The Five R's of Environmental Responsibility:
Refuse, Reduce, Reuse, Recycle, ROT

By linking worldwide data on solid waste, population density, and economic status, Jenna R. Jambeck and co-authors writing in the Journal Science estimated that 275 million metric tons of plastic waste were generated worldwide in 192 coastal countries in 2010, with 4.8 to 12.7 million tons entering the ocean (Science 13 February 2015: Vol. 347 no. 6223 pp. 768-771) The authors noted that world plastic production increased by 620% in the last 40 years, and without waste management infrastructure improvements, the cumulative quantity of plastic waste available to enter the ocean from land is predicted to increase by an order of ten by 2025.

The word, "plastic" is an umbrella term used to describe a variety of molecules, including polyethylene terephthalate (PET) or polyester, the same polyester that competes with cotton in world fiber markets. There are about 45 different types of "plastic," but six types account for the bulk of plastic production. Many containers are numbered on the bottom to indicate their molecular structure:

Plastic #1 is PET, used in soda and water bottles and clothing. This is the most common form of polyester used in textile fibers.
Plastic #2 is High Density Polyethylene (HDPE), used in soap bottles and milk jugs.
Plastic #3 is Polyvinyl Chloride (PVC) (often known as vinyl), used in outdoor furniture, shrink wrap and water bottles.
Plastic #4 is Low Density Polyethylene (LDPE), used in produce bags and food containers. The little plastic bags used in markets are made from LDPE, and these bags often become contaminants in seed cotton.
Plastic #5 is Polypropylene (PP), used in bottle caps and food containers. PP competes directly with many natural fibers, including jute, sisal, hemp and coir in rope and bagging applications, and PP is a major source of contamination in cotton because of its use in fertilizer and food bags that are often used by farmers in developing countries as seed cotton sacks.
Plastic #6 is Polystyrene (PS), used in packaging and foam cups.
Plastic #7 is all other types of plastic polymers with a variety of uses.

As reported in CNN, nearly every piece of plastic ever made still exists, regardless of whether it has been recycled. (Madison Park, CNN, February 12, 2015) While recycling programs have grown in recent decades, most trash ends up in the environment because plastic does not degrade, even after hundreds of years.

The problem is particularly acute in developing countries with large populations because of weak systems of collection, disposal and safe long term storage of waste. Developed countries can afford organized systems of municipal door-to-door garbage collection, combined with incineration or safe disposal in landfills. However, most developing countries cannot afford such systems outside of major urban areas, and therefore, the vast majority of plastic products used in developing countries end up as pollution in local, national and even world environments. Anyone who has traveled in rural areas of developing counties is probably shocked by the quantity of plastic waste that has accumulated just in recent decades.

In the United States, recycling grew from essentially zero in the 1960s to account for 35% of all solid waste generated in 2012 (United States Environmental Protection

Agency). Nevertheless, the amount of garbage added to the environment in the United States grew from 88 million tons in 1960 to 251 million tons in 2012 because population and income growth caused consumption to increase faster than recycling efforts, and because more synthetic materials were invented to replace natural ones.

Non-cellulosic fibers contribute to the load of trash weighing on the world's environment, and the molecules in these fibers are not biodegradable. Polyester, nylon, acrylic and other non-cellulosic fibers are made from petroleum, and rather than decomposing, these fibers break down into smaller and smaller pieces until they are too small to be seen by the naked eye. Eventually, these small pieces find their way into waterways and food supplies, damaging ecosystems, harming animals, contaminating food supplies and leading to chemical leaching.

A cow feeds on plastic bags and other garbage along a stream in New Delhi, India. David Guttenfelder/Associated Press. http://www.theguardian.com/environment/gallery/2009/jun/05/waste-world-environment-day.

World production of polyester totaled more than 60 million metric tons in 2012, including 41 million tons of polyester staple and filament, almost all of which goes into textile products, and 23 million tons of film used to make bottles and other consumer products (PCI – Fibers and Raw Materials). The polyester industry has put a heavy stress on recycling PET bottles, and they are the second most recycled material behind aluminum. However, polyester cannot be recycled endlessly, and there is leakage in even the most robust recycling programs. Further, only a small percentage of polyester, nylon, acrylic and other non-cellulosic fibers used in textile applications are recycled. Eventually, every molecule of polyester and the other oil-based fibers ends up in the environment somewhere.

Some environmental activists, retailers and advocates of organic cotton have demonized the cotton industry for decades by exaggerating or misstating pesticide and water use, by misrepresenting labor issues, by overlooking the contribution of cotton to food security and by ignoring or minimizing the economic and social benefits of cotton production.

Rarely, if ever, do those who demonize cotton mention the negative impacts associated with polyester production and disposal. This may be changing as even the most ardent activists are beginning to dimly perceive that the alternative to cotton is polyester, not organic fibers. And, as more attention is paid to the attributes of polyester, the issue of biodegradability will rise in importance.

A trash-covered creek in Manila, Philippines. Francis R. Malasig/U.S. EPA. http://www.theguardian.com/environment/gallery/2009/jun/05/waste-world-environment-day.

Environmentalists have advocated the three R's of Reduce, Reuse and Recycle for at least since the 1970s. But more recently environmentalists have expanded their admonition to encourage consumers to follow the Five R's: Refuse, Reduce, Reuse, Recycle and Rot (www.MotherEarthNews.com, Is Recycling Worth It?).

Refuse what you don't need,
Reduce what you do need,
Reuse by avoiding disposables and buying secondhand,
Recycle what you can't reuse, and
Rot (compost) what's left.

A Chinese boy jumping over trash. http://www.cnn.com/2015/02/12/world/ocean-trash-pollution/index.html

For all of cotton's problems with resource use, labor issues and health concerns, at least cotton and almost everything used to produce it are fully biodegradable. All the pesticides used in cotton production are biodegradable, all the fertilizers are natural substances themselves (nitrogen is a greenhouse gas and efforts must continue to reduce emissions; phosphate and potassium are natural substances that do not leach or evaporate), and water is obviously natural. In developed countries, fuel is used to power machinery, but every other input in cotton production can rot or is natural itself.

In sum, when the full environmental load imposed by polyester production, use and disposal is considered, cotton has an insuperable advantage in that it can rot. Cotton does not become marine waste. Cotton does not foul waterways or roadsides. Cotton does not pollute soil. Cotton goes away. In a world moving toward more than 9 billion people and increased environmental stress, natural fibers will always have a place in the world economy.