any, does your station play in supporting R&D in forestry? Prompt – has this role changed during your tenure? Do you wish your role were different? If so, how?

2.1.2. Does your station employ researchers directly engaged in R&D activities? Prompt – what are their job titles? **Please write your answers in the Chat Window.**

2.1.3. Does your station provide direct or in-kind support for R&D activities conducted by others? Prompt - Is this support provided as part of a collaborative effort involving similar organizations?

2.1.4. How does your station determine its level of spending on R&D?

2.1.5. Has the balance in your station between internal and external R&D spending changed over the last decade? Prompt – if so how? Do you expect changes over the next decade?

2.2. In your opinion, what role should **your station** play in setting forestry R&D priorities?

2.3. Who should be responsible for R&D in the forestry sector **in addition to your organization**?

2.4. Has your station engaged in advocacy for R&D funding over the last decade? Why or why not? For those who answered yes, which of the following level: National, Regional, State, Local, Other?

Section 3: Priority Setting

3.1 How does your station determine which R&D activities it should pursue and how do you determine whether or not activities should be conducted internally vs. through external contracts and collaborations?

3.2 Has your station provided input to other R&D organizations in setting research priorities over the last decade? Which organization have you provided input to? Have you been asked to provide such input and declined? If so, why?

3.3 What can researchers do to improve technology transfer and bring innovation to market?

3.4 What R&D activities do you think should be prioritized:

- Nationally v. Regionally?
- By universities vs. government agencies vs. NGOs vs. private sector?

3.5 From your perspective, what should the R&D efforts of the:

- USFS focus on?
- University focus on?
- Private sector on?
- NGOs on?

Closing question: If you could only fund three R&D areas (as in limited resources), which would you choose.

Section 4: Next Steps and Cases for Change

We are now on the final section, Next Steps.

4.1. Do you believe forestry organizations have expressed their needs and priorities effectively? If not, what do you believe are the biggest obstacles for forestry organizations to having a unified voice and set of R&D priorities across the US? Prompt: How would a unified voice set joint priorities?

4.2. What do you believe are the **advantages and disadvantages** of a unified voice on R&D priorities across the country?

4.3. What do you believe should be the next steps to increase R&D capacity in Forestry?

4.4. We would like to highlight *Cases for Change*, that help us tell the story of why integrated research efforts are needed [integrated: R&D taking place in a coordinated fashion between universities, government, landowners, and industry]. Do you or does someone in your organization have an example we could highlight? I will follow-up with you one-on-one after this group. Examples of a case for change could be fire, keeping forest as forests, and so forth. *Please type in the chat window if you can offer a Case for Change.*

Appendix II: Inter-rater reliability check

A sample of transcripts was coded by a team of social science researchers to check consistency of themes and interpretation. This inter-rater reliability (IRR) test produced an average agreement of 82% (kappa statistic). Discrepancies were resolved and codes were further clarified. We followed Campbell et al. (2013) as a general guide for IRR. Typically, IRR is done iteratively, but the initial Kappa statistic was reasonable for this project. Additionally, the project team had been meeting weekly to discuss results, providing additional support for the code system's discriminant capability and unitization of the results.

Campbell, J. L., Osserman, J., Pedersen, O.K., Quincy, C. (2013). Coding In-Depth Semistructured Interviews: Problems of Unitization and Intercoder Reliability and Agreement. Social Methods & Research, 42(3), 294-320

Appendix III: Top Three Priority Coding Schematic Example

We pulled the top three priorities from each focus group participants out of transcripts verbatim and recoded them into thematic categories. There were times when the re-coded term was the same as the verbatim term (e.g., Water) and times when we shortened the phrase (e.g., Ecological response to wildfire threat to “Fire”).

Stakeholder Group	**Priority (verbatim from participant)**	**Priority Re-coded**
NGO	Assessment of how improved forest management can improve carbon sequestration	Carbon and Climate
NGO	Ecological response to wildfire threat	Fire
State Foresters	New markets	Markets for Forest Products
National Forest System	Fire Recovery	Fire
Station Directors	Water	Water
Station Directors	Utilization of small diameter material	Markets for Forest Products