Returnable Plastic Crate (RPC) systems can reduce postharvest losses and improve earnings for fresh produce operations

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The Postharvest Education Foundation (PEF)

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Introduction

Several decades of postharvest research studies, consulting on development projects and observations made during fieldwork in many areas of postharvest technology in more than 20 developing countries have consistently pointed toward enormous problems with perishable food losses and high levels of damage to fresh produce during the postharvest period due to the use of poor quality packages and containers. The members of the board of directors of The Postharvest Education Foundation have concluded that improved containers would be one of the more practical and cost effective changes that could be made on an incremental basis by smallholder food producers, handlers and marketers.

The World Packaging Organization (WPO) General Secretary Carl Olsmats and the International Packaging Press Organization (IPPO) President Bo Wallteg, published a joint position paper in 2009 that highlighted the key contributions of packaging to agricultural sustainability and the fight against hunger in the world. WPO and IPPO are promoting improved packaging and logistics systems, and say that the forecasted increased global demand for food does not necessarily require increased production, but better packaging usage to ensure less food is wasted (WPO, 2009).

The use of returnable plastic crates (RPCs) for harvest, packing, transport and storage of fresh produce has repeatedly been shown to reduce damage and postharvest losses. In 2011, the SAVE FOOD! Interpack2011 Congress produced a report on the use of appropriate packaging for developing countries, in which RPCs are included in the category of innovative packages, since they reduce damage and better allow produce to withstand transport over rough roads, and are reusable many times (FAO, 2011). Returnable, reusable plastic containers are designed to be durable containers and have become common in the agri-food industry (Vigneault et al, 2009). UNFAO regional offices are currently introducing and promoting RPCs in Greater Mekong Sub-region (GMS) countries for selected vegetables and fruits (Rapusas, 2013). RPCs are ideal for handling fresh horticultural produce and other food since they were specifically designed for maintaining the quality of the produce (Vigneault et al, 2009).

One recent study, reviewing the use of RPCs for 10 fresh produce commodities, concluded that RPCs required 39 percent less total energy, created 95 percent less solid waste, and generated 29 percent less total greenhouse gas emissions than corrugated display ready containers (Source: PackagingRevolution.net white paper, 2012).

Use of RPCs in many countries for handling and storage of many types of fruits and vegetables can be highly cost effective, since overall RPC costs are often lower than the savings that can result from reduced food losses. While there are many factors to consider before making any large investment, a simple cost and benefit calculator worksheet developed by PEF can be used to plug in estimated local costs and expected economic benefits for small scale operators to check the numbers before making any investments. A sample spreadsheet is provided in Appendix A, and an Excel file spreadsheet is available for download from the PEF website.

Typical uses of RPCs

This desk study begins with the assumption that returnable plastic crates will be used to replace the typical poor quality containers currently in use in most developing countries. Boyette et al (1996) reported that a significant percentage of produce buyer and consumer complaints are traced to container failure because of poor design or inappropriate selection and use. These poor quality containers include cloth bundles, jute or polypropylene sacks, woven baskets, and flimsy low quality crates made of thin plastic or Styrofoam. RPCs can also be used to replace expensive single use fiberboard cartons, as well as locally made crates that are constructed from rough wooden planks or palm ribs. Many of these packages use natural resources to manufacture and wind up either being transported to landfills or decomposing underfoot as debris in marketplaces after one or two uses.

The illustrations provided in Figures 1 through 9 are examples of the many types of poor quality packages and containers currently in use in developing countries.

Figure 1a and 1b: Enlarged sacks for cabbages in Ghana and India (Photo credits: Adel A Kader (1a) and Amity University (1b), both 2009)

Figure 2: Woven baskets of fruits and vegetables waiting for transport in Nepal
(Photo credit: Lisa Kitinoja, 1999)

Figure 3: Mixed lot of poor quality containers in use for produce transport in Cape Verde
(Photo credit: Lizanne Wheeler, 2008)

Figure 4: Single use lightweight plastic crates for citrus fruits in Lebanon
(Photo credit: Hala Chahine, 2007)

Figure 5: Styrofoam crates used for vegetable marketing in Jordan (Fintrac, 2012)

Figure 6: Low quality fiberboard cartons of pineapples collapse during high humidity cool storage (McGregor, 1987)

Figure 7: Huge wooden crates of 50 to 60 kg of tomatoes in northern Ghana (Photo credit: Adel A. Kader, 2009)

Figure 8: Overloaded palm rib crates of vegetables in Egypt (Photo credit: Awad M. Hussein, 2011)

Figure 9: Cloth bundle of leafy vegetables ready for transport in Benin
(Photo credit: Hala Chahine, 2009)

Recently, RPCs have been promoted by national governments and international development projects, and are being used more often during field packing, for transport, or in cold storage. Rapusas and Rolle (2009; p.12) state, "In many developing countries, there has been the rapid adoption of plastic crates for bulk packaging of selected fresh produce items and this growth has offered new business opportunities for service providers such as farmers groups or clusters, cooperatives, traders, commercial farmers and foreign agribusiness firms, and even the plastic crate manufacturers who are engaged in rental services to farmers."

Rapusas and Rolle (2009) also report: "Increasing adoption of plastic crates for the bulk packaging of fresh produce in developing countries is stimulated by their reusability, their contribution to post-harvest loss reduction and the alleviation of human drudgery, buyer preferences and government support."

Four recent examples of RPC use include 1) a USAID project in Afghanistan where RPCs were provided by CNFA to tomato farmers for use during transport to market (CNFA, 2006), 2) the Government of India's subsidy program for postharvest investments, where 50% subsidies are provided for the purchase of RPCs, 3) Sri Lankan governmental efforts to promote the use of RPCs for fresh produce marketing and 4) USAID Hort CRSP sponsored demonstrations of the use of RPCs for cold storage in Tanzania (AVRDC, 2012).

Sri Jayewardenepura University – Institute of Postharvest Technology in Sri Lanka, introduced plastic crates to farmers, collectors and wholesale traders for transportation of fruits and vegetables under the "Fresh Produce Chain" concept that was initiated in 2001. The crates cost about US$5.00 and the government provides a 50% subsidy to the buyers. An exchange system has been developed wherein the farmer or trader who delivers a full crate of produce to the buyer gets an empty crate in return. In a study on RPC use conducted in Sri Lanka, the quality and safety of vegetables reaching the consumer were improved appreciably. In the case of mangoes and avocados, the use of plastic crates for handling and transportation resulted in a reduction of losses from 30% to 6% (Fernando, 2006).

The illustrations in Figures 10 through 12 are indicative of current and increasing use of RPCs in various developing countries.

Figure 10: RPCs in the markets of northern India (2012)
http://archives.lincolndailynews.com/2011/Aug/30/News/news082911_w.shtml

Figure 11: Stackable RPCs in use from farm to market in Sri Lanka (2009)

Figure 12: RPCs in cool storage in a Zero Energy Cool Chamber in India (Photo credit: Amity University, 2009)

Types and sizes of RPCs

An important factor to consider when making an investment in RPCs is the many shapes and sizes of plastic crates and matching these characteristics properly to the intended use. Use of containers for packing fresh produce is intended to serve two primary purposes: to ease bulk handling by providing a convenient sized load for the handlers, and to provide protection for the produce during handling. In addition, RPCs can help to facilitate cooling and to prevent condensation which can promote decay. Different sizes are available for different types of produce; for example, use of a shallow style RPC is best suited for delicate produce such as okra, herbs or snow peas. Appendix B provides illustrations of just a few examples of the many types and sizes of RPCs available for produce handling.

Medium size RPCs are suitable for field packing and handling most horticultural commodities during transport. Crate capacity is a key factor in reducing losses as a result of compression. A transport trial conducted by the Post Harvest Training and Research Center (PHTRC) in 2004 in the Philippines which compared compression damage for eggplant packed in 10 kg capacity polyethylene sacks and plastic crates of 10 kg and 13 kg capacity respectively, showed a reduction in compression damage from 54% for eggplants transported in polyethylene sacks to 4.4% for eggplants transported in 13 kg crates and 2.8% for eggplants transported in 10 kg crates (Rapusas and Rolle, 2009).

Large crates that can hold higher weights of produce (15kg to 25kg or more) are considered to be more suitable for packing more sturdy crops such as onions, potatoes or carrots. These larger crates are also suitable for longer term storage uses as opposed to every day handling since lifting and carrying such heavy crates can be difficult for most individuals.

Most plastic crates are manufactured from high density polyethylene (HDPE). Polyethylene offers good strength against impact (preventing breakage) and provides a high level of protection against degradation by ultraviolet radiation from sunlight (Rupasas and Rolle 2009).

There are three typical designs for RPCs, and all three provide for ease of handling and protection of the produce. The first type is stackable, but not "nestable", so empty crates take up the same amount of space as full crates. This type of design may increase the costs of returning empty crates, and so is used mostly for storage in systems where the RPCs remain within one facility and are reused each season (Figure 13).

The second type is made to be nestable when empty (Figures 14-15), and the third type is designed to be collapsible when empty (Figures 16 and 17). Both of these designs will help reduce the transport costs associated with empty RPC returns.

Nestable crates are available in a variety of sizes and shapes, and are slightly sloped with a narrower bottom so they can fit "nested" down inside one another when empty and stacked. Typically the RPCs will be of a shape that is slightly different on one end than the other, so reversing one crate's direction will make it stackable, and keeping all the crates lined up in the same orientation will make them "nestable". It is also possible to find stackable/nestable crates that have moveable (swing bar) metal handles, where moving the handles to the inner position makes the crates stackable, while moving the handles to the outer edge makes the crates nestable (Figure 15).

Collapsible crates takes up much less space when empty and folded up (typically $1/5^{th}$ of the space required for a full crate), but can be more difficult to find, more expensive to purchase, and have hinges that can break with repeated use.

Regardless of which size and type of RPC is used, the crates must have adequate but not excessive venting (5% is optimum since it provides for both strength and adequate airflow) and the quality of plastic must be high enough to with stand stacking. The interior of the RPCs should be smooth to prevent damage to any fresh produce packed inside. If the interior is rough or there is too much venting, a low cost paper or lightweight fiberboard liner can be added to the RPC (Figure 18). Fiberboard liners for RPCs can reduce abrasions and physical damage during transport, and/or can be used to block some of the container's vent holes in order to help reduce water loss during transport, but may impede cooling.

Figure 13: Stackable RPCs, shallow style

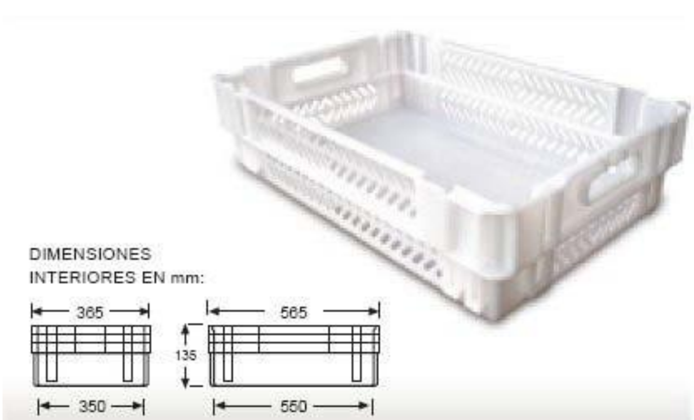

Figure 14: Two designs for stackable/nestable RPCs

Figure 15: RPCs nested for return transport (Rupasas and Rolle, 2009)

Figure 16: Collapsible (foldable) style RPCs (Photo source: GD Wholesale, 2013)

Figure 17: Collapsible RPCs in use in Sri Lanka (photo is showing how the volume of 5 folded crates = 1 open crate). Visit TranPak Inc's website to watch a short video of collapsible RPCs: http://www.youtube.com/watch?v=UI7tRIq_-BY

Figure 18: Fiberboard liners for RPCs
(Photo credit: Amity University, Noida, UP, India, 2009)

Costs and Benefits of the use of RPCs

Plastic crates are designed to be stackable, due to their uniformity in size and shape and are very strong. Therefore they are able to prevent damage to the produce being handled in the crates. RPCs are designed to be sturdy, easy to clean, capable of retaining their full strength while wet, and to be reusable for many years.

RPCs have the potential to replace single-use containers and reduce waste and costs. IFCO-USA (2013) and Singh et al (2006) report that RPCs use 39% less energy to produce as compared to single use containers, and produce 95% less solid waste than do corrugated fiberboard containers when used for handling fresh produce.

RPCs are designed to include wall openings (vents) that facilitate ripening, cooling and air circulation (Vigneault et al, 2009). Users report that they reuse RPCs 150 times or more before having to replace the crates. When properly used (not overloaded or packed above the top edge), RPCs can greatly reduce physical damage, thereby reducing fresh produce losses from the typically reported average of 30% to 5% or less.

In the CNFA project in Afghanistan, tomatoes were being handled in plastic bags during a 22 mile trip to the Herat market, resulting in up to 50% losses. The investment in 1500 RPCs for use during transport helped farmers to reduce these losses to less than 5%. While the benefits of using improved containers such as RPCs can be obvious, the cost of packaging is dependent on: a) the type of packaging; b) the size of the package; c) the design of the package; d) the number of packages purchased; e) transport and import costs and duties where applicable; f) assembly cost in the case of carton boxes; and g) the need for packaging accessories such as liners, pads and dividers (Schuur, 1988).

In Sri Lanka, Jayathunge et al (no date) studied the effects of different kinds of packages on vegetable crops during handling and transport. The economic feasibility of each package type for handling and transportation of each commodity was calculated using a cost-benefit analysis. Losses using the traditional packages (sacks) ranged from 10 to 30% for a variety of vegetable crops, while losses when using improved packages were generally reduced to 5% or less. For green beans, postharvest losses when handled in sacks was measured to average 22%, while the same crop handled during the same time over the same route suffered only 4.6% losses when handled and transported in nestable plastic crates.

According to Jayathunge et al,

"Ten types of packages, selected from those available in the market and also those developed by various institutions were used for evaluation. The types of packages selected were: nestable plastic crate (large and small size), collapsible plastic crate (large and small), steel collapsible crate, wooden box designed by ITI, wooden boxes designed by IPHT, fiber board box and wax coated fiberboard box. The evaluation study was conducted by transporting the fresh produce from farmer's field to Keppetipola Economic Center and then to Manning market, Colombo." The smaller nestable plastic crate of dimensions 52.5x35x30 cm was identified as the most suitable package for handling and transportation of tomatoes and the large nestable plastic crate of dimensions 60x42.5x30 cm was identified as the most suitable package for other vegetables such as beans, cabbage, brinjals (eggplants) and curry chilies, and the distance the produce traveled during the trials was approximately 230km.

The example in Table 1 is a cost-benefit analysis of the use of packages from farm gate to market and was modified from the analyses provided in Jayathunge et al (no date). The weight of produce handled in each type of package is consistent with global norms, where sacks are usually large and when filled can be very heavy, while RPCs are generally limited to a capacity of 20kg or less. The original study assumed that the selling price would be the same across all types of packages, but often the market price per kg will be slightly higher since physical damage is lower. Even though improved reusable containers initially cost more per unit than traditional packages or fiberboard cartons, the use of nestable plastic crates results in higher profits (Rs 2800 or US$28 per load) due to a combination of reduced postharvest losses and long term reusability (longest container life span).

Table 1: Cost benefit analysis for chilies packed in polysacks and rigid containers packed at the farm gate (1000 kg of chili peppers)

Parameters	Polysacks	Wax coated fiberboard carton	Nestable plastic crate (large)	Collapsible plastic crate (large)
Production cost	Rs. 35000	Rs. 35000	Rs. 35000	Rs. 35000
Capacity				
Average weight /unit	38.0 kg	11.0 kg	16.0 kg	12 kg
Number needed	27	91	63	84
Capital cost				
Unit cost of packages				
Cost for packages	Rs. 15.00	Rs. 150.00	Rs.559.00	Rs.450.00
Fixed cost	Rs. 405.00	Rs.13650.00	Rs.35217.00	Rs.37800.00

Table 1 continued				
	Polysacks	Wax coated fiberboard carton	Nestable plastic crate (large)	Collapsible plastic crate (large)
Life span of a package (# of uses)	2	4	215	144
Depreciation of package	Rs. 202.50	Rs. 3412.50	Rs.163.80	Rs.262.50
Variable cost				
Handling charge/unit	Rs.15.00	Rs. 15.00	Rs.15.00	Rs. 15.00
Handling charges	Rs. 405.00	Rs. 1365.00	Rs.945.00	Rs. 1260.00
Total revenue				
Losses/1000 kg load	88.0 kg	4.0 kg	13.0 kg	15.0 kg
Selling price/kg	Rs.44.00	Rs.44.00	Rs.44.00	Rs.44.00
Total revenue	Rs.40128.00	Rs. 43824.00	Rs.43428.00	Rs. 43340.00
Gross profit	Rs. 4520.50	Rs. 4046.50	Rs. 7319.20	Rs. 6817.50

100 rupees = US $1 (exchange rate in 2006)

During 2009 through 2011, the Sri Lankan government attempted to make the use of plastic crates compulsory for handling fruits and vegetables, but the return system was not fully established and the promised subsidies for the purchase of RPCs were not yet in place. After a series of public protests by vendors and produce traders the policy was suspended.

RPCs are useful for handling many types of fresh produce and can be used during field packing, for transport, in temporary or long term cold storage, and even during pre-cooling or in retail marketing displays (Figures 19 through 24).

Figure 19: Use of IFCO's RPC system during field packing of strawberries for Kroger's supermarket (Photo source: IFCO website, 2013)

Figure 20: Use of RPCs for transport of tomatoes in Afghanistan (CNFA, 2006)

(Photo credit: Amity Univ., Noida, UP, India)

Figure 21: Use of RPCs in temporary cool storage of vegetables in a ZECC in India (2009)

Figure 22: Use of RPCs for long term cold storage (Source: Jindal Mectec Pvt. Ltd.)


Figure 23: Use of RPCs during forced air pre-cooling in Bali, Indonesia
(Photo credit: Lisa Kitinoja, 2007)


Figure 24: Use of RPCs for retail display in Rwanda (Photo credit: Dan McLean, 2011)

Several recent studies have documented the technical benefits of the use of RPCs in developing countries for handling fresh produce. During 2009-10, UC Davis and WFLO collaborated on a postharvest research study for the Bill and Melinda Gates Foundation, and reported that the use of RPCs in Cape Verde for field packing during a Millennium Challenge Corporation (MCC) funded project reduced losses in tomatoes from 30% to 10%. Two sizes of plastic crates were field tested in Cape Verde – a full size crate to be used for field packing and temporary storage of carrots, potatoes and cabbages, and a shallow crate to be used for tomatoes, peppers, squash and more delicate crops. The length and width of both crates were of the same dimensions so they could be stacked together when transporting or storing a mixed load. The cost of purchasing plastic crates in Cape Verde was very high compared to other countries ($10 to $18 each, depending upon size and source) because the crates must be transported to the islands via air or ship, yet the return on investment is still positive for farmers.

RPCs may not be cost effective for handling and transport of all types of produce in all countries, but in general, RPCs are often cost effective when fresh produce market prices are relatively high, such as for higher value vegetable or fruit crops, or for any crop if sold during the off-season or can be supplied early in the season when the first harvests are coming to the market.

Costs of RPC systems

According to Vigneault et al (2009), a 2006 survey of California table grape containers showed that RPCs were the least expensive box type to use for handling and transport. A corrugated fiberboard container cost about 20% more than the cost of leasing an RPC. Expanded polystyrene (EPS) and wood boxes cost about 50% more than RPCs. Leasing RPCs is a way to reduce the initial costs as compared to outright purchase, however a leased RPC by contract typically must be used quickly and therefore cannot be used for long term produce storage.

It is recommended to purchase or lease at least two to three times the estimated number that will be needed at the farm or packinghouse per day, since typically up to two thirds of the RPCs will be in transit and/or at the market at any given time. The costs to consider when investing in the use of RPCs include:

1) initial cost of RPCs (if purchased) or annual fees for use (if RPCs are leased)
2) costs for full RPC transport from farm or packinghouse to market (transport costs may be higher than for traditional containers such as sacks, since more loads may be needed to transport the same volume of produce in RPCs)
3) any extra labor costs associated with RPC handling/packing/storage (i.e. smaller sized containers may require more labor for packing and loading; empties may need to be moved in and out of a storage area as needed)
4) replacement cost (losses due to breakage or pilferage)
5) costs for cleaning and sanitizing (labor, water and supplies)
6) costs for return transport of empty RPCs from market to farm or packinghouse

Carney et al (2000) provides the following diagram to illustrate how the costs contribute to the feasibility of using RPCs for any given type of produce. The diagram is based upon findings of a research study done for Alameda County (California) on baby carrots and red grapes.

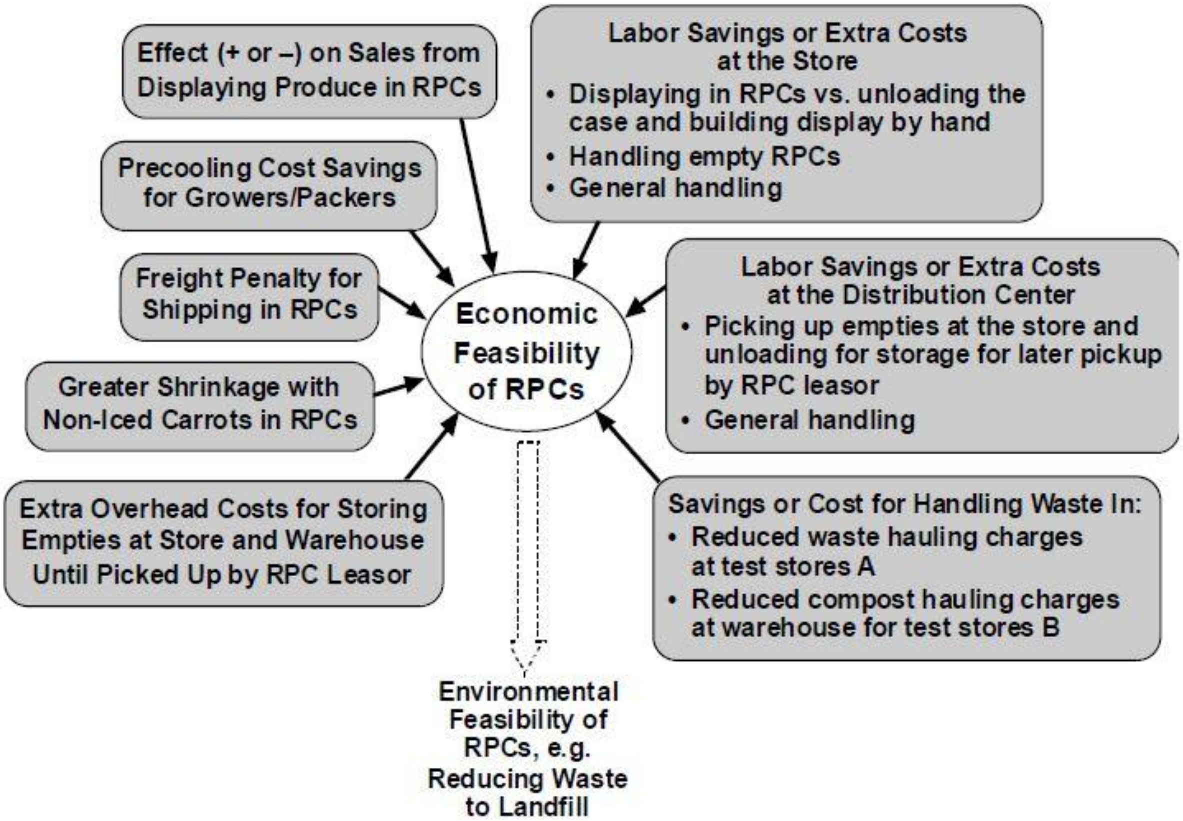

Figure 25: Major factors to consider when assessing feasibility of the use of RPCs (Source: Carney et al, 2000)

Food safety considerations require the use of Good Agricultural Practices (GAPs) whenever using RPCs, including proper hygiene of workers, approved cleaning and sanitation practices in the packinghouse and during RPC storage, and appropriate pest management practices. Reuse of any container introduces the possibility of cross contamination from the container. Decay organisms and human pathogens can move from a dirty container to the product held within the container. A program of regular cleaning and sanitation of the RPCs is important to maintaining the quality and safety of the contents. Rapusas and Rolle (2009) provide detailed guidelines for RPC management and logistics, including temporary storage, cleaning and sanitation practices. In the Philippines, annual pilferage can reach 20%, and the estimated cost of cleaning and sanitizing after each use is $0.05 per crate.

Keeping good records on the ordering, accounting, invoicing, and monitoring of containers must be part of any successful RPC use system. Since all these costs can add up to a substantial investment, the initial use of RPCs will often make economic sense only for higher value crops. Once an RPC system is in place, using the existing

RPCs for handling and transport of additional crops during the off-season for the primary crop can increase the return on investment.

Types of RPC utilization and distribution systems

Globally there are many different types of RPC management systems. Each one deals with the logistics of transport, cleaning/repairs, getting empties back to growers, etc. in different ways. The choice of which of the many options is most suitable for your own operation will depend upon which services are available locally and what the costs are for purchase versus rental or lease, fuel for transport, labor for cleaning, etc.

Business models and approaches

The following examples of business models represent the different kinds of RPC distribution systems and the varying approaches that are in use in various parts of the world.

1) Grower/shipper owned

This model works best when the buyer uses the crates for operations within the control of the RPC owner, such as for harvest, pre-cooling or temporary storage. An example comes from India, where Euro Fruits –India uses RPCs on their own farms and in their packinghouse for the harvest, transport and postharvest handling of table grapes. Each crate holds 5 to 6kg and costs approximately US$6. The company reports that they can use the same crates each day for 10 to 12 years (during the 4 month grape harvest season from January through April each year). The farms are located 50 to 70 km from the packinghouse, and the company has found that bruising during transport can be further reduced if they add a foam pad to the bottom of each crate before filling the RPC with grapes.

2) Plastic crate manufacturer owned/rented or leased to users

Most small farmers will need plastic crates only during the harvesting period, and if they don't have any other specific use for the PRCs during other periods then storage of the crates can become a costly issue for them. Being able to rent or lease RPCs during the harvest period is therefore a practical approach.

An example of a company in the USA utilizing this business model is BungoBox (http://bungobox.com/faqs/). According to their website, “every time you use BungoBox, environmental pressure is reduced and the planet is a little healthier. One BungoBox can be reused up to 400 times, saving up to 3000 gallons of water, 2000 Kilowatt hours of energy and 40 gallons (151 liters) of gasoline compared to fiberboard boxes.”

Dimensions: 27in x 17in x 12in = 2.5 Cubic Feet (0.7 Cubic Meters)
Made of durable, recyclable plastic

Available for rent: $1.75 per week/box (pickup and delivery is included in the rental price) or for sale: $19.99 per box

According to Ken Marsh (2012), a commonly used business model that is used for pallets also works for crates. CHEP is a company that rents pallets and RPCs as well as bins and other containers. A farmer or produce company can rent a crate at the origin and return it when empty at the destination. CHEP closes the distribution loop by handling the logistics for companies that cannot back haul crates (or pallets) economically. The CHEP website provides a case study of how use of RPCs can reduce damage to fresh produce (CHEP, 2013).

Rapusas and Rolle (2009) describe a lettuce operation in the Philippines in which the plastic crates are rented from a service provider who is also a manufacturer of plastic crates for the food industry. The crates are 52 cm long, 35 cm wide and 27 cm high, stackable and nestable and have ventilation holes and rust-free handles for easy handling. Each RPC is rented from the service provider at a cost of 35 pesos (1 US$ = 54 pesos) per "use" (where one "use" covers the movement of the full RPC from the farm to Manila market.)

3) Deposit system

In this system the user pays the owner of the RPCs a deposit for every container s/he uses. The deposit equals at minimum the market value of the containers. The sender debits the recipient for this deposit, who does the same with the next recipient, and so on. The moment the RPCs reach their final destination in the marketing chain, they are collected by the owner. At this point, the owner refunds the deposit to the party from which the containers were collected. The deposits finance any losses and theft of the containers, so, a tracking and tracing system to control the flow of containers is unnecessary. Finally the high deposit cost also stimulates the quick return of the containers, so the rate of circulation of the RPCs is expected to be high.

4) Produce buyer owned/managed/provided to users

An example of a retailer controlled RPC system comes from the UK (Twede and Clarke, 2005). Reusable crates on wheeled racks are widely used as shipping containers for fresh grocery products in grocery stores. The RPCs are packed at the growers' locations, transported to the retailer's distribution center and sent out to the retail stores where they go directly into displays. Empty containers are collected and shipped to a retailer-controlled site where they are washed and redistributed to growers for the next use. In most cases, a third party logistics provider controls the container returns.

According to Twede and Clarke (2005), although initial purchase and disposal costs savings were considered by the British grocery industry, the most important justification for implementing an RPC system was efficiency. They desired more sturdy interchangeable interlocking modular containers to improve the productivity of produce handling, order picking and shelf stocking. Many of the produce warehouses are now simple cross-dock operations that depend on the modularity of containers and mixed loads are easier to handle and more stable during transport because of the standard interlocking footprint of all of the RPCs. Shelf stocking is quicker because a full container is simply swapped for an empty one. Damage has been reduced through minimizing manual handling. The perishable nature of the fresh products, with a very short supply cycle, minimizes the number of containers required in the system. The UK also has geographic and demographic factors that favor reusable packaging: shipping distances are short and landfill costs for disposable packages are high.

In India there are three approaches being followed by many produce traders and modern retailers. In the first they maintain extra crates in their inventories. The retailers maintain anywhere from two to five times the typical inventory of RPCs. They transport produce from destination A to B in these crates and when a sufficient volume of empty crates accumulates at destination B (a full truck load) then they send them back to destination A in one backload.

The second approach being used is to sell the produce including the crates. In every major produce market there is availability of used crates and a few traders have a separate business involving the purchase/re-sale of used (second-hand) crates. In the case of tomatoes, for example, the supplier adds the cost of crates to the produce price. The buyer can then resell the used crates to state Agricultural Produce Marketing Committee (APMC) registered traders, and suppliers can purchase the used crates from dealers of the APMC markets.

The final approach is used by traders involved in reverse trade, for example, when two different types of produce from different production areas can be transported via the same set of RPCs. Tomatoes might be transported from destination A to B and then carrots transported from destination B to A using the same set of crates owned by the buyer or trader.

Policies affecting the use of RPCs

Use of plastic crates is slowly being adopted in developing countries, but many barriers still exist. Clarke (2004), reported on the main problems associated with managing the use of a returnable container system, which include:

- Who should own them?
- Is a deposit system workable?
- How can theft be prevented?
- How can a large number of containers be identified?

In a recent study in Nigeria, Adegbola et al (2011) found that the main reasons 150 respondents gave for why they were not using reusable plastic crates were: the crates were considered to be expensive when available (100%), the crates are not readily available but palm baskets, jute and polythene bags are (91%), the crate is not a unit of measure commensurate with the measure of traditional packages (65%), it is difficult to change old habits (18%), there is very low knowledge about the existence of the crates (11%), and there is a lack of contact with extension agents who promote the use of plastic crates (9%).

Adegbola et al (2011) and others have recommended that governments should provide heavy subsidies for the use of RPCs, since their use is a public good and will result in protection of natural resources and in an enhanced food supply for the population as a whole. India is an example of a government that provides 50% subsidies, plus a variety of infrastructure development support. Other supportive policy options include providing tax credits for investments in RPCs, or providing extension education or training for smallholder horticultural producers, traders and marketers on costs/benefits in order to create incentives for RPC use.

In many countries, RPC manufacturers do not yet exist, so the cost of crates is high due to added transport and import costs. In other countries, fuel costs are extremely high, or transport charges are set as a per unit standard fee regardless of the size of the container, both of which provide strong disincentives for using these typically smaller RPC containers. Any policy support that can reduce these disincentives will stimulate interest in RPC use, and help to move us away from using cheap, non-protective packages like sacks, bundles and baskets.

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Appendix A: RPC cost and benefit calculator worksheet

(Available on the PEF website for download as an MSExcel spreadsheet)
http//:www.postharvest.org

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Comparison of RPCs to single-use containers

Cost/Benefit Calculator Worksheet

	Plastic Crates (Own)	Plastic Crates (Rent)	Fiberboard cartons	Sacks	Baskets
Market price for fresh produce/kg	$2.50	$2.50	$2.50	$2.00	$2.00
Initial quantity	2500	2500	2500	2800	2800
Postharvest losses	125	125	125	490	308
Total quantity sold	2375	2375	2375	2310	2492
Revenue	**5937.50**	**5937.50**	**5937.50**	**4620.00**	**4984.00**
Unit cost of container	15.00	2.00	1.50	1.00	2.00
Lifespan of container (uses)	240	n/a**	1	1	10
Unit Cost/use	0.06	2.00	1.50	1.00	0.20
Total container cost/truck	7.81	250.00	187.50	70.00	18.60
Transportation					
Number of containers transported	125	125	125	70	93
Average weight per container (kg)	20.00	20.00	20.00	40.00	30.00
Total capacity of truck	2500.00	2500.00	2500.00	2800.00	2800.00
Transportation fuel costs	50.00	50.00	25.00	25.00	50.00
Labor cost for container handling/loading	14.00	14.00	14.00	14.00	14.00
Cleaning/sanitation	14.00	0.00	0.00	0.00	0.00
Tracking to ensure returns	5.00	5.00	0.00	0.00	2.00
Container maintenance costs	19.00	5.00	0.00	0.00	2.00
Total Costs	90.81	319.00	226.50	109.00	84.60
Net Profit	5846.69	5618.50	5711.00	4511.00	4899.40

Notes: Percentage losses for this example were estimated at 5% for RPCs or cartons, 11% for baskets and 17.5% for sacks. Fuel costs were doubled to account for return transport for reusable containers (RPCs and baskets). Users should insert their own local costs, if known, into the worksheet to determine the results for handling and transporting their crop(s).

Appendix B: Examples of RPC sizes and styles suitable for horticultural crops

Source: Phoenix Industries Ltd., Sri Lanka www.phoenix.lk
http://www.phoenix.lk/product_catalogue/product_index.php?section=5&cat=17
Visit the provided website link for the full catalog, additional illustrations and detailed information on RPC dimensions.

Appendix C: Sources of RPCs

Visit these websites to view just a few examples of reusable plastic crates suitable for produce handling, storage and transport.

Aristo Exports, Mumbai, India
http://www.industrialplasticcrates.com/series-fruits.html

CHEP, Australia (active in 50 countries)
http://www.chep.com/RPCs/Crates/

Fold C, India
http://foldc.com/

Galaxy Polymers, New Delhi, India
http://www.plasticcrates.co.in/vegetable-crates-852597.html

GD International, China Trade Online
http://www.gd-wholesale.com/chinaproduct/mf43d/av3589to2bv/foldable-plastic-crate-zm4835-m345304.html

Obal Centrum Ltd., Czech Republic
http://www.obal-centrum.com/crates/fruit_vegetables.php

Phoenix Industries Ltd., Sri Lanka http://www.phoenix.lk

Reusable Transport Packaging, Florida, USA
http://reusabletranspack.com/templates/Collapsible_Vented_Handheld_Distribution_Containers.html

Supreme Sales and Service, Noida, India
http://trade.indiamart.com/details.mp?offer=4588010833

Tulsi Extrusions, LLC, India
http://www.tulsigroup.com/Crate.html

TranPak Inc., Fresno, California, USA
http://www.tranpak.com/handheld-plastic-crates

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