ACCELERATING

SUSTAINABLE PEST MANAGEMENT:

A ROADMAP FOR CALIFORNIA

DEVELOPED BY:

Members of the Sustainable Pest Management Work Group and Urban Subgroup

IN COLLABORATION WITH:

California Department of Pesticide Regulation
California Department of Food and Agriculture
California Environmental Protection Agency

FACILITATED BY:

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ACRONYMS

This list includes acronyms used more than once in the Roadmap.

- **APHIS:** U.S. Department of Agriculture Animal and Plant Health Inspection Service
- **BIFS:** Biologically integrated farming systems
- **CA:** California
- **CalEPA:** California Environmental Protection Agency
- **CCA:** Certified crop adviser
- **CCC:** California Community College
- **CDFA:** California Department of Food and Agriculture
- **CE:** Continuing education
- **CEU:** Continuing education units
- **CSU:** California State University
- **DGS:** Department of General Services
- **DPR:** California Department of Pesticide Regulation
- **PCA:** Pest control advisors
- **PMAC:** Pest Management Advisory Committee (an advisory committee to DPR)
- **PMSP:** Pest Management Strategic Plan
- **PUR:** Pesticide use report
- **SPCB:** Structural Pest Control Board
- **SPM:** Sustainable pest management
- **UC:** University of California
- **UC IPM:** University of California Statewide Integrated Pest Management Program, a division of UCANR
- **UCCE:** University of California Cooperative Extension, a division of UCANR
- **UCANR:** University of California Agriculture and Natural Resources
- **US EPA:** U.S. Environmental Protection Agency

ACCELERATING

SUSTAINABLE PEST MANAGEMENT: EXECUTIVE SUMMARY

A ROADMAP FOR CALIFORNIA

THE SPM WORK GROUP AND URBAN SUBGROUP

ORIGIN

While much progress has been made in recent decades by a wide range of entities to transition to safer and more sustainable pest management practices, more work is clearly needed. Despite California's strict regulatory system and robust risk assessment process, there are still chemical tools in use that can cause harm to humans and the environment. The California Department of Pesticide Regulation (DPR), the California Environmental Protection Agency (CalEPA), and California Department of Food and Agriculture (CDFA) launched the Sustainable Pest Management (SPM) Work Group, as part of the State of California's commitment to accelerating the transition away from high-risk pesticides[1] toward adoption of safer, sustainable pest control practices.

SPM WORK GROUP

Thirty-three leaders representing diverse interests were charged with aligning on a pathway to minimize reliance on the use of toxic pesticides and promote solutions that protect health and safety, are agronomically and economically sound, eliminate racial and other disparities, and engage, educate, and promote collaboration toward safe, sustainable pest management practices in production agriculture. Twenty-five of the Work Group members focused on agriculture, and eight focused on urban issues.

URBAN SUBGROUP

While most people associate pesticide use with agricultural settings, there is significant use and impact in urban settings. Based on limited current data, nonagricultural uses account for between 35-55 percent of pesticide sales (pounds sold), 16-19 percent of reported pesticide use (pounds applied primarily by licensed applicators), and 65-75 percent of reported pesticide-related illnesses.[2] DPR invited nine leaders to collaboratively develop guidance on where and how to focus DPR resources, as well as other recommendations for ways that DPR and other entities might support urban sustainable pest management in California.

APPROACH

The SPM Work Group and Urban Subgroup developed this report "Accelerating Sustainable Pest Management: A Roadmap for California," hereafter referred to as simply the "Roadmap," through focus groups, learning journeys, a systems assessment, stakeholder feedback, and months of dialogue. Leaders representing a wide range of interests in the system, including production agriculture, farmworker and rural communities, Tribes, urban communities, socially disadvantaged and historically marginalized communities, the pest control sector, chemical input companies, government, supply chain companies, academia, environmental sciences, public health, and technical assistance, were asked to think holistically and work collaboratively in developing a roadmap that would advance pest management in California.

1 The SPM Work Group and Urban Subgroup define "high-risk pesticides" as active ingredients that are highly hazardous and/or formulations or uses that pose a likelihood of, or are known to cause, significant or widespread human and/or ecological impacts from their use.

2 Ranges provided by DPR for the four most recent years of data available through the pesticide mill reporting (2018-2021), pesticide use reporting (2018-2021), and pesticide illness surveillance program (2016-2019).

SPM: AN OVERVIEW

Sustainable pest management (SPM) is a process of continual improvement that integrates an array of practices and products aimed at creating healthy, resilient ecosystems, farms, communities, cities, landscapes, homes, and gardens. SPM examines the interconnectedness of pest pressures, ecosystem health, and human wellbeing. SPM asks each of us to become an active participant and an informed steward in the effort to enhance a healthy, thriving California.

WHAT IS SPM?

Sustainable Pest Management (SPM) is a holistic, whole-system approach applicable in agricultural and other managed ecosystems and urban and rural communities that builds on the concept of integrated pest management (IPM) to include the wider context of the **three sustainability pillars ▸**

SPM is an evolution of the IPM concept, which the University of California Statewide Integrated Pest Management Program (UC IPM) defines as an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.

Like IPM, SPM guides pest management decisions, and includes a wide range of tools and approaches. SPM goes beyond a checklist of practices or products to address: **1. Impacts on communities, and equity, 2. Linkages to broader environmental issues such as water conservation, biodiversity conservation, soil health, and climate impact, 3. A broader consideration of economic benefits and impacts.**

OUR NORTH STAR

By 2050, pest management approaches in both agricultural and urban contexts in California will promote human health and safety, ecosystem resilience, agricultural sustainability, community wellbeing, and economic vitality. The implementation of these approaches will help steward the state's natural and cultural resources, enabling healthy lives for all and an abundant, healthy food supply for future generations.

We believe that by implementing the Roadmap's recommendations, California will be able to achieve the following goals by 2050.

2050 GOALS FOR CALIFORNIA PEST MANAGEMENT

1

BY 2050...

California has eliminated the use of Priority Pesticides[3] by transitioning to sustainable pest management practices.

2

BY 2050...

Sustainable pest management has been adopted as the de facto pest management system in California.

A priority outcome of these 2050 goals is the elimination of the adverse human health and environmental impacts associated with pesticide use.

3 See pages 20 and 69 for more information on Priority Pesticides.

KEYSTONE ACTIONS

The following are the Work Group and Urban Subgroup's keystone actions - those that are urgent and foundational to the success of our collective efforts towards safer, sustainable pest management:

A **Prioritize Prevention**

Strengthen California's commitment to pest prevention by proactively preventing the establishment of new invasive pest species, and by proactively eliminating pest-conducive conditions both in agricultural and urban settings.

B **Coordinate State-Level Leadership**

Create an accountable and connected leadership structure to champion SPM in the field, effectively embed SPM principles across agencies, and improve coordination.

C **Invest in Building SPM Knowledge**

Significantly invest in SPM-focused research and outreach so that all pest management practitioners have equal and adequate access to the support and resources necessary to develop and implement their own SPM system.

▶ **IN AGRICULTURAL PEST MANAGEMENT:**

Secure a significant increase in SPM-trained technical advisors and funding for SPM multi-directional research and outreach.

▶ **IN URBAN PEST MANAGEMENT:**

Expand funding and infrastructure for urban SPM research, innovation, and outreach to align with and reflect the volume and impacts of pesticides used in urban contexts.

D **Improve California's Pesticide Registration Processes and Bring Alternative Products to Market**

Create mechanisms to improve DPR's registration review process and to prioritize and expedite safer, more sustainable alternative products to high-risk pesticides, and improve processes for evaluating currently registered pesticides.

E **Enhance Monitoring and Data Collection**

Significantly expand and fully fund health and environmental monitoring infrastructure, data collection, and interpretation.

PRIORITY PESTICIDES

"Priority Pesticides," which we are intentionally capitalizing, refer to pesticide products, active ingredients, and groups of related products within the context of specific product uses or pest/location use combinations that have been deemed to be of greatest concern and warrant heightened attention, planning, and support to expedite their replacement and eventual elimination. The criteria for classifying pesticides as "Priority Pesticides" includes, but is not limited to hazard and risk classifications,[4] availability of effective alternative products or practices,[5] and special consideration of pest management situations that potentially cause severe or widespread adverse impacts. The identification of these Priority Pesticides will be conducted by DPR under advisement of the multistakeholder Sustainable Pest Management Priorities Advisory Committee (see page 32 for more details on the prioritization process). Priority Pesticides are a subset of high-risk pesticides. We define "high risk" pesticides as active ingredients that are highly hazardous and/or formulations or uses that pose a likelihood of, or are known to cause, significant or widespread human and/or ecological impacts from their use.

LEVERAGE POINTS

The keystone actions above are part of a complete and interconnected set of recommendations developed by the SPM Work Group and Urban Subgroup, which fall into the following leverage points in the system–places where sustained and focused effort lead to outsize effect in moving the system toward a greater state of health.

TO ACHIEVE AGRICULTURAL AND URBAN SPM

1. Update California's pest prevention, exclusion and mitigation systems.
2. Improve California's pesticide registration and continuous evaluation.
3. Strengthen coordinated SPM leadership structures.

TO ACHIEVE AGRICULTURAL SPM

4. Enhance knowledge, research, and technical assistance.
5. Align pest control advisors with SPM.
6. Reduce economic risk for growers transitioning to SPM.
7. Activate markets to drive SPM.

TO ACHIEVE URBAN SPM

8. Enhance data and information collection for urban pesticide use.
9. Advance research and outreach on urban pest management issues.
10. Make SPM the preferred choice for both licensed and unlicensed users.
11. Refocus urban design, building codes, and regulations to enhance pest prevention.

4 Including but not limited to California classifications of groundwater contaminants, toxic air contaminants, and restricted products as well as carcinogens, endocrine disruptors, reproductive and developmental toxicants, and environmental toxicants, such as those toxic to non-target pollinators, mammals, birds, and fish.

5 Consideration of alternative products or consideration of the availability of multiple techniques and products to prevent resistance development and when the product under review has no viable alternatives. Viability includes but is not limited to the variables of efficacy, affordability, and availability. Preventive practices include methods of biological and cultural ecosystem management that minimize pest problems and the need for pest control.

WHAT'S NEXT

By 2025, as a first step in implementing these priorities, the SPM Work Group and Urban Subgroup call on the state to develop a plan, funding mechanisms, and programs to prioritize pesticides for reduction, and to support the practice change necessary to transition away from the use of high-risk pesticides in agricultural and nonagricultural settings.

No one recommendation—or even one leverage point—will, on its own, bring about systemic change. To meet the 2050 goals, the full breadth of the Roadmap must be implemented. In addition, the Roadmap recommendations can only be effectively implemented if the entire system is working together to create the conditions necessary for these outcomes to be realized. Please join us in making this bold vision a reality!

Photo: Pam Marrone, Invasive Species Control Corporation

SUSTAINABLE PEST MANAGEMENT:

A ROADMAP FOR CALIFORNIA

Photo: Park Farming Organics

Pests affect everyone, and learning to manage them in safe and sustainable ways is essential to living with them.

INTRODUCTION

California is arguably the most diverse state in the nation in terms of socioeconomic, political, religious, cultural, household, and economic diversity;[6] biological and ecological diversity;[7] and agricultural diversity. It boasts an astonishing range of natural landscapes and climate zones, as well as the built environments–parks, cities, and buildings–that Californians call home.

Not surprisingly, along with this diversity comes a wide range of pests and a complexity of impacts. Pests include insects, weeds, fungi, bacteria, and other species that negatively impact human health, cause property damage, create a nuisance, or negatively affect crops or other managed resources. Pests continue to cause very real and significant damage to our natural and managed ecosystems and built environments. Pests can cause serious crop loss and undermine our food supply, with considerable implications for the nation's food security and the state's economic health. In urban areas, pests can cause massive property damage and pose serious health concerns (e.g., cockroaches and bedbugs). Pests affect everyone and learning to manage them in safe and sustainable ways is essential to living with them.

6 Clarke, Sara (2020). California is the Most Diverse State, Report Says: Education, socioeconomic, and cultural diversity are among the facets considered in this ranking. *U.S. News & World Report*. https://www.usnews.com/news/best-states/articles/2020-09-10/california-is-the-most-diverse-state-in-the-us.

7 *The Diverse Plants and Animals of California*. Guide of U.S.: California. Retrieved December 22, 2022, from, https://guideofus.com/california/california-plants-and-animals.

Photo: Pam Marrone, Invasive Species Control Corporation

Photo: Park Farming Organics

Thankfully, humans have developed a variety of approaches to pest management, which include biological controls, cultural and physical practices, and chemical products. While much progress[8] has been made in recent decades by a wide range of entities[9] to transition to safer and more sustainable pest management practices, more work is clearly needed as high-risk pesticides continue to have a high likelihood of posing significant or widespread human and/or ecological impacts. Despite California's strict regulatory system, which includes a robust risk assessment process and related risk management requirements, there are still pest management practices and chemical tools in use that can cause harm to humans and the environment.

Now more than ever, we must work together to manage California's complex and challenging pest problems sustainably, reduce high-risk pesticides, and advance a systems approach that truly integrates the needs and interests of all those connected to, and impacted by, pest management. That is the vision we put forward in this document, "Accelerating Sustainable Pest Management: A Roadmap for California," hereafter referred to as simply the "Roadmap." It is a vision for sustainable pest management (SPM) that builds on integrated pest management (IPM), and calls for smart, systemic ways forward that address existing and new pest threats, climate change, resource conservation, inequity, human and environmental health impacts, and emerging science, among other cross-cutting issues.

At the heart of sustainable pest management is preventing pest problems before they occur. Prevention includes everything from a robust biosecurity program that keeps invasive species out of California, to wide-scale detection efforts that help identify pests early so we can manage them proactively, to urban sanitation and creating conditions non-conducive to pests. Prevention also means using biological and cultural approaches to ecosystem management to foster healthy farms and landscapes that minimize pests and the need for pesticides or other potentially harmful forms of pest control.

The SPM Work Group and Urban Subgroup navigated very diverse interests and concerns of the stakeholders they represent to advance recommendations that accelerate systemwide SPM. The Roadmap articulates a vision for pest management that promotes human health and well-being, environmental health and resilience, and economic viability for all. It is an invitation and a call to action for all Californians to join the effort in co-creating a healthy, thriving California with safer, more sustainable pest management for generations to come.

8 See for example the IPM Award Recipients List (1994 to most recent): https://www.cdpr.ca.gov/docs/pestmgt/ipminov/awardmenu.htm

9 These entities include but are not limited to California state and local agencies, nonprofit and nongovernmental organizations, the agricultural community, researchers and farm advisors, licensed pest management practitioners, and many others.

THE CHARGE OF THE SPM WORK GROUP AND URBAN SUBGROUP

The California Department of Pesticide Regulation (DPR), in collaboration with the California Department of Food and Agriculture (CDFA) and California Environmental Protection Agency (CalEPA), convened the SPM Work Group and Urban Subgroup to develop a prioritized Roadmap. The group was given the following charge:

MINIMIZE

Minimize the reliance on use of toxic pesticides and deploy traditional and new agronomic practices to protect and preserve soil health, water resources, air quality, and biodiversity; provide safe and resilient food systems; and ensure economic viability for growers and consumers.

IDENTIFY

Identify additional solutions needed to protect the health and safety of communities and agricultural and pest management professionals, and eliminate racial and other disparities associated with traditional pest management approaches.

ENGAGE

Engage, educate, and promote collaboration among growers, pest managers, scientists, farmworkers, government agencies, environmental programs, and urban and rural communities around safe, sustainable pest management practices.

The agricultural sections of the Roadmap build directly upon the collaboratively developed "Roadmap for Integrated Pest Management,"[10] published in 2018 by the UC Division of Agriculture and Natural Resources (UCANR) Integrated Pest Management Program, and the five-year action plan[11] of the Chlorpyrifos Alternatives Work Group convened in 2019-2020. The Chlorpyrifos Alternatives Work Group, which was convened following the state's announcement of the cancellation of chlorpyrifos, was charged to "identify, evaluate, and recommend safer, more sustainable pest management alternatives to chlorpyrifos." The group acknowledged that "pest management's complexity means there are no quick and easy solutions," and that "managing pests requires balancing multiple pressures, including agricultural productivity and profitability, regional ecology, community health, local economies, global trade systems, supply chain systems, and regulatory frameworks." With this in mind, the group recommended that DPR establish another work group to continue these conversations and explore thinking about the pest management system as a whole instead of individual active ingredients.

The Urban Subgroup was formed to elevate the state's focus on urban/nonagricultural pest management challenges and support the evolution to safer, more sustainable urban pest management in California. The Urban Subgroup was asked to consider issues of significance in urban areas of the state, as well as across application areas (indoor and outdoor), users (including professionals and nonprofessionals), and various types of products.

The Roadmap furthers DPR's strategic goal to accelerate the development and adoption of SPM systems. It presents an opportunity for the wider field to achieve bold goals and implement a new framework to identify, evaluate, and implement SPM practices.

10 "Roadmap for Integrated Pest Management: Systems Thinking to Build Better IPM for All Californians," Lori A. Berger, James J. Farrar, Peter B. Goodell, Joseph McIntyre. UC Division of Agriculture and Natural Resources (UCANR) Integrated Pest Management Program. 2018.

11 "Towards Safer and More Sustainable Alternatives to Chlorpyrifos: An Action Plan for California," The Alternatives to Chlorpyrifos Work Group. 2020.

Photo: CDFA

A note on the SPM Work Group and Urban Subgroup's process: The SPM Work Group and Urban Subgroup worked together to identify and address a wide range of interests and perspectives, and developed a North Star vision that all members agreed to. Members within each group sometimes had opposing viewpoints about how best to reach the North Star and at times struggled to reconcile their divergent thinking. Nevertheless, the group members were committed to developing a Roadmap that all members were willing to work with. Throughout their work together, they were asked to stretch beyond their preferences and identify solutions that everyone was willing to live with. This means that not every member values any one of the goals or recommended actions equally; there was, however, at least willingness to include each one, knowing that each one is important to at least one stakeholder, and that as a whole, they provide a holistic, systemic approach to accelerating safer, more sustainable pest management in California.

THE SCOPE OF THE ROADMAP

The Roadmap covers many pesticide use contexts in California. The SPM Work Group[12] was tasked with addressing pesticide use in production agriculture, with a focus on crop agriculture. The SPM Work Group focus excluded animal agriculture, as well as forests and other natural lands.

The Urban Subgroup examined the wider landscape of pesticide use outside of production agriculture to clarify its scope. Uses that fall outside of production agriculture include both (a) "nonagricultural use" (uses in homes, industry, institutions, structural pest control, veterinary, and vector control districts that share a common theme of benefitting congregated populations and infrastructure that are most often associated with urban and suburban environments); and (b) "nonproduction agriculture use" (e.g., uses in watersheds, rights of way, landscaped areas, parks, recreation areas, golf courses, and cemeteries, and in habitat management in urban and rural contexts).[13]

The Urban Subgroup focused primarily on "nonagricultural use." But given that many of the "nonproduction agricultural uses" listed above also occur in, or are associated with, urban and suburban environments, the Urban Subgroup also considered some uses in the "nonproduction agriculture use" category. Ultimately, through this process, the group developed its own conceptual framework to identify different classes of pesticide users and uses, summarized in Appendix 3. This framework is helpful in understanding the full breadth and complexity of pesticide use in California. For the purposes of the Roadmap, the use of the term "urban" (use, pest management, subgroup, etc.) includes both "nonagricultural" use and some types of "nonproduction agricultural" use. The Urban Subgroup did not explicitly focus on forests, wildlands, transportation corridors, parks, habitat management, aquatic weed control, and disinfectants.

While recognizing the ongoing importance of effective pest management in agriculture, a key objective of the Urban Subgroup was to call attention to the need for DPR and other agencies to increase their focus on supporting urban SPM, while considering the extremely diverse and complex nature of pest management in these settings. While most people associate pesticide use with agricultural settings, there is significant use and impact in urban settings. Based on limited current data, nonagricultural uses account for between 35-55 percent of pesticide sales (pounds sold), 16-19 percent of reported pesticide use (pounds applied primarily by licensed applicators), and 65-75 percent of reported pesticide-related illnesses.[14] It is important to note that some categories of nonagricultural pesticide uses (e.g., residential use and most institutional and industrial use) are not reported in DPR's pesticide use reports (PUR), suggesting that total nonagricultural pesticide use is significantly higher than what is accounted for in the PURs. This use of pesticides in urban areas, coupled with the challenges specific to urban pest management (enumerated in Appendix 4), points to the need for an increased focus of attention and resources on urban SPM.

While distinct in many ways, agricultural and urban pest management do not happen in isolation from one another. For example, pests that damage agricultural crops can originate in neighboring parks or urban areas and pesticides applied in a field can migrate to nearby neighborhoods. This interconnectedness points to the need for some coordinated planning across landscapes. The Roadmap identifies a set of recommendations that span both urban and agricultural settings, as well as recommendations specific to each context.

12 Neither work group was representative of the full breadth and scope of stakeholders or issues from any entity engaged in pest management in California.

13 These categories are detailed further in Appendix 2.

14 Ranges provided by DPR for the four most recent years of data available through the pesticide mill reporting (2018-2021), pesticide use reporting (2018-2021), and pesticide illness surveillance program (2016-2019).

WHAT IS SPM?

FROM IPM TO SPM

Integrated pest management (IPM) is an established approach to pest management decision-making, and is a widely applied concept. The SPM Work Group concluded that a broadening of the IPM concept is needed in order to address the many environmental, economic, and equity challenges connected to pest management. The term "sustainable pest management" is used in this document to represent this broader set of goals.

SPM: AN OVERVIEW

Sustainable pest management (SPM) is a process of continual improvement that integrates an array of practices and products aimed at creating healthy, resilient ecosystems, farms, communities, cities, landscapes, homes, and gardens. The priority outcomes for SPM are reducing human and environmental risks from pest management activities, while also providing effective pest management solutions.

SPM involves stepping back and intentionally looking at the interconnectedness of pest pressures, ecosystem health, and human well-being. SPM asks each of us to become an active participant and an informed steward in the effort to enhance a healthy, thriving California.

THE SPM WORK GROUP'S DEFINITION OF SPM

Sustainable pest management (SPM) is a holistic, whole system approach applicable in agricultural and other managed ecosystems and urban and rural communities that builds on the concept of integrated pest management (IPM) to include the wider context of the three sustainability pillars: human health and social equity, environmental protection, and economic vitality.

SPM is an evolution of the IPM concept, which UC IPM defines as an ecosystem based strategy that focuses on long term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.

Like IPM, SPM guides pest management decisions, and includes a wide range of tools and approaches. SPM goes beyond a checklist of practices or products to address:

- linkages to broader environmental issues such as water conservation, biodiversity conservation, soil health, and climate impact;
- impacts on communities and equity; and
- a broader consideration of economic benefits and impacts.

SPM AND ORGANIC, REGENERATIVE, AND OTHER SUSTAINABLE FARMING METHODS

As noted, SPM uses a set of principles to guide pest management decisions. Many farmers are already employing aspects of SPM. Some existing certifications, such as Regenerative Organic and USDA Organic, include practices consistent with the goals of SPM; however, these terms are not completely interchangeable. For example, some certified organic farms may not be prioritizing SPM in their decision-making processes, while some conventional farms are. While organic and similar certifications are stepping stones on the way to SPM, SPM includes pest management practices over and above those associated with certification programs.

SPM Applied in Agriculture

In agricultural settings, SPM is rooted in an agroecological approach that considers the whole farm as well as the wider landscape in which it sits. SPM is supported by a wide scope of practices and products that range from the use of traditional ecological knowledge to modern technologies, and from biological controls to high-tech solutions.[15] The practices and products together aim to build healthy, pest-resilient agroecosystems that reduce the need for external inputs.

Agricultural SPM takes a systems approach to pest prevention and management, while considering environmental health, social equity, and economic viability each step of the way. Therefore, SPM facilitates, where possible, an enhancement of the following co-benefits:

A. *improving soil health;[16] water quality, use efficiency, and supply; air quality; and biodiversity;*
B. *advancing climate mitigation and adaptation;*
C. *increasing nutrient density in crops while maintaining yields;*
D. *improving land management practices;*
E. *improving farmer and farmworker working conditions; and*
F. *increasing community health and well-being.*

15 See Appendix 5 for a list of examples of on-farm SPM practices.
16 While not every aspect of soil health is directly linked to SPM, soil health is foundational to successful SPM implementation in agricultural settings.

SPM Applied in Urban Environments

In urban settings, SPM looks broadly at the urban environment as a whole and aims to manage pests as effectively as possible, while also achieving a range of additional beneficial outcomes, including protecting public health, the environment, physical assets, quality of life, and aesthetics.

Pest management in urban contexts is subject to a unique set of conditions that distinguish it from agricultural pest management. Urban pest management is carried out by a much greater diversity of users, ranging from residents to pest management service providers, with varying degrees of knowledge about pesticides and their impacts.[17]

The diversity of pesticide uses and users in urban settings,[18] and gaps in the oversight and reporting of pesticide use, further undermine our ability to collect and interpret meaningful data about how and where pesticides are used as well as their associated health, environmental, and other unintended impacts. Limited data on urban pesticide use limits our understanding of urban pesticide use patterns, which in turn hinders informed product design, identification of SPM solutions, and science-based and complete regulatory evaluations of pesticide products.

Only a small portion of urban pest applicators are trained and licensed to apply pesticides. Although the directions on home-use product labels provide safe handling and use instructions, data show they are rarely fully read and adhered to[19] and these safe handling directions are very difficult to enforce. Lack of training and oversight for most users also complicates the dissemination, understanding, and adoption of information on SPM principles and practices.

Furthermore, the public, primarily through local government expenditures, is bearing the burden of mounting costs associated with both compliance with state and federal laws and regulations as well as the costs of addressing the problems associated with pesticide use (e.g., removing pesticides during the wastewater purification process).

Decisions about pesticide use in urban settings are influenced by a wide set of interests, including the desire to maintain aesthetic landscapes, protect structures, satisfy individual tolerance thresholds for pest presence, and mitigate real and perceived health risks posed by pests. The urban environment creates additional unique challenges for SPM, such as substandard housing conditions that harbor pests, higher population density, and emerging climate-friendly water reuse infrastructure that may increase exposure to pesticides.[20]

SPM and Climate Change

Climate change is expected to meaningfully influence the biology, distribution, and outbreak potential of pests. Climate-related changes, such as higher temperatures and extreme weather events, may directly increase pest pressures. They may also indirectly increase urban and crop susceptibility to pest problems by creating conditions that favor new or invasive pests, or that adversely impact natural pest predators. This creates new uncertainties and challenges for pest management, as well as new potential human and environmental exposures to pesticides.[21] As climate change advances, pest prevention and building resilience to pests is more critical than ever.

Importantly, in the agricultural context, many of the approaches that build the resilience of agricultural systems to climate stressors may also enhance resilience to pest pressures and support community health in rural areas. Because agricultural ecosystems are complex, special care must be taken to implement practices that are locally and situationally appropriate and minimize unintended consequences. California will inevitably see crop distribution evolve because of climate change; a focus on SPM can build greater resiliency and support a transition that creates more resilient agroecosystems.

In the urban context, climate change can increase the range and seasonality of some significant pests, such as mosquitoes, rats, fleas, ticks, and termites. Several urban pests transmit human pathogens in their natural habitat, so an improvement in pest-favorable conditions, especially temperature, outside their typical range can increase the incidence of vector-borne diseases.

Invasive species can move into new areas that were previously unfavorable to the pest's biology, impacting homes, gardens, and landscapes, as well as nearby agriculture. Climate change and pest management intersect in other ways to create challenges for public health. For example, water supply challenges are driving potable reuse of wastewater and stormwater runoff, yet the technical obstacles and cost of removing pesticides from these waters could limit future access to potable water.

17 See Appendix 3 for a more full description of pesticide users and uses in urban settings.

18 See Appendix 2 for more information on urban and nonagricultural pesticide uses and users.

19 See for example, Lockwood JA, Wangberg JK, Ferrell MA, Hollon JD. Pesticide labels: proven protection or superficial safety? J Am Optom Assoc. 1994 Jan;65(1):18-26. PMID: 8132948; Rother H-A, Pesticide Labels: Protecting Liability or Health? – Unpacking "misuse" of pesticides, Current Opinion in Environmental Science & Health (2018), doi: 10.1016/j.coesh.2018.02.004; and Dugger-Webster A, LePrevost CE, Following Pesticide Labels: A Continued Journey Toward User Comprehension and Safe Use, Current Opinion in Environmental Science & Health (2018), doi: 10.1016/j.coesh.2018.03.004.

20 Appendix 4 provides additional detail about the set of challenges unique to urban SPM outlined above.

21 California Department of Food and Agriculture. (2013). Climate Change Consortium for Specialty Crops: Impacts and Strategies for Resilience. Retrieved November 14, 2022, from https://www.cdfa.ca.gov/oefi/climate/docs/CCC_Report.pdf

PATHWAY TO SPM: GOALS AND RECOMMENDED ACTIONS FOR CHANGE

OUR NORTH STAR

By 2050, pest management approaches in both agricultural and urban contexts in California will promote human health and safety, ecosystem resilience, agricultural sustainability, community well-being, and economic vitality. The implementation of these approaches will help steward the state's natural and cultural resources, enabling healthy lives for all and an abundant, healthy food supply for future generations.

We believe that by implementing the Roadmap's recommendations, California will be able to achieve the following goals by 2050.

▶ 2050 GOALS FOR CALIFORNIA PEST MANAGEMENT

1. **By 2050, California has eliminated the use of Priority Pesticides**[22] by transitioning to sustainable pest management practices.
2. **By 2050, sustainable pest management has been adopted** as the de facto pest management system in California.[23]

A priority outcome of these 2050 goals is the elimination of the adverse human health and environmental impacts associated with pesticide use.

22 See pages 20 and 69 for more information on Priority Pesticides.

23 Potential indicators and measurement tools might include:

i. *Pesticide use and sales data, PCA and other pest management professional training, residue data, participation in the SPM Transition Initiative, and health and environmental monitoring data.*
ii. *An increase in participation in certifications that are in alignment with the goals of SPM systems, such as Organic, Regenerative, and other sustainable farming certification programs.*
iii. *Broad-based adoption of NRCS and CDFA climate smart programs.*
iv. *An increase in producers eligible under the SPM purchasing criteria (see page 52 for more on SPM purchasing criteria).*
v. *The extent to which local governments and municipalities have significantly integrated SPM principles into their community planning and operational processes, such as urban community and land-use planning, subdivision/housing development requirements, and municipal operations.*

KEYSTONE ACTIONS

The following are the SPM Work Group and Urban Subgroup's keystone actions—those that we believe are urgent and foundationally critical to the success of our collective efforts towards safer, more sustainable pest management:

A. PRIORITIZE PREVENTION: Strengthen California's commitment to pest prevention in two fundamental ways: (1) by proactively preventing the establishment of new invasive pest species through a significant expansion of the state's biosecurity and invasive pest mitigation system, and (2) by proactively eliminating pest-conducive conditions both in agricultural and urban settings.

B. COORDINATE STATE-LEVEL LEADERSHIP: Create an accountable and connected leadership structure so that we effectively embed SPM principles across agencies. Identify ways to improve coordination within and between agencies and programs for both agricultural and urban pest management. Enhance DPR's ability to champion SPM practices in urban and agricultural settings. Promote the development of alternatives to Priority Pesticides by encouraging research and innovation.

C. INVEST IN BUILDING SPM KNOWLEDGE: Significantly reinvest in SPM-focused research and outreach so that all pest management practitioners have equal and adequate access to the support and resources necessary to develop and implement their own SPM system in a way that effectively manages pests, minimizes adverse impacts to humans and the environment, and is economically viable.

- ***i. In agricultural pest management,*** *this includes securing a significant increase in SPM-trained technical advisors and funding for SPM research and outreach. Human capacity for those programs should be increased in ways that reflect and serve the diversity of California farms and agricultural producers.*
- ***ii. In urban pest management,*** *this includes expanding funding and infrastructure for urban SPM research, innovation, and outreach to align with and reflect the volume and impacts of pesticides used in urban contexts. This requires providing adequate dedicated annual funding for urban-focused academics, research, and extension.*

D. IMPROVE CALIFORNIA'S PESTICIDE REGISTRATION PROCESSES AND BRING MORE ALTERNATIVE PRODUCTS TO MARKET:[24] Create mechanisms to improve DPR's registration review process and to prioritize and expedite safer, more sustainable alternative products to high-risk pesticides.[25] DPR's processes must reflect the goals of SPM and provide clarity on its scientific review and decision-making process for both registrants and the public. DPR must also improve its processes for evaluating currently registered pesticides.

E. ENHANCE MONITORING AND DATA COLLECTION: Significantly expand and fully fund health and environmental monitoring infrastructure, data collection, and interpretation. This will enable us to accurately track pesticide-related human illness and the presence of pesticides in land, water, air, biota, and structures, and provide pesticide use data and information needed for sound regulatory decisions.

By 2025, as a first step in implementing these priorities, the SPM Work Group and Urban Subgroup call on the state to develop a plan, funding mechanisms, and programs to prioritize pesticides for reduction, and to support the practice change necessary to transition away from the use of high-risk pesticides in agricultural and nonagricultural settings.

24 This would build on other SPM practices for pest management that may not require registration by DPR. See Appendix 5 for examples of SPM practices.

25 In this Roadmap, the term "high-risk pesticides" is defined as active ingredients that are highly hazardous and/or formulations or uses that pose a likelihood of, or are known to cause, significant or widespread human and/or ecological impacts from their use.

Photo: Park Farming Organics

PRIORITY PESTICIDES

Priority Pesticides," which we are intentionally capitalizing, refer to pesticide products, active ingredients, and groups of related products within the context of specific product uses or pest/location use combinations that have been deemed to be of greatest concern and warrant heightened attention, planning, and support to expedite their replacement and eventual elimination. The criteria for classifying pesticides as "Priority Pesticides" includes, but is not limited to, hazard and risk classifications,[26] availability of effective alternative products or practices,[27] and special consideration of pest management situations that potentially cause severe or widespread adverse impacts. The identification of these Priority Pesticides will be conducted by DPR under advisement of the multistakeholder Sustainable Pest Management Priorities Advisory Committee (see page 32 for more details on the prioritization process). Priority Pesticides are a subset of high risk pesticides. We define high risk pesticides as active ingredients that are highly hazardous and/or formulations or uses that pose a likelihood of, or are known to cause, significant or widespread human and/or ecological impacts from their use.

26 Including but not limited to California classifications of groundwater contaminants, toxic air contaminants, and restricted products as well as carcinogens, endocrine disruptors, reproductive and developmental toxicants, and environmental toxicants, such as those toxic to non-target pollinators, mammals, birds, and fish.

27 Consideration of alternative products or consideration of the availability of multiple techniques and products to prevent resistance development and when the product under review has no viable alternatives. Viability includes but is not limited to the variables of efficacy, affordability, and availability. Preventive practices include methods of biological and cultural ecosystem management that minimize pest problems and the need for pest control.

LEVERAGE POINTS

The keystone actions above are part of a complete and interconnected set of recommendations developed by the SPM Work Group and Urban Subgroup. These recommendations are themed according to the following 11 leverage points. Leverage points are places where sustained and focused effort lead to outsize effect in moving the system toward a greater state of health:[28]

LEVERAGE POINTS TO ADVANCE BOTH AGRICULTURAL AND URBAN SPM[29]

1. Update California's pest prevention, exclusion, and mitigation systems.
2. Improve California's pesticide registration and continuous evaluation.
3. Strengthen coordinated SPM leadership structures.

LEVERAGE POINTS FOR AGRICULTURAL SPM[30]

4. Enhance knowledge, research, and technical assistance.
5. Align pest control advisors with SPM.
6. Reduce economic risk for growers transitioning to SPM.
7. Activate markets to drive SPM.

LEVERAGE POINTS FOR URBAN SPM[31]

8. Enhance data and information collection for urban pesticide use.
9. Advance research and outreach on urban pest management issues.
10. Make SPM the preferred choice for both licensed and unlicensed users.
11. Refocus urban design, building codes, and regulations to enhance pest prevention.

In each of these leverage points, the SPM Work Group and Urban Subgroup identified more specific goals, priority actions, and, in some cases, additional actions that are needed to help transform California's approach to pest management so that it delivers safer and more sustainable pest management.

In many cases, the groups also included design guidance to help inform implementation of these actions. This design guidance is an integral part of the recommendations. Building true SPM is not just about what should happen, but how it can be implemented to maximize systemic impact and reduce unintended consequences. The design guidance sections spell out considerations that should be addressed during implementation of the recommendations in order for them to be successful.

No single recommendation—or even one leverage point area—will, on its own, bring about systemic change, nor will one entity be able to implement change alone. To meet any one of 2050 goals, the full breadth of the Roadmap must be implemented. The goals and recommendations throughout the Roadmap are inherently interconnected, and can only be effectively implemented if the entire system is working together to create the conditions necessary for these outcomes to be realized.

28 The following items are not listed in order of priority.

29 The goals and recommendations in these leverage points were developed by both the SPM Work Group and Urban Subgroup.

30 The goals and recommendations in these leverage points were developed by only the SPM Work Group for the context of agricultural pest management.

31 The goals and recommendations in these leverage points were developed by only the Urban Subgroup for the context of urban and nonagricultural pest management.

ADVANCING SPM IN BOTH AGRICULTURAL & URBAN CONTEXTS

UPDATE CALIFORNIA'S PEST PREVENTION, EXCLUSION, AND MITIGATION SYSTEMS

Successfully preventing pest outbreaks in both agricultural and urban contexts is the foundation of an effective sustainable pest management strategy and limiting the need for pesticides in the first place. If pests are addressed early on, this can lead to a reduction in the long-term use of pesticides, making early detection and swift action an essential component of SPM. Systematic detection, prevention, surveillance, exclusion, mitigation, and proactive planning are essential to keeping pests in check. However, pest monitoring and exclusion have long been underfunded,[32] and funding has been significantly cut in recent years, severely diminishing critical biosecurity infrastructure. In 2011, CDFA was required to make approximately $32 million in cuts to General Fund pest prevention programs, including completely cutting weed programs and significantly scaling back others. Corresponding with these cuts, California has experienced a concomitant increase in pest infestation problems. Coupled with growing invasive pest pressures exacerbated in part by climate change, the decline in funding increases California's vulnerability to pest problems. A top priority of the SPM Work Group and the Urban Subgroup is to see a state-of-the-art biosecurity infrastructure built in order to proactively detect, exclude, mitigate, and prevent outbreaks of invasive pests.

▶ GOALS

1. **State efforts:** By 2030, California, coordinating across federal, Tribal, state, and county programs, has strengthened its biosecurity measures in alignment with SPM. These measures are sufficient to effectively prevent, eradicate, and mitigate invasive pests, and protect California's agricultural industry, ecosystems, and natural and cultural resources.
2. **Regional efforts:** By 2030, every region in California has a strong collaborative process in place to prioritize invasive pest prevention and enable coordinated pest detection, exclusion, and mitigation at a landscape scale.
3. **Farm-scale efforts:** By 2030, all growers understand their role in invasive pest detection and reporting.

PRIORITY ACTIONS

A. Strengthen SPM-aligned pest prevention and detection by securing dedicated, ongoing funding for CDFA. Such funding would enable CDFA to fully build the expertise, infrastructure, and capabilities needed for interception, detection, eradication, and mitigation of potential and actual invasive pests of all types, including weeds, insects, diseases, animals, and others. Funding should be based on an analysis of CDFA's funding gaps[33] with respect to pest exclusion and prevention, which CDFA should conduct immediately to determine the funding required to implement programs to maximum effectiveness. Funding should fully cover the following top priorities:

i. ***Expedite completion of the Comprehensive Pest Prevention Program Analysis Update*** *and fund its implementation and periodic reviews. The state should fully fund the recommendations from the study. Carry out reviews of the analysis every five years, looking to the California Water Plan Bulletin 160 as a model.*

32 A 1997 study by the Rogers Group, "A Review of County Agricultural Commissioners' Activities," identified a funding target for CDFA to implement pest prevention; however, this target has not been reached.

33 Some key gaps have been estimated as follows: Los Alamitos medfly rearing facility upgrades (USDA) require at least $65-75 million; USDA Wildlife Services 50/50 split requires $1 million for California's portion; there is an immediate need to reinstate $2 million to counteract cuts to CDFA's fruit fly program to cover this and next fiscal year; the West Coast Canine program's construction of the National Dog Training Academy is $25 million (50/50 split with USDA) with operating costs of $5 million; California requires an additional $5 million in response to the glassy-winged sharpshooter to combat increased pest pressure and for biocontrol rearing facility upgrades; and the spotted lanternfly would require roughly $20 million immediately if found in CA.

ii. *Finalize the CalTrap initiative, which is working to transition detection and mapping to a digital platform. This includes securing at least $500,000 in funding and $350,000 in annual maintenance and support, plus providing training needed to complete this effort. Provide funding for disease surveys at the county level to document pathogen outbreaks.*

iii. *Fund investments in new technologies that make it easier to monitor and detect pests, such as spatial mapping, precision tools such as smart traps, and new molecular diagnostic tools such as high throughput sequencing (HTS). Fund communication of pest detection and related activities.*

iv. *Support growers' engagement in biosecurity: Initiate a coordinating effort to ensure that, by 2030, all California farmers and farmworkers have received language- and culturally-appropriate information and training in state, federal, and on-farm biosecurity measures pertaining to invasive pests and diseases. This training should include their own role in monitoring for, and preventing, the introduction of invasive pests. Assure that farmers have easy access to on-farm pest detection training that provides current information on California-specific invasive pest issues and related pest detection and exclusion. Develop biosecurity outreach materials and/or short educational modules focusing on "What to Know and What You Can Do to Prevent Invasive Pests on Your Farm" that are available in multiple languages and are accessible online and through farmer networks.*

B. Fund the High Risk Pest Exclusion (HRPE) Program: The statutory mandate of $5.5 million should be instated, per Food and Agriculture Code 2282.5. CDFA has only $3.1 million in its budget for HRPE. Full statutorily-mandated funding would allow time to complete the Comprehensive Pest Prevention Program Analysis.

Photo: CDFA

Photo: Department of Pesticide Regulation, School IPM Program

ADDITIONAL ACTIONS

A. Enhance state leadership in state and federal pest prevention:

i. Continue to engage in interagency collaboration with other agencies (Fish and Wildlife, Boating and Waterways, Water Resources, U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS)) for rapid response/ exclusion.

ii. Continue to partner with the federal government on pest exclusion efforts, particularly at ports, and keep APHIS engaged as a strong partner in pest prevention.

B. Implement robust education programs for the general public on the need to avoid invasive pest introductions, for example through TV and radio public service announcements and signage and warnings at ports of entry.

C. UC IPM should develop and share pest and disease forecasting models by region for integration into technology systems used by farmers, considering potential modification of models as climate changes occur. Develop forecasting systems where relevant for non-ag pests. Include incorporation of the latest precision tools such as smart traps and real-time quantitative spore detection.

D. Mitigate pest challenges associated with fallow agricultural land, lands under SPM transition, or abandoned acreage. Enhance support for county agricultural commissioners for enforcement. Play a role in regional pest prevention and engaging the California Department of Conservation's Multibenefit Land Repurposing Program[34] to creatively address pest issues.

E. Expand pest management efforts managed through geospatial technology, targeting both exclusion and general pest management.

F. Develop mechanisms to ease the burden of invasive pests on growers and enhance reporting:

i. Provide indemnification for the loss of crops due to invasive pests as a mechanism for incentivizing grower transparency and reporting, similar to FAC 9591-9595 Compensable Destruction of Diseased Animals.

ii. Develop pathways for the state to cover the cost of eradication efforts once invasives have been identified.

G. Model impacts of climate change on pests: The Department of Food and Agriculture, in coordination with the California Department of Pesticide Regulation, should develop a report modeling the impact of climate change on California pest pressures. This should include but not be limited to changing pest life cycles, presence of new exotics and invasive pests, pest movement, and susceptible production regions. The report should build on the Indicators of Climate Change in California report of the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment.[35]

34 Multibenefit Land Repurposing Program (MLRP). n.d. Retrieved November 14, 2022. https://www.conservation.ca.gov/dlrp/grant-programs/Pages/Multibenefit-Land-Repurposing-Program.aspx.

35 Indicators of Climate Change in California. May 9, 2018. Retrieved November 14, 2022, from https://oehha.ca.gov/climate-change/document/indicators-climate-change-california.

IMPROVE CALIFORNIA'S PESTICIDE REGISTRATION AND CONTINUOUS EVALUATION

Improving DPR's pesticide registration and reevaluation process is a powerful strategy to facilitate adoption of lower-risk materials and advance systemwide shifts towards SPM. Expediting a transition to lower-risk chemicals requires development, approval, and testing for efficacy, both in the lab and in the field, and then approval for use by DPR. These products must be moved through the registration process with as much efficiency as possible, while still maintaining the high standard for scientific rigor and assessment of human health and environmental risks that DPR is committed to. The review process must prioritize the registration of safe and effective alternative products. This should complement other actions that support pest management throughout California. It's also important to ensure that DPR's standards of review are at or above those of US EPA, and that any product alternative to currently available pesticides remains subject to the same safety and efficacy requirements now required by law

With the most robust pesticide registration program of any state, DPR is able to consider California-specific conditions when registering new pesticides. As DPR integrates the latest science and makes continuous improvements in its registration process, each generation of approved products is more sustainable. While this means progress for new products, it also means that pesticides registered prior to DPR's implementation of these and other modern science-based review procedures may not reflect the best scientific understanding of risks, or have appropriate use instructions to address those risks. Through improvements to DPR's continuous evaluation program, DPR will establish a regular and transparent review process for evaluating these risks. (See the Priority Action to "Establish a state-level prioritization process" on page 31)

▶ GOALS

1. **New products:** By 2025, DPR's registration review process prioritizes and expedites alternative products to high-risk pesticides,[36] reflects the goals of SPM, and provides clarity on its scientific review and decision-making process for both the registrants and the public.
2. **Existing products:** By 2025, DPR has developed a process for evaluating currently registered pesticides, consistent with the recommendations outlined in this Roadmap, and with scientific and legal requirements. DPR has prioritized actions addressing state SPM priorities established through the process laid out in the SPM Leadership Structures section, and human health (e.g., acute toxicants, carcinogens, endocrine disruptors, and developmental and reproductive toxicants) and environmental risks (e.g., significant impacts to water, air, flora, and fauna).

PRIORITY ACTIONS

A. Support the adoption of SPM and the fast-tracking of alternative products[37] by creating mechanisms to expedite reviews of softer chemistries and biologicals, while improving registration processes generally.

36 See the Priority Action, "Establish a state-level prioritization process," on page 32.

37 Note that not all alternative products will, or should, require registration through DPR.

DESIGN GUIDANCE:

FOR ADOPTION OF SPM AND THE FAST-TRACKING OF ALTERNATIVE PRODUCTS TO BE SUCCESSFUL, DPR SHOULD DO THE FOLLOWING:

a. Develop a funding structure and process to support registration of alternative products.
b. Explore a simplified process for expediting reduced-risk alternative products.
c. Review internal processes to address inefficiencies.
d. In considering active ingredients to expedite, conduct a system-level analysis to help avoid unintended negative impacts.
e. Explore ways to remove barriers for smaller companies.
f. Explore mechanisms to account for available alternative products, including biological control options, when registering new products.
g. Develop a process to prioritize consumer products for evaluation with specific attention to equity and environmental impacts, along with more typical considerations.
h. Explore modeling after the European Union's "candidate for substitution"[38] approach to help expedite time frames.
i. Maintain science-based decision-making standards throughout the review process.
j. Take into account resistance management in evaluation of all potential uses and formulations.
k. Account for additive effects in any update to the review process. For example, a biological pesticide may have higher efficacy if used in combination with other products or practices.
l. Integrate advice from the state-level multistakeholder work group proposed in this Roadmap.

B. Streamline coordination with the U.S. Environmental Protection Agency (US EPA) and others to increase instances of concurrent review:

i. Update the review process so that registrants can submit their application without including all the efficacy data up front in order to enable concurrent review and therefore greater efficiency in the registration process.

ii. Create channels for DPR and US EPA to identify shared priorities and ways to advance alternative products in these areas.

iii. Where feasible, conduct joint reviews to expedite and improve the efficiencies of the review processes.

C. Promote development of alternatives to high-risk pesticides: Encourage research and innovation in developing alternative products, practices and approaches among UC, CSU, registrants, applicators, farmers, input suppliers, and other networks of researchers and innovators such as the public-private SPM foundation we propose on page 42 of this Roadmap. This will also support the pesticide prioritization process as part of the priority action "Establish a state-level prioritization process" on page 32.

D. Improve transparency and efficiency in registration processes:

i. Create an electronic dashboard for registrants to track where their products are in the registration process as a part of the development of CalPEST.

ii. Publish metrics on review times for individual evaluation stations and set general targets for those review times.

iii. Conduct an audit on the registration process to identify opportunities to improve the process for users and stakeholders, taking into account scientific and legal requirements.

38 Sante, DG. "EU Pesticides Database (v.2.2) Search Active Substances, Safeners and Synergists." European Commission. Retrieved November 16, 2022. https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/active-substances/?event=search.as.

DESIGN GUIDANCE:

TO IMPROVE TRANSPARENCY AND EFFICIENCY OF THE REGISTRATION PROCESS, DPR SHOULD DO THE FOLLOWING:

a. Revise redundant, unnecessary, or outdated components of review processes.
b. Review internal processes for inefficiencies to redress.
c. Explore ways to remove barriers for smaller companies.
d. Provide clarity and transparency on scientific review and decision-making process for both registrants and the public.
e. Integrate advice from the state-level multistakeholder work group proposed in this Roadmap.

ADDITIONAL ACTIONS

A. Issue an annual report for currently registered pesticides in both urban and agricultural areas detailing:

i. which active ingredients or products had been reviewed in that year;

ii. whether reevaluation or other mitigation development (such as label changes, regulation, or cancellation) is necessary, based on human health or environmental risks;

iii. what mitigation has been conducted pursuant to this process; and

iv. which active ingredients or products will be reviewed in the upcoming year and the basis for that review.

DESIGN GUIDANCE:

FOR CONTINUOUS EVALUATION TO BE SUCCESSFUL, DPR SHOULD DO THE FOLLOWING:

a. Rely on existing authorities for reevaluation and other mitigation.
b. Consider ways to address the risks from products in urban areas, which may have less data associated with their use.
c. Cover products used in both agricultural and urban settings.
d. Be informed by the prioritization process that is outlined under the "Strengthening Coordinated Leadership Structures" section.
e. Consider how to address products not currently regulated in California, such as treated products and federally exempt products.
f. Enhance opportunities for greater scientific data/research development (as specified in the "Enhance Knowledge, Research, and Technical Assistance" section), and utilize urban data collection (as specified in the "Enhance Data and Information Collection for Urban Pesticide Use" section) into DPR's registration and reevaluation process.
g. Include consideration of viable alternative sustainable pest management tools and methods in the reevaluation prioritization process.
h. Consider how to incorporate practitioner knowledge, including Indigenous traditional ecological knowledge, into the process.

STRENGTHEN COORDINATED SPM LEADERSHIP STRUCTURES

One of the most entrenched dynamics undermining SPM across California is the lack of sufficient communication, coordination, and collaboration among leaders with various pest management-related interests and responsibilities. Conflict and breakdown in communication means that leaders are not getting a full understanding or the insight needed to move the whole system forward in a productive way. Conflict erodes trust and hinders collaboration, limiting the breadth of these leaders' understanding and ultimately amplifying a range of unintended negative ecological and health consequences that serve to further amplify conflict and breakdown.

To counteract this vicious cycle, intentional forums are needed the enhance collaboration and coordination across differences, coupled with leadership and resourcing at both a state and regional level. A consistent understanding of SPM among all relevant agency staff, and adequate staffing and funding for DPR, CDFA, and other relevant state and local entities, are essential for the state to effectively implement the recommendations of the Roadmap.

SPM LEADERSHIP AT THE STATE LEVEL

▶ GOAL

1. **By 2024, relevant state agencies and departments have the funding, staffing, and mission to advance the goals of SPM.**

PRIORITY ACTIONS FOR SPM LEADERSHIP AT THE STATE LEVEL

A. Embed SPM principles across agencies, and identify formal, consistent ways to improve coordination to help create and maintain intentional collaboration across agencies and programs for both agricultural and urban pest management.

DESIGN GUIDANCE:

FOR SPM PRINCIPLES TO BE SUCCESSFULLY EMBEDDED, THE STATE SHOULD DO THE FOLLOWING:

a. Provide leadership and help create a culture that fosters greater SPM across state agencies (including DPR, CDFA, CDPH, Structural Pest Control Board (SPCB), California State Water Resources Control Board, and Regional Water Quality Control Boards); affiliated organizations such as universities; pest control advisors (PCA) and Certified Crop Adviser (CCA) communities; and federal entities (USDA APHIS, US EPA, and National Resources Conservation Service).
b. Include both agencies that perform regulatory roles and those that have pest management functions.
c. Coordinate outreach, funding grants, and advice to pesticide users about implementing SPM.
d. Improving coordination could include a coordinator, a joint task force, a series of meetings, or other mechanisms.

B. Enhance DPR's ability to champion SPM in both urban and agricultural contexts through its activities and programs.

DESIGN GUIDANCE:

FOR DPR TO EFFECTIVELY CHAMPION SPM, IT SHOULD DO THE FOLLOWING:

a. Consider the roles and authorities that CalEPA, California Natural Resources Agency, California Department of Public Health, and other relevant agencies all fill with regard to the aims of SPM. Adjust the scope and mission of DPR in order to address gaps or increase interagency coordination and collaboration.

b. Ensure that DPR's current regulation and monitoring authorities are functionally and financially maintained.

c. Collaborate with other agencies and experts in areas of pest management not explicitly covered by the SPM Work Group and Urban Subgroup, including forests, transportation corridors, parks, habitat management, aquatic weed control, and disinfectants.

d. Consider how a change to the scope and/or mission at DPR or, alternatively, at another agency, could support collaboration with other agencies, such as CDFA, California Department of Fish and Wildlife (CDFW), California State Parks Division of Boating and Waterways, California Department of Water Resources, USDA APHIS, California State Water Resources Control Board, State and Regional Water Quality Control Boards, and local governments and other government agencies as appropriate.

e. Embed SPM principles throughout DPR branches (from the people in the field, to the manager, and to leadership), including training DPR staff in the basics of SPM.

f. Consider if and how the Pesticide Registration and Evaluation Committee and/or Pest Management Advisory Committee (PMAC) can be used to advance this recommendation.

g. Consider the relationship these entities, in particular DPR, have with the stakeholders and create structures that engage stakeholders in the most meaningful and effective ways.

h. Ensure that any changes enable DPR to continue with, if not improve, its ability to serve user communities, including farmers, applicators, and PCAs.

i. Increase attention to SPM in urban settings.

j. Align DPR staffing and resources with the current market of products coming in, for example increasing staffing to address an uptick in reduced-risk products.

k. Invest heavily in advancing SPM products, practices, technologies, and systems while being mindful to avoid promoting one product over another.

l. Ensure that out-of-state suppliers (online and those with direct relationships to professionals and consumers) comply with California sales and licensure laws and regulations.

m. Enable county agricultural commissioners to:
   - *advance SPM and consider how to modernize their relationships with farmers, licensed pest control providers, and communities they serve;*
   - *with sufficient resources, enhance evaluations of feasible alternatives prior to approving restricted materials applications; and*
   - *increase enforcement of existing laws and regulations in the urban context (e.g., commercial or structural pyrethroid applications, retail sales).*

C. Enhance health and environmental monitoring to gather accurate metrics for measuring the 2050 goals and other outcomes of this Roadmap.

DESIGN GUIDANCE:

FOR THE STATE TO EFFECTIVELY ENHANCE HEALTH AND ECOSYSTEM MONITORING, IT SHOULD DO THE FOLLOWING:

a. Ensure sufficient and/or expanded monitoring of surface water, groundwater, soil, and air quality to enable the success of the 2050 goals.
b. Create better connections with populations and their medical providers who may be underreporting pesticide impacts.
c. Consider the unique monitoring needs of different regions, and how local groups and growers can partner to help address these needs.

Photo: Pam Marrone, Invasive Species Control Corporation

STATE- AND REGIONAL-LEVEL COLLABORATION FOR SPM

▶ GOAL

1. **Coordinate SPM Activities:** By 2024, California should have in place strong multistakeholder bodies at the state and regional levels to ensure that activities to advance SPM in agricultural and urban contexts are well-coordinated and collaborative, working together to reduce unintended negative consequences and enhance co-benefits.

PRIORITY ACTIONS FOR STATE- AND REGIONAL-LEVEL COLLABORATION FOR SPM

A. Establish a state-level prioritization process and advisory body for Priority Pesticides: The state should establish a scientific process with stakeholder and public input to advise on identification and prioritization of Priority Pesticides (see box on page 20) for replacement, eventual elimination, and/or other actions aimed at reducing usage. The process should consist of a multistakeholder advisory body representing diverse scientific and stakeholder experts, including both public and state-agency representatives. This advisory body (the "Sustainable Pest Management Priorities Advisory Committee") and the prioritization process would require support from a fully-funded DPR scientific and other staff.

i. ***The primary focus for this process and the associated advisory committee*** *would be to advise DPR on prioritization of pesticide products, active ingredients, and groups of related products within the context of specific product uses or pest/location use combination, and on the development of action plans for each priority.*

ii. ***This body will recommend clear criteria to guide the prioritization process.*** *This includes but isn't limited to hazard and risk classifications,[39] alternative products or practices,[40] and special consideration of pest management situations that potentially could cause severe or widespread adverse impacts.[41]*

39 Including but not limited to California classifications of groundwater contaminants, toxic air contaminants, and restricted products as well as carcinogens, endocrine disruptors, reproductive and developmental toxicants, and environmental toxicants, such as those toxic to pollinators, mammals, birds, and fish.

40 Consideration of alternative products or consideration of the availability of multiple techniques and products to prevent resistance development and when the product under review has no viable alternatives. Viability includes but is not limited to the variables of efficacy, affordability, and availability. Preventive practices include methods of biological and cultural ecosystem management that minimize pest problems and the need for pest control.

41 This process should give special consideration to when protection from or abatement of a pest or disease is necessary: (a) for local, state, or federal compliance; (b) because products are used or pests are identified as part of an area or statewide treatment program, an area under a quarantine, or an area specified in trade agreements; (c) for phytosanitary or food safety compliance; or (d) to otherwise protect public health, safety, and/or the environment.

iii. ***With input from the advisory committee and the public, DPR should determine priorities and create and implement an action plan for each priority.*** *The action plans are meant to be holistic approaches to address an identified priority, centered on equity, and would be intended to guide the work of DPR, the UC IPM, and other agencies and programs as appropriate, and may include recommended actions listed in this Roadmap, such as:*

- **a.** priority-specific work groups to lead multistakeholder problem-solving efforts aimed at the priority issues;
- **b.** focused pilot programs, training, and outreach;
- **c.** sustainable pest management research that includes but is not limited to key pest management problems and gaps in alternative practices and products;
- **d.** registration priorities and the fast-tracking of low- or non-toxic alternative products (e.g., for issues that require a multiproduct/alternate analysis approach);
- **e.** grant priorities or other investments of state resources in developing alternative practices and products;
- **f.** social equity evaluations;
- **g.** nonregulatory use reduction targets for priority products or active ingredients, up to and including complete replacement;
- **h.** projected timelines, recognizing demands on specific DPR programs with other work, and multiyear timeframes for all priorities; and
- **i.** other actions as appropriate.

DESIGN GUIDANCE:

FOR THIS PRIORITIZATION PROCESS AND ADVISORY BODY TO BE SUCCESSFUL:

a. Membership in the advisory committee should give equal access and consideration to stakeholder experts with science and practice knowledge related to both agricultural and urban/nonagricultural contexts.

b. Areas of scientific expertise to be represented among the group include but are not limited to: pesticide-related public health, management of agricultural ecosystems for pest prevention, management of built ecosystems for pest prevention, biological pest management, toxicology and efficacy of chemical pesticides, and Indigenous Traditional Ecological Knowledge.

c. Priorities should be updated periodically, and at least once every three years, in parallel with reporting on the progress on each previous priority.

d. Separate prioritization processes should be taken for the agricultural and nonagricultural sectors. However, the Sustainable Pest Management Priorities Advisory Committee as a whole should specifically identify any issues that overlap agricultural and nonagricultural sectors and provide joint input to the state on any such items.

e. The prioritization process should be informed by current regulatory and statutory standards.

f. When necessary for specialized subject matter, the advisory committee may choose to create project-specific working groups that include other appropriate stakeholders or subject matter experts.

g. Establish a clear workflow for the state prioritization process, such as that illustrated in Appendix 9. The envisioned process builds on the implementation of other Roadmap elements, provides public input on priorities and action plan outlines, is guided by advice of the Sustainable Pest Management Priorities Advisory Committee (with a goal of consensus), and is implemented in a transparent manner by dedicated state staff.

B. Establish a state-level SPM implementation work group. Create a diverse multi stakeholder body to advance collaboration, accountability, and the impact of SPM. This entity will help support the administration's plan for implementation of the SPM Roadmap in both agricultural and urban contexts, including supporting DPR to move from a focus on mitigating harm to a more holistic response, including ecologically-based pest prevention. This entity will include relevant state agencies and leaders from a range of key interest groups. It should receive dedicated funding and support and have dedicated scientific staff, incorporating relevant staff from the existing environmental monitoring division and other departments as helpful.

The group will focus on the following themes, as well as others deemed necessary: agricultural research, urban research, evaluation, and regulation. The group will bring in experts and create subgroups as needed. Topics may include:

i. Urban research:

a. Advise on how to improve data and science on urban pest management issues as well as building a research and advisory infrastructure.
b. Consolidate data and identify data gaps; identify gaps where there is limited science vs. places where we "don't know what we don't know."
c. Coordinate, maintain, and ensure dissemination of a list of key research needs (see National Grape Research Alliance for inspiration).
d. Support development of a forum or entity that develops and gathers urban pest management technologies, and that has the credibility to vet new technologies.
e. Secure the resources to conduct strategic outreach for urban pest management applications, bridging research and user communities.
f. Develop or support research on cumulative impacts of pesticide use.

ii. Agricultural research:

a. Coordinate and maintain a shared "key research needs" list, sourcing from experiential as well as scientific knowledge, to signal direction of research. Build on the research needs identified for specific crops through Pest Management Strategic Plans (PMSPs), referenced below, while also integrating the wider systems approach integral to SPM. Historically, the PMSPs have been helpful for supporting identification of key research needs by agencies and researchers, and should be used in the future as a starting point.
b. Advise research and funding communities on key research gaps that need to be addressed.

iii. Regulation and registration:[42]

a. Monitor emerging trends to inform an adaptive regulatory response.
b. Consider additional SPM-specific regulatory and/or policy changes that could support effective pest management and further reduce overall risk from pests and pesticides.
c. Explore and advise on the necessary and appropriate level of efficacy review, with the intention of supporting concurrent reviews and as much streamlining as possible.

42 This section supports the recommendations made in "Improve California's Pesticide Registration and Continuous Evaluation," particularly Priority Actions C and D on page 26.

Photo: Ron Whitehurst

DESIGN GUIDANCE:

FOR THIS MULTISTAKEHOLDER COLLABORATIVE GROUP TO BE SUCCESSFUL, IT SHOULD DO THE FOLLOWING:

a. Ensure that the design and composition of the group (and potential subgroups) take into consideration the unique nature of urban pest management issues, and that these issues are given the time, attention, and resources to be adequately addressed ongoingly.
b. Evaluate relationship with the existing Pest Management Advisory Committee (PMAC) in order to avoid duplication; potentially reevaluate the role of PMAC.
c. Enable space for creative thinking and honest, authentic dialogue.
d. Enable greater connections among research, practice, and policy through a diverse stakeholder mix, including:
   - *environmental representatives*
   - *Native American representatives*
   - *socially disadvantaged, marginalized, or otherwise impacted communities*
   - *urban-focused stakeholders representing the diversity of urban pest management issues*
   - *agriculture, representing a range of scales and production types and racial diversity*
   - *other licensed pesticide applicator groups*
   - *start-ups developing alternative technologies*
   - *multiple agencies, including local governments*
   - *universities*
   - *independent scientists with relevant expertise*
   - *public foundations*
   - *farm labor*
   - *nonagricultural pest user groups*
   - *pest control advisors*
   - *registrants*
   - *trade associations*
e. Account for time required—be mindful of where we are using volunteers vs. paid professionals.
f. Include focus on challenges at the agriculture-urban interface.
g. Coordinate with any existing resources, both in California and at the federal level.

C. Create regional agricultural pest management collaboratives:

i. ***The SPM Work Group recommends instituting strong multistakeholder regional-level forums, networked with the state-level collaborative body, as an important vehicle to coordinate landscape-scale pest management.*** *These forums should focus on prioritizing invasive pest prevention, enabling coordinated pest detection and exclusion at a landscape scale, and managing agricultural ecosystems to eliminate conducive conditions for current and potential pests. These collaboratives can build on the successes of county-level special districts,[43] existing pest control districts, and pest management alliances. The purpose of these collaboratives, more specifically, includes:*

a. fostering grower-to-grower exchanges for shared learning and dissemination of best SPM practices;
b. coordinating on mitigation, monitoring, early detection, communication, and response;
c. creating organizational and communications structures that facilitate rapid response;
d. advancing pest management solutions that require a larger area than farm-scale to be effective, such as pheromone-mating disruption and robust agroecological landscapes;
e. experimenting with coordinated alternative pest management approaches;
f. identifying and advocating for research and other activities that address key local SPM needs, and communicating these priorities to the state-level working group;
g. identifying and communicating key risks to SPM in the region; and
h. fostering trust and collaborative mindsets as a way to address existing cultural barriers to information-sharing in grower and advisory communities.

DESIGN GUIDANCE:

FOR THESE REGIONAL AND PROJECT-SPECIFIC PEST MANAGEMENT COLLABORATIVES TO BE SUCCESSFUL, THEY SHOULD DO THE FOLLOWING:

a. Identify and invite representatives across wide interests through a thoughtful process and be holistic about who is involved. These should include, but not necessarily be limited to:
   - *pest management experts;*
   - *pesticide applicators across agricultural and urban applications;*
   - *representatives of commodity groups, environment and public health, input suppliers, insectaries/pest mitigation, local tribal leaders, professional associations, and coalitions;*
   - *county agricultural commissioners and/or liaisons to agricultural commissioner offices;*
   - *representatives of local UC, CSU, and community colleges; and*
   - *other relevant organizations focused on environmental stewardship and pest management.*
b. Consider starting with pilots but ultimately build out across the state.
c. Staff the collaboratives with paid coordinators.
d. Learn from other efforts, such as flood management districts collectively managing risk, San Francisco's IPM Technical Advisory Committee, existing regional pest management districts, and the former Soviet Union's system for biological pest management in cotton.
e. Structure for adaptability, nimbleness, and flexibility to scale up staffing and funding to address specific emergency eradication efforts.
f. Design explicitly to maximize access and equity, enabling all voices to be heard.
g. For agriculture-focused regional collaboratives:
   - Keep a focus on community-wide, cross-functional needs across different crops (rather than being too crop-specific).
   - Focus strategically based on the region's best opportunities for SPM.

43 See Districts Make the Difference, "About Special Districts." Retrieved November 18, 2022, from https://www.districtsmakethedifference.org/about

Photo: Pam Marrone, Invasive Species Control Corporation

ADDITIONAL ACTIONS TO SUPPORT REGIONAL PEST MANAGEMENT COLLABORATION

A. Through regional agricultural pest management collaboratives and other groups, foster regional SPM collaboration, demonstrations, and peer-to-peer learning among agricultural producers, including farmers, farmworkers, PCAs, and others.

i. Support annual regional SPM conferences for farmers that combine information-sharing, capacity-building, skill-sharing, and networking.

ii. Create a CDFA-sponsored peer-to-peer farmer support network that facilitates shared knowledge, advances implementation of on-farm biosecurity measures, and helps farmers connect and obtain current knowledge on biosecurity practices.

iii. Incentivize participation in regional grower organizations and gatherings, leveraging, where possible, existing commodity marketing orders, pest control districts, task forces, advisory committees, and boards.

iv. Develop effective messaging that is pitched to growers in relatable, practical terms.

v. Develop detailed crop-, commodity-, and region-specific best management practices in line with pesticide risk reduction and, where possible, other co-benefits and interrelated sustainability goals. These co-benefits may include climate mitigation and adaptation; enhancement of natural enemy habitat; improving soil health, water stewardship, and land conservation practices; and coordination with various agricultural associations that are addressing similar pest problems.

B. Build out the model and promote use of sustainable pest management plans based on the model of pest management strategic plans (PMSPs):[44]

i. Combine the PSMP model with information funded by regional IPM centers (funded by the U.S. Department of Agriculture's National Institute of Food and Agriculture).

ii. Include information on the "compounds for substitution;" technology needs or opportunities; knowledge and gaps in ecological farming approaches; and

iii. Expand consideration of issues that have not been traditionally included, such as ecosystem research and new technologies. This will provide a roadmap for research needs and priorities, and identify where there are SPM practices ready for outreach. This should also be expanded to urban settings to assess key pest issues, current available tools, risks to ongoing use of those tools, and prioritization of replacement compounds.

44 Pest Management Strategic Plans (PMSP) are commodity-specific plans that assess the current risks to and gaps in pest management and pest management tools to prioritize research and outreach needs. The PMSP model has been used by USDA to help growers address possible regulatory changes, but also issues such as resistance development, lack of efficacy, and lack of monitoring tools. See IPM Data website. Southern Integrated Pest Management Center. USDA, National Institute of Food and Agriculture. Retrieved November 18, 2022, from https://ipmdata.ipmcenters.org/source_list.cfm?sourcetypeid=4

ADVANCING SPM IN AGRICULTURAL CONTEXTS

"When we think about the pest management challenges facing ag, we have to consider: the lack of knowledge; the lack of a holistic model for an SPM farm; the lack of research into the power of healthy soil solving pest problems; the insecurity of farmers embarking on different cultural practices; the pressure from buyers for consistent quantity and quality; the peer pressure amongst farmers for fields to look a certain way; the lack of markets for organic products; the fact that many farmers are currently making a decent profit and therefore don't have incentive to change and the ways that others benefiting from the status quo uphold policies that preserve it; a farmers' lack of tolerance for risk; the fact that the use of pesticides for problem solving is deeply embedded into state, academia, and corporate thinking; the fact that consumers, on the whole, want cosmetically perfect produce at the lowest possible price and generally have an intolerance for even slightly blemished produce; the food safety issues that all farmers must be considering in their pest management choices; the fact that wholesale buyers seek farmers who can grow crops at a low price, therefore making pesticides a logical alternative over hand labor; the fact that a PCA risks losing his/her farmer client if he discourages a spray that then leads to crop loss; the lack of water to grow cover crops and flush salts; the cost of equipment investment; and finally, the fact that real change takes time."

Scott Park, Park Farming Organics
SPM Work Group Member

ENHANCE KNOWLEDGE, RESEARCH, AND TECHNICAL ASSISTANCE

Accelerating a transition to SPM is dependent on building a knowledge base of alternative tools, practices, systems, technologies, biological controls, biopesticides, chemistries, and preventive measures to effectively manage pest problems and reduce pesticide-related risk. This includes speeding adoption of already-known alternative approaches, as well as developing new ones and further building effective knowledge-sharing structures. The SPM Work Group envisions a thoughtful, strategic, and coordinated next-generation research and support infrastructure for SPM

In this system, there is a strong coupling between researchers, growers, farmworkers, and other key partners so that knowledge is applied and research can be informed by on-the-ground needs [45] Research and outreach is holistic, collaborative, and rooted in the whole farm system. Research institutions and funders incentivize and support research on alternatives to high-risk pesticides, starting with alternatives to Priority Pesticides

The principles, practices, and tools of SPM must be easily accessible to all growers, regardless of farm size, crop type, language, or socioeconomic background. More public investment into SPM research in line with the above approach, along with more structures to support it, will produce a much greater breadth and balance of SPM knowledge in the field. Coupled with expanded and coordinated outreach, this will significantly expand the tools available to growers and farmworkers for adoption of safer pest management approaches

▶ GOALS

1. **Expand research and development infrastructure:**
   a. By 2030, California has revitalized and expanded the public and private institutional infrastructure, workforce, and processes that meaningfully fund and support SPM research and technology development.
   b. The research community is prioritizing sustainable pest management options that are viable and are low-risk and low-impact to humans and the environment. It is prioritizing biological control, and adding more alternative products and practices to the suite of available tools.
   c. From start to finish, SPM research is regularly and explicitly engaging and integrating farmer, farmworker, and other stakeholder expertise and needs, from both traditional and Indigenous knowledge sources, supporting multi-directional learning.
2. **Enhance extension and education:**
   a. By 2030, every farm in California has access to free or affordable SPM education, training, and independent technical advice that is relevant to its crops, region, farm size, pest pressures, and language needs.
   b. By 2040, every growing region in California has successful, trusted, transparent, knowledge-based networks focused on farmer-informed technical assistance and farmer-to-farmer learning.

45 See Appendix 6 for additional framing about knowledge systems in sustainable pest management.

PRIORITY ACTIONS

A. Reinvest in SPM research and outreach to achieve a significant increase (over 2021 levels) in SPM-trained technical advisors (including UC Cooperative Extension, resource conservation districts, and other advisors) per farmer. Secure funding for SPM research and outreach (including human capacity for those programs) that reflect and serve the diversity of California farms and agricultural producers.

To make SPM the standard in California, it is critical that staffing and funding for SPM research and outreach (and the training required to build the workforce) be meaningfully enhanced at the University of California (UC), California State University (CSU), California Community Colleges (CCC), and other academic institutions, as well as nonprofits and other organizations that advance educational efforts. These efforts must prioritize bringing viable practices, products, and other alternative approaches to high-risk pesticides to the field—including chemistries that are low-risk to humans and the environment as well as a broader set of approaches (e.g., building resilient agroecosystems, biological control and biopesticides, technological alternatives) that reduce the use of high-risk pesticides.

*i. **Increase UC funding and staffing for SPM training, research, and extension:***

- **a. Extension:** We recommend that UC fully fund, staff and expand UC Cooperative Extension (UCCE), prioritizing filling all vacant staff positions and then increasing staffing levels by at least 20 percent. UCCE should significantly increase the number of SPM-trained farm advisors in the field with special attention to small farmers, as well as farmers from socially disadvantaged or historically marginalized communities, such as women, Indigenous, Black, Chicano, LatinX, Indigenous, immigrant, and others. It should also increase the number of farm advisors/specialists with SPM-related assignments, including but not limited to those with "organic farming," "ecological agriculture," and "small farms" in their position titles or descriptions.
- **b. Research:** As part of the academic system focused on pest management research in the state, it is also essential that the UC system prioritize SPM research within its academic research programs.
- **c. Provide sufficient and consistent funding for basic and applied research, such as:** (1) the UCANR Organic Agriculture Institute at Kearney Agriculture Research and Extension Center, (2) ANR's plan for a biological control research center in the upgrade of the Hansen Agricultural Research and Extension Center, (3) long-term research at Russell Ranch, and (4) departments that engage in pest management at UC, CSU, California Community Colleges, and other relevant educational institutions.

*ii. **Leverage the capacity of California Community Colleges (CCC) and the California State University (CSU) system**, particularly the campuses that have strong pest management training programs, to develop a sustainable career pipeline, promote applied research, and advance agricultural technology development and adoption that supports SPM. These institutions not only carry out critical research by top academics, but also educate pest control advisors, current and future generations of farmers, and related personnel. These systems must be supported in deepening and broadening their research and outreach capacity. Provide sufficient funding to enable the following:*

a. CSU and CCC systems expand coursework in existing education programs to incorporate SPM principles.
b. The CCC system expands pathways for diverse student populations to access training, coursework, and certification for careers as future PCAs or SPM field scouts, able to monitor and obtain identification of pests and natural enemies and implement conservation and applied biological control strategies.
c. Grants are available to CCC and CSU for expansion of applied agricultural technology programs (including certificates and curriculum expansion) that support SPM incorporation.
d. CSU University Farms builds capacity to expand on-farm research projects, laboratory capacity, and field equipment in order to advance ag technology development and adoption (precision ag), detection, surveillance, and eradication actions that conform with SPM.

*iii. **Increase funding that incentivizes research, extension, outreach, and technical assistance providers** beyond the university systems, to include governmental and quasi-governmental organizations,[46] nonprofits, businesses, and other entities.*

46 For example, resource conservation districts, pest control districts, state commissions, and commodity boards.

DESIGN GUIDANCE:

TO BE SUCCESSFUL, INVESTMENT IN RESEARCH AND OUTREACH SHOULD DO THE FOLLOWING:

a. Train farm advisors in SPM and crop production with diversity and inclusion in mind to serve a broad base of farmers, both large and small, as well as Indigenous communities.

b. Include programs that specifically address the needs of women, Indigenous, Black, Chicano, LatinX, Indigenous, immigrant, and other farmers from historically marginalized or socially disadvantaged communities. Engage in formal ongoing inquiry into how to better serve groups who are traditionally marginalized to minimize the barriers they may face in implementing SPM.

c. Encourage research institutions to explore mechanisms in the hiring process that give priority consideration to experts trained in SPM.

d. Call for budget transparency from funded research institutions.

e. Integrate outreach to growers that enhances their understanding and active participation in biosecurity (especially pest detection and prevention).

f. Create incentives for research into alternatives to high-risk pesticides, including alternative practices, products, and approaches.

g. Create the conditions needed to attract qualified, diverse applicants to agricultural extension roles (a "pipeline"), including meaningful compensation and other mechanisms that support agricultural extension as a career. Particular emphasis should be placed on populations that are underrepresented in entomology, plant pathology, and other applied agricultural sciences.

h. Enable all technical advisors to receive training in SPM (including UCCE, RCD, and other advisors and nonprofits), to reflect and serve the diversity of California farms and farmers.

i. Encourage research funding agencies to ensure that research considers unintended consequences and trade-offs.

j. Include focus areas such as maintenance of germplasm/seed repositories and expansion of breeding programs to provide genetic resistance and resilience. Agricultural engineering and technology should focus on tools and equipment for SPM.

B. Expand research, demonstration, and outreach grantmaking: CDFA and DPR should expand and restructure existing grant programs to support collaborative and long-term research, implementation, demonstration, and outreach. This should include, but not be limited to:

i. providing $3 million in annual funding to expand grants from CDFA's Biologically Integrated Farming Systems (BIFS) Program in order to increase stability and reach of the program, and

ii. expanding DPR's Alliance Grants Program to make these grants longer-term and larger in order to support the success of pest management alliances.

DESIGN GUIDANCE:

TO HAVE SUCCESSFUL GRANTMAKING, CDFA AND DPR SHOULD DO THE FOLLOWING:

a. Consider creating a dedicated fund for awarding contracts or grants with the specific objective of supporting collaborative and long-term research.

b. Facilitate collaborative, long-term research through the following:
   - *Investigate mechanisms to encourage and compensate engagement of growers and rural communities in funded projects.*
   - *Institute timelines for grants that reflect the long-term nature of the research (i.e., allow for spending over more than a three-year period).*
   - *Prioritize funding that covers multidisciplinary research collaborations and sustainable pest management beyond pesticide product testing and development.*

c. Support greater diversity of applicants and projects by doing the following:
   - *Design to enable access for farms of all sizes and commodities, and provide SPM options to those employing the full spectrum of growing practices.*
   - *Engage in outreach to traditionally underrepresented grant recipients to ensure programs specifically address the needs of farmers from historically marginalized or socially disadvantaged communities.*
   - *Minimize barriers for grantees such as overly burdensome compliance paperwork.*
   - *Clarify disqualification rules.*

d. Include SPM as a consideration in pest management-related grant offerings (e.g., if a grantee is looking at alternatives for priority products, SPM could make their application more competitive by giving the applicant extra points).

e. Increase flexibility and connectivity of the state's grant proposal evaluation processes to ensure that nontraditional research needs, projects that integrate research and outreach, and new ideas don't fall through the cracks between agency grant programs.

f. Include funding specifically for connecting growers and pest control advisors (PCAs) with the latest SPM research and technical assistance.

g. Make adjustments to the BIFS Program specifically so that it:
   - *allows for three concurrent projects;*
   - *includes coverage of "minor" specialty crops, so that in each funding year, one of the three grants approved is from such a crop (e.g., not on the list of the top 10 specialty crops by annual farm gate value);*
   - *reduces barriers for applicants with insufficient resources, including simplifying applications; and*
   - *includes an outreach and education program for potential BIFS Program applicants to increase the pool of qualified applicants beyond typical grantees.*

C. Launch a public-private SPM foundation to scale and coordinate investment in SPM: Create a public-private foundation funded with $1B over five years to invest in technologies and techniques (including, but not limited to, biological, ecological, technological, chemical, practice-based, and Indigenous Traditional Ecological Knowledge) that reduce the impacts of pest management on humans and the environment.

DESIGN GUIDANCE:

FOR AN SPM FOUNDATION TO BE SUCCESSFUL, IT SHOULD DO THE FOLLOWING:

a. Develop its own expertise, its own multistakeholder set of advisors, and its ability to broadly bring in money from a variety of sources.
b. Include representation from various stakeholders and community leaders and explicitly address institutional racism and bias.
c. Consider modeling after the Foundation for Food and Agriculture Research (FFAR)[47] at the federal level or partnering on a FFAR SPM-specific fund for California.
d. Be based on the philosophy of avoiding the use of high-risk pesticides, not removing available tools for producers.
e. Support not just large institutions but also more informal training and networks.
f. Create a thoughtful long-term plan for who administers the foundation.
g. Design in part to be a pass-through for federal funding.
h. Consider funding specific research positions.
i. Attend to the capacity and funding needs of all potential grant recipients, with consideration of the challenges for smaller entities, such as match funding.
j. Build in structures that incentivize participatory community research and support and fund the ability of community-based organizations and practitioners to fully participate.
k. Be flexible enough to support nonconventional research and outreach needs.

D. Promote institutional structures in agricultural research institutions that support SPM applied research and outreach for collaboration, communication, and multidirectional learning. Institutional structures should be updated to foster a paradigm shift in California agricultural research, centering systems approaches that combine (a) collaborative, long-term, holistic, landscape-scale, and applied research; (b) outreach and multidirectional learning; and (c) demonstration. Implement incentives for field experts to work together in multidisciplinary teams.

Photo: CDFA

47 See Foundation for Food and Agricultural Research. Retrieved November 18, 2022, from https://foundationfar.org/

DESIGN GUIDANCE:

FOR A PARADIGM SHIFT TO BE SUCCESSFUL, WE SHOULD DO THE FOLLOWING:

a. Incentivize or require multidisciplinary teams.
b. Include a supra-institutional structure that enables collaboration between UC and non-UC institutions and a joint effort building on the best of UC Extension and other programs, such as the Lighthouse Farm Network of the Community Alliance with Family Farmers.
c. Continue to enable basic research as well as comprehensive, landscape-scale and areawide biological control research on key questions that are hindered by current incentive and funding structures.
d. Build in accountability and feedback mechanisms to ensure that research and outreach also integrate the needs of historically marginalized or socially disadvantaged growers and communities served.
e. Enhance representation of farmers from historically marginalized or socially disadvantaged communities in research institutions, both in meaningful positions on research teams and throughout the process.
f. Develop stronger on-ramps and recognition for SPM advisors to support the extension profession being an attractive one that pays competitive wages.
g. Ensure that collaborative or participatory research with community-based organizations does not unduly burden these organizations.
h. Engage existing farmer-focused partner organizations, farmer cooperatives, trade associations, and commodity groups in research and learning.
i. Enable support for nonprofit training.
j. Diversify UCCE farm advisors so that they are representative of the diversity of California farmers.
k. Engage academic institutional leadership and instructors in statewide SPM meetings to participate early in policy, content, and project development and to enhance awareness of the momentum, context, funding, etc.

E. Fund and encourage on-farm demonstration programs to show growers the value of SPM programs, building on the success of DPR's Pest Management Alliance grant program, BIFS, the Healthy Soils Program, Western SARE, and the former USDA Interregional Research Project No. 4 (IR-4) demonstration grant program.[48]

ADDITIONAL ACTIONS

A. Develop and invest in a public/private/nonprofit alliance to deliver technical information to growers. The alliance would be made up of UC campus specialists, farm advisors, PCAs, and basic manufacturers of plant production/protection technologies and other ag support organizations (formal and informal). Members of this network of specialists could be called upon to deliver information, develop systems, and solve problems with growers. Enable current DPR alliance funds to cover this and request that industry members pay a membership fee based on size/revenues.

B. DPR, CDFA and/or UC should collaborate with the private sector to develop and share pest and disease forecasting models that include the latest precision technologies, such as real-time spore monitoring. Regional pest monitoring collaborations should also be encouraged. Forecasting models should be integrated into technology systems used by farmers, taking into account potential modification of models as climate changes occur.

48 See "Minor Crop Pest Management Program Interregional Research Project #4 (IR-4)". National Institute of Food and Agriculture. Retrieved November 18, 2022, from https://www.nifa.usda.gov/grants/funding-opportunities/minor-crop-pest-management-program-interregional-research-project-4-ir

Photo: CDFA

C. Support biologicals, new technology, and initiatives led by Indigenous Traditional Ecological Knowledge: Commodity and grower groups and the state should collaborate and help fund projects that vet and validate new technologies and biologicals in high priority areas where new solutions are badly needed to reduce risk or where there is an unmet need. These projects should include knowledge and research from Indigenous communities that are not always part of the established research institutions.[49]

D. The state of California should investigate ways to increase public research and advisory positions, including considering a large competitive SPM fund that would support endowed chairs, key staff, and/or funding to SPM-focused entities within state college and university institutions.

DESIGN GUIDANCE:

TO BE SUCCESSFUL IN SUPPORTING PUBLIC RESEARCH, THE STATE OF CALIFORNIA SHOULD DO THE FOLLOWING:

a. Explore the creation of a $25 million competitive fund for SPM research positions.
b. Consider a range of structures including cooperative agreements[50] and grants.
c. Ensure that funds are not replaced or displaced for existing state grant programs.
d. Make funds available to higher-education institutions that can handle significant initiatives.
e. Create an advisory group that includes farmers, farmworkers, community members (and possibly others) to help oversee how programs are implemented.
f. Create guiding requirements to ensure institutions advance a strong framework.

49 See "USDA NIFA Invests $16M for Undergraduate Ag Research and Extension Experiences." (February 28, 2022) California Ag Network. Retrieved November 18, 2022, from https://californiaagnet.com/2022/02/28/usda-nifa-invests-16m-for-undergraduate-ag-research-and-extension-experiences/

50 See "What is a Cooperative Agreement, and How is It Different from a Grant?" Office of Sponsored Programs, University of Pittsburgh. Retrieved November 20, 2022. https://www.osp.pitt.edu/news/what-cooperative-agreement-and-how-it-different-grant.

ALIGN PEST CONTROL ADVISORS WITH SPM

As a primary source of pest management advice for agricultural producers, pest control advisors (PCAs) are important messengers of SPM. With enhanced training, PCAs can be powerful motivators of sustainable pest management across landscapes. Currently, licensing and education focus narrowly on how to use pesticides, and educational opportunities about SPM for advisors are limited. Additional barriers to PCAs' ability to champion SPM include grower preference and cost inputs, corporate structures in chemical input companies that favor products over services, consolidation in the chemical input (particularly fertilizer and pesticide) sector, and commission structures that encourage promotion of chemical inputs. Addressing these challenges can greatly bolster PCAs' leadership in sustainable pest management

▶ GOAL

1. **By 2030, all PCAs have received meaningful training in SPM and are incentivized to promote it in the field.** PCA advice is guided by SPM principles and practices and their recommendations are not commission-driven.

PRIORITY ACTIONS

A. Require all PCAs to become trained in SPM. Specifically:[51]

i. Add a new category for continuing education (CE) courses on "sustainable pest management" and expand the type of content approved for PCA CE units to include all aspects of a farm's SPM system. This should include soil health, irrigation management, nutrient management, beneficials, farm biodiversity, and other content applicable to pest management.[52]

ii. Update CE requirements for all license categories to include new PCA and qualified applicator (QA) licensing requirements of a minimum of three semester units or five quarter units of SPM content. For all license renewals, require a minimum of six hours of continuing education units (CEUs) in SPM training.

iii. Expand academic course offerings, so that academic institutions training PCAs have revised their curricula to include a variety of SPM offerings.

Photo: Pam Marrone, Invasive Species Control Corporation

51 Recommendations for CEUs for licensed urban users are a part the section "Make SPM the Preferred Choice for Both Licensed and Unlicensed Users."

52 This recommendation builds on the Alternatives to Chlorpyrifos Work Group's Recommendation 3.2 to expand the range of topics offered for pest control adviser certification and continuing education.

DESIGN GUIDANCE:

FOR SPM TRAINING TO BE SUCCESSFUL, IT SHOULD:

a. Streamline the approval process for CEUs in order to speed up approval for presentation content for conference organizers.
b. Include an expansion of disciplines in CE courses rather than simply the creation of new courses.
c. Expand courses that count towards CEUs to include soil science, plant physiology, ecology, and cropping adaptability and appropriateness in the context of climate change as it relates to pest management.
d. Allow for prior SPM-related CEs and other work to count towards these new requirements.
e. To address occasions when alternative approaches are not accepted in CE courses, build in an option to appeal denials to demonstrate a presentation's relevance to pest management.
f. Consider if and how the certified crop advisor (CCA) certificate curriculum can enhance the field of PCAs and their continued education, and vice versa.
g. Create ways to make on-demand, low-cost, and/or online courses available to low-income students and students from socially disadvantaged or historically marginalized communities to fulfill PCA course requirements.
h. Consult with SPM educators and other relevant content experts in designing continuing education course content and PCA exams.

B. Create a new licensing category for SPM for agricultural PCAs and applicators, requiring that it must be passed in order to qualify for a PCA license (similar to the Laws and Regulations category).

DESIGN GUIDANCE:

FOR THE NEW SPM LICENSING CATEGORY TO BE SUCCESSFUL, DPR SHOULD DO THE FOLLOWING:

a. Add a new category named SPM, which should, like the Laws and Regulations category, be required as a precursor to other categories and also to new PCAs being able to obtain their first license and write pest control recommendations for clients. Require PCA license renewals to add this category to their license before being able to continue writing recommendations.
b. Require a minimum number of annual hours of training for license renewal, similar to the Laws and Regulations category.
c. Develop requirements for the new category so that it can be satisfied by coursework or functional experience, and an exam, allowing candidates to draw on their experience and information collected over the years.
d. Add "Integrated and Sustainable Pest Management" as a fourth category of continuing education that is consistent with both California and federal standards.[53]
e. Create measures to address equity of access for PCAs in order to encourage diverse representation from socially disadvantaged and historically marginalized communities.

53 The current categories include: "Pesticide Laws and Regulations," "Aerial Pest Control Equipment and Application Techniques," and "Other."

Photo: Pam Marrone, Invasive Species Control Corporation

ADDITIONAL ACTIONS

A. DPR should assemble an ad hoc work group to explore additional ways to remove structural barriers to SPM advice: The objectives of this group should be to:

i. Further explore how we might shift incentives for PCAs away from advising chemical pest management (incentives such as commissions for chemical pesticide sales) and towards recommending SPM products and practices, without adding financial burdens to farmers. Examples could include services and tools associated with SPM such as cover crop seeds, crop diversification, crop rotations, use of natural habitat, real-time pest and pathogen monitoring, robots, and software as a service (SaaS).

ii. Identify ways the state might be able to support accessibility so that independent PCA advice is available to all growers.

iii. Advise on a "transparency policy" which would require full disclosure of how PCAs are compensated for product recommendations.

iv. Identify additional ways to build PCA leadership on SPM (e.g., via the SPM Transition Initiative proposed in this Roadmap).

v. Explore how we might build on existing research and resources to expedite the development of college coursework on SPM and build a greater focus on cultural practices and other nonchemical SPM approaches.

B. Promote industry training: Existing grower and PCA trade associations should cooperate in developing SPM outreach workshops for grower members and PCAs via their outreach programs.

C. Establish scholarship programs: Create a state-funded scholarship program that would include donations from private sources for students who want to become PCAs or crop consultants. These scholarships should include requirements to take SPM classes. The state could work with, build on, and provide funding for the SUPERSTAR project[54] at CSU Bakersfield and expand it to other state schools. The program could also include creation of state-funded paid internship and scholarship programs that connect PCA consulting companies with students about to graduate or who have recently graduated. These programs would have SPM requirements for completion.

D. Develop educational materials: Develop a document and/or workbooks that comprehensively cover IPM and SPM for all pests and diseases, including chemical, biological, and cultural approaches.

E. Implement alternatives assessments: Develop guidance for PCAs' alternatives assessments as a way to support thorough compliance with this requirement. The state could develop a baseline set of values and principles to guide, and be included in, these alternatives assessments.

F. Involve PCAs in research: This would help enable PCAs to learn new techniques and share what they learn with their clients.

54 Media, M. (2022, February 28). "USDA NIFA invests $16m for undergraduate AG research and extension experiences". California Ag Network. Retrieved November 18, 2022, from https://californiaagnet.com/2022/02/28/usda-nifa-invests-16m-for-undergraduate-ag-research-and-extension-experiences/

REDUCE ECONOMIC RISK FOR GROWERS TRANSITIONING TO SPM

California's agricultural producers are facing growing uncertainty and instability as a result of many pressures, such as high input costs, changing land tenure, demands from bank loans and insurance companies, climate change and water insecurity, labor shortages, an increasingly complex regulatory landscape, and much more Against this backdrop and with many operating close to the edge of their capacity, growers are particularly hard-pressed to take on the additional risks inherent in shifting their operations toward SPM. The SPM Work Group envisions a future where all growers have the support they need to mitigate the operational risks associated with adopting SPM practices and systems [55] A key intervention in the system to accelerate SPM is support for growers to mitigate these risks and move more growers beyond a "business as usual" mindset toward innovation

▶ GOALS

1. **By 2030, every grower in California has a suite of effective and feasible alternative practices and products, where available.** Where not currently available, California has a research and funding infrastructure in place for the development of cost-effective and efficacious alternative pest management options.
2. **By 2030, California has implemented a system of incentives and financial risk management** that integrates supply chain partners, educational institutions, private financial markets, and state and federal risk management programs to drive widespread adoption of SPM.
3. **By 2030, SPM has been adopted as the de facto pest management system** for state agencies and state-managed land.

PRIORITY ACTIONS

A. Design, fund, and launch the SPM Transition Initiative to incentivize and provide sufficient risk management to support growers to adopt SPM. The SPM Transition Initiative would be a state-led effort to support farms of all sizes, commodities, and production types, and farmers of all socioeconomic backgrounds and languages, to transition to SPM. It would steward public and environmental health by creating a short-term safety net for participating growers as part of their transition to SPM. Under the initiative, the state would cover the cost of reasonable lost yields suffered during a fixed period of time during which a farm is moving to adopt and implement SPM practices. By creating this powerful incentive for growers to adopt SPM practices, the state would be making a crucial investment in the health and well-being of the public and the environment.[56]

B. Identify opportunities to implement SPM on lands owned or leased by the state of California.

55 See Appendix 5.

56 A preliminary program design is outlined in Appendix 7.

DESIGN GUIDANCE:

IN ORDER FOR THIS OPPORTUNITIES IDENTIFICATION PROCESS TO BE SUCCESSFUL, IT SHOULD DO THE FOLLOWING:

a. Consider making unused working lands invested in by California public entities available to farmers practicing SPM, with priority for small farmers and farmers from socially disadvantaged or historically marginalized communities.

b. Explore mechanisms to engage state-owned agricultural easements to advance farmer implementation of SPM. Ensure any proposals are designed so as not to undermine farmer enrollment in easements.

c. Engage UC IPM and qualified UCCE farm advisors or other experts to share SPM best management practices with the Bureau of Land Management and state land management agencies. Those practices should include the importance of, and procedures for, reporting pests.

ADDITIONAL ACTIONS

A. The state should study opportunities to encourage SPM through its financial investments (such as through CalPERS and CalSTRS) and develop a proactive strategy to implement its findings.

B. Expand and improve CDFA programs to increase access and funding for farmers, especially for farmers from socially disadvantaged or historically marginalized communities, to support near-term grower transition to SPM:

i. Increase the budget annually to support expansion of the Healthy Soils Program and explore ways the Healthy Soils Program can further support SPM.[57]

ii. Continue to review grant processes to make them more user-friendly, including an audit or evaluation of paperwork requirements for grantees to streamline those requirements and providing language and culturally appropriate technical assistance.

iii. Ongoingly incorporate farmers' feedback, especially that of small farmers and those from socially disadvantaged or historically marginalized communities, in order to help the programs meet the needs of the diverse array of California's farmers.

iv. Explore ways to provide regulatory and/or loan relief for farmers implementing SPM-related practices.

C. Evaluate the implications for SPM of land tenure and land rental agreement trends. Further study of this area, as well as opportunities to incentivize SPM through lease agreements, is warranted. Early ideas identified by the Work Group include providing tax incentives for landowners willing to rent land on certain terms; taking action to ensure that land owners understand that land farmed in alignment with SPM is beneficial for property value; and tapping into the ethic of responsible stewardship among the next generation of landowners.

D. Study risk management barriers and successes: CDFA and DPR should commission a study of successful private and public risk management programs from around the world. The study should identify barriers to and opportunities for implementation in California agriculture.

57 For reference see, Healthy Soils Program. "Incentives Program 2017-2020 Program Level Summary." (November 1, 2021) California Department of Food and Agriculture. Retrieved November 18, 2022, from https://www.cdfa.ca.gov/oefi/healthysoils/docs/HSP_Incentives_program_level_data_funded_projects.pdf

Photo: CDFA

Photo: Department of Pesticide Regulation, School IPM Program

Photo: Pam Marrone, Invasive Species Control Corporation

E. Advance SPM through crop insurance:

i. Request that the appropriate entity evaluate agricultural loans offered in the state and consider inclusion of SPM standards as eligible expenses under program rules. Consideration should be given to other ways loans may advance SPM.

ii. The state should review gaps in Farm Service Agency (FSA) insurance and investigate ways to improve coverage for risk during SPM transition.

iii. A multistakeholder group representing diverse interests should advocate for California SPM priorities to be integrated into the federal farm bill, including changes to the federal crop insurance program to cover risk. This could include speaking directly to the Risk Management Agency.

F. Promote SPM incentives:

i. Expand DPR funding for legacy pesticide take-back/collection events, as a way to incentivize both agricultural and urban users to transition to lower-risk chemicals and practices and to minimize cost barriers for returning high-risk products.

ii. Provide technical assistance for growers applying for SPM grants.

iii. Help to incentivize key influencers like UC and growers to adopt alternatives that are "shovel ready" but lack support, awareness, and education for their use.

iv. Develop and fund new equipment-lending libraries.

v. Support trials and demonstrations for on-farm and areawide SPM-related projects.

ACTIVATE MARKETS TO DRIVE SPM

Strong market demand for California-grown sustainable and socially just agricultural products[58] is an important linchpin in driving a widespread shift toward sustainable pest management Buyers of agricultural products can be a powerful engine of change toward on-farm SPM approaches by leveraging their procurement power and prioritizing high-standard, California-grown products. But this must be done in ways that align with on-farm conditions and constraints and which don't unduly burden growers already stretched thin with complex demands. Strategic and coordinated action to build buyer and market demand for California-grown, socially just, and sustainable food would accelerate SPM and enhance the market for these products

Ultimately, this would result in a meaningful shift away from high-risk pesticides, benefiting farmworker health and the environment[59] while helping farms by supporting their transition to SPM. With the support of incentive programs and partnerships across government, private, and non-profit sectors, all residents in California can access affordable, sustainably California-grown fruits and vegetables

▶ GOALS

1. **Establish purchasing criteria:** By 2025, the state has established purchasing criteria for identifying and validating agricultural products that are grown in accordance with SPM.
2. **Increase procurement:** By 2030, there is 50 percent increase (above baseline from the 2026 audit) in purchases by state-owned or state-run institutions (including public universities and colleges) of California-grown agricultural products grown in accordance with SPM criteria. There is a comparable increase in funds to local educational agencies for pupil meal reimbursement.
3. **Expand presence in retail markets:** By 2030, a diversity of affordable California, SPM-grown agricultural products are recognized by national retailers for the value of SPM. SPM is accepted as meeting supplier approval requirements, including but not limited to ESG (environment, social, governance) buying requirements.

PRIORITY ACTIONS

A. Establish SPM Purchasing Criteria Task Force. By 2024, the Department of General Services, in collaboration with CalEPA, DPR, and CDFA, has established a multistakeholder task force to inform the creation of SPM purchasing criteria.

58 According to the Food and Agriculture Code (FAC § 47000.5), "agricultural product" means a fresh or processed product produced in California, including fruits, nuts, vegetables, herbs, mushrooms, dairy, shell eggs, honey, pollen, unprocessed beeswax, propolis, royal jelly, flowers, grains, nursery stock, raw sheared wool, livestock meats, poultry meats, rabbit meats, and fish, including shellfish that is produced under controlled conditions in waters located in California.

59 Impacts of pesticides on human health and the environment are widely documented. See for example, Gunstone T, Cornelisse T, Klein K, Dubey A, Donley N. "Pesticides and Soil Invertebrates: A Hazard Assessment." Available at: https://www.frontiersin.org/articles/10.3389/fenvs.2021.643847/full; Calvert GM, Beckman J, Prado JB, Bojes H, Schwartz A, Mulay P, Leinenkugel K, Higgins S, Lackovic M, Waltz J, Stover D, Moraga-McHaley S. "Acute Occupational Pesticide-Related Illness and Injury -United States, 2007-2011." MMWR Morb Mortal Wkly Rep. 2016 Oct 14;63(55):11-16. doi: 10.15585/mmwr.mm6355a3. PMID: 27736824; Curl CL, Spivak M, Phinney R, Montrose L. "Synthetic Pesticides and Health in Vulnerable Populations: Agricultural Workers." Curr Environ Health Rep. 2020 Mar;7(1):13-29. doi: 10.1007/ s40572-020-00266-5. PMID: 31960353; PMCID: PMC7035203.

DESIGN GUIDANCE:

FOR SPM PURCHASING CRITERIA TO BE SUCCESSFUL, THE TASK FORCE MUST DO THE FOLLOWING:

a. Represent a diversity of stakeholders and interests and carry on the work of the SPM Work Group, ideally by including members from this group as well as the criteria list they collaboratively developed. It is critical to have expertise in both agricultural production systems and certification auditing.
b. Build on the groundwork laid in discussions by the SPM Work Group on this subject in Appendix 8.
c. Consider how to drive buyer initiatives to incorporate SPM, and align SPM purchasing criteria with buyer sustainability metrics, key buyer initiatives, and buyers' supplier-approval requirements. This also needs to mitigate the potentially negative impacts that buyer-led initiatives can have on farms.
d. Create a clear process for validating producers who comply with SPM purchasing criteria, including consideration of a metric-based approach such as the Pesticide Risk Tool.[60]
e. Consider ways to enable participation by farms of all sizes, commodities, and production types (e.g., conventional, organic).

B. Establish interim purchasing criteria. By 2024, CDFA should review existing certification and buyer programs and standards to use as interim purchasing criteria, including but not limited to organic, regenerative, sustainable, and others. The department shall use these interim procurement criteria to advise the SPM purchasing criteria in Priority Action A.

C. Conduct a market assessment. Once SPM purchasing criteria have been clearly defined, the state should conduct a market assessment of agricultural product sales in California to determine a baseline and identify economic mechanisms that incentivize SPM in the long term. The multistakeholder purchasing criteria task force should be engaged to help identify incentives.

D. Expand state procurement. The Department of General Services, in collaboration with CalEPA, DPR, and CDFA, and in consultation with other state agencies as needed, should take actions to institutionalize and incentivize the purchasing of SPM products within its own procurement processes. These actions should include:

*i. **By 2026, the state should conduct an audit of:**[61]*
   a. institutional purchasing practices (including state institutions and local educational agencies);
   b. implementation of the California-grown purchase preference;
   c. requirements of the Buy American Act; and
   d. SPM criteria met or volunteered on bids, if possible.

*ii. **The Department of General Services should:***
   a. audit all food procurement contracts for compliance with Department of General Services (DGS) procurement standards and include an evaluation of the average price differential between CA-grown bids and out-of-state or nondomestic bids;
   b. change its procurement manual and purchasing standards to require that bids reflect SPM and point of origin and incorporate SPM procurement percentage standards and point of origin (CA); and
   c. report annually to CDFA, the Governor's Office, and the Legislature on compliance with the CA-grown and CA-grown SPM standard.

*iii. **Mandate SPM and CA-grown state procurement requirements** by offering California growers an automatic 25 percent bid preference (currently at five percent) and California growers practicing SPM a 30 percent purchase preference (above non-CA-grown bids on institutional contracts).*

60 Pesticide Risk Tool: Science Informing Decisions. (n.d.) IPM Institute of North America, Inc. Retrieved November 20, 2022, from https://pesticiderisk.org/

61 The state currently offers a five percent purchase preference for California-grown products for state institutional bids/contracts, and local educational agencies are required to comply with USDA NSL Buy American standards. Both the purchase preference and Buy American provision are not enforced or enacted nor does the DGS procurement manual request bids include information about SPM-produced commodities.

DESIGN GUIDANCE:

FOR LONG-TERM SUPPORT OF THE SPM PURCHASING PROGRAM TO BE SUCCESSFUL, THE PROGRAM SHOULD DO THE FOLLOWING:

a. Consider at least a 25 percent bid preference, and then peg it to findings of the DGS audit (see above), to be adjusted over time.
b. Include all state LEA-affiliated programs.
c. Address grading standards as purchasing requirements for local agencies as a way to lessen potential budget impacts resulting from purchasing SPM products that may initially be more expensive than conventional.
d. Work to ensure that all students have access to SPM-grown food by considering the diversity of school budgets, financial inequities, and access to local, regional, and state growers.
e. Address quality issues to mitigate food waste.
f. Consider Sweden's sustainable procurement system[62] and the Good Food Purchasing Program[63] as models.

ADDITIONAL ACTIONS

A. The Department of General Services (DGS) should facilitate methods for school food buyers to locate and purchase California-grown SPM products.

i. Create mechanisms for local educational agencies to choose CA-grown SPM products with consideration for their budgets for meals.

ii. By 2030, establish a pilot or enhancement within CDFA's Farm to School Incubator Grant Program to offer grant funds to local education agencies on a per-pupil-meal basis (i.e., $x/meal) for products used and purchased from California producers that practice SPM.

B. Create voucher incentives for SPM: In consultation with the California Department of Social Services, expand incentives to promote the purchase of SPM-aligned products to CalFresh, the California Women, Infants, and Children (WIC) program, and other state voucher programs. Until SPM purchasing criteria are established, enabling WIC recipients to purchase organic foods using vouchers will help achieve SPM goals.

C. Develop a clearinghouse of information about SPM approaches, information on trade-offs inherent in pest management, and best management practices to guide both growers and buyers to desired outcomes. The clearinghouse can list buyers that recognize SPM standards and incentives for SPM standards use (state support, buyer support, business contract support). It can also promote the marketing of SPM standards among practitioners.

D. Promote purchasing standards by creating marketing materials for grower and buyers to highlight SPM benefits. Promote the marketing of SPM purchasing standards, and the procurement of goods grown in accordance with these standards, through California commodity boards, commissions, and grower groups.

E. Incentivize participation in regional grower groups:

i. Support regional grower groups to establish programs that develop SPM farming systems linked into the market by some kind of standard.

ii. CDFA and DPR should make presentations at commodity commissions and boards, agricultural trade associations, and conventions/conferences about advancing SPM. Such presentations should cover important tradeoffs to consider, how to get into the state procurement system, and other relevant topics to advance this Roadmap.

62 "Sustainable public procurement." Upphandlings myndigheten. Retrieved November 20, 2022, from https://www.upphandlingsmyndigheten.se/en/sustainable-public-procurement/

63 See Good Food Purchasing Program, Center for Good Food Purchasing. Retrieved November 20, 2022, from https://goodfoodpurchasing.org/

ADVANCING SPM IN URBAN CONTEXTS

Photo: Dept of Pesticide Regulation, School IPM Program

"In short, it's about keeping pests away from where you don't want them, but doing so in a way that protects you, others, and the environment."

- SPM Work Group Member

ENHANCE DATA COLLECTION AND INFORMATION FOR URBAN PESTICIDE USE

As outlined above in "What is SPM in Urban Environments?", as well as Appendix 4, there is very little data available about how and where pesticides are used in urban contexts, making it particularly difficult to understand and address problems associated with their use. Efforts to advance urban SPM would be greatly enabled by robust, publicly available information about urban pesticide use

▶ GOALS

1. **By 2030, the state of California has established systems that provide the urban pesticide use data and information** needed for sound regulatory decisions, SPM initiative prioritization, product design, and effective pest management. The state also maintains a public data management system to make this information available.

PRIORITY ACTION

A. **Develop and implement systems that provide publicly available data on urban pesticide use and a robust understanding of that data. Utilize each of DPR's existing databases on pesticides sales, urban use reporting, and registered products and their labels, building on and enhancing them as needed. Add other new information sources (such as market data and targeted surveys) to provide detailed information about how and where pesticides are actually used in urban areas. Systems should provide geographic, use type, and user specificity to inform understanding of potential exposures.**

DESIGN GUIDANCE:

A SUCCESSFUL DATA AND INFORMATION SYSTEM SHOULD DO THE FOLLOWING:

a. Include a framework outlining all categories of urban pesticide users.
b. Provide reliable gross estimates of pesticides use by major categories (e.g., antimicrobials, outdoor conventional pesticides, facility maintenance, water/wastewater disinfection, pet flea control).
c. Provide the basis for DPR or other organizations to develop detailed user/use location information to support SPM initiatives or to implement other programs in the urban context (e.g., surface water quality protection, training unlicensed workers).

Additional data sources:

a. Consider purchase of available relevant market data sets, such as sales of major categories of pesticide-treated products like paint and building materials.
b. When surveys are used, employ robust, targeted multilingual approaches that leverage partnerships with user category organizations (e.g., building managers, restaurant owners, unions, swimming pool maintenance firms) and other entities with relevant data (e.g., waste management agencies).

Pesticide sales data enhancements:

a. Implement steps to improve pesticide sales data quality, such as increased accountability for accuracy on the part of reporters and enhanced data quality review and validation. Ensure inclusion of internet sales.
b.. Enhance the public sales database to divide up sales data for each active ingredient by types of uses and major formulation categories (e.g., separate agricultural from nonagricultural sales; separate pet products sales from structural pest control product sales of the same active ingredient; distinguish between baits/gels, concentrates, and ready-to-use products).
c. DPR should work with data users and nonagricultural pesticide distributors, retailers, and others in the supply chain to develop a practical, non-burdensome data and information system to provide additional geographic details on urban pesticide sales (e.g., by city).

Pesticide use data enhancements:

a. Modify urban pesticide use reporting to specify target pest and application site information (at a minimum: indoor, outdoor, underground, and aquatic). Give consideration to specifying additional common categories (e.g., “park,” “wastewater collection system,” “residential landscape”).
b. DPR should work with data users, urban professional pest control applicators, and county agricultural commissioners to develop a practical, non-burdensome data and information system providing additional geographic details for urban applications, with data confidentiality restrictions to protect the privacy of the locations of where the pesticides are applied.
c. Implement steps to improve quality of urban pesticide use data, such as increased accountability for accuracy and enhanced data quality review and validation.

ADVANCE RESEARCH AND OUTREACH ON URBAN PEST MANAGEMENT ISSUES

Currently, research funding for pest management is heavily focused on applications in production agriculture, resulting in relatively poor investment in research and outreach on urban pest challenges Particularly given the high proportion of pesticide use in urban contexts and the diversity of users with varying degrees of knowledge, California's efforts to implement SPM statewide would be greatly enabled by an increase in research, outreach, and technical assistance for urban uses [64]

▶ GOAL

1. **By 2030, California research institutions will have infrastructure for urban SPM research**, innovation, and outreach that aligns with and reflects the volume and impacts of pesticides used in urban contexts.

PRIORITY ACTIONS

A. Fund urban SPM research and outreach: Provide adequate dedicated annual funding for UC IPM, CSU, and CCC for urban-focused academics, research, and extension. Consider funding other partners to support communication to priority audiences.

DESIGN GUIDANCE:

FOR THIS FUNDING TO ACHIEVE ITS INTENDED OUTCOMES IT SHOULD:

a A significant part of the funding should take into consideration science-based prioritizations conducted by a multistakeholder working group at DPR (see "Leadership" recommendations on page 29).

b Funding should cover an increased urban pest management focus for UC academic positions.

c Funding should support and incentivize UC IPM's partnerships with other agencies and NGOs conducting urban-focused research and extension.

d Use framework established in "Enhance Data Collection and Information for Urban Pesticide Use" (above) to inform funding streams to support research and innovation that achieves the highest impact for improving SPM.

e Account for the significant role of consumer products in structural pest control when considering funding amounts.

f Enable more responsive, flexible, and integrated funding structures that encourage collaboration between industry and government funding.

g Funds should enable these entities to develop more effective ways to communicate about SPM, especially including public health significance.

h Ensure that urban SPM research feeds into DPR regulatory processes, particularly examination of alternatives, as well as priority-setting for pest management initiatives at all levels.

B. Support urban SPM grants and contracts: The state should support SPM research, innovation, implementation, and education in urban settings through grants or contracts.

64 See Appendix 3.

Photo: Dept of Pesticide Regulation, School IPM Program

DESIGN GUIDANCE:

FOR FUNDING TO ACHIEVE ITS INTENDED OUTCOMES IT SHOULD:

a. Include eligible projects that focus on advancing SPM knowledge, tools, research, practices, and implementation. Project selection should include consideration of the relationship of SPM to healthy housing, environmental health in schools, effects of climate change on pest pressure and pest management systems, and preventing pesticide impacts on water supplies, including reused water.

b. Projects should be targeted according to science-based prioritizations conducted by a multistakeholder working group at DPR as recommended in this Roadmap.

MAKE SPM THE PREFERRED CHOICE FOR BOTH LICENSED AND UNLICENSED USERS

There are many reasons why people reach for pesticides as a pest management approach. First, pesticides can be perceived as more affordable and convenient than preventative measures or nonchemical pest removal approaches. Most people, particularly those who are not licensed (see Appendices 3 and 4 for more information on urban and nonagricultural pesticide uses and users), possess limited understanding of proper pesticide use and environmental exposure pathways and may lack the interest in learning. In addition, opportunities for prevention and nonchemical interventions may not be available to many urban residents. For instance, renters may be unable to secure the necessary building improvements to mitigate pests. Pest-conducive conditions maintained by neighbors may also contribute to pest pressures. Key advisors and influencers, such as health inspectors and code enforcement officers, may lack the knowledge and tools necessary to make informed recommendations, and education and training opportunities are scarce

In many cases, ease of access and a quick-fix orientation contribute further to widespread use of high-risk pesticides in instances where preventative or alternative pest control measures may be effective in limiting pest proliferation. The "ick" factor among consumers may lead to hasty decision-making on treatments, driving a culture of reliance on quick and convenient solutions. Conventional pest management solutions are also reinforced by a widespread assumption that registered products have minimal risk, and by limited awareness about the different levels of hazard associated with various pesticides [65]

▶ GOAL

1. **By 2030, California has systems in place** that enable both licensees and non-licensees to identify and implement SPM options that meet their needs.

PRIORITY ACTIONS FOR UNLICENSED USERS

A. Advance SPM at school sites: DPR should create a process to identify and implement mechanisms to overcome the barriers that prevent widespread adoption of SPM at school sites. Specific elements that warrant exploration include:

i. *Every 5-10 years, perform a formal review of the Healthy Schools Act (HSA) of 2000, including responsibilities of school personnel applying pesticides and how these activities relate to the overall IPM program. Produce a written report of findings including any additional HSA improvements, guidelines, or requirements necessary to support SPM implementation at school sites.*

ii. *Consider requiring certification or licensing (e.g., creating a special category), with expanded annual requirements for pesticide application and SPM training and/or periodic consultation on SPM implementation with DPR for school personnel applying pesticides. This would ensure a minimum competence level to implement SPM and continuing education for the latest information on pests and their management.*

iii. *Provide dedicated ability for DPR to provide customized SPM compliance assistance and consultation capacity for school sites.*

iv. *Promote and incentivize HSA implementation and compliance. Develop a centralized means for increasing compliance visibility through a simple, easily understood HSA compliance information online interface that provides at-a-glance details on school site compliance.*

65 See Appendix 4 for more on the challenges in urban pest management.

B. Conduct urban SPM outreach: The state should invest in an outreach initiative coordinated by DPR to influence high-leverage messengers to promote and magnify urban SPM messaging. Identify, prioritize, and strategically engage with influencers of key urban pest management decision-making realms to promote lower-risk SPM alternative approaches and potentially partner in examining and piloting safer alternative products and practices. Targets may include associations of veterinarians for pet products, building managers (for example, as regards use of antimicrobials in cooling water, pools, fountains, boilers, etc.), golf course managers, paint formulators, schools, retailers, nursery and garden centers, homeowner associations, and local governments. Other key influencers that should receive more information on a consistent basis, with recommendations on how they can contribute to SPM outcomes, include: code enforcement officials, environmental health inspectors, landscape architects, building code officials, and housing agencies.

DESIGN GUIDANCE:

IN ORDER FOR AN OUTREACH EFFORT ON URBAN SPM TO BE SUCCESSFUL, IT SHOULD DO THE FOLLOWING:

a. Identify priority areas according to science-based prioritizations conducted by a multistakeholder working group at DPR, as recommended in the "Strengthen Coordinated Leadership Structures" section of this Roadmap, and in combination with trend analyses.
b. Strategically target influencers in these high-priority areas.
c. Assemble an advisory team of relevant stakeholders and experts for each focus area identified.
d. Collaborate with other state and regional agencies, as well as state associations of local agencies, working on interrelated issues (e.g., CalEPA, California Natural Resources Agency, municipal wastewater treatment plants, stormwater programs).

C. Require retail education: The state should implement pesticide education requirements and programs in the retail sector.

i. Require pesticide retailers to train employees and disseminate reliable information to customers about pesticide alternatives and SPM at the point of sale.

ii. Enhance programs that educate retailers about SPM, such as the IPM Advocates for Retail Stores program housed within the California Stormwater Quality Association (CASQA), that could be expanded statewide to work directly with stores.

D. Initiate a public awareness campaign: By 2024, fund and launch a 3-5 year, $6-10 million public awareness campaign, or multiple campaigns, focused on building public understanding about pesticide risks and impacts, SPM and its principles, and the need to shift the public's mindset about pests. Identify key issues and audiences, research key obstacles and leverage points, and develop high-quality campaigns focused on these findings, with metrics and adequate funding. Desired outcomes include:

i. More visibility is achieved for new or little-known research and innovation results, and for ideas to drive adequate and effective communication.

ii. User audiences pay attention to and reduce conducive conditions for pests, such as harborage and access to structures and food.

iii. Goals are understandable to the average person through branding or other means, promoting public utilization of certified IPM service providers.

iv. Use of social media and apps is increased to help build public understanding of pesticide use risks and alternative pest management strategies.

DESIGN GUIDANCE:
FOR A SUCCESSFUL PUBLIC AWARENESS CAMPAIGN:

a. "Public awareness" should be interpreted broadly to encompass efforts pointing to consumers, industry, and subsets of various groups (homeowners, renters).
b. It should include targeted implementation informed by the science-based prioritizations conducted by a multistakeholder working group at DPR, as recommended in the "Strengthen Coordinated Leadership Structures" section of this Roadmap.
c. Work with stakeholders and/or a consultant to engage different messaging partners as appropriate to the campaign(s). Consider enlisting a marketing firm conversant in community-ased social marketing, which has a good track record for making progress in these kinds of topics.
d. UC Cooperative Extension and UC IPM should play an integral role in public outreach design and implementation.
e. Specific priorities have to be further considered and discovered through market research.
f. Engage staff at DPR to perform targeted outreach to youth and provide age-appropriate education on SPM as it relates to gardening, healthy food, healthy homes, and environmental and human health benefits.

E. Establish workplace SPM training: Establish an ongoing program for DPR to partner with state and local regulatory agencies that interact with unlicensed workplace pesticide users. The goal of such a program should be to enhance training for both agency staff (including inspectors) and workers on their workplace use of pesticides and SPM alternatives. Examples of potential partners include county environmental health regulators, the Occupational Safety and Health Administration, and the California Department of Industrial Relations. DPR priorities for implementing interagency partnerships should mesh with its SPM priorities.

F. Build positive incentives and opportunities for urban users to increase their adoption of SPM tools and practices. Such incentives could include grants supporting or offsetting initial implementation costs, social recognition and promotion programs, and streamlined regulatory and administrative requirements.

ADDITIONAL ACTIONS FOR UNLICENSED USERS

A. Promote mechanisms available to residents to report concerns about pesticide use or unmanaged pest problems. (See, for example, California Civil Code Section 1941.1, which requires landlords to keep dwellings in habitable condition, including removing harmful insects.)

PRIORITY ACTIONS FOR LICENSED USERS

A. Review the criteria for approving continuing educations units (CEUs) and make the following changes:[66]

i. Revise the CEU credit requirements for all DPR licenses (PCA, QAL, QAC) and SPCB licenses to include requirements for IPM/SPM.

ii. Expand topics to include non-pesticide topics important to an IPM/SPM discussion. These include but are not limited to topics on non-pesticidal methods, such as managing pests by proper pruning, soil fertility, plant nutrition, irrigation, exclusion, and sanitation. All topics should center pests, instead of focusing on pesticides and why a pesticide would be used or eliminated.

B. Consider licensure or training requirements for property managers and "in-house" pesticide applicators based on type of business and/or size threshold (e.g., rental properties of a certain size).

66 Recommendations for updates to CEUs for agricultural users are part of the "Align Pest Control Advisors with SPM."

Photo: Chris Geiger, Lacewing Collaborations LLC

C. DPR and the Structural Pest Control Board should establish criteria for SPM certifications of pest management providers or services that further the goals of this Roadmap. These criteria can be applied to new or existing certification programs (e.g., EcoWise, GreenShield, and GreenPro).

D. DPR and the Structural Pest Control Board should promote qualifying certifications by:

i. encouraging pest management providers to become certified;

ii. incorporating incentives for certified SPM companies into state contracting language by, for example, offering points to certified companies in requests for proposals; and

iii. encouraging local public agencies, businesses, and consumers to choose SPM-certified companies and services.

REFOCUS URBAN DESIGN, BUILDING CODES, AND REGULATIONS TO ENHANCE PEST PREVENTION

The effective prevention of pests is a cornerstone of SPM, which depends in large part on addressing the conditions that are conducive to pests. A significant focus of conducive conditions in urban areas are deficiencies in the built environment. Such deficiencies can be caused by neglected maintenance and poor operation of existing buildings and landscapes, and/or flaws in design and construction. This section is intended to encourage the development of systems and requirements to enhance the identification and correction of conducive conditions in existing buildings, and to reduce the extent to which poor design and construction practices contribute to persistent pest problems.

▶ GOAL

1. **Advance urban pest prevention:** By 2030, California urban design meaningfully incorporates pest prevention, and pest prevention is a centerpiece of pest management training, licensing, standards, and building codes.

PRIORITY ACTIONS

A. Formalize general pest inspection requirements (following the model of Branch III wood-destroying organism inspections) that would be offered under Branch II services, or separately. This includes general pest inspection requirements being added in state code language.

DESIGN GUIDANCE:

FOR GENERAL PEST INSPECTION REQUIREMENTS TO BE SUCCESSFULLY FORMALIZED:

a. Include requirements to assess conducive conditions.
b. Include enforcement requirements.
c. Include definition of spatial scope for inspections, which should be very wide and include adjacent landscapes.
d. Focus on identifying conditions, not fixing them.
e. Provide a specific list of items that must be included (e.g., map of house, construction materials, moisture sources, entry points, harborage) and specific recommendations to address pests and conditions. This could be modeled on language for existing wood-destroying organisms.
f. Include a requirement that licensees offer the option of doing an inspection for each new account.
g. After a period of time, evaluate options for requiring general pest inspections in high-priority situations such as multifamily housing and day care facilities. This could be based on building size and/or Federal Housing and Urban Development (HUD) designation (Section 8).

B. Formalize licensing: Formalize another license category under PCA licenses focused on general pest inspections of urban landscapes, including a requirement to assess conducive conditions. The Structural Pest Control Board should develop training materials and exam questions to support general pest inspection requirements above.

C. Update building codes: Enable a multistakeholder task force (including building code experts) to study feasibility of incorporating pest prevention into building codes, such as the California Green Building Standards Code (CALGreen).

Photos: Chris Geiger, Lacewing Collaborations LLC

D. Promote SPM through landscape design: Create guidelines and incentives for the application of sustainable landscape design and renovation methods and for certifications that support pest prevention.

E. Implement SPM at state-owned structures: The state should require state-owned and state-leased buildings to have pest management plans or practices that incorporate SPM.

F. Reduce conducive conditions: Identify opportunities and propose action for reducing pest pressure by addressing conducive conditions through regulation by other state agencies and local agencies (e.g., housing codes, nuisance codes).

LOOKING AHEAD: IMPLEMENTING THE ROADMAP

RESOURCING THE FUTURE

The suite of recommendations contained in this Roadmap, from supporting research and technical assistance, to state leadership on SPM, to improving registration processes, to special initiatives, to implementing SPM in government land, buildings, and procurement processes, and beyond, will require significant public funding to implement. This funding is absolutely necessary to support the success of the Roadmap and to achieve a healthy future for all Californians and the ecosystems on which we depend

The SPM Work Group and Urban Subgroup recommend that the state, with DPR, CalEPA and CDFA's leadership, immediately identify and secure consistent funding[67] and staffing to enable state leaders to champion SPM statewide and to successfully implement the Roadmap's recommended state actions. As part of this effort, we recommend the state examine various funding options and their impacts

Progress toward Roadmap goals should be reassessed periodically in order to support accountability and ongoing, adaptive strategy. Ideally, through the multistakeholder state-level SPM Implementation Work Group proposed in this Roadmap, and through other processes, there will be ongoing conversations to understand where course correction is necessary and what other emergent strategies make sense in light of the lastest science, emerging knowledge in the field, and evolving pest pressures. To this end, we recommend a comprehensive review of SPM implementation recommendations every 10 years until 2050

CONCLUSION

The SPM Roadmap is an ambitious and achievable strategy for sustainable pest management that is vital to our future food security, agricultural vitality, ecosystem resilience, community health and well-being, and built environment, and so much more. Achieving our goals will require not only strong state leadership, but thoughtful collaboration across the system on the leverage points and recommendations laid out above

Regardless of your sphere of influence, we all have an important role to play in shaping the future of pest management. We invite you to consider which goals and recommendations you can help advance and where you can most effectively contribute to safe, sustainable pest management choices

Please join us in making this bold vision a reality!

67 Such as a service-based budgeting process that is task-based and labor-focused, and informs the budget based on the time and resources needed to accomplish the tasks. See "Service based budgeting." California Department of Fish and Wildlife. Retrieved November 18, 2022, from https://wildlife.ca.gov/Budget/Service-Based-Budgeting

APPENDICES

APPENDIX 1:
GLOSSARY OF TERMS

- **Agricultural pest applicators:** Individuals who apply pesticides. Can include growers and professional applicators, sometimes working with the guidance of pest control advisors.
- **Agricultural products:** According to the Food and Agriculture Code (FAC § 47000.5), "agricultural product" means a fresh or processed product produced in California, including fruits, nuts, vegetables, herbs, mushrooms, dairy, shell eggs, honey, pollen, unprocessed beeswax, propolis, royal jelly, flowers, grains, nursery stock, raw sheared wool, livestock meats, poultry meats, rabbit meats, and fish, including shellfish that is produced under controlled conditions in waters located in California.
- **Alternative practices:** Alternative practices in agriculture include manipulation of the crop and surrounding ecosystem to prevent potential pests from becoming pests. This includes many practices such as improving soil health, crop nutrition, crop diversity, crop rotations, natural enemy habitat, etc. Alternative practices in nonagricultural systems encompass a wide variety of actions, including modification of structures (to reduce pest entry, harborage, or sources of food and water), modification of policies (such as improved lease agreements or move-in policies for multifamily dwellings), modification of landscape designs and maintenance practices, as well as the use of various nonchemical pest management approaches such as heat treatments.
- **Biological control (biocontrol)**: As an applied field for human intervention, as opposed to the phase of natural control, biocontrol is the study, importation, augmentation, and conservation of beneficial organisms for the regulation of population densities of other organism's abundance below the level of economic injury
- **Biologicals:** Biologicals are products derived from naturally occurring microorganisms, plant extracts, insects, or other organic matter that may be categorized as biostimulants to enhance plant growth and productivity They also include biopesticides to protect plants from pests along with biofertility or plant nutrition products.
- **Biocontrol monitoring:** Biological monitoring consists of skills and tools to assess the ratio of the pest and natural enemy populations to indicate whether biological control is increasing or decreasing. Each farming and cropping system has relevant observable phenomena in the arthropod ecology that can be identified, counted, recorded, and compared with samples from other farmscapes and time scales. In some situations visual inspection, sticky traps, or pheromone traps are sufficient. In other situations the sweep net is essential and sometimes a vacuum insect net is the only way to observe the presence of important natural enemies. Identification of organisms follows monitoring of the insect ecology The required degree of precision in identification and the accuracy in counting numbers present depends on the level of consequence for cost-effective decision-making.
- **High-risk pesticides:** The SPM Work Group and Urban Subgroup define high-risk pesticides as active ingredients that are highly hazardous and/or formulations or uses that pose a likelihood of, or are known to cause, significant or widespread human and/or ecological impacts from their use

- **Indigenous Traditional Ecological Knowledge (ITEK):** ITEK is a body of observations, oral and written knowledge, practices, and beliefs that promote environmental sustainability and the responsible stewardship of natural resources through relationships between humans and environmental systems. It is applied to phenomena across biological, physical, cultural, and spiritual systems. ITEK has evolved over millennia, continues to evolve, and includes insights based on evidence acquired through direct contact with the environment and long-term experiences, as well as extensive observations, lessons, and skills passed from generation to generation. ITEK is owned by Indigenous people—including, but not limited to, Tribal Nations, Native Americans, Alaska Natives, and Native Hawaiians.[68]
- **Integrated pest management (IPM):** IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.
- **Pest:** "Pest" means any of the following that is, or is liable to become, dangerous or detrimental to the agricultural or nonagricultural environment of the state: (a) Any insect, predatory animal, rodent, nematode, or weed; (b) Any form of terrestrial, aquatic, or aerial plant or animal, virus, fungus, bacteria, or other microorganism (except viruses, fungi, bacteria, or other microorganisms on or in living man or other living animals); (c) Anything that the director, by regulation, declares to be a pest (FAC section 12754.5).
- **Pesticide:** Includes any of the following: (a) Any spray adjuvant; (b) Any substance, or mixture of substances which is intended to be used for defoliating plants, regulating plant growth, or for preventing, destroying, repelling, or mitigating any pest, as defined in Section 12754.5, which may infest or be detrimental to vegetation, man, animals, or households, or be present in any agricultural or nonagricultural environment whatsoever (FAC section 12753).
- **Priority Pesticides:** Pesticide products, active ingredients, and groups of related products within the context of specific product uses or pest/location use combinations that have been deemed to be of greatest concern and warrant heightened attention, planning, and support to expedite their replacement and eventual elimination. The criteria for classifying pesticides as "Priority Pesticides" includes, but is not limited to hazard and risk classifications,[69] availability of effective alternative products or practices,[70] and special consideration of pest management situations that potentially cause severe or widespread adverse impacts. The identification of these Priority Pesticides will be conducted by DPR under advisement of a multistakeholder Sustainable Pest Management Priorities Advisory Committee (see page 31 for more details on the prioritization process). Priority Pesticides are a subset of high-risk pesticides.

68 Elevating Indigenous Traditional Ecological Knowledge. (2022, March 4). National Institute of Food and Agriculture. Retrieved November 18, 2022 , from https://www.nifa.usda.gov/about-nifa/blogs/elevating-indigenous-traditional-ecological-knowledge

69 Including but not limited to California classifications of groundwater contaminants, toxic air contaminants, and restricted products as well as carcinogens, endocrine disruptors, reproductive and developmental toxicants, and environmental toxicants, such as those toxic to non-target pollinators, mammals, birds, and fish.

70 Consideration of alternative products or consideration of the availability of multiple techniques and products to prevent resistance development and when the product under review has no viable alternatives. Viability includes but is not limited to the variables of efficacy, affordability, and availability. Preventive practices include methods of biological and cultural ecosystem management that minimize pest problems and the need for pest control.

APPENDIX 2:
PESTICIDE USE CLASSIFICATION

The California Department of Pesticide Regulation classifies pesticide use as follows. "Agricultural use" has two definitional subdivisions: "production agriculture use" (use in the production of an agricultural commodity) and "non-production agriculture use" (e g , use in watersheds, rights of way, landscaped areas, parks, recreation areas, and cemeteries).

"Nonagricultural use" is defined as use in homes, industry, institutions, structural pest management, veterinary, and vector control districts—categories which have their own explicit regulatory definitions and share a common theme of benefitting congregated populations and infrastructure that are most often associated with urban and suburban environments [71]

DPR USE-RELATED DEFINITIONS/GUIDANCE[72]

TERM	DEFINITIONS	COMMENTS
Agricultural Commodity	An unprocessed product of farms, ranches, nurseries and forests (except livestock, poultry, and fish). Agricultural commodities include fruits and vegetables; grains, such as wheat, barley, oats, rye, triticale, rice, corn and sorghum; legumes, such as field beans and peas; animal feed and forage crops; rangeland and pasture; seed crops; fiber crops such as cotton; oil crops, such as safflower, sunflower, corn, and cottonseed; trees grown for lumber and wood products; nursery stock grown commercially; Christmas trees; ornamentals and cut flowers; and turf grown commercially for sod.	Excludes use on livestock, poultry, and fish, thus removing applications on these specific commodities from DPR's scope.
Agricultural Use	The use of any pesticide or method or device for the management of plant or animal pests, or any other pests, or the use of any pesticide for the regulation of plant growth or defoliation of plants. ***It excludes the sale or use of pesticides in properly labeled packages or containers that are intended for any of the following:*** ► home use, ► structural pest management use, ► industrial or institutional use, ► the management of an animal pest under the written prescription of a veterinarian, and ► certain vector (mosquito abatement) control districts. ***Sub-categories of agricultural use are:*** ► production agriculture: pest management use conducted in the production for sale of an agricultural commodity or agricultural plant commodity; and ► non-production agriculture: all other agricultural use, including for watersheds, rights-of-way, and landscaped areas (golf courses, parks, recreation areas, cemeteries, etc.).	

71 See also California Department of Pesticide Regulation (2019, March). Pesticide Use Enforcement Program Standards Compendium Volume 8, Guidelines for Interpreting Pesticide Laws, Regulations, and Labeling. Retrieved November 18, 2022, from https://www.cdpr.ca.gov/docs/enforce/compend/vol_8/pestlaw.htm

72 California Food and Agriculture Code Section 11408. Further definitions for terms referred to in California Food and Agriculture Code 11408 are found in the California Code of Regulations Section 600.

TERM	DEFINITIONS	COMMENTS
Non-Agricultural Use	**Includes:** ***Home use:*** ► Use within, or in the immediate environment of, a household including single-family homes, apartment units, dormitories, or any occupied dwelling. ***Structural:*** ► Use by a licensed structural pest control operator within the scope of their license. ***Industrial:*** ► Use within the confines of, or on property necessary for, the operation of factories, processing plants, packinghouses, or similar facilities, or use for or in a manufacturing, mining, or chemical process. In California, industrial use does not include use on rights-of-way. Post- harvest commodity fumigations at facilities or on trucks, vans, or rail cars are normally industrial use. ***Institutional:*** ► Use within the confines of, or on property necessary for the operation of, buildings such as schools (playgrounds are necessary for the operation of a school), hospitals, office buildings, libraries, or auditoriums. When a licensed structural pest control operator treats these buildings, it is structural use. Landscaping of walkways, parking lots, and other areas immediately adjacent to these buildings is institutional. Landscaping of larger, more independent areas is not considered institutional. ***Vector control:*** ► Use by certain vector control (mosquito abatement) districts. ***Veterinary prescribed:*** ► Use by or pursuant to the written prescription of a licensed veterinarian within the scope of their practice. There is no requirement for veterinarians to write prescriptions to themselves, so although not specifically mentioned in the law, by policy, veterinarians are covered by this use pattern.	

CAUTION ABOUT CLASSIFICATION COMPLEXITIES

The site or situation of use and the user will all affect how a particular use is classified. A particular use in one context may be classified differently in another. For example:

i A tree can be residential landscape (home), institutional landscape (institutional), or watershed (non-production agriculture), depending upon where it is growing. However, if that same tree is growing in an orchard, it would be production agriculture

ii An agricultural commodity fumigated in storage on a farm could be production agriculture while that same commodity fumigated in storage at a processing plant would be industrial

iii A swimming pool that is part of a residential property would be home use. A city, school, or other public pool would generally be institutional

USE-CATEGORY EXAMPLES

(Note: Common designations are offered, but actual site/user specifics may result in different designations, as mentioned above)

USE CATEGORY	EXAMPLES, WITH MOST COMMON SUB-DESIGNATION	
Nonagricultral Use	▸ Airports - industrial ▸ Amusement parks - institutional ▸ Apartments/townhouses - home ▸ Auditoriums - institutional ▸ Clubhouse landscape - institutional ▸ Condominiums - home ▸ Construction sites - industrial ▸ Food manufacturing plants - industrial ▸ Grain elevators (production agriculture if on farm) - industrial ▸ Home gardens (no distribution) - home ▸ Homeowner association (HOA) property (except golf courses) - various ▸ Homes and residences - home ▸ Hospitals - institutional ▸ Libraries - institutional ▸ Lumber yards - industrial ▸ Mobile home parks - home ▸ Mosquito abatement districts - vector control ▸ Nurseries (retail non- production) - industrial ▸ Office complex (around outside) - institutional ▸ Office parking lots - institutional	▸ Oil wells - industrial ▸ Packing houses - industrial ▸ Paper mills - industrial ▸ Pet animals - home ▸ Ports - industrial ▸ Post-harvest commodity treatments - industrial ▸ Prescription from veterinarian - veterinarian ▸ Ranchette pasture (no distribution) - home ▸ Restaurants - industrial ▸ Schools (buildings and grounds) - institutional ▸ Seed treatment - industrial ▸ Sewage treatment plants - industrial ▸ Sewer lines - industrial ▸ Shipyards - industrial ▸ Shopping malls (inside or outside) - institutional ▸ Swimming pools - various ▸ Uncultivated non- agricultural ground - various ▸ Water treatment plants - industrial ▸ Wood treatment plants - industrial ▸ Zoos - institutional

APPENDIX 3:
URBAN PEST MANAGEMENT USES AND USERS

The Urban Subgroup developed the following framework to identify the landscape of pest management users and use settings in order to inform their discussions. Urban Subgroup members acknowledge that their expertise covers many–but not all–of these areas of urban pest management, and identify recommended actions to fill the gaps.

A. NON-LICENSED USERS AND USES

i. **At home.** These are individual users engaging in household-related pest management and/or pesticide use, such as: incidental in-home pest management treatments; use of sanitizers and disinfectants; pet treatments; home gardening; landscape and lawn care (including "weed and feed" products); and swimming pool treatment. These activities are subject to labeling and sales reporting oversight and requirements. While users are required by law to follow label instructions and requirements, at-home users typically receive no formal training outside of any voluntary learning, and are not required to report their pesticide use, nor is there a mechanism to do so. As such, there is little data surrounding at-home pesticide uses

ii. **On the job but not licensed to apply pesticides.** These are individuals for whom pest management is an incidental part of their job and their pesticide use has no licensing requirements. This class excludes those unlicensed users who work for a pest management business and perform pest management under the direction and training of a licensed applicator. This class includes individuals who perform pest management work for their employer at their employer's property, such as landscapers employed by homeowner associations, facility managers, school district staff, pool maintenance, health care facilities, and managers of cooling water system protection. In this class, pesticide use decisions may be driven by groups of individuals with widely varying goals, from personal tolerance to safety concerns. In some cases, users may be required to have training, such as school district staff who are required by the Healthy Schools Act to complete one hour of training annually if they apply pesticides. As with at-home use, unlicensed on-the-job users tend to have little training and low overall awareness about proper use, and while all users are required to follow labeling requirements, the label adherence of this group is unknown (likely highly variable depending on setting). All users in this category are required to follow label instructions and misuse is subject to enforcement. Additionally, some users in this category are subject to reporting requirements and/or enforcement action under pesticide and/or workplace safety standards

B. LICENSED USERS AND USES

i. **Professional applicators**

   a. ***Professional structural control.*** *This class includes professional, trained applicators registered and licensed under the Structural Pest Control Board[73] at the California Department of Consumer Affairs. Pesticides are used by these individuals to manage pests associated with structures such as rodents and insects, including pests that destroy wood in structures such as buildings, docks, railroad cars, and airplanes, among others.[74] Reporting of these pesticide applications is required; however, reporting requirements are not as detailed as for production agriculture.*

73 See State of California. "The Structural Pest Control Board." Department of Consumer Affairs Structural Pest Control Board. Retrieved November 18, 2022, from https://www.pestboard.ca.gov/

74 See also, State of California. "What is Structural Pest Control?" Department of Consumer Affairs Structural Pest Control Board. Retrieved November 18, 2022, from https://www.pestboard.ca.gov/about/whatis.shtml

b. ***Professional landscape management.*** *These users are professional, trained "qualified applicators" who are, or who work at, the direction of individuals certified, registered, and licensed under the California Department of Pesticide Regulation. Applicators include maintenance gardeners for hire who perform incidental weed management, as well as habitat managers, landscaping companies, and qualified applicators working for local governments applying pesticides to manage weeds in parks or vegetation along roadsides and rights-of-way.*

c. ***Public health-related pest management.*** *This class of users manages pests related to public health or medical reasons as part of official governmental pest management programs, such as those conducted by local mosquito abatement districts. Public agencies that carry out vector control services are certified by the California Department of Public Health (CDPH) and are exempt from licensing by DPR under the terms of a memorandum of understanding (MOU).*[75] *Public health-related pest management is also provided by private companies under Category K and are licensed by DPR.*

C. USE OF PESTICIDE-TREATED PRODUCTS

i. **Pesticide-treated articles contain pesticides that have been incorporated into the product with the intent to protect the product.** Examples include certain mold-resistant paints, roofing materials, treated wood (including telephone poles), treated seeds, and fabrics treated to resist odor. Although the pesticides used to treat these items are regulated by DPR, US EPA has determined that the end-product treated items fall under the "treated article" definition. Treated articles are not subject to US EPA or DPR regulation. Conversely, materials that are intended to protect the user, such as clothing impregnated with mosquito-repelling insecticides, are subject to regulation by DPR

ii. **In this class of uses and users, the application of the pesticide to the product occurs during product manufacturing, and the final product is then put to use elsewhere.** Human exposure to, and ecological impacts from, these pesticide-treated products at and around their actual use endpoint is not presently fully known

75 "Memorandum of Understanding Between the California Department of Public Health and the California Department of Pesticide Regulation and the County Agricultural Commissioners for the Protection of Human Health From the Adverse Effects of Pesticides." November, 2008. California Department of Pesticide Regulation. Retrieved November 20, 2022, from https://www.cdpr.ca.gov/docs/enforce/mous/dhs_cac.pdf

APPENDIX 4:
CHALLENGES IN URBAN PEST MANAGEMENT

There are several dynamics at play that distinguish urban pest management from production agricultural pest management that should be taken into account when considering approaches to SPM in urban settings. These include:

- **Heterogeneity of knowledge and use.** Urban pest management includes a wide range of users with highly varying degrees of knowledge, from residents to professional pest management companies. Some uses require professional licensing (e g., structural applications, such as termite treatment) and use reporting, while others do not (e g., residents spraying for ants or administering flea medications to a pet).

- **Public perception, knowledge, and attitudes.**

  Visibility. *The public visibility of urban pesticide use is low relative to production agricultural use, particularly as it takes place in a more complex human environment with a wider and more diffuse range of potential causal agents, as described above. Many in the public are not aware of what constitutes a pesticide, nor the risks to human health from everyday items containing high-risk chemicals such as non-labeled antimicrobials in clothing or sanitizers. Additionally, many urban landscape applications occur in marginal areas, such as roadsides, parks, and private landscaping that are not always visible to the public.*

  Awareness. *Agricultural producers are a more clearly defined user group that increasingly understands the short- and long-term economic incentives of ecologically based pest management, as pests are competitors that have direct economic impact. Urban pest management decisions are based on more subjective thresholds, for example, aimed at avoiding property damage, maintaining aesthetic landscapes and pest-free interiors, or reducing perceived health risks. Average pesticide users in an urban setting may not always know, ask, or know where to ask how pesticide applications can affect their health or that of the environment, either in the short- or long-term.*

  Tolerance and attitudes. *Awareness about SPM options in urban settings is generally low among unlicensed and untrained persons who perform pest control and the wider public[76] alike. Some minimum-risk pesticides that are exempt from EPA registration, such as essential oils, face additional barriers such as lack of residual control and complaints from consumers about their odor. Unlicensed urban users may be less conscious of pest prevention approaches in the absence of an immediate problem or need, which may make holistic approaches less successful. Habitat management in natural areas may be an exception as some urban residents and land managers question whether the risk of pesticide use exceeds the risk of the invasive species.*

  In addition, with the rare exception of a few external requirements (such as control of structure-damaging pests upon property transfer), thresholds are subject to the tolerance of the consumer. For example, a majority of spiders are beneficial predators of pests, yet residents may be unwilling to tolerate them and seek quick fixes involving conventional pest control measures. A public mindset in which the presence of insects and other pests is perceived as a problem that requires active intervention contributes to a proliferation of conventional eradication controls. Common attitudes and beliefs are informed at least in part by awareness: for example, public perception about weed-free lawns might be different if communities understood the risks associated with some herbicide products.

76 See Schoelitsz, Bruce, Bastiaan G. Meerburg, and Willem Takken. "Influence of the public's perception, attitudes, and knowledge on the implementation of integrated pest management for household insect pests." Entomologia Experimentalis et Applicata 167, no. 1 (2018), 14-26. doi:10.1111/eea.12739.

- **Insufficient support infrastructure.** Pest management in production agriculture is supported by a much more well-developed and funded set of organizations, infrastructure, and standards affecting its pest management activities, such as commodity associations, extension services, federal conservation programs, phytosanitary rules, USDA standards, and research centers. By contrast, SPM research related to structural and ornamental landscapes and UC Urban Cooperative Extension programs receive comparatively little support. More broadly, urban pest management challenges beyond landscape and structural pest control receive little ongoing support.
- **Data gaps.** Our collective ability to understand the scope of urban pesticide use and impacts is severely limited by the lack of data that can fully define the problem and by the challenges inherent in quantifying nonagricultural use. Labels allow a plethora of uses but there is often limited use data available, and in regards to unlicensed use, no data are available to determine which uses actually occur Most urban pesticide use is not subject to reporting requirements. With some exceptions, current requirements for pesticide use reporting generally do not require that locations of treatment or other details be included for urban applications. The only data on consumer uses of pesticides are available as total statewide product sales volumes gathered by DPR for mill assessment purposes, and requires assumptions as to whether and how products that are sold are actually used by purchasers. In some cases, reported data do not provide sufficient detail to allow for useful analyses or to enable counties and DPR to easily identify use errors or potential data reporting errors that can skew our understanding of urban pesticide use [77] Understanding use patterns is critical to informed product design, informed identification of SPM solutions, and science-based and complete regulatory evaluations of pesticide products.

77 For example, users reporting applications for structural, landscape maintenance, right-of-way, public health, vertebrate pest control, commodity fumigation, and regulatory pest control do not have to report a value for the amount of area treated. Without an area treated value, it is not possible to calculate a use rate (product amount/area treated) that can be used to accurately identify reporting errors or potentially illegal (conflicting with label) uses. As another example, while uses involving production agriculture require the user to report the use location to a specific 1-by-1 square mile section of land, nonagricultural and non-production agricultural users that are required to report need only identify the county in which the application occurred. The lack of specificity makes it impossible to identify proximity to residential addresses, schools, waterways, and related possible unintended pesticide impacts.

- **Complexity of classification, reporting, and oversight, with gaps for unlicensed users.** The portion of regulated pesticide use in urban settings may have different oversight requirements than those for production agriculture As an example of the oversight complexity related to licensing, the California Department of Pesticide Regulation regulates all of the following: qualified applicators of pesticides applied in residential, commercial, industrial, governmental, and institutional settings; landscape maintenance; right-of-way; plant agriculture; forest pest control; aquatic; regulatory; seed treatment; animal agriculture; demonstration and research; public health-related; wood preservation; sewer line root control; field fumigation; and microbial pest control. County agricultural commissioners oversee and issue certifications to private applicators who apply pesticides in some of the same settings when that property is owned or operated for producing an agricultural commodity, while those performing similar work in structural pest control obtain structural pest control licenses issued by the Structural Pest Control Board, and vector control technicians are certified by the California Department of Public Health.

  In many cases, these licenses can overlap or two licenses can be required to perform the work. For example, a pest control business performing residential pest control may be required to have a DPR license for pest control done outside the home for purposes other than protecting the structure; the business may also be required to have a Structural Pest Control Board license for pest control performed to protect the structure. Pesticide use reporting and oversight is particularly challenging for unlicensed pesticide users. Consumer, and some other, uses do not require licensing. Management systems are limited to pesticide sales reporting and registration-related mechanisms. Labels convey safety and use information that users are required by law to follow. However, although the directions on home-use product labels provide safe-handling and use instructions, these directions are difficult to enforce and data shows they are rarely fully read and adhered to [78] At the same time, statistics from the nationwide Poison Control System indicate that the top 10 most common adult poisoning calls relate to use of household cleaning products and pesticides.[79]

  As a result of both the regulatory complexity and the varied circumstances in which urban pest management is performed, it is especially challenging to distinctly categorize and assess urban pest management use and needs.

- **Externalized government costs.** Legal structures, particularly the Federal Clean Water Act, create mutual responsibilities and costs associated with the pest control decisions made by individual actors. For example, cities and counties have been subject to costly permit requirements of the National Pollutant Discharge Elimination System around the occurrence of pesticides and pesticide-related toxicity in urban runoff and municipal wastewater effluent.

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78 See for example: Edworthy J, Hellier E, Morley N, Grey C, Aldrich K, and Lee A, "Linguistic and location effects in compliance with pesticide warning labels for amateur and professional users." In: Human Factors (2004, Spring): 11-31. doi.org/10.1518/hfes.46.1.11.30383; Rother H-A, "Pesticide Labels: Protecting Liability or Health? – Unpacking 'misuse' of pesticides," Current Opinion in Environmental Science and Health (2018), doi: 10.1016/j.coesh.2018.02.004; Dugger-Webster A, LePrevost CE, "Following Pesticide Labels: A Continued Journey Toward User Comprehension and Safe Use," Current Opinion in Environmental Science and Health (2018), doi: 10.1016/j.coesh.2018.03.004; .Lockwood JA, Wangberg JK, Ferrell MA, Hollon JD, "Pesticide labels: proven protection or superficial safety?" Journal of the American Optometric Association (1994 Jan) 65(1):18-26.

79 To view these statics, see https:// www.poison.org/poison-statistics-national

APPENDIX 5:
EXAMPLES OF ON-FARM SPM PRACTICES

SAMPLE LIST OF SPM PRACTICES

SPM is a decision-making tool. The following are some of the practices that could be used in the process of sustainable pest management. This list is not exhaustive, nor is it meant to be. Rather, it's meant to illustrate the kinds of practices, or combination of practices, that are inherent to SPM when implemented with the intent to create healthy, resilient farms and ecosystems

It is important to note that simply implementing a couple of the practices below does not necessarily mean that SPM is being realized. As mentioned above, SPM is a systems approach, and the goal is to be ongoingly moving further down a continuum towards integrated, holistic SPM

BIOLOGICAL

a. *classical and augmentative biological control*
b. *mating disruption (including pheromone and SIT disruption)*
c. *enhancing natural enemy populations through conservation plantings*
d. *resistant rootstocks and/or varieties*
e. *biological crop inputs (e.g., microbes, crop stimulants, seaweed)*
f. *plant breeding*
g. *soil microbiome assessment*

CULTURAL

a. *cover crops*
b. *no-till farming, minimum or reduced tillage*
c. *irrigation regimes*
d. *trap crops*
e. *polyculture*
f. *weed barriers*
g. *selection of appropriate cropping systems for the location (matching the soil, climate, water, pest pressures of a particular location with crops best suited for those conditions)*
h. *pest management districts (area agreements)*
i. *pest prevention and surveillance activities*
j. *monitoring pest populations and weather conditions*
k. *taking management actions only when insect, mite, or weed pest populations exceed their economic threshold*
l. *predictive modeling for insects and disease populations*
m. *crop rotation*
n. *soil testing for nematodes and diseases along with crop selection*
o. *germination of weeds prior to planting*
p. *inclusion of perennials*
q. *rotation of crop protection products*

Photo: Pam Marrone, Invasive Species Control Corporation

PHYSICAL

a. *manual weeding*
b. *crop-free periods (staggered planting and harvest)*
c. *buffer zones*
d. *weed flaming*
e. *mulch*
f. *steaming*
g. *traps (manual and automated)*
h. *precision planting and cultivation*
i. *robotic weeders*
j. *technological approaches:*
    - *mechanical weeding*
    - *precision application technologies*

SPM AND PESTICIDES

There will no doubt be times when all other pest management options have been exhausted, and still a significant pest pressure remains, or immediate action is required. In these cases, pesticides may still be employed, so long as the intention is to apply these products in a targeted way, as needed in order to eradicate the pest(s) and continue with a holistic, integrated pest management approach that aims to build overall system health. Pesticides and pesticide-related uses include but are not limited to:

a. *fumigants*
b. *repellents*
c. *use of seeds that have been treated with pesticides*
d. *antibiotics*
e. *herbicides*
f. *fungicides*
g. *insecticides*

APPENDIX 6:
A NOTE ON SCIENCE-BASED, EXPERIENTIAL, AND OTHER WAYS OF KNOWING

The SPM Work Group grappled with many complex questions, including several related to the kinds of knowledge that the field of pest management relies on and where and how this knowledge is generated. The group asked:

- ***How do we generate the information we need?***
- ***Who is generating the information and decides what information is valid in a given situation?***
- ***How is the available information being used, and who decides?***

In reflecting on these important questions, the SPM Work Group acknowledges that there are multiple ways of knowing, including Western science, farmer experience, and Indigenous Traditional Ecological Knowledge sources, that yield important information for the field of pest management. Instead of thinking of these as competing or even separate methodologies, this group considers science and experiential and observational knowledge as important pieces of the puzzle that must inform each other in order to generate the full breadth and depth of knowledge needed to move California towards safer and more SPM

While this sentiment is becoming increasingly understood across the field, there still exists a large gap between the experiential knowledge being generated and it being influential and implemented. It is important to consider how Indigenous and other forms of observational data can meaningfully inform research which then informs decision-making, regulations, policies, and on-farm practices. Additionally, it's important to acknowledge that while research can be a powerful tool used in making decisions, policies,and regulations, these frameworks are ultimately informed by societal values, government structures, and politics

The SPM Work Group recommends that scientists, practitioners, and traditional and experiential knowledge holders work together early and often when conducting pest management research in order to bring the full breadth of experience needed. For example, this means bringing in practitioner knowledge and Indigenous Traditional Ecological Knowledge to the research design process early, rather than after the research has begun or once the results have been gathered

The SPM Work Group would like to see transparency and equity of access in how information is generated, in the information itself, and in the decision-making process for how that information is used. When considering how the information is used, the SPM Work Group recommends that those who are impacted by the decisions be included in the decision-making process. A thorough understanding of impacts should be developed by multistakeholder teams, including scientists, practitioners, and community members

The intention here is to enable a robust and thorough process of knowledge generation and dissemination, and to help balance the influence that entities with substantial access to power and financial resources have on this process. The ultimate goal is to protect and enhance practitioner, public, and environmental well-being

APPENDIX 7:
SPM TRANSITION INITIATIVE - PRELIMINARY PROGRAM DESIGN

The following design elements are intended as a starting point to develop the SPM Transition Initiative recommended on page 49.

A The state should commit to paying the negative difference between a previous three- to five-year average yield and the yield a farmer produces while they are actively transitioning to SPM

B We encourage the state to develop guidelines that account for cases when previous yields were exceptionally low, so as to not create a disincentive for farmers to join this initiative. These guidelines should also account for crop loss due to non-pest-related issues and how these will be factored into this program

C This "transition funding" should be available to all growers in California during the terms of transition, to be determined based on crop type. Design to enable participation by farms of all sizes, commodities, growing practices

D Provide all farmers participating in this initiative with the knowledge needed to implement SPM. This could include free or low-cost SPM-trained technical assistance (from UC, CSU, or other independent technical assistance providers) to all participating growers. In carrying out implementation, the state needs to pay particular attention to removing barriers to participation by small farms and farmers from socially disadvantaged or historically marginalized communities This could include providing language-relevant technical assistance to these farmers during the application process and throughout implementation

E The department should set a percentage reimbursed per parcel proposed for transition. The amount of eligible parcels should be significant enough to drive a large shift towards SPM, while also capping the state-led investment at a reasonable amount

F Encourage synergy with CDFA's Office of Pesticide Consultation and Analysis (OPCA) and Healthy Soils Program, where possible. This may include harmonizing applications and/or giving additional application points to those growers implementing Healthy Soils management practices

G Collaborate with supply chain leaders to identify ways that buyers can help offset risk and support the goals of this initiative. This may include programs that preserve market share for a period of time as growers develop new production strategies based on SPM

H Engage partners at the federal level to gain support infunding and implementation of this initiative

I Bring banking and insurance leaders to the table

J Engage PCAs to be champions of this initiative and explore ways to incentivize their participation

K An outcome of this initiative will be a diversity of grower demonstration plots showing the viability of SPM practices

L One of the key performance indicators of the program should be long-term implementation of SPM, so as to track the overall goal of transitioning parcels to being managed with SPM practices

M Funding for this program should not inadvertently burden farmers

APPENDIX 8:
CERTIFICATIONS AND PROGRAMS ALIGNED WITH SPM

In the chart below is an initial list of international, federal, national, and California-based programs and certifications that address, to varying degrees, the following SPM criteria:

A pesticide reduction
B soil health
C risk reduction: workers
D risk reduction: community
E risk reduction: environment
F risk reduction: water
G risk reduction: pollinators

The list of criteria and programs is not comprehensive; it is meant only as a starting point for consideration in the development of SPM purchasing criteria, as recommended in the "Activate Markets to Drive SPM" section.

EXISTING CERTIFICATIONS & PROGRAMS	LINK	SEAL OR LABEL CLAIM
Government Programs		
CDFA Healthy Soils	https://www.cdfa.ca.gov/oefi/healthysoils/	none
California Department of Pesticide Regulation	DPR Programs (ca.gov)	none noted
USDA Climate Smart Agriculture	https://www.usda.gov/climate-solutions/climate-smart-commodities	none noted
USDA National Organic Program - Organic Certification	https://www.ams.usda.gov/about-ams/programs-offices/national-organic-program	USDA Organic Seal
USDA NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/initiatives/	none noted
USDA NRCS - Indigenous Stewardship & NRCS Conservation Practices Guidebook	https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/plantmaterials/technical/publications/?cid=stelprdb1045246	none noted
Market-based programs		
Pollinator Partnership	https://www.pollinator.org/bff/bff-us	Bee Friendly Farming seal
Certified Pesticide Free - Clean Label Project	https://cleanlabelproject.org/clean-label-project-certification/	online list of products meeting the requirements
Demeter	https://demeter.net/certification/standard/	Demeter seal
Green Shield Certified - IPM North America	https://greenshieldcertified.org/	none noted
EFI - Equitable Food Initiative	https://equitablefood.org/	EFI Seal
Fair Trade	https://www.fairtradecertified.org/	FairTrade Seal

EXISTING CERTIFICATIONS & PROGRAMS	LINK	SEAL OR LABEL CLAIM
Global GAP	https://www.globalgap.org/uk_en/for-producers/	Global GAP Logo - not widely used
Global GAP - BioDiversity Add-on	https://www.globalgap.org/uk_en/for-producers/globalg.a.p.-add-on/biodiversity/	Global GAP Logo - not widely used
Green Pro	https://www.npmaqualitypro.org/available-credentials/greenpro/	The service provider can be certified
Eco-wise	https://www.ecowisecertified.com/ecowise_cert_guide.html	The service provider can be certified
IPM Institute of North America	https://ipminstitute.org/	none noted
Rainforest Alliance	https://www.rainforest-alliance.org/for-business/2020-certification-program/	Rainforest Alliance Seal
ROC - Regenerative Organic Certification	https://regenorganic.org/	ROC Seal
Sustainably Grown - SCS Global Services	https://www.scsglobalservices.com/services/sustainably-grown-certification	Sustainably Grown Seal
Xerces Society for Invertebrate Conservation - Bee Better Certified	https://beebettercertified.org/	Bee Better seal

APPENDIX 9:
PROPOSED SPM PRIORITIZATION PROCESS

This graphic shows the proposed prioritization process outlined on pages 31 and 32.

KEY

- State Staff
- Data
- Public Process

APPENDIX 10:
CRITERIA LISTS

The following lists were developed by the SPM Work Group and Urban Subgroup as a way to clearly articulate the diversity of needs and interests represented in the groups. These criteria acted as guiding principles for the groups as they developed the Roadmap's goals and recommendations, and served as a tracking mechanism for ensuring that everyone's interests were addressed. All members committed to developing a Roadmap that integrated everyone's interests, so while the relative importance of each item differs from member to member, each member agreed to steward their group's entire list

SUMMARY OF CRITERIA LIST DEVELOPED BY THE SPM WORK GROUP

SYSTEMS APPROACH (ECOSYSTEM LEVEL)

1 Create diverse, healthy, economically productive systems that prioritize prevention of pests (e g , insects, noxious plants, plant diseases) and support ecosystem health and resilience

- *This may include understanding the ecology of the ecosystem to manage surrounding habitat, prioritizing cropping systems and natural enemies.*

SYSTEMS APPROACH TO PEST MANAGEMENT

1 Conduct pest management following a systems approach

- *This may include efforts to exclude (eliminate invasion pathways), detect, survey for disease, identify disease pathogens, develop response (eradication, control, etc.) and incorporate integrating/ stacking methods and technologies.*
- *Provide for a variety of tools and techniques to effectively manage pests while still being economical, practical, and accessible to the diversity of California producers.*
- *Make sure all decisions are based on science and/or empirical knowledge, supported by comprehensive, informed and transparent decision-making.*
- *Prioritize the potential of natural systems and traditional ecological knowledge.*

PUBLIC AND ENVIRONMENTAL HEALTH

1 Protect public health and the environment with specific attention to sensitive populations and habitats

- *Populations to be considered include, but are not limited to, farmworkers, farmers, pesticide applicators, and vulnerable, underserved, disadvantaged, or otherwise impacted communities.*

2 Where possible, encourage and pursue multi-benefit pest management solutions

RESOURCES

1 Support the capacity-building and deployment of resources to all stakeholders to develop and implement SPM skills

- *These efforts may include education (at all levels), incentives, demonstrations, adaptive research, and innovation focusing on that which supports ecological pest management (agroecology and ecological management of crop, soil, and habitat).*

STATE AND LOCAL ACTION

1 Ensure transparency in the regulatory process and seek continual improvement to further SPM

2 Strengthen and enhance the state's robust pest detection, prevention, and exclusion programs that meet SPM standards, including those that are alternatives-based

- *Alternatives-based could be mating disruption, biocontrol, weed management.*

FULL LIST OF CRITERIA DEVELOPED BY THE SPM WORK GROUP

We want the future of pest management in California to...

SYSTEMIC APPROACH[80]

- *be holistic.*
- *be ecology- based, focusing on plant and animal health.*
- *be bio-intensive.*
- *be practical.*
- *be systems-based.*
- *create an environment where a systems approach, such as integrated pest management (IPM), can be effectively implemented.*
- *realize the ecological health and economic potential of natural systems.*

FARMS

- *attend to farms of all sizes.*
- *attend to farms of all commodities.*
- *be viable to the full spectrum of growing practices.*
- *provide the tools to ensure food and fiber production that meets consumer needs.*
- *support growers to make informed decisions that further the principles of SPM.*

PEOPLE (FARM OWNERS, FARMWORKERS, IMPACTED COMMUNITIES, AND PUBLIC HEALTH)

- *attend to all farmers and ranchers in California, without exclusion due to cultural, ethnic, racial, or economic differences.*
- *consider the livelihood of farmers and ranchers, farmworkers, and community members.*
- *be economically viable for growers, farmworkers, communities, and consumers.*
- *minimize negative health impacts on all people.*
- *ensure the safety and well-being of farmers, farmworkers, pesticide applicators, and low-income, vulnerable, disadvantaged, or otherwise impacted communities.*
- *address the risk and vulnerability of Indigenous and other communities whose way of life and cultural practices depend on extensive use of natural resources.*

ENVIRONMENT (ENVIRONMENTAL HEALTH AND CLIMATE CHANGE)

- *actively consider and minimize impacts on all wildlife populations and ecosystems, including but not limited to pollinator populations, aquatic life, soil health, and others.*
- *support and encourage biodiversity.*
- *work to improve the health of natural resources, including but not limited to soil nutrients, water quality, and air quality.*
- *have appropriate mitigation strategies in place to avoid harm to natural resources.*
- *actively work to minimize climate change and its implications for pest management.*

80 The categories below are ONLY to help us see themes and find redundancy. There is no other hierarchy or implied meaning in the categories here.

SCIENCE, RESEARCH, AND INNOVATION

- *be guided by science that is evidence-based, peer-reviewed, and characterized by qualities like high standards, high quality, and "soundness."*
- *promote publicly funded research and research capacity.*
- *be supported by robust public and privately funded research and education programs.*
- *embrace the most efficacious and safe technologies, new and old, that will appropriately increase effectiveness of pest management.*
- *encourage an environment that supports innovation for pest management.*
- *be characterized by a separation of advice from commission payment.*
- *be characterized by disclosure and transparency in the process of giving recommendations for use of materials.*

IMPLEMENTATION AND REGULATIONS

- *provide sufficient funding and access for adequate implementation of SPM options.*
- *be characterized by clear communication.*
- *be characterized by regulatory clarity.*
- *encourage effective enforcement.*
- *apply an alternatives analysis perspective in regulatory activities.*

CONSIDERING IMPACTS

- *actively consider and work to avoid unintended negative impacts of potential solutions, in the short and long term.*
- *support pest management choices that are based on a thorough understanding of different impacts and support informed choice about which risks and costs to incur.*
- *assist various audiences in interpreting and understanding risks and benefits related to pest management activities.*
- *include overall public health, environmental, and economic impacts in how we measure effective pest management.*

EDUCATION AND OUTREACH

- *facilitate farmer-to-farmer sharing of information and best practices.*
- *support farmer collaboration to reduce pest pressure on a regional basis.*
- *support farm owners, farmworkers, and impacted communities in communicating effectively amongst each other about pest management strategies and their impacts*
- *build community among growers, farmworkers, community members, government and others.*
- *support outreach efforts from SPM researchers to farmers, pesticide applicators, and communities, and vice versa.*

PEST MANAGEMENT

- *achieve pesticide risk reduction.*
- *effectively manage pests.*
- *prevent pest problems before they happen.*
- *actively identify pest pathways and look for ways to exclude pests from entering California.*
- *maximize reliance on effective, low-toxicity approaches to pest management.*
- *support greater understanding and adoption of biological control.*
- *include the understanding of and increase access to Black, Indigenous, and other historically excluded methodologies of agriculture and pest management.*

NON-AG PEST MANAGEMENT

- *address the special pest management needs of habitat management.*
- *address the special needs of urban pest management activities.*

FULL LIST OF CRITERIA DEVELOPED BY THE URBAN SUBGROUP

The categories below are only to help us see themes and find redundancy. There is no other hierarchy or implied meaning in the categories below

We want the future of pest management in California to...

SYSTEMIC APPROACH

- *be holistic.*
- *be ecology-based, focusing on people, plant and animal health.*
- *be bio-intensive.*
- *be practical.*
- *be systems-based.*
- *create an environment where a systems approach, such as integrated pest management (IPM), can be effectively implemented.*
- *realize the ecological health and economic potential of natural systems.*
- *support effective options that don't rely on specialized knowledge.*

URBAN AND NON-PRODUCTION AG SETTINGS

- *attend to urban settings of various geographic and population sizes.*
- *attend to an array of socioeconomic and ethnocultural groups in urban settings.*
- *encourage and support pesticide applicators and dwellers in urban structural settings to practice environmental-friendly pest management or IPM.*
- *address the special needs of urban and non-ag pest management activities, including those pertaining to:*
  - *households,*
  - *pets,*
  - *professions (e.g., veterinarians, swimming pool maintenance),*
  - *institutions (e.g., hospitals),*
  - *industries (e.g., hospitality, veterinary, manufacturing),*
  - *home gardens,*
  - *nurseries,*
  - *urban landscapes,*
  - *retailers,*
  - *impregnated products,*
  - *golf courses,*
  - *natural habitats,*
  - *schools and childcare centers,*
  - *rights of-way,*
  - *government agencies, and*
  - *other non-production ag locales.*

PEOPLE (URBAN DWELLERS, IMPACTED COMMUNITIES, AND PUBLIC HEALTH)

- *be economically viable for pesticide applicators and consumers in urban settings.*
- *minimize negative health impacts on all people.*
- *address the risk and vulnerability of urban dwellers experiencing health care inequalities in low and very low-income communities.*
- *be informed by the concerns and interests of those who are most affected by the impacts of pest management choices.*

THE ENVIRONMENT (ENVIRONMENTAL HEALTH AND CLIMATE CHANGE)

- *actively consider and minimize impacts on all wildlife populations and ecosystems, including but not limited to pollinator populations, aquatic life, soil health, and endangered species.*
- *support and encourage biodiversity.*
- *work to improve the health of natural resources, including but not limited to soil nutrients, water quality, and air quality.*
- *have appropriate mitigation strategies in place to avoid harm to natural resources.*
- *protect future water supplies.*
- *actively work to minimize climate change and its implications for pest management.*
- *incorporate proactive climate change adaptation measures.*

SCIENCE, RESEARCH, AND INNOVATION

- *be guided by science that is evidence-based, peer-reviewed and characterized by qualities like high standards, high quality, and "soundness."*
- *promote publicly funded research and research capacity.*
- *be supported by robust public and privately funded research and education programs.*
- *embrace the most efficacious and safe technologies, new and old, that will appropriately increase effectiveness of integrated pest management.*
- *encourage an environment that supports innovation for pest management.*
- *be characterized by a separation of advice from commission payment.*
- *be characterized by disclosure and transparency in the process of a licensed professional suggesting or prescribing the use of products.*

IMPLEMENTATION AND REGULATIONS

- *provide sufficient funding and access for adequate implementation of SPM options.*
- *be characterized by clear communication.*
- *be characterized by regulatory clarity.*
- *encourage effective enforcement.*
- *apply an alternatives analysis perspective in regulatory activities.*

CONSIDERING IMPACTS

- *actively consider and work to avoid unintended negative impacts of potential solutions, in the short and long term.*
- *support pest management choices that are based on a thorough understanding of different impacts and support informed choice about which risks and costs to incur.*
- *assist various audiences in interpreting and understanding risks and benefits related to pest management activities.*
- *include overall public health, environmental, and economic impacts in how we measure effective pest management.*

EDUCATION AND OUTREACH

- *facilitate peer-to-peer sharing of pest management information and best practices among those with cultural, economic and language commonalities.*
- *support collaboration amongst pest control applicators in order to share effective IPM practices and to reduce overuse and ineffective use of pesticides.*
- *support the education of those needing to make pest management decisions, including:*
  - *licensed pesticide applicators,*
  - *property managers,*
  - *pet owners,*
  - *urban and rural dwellers,*
  - *members of government agencies,*
  - *political officials,*
  - *veterinarians and other medical professionals, and*
  - *others who do incidental pest control, such as institutional and industry staff.*

PEST MANAGEMENT

- *achieve pesticide risk reduction.*
- *effectively manage pests.*
- *support the prevention of pest problems before they happen (e.g., building codes, landscaping practices).*
- *actively identify pest pathways and look for ways to exclude pests from entering California.*
- *maximize reliance on effective, low-toxicity approaches to pest management.*
- *support greater understanding and adoption of biological control.*
- *include the understanding of and increase access to Black, Indigenous and other historically excluded methodologies of growing food and pest management.*

APPENDIX 11:
METHODOLOGY

To develop this Roadmap, the SPM Work Group and Urban Subgroup underwent an in-depth, multistakeholder collaborative process, which took place over the course of 20 months, from April 2021 through December 2022 Throughout this time, the groups were committed to developing a plan and strategy that would advance pest management in California in ways that meet the wide range of needs at the table. Making improvements to a field as complex and far-reaching as pest management is in and of itself an ambitious goal, but doing so in a way that considers all interests and leaves no one behind is an extraordinary undertaking. And yet, it is also essential because no one person or one stakeholder group holds the solutions to the challenges we collectively face A high-level overview of the process approach is outlined below [81]

PRE-LAUNCH: HEARING FROM THE FIELD

The first step of the Roadmap development process was to hear from a diverse set of stakeholders about their perspectives on key challenges and opportunities in the field of pest management. The facilitation team interviewed 50 leaders from a wide array of organizations, interest groups, agencies, farms, and communities The primary objectives were to understand the landscape of issues and to identify the groups and potential members for the SPM Work Group and the Urban Subgroup. A summary of the challenges, opportunities, and potential solution areas was then presented to the group as a launch point for their work. The representatives from the groups that were ultimately convened represented a wide spectrum of stakeholders who are invested in and impacted by pest management in California

PHASE 1: CRITERIA GATHERING

An important design principle of this project was “working on behalf of the whole ” From the very beginning, the members of both groups were asked to advocate not only for their own perspectives and the stakeholders they represent, but also to work to find creative solutions that integrate everyone’s needs and interests. In order to understand these needs and enable us to track our progress towards our goal, both groups created a list of interests that the group collectively agreed would need to be addressed in order for the Roadmap to truly work for everyone [82]

The SPM Work Group spent their first three meetings listening to each other’s perspectives and understanding the landscape of diverse concerns and interests represented in the group. Together, they reflected on what the future of pest management would look like if it were to attend to all these interests and needs. Each item on the SPM Work Group’s criteria list is important to at least one member of the group. Each of the criteria vary in importance to the various members, but all agreed to develop a Roadmap that tends to all of the interests listed

The Urban Subgroup, initiated six months after the SPM Work Group, used the SPM Work Group’s list as a starting point and built on it to address the needs and interests of urban pest management and the unique uses and users in this context

81 The two primary frameworks used to support the work of the groups were convergent facilitation and systems practice.

82 See Appendix 10, Criteria Lists.

PHASE 2: SYSTEMS ASSESSMENT AND STRATEGY DEVELOPMENT

Another design principle that guided this project was “thinking like a system ” Once the two groups clearly identified and aligned on their criteria lists, the next task was to develop a shared understanding of the system of pest management in California. The SPM Work Group engaged in a robust system assessment that began by articulating what a healthy system would look like, and then explored the interconnected dynamics that were most powerful in shaping the behavior of the system. The group identified feedback loops that contribute to keeping problems in place, and those which are moving it toward a greater state of health. The causal loop diagram developed in this process is pictured on page 94 [83] The group then identified key leverage points in the system–places where sustained and focused effort could lead to outsize effect in moving the system toward a greater state of health

For the SPM Work Group, this initial set of leverage points included:

1 enhancing knowledge, outreach, and technical assistance funding and infrastructure;

2 activating markets and supply chains;

3 supporting growers’ capacity to take risks inherent in transitioning to SPM; and

4 addressing regulatory and permitting challenges, and the need to update California’s pest prevention and exclusion systems

The Urban Subgroup underwent a more modest systems assessment that identified and ranked key forces shaping the behavior of the system in the urban context, a process that then led to the identification of the following leverage points:

1 strengthening and expanding systems to provide the data and science needed for sound regulatory decisions, product design, and effective pest management;

2 supporting and empowering key influencers and magnifiers to build adequate and effective SPM communication and implementation; and

3 better aligning regulatory frameworks with sustainable pest management

In discussions following the systems assessments, these leverage points evolved to form the main structure of the Roadmap, along with two additional themes that were identified as being essential to both groups:

1 improving California’s pesticide registration and continuous evaluation process; and

2 strengthening coordination within California’s leadership

For each of these leverage points the groups developed goals, priority actions, additional actions, and design guidance. While both the SPM Work Group and Urban Subgroup offered input into the other group's recommendations, it is important to note that the agricultural and urban recommendations are the work product of each group separately. The groups worked collaboratively to develop goals and recommendations for the overarching areas. While there are differing opinions about the priorities of these goals and recommendations, the members all agreed that the ideas put forth in this Roadmap will greatly support California’s progress towards safer and more sustainable pest management

83 The causal loop diagram developed in this process is available to view online as an interactive map, at https://embed.kumu.io/d91e0eeb4544f51b757c8083c0854c07

Photos: Jenny Broome, Driscoll's, Inc. Global Plant Health Department Manager

SPM WORK GROUP LEARNING JOURNEYS

As a way to support the group's learning, the SPM Work Group went into the field to visit farmers and farm workers, and brought in several panels of practitioners and experts to share their first-hand experience and understanding of the challenges and opportunities. The first "learning journey" took the group to the Salinas Valley, where the group visited:

- **Driscoll's Strawberry Test Plot:** We heard from Miles Reiter, CEO; Henry Gonzales, Monterey County agricultral commissioner; Jenny Broome, global plant health manager, senior scientist; Phil Stewart, global plant breeding director; and Joji Muramoto, UCSC Cooperative Extension specialist
- **The home of agricultural workers and community members:** We heard from and shared lunch with Olga Montes, agricultural worker and CHAMACOS Study[84] participant; Rosa Lopez, community member and CHAMACOS Study participant; Maria Ines Catalan, Catalan Family Farms and graduate of the Rural Development Center in Salinas.
- **Pinnacle Organic:** The group went on a walking tour and heard from Phil Foster, owner/farmer; and Margaret Lloyd, farm advisor.

84 To learn about the CHAMACOS Study, visit https://cerch.berkeley.edu/research-programs/chamacos-study

The second learning journey was designed to bring insights to the group focused on the four leverage point areas identified in the systems assessment process. These panel discussions took place over two days on Zoom and included the following topics and guests:

- **Research Discussion: Understanding Influences Shaping Pest Management Research**
  - *Dr. Akif Eskalen, Department of Plant Pathology, UC Davis*
  - *Dr. Jim Adaskaveg, Department of Microbiology and Plant Pathology, UC Riverside*
  - *Dr. Miguel Altieri, Department of Environmental Science, Policy, and Management (Entomology and Agroecology), UC Berkeley (retired)*
- **Outreach Discussion: Scanning the Landscape of Knowledge Communication to Growers**
  - *David Haviland, farm advisor, UC Cooperative Extension Kern County*
  - *Dr. Steven Fennimore, professor of extension, UC Davis Plant Sciences*
  - *Chris Storm, PCA/viticulturist, Starr and Storm Crop Solutions*
  - *Charlie Hamilton, pest control advisor, Grow West*
- **Grower Panel: Understanding Influences Shaping Agricultural Pest Management Decisions**
  - *Bruce Rominger, Rominger Brothers Farm*
  - *Derek Azevedo, Bowles Family Farm*
  - *Helen McGrath, Flying M Ranch*
  - *Javier Zamora, JSM Organics*
  - *Paul Wenger, Wenger Ranch*
- **Farm Risk Management: The Role of Banking and Insurance**
  - *Roland Fumasi, Rabobank*
  - *Ryan Mortenson, USDA Risk Management Agency*
- **Human Health and Ecological Impacts of Pest Management**
  - *Kim Harley, UC Berkeley*
  - *Nan Singhasemanon, California Department of Pesticide Regulation*
  - *Susan Kegley, Pesticide Research Institute*
- **Supply Chain: What Role Do Buyers Have in Shifting the Paradigm of Pest Management?**
  - *John McKeon, Taylor Farms*
  - *Paula Daniels, Center for Good Food Purchasing*
  - *Scott Dray, Walmart*

PHASE 3: STAKEHOLDER INPUT

The SPM Work Group and Urban Subgroup drafted a Roadmap advancing their best collective thinking Members shared this draft Roadmap and collected input from their constituencies [85] This phase was meant to help the groups "ground truth" the Roadmap, and to understand what perspectives might still be missing, hear ideas that may not have surfaced yet, and harness the creativity and insight of stakeholders that may not otherwise be represented

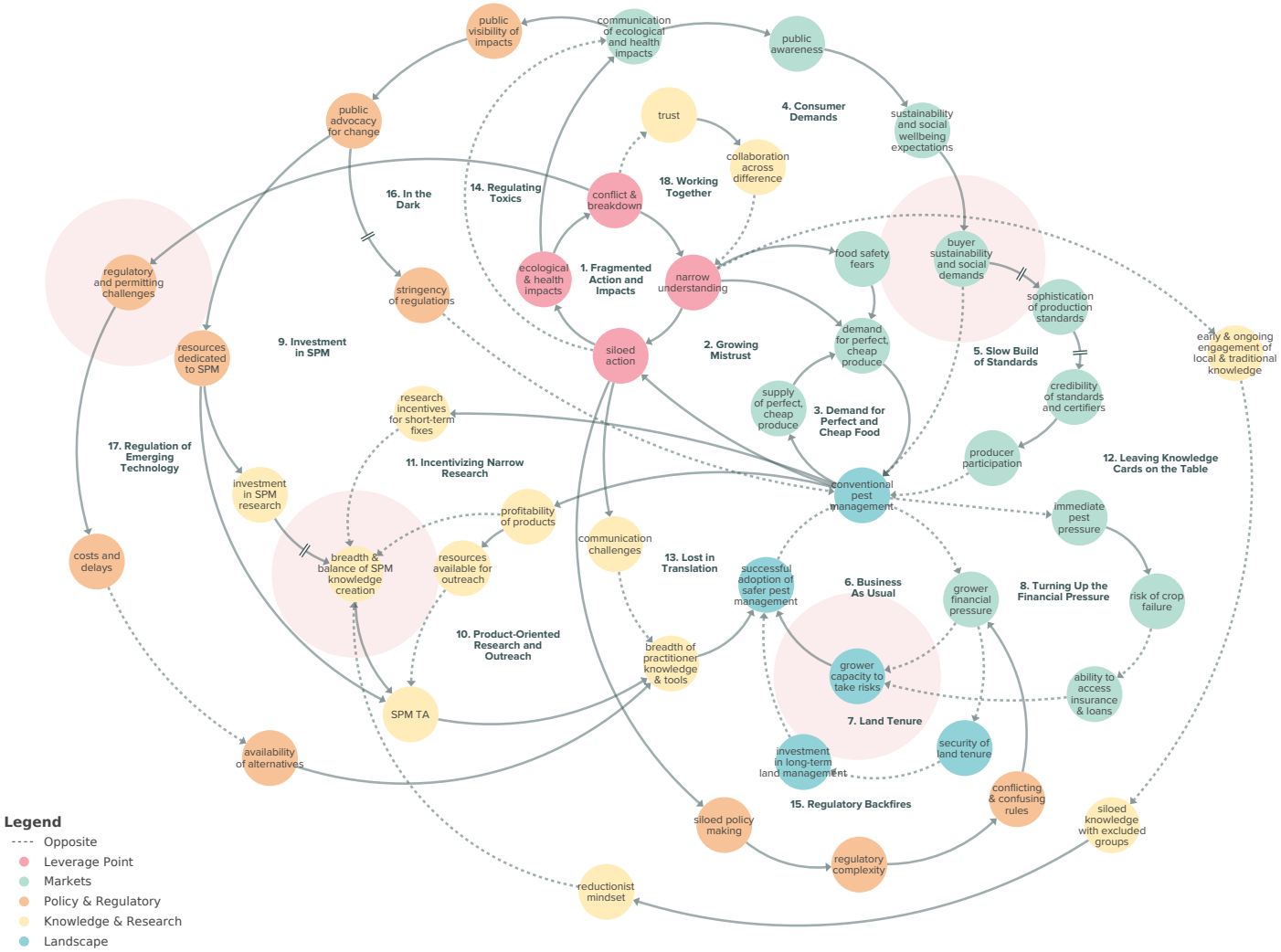
85 A summary of the submitted feedback on the draft can be reviewed online at https://docs.google.com/document/d/1IgdaS7nGDXwWi49EYchxZe1ZPTiGZVXb

PHASE 4: FINAL DECISION-MAKING

Once the SPM Work Group and Urban Subgroup had a chance to consider stakeholder input, the groups worked through outstanding issues and fine-tuned the Roadmap so that it addressed the wide array of interests and perspectives represented in the group, as well as those identified in the stakeholder input phase. The Roadmap reflects the group's alignment on the North Star and their best thinking on the goals and strategic interventions that will help us collectively move towards safer, more sustainable pest management

Throughout the process, members were asked to consider and attend to the full range of needs and interests represented in the groups, and to work together to find creative and bold solutions that could work for all members. This threshold meant that members were asked to stretch beyond their "preference" and work towards "willingness " In some cases, this means that there is content in the Roadmap that is not what one or more members would prioritize themselves. However, knowing that content was essential to one or more of their colleagues and the interests they hold, and that as a whole the goals and recommendations meet the guiding criteria established at the outset of the project, they were willing to include it

The end result is a strategic roadmap that holds all the interests represented in this process and which has the potential to advance safer, more sustainable pest management in California



BEYOND THE ROADMAP

The group process outlined above produced additional outcomes. Over the course of the project, through mini-trainings and coaching, these leaders also gained skills in collaborative leadership and strategy for understanding and transforming complex systems Through the process, trust and relationships were built across significant differences, and this web of relationships in the field will help carry the spirit of the Roadmap forward for years to come. Finally, it is our hope that the leaders at the table gained significant perspective on the systems in which they operate to inform their own strategies to align with future sustainable pest management

Photo: Ron Whitehurst