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ARTICLE

Reducing the Impact of Plastic Pollution in a Rural Coastal Area: Focus on the Hospitality Industry & Tourism of the Central Nicoya Peninsula, Costa Rica

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Plastic pollution has become a major plague upon the world's oceans and coasts (Fauziah & Nurul, 2015; Jambeck *et al*., 2015), affecting the marine species all throughout the food chain (Vegter *et al*., 2014), possibly even impacting human health (Rochman *et al*., 2013), and the tourist economy (Balance, Ryan, & Turpie, 2000). In the Central Nicoya peninsula of Costa Rica, a local sea turtle research voluntourism operator Turtle-Trax S.A. and the marine conservation organization CREMA (Center for the Rescue of Endangered Marine Animals) believe that plastic pollution in the area is a serious and growing problem. The staff noted that many of the hospitality businesses (restaurants and mini markets - minisupers) in the area are using single-use plastic products (i.e. drinking straws, plastic bags, take-away containers, etc.). There may be an especially acute problem in the San Francisco Coyote area in part because there may be poor waste management, with the Turtle-Trax staff noting that garbage is traditionally burned, buried, or dumped in the river; a common problem in rural Costa Rica which has been researched in other communities (Meletis, 2007).

The remote, rural central Nicoya Peninsula, specifically the small district of Bejuco (population ~3,313)(INEC, 2011) in the Guanacaste province of Costa Rica is an important habitat for several marine turtle species including the endangered Green Sea Turtle (*Chelonia mydas*), the critically endangered Hawksbill (*Eretmochelys imbricata*), Leatherback (*Dermochelys coriacea*) turtles, and the vulnerable Olive Ridley (*Lepidochelys olivacea*) (Beange, Clift, & Arauz, 2015), as well as several other animal species. The area contains several designated protected areas, including two marine protected areas, the Camoronal MPA and the

Caletas-Arío MPA. The potential for negative impacts from plastic pollution is high in this area; with marine turtles being highly susceptible to danger (Vegter *et al*., 2014), especially the Olive Ridley turtles which nest in great numbers in the area. The fact that the local beaches are important nesting sites for marine turtles adds another dimension of risk from plastic pollution as the plastic altered thermal properties of the sediment can affect the turtle population's sex ratio (Carson *et al*., 2011) and lead to difficulty laying eggs in the first place (Plot & Georges, 2010). Plastic pollution in the area could do harm to the economy, which includes traditional sun and surf tourism, "turtle tourism" (Meletis, 2007), as well as cause potential human health and economic impacts from the contamination of local seafood (Vegter *et al*., 2014). The area is a popular beach destination for Costa Rican nationals who may be driven away by the prevalence of plastic pollution on the beaches (Ballance *et al*., 2000). Previous research in the study area has indicated that the prevailing ocean currents pull micro-plastic pollution away from the area while concentrating macro-pollution on the beach leading to an unsightly problem (Roos Lundström & Mårtensson, 2015). The grave risk to the area from this pollution necessitates investigation into the "problem products", sources of pollution, and incentives to use these "problem products" in the area (Cummings, 1992).

However, identifying the problem is only the first step in any process to change environmental behavior (Stern, 2000). The issue of improving the environmental friendliness of the local businesses may be difficult because the area is very rural, and characterized by small businesses which "generally … do not have the resources to provide a detailed description of their environmental situation and the relevant flows into the environment" (Laner & Rechberger, 2009). Past studies regarding the reduction of plastic in the hospitality industry have been completed but were undertaken in developed countries (Su *et al*., 2015). Thus, we must understand the decisions to use these products from the context of the small business owner in rural Costa Rica, not from the perspective of the ecologist or marine biologist (Stern, 2000). Plastic pollution in the Coyote area is a critical problem which needs further study.

Literature Review

Impacts of plastic pollution

With plastic pollution becoming an increasingly recognized problem worldwide, its impacts are becoming clearer (Vegter *et al*., 2014). Plastic, although it has only existed for about 100 years (Derraik, 2002), is one of the most pervasive and persistent impacts that humanity has inflicted on our planet; its ubiquity is a function of its low cost of manufacturing and its incredible durability (Vegter *et al*., 2014; Su *et al*., 2015). However, this low cost is a function of the ignored externality this plastic imposes upon the rest of society, the true costs are rarely ever accounted for; especially in the developing world (Gupta & Somanathan, 2011). About half of all plastic is used for single use items like packaging, drinking straws, disposable kitchenware, bags, etc. which are used

and disposed of (Hopewell, Dvorak, & Kosior, 2009). In 2010 there was up to 12,700,000 tons of plastic entering the ocean (with the amount only increasing over time) (Jambeck *et al*., 2015), mostly from land based sources (~80%), and a high percentage of that plastic being single-use plastic items (Slavin, Grage, & Campbell, 2012; IEEP, 2016; Ocean Conservancy, 2016). These single use items "create the foundation of the marine debris problem" (Sheavly & Register, 2007). Much of the past research has focused solely on plastic bag use and pollution (Weinstein, 2009; Gupta & Somanathan, 2011), leading to bans and taxes in nations, states, and municipalities around the world (including a law under review in the Costa Rican Legislature) (IEEP, 2016). However, this focus on plastic bags has left a gap in our knowledge and action on many other single use plastic items which are considered "high risk" due to their disposable nature (Vegter *et al*., 2014). This has been singled out in several studies as one of the first changes that need to be made with regards to plastic use (Cummings, 1992; Su *et al*., 2015).

Plastic pollution is a threat to marine wildlife with risks of ingestion, entanglement, and even habitat level changes (Rochman *et* al., 2013; Vegter *et al*., 2014; Ocean Conservancy, 2016). Sea turtles are especially vulnerable to plastic pollution (Vegter *et al*., 2014); they suffer from entanglement and ingestion, with estimates of more than half of all individual turtles having ingested plastic (Ocean Conservancy, 2016). The plastic can cause internal injuries, increase buoyancy, occlude the digestive tract of the turtles, and give a false sense of fullness leading to starvation, among other issues (Nelms *et al*., 2014; Eagle, Hayman, & Low, 2016). The ingestion of plastic can even lead to difficulty reproducing, as sea turtles, like many animals have a cloaca which is used for waste expulsion and reproduction; the occlusion of the cloaca has been witnessed in turtles trying to nest (Plot & Georges, 2010). Another possibly greater risk in the long run for turtle populations of all species is the fact that plastic debris in the sand of turtle nesting beaches can change the thermal properties of the nests such that the sex ratio of the hatchlings is skewed in favor of males (Carson, Colbert, Kaylor, & McDermid, 2011). This is a serious issue for turtle populations worldwide. Other risks to turtle reproduction from plastic pollution on nesting beaches includes the risks of nesting females becoming discouraged by plastic on the beach and not nesting, nesting females becoming entangled on the beach, hatchlings not being able to dig out of litter filled nests, and the litter slowing down the hatchlings journey to the sea and making them more vulnerable to predators (Nelms *et al*., 2014). Time consuming beach cleaning can help to reduce these risks but the only long term solution is prevention of the plastic pollution in the first place (Carson *et al*., 2011).

Another, perhaps more insidious problem becoming associated with plastic pollution is its ability to infiltrate the marine food chain (Rochman *et al*., 2013; Fauziah & Nurul, 2015). When plastics in the ocean are acted upon by mechanical and photochemical processes they simply break into smaller and smaller pieces, eventually becoming microscopic

(Reissier, Shaw, Wilcox, Hardesty, Proietti, Thums, & Pattiaratchi, 2013; Vegter *et al*., 2014). Most plastics contain ingredients known to be hazardous to humans and other life (Reissier *et al*., 2013; Vegter *et al*., 2014), even more troubling there is increasing evidence that these plastic particles attract and adsorb hazardous chemical pollutants from the ocean (Reissier *et al*., 2013; Vegter *et al*., 2014). These microscopic particles are then ingested by plankton and small fish, which are then eaten by larger marine life increasing the risk of bio-magnification of the hazardous chemicals in the plastic and the adsorbed pollutants on the plastic (Reissier *et al*., 2013; Vegter *et al*., 2014; Fauziah & Nurul, 2015). This is a major concern for those people who depend on seafood as a major source of protein in their diets as there is evidence that the chemicals in the plastic as well as the adsorbed pollutants can be damaging to human health (Rochman *et al*., 2013; Reissier *et al*., 2013; Fauziah & Nurul, 2015). The cryptic nature of the marine world relative to terrestrial environmental issues means that the general public may be less aware of the current level of damage, summed up well by Ray (1988): *"The last fallen mahogany would lie perceptibly on the landscape, and the last black rhino would be obvious in its loneliness, but a marine species may disappear beneath the waves unobserved and the sea would seem to roll on the same as always".*

Hospitality industry and plastic pollution

The hospitality industry is a major source of the single use plastics (straws, lids, take-away packaging, food packaging, etc.) which often escape the waste stream and contribute to the problem of plastic pollution (Cummings, 1992; Meletis, 2007; Sheavly & Register, 2007), with one survey of street litter finding 68% was food and beverage related (Scott, 2011). There are concerns about the potential for improving the industry's record on the issue of solid waste management, primarily the cost associated with substitute products/behaviors (Pirani & Arafat, 2014; Su *et al*., 2015). However, the industry is also affected by this waste, Williams and Ponsford (2009) note that a pristine natural environment will increasingly give a destination a competitive advantage in the future, providing an incentive to better manage waste. The level of pollution on a beach is a major part of the decision making process that people go through when choosing a beach to visit (Slavin *et al*. 2012). This is a serious problem for those destinations with a high reliance on beach tourism (McIlgorm, Campbell, & Rule, 2008), with some studies showing the potential loss of up to 52% of tourism revenue due to lower levels of beach cleanliness (Ballance, Ryan, & Turpie, 2000). The risk of contamination of seafood products is also a very real risk for restaurants serving seafood to their customers (Rochman *et al*., 2013). This should be another reason for restaurants near the coast to stop polluting, because they are adding to the contamination of the locally caught seafood they serve (Rochman *et al*., 2013; Reissier *et al*., 2013; Fauziah & Nurul, 2015). Another concern for the hospitality and tourism industry is the fact that plastic pollution is a common cause of engine breakdowns in small boats, with costly repairs possibly driving

up the costs for seafood and marine tourism (Sheavly & Register, 2007). Also, a major economic concern for the industry is the potential loss of turtle tourism in a rural community (Meletis & Harrison, 2010).

There are several reasons why a business would want to reduce its use of plastic. Plastic, being primarily manufactured from petroleum products is subject to price volatility as oil prices swing decreasing the certainty of businesses' budget (UNEP, 2014). There needs to be strong consideration to economics in any plan to reduce the environmental impact of plastic pollution, Ray and Grassle (1991) note that 'no effort to conserve biological diversity is realistic outside the economics and public policies that drive the modern world''. In fact, past studies of plastic use in hospitality businesses have shown that one of the primary concerns when attempting to reduce the use of plastic is the higher costs associated with this change (Su *et al*., 2015). This corresponds with the idea that people make environmental decisions based in large part on the context of those decisions (cost, ease of implementation, etc.), with their attitudes and beliefs having smaller and smaller influence as contextual forces grow (Stern, 2000; Kollmuss & Agyeman, 2002). Any program that ignores this context and only takes values/attitudes into account is doomed to fail.

However, this singular focus on cost by businesses is not by rule, Andrews (1998) notes that businesses can and occasionally do adopt environmental practices that drive up costs. Sometimes businesses, like individuals, will continue a practice or the use of a product simply out of habit and a lack of knowledge of another way (Andrews, 1998; Stern, 2000; Kollmuss & Agyeman, 2002). Michaelis (2003) notes that even small firms have the ability to make important contributions to the social and cultural change which is required to achieve sustainable consumption, something which is important to note since tourism industry is dominated by small and middle enterprises (SMEs) (Williams & Ponsford, 2009). SMEs also have great potential to contribute to environmental degradation (Laner & Rechberger, 2009), especially in the remote and fragile areas where "ecotourism" is popular. Often these SMEs do not understand the environmental impact that their business operations are creating and do not have the resources (financial, education, time) to accurately measure these impacts (Laner & Rechberger, 2009). However, these small businesses by their nature (not beholden to outside investors) can better act their conscience rather than the pure profit motive that large corporations are often beholden to (Andrews, 2000). With regards to business it is clear that profit motive is important, but may not be the only factor in the use of plastic products.

Behavior and cultural element of plastic pollution

Stern's (2000) coherent theory of environmentally significant behavior offers a framework to build upon when attempting to make behavior changes. With several causal variables: attitudinal, based on an individual's values and beliefs; personal capabilities, based on the ability of the individual to change, including financial and educational

resources; contextual factors of the cost/benefits of change, social norms, laws, support, etc.; and habit and routine (Stern, 2000). These variables impact the different types of environmentally significant behaviors: environmental activism, willingness to publicly fight for environmental change; private-sphere environmentalism, purchasing behaviors, changes in lifestyle, waste disposal behaviors, etc.; and other, encompassing changes in organizational behavior (Stern, 2000). To persuade individuals/businesses to change their behavior one must understand the behavior from their perspective and the context the behaviors are part of, and set realistic goals for change (Stern, 2000). It is important to set realistic goals, use participatory decision making, and not overstep the bounds of intervention the actors are comfortable with to increase buy in from the participants (Stern, 2000). Constant monitoring and adjustment are an essential part of any program (Stern, 2000).

Even when new technology or ideas are introduced which have the potential to reduce pollution there is an important need to change behaviors and the cultural element of plastic pollution (Sheavly & Register, 2007). Stern's (2000) theory of environmentally significant behavior proposes that people's behavior is influenced by both their attitudes and their context. Social and cultural norms have a great impact on the way people interact with litter, people are more likely to littler if there is already litter present because it signals that a place is unclean and that littering is the norm (Gupta & Somanathan, 2011; Slavin *et al*., 2012). This may indicate that cultural and educational programs can have a large impact on the level of pollution in a community by helping people to understand the externalities of plastic use (Gupta & Somanathan, 2011).

Vegter et al. (2014) identified the need to better understand the psychological reasons behind plastic use. Behavior is related both to attitudes and to context, to try to affect change in behavior the whole picture of the target must be understood (Stern, 2000). Past studies have found that a lack of environmental awareness in developing countries about plastic pollution and its impacts may be a major limitation in the adoption of more environmentally friendly behavior (Gupta & Somanathan, 2011). Educational programs have also shown to be effective at a low cost compared to technological or legal interventions, making them especially useful in for smaller organizations and poorer areas (Gupta & Somanathan, 2011). There is evidence that women are more concerned with litter than men, possibly highlighting a need to better educate men on the issue (Gupta & Somanathan, 2011; Slavin *et al*., 2012). Past studies have found people's levels of active littering to be low (although this could be different across cultures) (Slavin *et al*., 2012) which would seem to indicate that much of the litter has escaped the waste stream accidentally and thus reduction of potential litter via prevention is likely to be more important than other actions like recycling or reuse.

The technique of "demarketing" is to use marketing strategies to reduce the demand for a product or reduce a behavior (Eagle *et al*., 2016). People's attitudes are most strongly tied to their

natural experiences as children (Kollmuss & Agyeman, 2002), something that should be taken into account in any study and which may benefit those who are working on small local problems in a community. Past studies have found that much of the plastic pollution on shorelines is from local sources, much of it deposited directly on the beach (Thiel, Hinojosa, Miranda, Pantoja, Rivadeneira, & Vasquez, 2013), meaning that local campaigns have to chance to be effective in alleviating the problem of plastic pollution. However, it must be remembered that more education about the issue to a single individual may do nothing to change their environmental behavior if the context of that behavior remains unchanged (Stern, 2000; Kollmuss & Agyeman, 2002), and thus a multipronged approach must be made to affect lasting change.

Gaps in research

There are several gaps in our knowledge about plastic pollution, and yet understanding what we can do to prevent the creation of plastic pollution is critically important (Vegter *et al*., 2014). No waste stream can be perfectly contained, trash will always escape, especially in developing areas (Ocean Conservancy, 2015), and thus the less plastic produced and used, the less potential for pollution (Jambeck *et al*., 2015). Cleaning up plastic pollution is difficult, time consuming, and expensive, and so it is far more efficient to prevent the creation of waste than to try to deal with the pollution (Carson *et al*., 2011; Vegter *et al*., 2014).

Several studies have confirmed the primacy of waste minimization as a recommendation for the hospitality industry (Cummings, 1992; Su *et al*., 2015). This is why the reduction, reuse, recycling and recovery strategy (4Rs) of managing plastic waste has become standard, meaning the desired actions are in descending order reduce, reuse, recycle, and recover (energy) (Hopewell *et al*., 2009). Unfortunately, the options of recovery and recycling, especially on a community level, require a dedicated and complex waste management system (Cummings, 1992; Meletis, 2007), and in Latin American it is estimated that 32% of all plastic waste is not collected (UNEP, 2014). Waste management deficiencies in developing countries are some of the main causes of plastic pollution worldwide (Ocean Conservancy, 2015). It is often buried or burned, leading to the easy escape of plastic waste and the creation of hazardous emissions (Cummings, 1992).

To reduce the use of plastic, we must understand why single use plastics are so prevalent and where along the disposal chain the plastic is entering the environment to allow for a more targeted approach to mitigate the problem (Vegter *et al*., 2014). Many studies of plastic use focus on the incentives to reduce consumer use of plastics (Weinstein, 2009; Sharp, Hoj, & Wheeler, 2010), but the realization that prevention of plastic from entering the market is critical, shows that investigation of the supplier side of the relationship is needed because of the greater potential reductions it can achieve (Su *et al*., 2015). High levels of plastic use are often assumed to be due to its low cost and durability (Vegter *et al*., 2014). However, other causes for its use cannot be discounted such as ingrained cultural

practices, lack of education, limited access to alternatives in remote areas, etc. (Slavin *et al*., 2012; Vegter *et al*., 2014). The reasons behind human behavior are often complex (Stern, 2000) and there is little existing research on these incentives and the underlying psychology behind the decisions to use these products, with researchers pointing to it as an area of need in research (Vegter *et al*., 2014). One of the key areas that experts on the issue have identified for study is the investigation of the problem in developing countries and small rural communities, and how to build their capacity to reduce and deal with plastic waste (Vegter *et al*., 2014). An important priority for research is understanding how these communities can be convinced to use alternative products and/or change their behavior (Vegter *et al*., 2014).

Research Objectives

Plastic pollution is a worldwide recognized problem (Jambeck *et al*., 2015) with specific implications for the central Nicoya Peninsula due to its rural nature and importance as marine turtle habitat (Meletis, 2007; Carson, *et al*., 2011; Vegter *et al*., 2014). The staff of the scientific research tourism organization Turtle-Trax has identified plastic use in the local hospitality industry as a concern for the region, something that aligns with past research on plastic pollution (Ocean Conservancy, 2016). Past reviews (Laner & Rechberger, 2009; Vegter *et al*., 2014) of the issue of plastic pollution and small business environmental management point to several areas of needed study which this proposed research will help to achieve. Adding the resources of multiple academic research institutions (UNT and CATIE) and those of a local NGO (CREMA/Turtle-Trax) to work with the local small businesses on a full investigation to better understand the potential sources of plastic pollution in the region, the "problem products". The incentives behind their use will allow for Turtle-Trax to implement a program to reduce the problem in the region and ideally serve as a template for similar communities. Based on the literature review about plastic pollution and its impacts and the information provided by the Turtle-Trax staff the researcher decided upon several questions to be investigated in this study:

- Does the Coyote area have a problem with the prevalence of single-use plastic products in the hospitality industry and why?
- Is the current waste management regime sufficient to handle the waste being produced?
- What can be done to reduce the impact of plastic pollution in the Coyote area of the Nicoya Peninsula?

This study conducted research pertaining, to and created recommendations to reduce the impact of single-use plastic pollution in the San Francisco de Coyote area. Working in conjunction with Turtle-Trax S.A. our contribution is to help reduce the plastic pollution entering the ecologically important waters off the coast of the central Nicoya Peninsula.

Methodology

Area of Study

The study area is the area around the community of San Francisco de

Coyote on the Nicoya Peninsula in Costa Rica. The area is in the Bejuco District of the Canton of Nandayure in Guanacaste Province. The area is very rural and isolated, the whole Bejuco district has only ~3300 residents (INEC, 2011). The study looked at the hospitality businesses in the Coyote area, including those in San Francisco, Playa Coyote, and nearby Costa de Oro/Javilla/San Miguel. This area was chosen because Turtle-Trax is headquartered in San Francisco de Coyote, the study was limited to this small geographic area due to limited time and resources. The field portion of the study was conducted over several days/weeks long visits to the area from January – April 2017.

Methods and procedures

The methodology is based in part on Stern's (2000) Coherent Theory of Environmentally Significant Behavior, as well as other past research. With so much of the plastic waste pollution found on beaches being of the type that originates in the hospitality industry (Ocean Conservancy, 2016,) and the industry being such an important part of the Costa Rican economy (WTTC, 2015), especially in the coastal zones most vulnerable to plastic pollution (Jambeck *et al*., 2015), the researchers decided to focus on the local hospitality industry. With our target behavior identified, the researcher must analyze the behavior to understand the actors and actions associated with the behavior (Stern, 2000). This was accomplished by compiling an inventory of the hospitality businesses in the area in question to get a full understanding of the source of the potential problem. An additional benefit in a small rural community like this, is that the limited amount of businesses in the area means that the proprietors of these few businesses likely come in contact with a large proportion of the population. This gives them potentially powerful insight into the consumptive practices of the community; this creates an opportunity for a study done with limited time and resources. With an inventory of the local businesses complete, further investigation took place via structured in-person interviews with the business owners/managers; past studies of solid waste pollution in Costa Rica have used this less technical approach (as opposed to more technical methods like waste audits) to capture the cultural dimension of pollution (Meletis, 2007). The next step was to investigate what single –use plastic products (straws, cutlery, small bags, take-away containers, etc.) are being used in the local businesses, as these have consistently been identified as "problem products" seriously contributing to plastic pollution in the literature (Cummings, 1992; WIDNR, 2008; UNEP, 2014; Vegter, 2014; PSI, 2015a; 2015b; Ocean Conservancy, 2016; PPC, 2016).

Although it may seem like a simple issue, we must understand the behavior from the perspective of the actors (Stern, 2000). Therefore, the next step was to interview the proprietors of these establishments to understand why they are using these single use plastic products, what are the barriers to change (Eagle *et al*., 2016)? The interview questions were based on past research about plastic/resource use in businesses and environmental behavior. Is it because economic incentives? Lack of knowledge about, or access to, alternative products?

Are they considering the negative externalities created by their use of these products (Gupta & Somanathan, 2011); do they understand the impacts the pollution can have (Vegter, *et al.*, 2014), including damage to the tourism industry (Balance, Ryan, & Turbie, 2000)? Is there a lack of education about their impact? What are the owners' general opinions about plastic pollution? This give a better idea of what incentives may be able to convince these businesses to enact a change in behavior. Will community pressure to reduce plastic use be enough to overcome economic incentives to continue using it? Based on what the Turtle-Trax staff reported about waste management in the area, and past research about pollution issues in rural Costa Rica (Meletis, 2007) the interviews will include questions about the current waste management regime, one of the key components in reducing the impact of plastic on the environment (Ocean Conservancy, 2015). This will give a more complete picture of the potential problems regarding plastic pollution in the area.

Based on the interviews about the problem products, the current waste management issues, and the business incentives for change a final report was compiled about what is likely to be causing the problem of plastic pollution in the area. This information will be used to research the best (realistic) solutions for reducing the impact of single-use plastic products (economics, access to products, education, etc.) (WIDNR, 2008; UNEP, 2014; Vegter, 2014; PSI, 2015a; 2015b; Ocean Conservancy, 2016; PPC, 2016) or their impacts. These recommendations take into account the rural, developing nature of the community and the businesses limited access to finances, education, alternative products, etc. (Stern, 2000; Kollmuss & Agyeman, 2002). These recommendations focused on how Turtle-Trax and the community can to try to implement a program to make concrete progress on reducing the amount of plastic used in the San Francisco de Coyote Area.

Findings

In total 12 businesses (11 owners/managers) were surveyed in San Francisco de Coyote, Playa Coyote, and Costa de Oro/Javilla (a small beach community north of Playa Coyote) to assess their use of single-use plastic products and their opinions and understanding regarding the impact of plastic on the area. The businesses consisted of 2 mini-supermarkets (one with a drink counter), 1 bar, 4 bar/restaurants, 1 café, 1 hotel bar/restaurant, and 3 restaurants. Eleven of the businesses were owned by 10 people, the hotel restaurant manager was interviewed. Of these 11 owner/managers 6 were from the local area, 3 were from Europe but now live in the area, and 2 were from another region of Costa Rica but live in the area. The owners of the businesses were generally from their mid forties to their mid fifties, with the youngest owner being 37, and the oldest 61. The businesses vary in time open/under current management from 4 months to approximately 30 years.

Common Plastic Products and why they are used:

All of the businesses use some single-use plastic products, and although

Figure 1: Common single-use plastic items used by owners/managers interviewed

Common Single-Use Plastic Items
Drinking Straws
Cutlery Service Bags
Take-Away Containers
Plastic Bags
Plastic Drink Bottles
Single Serving Condiment Packets

Figure 2: Top reasons for single-use plastic use given by owners/managers

Top Reasons for Single-Use Plastic vs Alternative
Customer Desire
Convenience
Availability
Habit
Cost
Hygiene

the exact ones vary, there are several commonly used items across the surveyed businesses and many reasons for their use. The most common items were plastic drinking straws, Styrofoam take-away containers, cutlery bags, condiment packets, plastic drink bottles, and plastic bags. With regards to these items the businesses had many reasons for using each. The owners were also asked about the price and quantity of these products. Most of the businesses noted that the demand was very unreliable other than the fact that tourism season was the busiest time of the year. The most common products used by the businesses are listed in Figure 1, with the most common reasons for use in Figure 2.

One of the products the researcher and Turtle-Trax had hoped to reduce the use of was plastic drinking straws, used by every surveyed business but one of the minisuper markets. When asked, why are straws so prevalent? The answer was nearly universal, "the customers want them". The restaurant owners all noted that the customers, especially the Costa Rican ones, often wanted a straw with each drink, although one owner told the researcher that foreigners often do not want a straw.

The restaurants in Coyote and in many places in Costa Rica often serve the cutlery to the customer in a small plastic bag, this is another item that the Turtle-Trax staff noted as a problem product (in that it seemingly serves little purpose and is very quickly disposed of). Nearly all of the restaurants surveyed use these small plastic bags. When asked why, many responded that it had to do with regulations from Costa Rica's ministry of health, which they said required the cutlery to be either wrapped in paper (like a napkin) or in a plastic bag when given to the customer. Several of the restaurants noted that when it is busy, it is easier and faster to use the bags. Others professed to using the bags out of custom.

Plastic bags were another very common item, being used by both mini-supers and several of the restaurants for

takeaway food. The reasoning was similar to the straws, in that at the mini-supers the owners claim that the customers want the plastic bags. Staff at Turtle-Trax noted that people use these plastic bags for other things around their homes, possibly indicating why they want them so badly. The owners of the minisupers said that the people just want more and more bags, and they can't stop people; with one owner reporting that some customers come in up to eight times a day and want a new plastic bag for each small item they purchase.

Take-away containers for food were common among the restaurants, with only two not offering them. The containers were generally polystyrene foam; with the owners telling the researcher that there is no other option available for take-away containers in the area.

Other items common to the businesses were plastic drink bottles at all of the businesses used because of availability; as well as the single serving condiment packets used by many of the restaurants, which one owner reported as believed to be more hygienic that large bottles, although more expensive.

Investigation of Alternative Products/Behaviors:

The use of plastic products in Coyote was generally understood to be a problem by the business owners, but the level of investigation of alternative products or behaviors was quite low. The main reasons given to the researcher for lack use/investigation of alternative products/behaviors were lack of availability, expense, or just not thinking about it. In other cases, the owners have tried alternative products/behaviors with varying levels of success. However, all business owners reported that if there were an alternative product for a similar price, they would be willing to try using the alternative.

Several of the businesses had investigated and even tried different alternatives to plastic drinking straws, more than any other item. Some had investigated the possibility of bamboo straws, but one owner believed they violated the health code; and one local man manufactures bamboo straws, however they are far more expensive than plastic straws and the man was not thought reliable by many of the owners. One business has used paper straws in the past but found they did not work well in the climate, although another business is switching to paper straws soon. Another business recently ordered stainless steel reusable straws and believes that their use of them may inspire others to switch products to keep up. Finally, one owner noted (in conjunction with the main reason for using the straws) that the business could stop using straws altogether, but the customers want them so they will not.

The small cutlery service bag was an item where some businesses were using an alternative product/behavior by wrapping the cutlery in a napkin, which the owners said was the preferred method. However, some of the restaurants only used the napkin technique over the plastic bag when they had time to do the wrapping. Other restaurants served the cutlery in napkins at all times. None of the owners mentioned investigating a bag made of other materials.

In the case of the take-away containers for the restaurants there was some investigation of alternatives. One owner found take-away containers made of paper products, however they are only available in a small size, making them useful for sending home leftovers but not large enough for a full meal ordered to go. Other businesses told the researcher that they give to-go food in a reusable Tupperware container and collect a deposit which is given to the customer upon the return of the container; with another only selling take away food to those customers who bring their own reusable container. An owner noted that she would like to charge more for takeaway but the customers would not like it. Pizza boxes are available in cardboard in the area.

The minisupers both talked about the possibility of alternatives to plastic bags. Both offer cardboard boxes to their customers to carry their groceries home, but that they are not wanted by the customers. One owner once purchased 15 reusable bags and gave them to members of the community, but only 2 of them ever used them, the rest returned and wanted plastic bags. Paper bags are more expensive, but the customers don't want the paper bags anyway, they like the plastic bags. Both owners brought up a law that is currently in review in the Costa Rican legislature which would force them to charge for the plastic bags, they both want the law to pass so they can then charge their customers and have an excuse. When asked if they would consider charging their customers without the law and one owner quickly responded "no", because their customers would think they are cheap.

Many of the businesses do use glass bottles for some soft drinks, but they are not available for all drinks; one owner was able to reduce plastic bottle use to just water, which he was not able to find in another type of container.

***Amount of Products in Use and Cost*:**

The business owners in general did not have a precise understanding of how much of these products they were using, with several noting that the demand in the area is very unpredictable and varies greatly. The minisupers both noted that they give out several kilograms a week in plastic bags ("a lot"). The restaurants noted using hundreds of straws a week. However, most of the businesses did not appear to have a detailed accounting of their product inventory and use. However, all agreed that the busiest time was from December to Holy Week, with the weeks of Christmas and Holy Week being the busiest times due to increased tourism.

Plastic products are simply cheaper that the alternatives on a per unit basis, this was acknowledged by several of the owners. However, the costs add up, with both of the Minisupers noting that they spend a great deal on the plastic bags that they then give away for free. These costs also ignore the externalities imposed on society by this plastic; health impacts from burning and consumption, increased volume of trash, environmental impacts (to marine life). The apparent lack of detailed accounting in the business may also be obscuring the long-term continuous costs of these single-use products relative to reusable alternatives. Several owners denied that cost was a

major factor in plastic use, stating that availability was a more pressing issue.

Waste Disposal Methods and Waste Management in the Area:

A major issue in the area is the poor quality of waste management. There is highly irregular waste collection provided by the municipality of Nandayure, with the business owners giving responses varying from once every two weeks, to once a month, to occasionally months without pickup. One of the business owners reported bringing their trash to nearby Jicaral or Nicoya to dispose of it because the pickup in Coyote was so unreliable. Many of the businesses noted that they separated their garbage and recycled some of it, cans, glass, plastic bottles; most responded that they sent their recycling to the nearby town of Corozalito, upon further investigation there is not a recycling center at Corozalito, however when meeting with the head of the nearby Punta Islita's waste management plant the researcher was informed that the recycler is in the nearby town of Las Parcelas. The businesses report that a truck comes perhaps once a month (inconsistently) to collect the recyclables. Although when asked about the capacity for plastic bottle recycling one of the owners reported; "No, nothing, you burn it or just throw it on the ground, but nothing else.", indicating that some in the community do not recycle. Almost all of the businesses noted that in the community most trash (including their own) is burned, either because it is unrecyclable (anything with food residue) and/or because it would simply pile up too much in between pickups; a common response regarding the burning of trash from several interviewees was "there is no other option". The burning is evident throughout the area with small piles of ash (and incompletely burned trash) abundant in the area.

Others will simply leave their trash in piles in town or at the bus stations. One of the biggest complaints from the business owners was of the large trash pile at the entrance to the Costa de Oro beach. The owner of a restaurant in Costa de Oro noted that the people staying in houses in the area will simply leave all of their trash in a pile which due to irregular collection will be torn apart and dispersed by animals. Some in the community will simply throw their trash into the rivers on the side of the road. The owners of one business in Coyote central noted that people will leave trash in front of the store, assuming that they will deal with it or that the municipality will come and collect it but they do not. At the beach in Playa Coyote there is an area for collection of trash but written on the side it reads "trash from houses prohibited". Some business owners, as well as other residents interviewed in nearby Corozalito, noted that while at some of the beaches there are separate bins for different types of trash, the municipal truck will dump them into the same bin together, discouraging them from separating their trash.

Based on the interviews with business owners and personal observation of the waste collection and pollution the area, the researcher met with the officials at the municipality. Douglas Arauz, the official at the municipality in charge of trash collection told the researcher that the municipality understands that the collection needs to be more regular but a

lack of resources has been a problem. The municipality currently has an order out to buy a new truck for trash collection, which will enable them to have once a week pickup throughout the municipality. They hope to have this new truck within the next month or two (Summer 2017). However, one of the problems the municipality faces is that the truck has a limited capacity and must turn around when full; this is an issue because according to a waste analysis the municipality performed in the town of Carmona the waste is composed of 64% organic waste which is filling the truck and limiting their ability to collect everyone's trash. He also has submitted a proposal to purchase large trash receptacles for the beach areas, these bins would have separate areas from general trash, cans, glass, plastic, and paper and a filtration system for the liquid residue. This is similar to what residents of the area have reported they were told by the mayor of the municipality; that there would be more regular collection in the next few months, but they are highly skeptical.

In the general area there is one town that has a proper waste management regime; the town of Islita, home to the luxury resort Hotel Punta Islita, has a privately funded waste management plant. The hotel has trash collection centers at the beach, in the town, and throughout the hotel property for the disposal and separation of trash. The hotel then collects the waste and brings it to a small management plant for processing. The organic waste is composted in several steps (including vermiculture) for use on the hotel grounds. The other waste is separated and plastic, aluminum, other cans, tetrabrik, and glass are all cleaned and dried. Scrap metal and used oil are also collected and stored. Contaminated plastic and paper and other non recyclable goods are burned in their multilevel incinerator oven as opposed to the open burning in the rest of the area. The separated trash is collected by a scrap recycler from Nicoya who pays for the aluminum, scrap metal, and used oil, but takes the rest of the trash for free. This is the best example of waste management in the area.

Awareness level in the area?

With past research indicating that in rural areas and developing countries a lack of understanding and awareness about plastic pollution and its impacts could be a major impediment to reducing its impacts (Gupta & Somanathan, 2011), the interviewed owners were asked about the level of awareness in the area and if they believed an educational program would be beneficial. There was a general consensus that some people realized that waste management was a problem in the area but that a more complex understanding of the issue was lacking, and the area could benefit from an educational program. One restaurant owner believed that the reason there is not a greater groundswell of complaints about the issue is the small population in the area. One noted that it is good for outsiders who may have seen places with even worse trash problems to warn the locals (who have not seen how bad it can get) about what can happen if steps to change are not taken. Some of the owners noted that the people in the area were not educated about waste management and the impacts that pollution has on the

environment; this impacts their consumption patterns according to the owners of the mini-supers leading to the locals desiring to use plastic bags as opposed to alternatives. Several owners noted that there needs to be a complete educational campaign reaching the whole community, "*everyone*", and the tourists to raise awareness and hopefully concern about the issue in the area. They note that the mentality needs to change "little by little", with one owner noting the need to educate the community on the benefits of reusable products. One owner noted a sense of apathy in the area, the people will not show up when meetings are called, something that could make an educational program hard to implement.

A common theme among the owners' responses to questions about awareness/need for education in the community was the potential benefits to focusing on the children in the community. Several owners noted that focusing on the children could create a cultural shift by educating them about plastic pollution before they develop the bad habits prevalent in the area. The owner of Pizza Tree noted that in Europe you learn about these environmental issues when you are young and it sticks with you into adulthood, telling a story of a Dutch man who recently came to the beach with a backpack and cleaned all of the plastic he found; but that many in the area had no respect for their environment and would simply throw trash on the ground. However, according to Turtle-Trax staff, partnerships with the school are difficult due to high teacher/administrative turnover.

Could Tourism Be Negatively Impacted?

With past research indicating that pollution in an area (specifically beaches) can suffer loss in tourism and revenues from increased pollution (Ballance, Ryan, & Turpie, 2000) it was important to see if the local business owners (whom are admittedly busiest during tourism high season) understand the potential loss of tourists due to worsening plastic pollution. Tourism is very important to the region, with the business owners all indicating that their busiest time of the year is during the tourist high season. With one owner noting that the town lives on tourism, it is the most sustainable source of good jobs. The business owners generally agreed that the tourism could be negatively impacted by plastic pollution. With several noting that of course tourists would be repelled by the trash. One minisuper owner reported that some tourists come and see the beach and turn around. The owner of one restaurant noted that there may be tourists who see trash on the beaches may say how dirty the people who live here are and leave. The manager of one restaurant did not really think tourism would be negatively impacted but that the pollution can leave a bad impression. The owner of another restaurant noted that the area was once in a guidebook noting that the beaches in the area were dirty, and that when tourists would see the pile of garbage at Costa de Oro they would turn around. The owner of one minisuper relayed a story of talking to a tourist who had been at the beach two years earlier and was now complaining that it was much dirtier than it had been the last time he was there and is now very ugly. The owner of one beachfront restaurant said its obvious that if you won't go somewhere if you know

its polluted and you won't go there if others tell you its polluted. Another owner said "yes of course, noted that there were mountains of trash, Tourists would stop and ask where to go, he would tell them that Playa Coyote is beautiful, but he knew that they would see all the trash. It was very bad. Ugly for the view and nature, lots of it in the sea, bags, diapers."

Emergent Themes:

The initial focus of this study was on the local businesses as they were assumed to be an important source of plastic products in the area. However, an emergent theme brought up by many of the business owners is the contribution of tourists (including those who are part time residents) to the waste problem in the area. This began in my first interview and continued to be brought up in nearly every interview. The area receives a large amount of tourists, especially during the season from December through Holy Week, according to the business owners and other locals the tourists are often Costa Rican nationals (especially during Christmas week and Holy Week). Tourists bring in even more trash and do not always properly dispose of it. The owners in the center of town complain that these tourists will bring their trash and leave it at the bus stop or in front of the businesses. Some mention that these tourists, being from other areas with better waste management (like San Jose or other central valley locations) may not understand how poor the waste management capacity is in the area: other owners say that the tourists just don't care. The tourists "don't understand their impact" on the area since they leave and do not see the aftermath. However, some of the business owners brought up the fact that the foreign tourists are generally more aware of the plastic pollution and environmental issues in general. The owner of one restaurant also noted that the foreign visitors are generally better educated about this issue, but that the Costa Rican tourists are causing more of a problem.

Discussion

This investigation confirmed what the staff of Turtle-Trax was concerned about, there is indeed a plastic pollution problem in the Coyote area of the Nicoya peninsula, due to several factors. Single-use plastics, the most dangerous plastics in terms of their potential for pollution (Sheavly & Register, 2007), were used by all 12 of the hospitality businesses in the area. The waste management in the area is inadequate to handle the volume and type of trash being produced in the area, creating massive potential for plastic to escape the waste stream.

Single-Use Plastics:

The high levels of single-use plastics being used in the San Francisco de Coyote area is a serious concern as these items have been prioritized in the literature for their high percentage of in previous studies of pollution. Changing the behavior in a long term sustainable manner requires understanding why the behavior is being performed in the first place, from the point of view of the actor (in this case the business owners) (Stern, 2000). This is a more complex issue than it

may have been assumed to be, with different business owners using different products for different reason, one approach will not be sufficient to change all of the behaviors; the proposed changes must be realistic and conform to the values held by the business owners (Stern, 2000). One example of an intervention which has already begun based on this research is the implementation of an awareness campaign to reduce the use of plastic drinking straws in the local restaurants. Based on the literature (PSI, 2015) the drinking straw is one of the main targets for any intervention in the Coyote area due to its ephemeral use and lack of necessity. The business owners believed they needed to provide the straws because their "customers wanted them", they do not want to disappoint their customers and potentially harm their business. Working from this context, the researcher created a small sign for the tables at all of the restaurants asking customers to say no to plastic straws. This fits in the context of the business values (Stern, 200), they are providing the straws to satisfy the customer, if the customer does not want the straw, then they are satisfying them by not providing one. The signs also feature a turtle and the Turtle-Trax, CREMA, and MIST logos; using the appeal of the charismatic mega-fauna has been effective in the past (Kollmuss & Agyeman, 2002) and informing the public as a credible source has been shown to be effective (Manning, 2003). The signs also feature the names and locations of all of the participating restaurants, making them a free promotional item for the businesses as well as the Turtle-Trax, CREMA, and the MIST program. The signs are aimed at straws specifically but they may also help to get the customer's to be more conscientious about their use of plastic in other aspects of their lives (PSI, 2015), possibly leading to more widespread impacts.

Interventions on the other single-use items should follow this same model of considering the reasons the businesses are choosing to use these specific products and tailoring a solution around those, whether it is increasing the availability of alternatives for take-away containers, or finding an alternative to the cutlery bag which is just as convenient but less wasteful. With plastic bags it may require an educational component to reduce demand from the community. Alternative products and/or behaviors suggested to the businesses need to conform to their needs and values or they will not change their behaviors in a meaningful, lasting way (Stern, 2000). As noted in the literature, plastic products are inexpensive to buy, but these prices do not incorporate the many negative externalities that these products inflict on the environment and society (Gupta & Somanathan, 2011). More education to the business owners about the true cost of these products (including the full dangers from dioxins and other contaminants released when burning and the potential negative impact on the local fisheries (Ocean Conservancy, 2015) may help influence their decision making when weighing incentives and disincentives for use. This ties into the need for a program to raise awareness and understanding of plastic pollution in the area. Past studies (Laner & Rechberger, 2009) have shown what this research discovered about the businesses in the Coyote area, that they do not have the numbers and accounting

to truly understand their impacts. Aiding these businesses in keeping track of their product use and costs could help to convince them of the long term benefits of switching from single-use plastics to alternative products/behaviors.

Both minisuper owners brought up their desire to see a law passed which would give them an excuse to not give plastic bags away for free, and while this will likely help it is unclear when this law may get passed if ever. In addition, past research has shown that in developing countries and especially rural areas there is a lack of enforcement for more state driven initiatives to reduce the impact of plastic waste which often hampers their effectiveness, meaning that other types of decentralized and non-mandatory initiatives may be more effective (Gupta & Somanathan, 2011). This means that bans on products may not be effective in places like the Coyote area, and convincing the businesses to reduce their use voluntarily would likely be more effective. However, this would depend on the businesses believing that these changes would not hurt their reputation amongst their customers and therefore their business.

Waste Management:

The study area is rural with very poor waste collection. Without exception those interviewed by the researcher believed that the municipality should be doing more to deal with the waste from the community and the municipality agreed. The limited resources available to the local authorities are typical of rural areas in developing countries (Vegter *et al*., 2014; Ocean Conservancy, 2015). The proximity of the study area to the ocean makes the open dumping of trash an even greater concern, with past studies of similar issues in developing countries coastal areas showing very high rates (up to 90%) of waste entering waterways (Ocean Conservancy, 2015). If the municipality follows through on their pledge to begin weekly collection for the entire area this could have a major impact on the pollution in the area. Since many people claim that they need to burn or dump their trash due to the long wait in between collections, thus more regular collection could help to alter the behavior of the residents.

While many of the businesses report sending their plastic, cardboard, and cans with a recycler, this service appears to be inconsistent and only collecting some of the products. The nearby Hotel Punta Islita has a deal with the recycler they deal with to take even the products that are not profitable when collecting those which are, thus ensuring that all of their waste is brought to an area where it can be better processed. Another great example of waste management in Costa Rica visited by the researcher is the community run plant in Tortuguero, Costa Rica, with it being an important tourist destination (with far more visitors than Coyote), remote and disconnected from its municipality, and an important turtle nesting beach this is a good example for the Coyote area. The Tortuguero plant is mostly community supported, with some aid from the municipality, however the plant generates money from its processing of trash into raw materials (plastic pellets, compost, glass shards/sand, etc.) and selling those materials. This turns the community's waste into an economic benefit by selling

what they normally dispose of and creating jobs for locals. It may be beneficial for the local municipality to investigate the possibility of setting up a system like that of the plant in Tortuguero, as it has some similar characteristics to the study area.

Other potentially high impact interventions which could be made in the area are minor infrastructure improvements, possibly building an incinerator for the area where people can more completely burn their garbage, preventing the plastic escaping from incomplete combustion. A physical container to keep dogs and vultures from the trash could help to prevent it from being torn apart in between collections, something the municipality is supposedly working on, but something that Turtle-Trax can try to keep pressure about (NOAA & UNEP, 2011).

Local Awareness and Education:

With all respondents believing that an education program for the community regarding plastic pollution and waste management would be beneficial it should be one of the main areas of focus in any program to deal with the issue. This is in line with past studies regarding plastic pollution in developing countries (Gupta & Somanathan, 2011). However, based on the information from the municipality's waste audit (showing that 65% of trash was organic) there needs to be general information about waste management (composting, separation, recycling, etc.). An educational program in the community would appear to be well received based on the interviews in this study, and could be a low cost and high reward investment (Gupta & Somanathan, 2011). However, as noted before it can be difficult to get a program like this off the ground in this community specifically, due to apathy and the lack of stability at the local school. Thus, Turtle-Trax will need to find a way to attract the attention of the community and find a way to make their outreach to the youth of the community more stable in the long run.

Modern social media and technology with their global reach and now near complete saturation of the population, will be increasingly important in bringing about cultural change (Eagle, Hamann, & Low, 2016). Past research has suggested using "demarketing" techniques, aimed at reducing consumer demand for a certain product or behavior, in this case single-use plastics; a powerful tool in this fight is the video, from a nearby researcher in Costa Rica of a plastic drinking straw being removed from sea turtle's nostril (Eagle *et al*., 2016). The use of charismatic mega-fauna like sea turtles has been shown to be more effective than campaigns focusing on more intangible issues, giving Turtle-Trax a potential advantage in any future campaign (Kollmuss & Agyeman, 2002). A possible strategy in Costa Rica would be the large marine conservation organizations and tourism operators creating a media campaign in the time before the two big domestic tourism weeks (Christmas and Easter) to inform the public more about their impacts on the beach and marine environment before they go on their vacation and hopefully alter their behavior. While a large traditional media campaign would be expensive, a campaign on social media to target Costa Ricans before their vacations,

using charismatic mega-fauna (sea turtles) and appealing to their targets' childhood connections to the beach may be impactful nationwide (Kollmuss & Agyeman, 2002).

Tourist Contribution to Pollution:

As noted in the findings, one issue which almost all of the business owners raised was the contribution of tourists to the trash problem in the area. This was backed up by the observations of the researcher during the tourist high season. This is an issue previously observed in rural tourist destinations in Costa Rica (Meletis, 2007). This is clearly an issue that these members of the community are concerned about, it is possible that some of the attention being brought to this issue is deflection of responsibility from the community's role in the waste problem in the area. The response about the tourists leaving the trash was generally more that the tourists did not understand the poor waste collection in the area and did not realize the impact they were having. This is something that seems plausible based the researcher's direct observation, the tourists were bagging their trash and piling it in areas for collection (which rarely or never occurred), suggesting that they were attempting to deal with it properly but did not understand the reality of waste collection in the area.

Trash piling up from the tourists is a potentially very serious issue because these tourists are camping/renting hoses right on the beach meaning the trash does not have to travel far to enter the ocean. This is an issue that Turtle-Trax/CREMA can work on by educating the tourists about their impacts and promoting a carry-in carry-out ethic regarding plastic and other waste. Past research has shown that educating tourists can be effective at getting them to change their behavior, especially "when applied to problem behaviors that are characterized by careless, unskilled, or uninformed actions." (Manning, 2003). Multiple source of information targeted at the tourists' values (different from the educational campaign for residents) are more effective than a single source, and in person interpretative programming is highly effective (Manning, 2003). A campaign where Turtle-Trax/CREMA staff and volunteers visited the beaches during the tourist high season (especially the two main weeks) and informed to the tourists about the poor waste collection and their impacts, they may have a significant impact. Research also suggests that delivering the information early (even during the planning stages of a trip) is another effective strategy (Manning, 2003). One tactic discussed with some of the business owners was to provide a letter to those who rent houses and cabinas to send to their guests before their trip warning them about the poor waste management and asking them to either bring less plastic or to carry-out what they bring. Past research has shown that campaigns built around tangible impacts and charismatic mega-fauna like sea turtles has been shown to be more effective than campaigns focusing on more intangible issues (Kollmuss & Agyeman, 2002, Manning, 2003). Research has also shown that information from sources which are seen as highly credible are more likely to be effective (Manning, 2003), Turtle-Trax has a great opportunity to use both of these

advantages in their pollution reduction campaign.

Final Thought

While this study began with the seemingly simple idea to reduce the impact of plastic pollution by focusing on the single-use plastics in the hospitality industry, it soon became clear that plastic pollution in the area was a complex issue. This involves issues from the supply of the plastic products to the customer demand, and the poor waste management requiring complex systems thinking to create any sustainable solution. A simple solution targeted at one part of the system will likely not solve the problem, but a multipronged approach may have success. The issue of plastic pollution in the area includes components in supply chain management, consumer behavior, environmental justice in tourism, technological and management deficiencies in waste management, and education and awareness deficiencies. It will require a long term multipronged effort from Turtle-Trax, CREMA, the local municipality, and the residents. But it is a problem which can be solved as long as the actors trying to affect change understand the complexity of the system and do not look for simple solutions to fix the whole problem but work in conjunction with other efforts to target other parts of the system.

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ARTICLE

A Brief Overview of Impact of Air Pollution on Children

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Good air quality is fundamental for living well. We reviewed some existing air monitoring data and literature related to Nepal and correlation of air quality, and the health status of children. Both indoor and outdoor air quality can be significant on health status of the population, especially outdoor areas where children play could be critical for their health. To increase official and public awareness, this overview attempts to provide a summary of the health of children and the level of air pollution in the Kathmandu, Nepal region. Our primary focus was Particulate Matter and its impact on human health. This form of air pollution has the most long-term negative impact on health status.

Globally, public concern is growing with respect to air quality. With the rise of air pollution in many cities across the world, the health status of adults and children are being negatively affected. While public policy has led to a reduction in air pollution in some economically powerful nations, the decline in the quality of the air in moderate and low-income societies is alarming, e.g. India and China. This paper describes how air quality has been correlated with lower health status and well-being of children in Nepal. Other factors that correlate with lower health status of children, e.g., nutrition, water pollution, and economic status were not the focus of this paper.

General Geography of Nepal

Nepal is a country with an estimated population of 30 million with some one fifth of the population living in urban areas. The country can be divided into three geographic regions: The Himalayan region is covered in snow, the Middle Hill region is also mostly hilly areas and the Terai is plain land region. It has five types of climate. It is quite amazing that within the span of 200km from north to south, the climate of Nepal varies from arctic to tropical.

Frequently, cold air flows down from the mountains and is trapped under a 'layer of warmer air', thus a city such as Kathmandu has more air pollution than what might be assumed. This layering acts as a 'lid' and pollutants are trapped close to the ground for extended periods of time [1]. Kathmandu valley is surrounded by high mountains ranging from 2000 to 2800 meters from sea level [2]. The valley structure looks like a bowl which restricts the movement of wind thereby allowing pollutants in the air to

Photo Source:© Felix Dance / Flickr. https://theculturetrip.com/asia/nepal/articles/why-is-kathmandu-in-the-midst-of-a-pollution-crisis/

remain and to accumulate over time. This makes the valley particularly vulnerable to air pollution [3 and 4].

- Outdoor Air Pollution in Nepal

Kathmandu city and other south Asian capitals' air quality is worsening. [5]. The atmosphere of Kathmandu every morning is increasing the level of serious particulate matter pollution as well as the number of toxic gases in the air. According to some researchers, the air in Kathmandu valley is a threat to human health [6].

Nepal is the eighth most polluted country of the world. Of the world's most polluted 30 cities, 22 are in India, according to research by IQ Air Visual, a Swiss-based group that gathers air-quality data globally. The remaining eight cities are all in Pakistan, Bangladesh and China. When comparing only national capitals, Kathmandu is included within ten most polluted capitals of the world in terms of pollution [7].

According to AIRVISUAL, an air quality index based in Switzerland (Airvisual.com), most air monitoring stations near Kathmandu show unhealthy air quality with a range of 101-160 Particulate Matter (2.5 microns). This index also covers five air quality pollutants: Particulate matter (2.5 microns and 10 microns), carbon monoxide, sulfur dioxide, nitrogen dioxide and ground level ozone

One estimate indicates that some 37,399 people die every year in Kathmandu due the reason of air pollution. Kathmandu's particulate matter pollution increased from 45.9 micrograms per cubic meter in 2017 to 54.4 in 2018, which is an increase of 19 percent [8]. The local Rotary organization has been passing out masks to local police who direct traffic in the city for some years.

The list on Table 2 shows some examples of other cities in Nepal and their air quality on one given day. However, to secure government and community action, more local studies are needed to document the cause and effect relationship between children's environmental health status and air pollution in Nepal [10].

Table 1- Air quality descriptions.

Air Quality Value Levels in Numerical Terms	**Meaning of Colors , Actions and Caution To Protect Health From Particulate Pollution**
Good (0 to 50)	**Air quality is considered satisfactory, and air pollution poses little or no risk.** It's a great day to be active outside. No action needed.
Moderate (51-100)	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution. Some people who may be unusually sensitive to particulate pollution. Unusually sensitive people should consider reducing prolonged or heavy exertion.
Unhealthy for Sensitive Groups (101 to 150)	**Members of sensitive groups may experience health effects. The general public is not likely to be affected.** Sensitive groups include **people with heart or lung disease, older adults, children and teenagers.** People with heart or lung disease, children and older adults should reduce prolonged or heavy exertion.
Unhealthy (151 to 200)	**Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects. Everyone is needs to be concerned.** The following groups should reduce prolonged or heavy exertion: • People with heart or lung disease • Children and older adults
Very Unhealthy(201-300)	**Health alert: everyone may experience more serious health effects. Everyone needs to be concerned.** The following groups should avoid prolonged or heavy exertion: • People with heart or lung disease • Children and older adults Everyone else should reduce prolonged or heavy exertion.
Hazardous	**Health warnings of emergency conditions. The entire population is more likely to be affected. Everyone need to be concerned. Especially,** people with heart or lung disease as well as children and older adults should be alerted . Everyone else should avoid prolonged or heavy exertion.

Table 2. Air Quality in Ten Cities in Nepal

Stations	Air Quality Index
Simara	178
Damak	92
Bhaisipati	87
Dhankuta	74
DHM, Pkr	73
PU Pkr	73
Nepalgunj	64
Shankapark	60
Dhulikhel	43
Dang	38

Figure Sources: Government of Nepal, Ministry of environment air quality monitoring. Date 3/29/2020. http://pollution.gov.np/#/home?_k=5wzxmd[17]

In Table 1, six levels of health concerns are defined in terms of associated health effects of air pollutants. The effects can be a few hours or few days after breathing unhealthy air [9]. Air quality is not monitored in all parts of the nation. More monitoring is needed. Patan city has an estimated population of some 184,000 residents as of 2020 and Patan is one the three cities to make up Greater Kathmandu and is located in the Kathmandu Valley. Bhaisipati in Patan has an air monitoring station and shows a level of 87 pollution or moderate air pollution (See list above). Kathmandu and Bhaktapur along with Patan make up Greater Kathmandu with a combined population of over 1.6 million with the Kathmandu Valley (https://www.worldometers.info/world-population/nepal-population/).

While air pollution is mostly an urban issue, Simara, a relatively small city of some 10,000 residents, has the worst out-door air quality of those cities where monitoring exists with a level of 178 (See list above). Based upon discussion with government officials, this air pollution is mainly due to the illegal brick making kilns in Simara. In the nearby city of Siraha that is an account of how local families suffer from illegal brick kilns. (https://myrepublica.nagariknetwork.com /news/ locals-suffer-from-illegal-brick-kilns-in-the-middle-of-settlements). All residents of Simara (also in Siraha) will experience health effects and members of sensitive groups may experience more serious health effects. Everyone in Simara and Siraha need to be concerned about children and older adults with compromised health withthe level of air pollution in their cities.

Indoor Air Pollution

Nandasena, Wickremasinghe and Sathiakumar, in their article in 2013 show how indoor air pollution affects the respiratory health of children in the lower income communities. Cooking over an open fire in a room without proper ventilation is a major cause of indoor air pollution around the world. Our colleagues in Chapala, Mexico have been replacing inefficient stoves in homes to reduce indoor air pollution in the barrio of Tepehua, and thus, lowing the risk of respiratory illness one house at a time (www.tepehua.org). In a paper by Ranabhat, and colleagues on the consequences of indoor air pollution in rural areas of Nepal provided a review of the extent of indoor air pollution exists in Nepal and how to measure this pollution [12]. Below is photo of one home in Nepal where a family cooks over open fire in their home and thus, reducing the quality of the air in the home. This is a very common scenario that one can find in the poorest houses in the Tepehua Barrio in Chapala, Mexico.

Human Health

Study shows that air pollution has many effects on the health of both adults and children. The impact can be *in utero* and during early life may permanently change the body's functions like- physiology and metabolism- and lead to diseases in adult life [13]. Likewise, in comparisons the infants are particularly vulnerable because of their rapid growth and cell differentiation, immaturity of metabolic pathways and the development of vital organ systems. The central nervous system has unprotected barriers and a broad time window of conformation, leading to a long period of vulnerability in the developmental process and leave the younger population susceptible to any environmental insult [14].

The USC Children's Health Study also documents how children are at much greater risk of increased asthma and asthma attack. Ozone levels is especially important pollutant because of the negative impact they have on the respiratory tract and lungs [15]. In contrast to adults, most children prefer to live outdoors more hours per day where they can exert themselves to a greater degree. However, some children in poor housing situations face air pollution challenge in their homes as well as outside where they may play.

Conclusion

We have pulled together existing data and studies attempting to illustrate the relationship between health status and air pollution in Nepal. Not surprisingly, most data comes from urban area of Nepal. More information is needed in rural Nepal. The media is becoming aware of the issue of air pollution and can become a partner in the process of stimulating community action to improve air quality in Nepal.

The CNN reporter Mary McDougall, in 2018 reported that more than 90% of world's children breathe toxic air, around 93% of the world's children under 15 years of age breathe polluted air and that puts their health and development at serious risk. There are some 1.8 billion children globally [16]. Around 120 million cases of childhood pneumonia were reported in 2010 and among of them 47.4 million cases were reported from South Asia [17]. It has been shown that childhood pneumonia is a major cause of mortality worldwide. In addition to outdoor air pollution, it has been document that indoor or household air pollution (HAP) is a major contributor to childhood pneumonia in low and middle-income countries [18]. Daily cooking using inefficient stoves that allow the smoke to remain in the house is harmful for adults and children.

Thus, we conclude that more monitoring devices to record air quality levels is needed in Nepal. Using the model of "citizen science" in partnership with various organizations across the world are available to assist Nepal to expand air monitoring. (luftdaten.info) [19]. Schools and universities in Nepal can become important partners in this effort. Building and installing low cost air monitoring devices can be integrated into science and technology educational programs. With university involvement, more studies on the relationship between air pollution and children's health status can be done in Nepal. Community support for improving air quality can

increase as monitoring and studies increase.

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ARTICLE

Reducing the Impact of Plastic Pollution in a Rural Coastal Area: Focus on the Hospitality Industry & Tourism of the Central Nicoya Peninsula, Costa Rica

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Plastic pollution has become a major plague upon the world's oceans and coasts (Fauziah & Nurul, 2015; Jambeck *et al*., 2015), affecting the marine species all throughout the food chain (Vegter *et al*., 2014), possibly even impacting human health (Rochman *et al*., 2013), and the tourist economy (Balance, Ryan, & Turpie, 2000). In the Central Nicoya peninsula of Costa Rica, a local sea turtle research voluntourism operator Turtle-Trax S.A. and the marine conservation organization CREMA (Center for the Rescue of Endangered Marine Animals) believe that plastic pollution in the area is a serious and growing problem. The staff noted that many of the hospitality businesses (restaurants and mini markets - minisupers) in the area are using single-use plastic products (i.e. drinking straws, plastic bags, take-away containers, etc.). There may be an especially acute problem in the San Francisco Coyote area in part because there may be poor waste management, with the Turtle-Trax staff noting that garbage is traditionally burned, buried, or dumped in the river; a common problem in rural Costa Rica which has been researched in other communities (Meletis, 2007).

The remote, rural central Nicoya Peninsula, specifically the small district of Bejuco (population ~3,313)(INEC, 2011) in the Guanacaste province of Costa Rica is an important habitat for several marine turtle species including the endangered Green Sea Turtle (*Chelonia mydas*), the critically endangered Hawksbill (*Eretmochelys imbricata*), Leatherback (*Dermochelys coriacea*) turtles, and the vulnerable Olive Ridley (*Lepidochelys olivacea*) (Beange, Clift, & Arauz, 2015), as well as several other animal species. The area contains several designated protected areas, including two marine protected areas, the Camoronal MPA and the

Caletas-Arío MPA. The potential for negative impacts from plastic pollution is high in this area; with marine turtles being highly susceptible to danger (Vegter *et al*., 2014), especially the Olive Ridley turtles which nest in great numbers in the area. The fact that the local beaches are important nesting sites for marine turtles adds another dimension of risk from plastic pollution as the plastic altered thermal properties of the sediment can affect the turtle population's sex ratio (Carson *et al*., 2011) and lead to difficulty laying eggs in the first place (Plot & Georges, 2010). Plastic pollution in the area could do harm to the economy, which includes traditional sun and surf tourism, "turtle tourism" (Meletis, 2007), as well as cause potential human health and economic impacts from the contamination of local seafood (Vegter *et al*., 2014). The area is a popular beach destination for Costa Rican nationals who may be driven away by the prevalence of plastic pollution on the beaches (Ballance *et al*., 2000). Previous research in the study area has indicated that the prevailing ocean currents pull micro-plastic pollution away from the area while concentrating macro-pollution on the beach leading to an unsightly problem (Roos Lundström & Mårtensson, 2015). The grave risk to the area from this pollution necessitates investigation into the "problem products", sources of pollution, and incentives to use these "problem products" in the area (Cummings, 1992).

However, identifying the problem is only the first step in any process to change environmental behavior (Stern, 2000). The issue of improving the environmental friendliness of the local businesses may be difficult because the area is very rural, and characterized by small businesses which "generally … do not have the resources to provide a detailed description of their environmental situation and the relevant flows into the environment" (Laner & Rechberger, 2009). Past studies regarding the reduction of plastic in the hospitality industry have been completed but were undertaken in developed countries (Su *et al*., 2015). Thus, we must understand the decisions to use these products from the context of the small business owner in rural Costa Rica, not from the perspective of the ecologist or marine biologist (Stern, 2000). Plastic pollution in the Coyote area is a critical problem which needs further study.

Literature Review

Impacts of plastic pollution

With plastic pollution becoming an increasingly recognized problem worldwide, its impacts are becoming clearer (Vegter *et al*., 2014). Plastic, although it has only existed for about 100 years (Derraik, 2002), is one of the most pervasive and persistent impacts that humanity has inflicted on our planet; its ubiquity is a function of its low cost of manufacturing and its incredible durability (Vegter *et al*., 2014; Su *et al*., 2015). However, this low cost is a function of the ignored externality this plastic imposes upon the rest of society, the true costs are rarely ever accounted for; especially in the developing world (Gupta & Somanathan, 2011). About half of all plastic is used for single use items like packaging, drinking straws, disposable kitchenware, bags, etc. which are used

and disposed of (Hopewell, Dvorak, & Kosior, 2009). In 2010 there was up to 12,700,000 tons of plastic entering the ocean (with the amount only increasing over time) (Jambeck *et al*., 2015), mostly from land based sources (~80%), and a high percentage of that plastic being single-use plastic items (Slavin, Grage, & Campbell, 2012; IEEP, 2016; Ocean Conservancy, 2016). These single use items "create the foundation of the marine debris problem" (Sheavly & Register, 2007). Much of the past research has focused solely on plastic bag use and pollution (Weinstein, 2009; Gupta & Somanathan, 2011), leading to bans and taxes in nations, states, and municipalities around the world (including a law under review in the Costa Rican Legislature) (IEEP, 2016). However, this focus on plastic bags has left a gap in our knowledge and action on many other single use plastic items which are considered "high risk" due to their disposable nature (Vegter *et al*., 2014). This has been singled out in several studies as one of the first changes that need to be made with regards to plastic use (Cummings, 1992; Su *et al*., 2015).

Plastic pollution is a threat to marine wildlife with risks of ingestion, entanglement, and even habitat level changes (Rochman *et* al., 2013; Vegter *et al*., 2014; Ocean Conservancy, 2016). Sea turtles are especially vulnerable to plastic pollution (Vegter *et al*., 2014); they suffer from entanglement and ingestion, with estimates of more than half of all individual turtles having ingested plastic (Ocean Conservancy, 2016). The plastic can cause internal injuries, increase buoyancy, occlude the digestive tract of the turtles, and give a false sense of fullness leading to starvation, among other issues (Nelms *et al*., 2014; Eagle, Hayman, & Low, 2016). The ingestion of plastic can even lead to difficulty reproducing, as sea turtles, like many animals have a cloaca which is used for waste expulsion and reproduction; the occlusion of the cloaca has been witnessed in turtles trying to nest (Plot & Georges, 2010). Another possibly greater risk in the long run for turtle populations of all species is the fact that plastic debris in the sand of turtle nesting beaches can change the thermal properties of the nests such that the sex ratio of the hatchlings is skewed in favor of males (Carson, Colbert, Kaylor, & McDermid, 2011). This is a serious issue for turtle populations worldwide. Other risks to turtle reproduction from plastic pollution on nesting beaches includes the risks of nesting females becoming discouraged by plastic on the beach and not nesting, nesting females becoming entangled on the beach, hatchlings not being able to dig out of litter filled nests, and the litter slowing down the hatchlings journey to the sea and making them more vulnerable to predators (Nelms *et al*., 2014). Time consuming beach cleaning can help to reduce these risks but the only long term solution is prevention of the plastic pollution in the first place (Carson *et al*., 2011).

Another, perhaps more insidious problem becoming associated with plastic pollution is its ability to infiltrate the marine food chain (Rochman *et al*., 2013; Fauziah & Nurul, 2015). When plastics in the ocean are acted upon by mechanical and photochemical processes they simply break into smaller and smaller pieces, eventually becoming microscopic

(Reissier, Shaw, Wilcox, Hardesty, Proietti, Thums, & Pattiaratchi, 2013; Vegter *et al*., 2014). Most plastics contain ingredients known to be hazardous to humans and other life (Reissier *et al*., 2013; Vegter *et al*., 2014), even more troubling there is increasing evidence that these plastic particles attract and adsorb hazardous chemical pollutants from the ocean (Reissier *et al*., 2013; Vegter *et al*., 2014). These microscopic particles are then ingested by plankton and small fish, which are then eaten by larger marine life increasing the risk of bio-magnification of the hazardous chemicals in the plastic and the adsorbed pollutants on the plastic (Reissier *et al*., 2013; Vegter *et al*., 2014; Fauziah & Nurul, 2015). This is a major concern for those people who depend on seafood as a major source of protein in their diets as there is evidence that the chemicals in the plastic as well as the adsorbed pollutants can be damaging to human health (Rochman *et al*., 2013; Reissier *et al*., 2013; Fauziah & Nurul, 2015). The cryptic nature of the marine world relative to terrestrial environmental issues means that the general public may be less aware of the current level of damage, summed up well by Ray (1988): *"The last fallen mahogany would lie perceptibly on the landscape, and the last black rhino would be obvious in its loneliness, but a marine species may disappear beneath the waves unobserved and the sea would seem to roll on the same as always".*

Hospitality industry and plastic pollution

The hospitality industry is a major source of the single use plastics (straws, lids, take-away packaging, food packaging, etc.) which often escape the waste stream and contribute to the problem of plastic pollution (Cummings, 1992; Meletis, 2007; Sheavly & Register, 2007), with one survey of street litter finding 68% was food and beverage related (Scott, 2011). There are concerns about the potential for improving the industry's record on the issue of solid waste management, primarily the cost associated with substitute products/behaviors (Pirani & Arafat, 2014; Su *et al*., 2015). However, the industry is also affected by this waste, Williams and Ponsford (2009) note that a pristine natural environment will increasingly give a destination a competitive advantage in the future, providing an incentive to better manage waste. The level of pollution on a beach is a major part of the decision making process that people go through when choosing a beach to visit (Slavin *et al*. 2012). This is a serious problem for those destinations with a high reliance on beach tourism (McIlgorm, Campbell, & Rule, 2008), with some studies showing the potential loss of up to 52% of tourism revenue due to lower levels of beach cleanliness (Ballance, Ryan, & Turpie, 2000). The risk of contamination of seafood products is also a very real risk for restaurants serving seafood to their customers (Rochman *et al*., 2013). This should be another reason for restaurants near the coast to stop polluting, because they are adding to the contamination of the locally caught seafood they serve (Rochman *et al*., 2013; Reissier *et al*., 2013; Fauziah & Nurul, 2015). Another concern for the hospitality and tourism industry is the fact that plastic pollution is a common cause of engine breakdowns in small boats, with costly repairs possibly driving

up the costs for seafood and marine tourism (Sheavly & Register, 2007). Also, a major economic concern for the industry is the potential loss of turtle tourism in a rural community (Meletis & Harrison, 2010).

There are several reasons why a business would want to reduce its use of plastic. Plastic, being primarily manufactured from petroleum products is subject to price volatility as oil prices swing decreasing the certainty of businesses' budget (UNEP, 2014). There needs to be strong consideration to economics in any plan to reduce the environmental impact of plastic pollution, Ray and Grassle (1991) note that 'no effort to conserve biological diversity is realistic outside the economics and public policies that drive the modern world''. In fact, past studies of plastic use in hospitality businesses have shown that one of the primary concerns when attempting to reduce the use of plastic is the higher costs associated with this change (Su *et al*., 2015). This corresponds with the idea that people make environmental decisions based in large part on the context of those decisions (cost, ease of implementation, etc.), with their attitudes and beliefs having smaller and smaller influence as contextual forces grow (Stern, 2000; Kollmuss & Agyeman, 2002). Any program that ignores this context and only takes values/attitudes into account is doomed to fail.

However, this singular focus on cost by businesses is not by rule, Andrews (1998) notes that businesses can and occasionally do adopt environmental practices that drive up costs. Sometimes businesses, like individuals, will continue a practice or the use of a product simply out of habit and a lack of knowledge of another way (Andrews, 1998; Stern, 2000; Kollmuss & Agyeman, 2002). Michaelis (2003) notes that even small firms have the ability to make important contributions to the social and cultural change which is required to achieve sustainable consumption, something which is important to note since tourism industry is dominated by small and middle enterprises (SMEs) (Williams & Ponsford, 2009). SMEs also have great potential to contribute to environmental degradation (Laner & Rechberger, 2009), especially in the remote and fragile areas where "ecotourism" is popular. Often these SMEs do not understand the environmental impact that their business operations are creating and do not have the resources (financial, education, time) to accurately measure these impacts (Laner & Rechberger, 2009). However, these small businesses by their nature (not beholden to outside investors) can better act their conscience rather than the pure profit motive that large corporations are often beholden to (Andrews, 2000). With regards to business it is clear that profit motive is important, but may not be the only factor in the use of plastic products.

Behavior and cultural element of plastic pollution

Stern's (2000) coherent theory of environmentally significant behavior offers a framework to build upon when attempting to make behavior changes. With several causal variables: attitudinal, based on an individual's values and beliefs; personal capabilities, based on the ability of the individual to change, including financial and educational

resources; contextual factors of the cost/benefits of change, social norms, laws, support, etc.; and habit and routine (Stern, 2000). These variables impact the different types of environmentally significant behaviors: environmental activism, willingness to publicly fight for environmental change; private-sphere environmentalism, purchasing behaviors, changes in lifestyle, waste disposal behaviors, etc.; and other, encompassing changes in organizational behavior (Stern, 2000). To persuade individuals/businesses to change their behavior one must understand the behavior from their perspective and the context the behaviors are part of, and set realistic goals for change (Stern, 2000). It is important to set realistic goals, use participatory decision making, and not overstep the bounds of intervention the actors are comfortable with to increase buy in from the participants (Stern, 2000). Constant monitoring and adjustment are an essential part of any program (Stern, 2000).

Even when new technology or ideas are introduced which have the potential to reduce pollution there is an important need to change behaviors and the cultural element of plastic pollution (Sheavly & Register, 2007). Stern's (2000) theory of environmentally significant behavior proposes that people's behavior is influenced by both their attitudes and their context. Social and cultural norms have a great impact on the way people interact with litter, people are more likely to littler if there is already litter present because it signals that a place is unclean and that littering is the norm (Gupta & Somanathan, 2011; Slavin *et al*., 2012). This may indicate that cultural and educational programs can have a large impact on the level of pollution in a community by helping people to understand the externalities of plastic use (Gupta & Somanathan, 2011).

Vegter et al. (2014) identified the need to better understand the psychological reasons behind plastic use. Behavior is related both to attitudes and to context, to try to affect change in behavior the whole picture of the target must be understood (Stern, 2000). Past studies have found that a lack of environmental awareness in developing countries about plastic pollution and its impacts may be a major limitation in the adoption of more environmentally friendly behavior (Gupta & Somanathan, 2011). Educational programs have also shown to be effective at a low cost compared to technological or legal interventions, making them especially useful in for smaller organizations and poorer areas (Gupta & Somanathan, 2011). There is evidence that women are more concerned with litter than men, possibly highlighting a need to better educate men on the issue (Gupta & Somanathan, 2011; Slavin *et al*., 2012). Past studies have found people's levels of active littering to be low (although this could be different across cultures) (Slavin *et al*., 2012) which would seem to indicate that much of the litter has escaped the waste stream accidentally and thus reduction of potential litter via prevention is likely to be more important than other actions like recycling or reuse.

The technique of "demarketing" is to use marketing strategies to reduce the demand for a product or reduce a behavior (Eagle *et al*., 2016). People's attitudes are most strongly tied to their

natural experiences as children (Kollmuss & Agyeman, 2002), something that should be taken into account in any study and which may benefit those who are working on small local problems in a community. Past studies have found that much of the plastic pollution on shorelines is from local sources, much of it deposited directly on the beach (Thiel, Hinojosa, Miranda, Pantoja, Rivadeneira, & Vasquez, 2013), meaning that local campaigns have to chance to be effective in alleviating the problem of plastic pollution. However, it must be remembered that more education about the issue to a single individual may do nothing to change their environmental behavior if the context of that behavior remains unchanged (Stern, 2000; Kollmuss & Agyeman, 2002), and thus a multipronged approach must be made to affect lasting change.

Gaps in research

There are several gaps in our knowledge about plastic pollution, and yet understanding what we can do to prevent the creation of plastic pollution is critically important (Vegter *et al*., 2014). No waste stream can be perfectly contained, trash will always escape, especially in developing areas (Ocean Conservancy, 2015), and thus the less plastic produced and used, the less potential for pollution (Jambeck *et al*., 2015). Cleaning up plastic pollution is difficult, time consuming, and expensive, and so it is far more efficient to prevent the creation of waste than to try to deal with the pollution (Carson *et al*., 2011; Vegter *et al*., 2014).

Several studies have confirmed the primacy of waste minimization as a recommendation for the hospitality industry (Cummings, 1992; Su *et al*., 2015). This is why the reduction, reuse, recycling and recovery strategy (4Rs) of managing plastic waste has become standard, meaning the desired actions are in descending order reduce, reuse, recycle, and recover (energy) (Hopewell *et al*., 2009). Unfortunately, the options of recovery and recycling, especially on a community level, require a dedicated and complex waste management system (Cummings, 1992; Meletis, 2007), and in Latin American it is estimated that 32% of all plastic waste is not collected (UNEP, 2014). Waste management deficiencies in developing countries are some of the main causes of plastic pollution worldwide (Ocean Conservancy, 2015). It is often buried or burned, leading to the easy escape of plastic waste and the creation of hazardous emissions (Cummings, 1992).

To reduce the use of plastic, we must understand why single use plastics are so prevalent and where along the disposal chain the plastic is entering the environment to allow for a more targeted approach to mitigate the problem (Vegter *et al*., 2014). Many studies of plastic use focus on the incentives to reduce consumer use of plastics (Weinstein, 2009; Sharp, Hoj, & Wheeler, 2010), but the realization that prevention of plastic from entering the market is critical, shows that investigation of the supplier side of the relationship is needed because of the greater potential reductions it can achieve (Su *et al*., 2015). High levels of plastic use are often assumed to be due to its low cost and durability (Vegter *et al*., 2014). However, other causes for its use cannot be discounted such as ingrained cultural

practices, lack of education, limited access to alternatives in remote areas, etc. (Slavin *et al*., 2012; Vegter *et al*., 2014). The reasons behind human behavior are often complex (Stern, 2000) and there is little existing research on these incentives and the underlying psychology behind the decisions to use these products, with researchers pointing to it as an area of need in research (Vegter *et al*., 2014). One of the key areas that experts on the issue have identified for study is the investigation of the problem in developing countries and small rural communities, and how to build their capacity to reduce and deal with plastic waste (Vegter *et al*., 2014). An important priority for research is understanding how these communities can be convinced to use alternative products and/or change their behavior (Vegter *et al*., 2014).

Research Objectives

Plastic pollution is a worldwide recognized problem (Jambeck *et al*., 2015) with specific implications for the central Nicoya Peninsula due to its rural nature and importance as marine turtle habitat (Meletis, 2007; Carson, *et al*., 2011; Vegter *et al*., 2014). The staff of the scientific research tourism organization Turtle-Trax has identified plastic use in the local hospitality industry as a concern for the region, something that aligns with past research on plastic pollution (Ocean Conservancy, 2016). Past reviews (Laner & Rechberger, 2009; Vegter *et al*., 2014) of the issue of plastic pollution and small business environmental management point to several areas of needed study which this proposed research will help to achieve. Adding the resources of multiple academic research institutions (UNT and CATIE) and those of a local NGO (CREMA/Turtle-Trax) to work with the local small businesses on a full investigation to better understand the potential sources of plastic pollution in the region, the "problem products". The incentives behind their use will allow for Turtle-Trax to implement a program to reduce the problem in the region and ideally serve as a template for similar communities. Based on the literature review about plastic pollution and its impacts and the information provided by the Turtle-Trax staff the researcher decided upon several questions to be investigated in this study:

- Does the Coyote area have a problem with the prevalence of single-use plastic products in the hospitality industry and why?
- Is the current waste management regime sufficient to handle the waste being produced?
- What can be done to reduce the impact of plastic pollution in the Coyote area of the Nicoya Peninsula?

This study conducted research pertaining, to and created recommendations to reduce the impact of single-use plastic pollution in the San Francisco de Coyote area. Working in conjunction with Turtle-Trax S.A. our contribution is to help reduce the plastic pollution entering the ecologically important waters off the coast of the central Nicoya Peninsula.

Methodology

Area of Study

The study area is the area around the community of San Francisco de

Coyote on the Nicoya Peninsula in Costa Rica. The area is in the Bejuco District of the Canton of Nandayure in Guanacaste Province. The area is very rural and isolated, the whole Bejuco district has only ~3300 residents (INEC, 2011). The study looked at the hospitality businesses in the Coyote area, including those in San Francisco, Playa Coyote, and nearby Costa de Oro/Javilla/San Miguel. This area was chosen because Turtle-Trax is headquartered in San Francisco de Coyote, the study was limited to this small geographic area due to limited time and resources. The field portion of the study was conducted over several days/weeks long visits to the area from January – April 2017.

Methods and procedures

The methodology is based in part on Stern's (2000) Coherent Theory of Environmentally Significant Behavior, as well as other past research. With so much of the plastic waste pollution found on beaches being of the type that originates in the hospitality industry (Ocean Conservancy, 2016,) and the industry being such an important part of the Costa Rican economy (WTTC, 2015), especially in the coastal zones most vulnerable to plastic pollution (Jambeck *et al*., 2015), the researchers decided to focus on the local hospitality industry. With our target behavior identified, the researcher must analyze the behavior to understand the actors and actions associated with the behavior (Stern, 2000). This was accomplished by compiling an inventory of the hospitality businesses in the area in question to get a full understanding of the source of the potential problem. An additional benefit in a small rural community like this, is that the limited amount of businesses in the area means that the proprietors of these few businesses likely come in contact with a large proportion of the population. This gives them potentially powerful insight into the consumptive practices of the community; this creates an opportunity for a study done with limited time and resources. With an inventory of the local businesses complete, further investigation took place via structured in-person interviews with the business owners/managers; past studies of solid waste pollution in Costa Rica have used this less technical approach (as opposed to more technical methods like waste audits) to capture the cultural dimension of pollution (Meletis, 2007). The next step was to investigate what single –use plastic products (straws, cutlery, small bags, take-away containers, etc.) are being used in the local businesses, as these have consistently been identified as "problem products" seriously contributing to plastic pollution in the literature (Cummings, 1992; WIDNR, 2008; UNEP, 2014; Vegter, 2014; PSI, 2015a; 2015b; Ocean Conservancy, 2016; PPC, 2016).

Although it may seem like a simple issue, we must understand the behavior from the perspective of the actors (Stern, 2000). Therefore, the next step was to interview the proprietors of these establishments to understand why they are using these single use plastic products, what are the barriers to change (Eagle *et al*., 2016)? The interview questions were based on past research about plastic/resource use in businesses and environmental behavior. Is it because economic incentives? Lack of knowledge about, or access to, alternative products?

Are they considering the negative externalities created by their use of these products (Gupta & Somanathan, 2011); do they understand the impacts the pollution can have (Vegter, *et al.*, 2014), including damage to the tourism industry (Balance, Ryan, & Turbie, 2000)? Is there a lack of education about their impact? What are the owners' general opinions about plastic pollution? This give a better idea of what incentives may be able to convince these businesses to enact a change in behavior. Will community pressure to reduce plastic use be enough to overcome economic incentives to continue using it? Based on what the Turtle-Trax staff reported about waste management in the area, and past research about pollution issues in rural Costa Rica (Meletis, 2007) the interviews will include questions about the current waste management regime, one of the key components in reducing the impact of plastic on the environment (Ocean Conservancy, 2015). This will give a more complete picture of the potential problems regarding plastic pollution in the area.

Based on the interviews about the problem products, the current waste management issues, and the business incentives for change a final report was compiled about what is likely to be causing the problem of plastic pollution in the area. This information will be used to research the best (realistic) solutions for reducing the impact of single-use plastic products (economics, access to products, education, etc.) (WIDNR, 2008; UNEP, 2014; Vegter, 2014; PSI, 2015a; 2015b; Ocean Conservancy, 2016; PPC, 2016) or their impacts. These recommendations take into account the rural, developing nature of the community and the businesses limited access to finances, education, alternative products, etc. (Stern, 2000; Kollmuss & Agyeman, 2002). These recommendations focused on how Turtle-Trax and the community can to try to implement a program to make concrete progress on reducing the amount of plastic used in the San Francisco de Coyote Area.

Findings

In total 12 businesses (11 owners/managers) were surveyed in San Francisco de Coyote, Playa Coyote, and Costa de Oro/Javilla (a small beach community north of Playa Coyote) to assess their use of single-use plastic products and their opinions and understanding regarding the impact of plastic on the area. The businesses consisted of 2 mini-supermarkets (one with a drink counter), 1 bar, 4 bar/restaurants, 1 café, 1 hotel bar/restaurant, and 3 restaurants. Eleven of the businesses were owned by 10 people, the hotel restaurant manager was interviewed. Of these 11 owner/managers 6 were from the local area, 3 were from Europe but now live in the area, and 2 were from another region of Costa Rica but live in the area. The owners of the businesses were generally from their mid forties to their mid fifties, with the youngest owner being 37, and the oldest 61. The businesses vary in time open/under current management from 4 months to approximately 30 years.

Common Plastic Products and why they are used:

All of the businesses use some single-use plastic products, and although

Figure 1: Common single-use plastic items used by owners/managers interviewed

Common Single-Use Plastic Items
Drinking Straws
Cutlery Service Bags
Take-Away Containers
Plastic Bags
Plastic Drink Bottles
Single Serving Condiment Packets

Figure 2: Top reasons for single-use plastic use given by owners/managers

Top Reasons for Single-Use Plastic vs Alternative
Customer Desire
Convenience
Availability
Habit
Cost
Hygiene

the exact ones vary, there are several commonly used items across the surveyed businesses and many reasons for their use. The most common items were plastic drinking straws, Styrofoam take-away containers, cutlery bags, condiment packets, plastic drink bottles, and plastic bags. With regards to these items the businesses had many reasons for using each. The owners were also asked about the price and quantity of these products. Most of the businesses noted that the demand was very unreliable other than the fact that tourism season was the busiest time of the year. The most common products used by the businesses are listed in Figure 1, with the most common reasons for use in Figure 2.

One of the products the researcher and Turtle-Trax had hoped to reduce the use of was plastic drinking straws, used by every surveyed business but one of the minisuper markets. When asked, why are straws so prevalent? The answer was nearly universal, "the customers want them". The restaurant owners all noted that the customers, especially the Costa Rican ones, often wanted a straw with each drink, although one owner told the researcher that foreigners often do not want a straw.

The restaurants in Coyote and in many places in Costa Rica often serve the cutlery to the customer in a small plastic bag, this is another item that the Turtle-Trax staff noted as a problem product (in that it seemingly serves little purpose and is very quickly disposed of). Nearly all of the restaurants surveyed use these small plastic bags. When asked why, many responded that it had to do with regulations from Costa Rica's ministry of health, which they said required the cutlery to be either wrapped in paper (like a napkin) or in a plastic bag when given to the customer. Several of the restaurants noted that when it is busy, it is easier and faster to use the bags. Others professed to using the bags out of custom.

Plastic bags were another very common item, being used by both mini-supers and several of the restaurants for

takeaway food. The reasoning was similar to the straws, in that at the mini-supers the owners claim that the customers want the plastic bags. Staff at Turtle-Trax noted that people use these plastic bags for other things around their homes, possibly indicating why they want them so badly. The owners of the minisupers said that the people just want more and more bags, and they can't stop people; with one owner reporting that some customers come in up to eight times a day and want a new plastic bag for each small item they purchase.

Take-away containers for food were common among the restaurants, with only two not offering them. The containers were generally polystyrene foam; with the owners telling the researcher that there is no other option available for take-away containers in the area.

Other items common to the businesses were plastic drink bottles at all of the businesses used because of availability; as well as the single serving condiment packets used by many of the restaurants, which one owner reported as believed to be more hygienic that large bottles, although more expensive.

Investigation of Alternative Products/Behaviors:

The use of plastic products in Coyote was generally understood to be a problem by the business owners, but the level of investigation of alternative products or behaviors was quite low. The main reasons given to the researcher for lack use/investigation of alternative products/behaviors were lack of availability, expense, or just not thinking about it. In other cases, the owners have tried alternative products/behaviors with varying levels of success. However, all business owners reported that if there were an alternative product for a similar price, they would be willing to try using the alternative.

Several of the businesses had investigated and even tried different alternatives to plastic drinking straws, more than any other item. Some had investigated the possibility of bamboo straws, but one owner believed they violated the health code; and one local man manufactures bamboo straws, however they are far more expensive than plastic straws and the man was not thought reliable by many of the owners. One business has used paper straws in the past but found they did not work well in the climate, although another business is switching to paper straws soon. Another business recently ordered stainless steel reusable straws and believes that their use of them may inspire others to switch products to keep up. Finally, one owner noted (in conjunction with the main reason for using the straws) that the business could stop using straws altogether, but the customers want them so they will not.

The small cutlery service bag was an item where some businesses were using an alternative product/behavior by wrapping the cutlery in a napkin, which the owners said was the preferred method. However, some of the restaurants only used the napkin technique over the plastic bag when they had time to do the wrapping. Other restaurants served the cutlery in napkins at all times. None of the owners mentioned investigating a bag made of other materials.

In the case of the take-away containers for the restaurants there was some investigation of alternatives. One owner found take-away containers made of paper products, however they are only available in a small size, making them useful for sending home leftovers but not large enough for a full meal ordered to go. Other businesses told the researcher that they give to-go food in a reusable Tupperware container and collect a deposit which is given to the customer upon the return of the container; with another only selling take away food to those customers who bring their own reusable container. An owner noted that she would like to charge more for takeaway but the customers would not like it. Pizza boxes are available in cardboard in the area.

The minisupers both talked about the possibility of alternatives to plastic bags. Both offer cardboard boxes to their customers to carry their groceries home, but that they are not wanted by the customers. One owner once purchased 15 reusable bags and gave them to members of the community, but only 2 of them ever used them, the rest returned and wanted plastic bags. Paper bags are more expensive, but the customers don't want the paper bags anyway, they like the plastic bags. Both owners brought up a law that is currently in review in the Costa Rican legislature which would force them to charge for the plastic bags, they both want the law to pass so they can then charge their customers and have an excuse. When asked if they would consider charging their customers without the law and one owner quickly responded "no", because their customers would think they are cheap.

Many of the businesses do use glass bottles for some soft drinks, but they are not available for all drinks; one owner was able to reduce plastic bottle use to just water, which he was not able to find in another type of container.

***Amount of Products in Use and Cost*:**

The business owners in general did not have a precise understanding of how much of these products they were using, with several noting that the demand in the area is very unpredictable and varies greatly. The minisupers both noted that they give out several kilograms a week in plastic bags ("a lot"). The restaurants noted using hundreds of straws a week. However, most of the businesses did not appear to have a detailed accounting of their product inventory and use. However, all agreed that the busiest time was from December to Holy Week, with the weeks of Christmas and Holy Week being the busiest times due to increased tourism.

Plastic products are simply cheaper that the alternatives on a per unit basis, this was acknowledged by several of the owners. However, the costs add up, with both of the Minisupers noting that they spend a great deal on the plastic bags that they then give away for free. These costs also ignore the externalities imposed on society by this plastic; health impacts from burning and consumption, increased volume of trash, environmental impacts (to marine life). The apparent lack of detailed accounting in the business may also be obscuring the long-term continuous costs of these single-use products relative to reusable alternatives. Several owners denied that cost was a

major factor in plastic use, stating that availability was a more pressing issue.

Waste Disposal Methods and Waste Management in the Area:

A major issue in the area is the poor quality of waste management. There is highly irregular waste collection provided by the municipality of Nandayure, with the business owners giving responses varying from once every two weeks, to once a month, to occasionally months without pickup. One of the business owners reported bringing their trash to nearby Jicaral or Nicoya to dispose of it because the pickup in Coyote was so unreliable. Many of the businesses noted that they separated their garbage and recycled some of it, cans, glass, plastic bottles; most responded that they sent their recycling to the nearby town of Corozalito, upon further investigation there is not a recycling center at Corozalito, however when meeting with the head of the nearby Punta Islita's waste management plant the researcher was informed that the recycler is in the nearby town of Las Parcelas. The businesses report that a truck comes perhaps once a month (inconsistently) to collect the recyclables. Although when asked about the capacity for plastic bottle recycling one of the owners reported; "No, nothing, you burn it or just throw it on the ground, but nothing else.", indicating that some in the community do not recycle. Almost all of the businesses noted that in the community most trash (including their own) is burned, either because it is unrecyclable (anything with food residue) and/or because it would simply pile up too much in between pickups; a common response regarding the burning of trash from several interviewees was "there is no other option". The burning is evident throughout the area with small piles of ash (and incompletely burned trash) abundant in the area.

Others will simply leave their trash in piles in town or at the bus stations. One of the biggest complaints from the business owners was of the large trash pile at the entrance to the Costa de Oro beach. The owner of a restaurant in Costa de Oro noted that the people staying in houses in the area will simply leave all of their trash in a pile which due to irregular collection will be torn apart and dispersed by animals. Some in the community will simply throw their trash into the rivers on the side of the road. The owners of one business in Coyote central noted that people will leave trash in front of the store, assuming that they will deal with it or that the municipality will come and collect it but they do not. At the beach in Playa Coyote there is an area for collection of trash but written on the side it reads "trash from houses prohibited". Some business owners, as well as other residents interviewed in nearby Corozalito, noted that while at some of the beaches there are separate bins for different types of trash, the municipal truck will dump them into the same bin together, discouraging them from separating their trash.

Based on the interviews with business owners and personal observation of the waste collection and pollution the area, the researcher met with the officials at the municipality. Douglas Arauz, the official at the municipality in charge of trash collection told the researcher that the municipality understands that the collection needs to be more regular but a

lack of resources has been a problem. The municipality currently has an order out to buy a new truck for trash collection, which will enable them to have once a week pickup throughout the municipality. They hope to have this new truck within the next month or two (Summer 2017). However, one of the problems the municipality faces is that the truck has a limited capacity and must turn around when full; this is an issue because according to a waste analysis the municipality performed in the town of Carmona the waste is composed of 64% organic waste which is filling the truck and limiting their ability to collect everyone's trash. He also has submitted a proposal to purchase large trash receptacles for the beach areas, these bins would have separate areas from general trash, cans, glass, plastic, and paper and a filtration system for the liquid residue. This is similar to what residents of the area have reported they were told by the mayor of the municipality; that there would be more regular collection in the next few months, but they are highly skeptical.

In the general area there is one town that has a proper waste management regime; the town of Islita, home to the luxury resort Hotel Punta Islita, has a privately funded waste management plant. The hotel has trash collection centers at the beach, in the town, and throughout the hotel property for the disposal and separation of trash. The hotel then collects the waste and brings it to a small management plant for processing. The organic waste is composted in several steps (including vermiculture) for use on the hotel grounds. The other waste is separated and plastic, aluminum, other cans, tetrabrik, and glass are all cleaned and dried. Scrap metal and used oil are also collected and stored. Contaminated plastic and paper and other non recyclable goods are burned in their multilevel incinerator oven as opposed to the open burning in the rest of the area. The separated trash is collected by a scrap recycler from Nicoya who pays for the aluminum, scrap metal, and used oil, but takes the rest of the trash for free. This is the best example of waste management in the area.

Awareness level in the area?

With past research indicating that in rural areas and developing countries a lack of understanding and awareness about plastic pollution and its impacts could be a major impediment to reducing its impacts (Gupta & Somanathan, 2011), the interviewed owners were asked about the level of awareness in the area and if they believed an educational program would be beneficial. There was a general consensus that some people realized that waste management was a problem in the area but that a more complex understanding of the issue was lacking, and the area could benefit from an educational program. One restaurant owner believed that the reason there is not a greater groundswell of complaints about the issue is the small population in the area. One noted that it is good for outsiders who may have seen places with even worse trash problems to warn the locals (who have not seen how bad it can get) about what can happen if steps to change are not taken. Some of the owners noted that the people in the area were not educated about waste management and the impacts that pollution has on the

environment; this impacts their consumption patterns according to the owners of the mini-supers leading to the locals desiring to use plastic bags as opposed to alternatives. Several owners noted that there needs to be a complete educational campaign reaching the whole community, "*everyone*", and the tourists to raise awareness and hopefully concern about the issue in the area. They note that the mentality needs to change "little by little", with one owner noting the need to educate the community on the benefits of reusable products. One owner noted a sense of apathy in the area, the people will not show up when meetings are called, something that could make an educational program hard to implement.

A common theme among the owners' responses to questions about awareness/need for education in the community was the potential benefits to focusing on the children in the community. Several owners noted that focusing on the children could create a cultural shift by educating them about plastic pollution before they develop the bad habits prevalent in the area. The owner of Pizza Tree noted that in Europe you learn about these environmental issues when you are young and it sticks with you into adulthood, telling a story of a Dutch man who recently came to the beach with a backpack and cleaned all of the plastic he found; but that many in the area had no respect for their environment and would simply throw trash on the ground. However, according to Turtle-Trax staff, partnerships with the school are difficult due to high teacher/administrative turnover.

Could Tourism Be Negatively Impacted?

With past research indicating that pollution in an area (specifically beaches) can suffer loss in tourism and revenues from increased pollution (Ballance, Ryan, & Turpie, 2000) it was important to see if the local business owners (whom are admittedly busiest during tourism high season) understand the potential loss of tourists due to worsening plastic pollution. Tourism is very important to the region, with the business owners all indicating that their busiest time of the year is during the tourist high season. With one owner noting that the town lives on tourism, it is the most sustainable source of good jobs. The business owners generally agreed that the tourism could be negatively impacted by plastic pollution. With several noting that of course tourists would be repelled by the trash. One minisuper owner reported that some tourists come and see the beach and turn around. The owner of one restaurant noted that there may be tourists who see trash on the beaches may say how dirty the people who live here are and leave. The manager of one restaurant did not really think tourism would be negatively impacted but that the pollution can leave a bad impression. The owner of another restaurant noted that the area was once in a guidebook noting that the beaches in the area were dirty, and that when tourists would see the pile of garbage at Costa de Oro they would turn around. The owner of one minisuper relayed a story of talking to a tourist who had been at the beach two years earlier and was now complaining that it was much dirtier than it had been the last time he was there and is now very ugly. The owner of one beachfront restaurant said its obvious that if you won't go somewhere if you know

its polluted and you won't go there if others tell you its polluted. Another owner said "yes of course, noted that there were mountains of trash, Tourists would stop and ask where to go, he would tell them that Playa Coyote is beautiful, but he knew that they would see all the trash. It was very bad. Ugly for the view and nature, lots of it in the sea, bags, diapers."

Emergent Themes:

The initial focus of this study was on the local businesses as they were assumed to be an important source of plastic products in the area. However, an emergent theme brought up by many of the business owners is the contribution of tourists (including those who are part time residents) to the waste problem in the area. This began in my first interview and continued to be brought up in nearly every interview. The area receives a large amount of tourists, especially during the season from December through Holy Week, according to the business owners and other locals the tourists are often Costa Rican nationals (especially during Christmas week and Holy Week). Tourists bring in even more trash and do not always properly dispose of it. The owners in the center of town complain that these tourists will bring their trash and leave it at the bus stop or in front of the businesses. Some mention that these tourists, being from other areas with better waste management (like San Jose or other central valley locations) may not understand how poor the waste management capacity is in the area: other owners say that the tourists just don't care. The tourists "don't understand their impact" on the area since they leave and do not see the aftermath. However, some of the business owners brought up the fact that the foreign tourists are generally more aware of the plastic pollution and environmental issues in general. The owner of one restaurant also noted that the foreign visitors are generally better educated about this issue, but that the Costa Rican tourists are causing more of a problem.

Discussion

This investigation confirmed what the staff of Turtle-Trax was concerned about, there is indeed a plastic pollution problem in the Coyote area of the Nicoya peninsula, due to several factors. Single-use plastics, the most dangerous plastics in terms of their potential for pollution (Sheavly & Register, 2007), were used by all 12 of the hospitality businesses in the area. The waste management in the area is inadequate to handle the volume and type of trash being produced in the area, creating massive potential for plastic to escape the waste stream.

Single-Use Plastics:

The high levels of single-use plastics being used in the San Francisco de Coyote area is a serious concern as these items have been prioritized in the literature for their high percentage of in previous studies of pollution. Changing the behavior in a long term sustainable manner requires understanding why the behavior is being performed in the first place, from the point of view of the actor (in this case the business owners) (Stern, 2000). This is a more complex issue than it

may have been assumed to be, with different business owners using different products for different reason, one approach will not be sufficient to change all of the behaviors; the proposed changes must be realistic and conform to the values held by the business owners (Stern, 2000). One example of an intervention which has already begun based on this research is the implementation of an awareness campaign to reduce the use of plastic drinking straws in the local restaurants. Based on the literature (PSI, 2015) the drinking straw is one of the main targets for any intervention in the Coyote area due to its ephemeral use and lack of necessity. The business owners believed they needed to provide the straws because their "customers wanted them", they do not want to disappoint their customers and potentially harm their business. Working from this context, the researcher created a small sign for the tables at all of the restaurants asking customers to say no to plastic straws. This fits in the context of the business values (Stern, 200), they are providing the straws to satisfy the customer, if the customer does not want the straw, then they are satisfying them by not providing one. The signs also feature a turtle and the Turtle-Trax, CREMA, and MIST logos; using the appeal of the charismatic mega-fauna has been effective in the past (Kollmuss & Agyeman, 2002) and informing the public as a credible source has been shown to be effective (Manning, 2003). The signs also feature the names and locations of all of the participating restaurants, making them a free promotional item for the businesses as well as the Turtle-Trax, CREMA, and the MIST program. The signs are aimed at straws specifically but they may also help to get the customer's to be more conscientious about their use of plastic in other aspects of their lives (PSI, 2015), possibly leading to more widespread impacts.

Interventions on the other single-use items should follow this same model of considering the reasons the businesses are choosing to use these specific products and tailoring a solution around those, whether it is increasing the availability of alternatives for take-away containers, or finding an alternative to the cutlery bag which is just as convenient but less wasteful. With plastic bags it may require an educational component to reduce demand from the community. Alternative products and/or behaviors suggested to the businesses need to conform to their needs and values or they will not change their behaviors in a meaningful, lasting way (Stern, 2000). As noted in the literature, plastic products are inexpensive to buy, but these prices do not incorporate the many negative externalities that these products inflict on the environment and society (Gupta & Somanathan, 2011). More education to the business owners about the true cost of these products (including the full dangers from dioxins and other contaminants released when burning and the potential negative impact on the local fisheries (Ocean Conservancy, 2015) may help influence their decision making when weighing incentives and disincentives for use. This ties into the need for a program to raise awareness and understanding of plastic pollution in the area. Past studies (Laner & Rechberger, 2009) have shown what this research discovered about the businesses in the Coyote area, that they do not have the numbers and accounting

to truly understand their impacts. Aiding these businesses in keeping track of their product use and costs could help to convince them of the long term benefits of switching from single-use plastics to alternative products/behaviors.

Both minisuper owners brought up their desire to see a law passed which would give them an excuse to not give plastic bags away for free, and while this will likely help it is unclear when this law may get passed if ever. In addition, past research has shown that in developing countries and especially rural areas there is a lack of enforcement for more state driven initiatives to reduce the impact of plastic waste which often hampers their effectiveness, meaning that other types of decentralized and non-mandatory initiatives may be more effective (Gupta & Somanathan, 2011). This means that bans on products may not be effective in places like the Coyote area, and convincing the businesses to reduce their use voluntarily would likely be more effective. However, this would depend on the businesses believing that these changes would not hurt their reputation amongst their customers and therefore their business.

Waste Management:

The study area is rural with very poor waste collection. Without exception those interviewed by the researcher believed that the municipality should be doing more to deal with the waste from the community and the municipality agreed. The limited resources available to the local authorities are typical of rural areas in developing countries (Vegter *et al*., 2014; Ocean Conservancy, 2015). The proximity of the study area to the ocean makes the open dumping of trash an even greater concern, with past studies of similar issues in developing countries coastal areas showing very high rates (up to 90%) of waste entering waterways (Ocean Conservancy, 2015). If the municipality follows through on their pledge to begin weekly collection for the entire area this could have a major impact on the pollution in the area. Since many people claim that they need to burn or dump their trash due to the long wait in between collections, thus more regular collection could help to alter the behavior of the residents.

While many of the businesses report sending their plastic, cardboard, and cans with a recycler, this service appears to be inconsistent and only collecting some of the products. The nearby Hotel Punta Islita has a deal with the recycler they deal with to take even the products that are not profitable when collecting those which are, thus ensuring that all of their waste is brought to an area where it can be better processed. Another great example of waste management in Costa Rica visited by the researcher is the community run plant in Tortuguero, Costa Rica, with it being an important tourist destination (with far more visitors than Coyote), remote and disconnected from its municipality, and an important turtle nesting beach this is a good example for the Coyote area. The Tortuguero plant is mostly community supported, with some aid from the municipality, however the plant generates money from its processing of trash into raw materials (plastic pellets, compost, glass shards/sand, etc.) and selling those materials. This turns the community's waste into an economic benefit by selling

what they normally dispose of and creating jobs for locals. It may be beneficial for the local municipality to investigate the possibility of setting up a system like that of the plant in Tortuguero, as it has some similar characteristics to the study area.

Other potentially high impact interventions which could be made in the area are minor infrastructure improvements, possibly building an incinerator for the area where people can more completely burn their garbage, preventing the plastic escaping from incomplete combustion. A physical container to keep dogs and vultures from the trash could help to prevent it from being torn apart in between collections, something the municipality is supposedly working on, but something that Turtle-Trax can try to keep pressure about (NOAA & UNEP, 2011).

Local Awareness and Education:

With all respondents believing that an education program for the community regarding plastic pollution and waste management would be beneficial it should be one of the main areas of focus in any program to deal with the issue. This is in line with past studies regarding plastic pollution in developing countries (Gupta & Somanathan, 2011). However, based on the information from the municipality's waste audit (showing that 65% of trash was organic) there needs to be general information about waste management (composting, separation, recycling, etc.). An educational program in the community would appear to be well received based on the interviews in this study, and could be a low cost and high reward investment (Gupta & Somanathan, 2011). However, as noted before it can be difficult to get a program like this off the ground in this community specifically, due to apathy and the lack of stability at the local school. Thus, Turtle-Trax will need to find a way to attract the attention of the community and find a way to make their outreach to the youth of the community more stable in the long run.

Modern social media and technology with their global reach and now near complete saturation of the population, will be increasingly important in bringing about cultural change (Eagle, Hamann, & Low, 2016). Past research has suggested using "demarketing" techniques, aimed at reducing consumer demand for a certain product or behavior, in this case single-use plastics; a powerful tool in this fight is the video, from a nearby researcher in Costa Rica of a plastic drinking straw being removed from sea turtle's nostril (Eagle *et al*., 2016). The use of charismatic mega-fauna like sea turtles has been shown to be more effective than campaigns focusing on more intangible issues, giving Turtle-Trax a potential advantage in any future campaign (Kollmuss & Agyeman, 2002). A possible strategy in Costa Rica would be the large marine conservation organizations and tourism operators creating a media campaign in the time before the two big domestic tourism weeks (Christmas and Easter) to inform the public more about their impacts on the beach and marine environment before they go on their vacation and hopefully alter their behavior. While a large traditional media campaign would be expensive, a campaign on social media to target Costa Ricans before their vacations,

using charismatic mega-fauna (sea turtles) and appealing to their targets' childhood connections to the beach may be impactful nationwide (Kollmuss & Agyeman, 2002).

Tourist Contribution to Pollution:

As noted in the findings, one issue which almost all of the business owners raised was the contribution of tourists to the trash problem in the area. This was backed up by the observations of the researcher during the tourist high season. This is an issue previously observed in rural tourist destinations in Costa Rica (Meletis, 2007). This is clearly an issue that these members of the community are concerned about, it is possible that some of the attention being brought to this issue is deflection of responsibility from the community's role in the waste problem in the area. The response about the tourists leaving the trash was generally more that the tourists did not understand the poor waste collection in the area and did not realize the impact they were having. This is something that seems plausible based the researcher's direct observation, the tourists were bagging their trash and piling it in areas for collection (which rarely or never occurred), suggesting that they were attempting to deal with it properly but did not understand the reality of waste collection in the area.

Trash piling up from the tourists is a potentially very serious issue because these tourists are camping/renting hoses right on the beach meaning the trash does not have to travel far to enter the ocean. This is an issue that Turtle-Trax/CREMA can work on by educating the tourists about their impacts and promoting a carry-in carry-out ethic regarding plastic and other waste. Past research has shown that educating tourists can be effective at getting them to change their behavior, especially "when applied to problem behaviors that are characterized by careless, unskilled, or uninformed actions." (Manning, 2003). Multiple source of information targeted at the tourists' values (different from the educational campaign for residents) are more effective than a single source, and in person interpretative programming is highly effective (Manning, 2003). A campaign where Turtle-Trax/CREMA staff and volunteers visited the beaches during the tourist high season (especially the two main weeks) and informed to the tourists about the poor waste collection and their impacts, they may have a significant impact. Research also suggests that delivering the information early (even during the planning stages of a trip) is another effective strategy (Manning, 2003). One tactic discussed with some of the business owners was to provide a letter to those who rent houses and cabinas to send to their guests before their trip warning them about the poor waste management and asking them to either bring less plastic or to carry-out what they bring. Past research has shown that campaigns built around tangible impacts and charismatic mega-fauna like sea turtles has been shown to be more effective than campaigns focusing on more intangible issues (Kollmuss & Agyeman, 2002, Manning, 2003). Research has also shown that information from sources which are seen as highly credible are more likely to be effective (Manning, 2003), Turtle-Trax has a great opportunity to use both of these

advantages in their pollution reduction campaign.

Final Thought

While this study began with the seemingly simple idea to reduce the impact of plastic pollution by focusing on the single-use plastics in the hospitality industry, it soon became clear that plastic pollution in the area was a complex issue. This involves issues from the supply of the plastic products to the customer demand, and the poor waste management requiring complex systems thinking to create any sustainable solution. A simple solution targeted at one part of the system will likely not solve the problem, but a multipronged approach may have success. The issue of plastic pollution in the area includes components in supply chain management, consumer behavior, environmental justice in tourism, technological and management deficiencies in waste management, and education and awareness deficiencies. It will require a long term multipronged effort from Turtle-Trax, CREMA, the local municipality, and the residents. But it is a problem which can be solved as long as the actors trying to affect change understand the complexity of the system and do not look for simple solutions to fix the whole problem but work in conjunction with other efforts to target other parts of the system.

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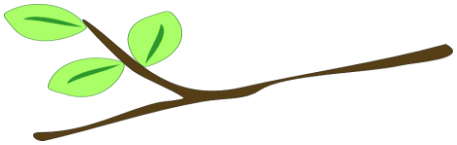

ARTICLE

The Social Impact of the use of Unmanned Aerial Vehicles (UAVs)

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The global healthcare system hugely relies on technology use. As the present system continues immersing people in virtual reality, it is also important that we consider its use as safe. The use of UAV or Drone technology, particularly for the elderly, can be of great use to check a failing heart rate or a head tilt. The drone design can be revised to make sure it is safe and people are able to interact with it. Access to labs and transporting samples for medical testing have become difficult owing to the presence of traffic, poor roads and lack of accessibility, which can be removed easily by flying the samples in a drone. Hence, reaping the many benefits from the technology can provide solutions to healthcare, starting with delivery services and then moving on to more complicated applications in the next decades.

Technology foresight involves qualitative means for monitoring the future. The emerging technology of UAVs or drones in societal and economic realities is correlative with the complex inter-relationship with existing human perceptions and social norms (Kohler & Som., 2014). The use of UAVs for human benefits and the ethical issues related to it comes with inherent complexities and risks that stall unexpectedly and increase with one another to surprise us with unforeseen systemic effects (Alcock & Busby, 2006; Assmuth et al., 2010).

Research Question

To deal with social consequences of the UAV technologies, we need to employ people's imagination, vision, foresight, creativity and then visualize the future world (Weibel & Hansman, 2004). To address the current gap in research focusing on ethical issues connected with commercial drone use, the following research question guided this study: Can the use of UAVs or drones increase human efficiency and improve the quality of life?

Ethics

Any predictions of the future are challenging when emerging technologies come into play. The UAVs technology are involved with countless components, such as policy, market, supply network, and infra technologies (Featherston et al., 2016; Kwon et al., 2017). The general perception of UAVs as 'unmanned machines' have had negative consequences and distanced

the UAV technology from acceptance in the real-life situation. This make the use of it more challenging from the ethical perspective. After an incident, and the obvious negative consequences, such as safety and privacy infringement, the question of how commercial drones can operate in residential areas is a growing concern (Luppicini & So, 2016).

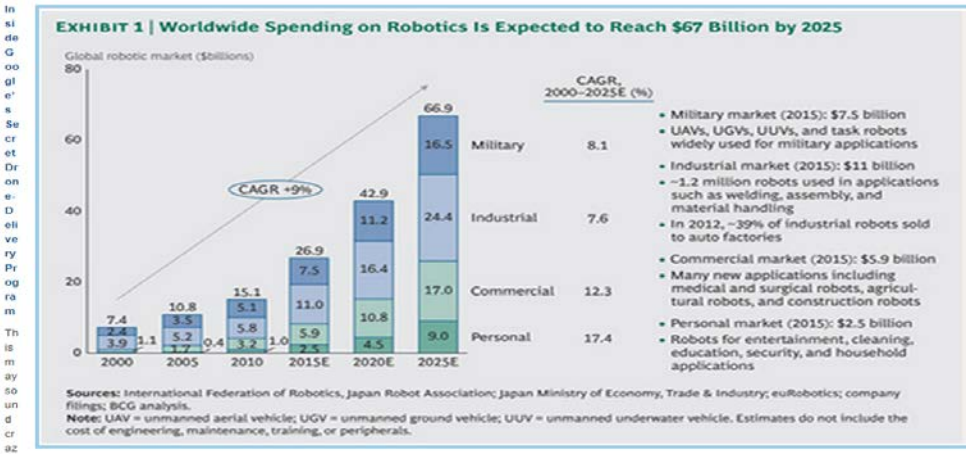
There is positive side of the story too. Virtual and augmented reality can benefit humans. A drone is a life savior and a virtual friend, when deployed to capture aerial images for surveillance where humans cannot reach or used in disaster/ medical relief measures. Obviously, there is a great potential in the UAV technology. The Washington Post, July 2016, published an article, titled '**elderly and end-of-life care'** where a Cleveland-based firm used drones to show people with terminal illness and living in hospice, their beloved locations, such as a childhood hometown or favorite vacation spot, one final time. "They're watching live on a screen while the drone is actually at their location of choice," ... "They can interact and say let's go over here, let's go a little higher, let's go out on the water." Patients had a visual escape from the pain of terminal illness and experiences life.

Transportation drones can improve the quality of service in congested or remote areas, enable rescue organizations to quickly deliver emergency medical supplies in the field. Inspection drones can fly in confined spaces to help fire-fighting and emergency units to assess dangers quickly. They also help logistic companies to detect cracks in the inner and outer shells of ships, road maintenance companies to measure signs of wear and tear in bridges and tunnels, security companies to improve building safety by monitoring areas outside the range of surveillance cameras, and disaster mitigation agencies to inspect partially collapsed buildings where ground clutter is an obstacle for terrestrial robots. Autonomous drones enable missions that last longer than the flight time of a single drone by allowing some drones to temporarily leave the team for battery replacement. Drone teams permit rescue organizations to quickly deploy dedicated communication networks for ground operators (Floreano & Wood, 2015).

Skepticism behind the Use

The progress in commercial drone use could be at risk if innovation stops because social and ethical concerns are not addressed. Ethical issues emerge with different types of drones in different types of uses, such as recreational, commercial, bio conservation and military and may impact on future development and deployment (Luppicini & So, 2016).

UAVs offer an inexpensive way to put cameras and sensors in the air to capture images and data. The technology behind it is computational and simulative and involves cognitive autonomy. Drones of artificial intelligence can identify human users, learn human behaviors and create representation of the environment. The human-motion-sensing device in drones helps in mapping and path planning for the autonomous flight in an unknown and changing environment setting. Indeed, UAVs have great potential to improve the quality of human life that brings the technology of UAVs to the brink of commercialization. But ethical



issues pose serious concerns about safety, privacy, conflict of interest, perspective, and credibility of the UAVs. Hence UAVs are still awaiting mainstream acceptance.

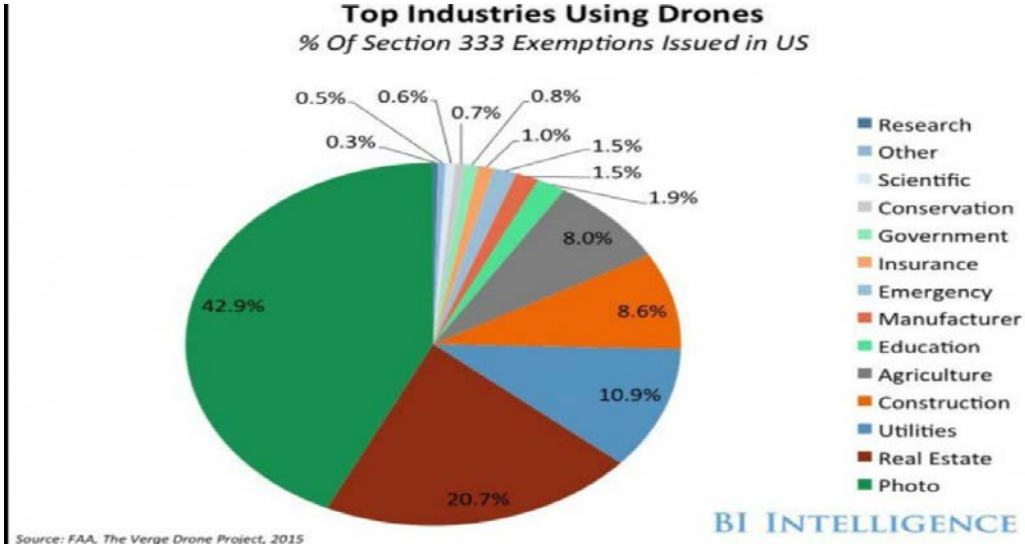
Conflict of Interest

Concerns have been raised about the public rejecting the drone technology. The UAV association with military applications and potentially controversial applications such as, policing and border control, medical aids, have caused a deep skepticism regarding unexpected detrimental effects of the drone use that might be critically altering the existing standards of the society (Kwon et al., 2017). A strategy for avoiding such public rejection is to downplay the connection between military and non-military remotely piloted aircraft system (RPAS) and focus upon less controversial applications such as search and rescue (Boucher, 2015).

Growth and Advancement

With the growth of technology and miniaturization of devices, drone manufacturers will prosper (as shown in Figure 1) from the tiny lower power sensor packages such as the inertial measurement unit (IMU), improved battery density, specialized high-performance and low-power hardware accelerators tuned for the various functions needed by autonomous drones. These accelerators provide solution to computation for the control of insect-scale drones (Floreano & Wood, 2015) charged with both reactive and cognitive autonomy for greater human benefits.

The Federal Aviation Administration (FAA) has initiated environment and ecofriendly regulation for the use of UAVs. A certificate of authorization is required to operate a UAV for non-recreational purposes. Even after obtaining a license to operate drones, there are certain limitations. FAA allows a government public safety agency to operate UAVs weighing only 4.4 pounds or less, inside Class G (uncontrolled) airspace etc. (Rana, Praharaj & Nanda, 2015). Following these regulations might scale up the use of small drones from a niche market to widespread use in civilian applications (as shown in Fig 2). Acceptability of use depends on how well the drone can autonomously and safely maneuver in confined spaces satisfying the human requirements. The legal requirement of a certified human operator within the line of sight of every single drone is still an ethical issue that can be removed depending on the reliability and safety of small drones (Floreano & Wood., 2015).



Implications

The emancipation of technological innovation, like drones, is possible in the reality when technology is not fetishized, and all misunderstanding is removed regarding how the technology is shaped by the clash of social forces (Susini, 2015). The drone technology and its use in human benefits is a novel implication for theory, practice, and policy. UAVs are alternative ways to understand the future depictions of emerging technologies and their potential usages. From the consumer perspective, a preemptive identification of unforeseen social impacts may alleviate public skepticism and remove distrust on the use of unknown or unfamiliar technologies (Kwon et al., 2017). Finally, from policy making perspective, UAVs might promote better regulatory policies of emerging technologies and thereby proliferate them in a sustainable and social friendly way.

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AYA™

THE JOURNEY HOME

• BY MICHELLE COOKE •

DR. JUDY GOFORTH PARKER, commissioner of health policy for the Chickasaw Nation Department of Health, has always had a passion for healthier living. She wears her Fitbit faithfully and enjoys the tracking applications it offers her. One day, it sent a notification to her cellphone congratulating her on walking a distance equivalent to the length of Italy, and in that moment, she realized she could have made a more meaningful journey. She could have walked back to the Chickasaw Homeland. Her Chickasaw ancestors had been removed from the Holly Springs, Mississippi, area in the mid-1800s, and she wanted to go there, to see where her family was from, and to experience a Homeland journey of her own.

On that day in 2015, she called Health Planning Senior Advisor Connie Merriman into her office and declared, "Connie, I'm walking home. … I just got this notification that I walked 400 miles, so why don't I just walk home, and why don't we figure out a way that we can get Chickasaw citizens involved in walking home with me regardless of where they are?"

At first, her idea was simple. She envisioned keeping a spreadsheet and enlisting people to email every day and say how far they had walked.

"I literally thought I would put something in the Chickasaw Times, and we would tell people [to] count your steps and let's see if we can log 400 miles of walking, but Connie said, 'No, I think we can do it a little bit fancier than that,' and so that's what happened." As they sat in Goforth Parker's office, one creative idea lead to another, and the AYA: Your Fitness Journey app was born.

In its basic form, the one-of-a-kind step-tracking app is a fitness tracker – an interactive mobile walking app – but its uniqueness lies in its historical storyline. The app provides users with an enjoyable way to learn about Chickasaw history and culture while improving their health through increased physical activity.

Merriman witnessed Goforth Parker's emotional reaction in that initial meeting, and she asked herself, what if they could create that kind of emotion in their walkers? She knew emotion was the element they needed to see some behavioral changes. They needed to create the feeling Goforth Parker experienced in that moment. She thought if they could recreate that moment for people to reconnect, to find out where they were from and to understand the culture they belonged to, then maybe they could prompt people to walk step-by-step to the Homeland.

"The culture and history piece was the lightbulb for us." Merriman said. "We know there are a lot of walking apps out there. But the lightbulb moment was that emotional connection with our history and culture. That's unique to us. It makes us different, and we have over 66,000 citizens that could relate to that. And like Judy said, if we can change the health of 66,000 citizens, we have changed the health of the Nation."

Goforth Parker and her team knew that turning these ideas into a tangible product would take an experienced app developer. They turned to Future Haus in Oklahoma City, Oklahoma, for help. Future Haus is a Christian company known for creating apps like the YouVersion Bible App for Life.Church and the Sonic App for Sonic Drive-Ins. Although the team had several companies turn in proposals, Merriman said Future Haus was the only one who responded with, "We get what you're saying. To see behavior changed over a sustained time, there's got to be an emotional excitement wrapped around it."

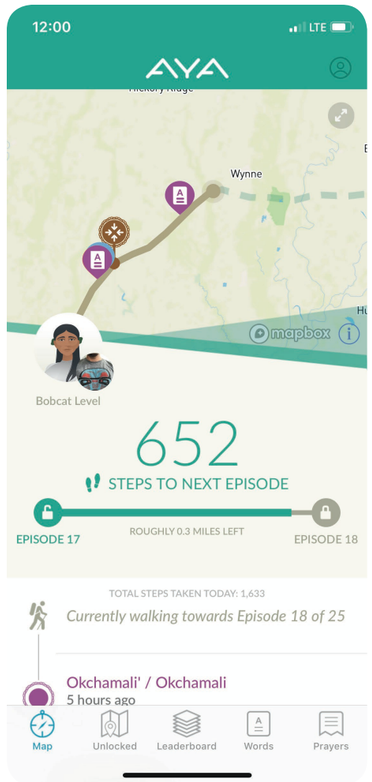
Future Haus knew that branding was important to an app as well, because it tells people what's in a name; it gives the name of the app symbolism. Future Haus looked at the components of the AYA app in order to accomplish that. They defined the app's key components as adventure, challenge, transformation and health. A symbol for each was created. They researched Chickasaw words and found that aya meant "to go" or "to journey," and Merriman reached out to the Chickasaw language department for confirmation. The Chickasaw Language Committee agreed, and the name was approved. Then they combined parts of each drawing and made the AYA logo. The colors of the name also play a big part in branding. The colors in AYA's logo transition from red to green representing the red Oklahoma dirt to the lush green of our Homeland forests.

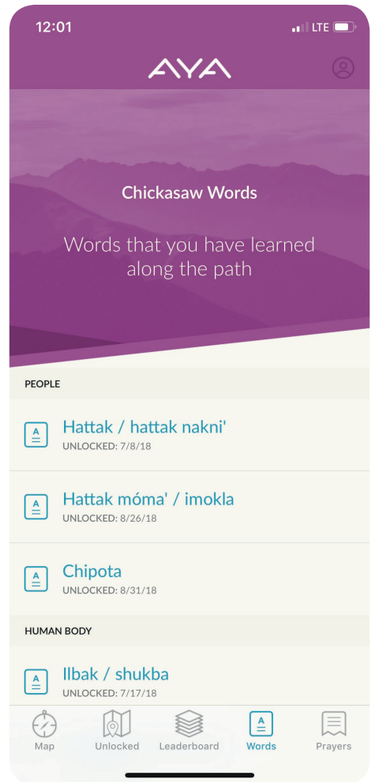
THE ADVENTURE

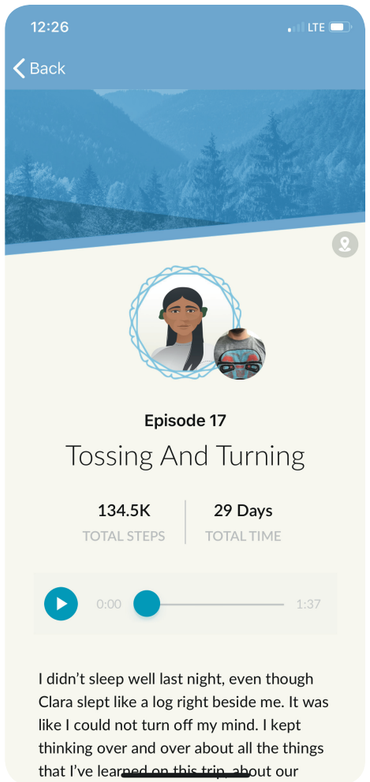
THE PATH

THE FITNESS

THE TRANSFORMATION







AS YOU WALK, YOU EARN

When it comes to health and fitness, it should be more than just going through the motions. AYA not only takes you on a journey to improved health, it unlocks a world of rich Chickasaw narratives.

CHARACTER EPISODES
Each character has 25 stories that you will unlock as you walk along your journey.

POINTS OF INTEREST
Unlock imagery and information about these historical locations anchored along the path.

CHICKASAW WORDS
You will see and hear Chickasaw words, as you learn more about the Chickasaw language.

CHICKASAW PRAYERS
Enrich your spirit and draw encouragement from prayers spoken by our fluent Chickasaw speakers.

AYA truly embraces the mission of the Chickasaw Nation, which is to “enhance the overall quality of life of the Chickasaw people.”

Photo by Corey Fetters

Cameron Mitchell records audio for the app as Eliza. A total of six people recorded including Vincent Baptiste (Hikatubby), Virginia Bolen (Akanowa), Monica Copeland (Mah Wah Ta), Solomon (Ahanowa), Ace Greenwood (Solomon), Cameron Mitchell (Eliza) and LaDonna Brown (Points of Interest) to produce over three hours of audio. Photo by Wyas Parker.

When users sign up for the free app, they are introduced to five fictional Chickasaw characters: Akanowa, Hikatubby, Mah Wah Ta, Solomon and Eliza. All five characters are from different time periods, and they are all related to one another. Akanowa is an elder from the mid-1500s, Hikatubby is a Chikasha warrior from the mid-1500s, Mah Wah Ta, age 29, and Solomon, age 32, are both from 1837, and 12-year-old Eliza is from 1907. Each character unveils a story or historical facts about their time period as the user walks their path—a path that equals 444 miles, or the distance from Tishomingo, Oklahoma, to Tupelo, Mississippi, in the Chickasaw Homeland.

But if storytelling isn't enough to keep the user engaged, AYA also includes badges that are awarded periodically as you walk. These are fun items such as Chickasaw words with audio recordings to teach and carry on our language, Chickasaw prayers to read and listen to for encouragement, and Choctaw hymns to audibly nurture your spirit. Tiffany Logsdon, a beta tester for the application, said that hearing our language spoken was deeply emotional for her. "I don't know how many times I got goosebumps."

Users follow their progress on a map as they come to points of interest on their journey that tell them about places our Chickasaw ancestors visited on their way to Indian Territory. All of the words, prayers, and points of interest are banked for the user to revisit any time they wish. The points of interest are accompanied by audio so the user can hear the text as well as read it.

The Center for Disease Control (CDC) explains that walking is a great way to get the physical activity we need to obtain health benefits because it doesn't require any special skills and doesn't cost any money or require special equipment.

Physical activity like walking has also been shown to improve sleep quality and reduce mental health concerns like anxiety and depression.

AYA truly embraces the mission of the Chickasaw Nation, which is to "enhance the overall quality of life of the Chickasaw people." Goforth Parker understood by using an app, they would be able to reach Chickasaw citizens anywhere, and that was the goal. She explained that "Governor Anoatubby, for one, wanted to make sure that we were able to reach our citizens. If you really think about it, a person could be anywhere and be able to experience the walk."

AYA fulfills the mission in two ways. With AYA, Chickasaw citizens will enhance not only their physical health, but also their historical knowledge of their culture. They will be walking their way to a healthier lifestyle, and as Goforth Parker said, "walking home." When asked her opinion on AYA, Logsdon replied, "It's a beautiful app. … It blew my expectations out of the water. It would be great for everyone to have it, even if they think they know everything about the Chickasaw Nation."

To learn more about the AYA app, visit AYAwalk.com. The free app is also available for download at the Apple App Store and Google Play.

Wyas Parker, Connie Merriman, Dr. Judy Goforth Parker and Nicole Schultz share ideas at a creative planning meeting for AYA.

Photo by Wiley Barnes

Book Review

Growth: From Microorganisms to Megacities. Vaclav Smil. The MIT Press. 2019. ISBN 9780262042833. 664 pp.

By Heath Harllee
University of North Texas, Denton, TX.

Growth, From Microorganisms to Megacities is a systematic investigation of growth in nature and society, from tiny organisms to the trajectories of empires and civilizations. A more comprehensive look at growth from the smallest organisms to the largest megacities on a simple level. A broader approach to the writing of Vaclav Smil is the understanding that the economy and the potential growth of the economy is not possible due to the finite resources homo sapiens continue to consume. As continued world growth continues, so will the consumption of resources and energy, leading to an eventual economic down-turn and a possible reversible fortune of society as it is known today. Vaclav Smil touches on the fact that increased GDP annually may be as unhealthy as it is viewed to be health for society. In fact, Vaclav Smil describes within the book not only the growth patterns of society, consumption, and economic possibilities, but what possibly lies ahead as well concerning an evolutionary future. The book raises question concerning human beings consumption rates and gives possible answers to the outcome of the world as we know it. Vaclav Smil is very clear that the book's major focus is on human energy consumption, human artifacts, populations, and economies.

The book today holds more weight than ever before with the current global pandemic taking place with the Coronavirus Disease 2019 (COVID-19). With an ever growing global population, which according to the United Nations (UN, 2019) report in 2011 will grow from 7.7 billion to 9.7 billion by 2050, this with combination of frequency, speed, and mass travel globally that is available, and epidemic has no means of quarantine as Vaclav Smil points out in chapter 2, page 95 of the book. With current outbreaks of disease and the not so distance past of disease desolation of the population, the trajectories and growth patterns discussed by Vaclav Smil should be examined deeper. Vaclav Smil's book is more than a discussion on human growth, disease, and possible outcomes of economic downturn and energy conservation, but quite possibly an inner examination of what the human

population has not only done to the planet with its consumption, but the population itself.

The book begins with a brief history of the evolution of the environment we currently consume, from the dwindling of the dinosaurs, man's ability to harness fire, and the manifestation of growth by man and society. Vaclav Smil goes on to explain past trajectories and how they correlate with growth today as we know. Vaclav Smil through various charts and graphs explain how over long periods even miniscule growth rates will produce impossible outcomes (pp 17). Using the Roman Empire circa second century of the common era as an example, in that the slow growth of the empire far exceeded the lack of growth in wheat production to feed the people, bringing an end to Cura Annonae (Bevan et. al, 2017) and an end to a society. Setting the reader up to better understand more modern trajectories and consumption of resources later in the book.

Vaclav Smil over the next three chapters takes the reader on a path that illuminates trends in the growth of nature, energies, and artifacts (man-made products). Vaclav Smil examines the growth of the human body and the correlation of growth of energy conversions and man-made objects that enable economic growth and developments that have changed the direction and growth of civilization. He looks at factors such as man's consumption of energy and resources to aid in a growth of population and further consumption. Through these correlations, pages 358 – 399, made by Vaclav Smil we get a look in to the future of the world as we may not know it. Food consumption today alone is inadequate to fee approximately 800 million people daily with a global population of 7.7 billion according to a 2014 study (Meyers et al., 2014) (Tilman, 2014). Following Vaclav Smil's trajectories and time spans, the future of feeding 9.7 billion human beings in 2050 seems an even greater task of the human race.

Vaclav Smil goes on to tell us that growth in systems, many complex, beginning with the population growth of human beings, global economies and continuing on to the most complex assemblies, cities. Vaclav Smil delves into the challenge of ascertaining the growth of societies, economies and civilizations, depicting how charting the growth of organisms across individual and evolutionary timelines can be done, but that the progress of societies and economies, not being linear, envelopes both possible failure and success. Vaclav Smil tells the reader in the beginning of the book that he is steering clear of any "rigid prescriptions" for addressing current or future crisis created by man's innate desire to consume energy resources, increase man's possessions, and the overall consumption of resources. Vaclav Smil has written another masterpiece book as so many before and endorsed by the likes of Bill Gates. Vaclav Smil is changing how the world views

energy and our unstainable consumption of resources.

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Book Review

How to Change Minds about Our Changing Climate. Seth B. Darling & Douglas L. Sisterson, The Experiment, LLC, New York, 2014, 200 pp.

By Justice Obiora
University of North Texas

The physical evidence and experience behind the changes in our environment in the present day are palpable such that there is no room to argue that such changes were not existing. However, this book paints the picture otherwise. The captions of the book, right from the front page and the introductory parts, clearly indicate that doubters of the changing climate still very much abound. Hence, the aim of the authors is to expand more facts relating to the climatic changes to permanently extinguish the perennial ideas that counter the actual existence of the changing climate.

Seth and Douglas believed that scientific breakthroughs and evidence, including technological advances, should be the right responses to the opposing minds that think differently about the climate. Prominent among those opposing thoughts as highlighted in the book is the belief among some people that the climate is not actually changing, that in fact, good thing is associated with global warming; and that even if there is a climatic change, it should be seen to occur naturally instead of being viewed as a man-made event. The book comprises fifteen chapters which are separated into five parts according to the major arguments by the climate change skeptics. In each case, the authors had an answer with scientific back-up to unsettle such arguments and prove the existence of the ongoing climate change and human as the cause of the change.

Cherry-picking of usually scanty uncertainties, such as the earth heading toward an ice age, and irrational and confusing use of timescales on rare topics that support nonexistence of climate change are among the major problems of climate change skeptics. Mistaking climate as the weather is another issue that is strongly pointed out and linked to the reasons why doubters on climate change have gotten it wrong. To advocate for a wait- and-see approach due to perceived uncertainties on whether the climate is absolutely changing or caused by humans if it is occurring seems baseless. The overwhelming findings from various scientific proofs strongly support the consensus and the fact that greenhouse gas concentrations have

increased, the ice and snows have reduced with rising sea levels while the oceans and the atmosphere have indeed warmed up. Even with the assumption that there are still minute uncertainties with these findings, the obvious fact is that it could only be explained as being caused by man.

Interestingly, a certain school of thought sees climate change as beneficial in some respects. Most important and crucial to the discussion is the supposedly positive effects of increased carbon dioxide in the greenhouse that causes plants to grow faster. However, as explained by Seth and Douglas, studies show that outside the protective effect of the greenhouse, and irrespective of an increased harvest of plant produce, plants are starved of basic resources such as water and other nutritional elements. Correspondingly, there is reduced additional nutritional value for consumption despite increased plant produce. After summation and subtraction with respect to the effect of climate change on agriculture, it could be concluded that it negatively affects food cultivation. Apart from the impact on agriculture and water supply, the authors identified climate disruption to have effectively impacted disease spread, economic crisis, ocean acidification, and extreme weather conditions adversely. Hence, the assumed good effects of climate change amid the negative alarming outcomes simply outweigh those perceived beneficial ideas it possesses. Arguments that increased temperature is not true or is unrelated to climate change due to urban-rural heat-island effect variations are also scientifically disproved as explained by the authors. They argued that climate change is already a long-term phenomenon that accounted for such heat-island effects. The direct linkage of excessive man-made emission of carbon dioxide to increased temperature among other causes that the natural environmental system cannot control is also established and explained. Seth and Douglas also argued and strongly defended that humans' activity is the etiology of climate change against the skeptics' argument that they are natural occurrences.

Seth and Douglas concluded the book while still in the argument against some thoughts that nothing could be done about the changing climate. Even though renewable energy is questioned to be variable or too costly to establish, they made suggestions on the use of carbon-free resources as cost-effective as the abundant solar energy supply. The book is very captivating to read, and the heated climate debate alone is mind-blowing. Once grasped, one would not want to drop the book until the reading is done.

Youth Corner

Sustainable Agriculture and Our Future

Ah-Young Kim[1]

Agriculture is defined as the cultivation and exploitation of animals and plants. (Mason, n.d) Ever since we started using it, it has always been a major component of people's lives; it provides food and jobs and has helped our life immensely with the advancement of technology. Agriculture has grown dramatically and very fast after proving itself as a much more efficient way to hunting and gathering hundreds of thousands of years ago. It helped civilizations all over the world, to harvest crops, and support a rapidly growing society. Today, it is easy to see that many countries are dependent on agriculture as a reliable food supply, and for the many benefits it poses to a country's economy. But with the constant pollution from feedlots and farms that are destroying our earth a more environment-friendly way is needed to continue to practice agriculture for future generations. Thus, sustainable agriculture could be a main key to meet all the demands without compromising the health of the environment.

Sustainable agriculture is a type of agriculture that can preserve long-term productivity of the land and minimize pollution, all while fulfilling the need for food, and allowing economic viability for the farmer (Feenstra et al., n.d.). Sustainable agriculture is shown to be promising for our future in many ways. Farmers have started to turn to sustainable agriculture after mainly relying on industrial agriculture due to dramatic changes in our environment over the years. Though industrial agriculture has come with its benefits, these large farms were inevitably damaging our environment. This form of agriculture is often competing with nature and disturbing the soil. With the mass use of chemical pesticides and fertilizers that harm the air, soil, water and climate it is self-evident that industrial agriculture was not built to last. ("Industrial Agriculture," n.d.)

[1] Ah-Young Kim is a 9th Grade at Guyer High School, Denton, TX.

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Thus, the practices include from the union of concerned scientists:

Sustainable Agricultural Practices:

- Planting over crops: Cover crops such as clovers can be used to cover areas where the crops don't cover to manage soil erosion, soil quality, and soil fertility.
- Integrating livestock and crops: Often livestock like pigs and cows are raised far from where their feed is grown, and crops are grown far from areas where livestock is raised. But by putting livestock and crops together, crops could benefit from the abundant manure fertilizers decreasing the need for other chemical fertilizers and pesticides, and the livestock would live close to their feed resulting in less carbon emissions due to transportation. This practice satisfies both transportation costs and the health of the environment.
- Renewable energy: Using renewable energy such as wind, solar or hydro power to run machines or fencing to help reduce pollution, and the use of non-renewable energy.
- Crop rotation: Rotating crops all year by using different types of crops depending on demand, season or health of the soil. Using different types of crops helps improve soil health while promoting crop diversity.
- Reducing or eliminating tillage: Traditional Plowing, also known as tillage, is a widely used agricultural practice that helps farmers efficiently prepare fields for crops to be planted; however, tillage results in lots of soil loss. By using no-till or reduced till methods it could improve soil health and reduce soil erosion further preserving the productivity of the land.

Soil is one of the key components in agriculture, and many crops cannot grow without healthy soil that is full of nutrients (Parikh, 2012). For example, slash-and-burn is an industrial agricultural practice that involves using up all the soils nutrients. Farmers would over-plant crops until the soil has run out of nutrients to support the growth of the crops, then all the remaining crops would be burned, and they simply moved on to the next lot of land. Though this may have worked in the past when there was plenty of nutrient-rich land to go around, there are more people than there has ever been on this earth, and simply wasting land by using the soils health is no longer something that will work. Therefore, these sustainable agricultural practices work to ensure soil health is not compromised for the mass production of crops.

Many companies have already joined the movement; *Organic Valley*, *Nature's Path*, and *Stonyfield.* These brands are revolutionizing the way food is grown, packaged, produced and sold. These activities are now further expanded by grazing cattle with their natural diet to minimize methane emissions, becoming carbon neutral, reducing, reusing, recycling and composting their waste. Even worldwide companies like *Coca-Cola* are working toward sustainability. It

has reported 2020 sustainability goals, that include sustainably sourcing their key agricultural ingredients. By 2015 they were able to finalize a *Supplier Engagement Program* that procured that 100 percent of the ingredients that go into coffee and tea were grown sustainably. And eventually by 2017 they were able to procure over 51-75 percent of lemons and beet sugar, 26-50 percent of grapes, and 0-25 percent of cane sugar from sustainable sources (The Coca-Cola Company, 2018). continue to make improvements every day to take big steps toward the future and continue to help preserve the environment.

But even though sustainable agriculture helps our environment, is economically viable and produces enough food there are some reasons we are still being held back from spreading sustainable agriculture everywhere.

Disadvantages of Sustainable Agriculture:

● There are currently no subsidies for sustainable agriculture farmers. Most farms are offered subsidies, but sustainable agriculture does not have a subsidization available for farmers which could be difficult for farmers financially.
● More time and labor demanding for many practices. Since the farming methods are environmentally friendly, they require more manual and physical labor while observing the field more often to ensure the crops stay healthy.
● Consumers may be met with higher costs in the beginning due to the different needs of sustainable agriculture. For a sustainable agriculture farm to run as smoothly as an industrial agriculture farms the conversion of different types of soil, technology, and tools is crucial. So, this may lead to high prices on products until the soil becomes healthier naturally and easier to maintain (Green Tumble, 2015).

By breaking through the minor disadvantages that sustainable agriculture poses we will be able to make a breakthrough for the health of our planet. Companies, organizations, and even the government can work to build better financial and economic stability for sustainable agriculture and the farmers that needed to be supported. These changes can lead to a major change in our environment that be withheld much longer than the countless industrial agricultural practices that are continuing to kill the one planet we have.

Agriculture has always been an easy way for humans to access food, and it has changed the ways humans live since it was first discovered over 12,000 years ago. Overtime civilizations have been able to improve their techniques, strategies, and practices to come up with bigger yields, bigger crops, and faster growth. To ensure that our earth and agriculture continues to thrive like it is today, we need to make changes fast. Change is not easy, but it needs to be done for the sake of our environment and the future generations. Everyone can help

by buying local, looking for meat alternatives, buying from companies that rely on sustainable agriculture, eating organically grown products, and supporting green education and community gardens (Brier, 2015). Together we can bring change, and make choices we won't regret.

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Youth Corner

Nutrition: Challenge Traditions- Promoting Sustainable Living

Laura Cecila Olvera [1]

When I told my parents, I would become a Registered Dietician, they showed disapproval and surprise… And of course, they asked me what does a dietician do?

Nutrition is a very new science in México, so not everybody knows what we really do, most people are familiar with doctors, dentists, and nurses, but not with dieticians (currently, we are not integrated in most hospitals in Mexico)… so, the health care industry is just starting to know us, and to trust our work. It's challenging being a Dietician in a country where people are dying of diabetes, heart disease, high blood pressure, and obesity. Most Mexicans lack of the knowledge about how nutrition, a healthy diet, and a healthy lifestyle could improve their lives and health.

Nutrition professionals have to fight against a low level of education, poverty, food industry, stress, lack of infrastructure (e.g., most of cities are designed for cars, and not for walking). Even insecurity is an issue; nowadays kids don't play and run freely in the parks or streets, mothers fear that someone could be harmed. Instead they stay at home watching television. Knowing the context where we live in México, I'm ready to tell you how I am helping people as a dietician. For many years I have felt that people can improve significantly their health, well-being, and even mood by exercising and eating nutritious food.

My very first patient was my father, who suffered from high blood pressure, high cholesterol, and high glucose. He took his pills for almost ten years, and he could control his problems, but he never really improved. He wanted to be healthy, so I suggested he try the treatment I outlined for him, and he accepted, as the last resort. He was like: - Ok, I´m going to try, I already did everything, nothing worked, and I guess I have nothing to lose by eating well and exercising- so he did. He lost 10 kilos, and after some months his doctor told him he could stop taking his pills for good.

[1] Laura Cecila Olvera is from Queretaro, Mexico.

I knew about the statistics, there´s enough scientific evidence that lifestyle changes improve your health, but my father's success filled me with confidence about my work. So, I started to see some patients on weekends, then, also during the week, and now it has been a year that I work as a dietician full-time.
Social media has been my best weapon, and it has been instructive. Did you ever hear that, when you want to catch fish you have to give, what the fish like, not what you like? Well, that was my initial mistake.

When I started. I wanted to give out all my information about nutrition, health, diseases, and more, but even if in my opinion, it was "high value" information, people didn't care at all. I hired a community manager, and six months later, still our project wasn't successful. So, he explained to me some facts he knew about our public: Mexican people like to laugh, a lot… so, did we had to make them laugh! We started to use funnier designs, and I started to focus on nutrition, health, and weight loss, topics not that serious, and but funnier. At the same time, we never lost sight of our goal, that is, we invited people to take care of themselves more than they were. Nowadays we're more successful interacting with our social media community and clients.

I also care a lot about our environment, and the real Mexican diet and foods. There's so much information in the media about what you should eat, and thus people become confused, they ask me often why I never use, for example, the berries, or hazel nuts, or quinoa, when it´s supposed to be so magical. My answer is simple: When it is about diet, my rule is always to make easy and realistic and sustainable meal plans. Some berries are not grown for Mexican consumption and if you buy them (they come from another countryand they´re so expensive. Similarly, hazel nuts, quinoa, and many foods come from abroad. … So, I always use what we have in Mexico: Corn, beans, lentils, mangos, avocados, bananas etc. I focus on local vegetables and grains.

I guess it is simple if you have an easy meal plan, when you don't have to spend tons of money trying to get "the superfoods", and when you can also make it fast, and you're not proposing complicated and fancy meals. I think your daily diet should just help you to have a better life, not make your life more complicated.

By eating local food, walking more and using our cars less, eating more natural and less processed products, drinking simple water instead of sweetened drinks, we could not only have a healthier lifestyle, but also a lower our health care spending, prevent diseases, and feel and be more productive in our daily life. If we think deeper, about spreading all these possible benefits to our nation, or to the world, we all can create a more positive impact in our communities and how much we can learn, and we may have an even greener planet, just by eating well.

Youth Corner

The Perfect Smile Comes from the Heart

Ely Yanira Galeano García [1]

Dentistry involves careful, precise handwork skills, a keen eye to details, aesthetics, creativity and a consideration of all the structures and tissues in the oral cavity, plus a great number of factors, including patient consideration and satisfaction.

I have the desire to help people, so I have the responsibility to educate patients on correct oral health practices, so the major focus is always going to be prevention. I've been practicing this career for more than three years now and I've seen lots of things. I work at my private practice, and at the beginning it was difficult to attract patients. I resorted to advertising through social networks and little by little the number of patients increased due to people's recommendations. I take very seriously the patients' trust. You know every person is different, as well as their needs, so it's important to pay great attention to details, since the first interaction with each patient is to ensure that they are comfortable and confident that they are receiving excellent dental care. All I want to do is restore oral health and transform the lives of people.

First impressions are very important, principally when we know some people are afraid of dentists or dental procedures, so imagine kids! It is not pleasant to see patients who fears us, especially when they don't have any idea of what the experience at the dentist is like, or they never had any prior procedures. It's important to talk to them and explain every little thing we are going to do. I can be very persuasive and patient with kids, and of course it's important to reward them for their good behavior. Kids get to like and trust me.

I have a weakness for elderly patients; they can be the most difficult ones, or the sweetest. Contrary to children, they have experienced lots of dental procedures so they are not afraid, yet they have high expectations on how things are going to go. I always remember a patient I had at the dental school; she had no teeth, so she needed a total dental prosthesis.

She was 67 years old, yet she looked older. This humble lady came for the first time to the university and we met in a hall, she was so sweet and she grabbed my hand and just told me she

[1] Yanira Galeano García is from Hondurus.

needed teeth with her other hand pointing to her mouth. My classmates told me that, while desperate to have teeth, she didn't look like someone that would consistently come to the appointments.

It was difficult for her to understand everything I asked or said to her, and she didn't have any phone number I could call. So my classmates told me because of her I would fail the class because she would stop attending appointments. But, I still wanted to help her and she, in fact, came to every appointment.

My class was at 3:00p.m., but this lady got to the dental school at 7:00 a.m., and even though I explained to her that she didn't have to get there early, she kept doing the same thing and waited for me for all those hours. Her explanation was that the people she lived with told her to leave early to the clinic so that she could get home early. I felt bad for her, and every time I had a chance in between my classes I went to talk to her for a little while and at lunch time I always tried to give her something to eat and drink. I even tried to get someone else to attend to her in the mornings so that she didn't have to wait for me, but I couldn't do it. She never looked tired and she was always smiling, but at every appointment she asked me if that day she would leave with her new teeth. The day she had the prosthesis on, she gave me the biggest smile and hug I can remember, she was so grateful, and she even hugged a friend that was next to me. I knew I was never going to see her again, but I felt so satisfied for the work I've done, she had her dentures and a new smile on her face.

I've been volunteering in medical brigades for more than two years now and I've had the opportunity to travel to a lot of communities in my country, Honduras. Along the way, I've encountered so much poverty, and therefore, poor oral hygiene because of the lack of education, financial means, and dental tools, and thus, not having the means to take care of their teeth.

Recently, I began working in Global Brigades. I had the opportunity to meet people from the United States and Canada; students that come in search of a different experience. They collaborate with the medical staff to help provide the best service we can give to the communities. As I am treating a patient, I explain all the procedures to the students who assist me, and the more questions I can get from the students the better because that means they are interested in what I'm doing. I really enjoy sharing my knowledge with them. From what I've heard from the students, they've had an amazing, fulfilling experience at every brigade they've worked on. I hope I have aroused the interest of many of the students in the world of dentistry, as well as the importance of volunteering for the ones in need.

One of the experiences I recall the most is one in which I let someone pull out a tooth from a patient. This girl got so excited she began crying. She thanked me for letting her do complete the

procedure. Now she is going to be a dentist herself and I feel happy for my friend and future colleague.

There was a brigade where an old lady came in with six teeth left in her mouth. She wanted them extracted and wanted a dental prosthesis. I was working with two students at that moment, so we began preparing what we were going to need, and the lady out of nowhere started talking about the nineteen children that she gave birth to and I was open-mouthed. The students were curious so I told them what she said and they could not believe it.

She continued telling us about how she had given birth to two of her children at her home and that now she was a midwife. We were impressed and she began laughing with us. It was more the time we spend talking to her, than the procedure. After the extractions were done, she stood up and hugged me, she was smiling, she hugged the students, she hugged the other dentist working with me, and everyone in the room before she left. She just wanted to thank everyone in the brigade for the attention received. I cannot forget that.

In another brigade, a girl came in crying with her mother. She had two loose teeth and was afraid of getting them extracted. The students talked to her, gave her stickers and even danced for her so she would stop crying. Then the mother wanted them to dance for her too, and this time I danced with the students as well.

Truly, the most rewarding thing is to see the smile on people's faces after they have received the care they need. No matter what treatments are performed, whether they got a tooth repaired or extracted, or a cleaning, they feel grateful for the attention and it makes everything worth it.

Youth Corner

A Team Sporty: We are a "team" for Earth!

Ha-Young Kim [1]

Sustainability can be defined as a unique method to leave a long healthy lasting home for earth's future children. Good examples can include upcycling, green education, reforestation, and the continuous love for our earth. We may believe that it is not our job or duty to save the earth, and that instead, someone else who cares for our earth will complete the task. In Stevenson's report (2012), it is strongly insisted that we need to save our planet by ourselves, and that the biggest threat to earth is if we believe that it is someone else's duty besides our own. In the following, I would like to explain why and how we should:

- Get involved with creating a sustainable earth immediately
- Learn and follow the actions people have already taken towards a more sustainable earth

To answer those statements, let's evaluate what we have done so far and how we are going to be ready for the future. An average American will throw out eighty-one pounds of clothes every year (Goldberg, 2016). This adds up to 26 billion pounds of textiles and clothing ending up in landfills yearly, but this issue can be solved if we upcycle.

Upcycling is reusing materials to create a product that has a higher quality than the original. With upcycling people around the world can reduce the amount of trash thrown away every year. How can we do this? Please, take a couple hours out of your weekend to get together with your family and friends to make upcycling crafts. For example, children and teens can make puzzles out of empty cereal boxes, and jewelry stands out of vacant glass soda bottles. Adults can pitch in too! They can make old rain boots that don't fit anymore into flowerpots. Or, can cut and stitch together different pieces of clothing to make a new quilt and bag. Upcycling is an even more valuable way to recycle for the environment since it makes garbage just as useful as the day it was bought again! Not only is upcycling good for

[1] Ha-Young Kim: 7th Grade at the Crownover Middle School, Denton, TX.

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nature, but it's also fun! A family can spend time together as they upcycle and turn recycling into an enjoyable bonding experience.

Students are taught about how important it is to keep our planet green, yet they may not be provided with many chances or ways to do so. A personal connection I can make with this is that in fifth grade on earth day, teachers would give us time to discuss how we were going to help the earth that day, but this "activity" didn't have enough of an effect to make us put in the work, and the main reason for this lack of motivation was because we didn't think it would help. As young pre-teens we needed a better reward or reason then "less pollution" to pause a NETFLIX show and get up from a binge-watching phenomenon. Green Education Foundation (GEF) has taken a step-in enlightening teachers and other educators on how to make helping the earth fun. They have created the *Green Classroom* Pledge contest which is a "pledge" that students take from K-12 about different rules in keeping their class green. Not only are activities like these fun but are also easy to get involved in and have rewards so students are driven to work hard and are able to nurse the planet at a young age.

A dangerous result is given to us as a result to the pollution, death. Around 4.6 billion deaths each year from the air pollution have been reported by the World Health Organization. In Gardiners article she informs us about the world's largest emitter of climate warming greenhouse gases. The main focus was about Tangshan a city in China that has a heavy industry of steel. Because of the many factories' different chemicals, the air pollution in Tangshan has gone ahead to make the citizens of Tangshan's water undrinkable and the air toxic. The article makes sure to key point how the public anger about the pollution caused the government to make changes for a cleaner city. Leaders ordered temporary closures to multiple factories and the government also created a nationwide network of monitors tracking levels of PM (Particular Matter)2.5, PM is the tiny combustion particles that spike deep into your body to cause breathing problems and other health effects. Gardiner manages to make readers believe that if we let our voice be heard to try and sustain the earth we will be listened to. (Gardiner, 2017).

If you were to be invited as a guest to someone's house you wouldn't destroy their home, so why not take the same amount of care to your planet? Cleaning up the earth is the same as playing a sport. When one person does not do their part, everyone else on the team will also have to deal with the effects of their team members poor choices. We must sustain the earth for ourselves and future generations to come. Although we may struggle at first but soon, we will begin to see change. It is said that all things are not easy at first, but with time and dedication, will soon be no trouble at all (Fuller, n.d.).

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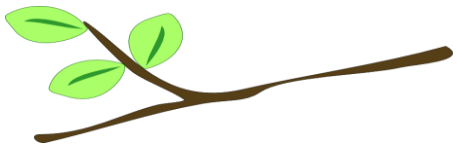

Youth Corner

What is Environment?

Brook Lakew [1]

Environment is the habitat that surrounds us. It can be living or nonliving things, it interacts mostly with living things such as plants animals and the air we breathe, the water we drink and what surrounds us.

However, still the environment is becoming polluted. The two main reasons are air pollution and water pollution. The air is being polluted due to smoke from cars, industries, cigarettes, burning coal and wood. On the other hand, water pollution is caused by industrial and household waste going into the surrounding rivers lakes and streams, even rain waters tend to wash off chemicals like fertilizers, etc. Due to these reasons we need to protect our environment.

Living things cannot survive if the environment is contaminated. If we don't protect it we may be exposed to harmful diseases and may even die. Of the numerous ways we can improve environmental pollution by replacing mechanical cars with electrical, giving treatment to chemicals before releasing them to the environment, avoiding plastic bags,
planting more plants, avoiding overgrazing of cattle and finding alternate grazing land, contour plowing technique and avoiding burning wood and waste materials etc.

[1] Brook Lakew, Sophomore High School, Ethiopia.

Youth Corner

Pollution in China

Robbie Ma [1]

Mom and I went back to China to see my dad and my grandparents during summer time in 2019. We live in the center of Beijing. There are many high buildings and large mansions in the area, such as International Trade Center, China Central Television, and China Zun, Which is the tallest building (528m) in Beijing. most of time, it is beautiful and amazing, just like New York or Paris, fashion and modern.

However, one day, the sky is dark and seems to be foggy. It is hardly to see these building clearly. It seems in the clouds looming (I just learn the new word). I thought it would take a while, but it last several days. My dad told me it is not fog, it is haze, one kind of pollution.

I checked it in internet and I found something. Beijing is one of the most polluted cities in China. There are 21.54 million people and 5.97 million vehicles in Beijing. People cook every day and make a lot of trash; the vehicles make a lot of vehicle exhaust in the air.

There are a lot of factories around Beijing, especially coal factories, also make many many pollution. Some scientist said that even the cow could make pollution. According the data from website, there are 96.85 million cows in China, experts said cows make global warming and some pollution when they fart.

But it is different when I went to Sichuan Panda Center with my

grandparents. The Center located in a small town nearby Chengdu. One side of center is in a low mountain, another side is in plain. There is less people, less cars and less factories. The sky looks blue every day. Some time it got a lot of rain, the bamboos can grow well and pandas can live well in there. Pandas is so cute and I love them.

[1] Robbie Ma is a 4th grader from China.