

Critical Issues in Consumer Horticulture: Gaps in Research and Public Gardens' Involvement in Consumer Horticulture

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SUMMARY. The retail gardening industry in the United States is expected to reach \$50 billion by 2023, and it is a significant driver of the agricultural economy. To meet the corresponding demand for information, consumer horticulture (CH) professionals will need to develop innovative digital outreach, research-based solutions, a concerted recruitment of youth, and enhanced collaborations. To understand the current gaps in CH research and the extent of the involvement of public gardens in CH, surveys were conducted among the two groups, CH/extension researchers and staff of public gardens. The results of the surveys were presented at the virtual conference of the American Society for Horticultural Science on 12 Aug. 2020 during a workshop hosted by the Consumer Horticulture and Master Gardener Professional Interest Group. The workshop included four presentations, and two of those are discussed in this paper: 1) research gaps in CH and 2) bridging the divide between CH and public gardens. Among researchers, even though there was a general understanding of CH, there was a disconnect in participants' perceptions of the roles of CH in the economy and recreation. The greatest knowledge gap was in basic horticultural practices. Regarding public garden professionals, there needs to be a concerted effort to educate them about CH so they can provide a consistent message to their audiences and the general public.

The National Initiative for Consumer Horticulture (NICH), a consortium of CH leaders from academia, industry, public gardens, governments, and nonprofits (Dorn et al., 2018), defines CH as “the cultivation, use, and enjoyment of plants, gardens, landscapes, and related horticultural items to the benefit of individuals,

communities, and the environment” (NICH, 2020). The definition provides further explanation regarding gardens, landscapes, and horticultural-related items and the importance of these activities regarding the understanding and application of the art and science of horticulture.

CH is a broad discipline that serves stakeholders from all sectors of the U.S. population, including diverse age groups (children, adults, and senior citizens), all sexes and ethnicities, every region of the country, and all income and education levels (Bauske et al., 2015). Relevant CH industries include manufacturers and distributors of input supplies; production businesses, such as nursery, greenhouse, and sod growers; wholesale distribution businesses, including importers, brokers, re-wholesalers, and transporters; horticultural service businesses providing landscape and urban forestry services, such as design, installation, and maintenance; and retail operations, including independent garden centers, florists, home improvement centers, and mass merchandisers or other chain stores (Hall and Dickson, 2011).

Consumers partake in a variety of educational services. They read books, subscribe to gardening magazines, study catalogs, take educational courses, talk with agriculture extension agents, and consult with other gardeners through Extension Master Gardener (EMG) organizations or garden clubs (Hamilton and DeMarrais, 2001). To reach the millennial generation [born between 1980 and 2000 (Smith and Nichols, 2015)] and younger audiences, it is recommended that CH researchers and extension personnel use social media platforms with the goal of mitigating generational gaps and reaching a wider audience (McGinnis et al., 2020).

Public gardens have an integral role in CH education, research, entertainment, and recreation. Public gardens across the United States have an aggregated visitation of 121 million visitors annually, which is more than Walt Disney World (Orlando, FL), Disneyland (Anaheim, CA), and Las Vegas, NV, combined (Benfield, 2013). Public gardens serve as a means for consumers to socially interact with others, enhance their personal well-being, strengthen their gardening background, and extend their gardening knowledge and skill (Hamilton and DeMarrais, 2001; Krishnan and Novy, 2016). Gardens are cited as one of the most successful methods for engaging youth in horticulture and, therefore, the development of future consumers (Meyer et al., 2016).

Despite benefitting large segments of society, few federal and state grants fund horticultural research that is intentionally helpful to consumers and end-users (Bauske et al., 2015). To remedy this inequity, the CH and Master Gardener Professional Interest Group (CHMG) met at the 2014 American Society of Horticultural Science annual conference in Orlando, FL, and called for the development of a national strategic plan to create a vision for CH research, education, and extension (Bauske et al., 2015). As a result, the NICH was created to champion the discipline's economic, environmental, health, and community impacts (Bradley et al., 2016). The goal of this consortium is “to unite national research efforts with the goals of the diverse stakeholders in the industry, the public sector, and the gardening public to advance knowledge and increase the benefits and application of horticulture

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for an improved quality of life.” Public gardens have been identified as an important stakeholder and potential collaborator in this initiative; however, few have actively participated in the NICH.

Modeled on the successful Specialty Crop Research Initiative, a grants award program by the U.S. Department of Agriculture (USDA), National Institute of Food and Agriculture to support the critical needs of the specialty crop industry, the NICH consortium is galvanizing the support of a diverse group of stakeholders to advocate CH research funding (Bradley et al., 2016). The NICH effort is unique because it would directly benefit end-users such as home, school, and community gardeners instead of just horticultural crop producers and distributors (Bradley et al., 2017). Although gardeners collectively wield immense buying power (National Gardening Survey, 2018), the consumer group is diverse and unorganized. Therefore, the NICH consortium exists to advocate change (NICH, 2020).

As part of its needs assessment, NICH subcommittees and stakeholders are in the process of identifying substantial research gaps that are worthy of funding and study (Dorn et al., 2018). The Community and Health Benefits Committee, one of eight committees and councils of NICH, found the need for research regarding the nutritional, social, psychological, and physical health impacts of home gardening on individuals and the greater community. This committee conducted a gap analysis of scientific articles from the years 2007 through 2017 that included reviewing 162 articles. At the 2018 ASHS annual conference, the CHMG also identified the need for consumer-focused research in the areas of vegetable crop breeding, human nutrition and flavor preferences, and human interactions with nature vs. cultivated plants (Bumgarner et al., 2019). Hall and Knuth (2019a, 2019b, 2019c) recently published a series of exhaustive literature reviews summarizing the state of research regarding the psychological, physiological, and social benefits of plants. Although questions to be researched were not specifically identified, these detailed literature reviews can lead scientists to detect gaps.

To aid in this process of identifying fruitful areas of CH research, the CHMG of the ASHS conducted a survey of CH practitioners that

included industry, academia, extension personnel, EMG coordinators, green industry professionals, and non-profit representatives and asked for their assistance identifying both specific issues and broader areas in need of research. In addition, a second survey was deployed specifically targeting the public garden sector to determine the role that public gardens should hold within the CH industry and to bridge the perceived divide between CH and the public garden industry.

The results of the surveys were presented at the virtual conference of the ASHS on 12 Aug. 2020, at a workshop hosted by the CHMG. The workshop included four presentations; of these, two are discussed here: 1) research gaps in CH and 2) bridging the divide between CH and public gardens. Including the presenters, a total of 45 people attended the virtual workshop.

Materials and methods

To understand the current gaps in CH research and the extent of the involvement of public gardens in CH, surveys were conducted among the two groups, CH/extension researchers and staff of public gardens. These surveys were qualitative in nature and focused on a needs-based assessment of participants for future research and guiding informed funding and research requests. Public gardens are not only a missing entity in the CH industry but also a vital component in engaging the public and partnering to conduct research. Therefore, qualitative survey questions were developed to provide a greater understanding of the barriers to participation by this sector and to expand partnership development to advance CH. Because this was a qualitative study, statistical analyses were not performed.

SURVEY 1: RESEARCH GAPS IN CH. A survey entitled research gaps in CH was developed and containing 12 questions to qualitatively understand where research gaps and needs among CH/extension researchers exist. The Institutional Review Board determination of exempt human subjects research was applied for and approved through North Dakota State University (AG20-279). The survey was created using an online survey platform (Qualtrics XM; Qualtrics, Provo, UT) and distributed using the NICH e-mail listserv and the EMG coordinator listserv. The NICH

listserv included 1427 contacts, of which 243 self-identified as educator/teaching/extension, 8 self-identified as health care/social science professionals, 132 self-identified as industry, 35 self-identified as public horticulture, 15 self-identified as strictly research, and 103 self-identified as other. Remaining contacts did not indicate their affiliation with CH. The EMG coordinator listserv, which includes state-level and county-level members, consisted of 335 contacts. The survey was distributed through online communications in early June 2020. The survey questions are listed in Table 1.

SURVEY 2: BRIDGING THE DIVIDE BETWEEN CH AND PUBLIC GARDENS. A survey was developed with 12 questions directed toward the staff of botanic gardens to qualitatively evaluate their understanding of CH, whether they considered the work they perform would qualify as CH, and the barriers to direct engagement in the CH community. The Institutional Review Board determination of exempt human subjects research was applied for and approved through North Dakota State University (AG20278). The online survey was distributed to members of key communities of the American Public Gardens Association (APGA) through internal e-mail and discussion forums in early June 2020. The communities to which the survey was distributed were garden management, public engagement, horticulture, plant collections, food and agriculture, and native plants. Collectively, across all communications, 810 unique members of the APGA were reached. The survey questions are listed in Table 3.

Results

Survey 1: Research gaps in CH

A total of 301 participants completed the survey (Table 1). Some participants were selective in their responses and did not complete all the questions; hence, the responses for each question did not total 301. In addition, there were several questions for which the participants could select multiple responses; therefore, more than 301 responses were possible. The number of responses received for each selection option within each question is provided in Table 1.

QUESTION 1: WHAT DOES CH MEAN TO YOU? Participants could select multiple responses for this question.

Table 1. Results of a survey questionnaire disseminated to the consumer horticulture (CH) industry at large to identify research gaps in CH. The total number of survey responses for each selection is indicated.

Question no.	Survey question	Total responses to each selection (no.)
1	What does CH mean to you? Check all that apply.	
	A. Home vegetable and fruit production	208
	B. Cultivation, use, and enjoyment of plants	204
	C. Plant and people connections	191
	D. Landscaping	177
	E. Retail garden center	171
	F. Indoor plants	158
	G. Environmental sustainability	137
	H. Local food systems and human health	131
	I. All of these answers	126
	J. Green industry	119
	K. Recreation (playing fields, parks, public gardens, sports, golf)	93
	L. Economy	85
2	What is your role or horticultural affiliation? Please check all that apply.	
	A. Extension service personnel	167
	B. Master Gardener coordinator	106
	C. Green industry (other)	72
	D. Academia	54
	E. Research	46
	F. Public gardens	30
	G. Wholesale grower	25
	H. Floriculture	21
	I. Retail center	20
	J. Green industry supplier	17
	K. Landscape architecture	13
	L. Turf industry	7
3	What knowledge gaps do you see in CH commodities? Please rank using a scale of 1 to 5 as a perceived gap, with 1 being the smallest gap and 5 being the largest gap.	
	A. Basic horticultural practices (planting, pruning, soil, preparation, etc.)	261
	B. Trees and shrubs (woody)	259
	C. Fruits and vegetables	253
	D. Houseplants/tropicals	249
	E. Herbaceous ornamentals	248
	F. Turf	247
	4	What knowledge gaps do you see in CH issues? Please rank using a scale of 1 to 5 as a perceived gap, with 1 being the smallest gap and 5 being the largest gap.
A. Ecosystem services/environmental benefits		256
B. Pests: weeds/insects/disease		254
C. Chemicals and organics		254
D. Natives, conservation, wildlife habitat, and invasive species		254
E. Water management (quantity and quality)		251
F. Substrates and fertility		251
G. Horticulture therapy and well-being		249
H. Landscape design and urban horticulture/sustainability		248
I. Nutritional value and health benefits of plants		239
J. Economics, marketing, and technology		232
K. Plant blindness		226

(Continued on next page)

The categories with the highest number of responses were home vegetable and fruit production with 208 responses (11.56%), followed by cultivation, use, and enjoyment of plants with 204 (11.33%), plant and people connections with 191 (10.61%) responses; 177 participants (9.83%) selected landscaping as the number 4 response (Table 1). The economic category received the least number of responses [85 (4.7%) respondents], followed by recreation (playing fields, parks, public gardens, sports, golf) [93 (5.17%)], thereby showing a disconnect in participants' perceptions of the role of CH in economy and recreation.

QUESTION 2: WHAT IS YOUR ROLE OR HORTICULTURAL AFFILIATION? Most participants were extension service personnel, which included county extension agents and state-wide extension specialists (167), followed by coordinators (106), green industry personnel (72), academia personnel (54), research personnel (46), public gardens personnel (30), wholesale growers (25), floriculture personnel (21), retail center personnel (20), green industry suppliers (17), landscape architecture personnel (13), and turf industry personnel (7) (Table 1).

QUESTION 3: WHAT KNOWLEDGE GAPS DO YOU SEE IN CH COMMODITIES? Respondents were asked to rank the commodities using a scale of 1 to 5 as a perceived knowledge gap, with 1 being the smallest and 5 being the largest. The answers were, for the most part, evenly distributed among the commodities listed (Table 1). There were six categories provided for respondents to choose. Respondents selected basic horticultural practices (planting, pruning, soil preparation, etc.) as the highest knowledge gap, with a score of 261. Trees and shrubs (woody) had the second highest knowledge gap with a score of 259, followed by fruits and vegetables with 253, houseplants/tropicals and herbaceous ornamentals with 249 and 248 scores, respectively, and turf with the lowest gap with a score of 247.

QUESTION 4: WHAT KNOWLEDGE GAPS DO YOU SEE IN CH ISSUES? PLEASE RANK ON A SCALE OF 1 TO 5 AS A PERCEIVED GAP; 1 BEING THE SMALLEST GAP AND 5 BEING THE LARGEST GAP. For Question 4, there were 11 categories listed as CH issues (Table 1). The

Table 1. (Continued)

Question no.	Survey question	Total responses to each selection (no.)
5	Are you involved in CH research?	
	A. No	183
	B. Yes	77
6	What is needed to fill these research gaps? Check all that apply.	
	A. Funding	50
	B. Understanding of the importance of CH by researchers and educators	41
	C. Support from administration and leadership	35
	D. Personnel	33
	E. Enrollment of graduate students	20
	F. Other (specify)	7
	G. Not sure	5
7	How important is collaboration to your research? 1 = not important to 10 = very important	
	A. Within your institution	70
	B. With other universities	67
	C. Green industry	67
	D. With public gardens	64
	E. Federal agencies (U.S. Department of Agriculture, National Science Foundation, etc.)	63
	F. Other (specify)	6
8	Have you ever applied for a specialty crop grant?	
	A. No	47
	B. Yes	25
9	If funded, please select the type and number of times for each.	
	A. Specialty crop block grant	15
	B. Specialty crop research initiative	5
10	Do you know of any other federal, national, or state grants that support CH research? Please list.	
11	If you had all of the funding, support, and personnel, what would be your next big research project?	
12	In your line of work associated with CH, what are the three big questions you want answered? What are some issues you are faced with that go unaddressed or that you need further support with?	

results are presented as the mean for each category ranked in order from highest gap to lowest gap perceived (Table 2). Knowledge gaps for all categories were above the average of 2.5, with the highest knowledge gap perceived as chemicals and organics, with a mean (\pm SD) of 4.02 ± 0.9 .

QUESTION 5: ARE YOU INVOLVED IN CH RESEARCH? IF YES, THEN WHAT AREA OF SPECIALTY? To understand how many of the survey participants are involved in CH research, we asked the above question. There were 77 participants who selected yes and 183 who selected no (Table 1). The areas of research specialty ranged greatly and included native plants, pollinators, invasive plants, plant breeding, ornamentals, vegetable disease control,

small urban farms, consumer food production, pollinators and people, water-wise gardening, invasive/ornamental interface, landscape management, public gardens, landscape design, urban horticulture, integrated pest management, fruit production, plant trials, best landscape practices, urban garden ecology, market research, human/environment interactions, rain gardens, indoor houseplant care, sustainability, consumer interests, growing media, entomology, turfgrass, xeriscape trials, cold-hardy grape (*Vitis* sp.) variety trials, amendments, use of hospital gardens by patients, families, and employees, right plant–right place, extension education, hemp (*Cannabis sativa*) seed and flower production, and care of african violets (*Saintpaulia ionantha*).

QUESTION 6: WHAT IS NEEDED TO FILL THESE RESEARCH GAPS? Funding was the number one choice among the options (with 50 responses), followed by understanding the importance of CH by researchers and educators (with 41 responses), support from administration and leadership (with 35 responses), personnel (with 33 responses), and enrollment of graduate students (with 20 responses); five participants selected “not sure” as an answer (Table 1). The last option was other, with seven responses. Under the “other” category, comments included engaging high school and middle school students, partnerships with scientists in other disciplines, volunteer assistance, and education and research of microbes and organic amendments without corruption from corporate funding to promote chemically sustained landscapes

QUESTION 7: HOW IMPORTANT IS COLLABORATION TO YOUR RESEARCH? 1 - NOT IMPORTANT TO 10 - VERY IMPORTANT. The majority of participants selected within your institution (70 responses), followed by green industry (67 responses) and with other universities (67 responses) (Table 1). Public gardens received 64 responses and federal agencies (USDA, National Science Foundation, etc.) received 63 responses. “Other” received three responses; of which, policymakers, private foundations, and volunteers were listed.

QUESTIONS 8 AND 9: HAVE YOU EVER APPLIED FOR A SPECIALTY CROP GRANT? IF FUNDED, PLEASE SELECT THE TYPE AND NUMBER OF TIMES FOR EACH BELOW. Of the participants who answered this question, 47 (65.28%) answered no and 25 (34.72%) answered yes.

Those funded by specialty crop block grants included 15 respondents (20.83%), with five funded once, four funded twice, and the remainder funded four or more times. Those funded by the Specialty Crop Research Initiative included five respondents, with three funded twice and two funded three times.

QUESTION 10: DO YOU KNOW OF ANY OTHER FEDERAL, NATIONAL, OR STATE GRANTS THAT SUPPORT CH RESEARCH? PLEASE LIST BELOW. Participants shared funding sources, such

Table 2. Knowledge gaps in consumer horticulture (CH) ranked on a scale of 1 to 5, with 5 being the largest gap. Gaps are listed from the largest identified gap to smallest gap. Means and standard deviation (SD) are listed.

Potential knowledge gap	Rank [mean ± SD (1–5 scale)]
Chemicals and organics	4.02 ± 0.9
Substrates and fertility	4.00 ± 0.9
Ecosystem services/environmental benefits	3.85 ± 1.1
Pests: weeds/insects/disease	3.84 ± 1.0
Water management (quantity and quality)	3.81 ± 1.0
Plant blindness	3.74 ± 1.2
Natives, conservation, wildlife habitat and invasive species	3.64 ± 1.0
Horticulture therapy and well-being	3.55 ± 1.1
Landscape design and urban horticulture/sustainability	3.50 ± 1.0
Economics, marketing and technology	3.38 ± 1.1
Nutritional value and health benefits of plants	3.15 ± 1.1

as National Horticulture Foundation, Horticulture Research Institute, Foundation for Food and Agriculture Research, Green Plants for Green Buildings, Bill and Melinda Gates Foundation, Rockefeller Foundation, Sustainable Agriculture Research and Education grants, United Fresh Start grants, Newman Foundation, local sponsors, National Urban and Community Advisory Council, Colorado Tree Coalition, Seed Your Future, USDA-Agriculture Marketing Service federal state marketing improvement program, American Floral Endowment, United Plant Saver, Farmer Veteran Coalition, Fruit Guys, Ohio Invasive Pest Council, Awesome Foundation, University of Arizona Haury Grant, and Colorado State Department of Agriculture (Table 1).

QUESTION 11: IF YOU HAD ALL THE FUNDING, SUPPORT, AND PERSONNEL, WHAT WOULD BE YOUR NEXT BIG RESEARCH PROJECT? There were 43 participants who answered this question. Although individual responses varied, the general themes were sustainable landscapes (7), pollinators and biodiversity (3), value to society (5), economics (3), pests and diseases (5), cultural practices (5), horticultural trials and demonstration gardens (6), food production (3), and other (6) (Table 1).

QUESTION 12: IN YOUR LINE OF WORK ASSOCIATED WITH CH, WHAT ARE THE THREE BIG QUESTIONS YOU WANT ANSWERED? WHAT ARE SOME ISSUES YOU ARE FACED WITH THAT GO UNADDRESSED OR YOU NEED FURTHER SUPPORT IN? There were 157 participants (or 52% of the respondents) who answered this question (Table 1). Respondents

gave three answers that varied greatly. However, there were common themes repeated among the answers. Themes are summarized as follows. 1) The environment, with issues such as sustainable landscapes, less turf, more natives, environmental impacts of gardening practices, concerns with climate change, minimizing invasive plants, organic gardening, pollinators and the issues with harmful insecticides, monocultures vs. gardening for habitats, and urban garden. 2) The benefits of gardening to our economy, to our environment, to our society, health, and well-being, and horticulture therapy. 3) Gardening techniques, including gardening basics, proper pest and disease identification, responsible pesticide use, disease and pest management, and integrated pest management. 4) Economics with issues such as how to link incomes or marginalized citizens with plants, helping consumers to buy more, and how to understand and teach others about the value of plants to local economies. 5) Educating consumers about issues such as how to reach the next generation of gardeners, a need to educate younger generations about CH, how to reach larger audiences to educate them on CH, and how extension across the nation could work together to better share information. 6) The need to address CH issues such as a lack of funding for CH research and marketing, a lack of personnel in CH, and a lack of support for EMGs.

Survey 2: Bridging the divide between CH and public gardens

A total of 56 participants completed the survey (Table 3). Some participants

were selective in their responses and did not complete all the questions; hence, the responses for each question did not total 56. In addition, there were several questions for which the participants could select multiple responses. The number of responses received for each selection option within each question is provided in Table 3.

QUESTION 1: WHAT DOES CH MEAN TO YOU? Participants could select multiple responses for this question. The categories of cultivation, use and enjoyment of plants, and retail garden center received the highest number of responses, with 49 (12.22%) responses each (Table 3). This was followed by landscaping with 43 (10.72%) responses, indoor plants and home vegetable and fruit production with 41 (10.22%) responses each, and people and plant connection with 40 (9.98%) responses. The three categories with the least number of responses were economy, recreation, and environmental sustainability with 24 (5.99%), 24 (5.99%), and 23 (5.74%) responses, respectively.

QUESTION 2: WHAT IS YOUR ROLE IN YOUR PUBLIC GARDEN? Most of the participants were horticulturists (17), followed by curators and directors (15 each) (Table 3). There were 15 participants in the “other” category. The roles that were specified in the “other” category were volunteer manager, fundraiser, plant recorder, head of horticulture, horticulture assistant, advocate for outdoor play, plant clinic manager, editor, assistant director, communications, and designer.

QUESTION 3: HAVE YOU HEARD ABOUT THE NICH? Of the 55 responses received for this question, 80% (44 participants) had not heard of the NICH (Table 3). Only 11% (6 participants) were aware of the NICH and the remainder were unsure.

QUESTION 4: IF YOU ANSWERED YES TO QUESTION #3, HOW DID YOU HEAR ABOUT NICH? As expected, a majority of those who had heard about the NICH (10 respondents) had heard about it through the APGA, which is the industry association for public gardens (Table 3). Of these, five respondents had answered “no” to the previous question. Three had heard about the NICH through the ASHS, one heard about it from

Table 3. Results of a survey questionnaire sent to public garden personnel to identify gaps in knowledge about consumer horticulture (CH). Results are presented as the total number of responses for each selection.

Question no.	Survey question	Total responses to each selection (no.)
1	What does CH mean to you? Check all that apply.	
	A. Cultivation, use, and enjoyment of plants	49
	B. Retail garden center	49
	C. Landscaping	43
	D. Indoor plants	41
	E. Home vegetable and fruit production	41
	F. Plants and people connection	40
	G. Green industry	37
	H. Local food systems and human health	30
	I. Economy	24
	J. Recreation (playing fields, parks, public gardens, sports, golf)	24
2	K. Environmental sustainability	23
	What is your role in your public garden?	
	A. Horticulturist	17
	B. Curator	15
	C. Director	15
	D. Other (specify)	15
	E. Educator	9
F. Gardener	6	
3	Have you heard about the National Initiative for Consumer Horticulture (NICH)?	
	A. No	44
	B. Yes	6
4	C. Not sure	5
	If yes, then how did you hear about the NICH? Check all that apply.	
	A. American Public Gardens Association (APGA)	10
	B. American Society for Horticultural Science (ASHS)	3
	C. NICH website (consumerhort.org)	1
	D. Colleagues	1
5	E. NICH E-Newsletter	0
	Have you used or engaged in any of the NICH marketing tools?	
	A. #plantsdothat campaign	3
	B. NICH infographics	1
6	C. Social media	1
	Are you a member of any professional societies? Check all that apply.	
	A. Horticultural societies (e.g., ASHS, International Society for Horticultural Science, American Horticultural Society, etc.)	33
	B. Specialty societies (e.g., cactus, native plant, rock garden, etc.)	20
	C. Plant conservation	14
	D. Others (specify)	13
	E. Education	9
	F. Entomology	4
	G. Arboriculture (e.g., International Society of Arboriculture)	4
	H. Landscape architecture	4
	I. Pathology	3

(Continued on next page)

colleagues, and one was familiar with the NICH through their website.

QUESTION 5: HAVE YOU USED OR ENGAGED IN ANY OF THE NICH MARKETING TOOLS? The selection options for this question were NICH infographics, social media, and the #plantsdothat campaign. Only three respondents answered this question; of these, one respondent selected all three options (Table 3). The two others had engaged with the #plantsdothat campaign.

QUESTION 6: ARE YOU A MEMBER OF ANY PROFESSIONAL SOCIETIES? Horticultural societies that covered multiple organizations (Table 3) received the highest number of responses (33), followed by specialty societies (20). Arboriculture, entomology, pathology, and landscape architecture received the lowest number of responses. The organizations specified under the “other” category included irrigation association, APGA, Botanic Gardens Conservation International, Center for Plant Conservation, Garden Communicators International, special public garden plant collecting consortium, EMGs, Council on Botanical and Horticultural Libraries, and American Alliance of Museums.

QUESTION 7: ARE MOST OF YOUR MEMBERSHIPS PERSONAL OR INSTITUTIONAL? The majority of the memberships were supported by institutions [36 responses (69%)], with 31% (16 responses) of the memberships being personal (Table 3).

QUESTION 8: DO YOU COLLABORATE WITH YOUR GREEN INDUSTRY? Of the 53 responses completed, 76% (40 respondents) engage with their local green industry and 15% (eight respondents) do not engage with their local green industry (Table 3). Five respondents (9%) were unsure.

QUESTION 9: IF YOU COLLABORATE, CAN YOU DESCRIBE YOUR COLLABORATION? There were many interesting ways in which those who collaborate with their local green industry engage. These engagements include the following: 1) access to plant material/propagules (public gardens’ living collections consist of many unique plant species that are not commonly available in the green industry and many gardens collaborate by providing source material for unique landscape plants); 2) work with nursery associations to develop

Table 3. (Continued)

Question no.	Survey question	Total responses to each selection (no.)
7	Are most of your memberships personal or institutional?	
	A. Institutional	36
	B. Personal	16
8	Do you collaborate with your local green industry?	
	A. Yes	40
	B. No	8
	C. Not sure	5
9	If you collaborate, then can you describe your collaboration?	
10	Do you think of your guests as participants in CH?	
	A. Yes	33
	B. No	19
11	How do you engage with the public? Check all that apply.	
	A. Classes and workshops	27
	B. Plant sales	23
	C. Interpretation	22
	D. Outreach	20
	E. Other (specify)	13
	F. Landscape consultation	8
	G. Urban food programs	8
	H. Plant introduction program	7
	I. Horticultural therapy programs	4
12	If you are not involved in CH, then what is preventing you from engaging?	

and promote plants that perform well in their region, collaborate on annual plant sales, purchase plants for plant display and sale at gift shops, and purchase specialty crops from specialty growers; 3) collaborate on special projects (e.g., school projects) and work with local vendors for irrigation upgrades and technology advancements; 4) host professional tours, training, workshops, and meetings for green industry professionals; 5) speak at industry events; 6) serve as a resource for horticultural/arboricultural advice to the landscape industry, provide on-call advice for green industry professionals through plant clinics and serve as an inspiration for design ideas for industry professionals; 7) solicit sponsorships and donations; 8) hire green industry members as instructors for community education classes; 9) sustainable landscape certificate program; and 10) green industry members serve on public garden committees (Table 3)

QUESTION 10: DO YOU THINK OF YOUR GUESTS AS PARTICIPANTS IN CH? Of the 52 respondents who completed this question, 33 (63%)

answered that they considered their guests as participating in CH, whereas 19 (37%) responded “no” (Table 3). This is consistent with the responses to Question 1, for which cultivation, use, and enjoyment of plants comprised one of the categories that received the highest score for what CH means.

QUESTION 11: HOW DO YOU ENGAGE WITH THE PUBLIC? Classes and workshops received the highest response (27), followed by plant sales, interpretation, and outreach with 23, 22, and 20 responses each, respectively (Table 3). Landscape consultation, horticultural therapy programs, urban food programs, and plant introduction programs received very few responses. Items listed in the “other” category included social media posts, demonstrations, volunteerism, and website.

QUESTION 12: IF YOU ARE NOT INVOLVED IN CH, WHAT IS PREVENTING YOU FROM ENGAGING? A majority of the responses received for this question came from those who had responded “no” to Question 10, indicating they did not consider their guests as participants in CH (Table

3). The main responses were lack of staff time and resources, limited collaborations, and lack of buy-in from senior management. There were a few responses indicating confusion about what CH is. One respondent perceived CH as sale of plants and considered consumerism as against the mission.

Discussion

Survey 1: Research gaps in CH

Participant results from the first survey about research gaps in CH indicated a clear gap in CH research because of a lack of funding and understanding of the importance of CH by both researchers and educators, a lack of trained CH personnel and educators, in addition to a lack of support from administrators. A large portion of the survey participants identified as being affiliated with academia and the extension service. Only 77 of the participants said they conducted CH research. Lack of funding, support, and personnel are major hurdles to conducting research. The survey revealed many areas of CH that lack research-based information, including issues regarding the role that gardening has in the environment, both negatively and positively, in addition to understanding more fully how gardening affects the economy, our health, and communities. One issue is that many extension personnel do not have a research appointment, and there is a real need for land-grant universities to hire faculty with a research appointment to help bridge the gap in CH research. Further studies should evaluate the appointment of academic and extension personnel. Many, for example, have a split among teaching, research, and/or extension, with many having no research appointment.

Survey 2: Bridging the divide between CH and public gardens

Among survey participants from public gardens, there was not a clear understanding of what CH is. Even though retail garden centers received a high response, there is a disconnect in participants’ perception of what CH is because the economic category received one of the lowest responses. The roles within a public garden are diverse and varied, thus providing an opportunity for those engaged in CH to educate public garden professionals

about the broad discipline and facilitating impactful engagement with the public. The majority of the respondents were not aware of the NICH. The NICH provides valuable tools for communicating the importance of horticulture with their #plantsdothat campaign, which can serve as educational material at public gardens (NICH, 2017). It is apparent that additional outreach about the NICH can be conducted at APGA conferences to educate its membership about the NICH and bring visibility to the educational materials created by the NICH. There needs to be a concerted effort to promote the NICH to public gardens staff so they can use these tools in their programs and participate as a collective voice promoting CH. Many public gardens have strong and historic associations with specialty societies, with horticultural staff members being actively involved in these societies. Members of many of these societies typically serve as volunteers assisting with the maintenance of these specialty gardens. Hence, public gardens can engage these societies to promote CH. In general, there is very low participation of botanic garden professionals in ASHS activities as well. This information provides an opportunity for the ASHS to conduct outreach to public gardens to recruit members. To engage public garden staff in CH activities, it is important that institutional support is provided to the staff members to expand their knowledge through society activities and peer engagement. Public garden horticulturists align their work with CH, but the term itself is not widely used and creates confusion.

Conclusions

Key takeaways from the gaps in CH research survey revealed some common themes. 1) Even though there was a general understanding of what CH is, there was a disconnect in participants' perceptions of the role of CH in economy and recreation. 2) The highest knowledge gap among participants was in basic horticultural practices with a lack of funding and lack of understanding by and support from researchers, educators, administration, and leadership. 3) Of those who identified as being involved in CH research, only $\approx 35\%$ of the respondents have applied for grants to

fund their research, and only 21% have applied for specialty crop grants. Even though participants identified several funding sources, it is surprising that few CH researchers are applying for grants. This could be because of the heavy workload of many CH researchers who divide their time among extension, research, and teaching. 4) Because CH provides significant economic, environmental, and human health and well-being benefits, there needs to be a concerted effort to advocate for funds for CH, and this can be best achieved through the NICH.

There were some key takeaways from the public garden survey to understand the extent of engagement in CH by garden professionals. 1) A concerted effort to educate public garden professionals about what CH is and its importance is needed. Many garden professionals are members of the APGA; therefore, the annual conference of the APGA could be a great venue to engage this audience through presentations and workshops. The APGA e-newsletter can also be a method of disseminating information. 2) The NICH is mostly unknown to the public garden community. This should also be promoted to public garden professionals. Through their #plantsdothat campaign, the NICH has developed numerous tools that can be used as educational materials by public gardens staff to communicate to the public. 3) Public garden professionals are involved in numerous plant societies and actively collaborate with their local green industry. Collectively, public gardens host ≈ 120 million visitors annually (McGinnis et al., 2020). With this broad reach, it would serve the CH industry well if efforts are in place to educate this audience using consistent CH messaging.

Regarding these key takeaways from both surveys, the next steps should include presenting these findings to the NICH executive committee, members of academia, and those in leadership roles at public gardens. Outreach through industry, extension, and public gardens' channels should become a priority. This can be achieved through webinars, publications, and networking.

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