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Nature and Extent of Extension Delivery on Postharvest Handling of Horticultural Perishables in the Philippines

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ABSTRACT

While postharvest operations account for more than 55 percent of the economic value of the agricultural sector, losses are high, the science or technology is relatively new, and the postharvest horticulture extension delivery system in the Philippines has not met the challenge. Thus, the delivery of extension services to the people involved needed to be assessed. Primary data from key informant interviews and secondary data from available publications and reports were analyzed. The two major extension providers for postharvest handling of fresh fruits, vegetables, and cut flowers are the Postharvest Horticulture Training and Research Center (PHTRC) of the University of the Philippines Los Baños (UPLB), and the Philippine Center for Postharvest Development and Mechanization (PhilMech), an attached agency of the Department of Agriculture (DA). From 2000–2010, the PHTRC implemented 93 percent of national extension projects and services in terms of training (51 training programs with 1,132 participants), technical assistance, production and dissemination of information (24 extension materials with 21,105 copies), and a few action-research projects. On the other hand, out of the remaining 7 percent of the extension projects, which were implemented by PhilMech, 99 percent were related to development and establishment of tramlines, cold chain facilities, and facilities support for hot water tanks and packinghouses including 16 training programs with 437 participants. The number of extension workers who have been trained over the last three decades who could be potential trainers of growers and traders was only 4.8 percent of the total number of participants of training programs of both institutions. The number of personnel in extension delivery was also reduced due to budget constraints for PHTRC and rationalization moves for PhilMech. Twenty-five personnel, 10 from PHTRC and 15 from PhilMech rendered extension services. All PHTRC staff and three from PhilMech were trained on perishables handling. Government support to extension of postharvest handling of horticultural perishables remains negligible. The major recommendations to improve the extension delivery system on postharvest horticulture sector are training of more extension workers in this field and establishment of zonal centers on postharvest research and extension.

Keywords: postharvest extension delivery, horticultural perishables, agricultural extension service

JEL Classification: Q, Q1, Q16

INTRODUCTION

The postharvest system for perishable crops refers to “the delivery of a crop from the time and place of harvest to the time and place of consumption with minimum loss, maximum efficiency, and maximum returns for all involved” (Spurgeon 1976). It includes processes and activities from harvesting, hauling, sorting/grading, trimming, packaging, storage, transport, and other handling activities until the crop reaches the consumer. Postproduction operations account for more than 55 percent of the economic value of the agricultural sector in developing countries.

Production ends in harvest, thus, postharvest systems start from harvest. Moreover, the manner and method of harvesting directly impacts on the results of postharvest handling of farm produce. Postharvest loss is of particular concern in horticultural perishables where the estimated losses range from 10–50 percent (Bautista and Maunahan 2007).

Renewed focus on postharvest management is mainly due to global market changes (e.g., consumers’ preference for high-quality and safe produce) and the relatively tight competition because of trade liberalization, especially with the full implementation of the ASEAN Free Trade Area (AFTA) agreement in the ASEAN (Association of Southeast Asian Nations) region in 2015. Additionally, in the light of market dynamism, the scope of postharvest management has also grown wider to include quality and food safety assurance along with loss reduction activities. The goals of the postharvest sector are, therefore, to reduce losses, maintain the fresh quality and assure the safety of the produce, and meet trade requirements (Serrano 2010).

Trade challenges require changes in the way the produce are grown, handled, and marketed. Depending upon the intended market, this would also require much

support in terms of technologies, capital, and organization. Production, postharvest handling, and marketing practices in the continuum of the value chain need to be orchestrated so that perishable crops from the Philippines will be globally competitive.

Lack of knowledge on postharvest handling technologies and quality requirements, including quality standards and food safety protocols, greatly limit the ability of farmers and traders to compete and access wider markets (Weinberger and Lumpkin 2005). The losses are mainly due to rough handling, use of poor quality packaging, poor temperature management, and a general lack of education regarding the need for maintaining the quality and safety of perishables at the producer, wholesaler, and retailer levels (Kitinoja et al. 2011).

Agricultural extension has an important role to play in creating awareness and improving knowledge of stakeholders on proper postharvest handling techniques. The effectiveness of extension service delivery in the postharvest horticulture sector, however, largely depends on the adequacy of extension workers and technical experts on postharvest handling; availability of information, education and communication (IEC) materials; and the budget allocation for the conduct of extension activities. If postharvest handling technologies will be widely disseminated and adopted, the quality and safety of horticultural perishables will be improved, hence, market competitiveness will be enhanced. Ultimately, this will lead to increased profits and incomes of industry stakeholders and increased foreign exchange earnings.

Based on the above premise, this study assessed the state of the extension delivery system of fruits and vegetables in the country, in order identify the needs, gaps, strengths, and weaknesses in the system and recommend possible courses of action to improve

postharvest extension services to this sector. Specifically, information from this study aims to provide a sound basis in crafting or recommending tenable programs/projects for policy consideration and for enhancing and strengthening extension service delivery in support of the horticulture industry.

METHODS

The study, conducted in 2011, entailed gathering and analysis of secondary and of primary data using key informant interviews with the authorities of the Postharvest Horticulture Training and Research Center (PHTRC) of the University of the Philippines Los Baños (UPLB), and the Philippine Center for Postharvest Development and Mechanization (PhilMech). Library and internet research were done to gather data and information on the state of extension delivery services in the postharvest horticulture sector in the country from 2000–2010. Year-end reports and publications were also examined.

RESULTS AND DISCUSSION

Establishment of PhilMech and PHTRC

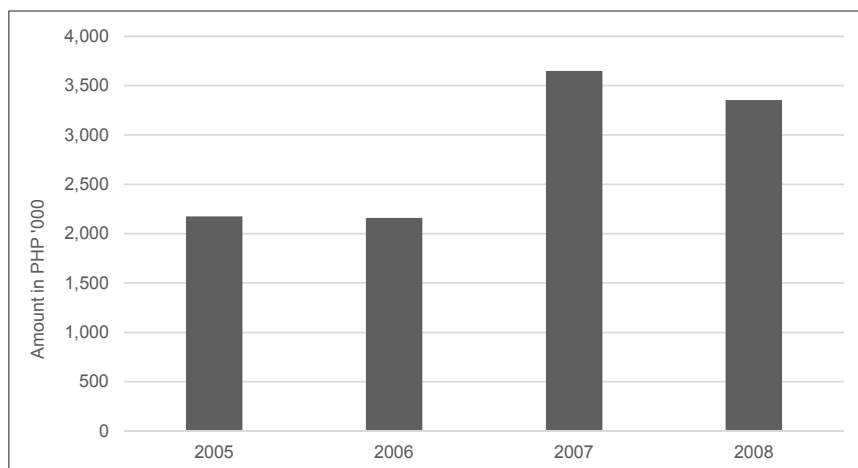
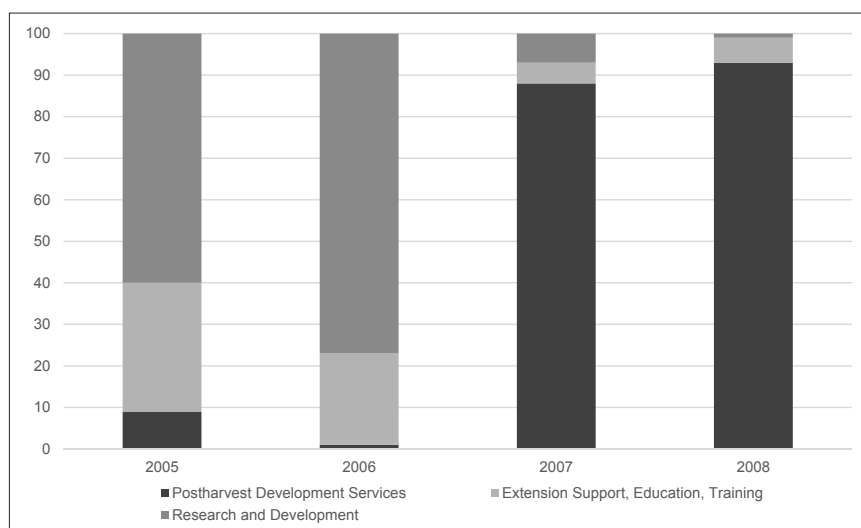
The need to reduce losses in food crops in developing countries was recognized in the late 1980's with the creation of PhilMech by the Philippine government and the PHTRC by ASEAN. PhilMech was created as the National Postharvest Institute for Research and Extension (NAPHIRE) in 1978 through Presidential Decree 1380 to reduce losses in grains and improve food and feed quality. In 1980, it became a subsidiary of the National Grains Authority (NGA) and in 1997, it became the Bureau of Postharvest Research and Extension (BPRE) under the Department of Agriculture. When the Agriculture and Fisheries Modernization Act was enacted in

1997, BPRE was mandated to cover postharvest research, development, and extension (RDE) of all agricultural crops. In 2009, BPRE was renamed PhilMech, concentrating its efforts on mechanization. The major thrust and expertise of PhilMech is on grains postharvest engineering. It collaborates with the PHTRC on perishable crops research and extension, especially on postharvest aspects other than engineering.

In an effort to reduce losses in fresh fruits, vegetables, and cut flowers in ASEAN, the ASEAN-Australian Economic Cooperation program established PHTRC based at UPLB in 1977. It aimed to train researchers and mid-level government managers of ASEAN member-countries on postharvest horticulture, a relatively new field of study. In turn, the trained personnel were to develop postharvest programs in their respective countries. After successfully fulfilling its mission in 1985, PHTRC became the Philippine center for postharvest horticulture, dropping its ASEAN identity. The Agriculture and Fisheries Modernization Act identified the PHTRC as one of the cooperating agencies of PhilMech, then BPRE, on postharvest handling.

PhilMech has been receiving regular budget allocations from the Philippine government since its establishment. From the latest data, it ranged from PHP 85 million (USD 1.93 million) in 2005 to PHP 673 million (USD 15.30 million) in 2008 (Figure 1). In 2008, around 70 percent of its budget was spent on the establishment of flatbed dryers for rice. Only about 1 percent of the budget was devoted for both research and extension of perishables. In fact, its budget for extension had been declining in proportion to the total budget (Figure 2).

As an ASEAN center, all the funds of PHTRC came from the ASEAN-Australian Economic Cooperation Program except for the salaries of UPLB staff involved with it. When it became a Philippine center, UPLB provided its operating budget for RDE activities. Of its total operating budget of around PHP 4 million

Figure 1. PhilMech's operating budget, 2005–2008**Figure 2. Breakdown of PhilMech's operating budget by major activities (%), 2005–2008**

(USD 0.09 million), 83 percent is allotted to personnel and 17 percent to maintenance and other operating expenses. The PHTRC allocation for extension is only 11 percent of PhilMech's allocation for extension, education support, and training activities in 2008. The funding for PHTRC extension activities is sourced from external agencies, both local and international. From 1989 to 2009, funding obtained from external sources for both research and extension amounted to PHP 100 million (USD 2.27 million) (Serrano 2010).

Training programs are not included in PHTRC's budget. Most of its training programs are conducted on demand and funded by the requesting clients or sponsors. Requesting agencies consisted of the various units of the DA, local government units (LGUs), Land Bank of the Philippines (LBP), Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCAARRD), state universities and colleges (SUCs), private companies, and occasionally,

the Food and Agriculture Organization of the United Nations (FAO) and other international organizations. Regular short courses are also offered every summer at subsidized rates. Training programs are also made part of the action-research projects and usually given free of charge to pre-identified industry stakeholders and project cooperators, specifically, farmers associations or cooperatives.

On the whole, the budget allotted to the two organizations' extension programs is very small. For PhilMech, the extension budget is only 6 percent of the total, while for PHTRC, extension projects have no regular funding support but are mostly implemented through the action-research projects funded by outside sources. This plight is common in most developing countries. Kitanoja et al. (2011) cited that less than 5 percent of funds in horticultural research and extension in developing countries was allocated to postharvest issues because for the past 20 years or more, the focus is on increasing production.

Current State of Extension Delivery Services in Postharvest Horticulture

Postharvest horticulture is a relatively new field of science and technology in the Philippines. Moreover, more than half of the economic value of crops is accounted for by the postharvest sector and losses are high. Thus, extension is a very important service to the millions of industry practitioners in the 16 regions of the country. Only a few state-run agricultural colleges and government units are known to provide limited expert services for postharvest concerns in the areas where they are located, so the two major extension service providers are PhilMech and PHTRC, with PHTRC being the foremost institution catering to the horticulture industry. While PhilMech's main focus is on grains postharvest, it also deals with perishables.

From 2000–2010, PHTRC implemented 93 percent of its national extension projects and services on perishables. On the other hand, out of the remaining 7 percent shared by PhilMech on postharvest perishable extension projects, 99 percent were related to development and establishment of tramlines, cold chain facilities, and facilities support for hot water tanks and packinghouses.

Prior to 2000, PhilMech also implemented postharvest extension projects on perishables through the establishment of techno-demo centers. However, the focus of these techno-demo centers was more on processing and very few activities on postharvest handling of fresh produce were done. Obviously, the PHTRC is currently still the sole institution in the country that provides extensive training on postharvest science and technology of fresh produce (Bautista and Esguerra 2010). The major extension activities of PHTRC include capability building, postharvest systems improvement services or expert services to industry, and, production and dissemination of IEC materials (Serrano 2010). The specific activities implemented by both agencies and accomplishments from 2000 to 2010 are discussed in the following sections.

Training

The number of training programs on postharvest of perishables by PhilMech from 2001 to 2010 is very few compared to postharvest of grains. It conducted 16 training programs with 437 participants on four subject areas, mostly on tramline and cold chain operations and technologies (Table 1). Of these training programs, 16 percent were on perishables through the high value commercial crops (HVCC) program, and 84 percent for grains. Training on proper postharvest handling of HVCC was usually done in collaboration with PHTRC staff who were invited as resource

Table 1. Training programs by PhilMech and PHTRC on postharvest handling, 2001–2010

Particulars	PhilMech	PHTRC
No. of training programs	16	51
No. of participants	437	1,132
Subject matter	<p>Agricultural tramline technology, Postharvest handling of HVCC</p> <p>Cold chain technology</p> <p>Operations and maintenance of tramline</p>	<p>Postharvest handling of fresh horticultural perishables: concepts and principles</p> <p>Postharvest handling technologies for horticultural crops (general and specific): fruits and vegetables, banana, mango, vegetables only, cut flowers only, eggplant, chrysanthemums and roses</p> <p>Mango production, postharvest handling, and packinghouse operations</p> <p>Raw material handling of fruits and vegetables, mango</p> <p>Postharvest handling of banana for export</p> <p>Horticultural chain management</p> <p>The art of plant preservation</p>
Type of participants	<p>Technical staff and extension workers from BPRE and DA-RFUs, LGUs (40.3%)</p> <p>SMS engineers (16.2%)</p> <p>Farmers (leaders, coop members) (39.6%)</p> <p>Information officers (3.9%)</p>	<p>Extension workers (9.5%)</p> <p>Researchers (3%)</p> <p>Teachers (1%)</p> <p>Farmers (41.4%)</p> <p>Farmer-traders (17.3%)</p> <p>Agribusiness company staff (17.7%)</p> <p>Combination (10.8%)</p>
Co-implementors (for PhilMech) and sponsors (for PHTRC)	<p>Government Agencies</p> <p>DA-ATI (Cordillera Autonomous Region)</p> <p>DA Regional Field Units (RFU's)</p> <p>LGUs</p> <p>PHTRC-UPLB</p> <p>NGO (Caraballo and Southern Cordillera Agriculture Development)</p>	<p>Government Agencies</p> <p>DA-ATI</p> <p>DA Regional Field Units</p> <p>National Agriculture and Fisheries Council (NAFC)</p> <p>Bureau of Agricultural Research (BAR)</p> <p>Bureau of Postharvest Research and Extension (BPRE)</p> <p>Department of Science and Technology-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCAARRD)</p> <p>Philippine Ports Authority (PPA)</p> <p>Land Bank of the Philippines (LBP)</p> <p>LGUs</p> <p>Private companies</p> <p>Philippine Fruit Association (PFA)</p> <p>State Universities and Colleges (SUC's)</p> <p>Food and Agriculture Organization of the United Nations (FAO)</p>

persons. Majority of the participants were technical staff and extension workers of DA (40%) and farmer leaders (40%) (Table 1). The project co-implementers of PhilMech include the DA, LGUs at the provincial level, a non-government organization, and the PHTRC.

While facilities have been established by PhilMech, the proper utilization of these postharvest facilities based on the changes in produce response and adjusting their use to suit the specific horticultural produce, should be understood by the extension workers and the end users, hence, the need for a corresponding training on the basis of their usage. Otherwise, these facilities will not be utilized properly and will eventually be discarded.

The PHTRC conducted 51 training programs on horticultural perishables with 1,132 participants from 2000–2010 (Table 1). Most of the participants in the training courses were farmers, traders, and private agribusiness workers/staff (total of 76%). Only 9.5 percent (or 95) were extension workers who were mostly from the local government units. In terms of the geographical distribution of extension workers, 37 were from Mindanao, 33 were from Visayas, and 25 were from Luzon. If the 30 researchers and 3 teachers who also attended the courses are to be included in the count, Luzon would have the highest number of potential trainers (58 in all) who could serve as resource persons to training programs on postharvest handling of perishable crops.

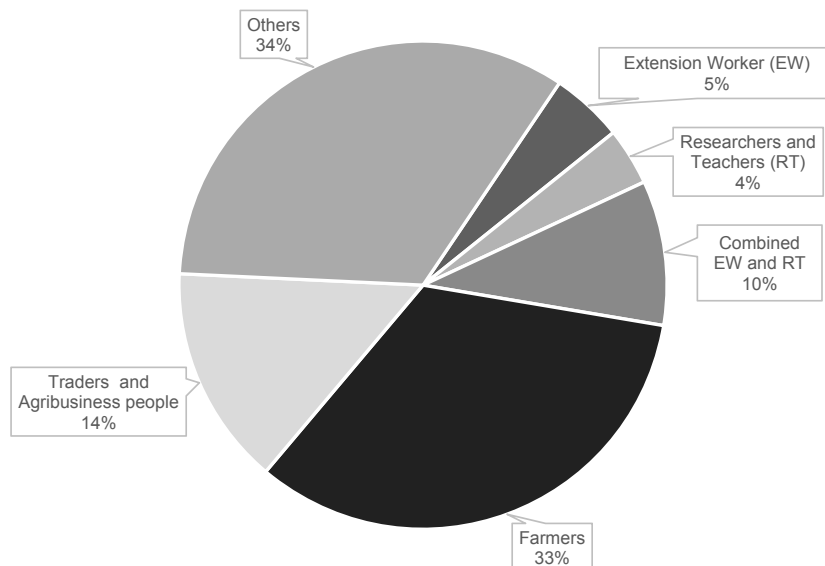
PHTRC is supposed to provide training only for the trainers, just like PhilMech. However, due to scarcity of trainers on postharvest of horticultural perishable crops, most of the clients served by the center are still the direct players in the horticulture industry, namely, farmers and traders. If the PHTRC training programs from 1977–2000 are to be reckoned, there would be an additional 168 training courses with 5,476 participants from 22 countries (Serrano 2010). Of these programs, 80 percent were local and

20 percent were international programs. Most of the foreign participants were from Thailand, Malaysia, and Indonesia.

From its establishment in 1977 up to 2010, the PHTRC had conducted 219 training programs on postharvest handling of fresh produce, with 6,146 participants. Of these total, 4.8 percent were extension workers. If teachers, researchers, and extension workers were included, the potential trainers would go up to 18 percent (Figure 3). But most of these people may have retired from service, hence, only the 95 extension workers and the 33 researchers and teachers trained during the last decade could be counted as potential trainers to date.

Relative to the span and scope of the horticulture industry, the training programs on postharvest handling are very few. Del Carmen (2011) showed that of the 1,078 extension agents doing work on horticultural perishables in 51 government agricultural offices in the country, only 2 percent have received training in postharvest horticulture. Due to the lack of trained staff (both formal and informal training) on postharvest horticulture, the estimated ratio of actual and potential extension workers to farmers in terms of rendering postharvest expert services is 1 to 16,000 horticultural farmers at the minimum and 1 to 75,000 horticultural farmers at the maximum. This is too far from the current estimated ratio of 1 agricultural production technician to 231–732 farmers. This also indicates that extension service delivery in agriculture is heavily focused on the production aspect with postharvest services lagging behind.

The inadequacy of dissemination of technologies on proper postharvest handling, and therefore the lack of awareness or knowledge of farmers and handlers, explain why postharvest losses in developing countries are still high and produce quality is poor (Kitanoja et al. 2011). Hence, farmers and traders could not compete and access wider markets (Weinberger and Lumpkin, 2005).

Figure 3. Participants in PHTRC training programs, 1977–2010

The agricultural development thrust of the Philippines must therefore give equal attention to postharvest extension services.

Information materials production

PHTRC and PhilMech produce IEC materials on postharvest handling technologies, protocols, and facility/equipment manuals. Based on PhilMech's annual reports, the production of IEC materials related to perishable postharvest and support technologies started in 2008. For 2008–2010, most IEC materials produced were manuals and leaflets on tramline, cold chain, and controlled atmosphere technologies. There were nine types of IEC formats, which also included radio plugs and infomercials, video documentaries, techno-posters, and techno calendars (Table 2).

PHTRC has produced a total of 219 extension materials on postharvest handling principles and technologies for horticultural crops from 2000–2010 (Table 3). As part of an academic institution (UPLB), it has produced information materials for students, teachers, and

RDE workers, such as books and proceedings, handbooks and monographs, and a serial on selective dissemination of information. For the general public, it has produced circulars, bulletins and flyers, radio scripts, press releases, and posters.

Table 4 shows the types of publications produced by the PHTRC in the last 10 years. Revised and updated leaflets on postharvest tips, flyers, and posters on quality defects and ripening techniques were added to the IEC collection. The second edition of the book *Postharvest Technology for Southeast Asian Perishable Crops*, which was published in 2007, won the Outstanding Book Award by the National Academy of Science and Technology in 2008. It is now included in the kit of the training program for trainers. PHTRC seeks external funding support for the first printing of its IEC materials. Thus, these materials are often sold to generate funds for their reprinting.

PHTRC also develops instructional materials for teaching postharvest horticulture, and recently, developed new courses in this

Table 2. IEC materials produced by Philmech on postharvest and related technologies in support of the HVCC program, 2008–2010

Item	Number, Kind	Copies Produced
Postharvest Digest	4 issues/year	3,000 per issue
Manual (Bi-cable tramline)	1 manual	1,000
Techno leaflets (cold chain, tramline, controlled atmosphere technology)	5 types	3,000 each
Q and A leaflets		3,000
Video documentary	1 video	
Techno posters	prototypes	
Regional infomercial	1 infomercial	
Radio plugs	12 plugs	
Techno calendars		2,500

Table 3. Publications of PHTRC on postharvest horticulture from 1977–2009

Type of Publication	Number
Books and Proceedings	16
Handbook and Monograph	4
Bulletins, Circulars, Flyers	97
Research and Extension serials	9
Radio Script and Press Releases	13
Posters	8
Selective Dissemination of Information Serial	71
Training Manual	1
Total	219

Table 4. Specific IEC materials produced by PHTRC, 2001–2010

Item	Number Kind/Type/Issues	Copies Produced
Book on Postharvest Technology for Southeast Asian Perishable Crops (2nd ed)	1 edition	1,500
Keeping Baby Corn Fresh after Harvest	1	500
Singkamas Production, Postharvest, Handling, and Marketing: Consultation Forum Proceedings	1	500
Postharvest tips for horticultural perishables	10 major fruits, vegetables and cut flowers; 2 postharvest operations	12,000
Postharvest Handling Tips (technology-focused)	8 commodities	8,000
Posters on quality defects	3 commodities: mango, banana, eggplant	1,500
Ripening guide for bananas	2	1000
Calendar; banana handling tips	1	100
Training Manual: Production and Postharvest handling technologies for Balangon Banana	1	5
Total	25	25,105

field. In 1981, the Association of Colleges of Agriculture in the Philippines (ACAP) recommended that a postharvest technology course be instituted in the curriculum of each ACAP member. However as of 2007, less than 10 percent of the more than 200 agricultural schools or colleges are teaching it, mostly as information infused into existing crop science courses and sometimes as a separate subject (Bautista and Maunahan 2007).

Information dissemination and expert services

PhilMech and PHTRC regularly participate in different agri-trade fairs to promote postharvest technologies. Their staff also provide technical assistance to members of the industry and serve as subject matter specialists and technical resource persons in training programs organized by other agencies, with PhilMech focusing on postharvest handling of grains and PHTRC on postharvest handling of perishables. Extension support for postharvest systems improvement for horticultural perishables is usually done by the PHTRC through action-research or applied research projects, and by responding to industry requests. In most cases, farmers' association/cooperatives, and identified farmer/trader leaders or champions were the cooperators in the implementation of technology interventions and/or commercialization.

The PhilMech library has an extensive collection of information materials on grains postharvest, available to researchers and other interested parties. Information and extension materials on postharvest perishables from PhilMech are few, mostly on tramline and cold chain technologies. The PHTRC on the other hand, boasts of its extensive library collection on tropical postharvest horticulture. It has the largest collection of library materials on this subject matter in the Philippines and possibly among most Southeast Asian countries. It provides services and materials to support programs of instruction, research, and

extension, not only of its own researchers and extension officers and the faculty members of universities but also those of other government and private institutions. While the library has no budget allotment, it has nonetheless continued to acquire library materials through open e-resources and requests for the latest reprints and books on postharvest and related fields. It has accumulated a total of 18,646 journal articles; 4,172 books; and other library materials including theses, e-books, CDs, etc.

Number and profile of PhilMech and PHTRC personnel involved in postharvest extension

The quantity and quality of personnel from the major extension institutions providing extension services to the postharvest horticulture sector are critical factors in capacitating extension leaders in the field, and in disseminating information and technologies to the intended beneficiaries nationwide. As of 2010, PhilMech's Extension Unit had 15 extension personnel for the postharvest handling sector for grains and horticultural perishables, which is about 50 percent of the extension unit's total personnel, and 11 percent of its overall 131 personnel (Table 5). Most of the staff have a Master's degree, are in the age range of 41 to 50 years old, with 5–25 years of experience. The personnel involved in extension have varying fields of specialization (Table 6). Two-thirds of the extension staff are in the social science fields (e.g., agricultural extension, economics, rural development, and communication) while one third are agricultural engineers who serve as the technical staff.

On the other hand, there are 10 regular (with permanent or tenured positions) and four contractual personnel of PHTRC who are involved in extension activities on postharvest handling of perishables. Only one of the regular staff has an extension position, the other nine are faculty members and university researchers,

Table 5. Number of personnel providing postharvest extension services, 2010

	PhilMech	PHTRC
Total Number of Staff	31	16
Total Number of Staff Doing Extension in HVCC postharvest	15	10
Number of Project Staff (Contractual)	0	4

Table 6. Profile of PhilMech and PHTRC personnel involved in postharvest extension

Items	PHILMECH (BPPE)		PHTRC-UPLB	
	No.	%	No.	%
Education				
BS	6	40	3	30
MS	6	40	1	10
PhD	3	20	6	60
Field of Specialization				
Agriculture-related	8	53	2	20
Agricultural engineering	5	33	1	10
Postharvest horticulture	0	0	6	60
Communications/extension	2	13	1	10
Tenure				
Permanent	15	100	9	90
Temporary	0		1	10
Age range				
30 years and below	0	0	1	10
31–40 years old	10	67	1	10
41–50 years old	5	33	2	20
Above 50 years old	0	0	6	60
Year in service				
Below 5 years	0	0	1	10
5–15 years	8	53	1	10
16–25	7	47	4	40
Above 25	0	0	4	40

who perform all the three functions of teaching, research, and extension. Contractual personnel are usually researchers (e.g., in action research projects) who perform little extension function.

The personnel of PHTRC represent only 4 percent of the total faculty, research, and extension staff of the College of Agriculture (244), UPLB. Most of the staff have PhDs, are above 50 years old, with over 25 years of experience. Most of the staff are specialists in the field of postharvest horticulture with various sub-specializations such as physiology, morpho-anatomy, biochemistry,

and engineering. The personnel in the field of social sciences (e.g., agricultural economics, development communication, and community development) have also received technical training on postharvest horticulture.

The number of personnel in extension for postharvest (25) in the two institutions is relatively very small considering that they are catering to millions of stakeholders of the horticulture industry in the 16 regions of the country. While education, expertise, and experience can be considered the strengths of the two institutions in providing postharvest

extension, the relatively aging personnel (although PhilMech's extension personnel are relatively younger compared to those of PHTRC) can also be an area of concern because hiring new staff or filling up the posts of retired personnel becomes difficult due to budgetary constraints (i.e., decreasing allotment for the SUCs). The number of PHTRC regular staff had been reduced from 15 in 1977 to 10 in 2009 (Serrano 2010). In the same manner, PhilMech's extension staff had also been reduced due to the rationalization program of DA.

Considering local and export demand for fruits, vegetables, and cut flowers, Serrano (2010) already pointed out the need for additional manpower for PHTRC. To function properly and address the multifaceted concerns of the postharvest horticulture sector, the PHTRC should have an additional staff with multidisciplinary expertise in physiology, biochemistry, morpho-anatomy, entomology, pathology, socioeconomics, engineering, microbiology, biotechnology, extension, and ICT. The same may hold true for PhilMech (even if its focus is mechanization) and for other extension providers such as the DA's Agricultural Training Institute (DA-ATI) (which is the lead agency in agricultural extension) and SUCs to provide technical backstopping in postharvest horticulture.

Strengths and Weaknesses in Postharvest Extension Delivery

The basic mandate of both institutions is to build the capability of trainers who are the extension workers of the LGUs and DA agencies, non-government organizations, and researchers and faculty members of SUCs. The trained personnel are expected, in turn, to provide training to their respective constituencies, particularly to farmers, traders, and other service providers of the horticulture

industry.

However, due to lack of trained experts in the field, the two agencies still assume the responsibility of training the direct users of technology. In a sense, this becomes both a strength and weakness of these institutions. It is a strength because they are able to reach out or provide extension services to the different stakeholders of the postharvest horticulture sector. It is a weakness because the agencies responsible for providing these services are not obliged or compelled to develop their capability to perform this mandate.

The basic strength of PhilMech is on the postharvest handling of grains, especially on the engineering aspect. Hence, the staff can render expert services in support of technology-based equipment and facilities development for tramline and cold chain systems and packinghouses. It also has funding support to strengthen its extension services, although it has yet to develop expertise on postharvest handling of horticultural perishables (Table 7).

On the other hand, PHTRC has a competent multidisciplinary team of experts on postharvest horticulture but because they are very few, most are burdened with doing the multiple tasks of research, teaching, and extension. Because of these, plus the limited budget for extension activities, PHTRC had not been able to expand the scope of its extension activities.

For the PHTRC, there is an urgent need for financial support, in order to expand its RDE activities to generate more technologies and reach out to more stakeholders in the horticulture sector. This is in terms of additional manpower (who will effectively address the varied needs of the postharvest horticulture sector) and upgrading of its facilities for research/technology generation (Serrano 2010). The center will also need to strengthen its linkages and establish new ones for collaborative undertakings, especially the complementation

Table 7. Strengths and weaknesses of PhilMech and PHTRC in the delivery of postharvest extension services to the horticulture sector

Particulars	PHILMECH	UPLB-PHTRC
Strengths		
Has competent experts who can render extension services to the various stakeholders of the postharvest horticulture sector	✓	✓
Has competent personnel on engineering-mechanization aspect of postharvest handling		✓
Has multi-disciplinary pool of experts who can render extension services to the postharvest horticulture sector	✓	
Availability of postharvest handling technologies, basic information and handling protocols for dissemination		✓
Have the sufficient funding and facilities to do its extension mandate; funding for production of IEC materials; modern training facilities	✓	
Availability of wide array of IEC materials		✓
Has dedicated or separate staff to do extension work	✓	
Weaknesses		
The few personnel are doing multi-tasks of teaching, research and extension		✓
Has yet to develop expertise on postharvest horticulture both in the extension unit and R and D cluster	✓	
Has no regular funding allocation for extension (including (R&D) activities		✓
Declining number of personnel	✓	✓

projects initially undertaken with PhilMech in the implementation of postharvest horticulture extension (including research) projects.

Although project complementation between PhilMech and PHTRC is still continuing, this is usually done on short-term projects and mostly through action-research or applied research. For extension projects, PhilMech just taps PHTRC staff to serve as resource persons in their training courses on postharvest handling of perishables. It is high time that a long-term complementation program on extension, including research, be initiated. Moreover, since the basic mandate of both institutions in training is supposedly to build the capability of trainers only and not the direct users, they should also institutionalize linkage with the DA-ATI (being the provider and coordinator of

national agricultural extension support services) as a partner in their training programs on postharvest. In order to make complementation and institutional linkages work, Dy et al. (2008) said that a common framework for action that is acceptable to all involved must be laid down.

CONCLUSION AND RECOMMENDATIONS

There is a need for better and more postharvest extension delivery services and programs in the Philippines to meet the challenges of global trade. Such will result in increased profitability and income of industry stakeholders, particularly small farmers. Only a few state-run agricultural colleges and institutions are known to provide limited expert

services in the areas where they are located, so the two major extension service providers in the field of postharvest horticulture are PhilMech of DA and PHTRC of UPLB.

An analysis was made from a survey of the extension delivery programs and activities of PHTRC and PhilMech with regard to postharvest handling of horticultural perishables to determine the nature and extent of extension delivery systems and activities.

From 2000–2010, PHTRC implemented 93 percent of the national extension projects and services. It implemented a total of 51 training programs with a total of 1,132 participants. It also produced and disseminated 24 extension materials (21,105 copies), provided technical assistance, and implemented a few action-research projects. On the other hand, PhilMech, the foremost institution on grains postharvest, conducted 16 programs on postharvest handling of perishables, with 437 participants, but 75 percent were focused on the technical operations of cold chain and tramline facilities.

The combined data of the two major extension providers in the last 10 years showed that on the average, six to seven training programs are conducted per year on postharvest handling of horticultural perishables benefitting a little over 150 participants, most of whom were farmers. While postharvest handling is an important component in expanding domestic and international markets for perishable crops, the PHTRC is currently still the sole institution in the country that provides extensive training on postharvest science and technology for fresh produce.

The basic mandate of both institutions in training is supposedly to build the capability of trainers who will, in turn, provide training to farmers, traders, and other stakeholders of the horticulture industry. However, due to lack of trained experts in the field, the two agencies still assume the responsibility of training the

direct users of technology. In a sense, this becomes both a strength and weakness of these institutions.

Postharvest IEC materials are still limited, and most of these were actually developed by PHTRC during the 1980's and 1990's when it was still serving as the ASEAN regional center and when there were sufficient funds allotted for extension.

The budget allotted to the extension program is very small. For PhilMech, the extension budget is only 6 percent of the total, while for PHTRC, extension projects have no regular funding support but are usually implemented through the action-research projects funded by outside sources. Around 70 percent of PhilMech's budget was spent on the establishment of flatbed dryers for rice (2008), while only around 1 percent is devoted for both research and extension of perishables.

The total number of personnel in the two institutions doing extension work is also small: 10 from the PHTRC and 15 from the PhilMech. Sixty-seven percent of the extension personnel of PhilMech have social science background while 33 percent are agricultural engineers. Most have MS degrees. PHTRC's staff members, mostly with PhDs, are multidisciplinary and have all received technical training on postharvest science. PhilMech's strength lies in its competent, young personnel in the mechanization aspect of postharvest (who are specified to do extension work), and because funding is available. PHTRC's strength is in terms of its multidisciplinary team of experts; they are few, however, and have to teach and do research at the same time. Moreover, PHTRC has no funding for specifically extension.

To function properly and address the multifaceted concerns of the postharvest horticulture sector, the PHTRC should have additional staff, ideally multidisciplinary experts in physiology, biochemistry, morpho-anatomy,

entomology, pathology, socioeconomics, engineering, microbiology, biotechnology, extension, and ICT. The same may hold true for Philmech (even if it focuses on mechanization), and for other extension providers such as DA-ATI and SUCs so they could effectively provide technical backstopping in postharvest horticulture.

On the whole, despite the limited programs, manpower, and resources for extension, PHTRC and PhilMech recognize the importance of developing postharvest horticulture technologies for fresh produce and extending such information to users. Recommendations to improve the extension delivery system and activities for policy considerations are as follows.

National review of agriculture extension

The program thrusts of agricultural extension should be reviewed to give more, if not equal, focus on production and postharvest aspects, including fund allocations. Moreover, extension projects that promote infrastructure/facilities and equipment must be complemented with training on basic postharvest handling and other forms of capability building. The national government, through the DA, needs to examine the infrastructure, facilities, and capabilities of PHTRC and PhilMech to meet the demands of horticultural perishables. The postharvest extension focus must capitalize on the strengths of the two major institutions.

Complementation and linkages

PHTRC and PhilMech can complement each other's manpower and resources in the implementation of postharvest extension, thereby minimizing duplication of efforts. A long-term complementation program needs to be formalized and institutionalized through a Memorandum of Agreement (MOA) between the two institutions. The MOA must specify

activity collaborations not only in the extension aspect but also research and development undertakings on horticultural perishables, which is currently done only on short-term projects. There should be a clear delineation of the focus of or subject area of specialization for each agency, so that resources and knowledge transfer can be maximized.

Philmech and PHTRC, through the complementation program, should also establish strong linkages with the DA-ATI as the main provider and coordinator of national agricultural extension support services together agricultural SUCs nationwide. The regional ATI centers and SUCs can be orchestrated to form zonal centers of postharvest extension and research. Institutional collaborations can ensure sustainability of the extension delivery system in the postharvest horticulture sector.

Manpower development

All extension service providers included in the survey identified both formal education (graduate degrees/diploma courses) and informal training as the priority intervention. Funds have to be provided for additional manpower, especially for the PHTRC internship program, which provides mentoring and development of complementary fields in postharvest horticulture. Scholarships and fellowships must also be provided to faculty members and researchers in SUCs as they are the ones who will provide technical backstopping to DA extension personnel in the various regions of the country. Postharvest handling technologies change so fast that the industry will stagnate without continuous updating of the different stakeholders in the supply chain.

Establishment of zonal centers

The role of DA-ATI in facilitating postharvest extension delivery system should be strengthened. DA-ATI, as the orchestrating agency for agriculture extension, can initiate

the formation of network linkages among the major postharvest extension providers and the subsequent establishment and funding of zonal centers for extension and research in strategic areas in Luzon, Visayas, and Mindanao through this network. The zonal centers for research and extension can be based in agricultural schools with PHTRC as the national center. This will ensure that capacity to respond to postharvest problems in localities will be faster and development of trainers will be more effective.

Working group on postharvest horticulture

A postharvest horticulture network working group can be established with DA as the lead agency to provide a forum for communication on postharvest handling of horticultural perishables. The working group members will come from all institutions—academic, research, extension, financial, and regulatory bodies and agribusiness enterprises; agricultural cooperatives and associations; and others involved in the postharvest industry. It can also provide a venue for promoting collaborations and partnerships among and between the public and private stakeholders of the postharvest horticulture industry to minimize duplication of efforts.

Knowledge bank on postharvest horticulture

While the PHTRC library has the largest collection of library resources on postharvest horticulture in the country, its website should be enhanced, its library collection expanded, linkages with local and international libraries improved, and its facilities upgraded.

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