Chapter 33
Extension Approaches for Horticultural Innovation

Peter F. McSweeney, Chris C. Williams, Ruth A. Nettle, John P. Rayner and Robin G. Brumfield

Abstract The focus of this chapter is towards the changing extension climate surrounding the horticultural industry and the implications for horticultural extension now and into the future. Extension as a function and a practice is being redefined in many countries alongside changes in the institutional arrangements for extension, changing funding models and varying degrees of involvement of the private sector. The chapter analyses:

- industry/sector changes and implications for extension
- traditional and more recent interpretation surrounding extension definitions and delivery models
- the evolving enabling environment, resource constraints and institutional roles surrounding extension service delivery
- the extension practitioner (their skills, competencies, roles)
- elements of a model suited to support industry needs with high, ongoing innovation requirements.

P. F. McSweeney (✉) · R. A. Nettle
Department of Agriculture and Food Systems,
Melbourne School of Land and Environment, The University of Melbourne,
Parkville Campus, Melbourne, VIC 3010, Australia
e-mail: peterm1@unimelb.edu.au

R. A. Nettle
e-mail: ranettle@unimelb.edu.au

C. C. Williams · J. P. Rayner
Department of Resource Management and Geography,
Melbourne School of Land and Environment, University of Melbourne,
Burnley Campus, Richmond, VIC 3121, Australia
e-mail: chriscw@unimelb.edu.au

J. P. Rayner
e-mail: jrayner@unimelb.edu.au

R. G. Brumfield
Department of Agricultural, Food and Resource Economics,
Rutgers, The State University of New Jersey, 55 Dudley Road,
New Brunswick, NJ 08901–8520, USA
e-mail: brumfield@AESOP.Rutgers.edu

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Introduction

Much has been written regarding the many dimensions surrounding extension for agriculture and horticulture. 'Extension' is a construct which has gained meaning through its praxis. It is linked to concepts such as outreach, knowledge or technology transfer, innovation diffusion, change management, capacity building, empowerment, 'suasion' and, to some extent, business incubation. The term 'rural advisory services' (RAS) has also gained recent currency as an alternative to the perceived outdated term of 'extension' (Adolph 2011). Implicit in all of these terms is the assumption of a pool of referent knowledge in specialist discipline areas, much of this based on research and development built up over many years.

Roling (1988) refers to extension science as the development of the body of knowledge (from extension research) into extension practice. Early agricultural extension involved the linked functions of diagnosis of farmer situations and opportunities, message transfer, gathering feedback and developing linkages between industry participants (Farrington 1995). On an international scale, approaches tend to differ between and within countries, and are shaped by the history and culture of extension, the governance of extension at a national, state and industry level, the degree of involvement of the public and private sector and the maturity and varying needs of sectors. While the provision of the extension function has had its roots in public service administration, models for extension provision are continually evolving in response to the growing sphere and need for extension services particularly within the challenge of fewer public resources. In some contexts, the outlook for future extension is a pessimistic one. Hunt et al. (2012) take the view that following periods of maturation and growth, the traditional extension models are "unravelling" which is directly related to government policy shifts, which in the Australian context at least, are moving away from public sector extension.

The focus of this chapter is towards the changing extension climate surrounding the horticultural industry and the implications for horticultural extension now and into the future. Initially we define the term 'horticulture', expanding on the historical context surrounding public and consumer horticulture in particular. We consider trends and recent tensions and challenges surrounding extension more broadly with particular reference to institutional changes affecting extension, funding arrangements and the relative involvement of the public and private sector. We review changes in extension delivery models and extension roles and review the key skills and competencies of extension practice. We then return to the horticultural sector, separating out some selected industry segments with respect to their extension needs, including mature areas of the horticulture industry (e.g. environmental or ornamental horticulture), pioneering and growth areas (e.g. urban green infrastructure), with particular reference

to the Australian context. We consider some of the models or paradigms that might assist the industry to develop the innovative thinking and capacity required across the development of green infrastructure, an emerging knowledge area.

Defining Horticulture

Horticulture as an industry and discipline has always been difficult to define. Two broad industry-based definitions have historically been used – 'amenity or ornamental horticulture' and 'production horticulture'. In recent times these definitions have been challenged through more specific industry sectors and/or groupings, and also through economic, social and technological changes driving industry development, diversification and employment. Amenity horticulture has included arboriculture, interior plant hire, landscape design and construction, nursery production and retailing, parks and gardens and turf production and maintenance. Amenity horticulture is also referred to as 'environmental horticulture', 'landscape horticulture', 'lifestyle horticulture' and 'urban horticulture'. The latter definitions also encompass newer design and community-based applications, particularly in urban and peri-urban settings, such as green infrastructure technologies, urban agriculture, therapeutic horticulture, community gardens and related areas. Production horticulture as it suggests is based around the more agricultural and productive food and resource industries and encompasses fruits, vegetables, flowers, mushrooms, nuts and some specialised crops. Some definitions also include nursery and turf production.

Urban horticulture can be usefully divided into two related sectors: private, residential landscapes, gardens and amateur gardeners, called consumer horticulture here; and then there is public landscape and vegetation management, comprising advanced vocational and professional skills, referred to here as public horticulture. Whilst the two sectors have historically been closely linked, since the 1980's there has been increasing divergence in their respective needs for information, practice and management. In public horticulture this has been driven by the increasing complexity of open space, landscape and vegetation management and the rise of relevant degree and post-graduate qualifications. In consumer horticulture differences have been driven by the growth of residential gardens and landscapes for leisure and recreation and the development of service and landscape businesses in support of these outcomes. There are however fundamental differences between the two, which also reflect the provision of extension services.

Consumer Horticulture

Consumer horticulture, or amateur and residential gardening, is largely a product of the rapid development of suburban landscapes in many countries over the last century, but particularly in the USA, Australia, United Kingdom, New Zealand and

Canada. A strong gardening culture emerged as middle classes grew more wealthy and leisured, aided by an increased focus on suburban development and sizable domestic gardens (Pollan 1996). It was further assisted by improved access to home garden machinery, equipment and materials and new plant introductions, supported by the plant nursery industry, garden-based media and publications, garden clubs and interest groups. Consumer horticulture places a high priority on specimen values and seasonal display, largely achieved by intensive garden practices and resource inputs to optimize soils, growing environments and maintenance.

The needs in consumer horticulture are largely derived from gardening culture translated freely into the horticultural practices found in public parks and gardens and vice versa. Indeed there was an expectation that skilful horticultural display in parks provided a model for private gardens. The nineteenth century vision of the urban parks movement was to create public spaces that used landscape design and horticulture as a civilising influence on the population as a whole. At the same time, private gardening was also seen as an important part of nation building and fostering civic pride. As secular, compulsory and free education expanded many governments created gardening classes for children (Whitehead 2001).

The focus on specimens and display has driven extension practice in consumer horticulture. Much of this has been delivered as garden cultivation information around plant groups (e.g. dahlias, roses, conifers, etc.), life forms (e.g. small trees, bedding plants, etc.) or garden practices (e.g. pruning, composting, pest and disease control, etc.). As private gardening developed, all the perceived inputs needed to optimise plant performance created a lucrative market for sales of horticultural products. This market grew rapidly after the Second World War, with extension increasingly becoming focused on translating agricultural research outcomes, aimed at commercial farmers, into advice pitched to the consumer horticulture sector. Home gardeners were encouraged to use pesticides, fertilisers and soil modifiers which had been developed for broadacre industrial agriculture, including chemicals that have subsequently been banned such as DDT (Anon 1965).

Since the advent of the environmental movement following the publication of Rachel Carson's *Silent Spring* in 1962 (Carson 1962), there has been increasing availability of 'organic' and environmentally friendly products. Like their mainstream counterparts, these are sometimes not tested for amenity horticulture applications and there is often minimal independent scientific evaluation of their effectiveness. In other words, the alternative products for home use, like those derived from agricultural research are not really subjected to dispassionate, objective research and then integrated into extension programs. A key question for responsible extension in this context is establishing whether recommended agricultural inputs are really necessary for optimal plant growth in the amateur gardening context? For example a common reason given for using gypsum in home gardens and promoted as such by many sources of gardening information is that will make it easier to dig into compacted soils. The reality is that gypsum, as tested for agriculture and production horticulture, is recommended for frequently cultivated sodic clay soils, cropped annually and not for soils that are simply "hard to dig" and then planted with perennial shrubs and trees (Chalker-Scott 2010).

In North America the tradition of extension to home gardeners has been largely maintained through the Cooperative Extension System delivered by state land-grant universities. Since the 1970's this has also encompassed Master Gardener programs, particularly in the USA. Delivered through universities using rigorous, scientifically-based curricula (Chalker-Scott and Collman 2006), Master Gardeners act as volunteers in training and education programs, provide residential horticultural advice (often at county offices), work in community gardens, schools and undertake a variety of other garden and horticultural outreach projects. An evaluation of the Washington State University Master Garden program over 30 years (1973–2004) identified 4,015 active volunteers, servicing > 350,000 clients with an estimated dollar value (of hours) at $US 4,058,796 (Chalker-Scott and Collman 2006). Recently land grant universities have responded to public interest by delivering programs on organics, home food growing and nutrition (Weisenhorn 2012), increasing their relevancy and currency to consumers. One of the more interesting recent examples of extension practice in action for home gardeners is the work of plant physiologist Linda Chalker-Scott at Washington State University in the USA. Chalker-Scott's blog and books set out to explain or de-bunk horticultural myths and to separate gardening folk-lore from scientific fact. Chalker-Scott examines topics as diverse as compost tea, water crystals, tree-staking and xeriscaping set within the context of how particular products or practices are heavily promoted through popular magazines or websites. She then uses peer-reviewed academic literature and her own experience as a scientist to examine the validity of claims made for various consumer horticulture products or practices (Chalker-Scott 2008, 2010).

In England extension services for consumer horticulture are provided through a registered charity, the Royal Horticultural Society (RHS). The RHS claims horticulture to be the biggest employer across the United Kingdom with 18.5 million gardeners, spending more than £ 2,000 million a year on plants and gardening products (www.rhs.org.uk). RHS services include its impressive information-rich and interactive website, public gardens, horticultural publications, garden shows and events, training and education programs and an increasing involvement in school and community garden programs. In 2012 the RHS had 383,046 members, an increase of 70,197 from the previous year, and recorded 1.455 million visitors to its four flagship gardens at Wisley, Rosemoor, Harlow Carr and Hyde Hall (Royal Horticultural Society 2012).

In Australia, agency based extension to residential gardeners has largely been provided through garden advisory services. Most of these state-based services were terminated in the 1990s after government cut backs, but many of the publications remain on-line and cover a range of topics as diverse as composting, lawns, indoor plants, fruit tree pruning and mulches (Garden Advisory Service 1989). While these agencies no longer exist, governments have more recently had to respond to the challenge of severe droughts and water restrictions, particularly the impacts on residential gardening. New agencies have been funded to assist extension in this area, including savewater!® (www.savewater.com.au). Formed through an alliance of eastern Australian water retailers, savewater!® provides detailed advice on water conservation for residential landscapes. This includes design, plant selection, irrigation and garden practice information and participation in garden shows, including demonstration gardens.

Public Horticulture

While gardening as a trade is well established, public horticulture as an advanced vocation and profession is more recent. Built around urban landscapes that comprise diverse vegetation elements and systems, extensive community engagement, comprehensive resources and assets and related issues of use and safety, over the last 30 years public horticulture has been transformed from parks and gardens maintenance to the management of designed and complex spaces with multi-purpose outcomes and needs (Cobham 1986). This has also occurred in the wider context of greatly reduced budgets for public landscapes, while at the same time more professions and disciplines have begun analysing and promoting the wider social, economic and social benefits of urban green space (Ward-Thompson and Travlou 2007). This has increased the need for more scientifically informed management and more sophisticated approaches to urban landscape management (Hitchmough 1994).

Public horticulture is largely derived from the extensive growth of cities over the past 150 years and the consequent creation of urban parks and gardens. Iconic urban green spaces such as Central Park in New York City have provided models for parks across the western world from the latter half of the nineteenth century. The philosophy behind the urban parks movement is well-documented and is essentially one which values the ideal of *rus in urbe* ('country in the city') as a way to provide beauty and health benefits to the wider population. In order to create the experience of the 'country in the city' the most influential designers and landscapers of the Victorian era combined elements of the picturesque and the gardenesque at the same time. In other words, public open space at its best sought to combine the experience of being in larger, free space, enjoyed through walking and taking in views, along with admiration for the display of carefully tendered individual plant specimens and planting beds. With varying degrees of success, but with great overall commitment over several generations, municipal parks and gardens became an essential part of the 'green infrastructure' of urban life.

By the middle of the twentieth century, the quality of urban green space began to decline in the West even while public open space, its need enshrined in local planning law, was still being created. This was the period of "middling Modernist" municipal park creation (Rabinow 1989) that saw many cookie-cutter spaces created, using simple combinations of mown turf and scattered trees and shrubs with a standard set of play equipment inserted for children and mothers. This urban "non-descript" was thus essentially "non-designed" in the sense that a formal design process was absent for the space as a whole but also in terms of where and why a particular planting regime would be used (Clouston 1986). A standard list of trees and shrubs used over many decades acted as a 'plant selection process'. In this context, extension for amenity horticulture was as largely informal and anecdotal as it was for private gardening. Information was largely relayed through the gardening apprenticeship system which prevailed in municipal government during this time.

The era of neo-classical economics, exemplified by the elections of Margaret Thatcher and Ronald Reagan in 1979 and 1980 respectively, marks the beginning of privatisation of many government services or their complete closure. For amenity horticulture this meant the end of the era for in-house horticultural crews at the municipal level. It can be argued that urban green space had been in decline for several decades despite over-employment of parks gardeners. However, it can equally be argued that compulsory competitive tendering for routine maintenance in municipal green space saw this decline only exacerbated. Whatever the complexity of this situation, it also seems the case that this process of outsourcing traditional in-house vegetation management focused the minds of professionals on a couple of long neglected issues: firstly, on how to do more for less i.e. defining and achieving quality cost effectively; and, secondly, on setting objectives and outcomes to work towards and in ways that were more responsive to what clients/customers (tax payers) actually wanted from urban green space. What emerges is some kind of rudimentary value chain for the kinds of services to be derived from professional amenity horticulture.

Several prevailing trends have led to this situation. One of these has been the rise of landscape architecture as a profession, especially since the 1970s and 1980s. As a design profession, landscape architecture has provided a much needed critique of the old horticultural formula of mown turf, scattered trees and some play equipment as the basis of park implementation. Interest in quality of life through good design has put the spotlight back on the greater aspirations for public open space and its central role in creating stimulating and sustainable landscapes. Ecology too has taken a greater interest in urban areas since the 1980s, helping to make the protection of nature and the restoration of ecosystems a standard component of managing city environments. Projects to bring nature back to cities frequently need on-ground implementation by staff with horticultural training. Arising out of broader ecological and sustainability concerns the concept of green infrastructure has gathered sometimes disparate uses of urban vegetation under one umbrella. This has been especially influential for our understanding of the ecosystem services delivered by trees in parks and streets, for example, in terms of energy efficiency. Ecology has also given horticulture new intellectual tools with which to manage urban vegetation.

Public health advocates and policy makers have begun looking at public open space as places to facilitate respite from stressful urban living and to provide physical exercise. This is essentially the same agenda that created the urban parks movement in the nineteenth century now framed within discourses about epidemics of mental illness, diabetes and obesity. For the first time since the allotment gardens of the Second World War, a range of advocates, both agency-based and non-governmental organisations (NGOs) are also calling for more food to be grown in cities and sometimes by the community at the municipal level in public open space. Essentially the confluence of design, ecology, urban health and financial constraint concerns have heightened awareness of the serious information gaps and associated extension needs in public horticulture.

Changing the Understanding of Extension

In examining the extension needs and challenges for the horticultural industry segments, a broader perspective on extension is also appropriate. Coutts and Roberts (2011) segregated recent extension history and influences into phases associated with linear or technology transfer (1960s), the influence of farmer discussion groups on farming systems research (1970s), systems thinking (1980s), pluralist approaches incorporating participatory methods (1990s) and then the capacity building and community engagement movement of the 2000s.

Early extension, based around top-down service delivery, and employing linear, unidirectional information flows, was frequently criticised. Such an approach did not make use of the multiple sources of "new agricultural inputs, ideas and practice" (Farrington 1995). The 'training and visit' (T and V) system, sometimes disparagingly referred to as the 'touch and vanish' system, was also criticised in part, at least in development agriculture, for its failure to achieve cost-effective change (Howell 1982). The 'train the trainer' model, also linked to extension, was also dependent upon people being adequately trained in a range of core discipline areas. The disconnect occurs with this approach when there is a mismatch between the knowledge and capacity of extension staff and the specialist programs required (Ward et al. 2011).

Over time, extension has applied different lenses in responding to changing needs of client groups. The traditional foundations for much extension work lies in agricultural science and horticultural science (i.e. building agronomic or horticultural expertise) and agricultural economics (i.e. enterprise decision making for profit). The Food and Agriculture Organization of the United Nations (FAO) encourages 'Good Agricultural Practice' (GAP) as a suitable basis for "local development of optimal good agricultural practice" (Poisot et al. 2007). This extension lens builds upon the three pillars of economic viability, environmental sustainability and social acceptance.

The agribusiness model also provides a framework to analyse enterprise performance within the supply/value chain. According to Ward et al. (2011, p. 135) agribusiness extension is directed to "improving management skills, decision making, and strategic thinking within value chain development". The process of value chain thinking also tends to sharpen managerial focus on responding to customer needs as opposed to a single production lens.

The role of extension has also been examined within a broader social context. Macadam et al. (2004) discussed extension programs as being complementary to capacity building. In this sense, agricultural extension overlaps with rural extension which takes on a broader rural development perspective. Taking the Rutgers New Jersey Agricultural Experiment Station (NJAES) Cooperative Extension as a typical example, its mission is to help "the diverse population of New Jersey adapt to a rapidly changing society and improve their lives and communities through an educational process that uses science based knowledge. Through science-based educational programs, Rutgers Cooperative Extension truly enhances the quality of life for residents of New Jersey and brings the wealth of knowledge of the state university to local communities." (http://njaes.rutgers.edu/extension/)

The breadth of contemporary extension and its directions far beyond strictly agrarian needs can be captured within the ambit of co-operative extension within the USA. Robson (undated) provides an overview of extension in the USA as part of the Land Grant System which has the three pillars of teaching, research and extension. In 1862, during the Civil War in the USA, the Morrill Act (1862) passed which provided grants of federal lands to create public institutions for teaching agriculture and mechanical arts. The subsequent Hatch Act (1887) established federal agricultural experiment stations to conduct research at land-grant institutions. In 1914 the Smith-Lever Act passed, established the Agricultural Extension Service at each land-grant institution with the intent of extending non-biased, scientific-based research findings to the citizens. The term 'cooperative' comes from the partnership of federal, state, and local government who share the funding and established Cooperative Extension Offices in every county in the USA to serve the citizenship.

The capacity of communities to deal with change in this context aligns with contemporary definitions of extension. For example, Coutts et al. (2005, p. 7) states that "extension is the process of engaging with individuals, groups and communities so that people are more able to deal with issues affecting them and opportunities open to them". A group of Australian state extension leaders (State Extension Leaders' Network)(Anon 2006) defined extension as "the process of enabling change in individuals, communities and industries involved in the primary industry sector and with natural resource management". A change response is also implicit in the definition by Leeuwis and van den Ban (2004) which states that "[e]xtension [is] a series of embedded communicative interventions that are meant, among others, to develop and/or induce innovations which supposedly help to resolve (usually multi-actor) problematic situations."

As the delivery approaches, lenses and capacities of extension adapt and adjust to the changing operating environment, it is increasingly suggested that the term 'extension' itself is losing currency. In a broad ranging synthesis report Adolph (2011) suggests the term rural advisory services (RAS) better represents "…the different activities that provide the information and services needed and demanded by farmers and other actors in rural settings to assist them in developing their own technical, organisational and management skills and practices, so as to improve their livelihoods and well- being" than the term 'extension'.

Changing Institutional Roles to Extension

Extension approaches adopted by individual countries are driven by many factors. As Coutts et al. (2005) state, "[e]xtension approaches do not develop in a vacuum. The structural, social, political, economic and philosophical contexts of the time all contribute to the types of projects that are developed, proposed and funded". So given the many variables at play within any one country and across countries, it is natural to find considerable diversity in approaches to extension. Extension practitioners and analysts, in seeking strategic, coherent mixes of extension solutions to

		Market Reforms Funding: Public	Market Reforms Funding: Private
Delivery: Public		Revision of public sector extension via downsizing and some cost recovery (Canada, Israel, USA)	Cost recovery (fee-based) systems (OECD countries, previously in Mexico)
Delivery: Private		Pluralism, partnerships, power sharing (Chile, Estonia, Hungary, Venezuela, South Korea, and Taiwan)	Privatization (total) Commercialization (The Netherlands, New Zealand, England and Wales)
		Non-Market Reforms	
Political Fiscal Administrative Issues		Decentralization of lower tiers of government (Colombia, Indonesia, Mexico, The Philippines, Uganda and others)	Transfer (delegation of responsibility) to other entities (Bolivia, to farmer organizations; Ecuador, mixed with farmer-led NGO programmes; Peru, extension devolved to NGOs)

Fig. 33.1 Public sector extension reform strategies. (Source: Food and Agricultural Organization of the United Nations, 2001, Rivera, W.M., Agricultural and rural extension worldwide; options for institutional reform in developing countries. Extension, Education and Communication Service. ftp://ftp.fao.org/docrep/fao/004/y2709e/y2709e.pdf)

their own problems, will logically explore and learn from the approaches used in contexts similar to their own in addressing the common challenges.

Extension is also frequently claimed to be a strategic policy instrument (Anon 2006), and there is evidence supporting the effectiveness of systematic change through considered policy initiatives.

In the context of agricultural development, Rivera (2001) argues that "no single approach best suits extension development in all circumstances, just as there is no single approach that best suits development. Otherwise the problems of extension and, for that matter, of development, would have been solved long ago." Fig. 33.1 highlights the diversity of approaches adopted across the globe with different in-country institutional arrangements and responses of NGOs many of which are highly idiosyncratic. In some of these countries, policy surrounding extension is clearly articulated. In others, the direction and sphere of extension efforts is much less clear. This is particularly the case in countries using pluralist approaches combining private and government service delivery, especially where government support operates through multiple tiers. Australia is one example of a country applying pluralist approaches to both funding and delivery of extension.

Funding or financing extension services or programs has been a particularly vexed issue. Any recent dissection of extension reforms and practices has focused on the divergent responses to funding shortages and to the consequences for extension efforts. This has applied to developed, developing and least-developed countries alike. Farrington (1995) discusses the fiscal crisis impacting on public sector services in least-developed countries and describes the "picture [as] one of resources spread too thinly to be effective, inflexibility and inability to respond to the changing infrastructural and institutional contexts" (p. 540). According to Kidd et al. (2000) "[a] particular challenge will be to find a strategy with a coherent mix of mechanisms for financing and providing extension that can help rigid public extension systems to evolve gradually in a flexible manner".

While scarcity of resources invariably focuses attention on privatisation and commercialisation of extension services, such pathways can be problematic in terms of the ideological tensions they may create, or, counter-productive impacts such as reduced knowledge sharing and learning stifling productivity and innovation. For example, Rivera (2008) argues that there is "a significant divergence between privatisation measures". There is an expectation privatisation brings "demand-led extension", "farmer participation in extension decision-making" and "farmer empowerment". This has proven not to be the case in all circumstances with potential risks of farmers becoming increasingly "beholden to commercial forces" (Rivera 2008).

A review of some of the studies into private and public investment in extension demonstrates some of the issues. Developed economies have adopted different mixes of public and private extension. The Netherlands, New Zealand, England and Wales have commercialised/privatised agricultural and related extension (Rivera 2001) with New Zealand "at the forefront of privatisation of government services since 1983…." (Botha et al. 2008, p. 125). The transformation of New Zealand's government extension services over the last 20 years has been particularly contentious. Whilst it has been argued that the transition to private consulting services has led to improvements in the quality, relevance and timeliness of advice provided at an individual grower level, this has come at the cost of a lack information sharing, more regionally-focused service delivery, poor staff recruitment and a decline in horticultural statistics compilation, biosecurity capability and the provision of leadership and advocacy (Warrington et al. 2004).

Countries like Australia are clearly at the crossroads in the extension space in terms of 'who does what and for whose benefit'. Marsh and Pannell's (2000) view on Australia was that "rapid change [was] occurring at the federal level and in all states …" (p. 605) and that "[a]gricultural information [was] increasingly perceived by policy-makers to have 'private-good' characteristics". In drawing on the lessons from neighbouring New Zealand's experience, Stantiall and Paine (2000) observed that "[while] it is legitimate to devolve consultancy to the private sector, it is crucial to retain a critical mass of extension capability to achieve public-good goals". Overall, Australia's extension approach sees the work of industry extension distributed among layers of government and private service providers. The country also employs research and development corporations (RDCs) which are designed to integrate the industry linkages and efforts in research and development initiatives. The RDC model works on a matching funding system where government matches

industry funds raised through industry levies. A recent Australian Productivity Commission report into Rural RDCs (Anon 2011) acknowledged the 'systems integrating' role of the RDCs yet questioned the return to the community on the sizable government investment. This focus is significant for horticulture in the sense that Horticulture Australia Limited (HAL) is one of the largest of the rural RDCs. The Productivity Commission identified many initiatives that could have been funded directly through farmer levies or stakeholder support. It should be noted that in a study of farmer levy-funded research, development and extension arrangements in the Netherlands, Klerkx and Leeuwis (2008) found that although end-users had the opportunity to raise issues, other groups in the research and development (R&D) planning process influenced the process so that farmers' innovation needs were not adequately reflected in the outcomes.

The USA is similarly challenged in a resourcing sense. In discussing the Californian extension system, Murray (2005) identifies the challenges as "[being] declining public support monies, changing societal needs or situations, the inability to behave as 'change agents' we so often claim to be, and competition from the public sector for many of the services we have traditionally offered". The "Great Recession" of 2008 has increased these challenges. As public funding continues to shrink, extension is turning to 'eXtension', webinars and other technologies to 'do more with less' and provide information to its clients in a more cost-effective way. Much of this mirrors, or is linked, to the use of web-based technologies, communications and instruction methodologies in horticultural education and training (Lineberger 2009a, b, c).

Evolving Enabling Environments

Overlapping with the above discussion regarding the changing institutional landscape and 'private/public good' debate in extension are trends within what may be described as the enabling environment surrounding extension. This includes some analysis of agricultural, horticultural and related education and the development of extension (or rural advisory services) capacity.

Commenting on agricultural education to start with, worldwide, there is considerable diversity in the relationship between agricultural and related education and research, advisory services, networks and stakeholder relationships (Adolph 2011). For example, in countries where agriculture remains the main economic and employment driver, the provision of agricultural and related education at secondary, vocational and higher education levels seems largely intact (Adolph 2011). On the other hand, the experience with some of the developed economies is quite different. Again, using Australia as the example with which we are most familiar there has been a steady decline in the uptake and provision of higher education (HE) agricultural and related programs since the 1990s (McSweeney and Rayner 2011). The reality is that more students are gravitating to areas of increased interest e.g. environmental sciences, biofuels, food science etc. and away from traditional major areas of study. One consequence of this lack of interest is the adverse effect on the

professional services and extension capacity necessary for a vibrant rural sector (Falvey 1998; Malcolm 2010; Pratley 2008).

Closely allied to the changes in traditional areas of agricultural education, enrolments in most areas of Australian horticultural education at HE levels have fallen significantly (Collins and Dunne 2009; Dunne 2010; McSweeney and Rayner 2011; Pratley 2012a and b). While enrolments at vocational education and training (VET) levels seem somewhat more stable, they remain concentrated at the lower curriculum levels (Rayner et al. 2009). Of concern for the development in professional capacity in horticulture are the lack of pathways between VET and HE systems and, not surprisingly, low levels of upward student progression. McEvilly and Aldous (2010) also highlight the difficulty of communicating and guiding young people into areas such as horticulture.

Following on from the trends surrounding public and consumer horticulture discussed earlier in this chapter we attempt to synthesise in Fig. 33.2 the current levels of support for horticulture in formal training (VET and HE), research and extension services, again for the Australian context. The four categories chosen are not mutually exclusive (e.g. public horticulture overlaps with green infrastructure), yet they serve to highlight some of the changes in terms of enabling support for the sector. Of particular interest with Fig. 33.2 are:

- the declining HE presence and increasing VET significance in traditional areas of consumer, public and production horticulture,
- the declining government role in extension in these segments and the growing reliance on industry-funded support for horticulture,
- the significant transformation away from the traditional advisory service models for consumer horticulture,
- how growth areas e.g. green infrastructure, are to be supported in light of trends in education, and
- to what extent niche curriculum areas will be developed and sustained in light of the growth areas.

It is also important to recognise that horticulture comprises segments that are at different stages of maturity which are supported by different levels of industry-driven extension facilitation. For example, both public and production horticulture segments typify mature segments in one sense in that they have progressed from cottage-type industries to those where larger scale commercial operations are more prevalent. In terms of the enabling environment for public and production horticulture, there are isolated pockets of higher education (HE) delivery into some traditional areas (nursery, turfgrass, cut flowers, parks and landscapes), yet most support comes from the vocational education and training (VET) sector through generic training packages or industry specific training initiatives.

In horticultural production and service areas, many enterprises are self-sufficient in technical expertise and employ in-house training; many remain family-owned and managed yet are operating on a larger scale; and many can access and afford agronomic and other technical advice as required. The sector is generally well supported through relevant industry associations. In Australia's case, the

1. Consumer horticulture			
Research / knowledge base	**Higher Education (HE)**	**Vocational Education and Training (VET)**	**Extension provision**
Long established principles **Many untested myths** **Research exploration of plant functionality / molecular biosciences and biotechnology**	**Minimal undergraduate footprint in traditional areas** **Growth in some specialist program areas e.g. sustainable horticulture, permaculture, organic.** **Variable pathways from VET**	**Trend toward generic vocational education and training via training packages** **Little or no integration into HE programs**	**Traditional advisory services discontinued** **Growth in online media**
2. Public horticulture			
Traditional links to horticultural science **Supported through the research and development corporations** **Static since rapid growth phase of the 1980 – 90s** **Loss of core institutional leadership / core players**	**Historically tied to older style colleges** **Variable HE presence but few undergraduate / postgraduate programs** **Linkages to some related discipline areas**	**As above**	**Declining areas of specialist expertise in government** **Targeted industry development** **Industry association initiatives** **Decline in professional development activity**

Fig. 33.2 Enabling environment elements supporting areas of Australian horticultural extension

aforementioned Horticulture Australia Limited (HAL) (Anon 2012a) is the peak industry body funded mainly by a combination of statutory industry levies, voluntary contributions, and Commonwealth government matching funds. Such funds are applied strategically to research and development and extension and provided primarily through industry development officers. One horticultural sector organisation that operates under the auspices of HAL, Nursery and Garden Industry Australia (NGIA), provides a useful illustration. In recent years the NGIA has shifted

3. Production horticulture			
Traditional links to agricultural science **Interest in sustainability initiatives / community responses**	**Highly variable presence from State to State**	**As above**	**Key roles of industry associations bodies and peak bodies, Horticulture Australia Limited** **Agronomic advice through rural services** **Public service provision rotates focus and its regional strengths**
4. Green infrastructure			
Rapid response innovations being sought **Inter-disciplinary research activity e.g. plants, water, design, climate, engineering, social**	**Emerging curriculum area across disciplines**	**Minimal coverage and at low skill level**	**Conference-based networking and knowledge diffusion** **Emerging associations (e.g. Green Roofs Australasia)**

Fig. 33.2 (continued)

its focus more towards urban landscapes, green infrastructure, urban forestry and lifestyle horticulture activities. To drive industry development and investment, this focus, together with outcomes in improved communications and enhancing skills, knowledge and practice, form part of the NGIA's strategic investment plan over coming years (Anon 2012b).

One could argue that the traditional industry research and education foundations systems have supported horticulture well. Significant innovations in horticulture and horticultural science have taken place through plant breeding, plant biotechnology, production system innovations, environmental management, improvements in media and fertilisers, irrigation design and protected cropping, plant health, integrated pest management, postharvest protocols and improved market access, to name a few. In more recent years, production horticulture has been exposed to some level of automation, mechanisation or sophisticated application of greenhouse technology.

Moving away from a mature segment, such as production horticulture, the growth of 'green infrastructure' in cities has brought about a new and pioneering approach to extension within horticulture, where new and different extension skills and knowledge are required in communicating. Green infrastructure has been defined

as “all natural, semi-natural and artificial networks of multifunctional ecological systems within, around and between urban areas” (Tzoulas et al. 2007). Operating at a range of scales and spaces, it includes traditional urban greening, such as trees, turfgrass, parks and gardens, etc., newer technologies, such as green roofs and green walls, and water-sensitive urban design strategies, such as rain gardens and swales. Green infrastructure is often hampered by the need to incorporate a range of different disciplines and skills, particularly in the design phase. Horticulture is ideally placed to ensure that functional outcomes from green infrastructure are achieved as it requires integrating design principles with a knowledge of plant materials, soils, plant husbandry, engineering, irrigation and climate systems. The challenge is to ensure this integration occurs in urban horticulture through research, education and teaching, and then relates this effectively and appropriately to extension.

To what extent and how extension provision in its broadest sense will be impacted in the long term by such trends in the underpinning education systems is unclear. The reality is that in the short to medium term at least, government agencies, industry associations, educators and private firms will be faced with declining output of graduates from traditional sources. This will be more critical to some segments than others. While at face value this is problematic it may be that human resource capacity to meet industry needs and the extension and advisory service provision into the future may be sourced and developed in a different way.

Evolving Extension Practice in Horticulture

In recent years, as a result of the sharply declining institutional extension capacity, the growth in horticultural information needs and rapidly changing models for information sharing, consumer horticulture, in particular, has experienced an explosion of on-line gardening information. User-generated content on the web, largely by private gardeners, provides information about plants and horticulture that far outweighs the available extension information provided by universities and colleges. Nevertheless, for those who seek less anecdotal information on plants, practices and products, science-based advice, partly sponsored by governments, still exists in some jurisdictions.

In public horticulture, while the information needs are potentially great, the sources of quality information are either lacking or belong to diverse and often informal networks. We can, however, conceive of an enabling environment for access to better quality information and therefore to different forms of extension for this sector. This enabling environment is derived from the resurgent interest in public open space and vegetation to achieve positive social, environmental outcomes for urban communities. Internationally, there are few examples of well developed extension services that support public horticulture. The United Kingdom, with its focus on gardening as a major leisure and recreation activity, also has a large number of representative industry organisations that support members engaged in public horticulture. This includes the Horticultural Trade Association (HTA), Institute of

Horticulture (IOH), Professional Gardeners' Guild, GreenSpace, British Association of Landscape Industries (BALI), The National Trust UK, The National Trust for Scotland, English Heritage, Botanic Gardens Conservation International (BGCI), The Arboricultural Association (AA), and the Institute of Groundsmanship (IOG). The range of extension services provided by these groups is impressive and includes business and technical information, guidance and publications, visual media and training resources, professional development through specific conferences, seminars and training and participation in shows, events and related outreach activities. There is also a weekly trade magazine, "Horticulture Week" (www.hortweek.com) which has a focus on key issues across all areas of horticulture and specifically on careers.

In the American context, extension for urban horticulture is seeking contemporary relevance in the face of new policy concerns. This requires extensive interdisciplinary collaboration to meet new extension challenges. Programs that tackle childhood obesity, diabetes, and crime in urban areas often use gardening and horticulture projects as part of their package of strategies e.g. 4-H programs on nutrition and anti-gang education for youth. At the same time, the resurgence of farmers markets and growing food generally has created opportunities for horticultural extension to provide good quality advice to home gardeners and small-scale commercial producers. Niche growers now grow and sell food, plants, and flowers to local specialty markets and upscale restaurants and need advice on a range of novel edible species that are relatively new to mainstream horticulture (Carlson 2012). Seeking commercial opportunities for extension services in these niche areas has become especially important in the post-GFC American economy when funding streams from federal, state, and county governments have declined or have been cut altogether.

Despite the many changes and challenges for extension and the continued questioning of the relevance of the term itself to the current needs of agriculture and horticulture, the recognised practices of extension appear to be increasingly in demand. Knowledge of farming or horticultural systems, an ability to understand and work with the goals and aspirations of producers and land managers (Nettle and Lamb 2010), an ability to understand, interpret and translate science to practice and policy (Nettle and Paine 2009), facilitation, communication and networking skills are referred to as essential capacities for agricultural industries and rural development more broadly (Roberts et al. 2004). The need for social and organisational capability, not just technical knowledge is considered part of an ability to support farm business systems in their community and environmental context (Nettle 2003, p. 4). Further, emerging challenges for agricultural and horticultural industries represent new professional situations requiring rural advisory services to engage in workplace learning alongside and with their clients, rather than fulfill information delivery functions (Nettle and Paine 2009). Finally, as agricultural and horticultural innovation systems emerge as an alternative conceptual framework in contrast to agricultural or horticultural 'RD&E', it is interesting to note that the features ascribed to the central role of "innovation intermediaries and brokers" (Klerkx and Leeuwis 2009) for successful innovation mirror the extension capacities described above. Despite this, as already discussed, the training ground for extension skills and capacities (via public sector agencies and in Universities) has declined in recent years alongside broader trends.

Extension Models to Support High Innovation Requirements

The growing demand for the skills underpinning innovation intermediation/broking is best illustrated in the green infrastructure industry segment. The development of knowledge and capacity underpinning the expansion of green infrastructure, particularly new technologies such as green roofs and green walls, for urban domestic and commercial applications provides an excellent case for considering the future of extension direction in Australian horticulture. Fig. 33.3 captures the traditional elements of a seemingly straightforward supply chain (marketing, sales, design, procurement etc) for any green infrastructure installation, yet more importantly it emphasises the knowledge requirements essential for the area (knowledge generation, adaptation, dissemination, application). Such knowledge roles are performed by multiple actors, institutions and intermediaries. For a horticultural segment in its relative infancy, the linear unidirectional information flows associated with traditional extension, as discussed early in this Chapter, are by necessity being replaced by many interactions. While many of these interactions collectively form the basis for 'small step' or incremental improvements; others contribute to 'big step' innovation.

The green infrastructure segment is but one challenge faced by agriculture and horticulture alike to consider the traditional agricultural and horticultural RD&E 'pipeline' and its replacement with 'innovation systems' thinking. This call flows from an increasing recognition that there are many sources of innovation (not just science) and innovation is a process of co-production of new knowledge, products and processes. The purpose of innovation is to provide benefits in society and requires technological, social, economic and institutional change (Hekkert et al. 2007). In this process, research and extension are part of a broader network of actors (Knickel et al. 2009) including in the case of green infrastructure, designers, ecologists, consumers, urban health specialists, and financiers. The environment for innovation to proceed requires institutional frameworks that support innovation as a co-production process and effective governance arrangements that allow people to work across organisational boundaries, work adaptively and create pathways to the desired benefits. Extension in an innovation context becomes an important practice for stimulating networks, translating different disciplinary knowledge, helping the piloting of new approaches and facilitating rapid learning (Howells 2006; Klerkx and Leeuwis 2008, 2009; Klerkx and Nettle 2013). In an Australian context, a program-team model drawing on innovation systems ideas has been described as one mechanism emerging within the current extension climate in Australia (Nettle et al. 2013).

Conclusions

Contemporary horticultural extension has become a diverse, multi-dimensional enterprise that has moved largely away from facilitating the adoption of new techniques or products by growers and farmers. Extension still embraces the need to provide objective, science and technology-based advice to producers, users and

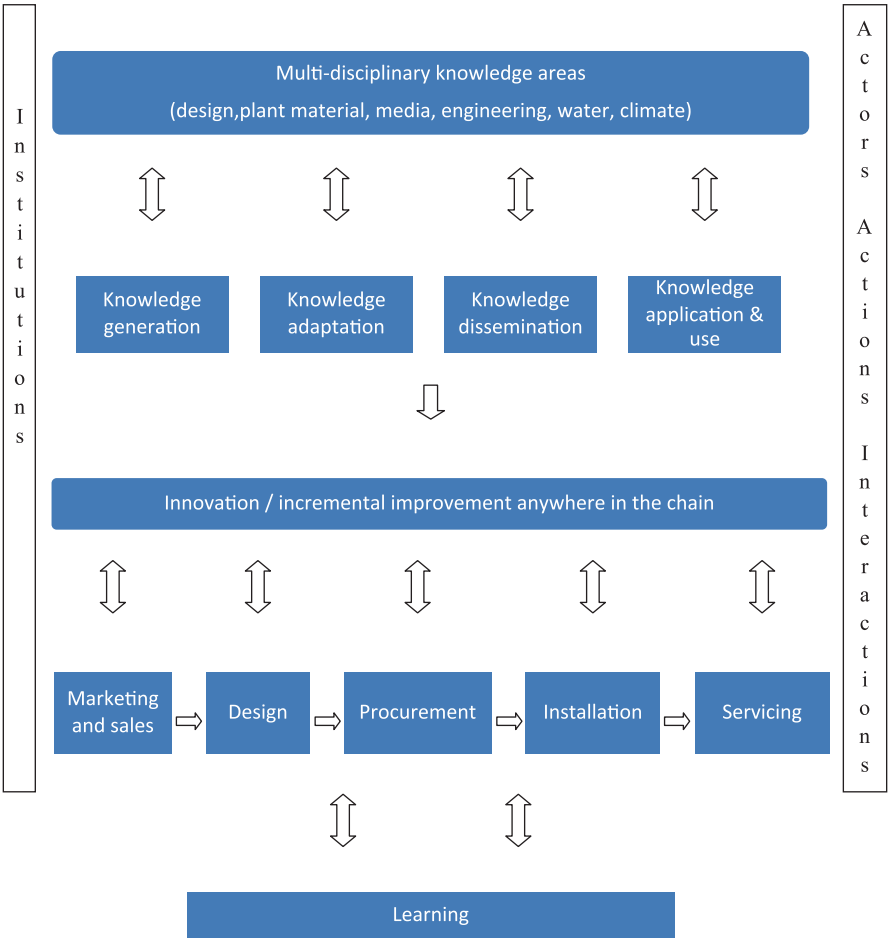

Fig. 33.3 Integration of value chain and innovation for green infrastructure. (Source: Adapted from Anandajayasekeram and Gebremedhin 2009)

managers of vegetation, but the overall scope has greatly expanded to include issues such as succession planning, natural resources management, rural development and emerging greening technologies. However, even within the broader rubric, extension for public horticulture has long been less formal and focused than extension to agriculture and production horticulture. Arguably, this is simply because the sector has always had fewer commercial and economic imperatives to drive the perceived need for practice change in ways comparable to agriculture. Significant components of horticulture have effectively by-passed the top-down phase of science-driven extension, despite the fact that there is a pressing contemporary need for this in many sectors, particularly in emerging, multi-disciplinary areas, such as green infrastructure. The broad challenge for horticultural extension in the future is to create an overall enabling environment that sustains and builds capacity in order to foster and support innovation and change toward industry development and growth.

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