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Sustainability And Agriculture

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ABSTRACT

Water resources are being threatened by farming initiatives in developing countries as well as in more advanced countries. It entails the disruption of aged soils for cultivation of palm oil emitting CO^2 gases into the atmosphere. It also results from the use of fertilizers in agricultural areas in Europe and the United States. Unless significant intervention by non-government and government entities persuade for-profit enterprises to engage in significantly more sustainable agricultural practices, the availability of clean water resources will reach catastrophically low levels. Suggestions for reaching more sustainable outcomes are provided.

INTRODUCTION

As noted earlier (Flynn, 2014), the defining issue of the twenty-first century may well be the control and more generally, management of water resources. While water supplies are dwindling because of groundwater depletion, waste, and pollution, with demand is rising. Consumption of groundwater is increasing faster than it is naturally replenished and causing water tables to decline unremittingly (Rodell et al., 2009). Currently, 338 million people are sometimes subject to severe water shortages and by 2025 this number is projected to increase to about 3 billion (Rosegrant, 1997). Efforts must be mad e to create more sustainable water resources.

A sustainable economy must limit withdrawals from, and produce investments in all forms of capital (human, social, and natural) to ensure that no form of capital is diminished in order to increase short-term output of marketable goods and service (Lant, 2004:22). “Sustainability of human activities (predominantly production and consumption) is a growing concern among businesses, customers, governments, international bodies and non-governmental organizations. These concerns are often linked to energy efficiency, reduction of environmentally harmful emissions, ecosystem preservation and other conservation efforts. They are becoming a part of a "triple bottom line" for business accounting: financial, social and environmental” (Hermanowicz, 2005). Water consumption by agriculture far outpaces other users. Furthermore, thee use of fertilizers has led to the pollution of streams, rivers, and lakes. Recently, Patel and Parshina-Kotaas (2017) have reported on the devastating effects of agricultural run-off in streams and rivers has caused the polluting of Lake Erie through algae growth. We will also consider the effect of agriculture, i.e. palm oil production, on indigenous populations especially in the Malaysian area on Borneo.

AGRICULTURE AND WATER CONSUMPTION

As argued Scott (2017) prior to The Neolithic Period, for roughly two hundred thousand years, modern humans lived as hunter-gatherers. Then, about twelve thousand years ago, cam what is said to be our ascent to planetary dominance: the Neolithic revolution. This was our adoption of agricultural innovations that includes the domestication of animals including cows and pigs, and the transition from hunting gathering to planting and cultivating crops. The most important of these crops have been wheat, barley, rice and maize that remain the staples of humanity’s diet. These cereal grains allowed population growth and the birth of cities and the

rise of complex societies (Lanchester, 2017). This development may arguably not be sustainable as currently practice by agro-business entities.

The Neolithic Period or Stone Age, 7,000 to 10,000 years ago, pertains to a stage of culture following the Paleolithic and is characterized by the use of polished stone implements, development of permanent dwellings, cultural advances such as pottery making, domestication of animals and plants, the cultivation of grain and fruit trees, and weaving. The change from hunting/gathering to primitive farming appears so abrupt that this technological change is often characterized as the Neolithic Revolution. The discovery of smelting and the creation of bronze tools has given the name Bronze Age to the Late Neolithic period (Hort).

Biotech in Agriculture

Biotech crops, genetically modified organisms (GMOs) have been steadily growing throughout the developed and developing world (see Figure #1). While the biotech crops are created to be resistant to various forms of blight, some biotech products may be less beneficial to the ecosystem. Monsanto, for example, has involved in litigation in the United States involving one of its weed killing fertilizers, Roundup. The active ingredient is glyphosate may cause non-Hodgkin's lymphoma as claimed by farmers, their families, and others (Hakim, 2017). European Union officials are considering blocking the use of glyphosate in its 28 nations. In the defense of bio-engineering Hugh Grant of Monsanto and James Collins of DuPont have considered the use of Crispr, the gene editing technique to increase the use of bioengineering for the future of agriculture after more than two decades of genetically modified organisms' usage in agriculture (Wall Street Journal, 2017).

Another herbicide, dicamba, has been found to damage 3.6 million acres of soybean, crops, or about 4 percent of all soybeans planted in the United States in 2017. Dicamba has been used beginning in 2017, on genetically modifies soybeans and cotton crops that are grown from seeds created (GMO) to be tolerant of weed killers. The problem is that the herbicide can drift off the fields where it is being applied, landing on nearby farms where conventional soybean seeds have been planted. An estimated 22 million acres of soybean crops were planted with G.M.O. seeds out fan estimated 89.5 million acres of soybeans planted nationwide (Lipton, 2017). Further, the algae outbreak in Lake Erie was most recently caused by phosphorous run-off from the Maumee and Sandusky rivers. Blue-green algae feeds on phosphorous which has sickened people and animals and caused damage to fishing and tourist industry (Maher, 2018: A3).

However, as recently argued by Lynas (2018) the problem is not only that almost all of the alarms about GMOs were false. It's that the anti-GMO campaign has deprived much of the world of a crucial, life-improving technology—and has shown the readiness of many environmentalists to ignore science when it contradicts their prejudices. Contrary to our initial fears, the overall impact of genetically modified crops has been to dramatically reduce the amount and toxicity of pesticides sprayed by farmers. Crops such as Bt corn, so called because it incorporates proteins toxic to insects from the bacterium Bacillus thuringiensis, have enabled farmers to rely less on sprayed insecticides. A meta-analysis, combining the results of nearly 150 peer-reviewed studies, was published in 2014 in the highly regarded journal PLOS One. It concluded that GMO crops used 37% less chemical pesticide (that is, both insecticide and herbicide) than conventional versions of the same crops, thanks largely to the new crops' internal biological protection against insects.

Pesticide reductions have been especially notable in developing countries. In Bangladesh, for instance, smallholder farmers have benefited from Bt varieties of eggplant. In the past, they

often sprayed their crop with toxic chemicals as many as 100 times in a season to fight off pests. The GMO eggplant has enabled them to dramatically reduce insecticide spraying, in some places almost to zero. Furthermore, the GMO seeds reproduce perfectly well. Those Bangladeshi farmers save and share their new Bt eggplant seeds, helping their neighbors and extended families also to reduce pesticide spraying. Many crops now in development in African countries, such as drought-tolerant corn and disease-resistant banana and cassava, will be sold royalty-free by local seed companies in an effort to improve the livelihoods of subsistence farmers and reduce poverty (Lynas, 2018).

In India, the water challenge is already grave and could get graver. By 2050, for instance, it is estimated that demand would go up to 1,180 million cubic metres, 1.65 times the current levels, a situation that would be made worse by fast dwindling fresh water resources (Vijayakumar, 2012). For example, the Yamuna River that flows through the ancient city of Delhi has helped sustain some of India's greatest empires. Hindu poets celebrated its life-giving properties. The Mughal dynasty built the Taj Mahal and other monuments along its banks. Today, the Yamuna is a foul sludge for much of its 855-mile run. In Delhi, it is black and nearly motionless, covered in many areas with a foam of industrial chemicals, floating plastic and human waste. Every 100 milliliters of the Yamuna in Delhi contains 22 million fecal coliform bacteria, up from 12,250 in 1988, scientists say. Anything over 500 is unsafe for bathing, India's government says. The comparable standard in Vermont is 235. Illnesses ranging from diarrhea to brain worms are reported along the river's edges. By the time the Yamuna exits Delhi, it is so defiled that scientists have declared the next 300 miles "eutrophic," or incapable of sustaining animal life (Pokharel & Rana, 2017) (please Figure #2).

A government report in 2015 found that 275 of 445 rivers in India are severely polluted, including the Ganges. An international nonprofit, WaterAid, says 70% of India's surface water is contaminated. Diarrhea, often caused by drinking bad water, is the fourth-leading cause of death in India, ahead of any cancer, and kills far more people than in China, which has a larger population. Greenpeace says that in 2015, the average Indian was subjected to more air pollution than the average Chinese for the first time, as China's "systematic efforts" to improve air have started working. A 2016 WHO report found that 10 out of the world's 20 most polluted cities were in India, based on residents' exposure to deadly small particulate matter (Pokharel & Rana, 2017).

Mixing Water and Poison

Recently, as reported by Tabuchi et al. (2018: A13), flooding throughout the United States is likely to worsen because of climate change, the federal government warned last year. Heavy rainfall is increasing in intensity and frequency. At the same time, rising sea levels combined with more frequent and extensive flooding from coastal storms like hurricanes may increase the risk to chemical facilities near waterways. The New York Times analysis looked at sites listed in the federal Toxic Release Inventory, which covers more than 21,600 facilities across the country that handle large amounts of toxic chemicals harmful to health or the environment. Of those sites, more than 1,400 were in locations the Federal Emergency Management Agency (FEMA) considers to have a high risk of flooding. An additional 1,100 sites were in areas of moderate risk. Other industrial complexes lie just outside these defined flood-risk zones, obscuring their vulnerability as flood patterns shift and expand. The presence of chemical sites in areas vulnerable to flooding is a holdover from an age where the advantages to industry of proximity to rivers and oceans — for transportation and trade, or for a ready supply of cooling water — seemingly outweighed the risks.

"Waterfronts are changing as a result of sea level rise," said Jeanne Herb, an environmental policy expert at Rutgers University who has researched hazards posed by climate-related flooding to industries in New Jersey. "More often than not, these are facilities are on the water for a reason," she said. "So how do we make sure that there are protections in place? That's the big question." Federal law does not explicitly require sites in floodplains that handle toxic chemicals to take extra precautions against flooding. Nor do most states or local governments have such requirements (Tabuchi et al., 2018: A13). The recent flooding as a result of Hurricane Harvey caused a release of lye into the waters in Barrytown, Texas. This is the case along the Gulf Coast because the country's oil, gas and petrochemicals industries are concentrated there. At least 46 facilities reported an estimated 4.6 million pounds of airborne emissions beyond state limits between Aug. 23 and Aug. 30, 2017, the week spanning Harvey's approach and landfall in Texas. The Chevron Phillips plant also reported one of the largest Harvey-related emissions of chemicals into the air.

When Tropical Storm Debby brought torrential rain to north and central Florida in mid-2012, it triggered a release of phosphoric acid from a chemical plant in White Springs that produces phosphates, which are used to make fertilizer. Flooding knocked out the power supply to its pumping system, causing water mixed with chemicals to spill into a storm-retention pond, which eventually also overflowed into a creek that feeds the Suwannee River. Released in large quantities into the environment, phosphates and phosphoric acid can cause uncontrolled algae and duckweed growth, causing oxygen levels in lakes and rivers to drop precipitously (Tabuchi et al., 2018).

We might also remember that on the morning of Thursday, January 9, 2014, the people of Charleston, West Virginia, awoke to a strange tang in the air off the Elk River. It smelled like licorice. The occasional odor is part of life in Charleston, the state capital, which lies in an industrial area that takes flinty pride in the nickname Chemical Valley. The company, Freedom Industries estimated the leak to be as small as twenty-five hundred gallons of MCHM—4-methylcyclohexane methanol (part of a chemical bath that the mining industry uses to wash clay and rock from coal before it is burned), about sixty barrels. Within days, the estimate had tripled. Eventually, the company raised it to ten thousand gallons, and reported that a second chemical, known as PPH, had leaked as well. At 6 *P.M.*, the Governor appeared on television and issued a warning unprecedented in Chemical Valley: he told three hundred thousand people that their tap water was not safe for "drinking, cooking, washing, or bathing." It was one of the most serious incidents of chemical contamination of drinking water in American history (Osnos, 2014).

In a new study published in the Proceedings of the National Academy of Sciences, reported recently (Plumer & Popovich, 2018: A10), researchers found that, since 1982, between 3 and 10 percent of the country's water systems have been in violation of federal Safe Drinking Water Act health standards each year. In 2015 alone, as many as 21 million Americans may have been exposed to unsafe drinking water. The problem is particularly severe in low-income rural areas, the study found. And the researchers identified several places, including Oklahoma and West Texas, that have repeatedly fallen short in complying with water safety rules issued by the Environmental Protection Agency over the past decade. "These are often smaller communities flying under the radar," said Maura Allaire, an assistant professor of urban planning at the University of California, Irvine, and a lead author of the study. "They're struggling to maintain their aging infrastructure, and they're struggling to keep up with the latest water treatment techniques" (Plumer & Popovich, 2018: A10).

PALM OIL AND SUSTAINABLE DEVELOPMENT

In less than 100 years, palm oil has moved from being a relatively minor subsistence crop in West and Central Africa to one of the world's major agricultural commodities. While oil palm in Africa has been cultivated for centuries by deliberate plantings and selective clearing, it has recently expanded dramatically in Southeast Asia, and increasingly in Africa and Latin America (Sayer, et al. (2012: 114). Palm oil production in Indonesia and Malaysia represents 33 % of the world's total production (Muna, 2016). Demand for palm oil continues to increase from India, Europe, China and the United States. Uses for palm oil is quite broad especially as fillers in many food products. Palm oil and its derivatives are part of thousands of products across the globe today (see Figure #3). One can find it in biodiesel, soap, doughnuts as well as soap, to mention only a few. Since 1990, palm oil consumption has quintupled worldwide. The demand in Asia, where palm oil is used in cooking oil, accounts for a $44 billion industry. Indonesia is the world's largest producer of palm oil, with a forecasted annual growth in production of 10%. Early 2013, exports from Indonesia hit a five-year high (UDP.org).

There do exist many obstacles to the sustainability of palm oil production especially if producers do not abide by the directives of the Roundtable on Sustainable Palm Oil (RSPO) certification, as one example. At present, only about 10% of palm oil producers are RSPO certified. As a result, rivers have become polluted and air carries noxious particulates that result in environmental degradation and critically premature deaths. For example, smoke related deaths from burning to allow for agriculture has resulted in 100,300 premature deaths in Southeast Asia from July through October 2015 (Schonhardt, 2016). Further, in the fall of 2015, Indonesia released more carbon per day than the European Union (Fountain, 2017).

Hunters and Gatherers

As reported by Lanchester (2017), anthropologist James Suzman, spent more than two decades studying the Bushmen of the Kalahari. About a hundred and fifty thousand years ago, fifty thousand years after the emergence of *homo sapiens*, the Bushman, or Khaosian moved to south Africa and still live there. They are divided into a norther group, who still have traditional control of their land and still have the opportunity to hunting and gathering of plant species. The southern Bushmen were deprived of their land and resettled into modern ways of living. The northern Bushmen have thrived and the southern Busmen have not. The hunting and gathering has continued to provide a balanced and sustainable way of life to this day.

The indigenous tribes of Malaysia on Borneo were hunters and gatherers until their lands were acquired and turned into palm oil plantations (please see Figure #4). Also, one of the elders of the Kadazadadun and Murat communities, the indigenous tribes of Borneo in Miri (Malaysia) was photographed by the author in Miri in 2015 while attending the celebration of the Kaamatan festival marking the end of rice harvesting. They represents one of the communities that have been "crowded out" as a result of move to palm oil production (please see Figure #5).

Forest Preservation and Soil Management

All peatlands, where palm oil production thrives, consists of slowly decomposing vegetation in swamp forests, that has been accumulating for more than 10,000 years. Peat covers only about 3 percent of the Earth's land surface, but because it stores carbon over a long time, it contains as much carbon as all of the world's plants and trees, and almost as much as the atmosphere. Most peatlands are in northern regions, including Alaska, Canada and Russia. But tropical peatlands, especially are highly vulnerable to land-use changes and climate warming, both of which can lead to peat drying out and decomposing quickly, which would release the carbon back into the atmosphere. Recently, scientists have mapped what is the largest peatland in the tropics, an area larger than New York State in the Congo Basin in Central Africa (Fountain,

2017). If this land is not preserved, environmental damage may be daunting. According to Emma J. Stokes, who directs the Central Africa program for the Wildlife Conservation Society, said that protecting the peatlands was crucial, as the swamp forests are home to many animals, including some of the highest densities of lowland gorillas anywhere (Fountain, 2017).

As suggested earlier, the lack of oversight has led to the clearing of forests across Southeast Asia for oil palm production. However, fortunately, in Sarawak, Malaysia on the island of Borneo, the government has succeeded in preserving 68% of the original forest according to Natural Resources and Environment Minister Wan Junaidi (Bahari, 2016).

According to Dr. Lulie Melling, the Director of the Tropical Peat Research Laboratory Unit (TPRL), "one of the most appropriate methods to resolve the problem of peat fires is by compacting the soil using excavators…consolidating the soil will increase the moisture holding capacity of the soil…via a capillary rise of the soil…to prevent the occurrence of fire." (Bernama, 2016: A1). Sarawak uses such a process virtually eliminating the chance of fires, whereas in Kalimantan Province of adjacent Indonesia is among the regions facing the most serious problems due to pet fires, with the Air Pollution Index (API) reposted in some areas to be more than 2000 in March of 2016 where an API of 3000is considered dangerous.

Soil management was carried out by draining the peat, compacting it, and then controlling the water levels to ensure good soil conditions and moisture levels resulting in better yields of palm oil. Indonesia has more than 4,000,000 hectares of abandoned peat land creating the opportunity for fires without proper soil management (Bernama, 2016).

In October of 2010, notoriously, the Rajang River in Sarawak, at a length of more than 560 kilometers, was clogged with timber arguably from forest clearing for palm oil production. Reports emerged that there were navigation problems on the lower reaches of the river. Unusually, these issues occurred not because of high or low river levels, but because the river was choked with wood (a logjam). An image of the clogged Rajang River illustrates the magnitude of the issue (see Figure #6, for example). The blockage reportedly extended for 250 km. The reason that the wood entered the river appears to have been intense rainfall on 6th to 7th October (2010), but the question is where the wood has come from. There are two likely sources of wood like this. The first is that a logging camp or store was inundated (unlikely on this scale); the second is extensive landslides. In Malaysia, a significant controversy is playing out over the cause of the disaster. The Land Development Minister, James Masin has claimed that the cause was logging in the catchment. Meanwhile, the state forest director, Len Talif, is blaming shifting rainfall patterns. The source area appears to have been Sungai Melatai in the Balleh sub-catchment (AGU.Blogosphere, 2010).

Further consideration of indigenous species being crowded out of their habitat must include the orangutans, especially on Borneo. The Borneo orangutans was declared critically endangered in 2016, after research showed its population had declined by more than 80 percent over the past 75 years, mainly due to habitat destruction (Emont, 2017a). Further research has shown that the off- spring of orangutans breast feed for up to 9 years, the most of any primate. The study found evidence that during periods when fruit and other food became scarce, young orangutans would supplement their diet with breast milk according to Christine Austin an author of this study and a researcher in the department of Environmental Medicine and Public Health at the Icahn School of Medicine at Mt. Sinai (NPR, 2017).

Recently, there has been discovered that there is a seventh great ape species: the Tapanuli orangutan from the upland forest on the Indonesian island of Sumatra. Unfortunately, the

Tapanuli orangutan may be the most endangered of all surviving apes, with only about 800 left. The Tapanuli orangutan population became isolated from other Sumatran orangutan populations sometime in the last 10,000 to 20,000 years (Cochrane, 2017). This species is being crowded out of their habitat by the exploitation of forests as experienced by other orangutans in Sumatra and Borneo. More recently, to estimate changes in the size of Borneo's orangutan population over time, researchers representing 38 international institutions compiled field surveys conducted between 1999 and 2015. They extrapolated the overall size of the island's population from the number of orangutan nests found throughout the species' range in Borneo. The team observed 36,555 nests and estimated a loss of 148,500 orangutans during that period. The data also suggested that only 38 of the 64 identified groups of orangutans now include more than 100 individuals, which the researchers say is the lower limit to be considered a viable grouping. That would leave the surviving number at around 148,000, according to the report. However, the World Wildlife Fund estimates that the remaining population of Borneo orangutans is much smaller, at around 105,000. The causes include illegal logging operations, slash-and-burn land clearing, hunting and other direct conflicts with humans (Cochrane, 2018: D2; please also see, Figure #7).

Roundtable on Sustainable Palm Oil Production (RSPO)

One of the rules of thumb in planting oil palm according to the RSPO is to avoid destruction to the environment – the rivers and streams, the erosion of the soil and the water catchment areas. A strip of land or forested area along rivers, must be at least 66 feet from the highest water mark is to be avoided. Further, the RSPO is a not-for-profit that unites stakeholders from the 7 sectors of the palm oil industry: oil palm producers, processors or traders, consumer goods manufacturers, retailers, banks/investors, and environmental and social non-governmental organizations (NGOs), to develop and implement global standards for sustainable palm oil. The RSPO has developed a set of environmental and social criteria which companies must comply with in order to produce Certified Sustainable Palm Oil (CSPO). When they are properly applied, these criteria can help to minimize the negative impact of palm oil cultivation on the environment and communities in palm oil-producing regions. The RSPO has more than 2,500 members worldwide who represent all links along the palm oil supply chain. They have committed to produce, source and/or use sustainable palm oil certified by the RSPO (RSPO.org). Certified PSPO palm oil production amounted to 2.4 million hectares in 2016 (please see Figure #8).

The lack of successful implementation of such programs as the RSPO, include, from the 1980s through the 2000s, there were issuances of Provisional Leases to so-called planters and contractors. These leases were issued before any survey was conducted on the land, that were often peat swamps (Munan, 2016). In the clearing of these peat swamps, fires were set to clear the land resulting in noxious haze. On South Sumantra, Indonesia, for example, 72% of the fire activity on was on peatlands (Schonhardt, 2016).

Rivers are often polluted and clogged from forest clearing for the purpose of palm oil planting. For example, the Sungai Pahang, the longest river on the Malaysian Peninsula, is now increasingly more shallow and may lose its historical standing as the longest river on the Malaysian peninsula. Further, a total of 43 rivers or 9% of Malaysian rivers, mostly in urban areas, are polluted (Borneo Post (b), 2016). It has affected the water supply for the residence and has threatened the ecosystem of the area that includes most aquatic life that are not able to fertilize their eggs between the rocks due to the murkiness of the water (Borneo Post (b), 2016). The life of organisms (including fish) downstream depends on the constant feeding of the river with debris. This debris includes leaves, twigs, branches, and whole trees, as well as the organic remains of dead animals. Debris not only provides food, it provides hiding places

for all sizes of animals and surfaces for phytoplankton and microorganisms to grow. Without flooding and without a healthy riparian zone, this debris will be scarce. Adding to the problem, although debris might come from the river above the dam, it is instead trapped in the reservoir, and never appears downstream. The bottom level of the food web is removed. All in all, the loss of sediment and debris means the loss of both nutrients and habitat for most animals (chamisa.freeshell.org/dam.htm). Recently discovered, altering the complex biological machinery with dams and diversions, leads to the long-term decline of the ecosystem. Only recently, have scientists explored the comprehensive ecological blueprint of river dynamics (Robbins, 2016: D6).

Another effect is the crowding-out of local species, as mentioned earlier. Recently, in Sulawesi, Indonesia, a heavily forested island in eastern Indonesia, a python consumed a man whole. The area has been cleared for palm oil plantations over the last decade. The local villagers searched for the twenty five year old father of two, Akbar Salubiro. He went missing after he had gone to harvest palm oil on the plantation. They discovered the 23 foot python with the outline of shoe in its stomach. They killed the python and found Mr. Akbar in its stomach. (Emont, 2017b: A10).

Sustainability of Palm Oil Production in Malaysia and Indonesia

Palm oil could help achieve high land use efficiency as its about 10 times more than other oilseed crops (Palm Oil Facts & Figures Factsheet, 2012). The energy yield ratio of palm biodiesel is 3.53, which is more than double that of rapeseed biodiesel (Yee et al., 2009), and also performs better than other competing oils, including soybean (Tam et al., 2007), coconut and jatropha (Pleanjai, 2009). In terms of greenhouse gas (GHG) emissions, a carbon saving benefit of 38% is achievable with the replacement of conventional diesel fuel with palm biodiesel (Yee et al., 2009). Oil palm plantation also allows agro-forestry and livestock crop integration (Tam et al., 2009), which could increase the intensification of land use in Malaysia.

The plantation area of oil palm in Malaysia has increased by 150% over the past 30 years (Fairhurst & Mutext, 1999). The fragmentation of forest associated with this man-made monoculture has adversely affected the forest ecological functions and threatens the already endangered species such as orangutans, elephants, tigers, and rhinos (Ardiansyah, 2006). Land clearing activities for palm oil plantations have been identified as the root cause for forest and peatland fires (Datamonitor, 2010) in Southeast Asia each years, which affect the health of millions of people in the region suffered from pneumonia and other respiratory diseases (Food and Agriculture Organisation of the United Nations, 2006).

As mentioned earlier, the majority of the world's palm oil production is in Indonesia and Malaysia (see Figure #9). As suggested by Lim et al. (2015), the success of sustainability efforts in Malaysia has met with limited success where the economic benefits of palm oil production have not fulfilled the commitment to many of the non-industrial stakeholders (see Figure #9). The existing palm oil production is economic focused rather than ecologically focused causing the disappearance of animal species and cultural values of those in the forest areas. The palm oil industry started with economic imperatives, rather than considering ecological issues by converting forests for palm oil production damaging natural environments and thus disempowering the local indigenous community (Lim et al., 2015: 14).

According to Sayer et al. (2012:117-118) the first of the ecosystem principles adopted by the Convention on Biological Diversity is that conservation is a matter of societal choice (Sayer and Maginnis, 2005). As such, many tropical countries with large populations of poor rural dwellers will opt for oil palm rather than natural forest. The overwhelming desire to escape

poverty and pursue economic advancement, coupled with continuing consumption of palm oil globally, suggests a future with more oil palm and less forest. The challenge is not to stop oil palm expansion, but to shape its development to minimize impacts on biodiversity, carbon, local peoples' welfare and other priorities. There are clear options for bringing degraded lands into production, improving yields, and providing incentives to stimulate smallholder innovations. Yet, much of the future expansion of oil palm will take place in regions where regional and local governance is relatively weak, spatial planning ineffective, and land tenure uncertain (Feintrenie et al., 2010). We might suggest that these institutional failures will be the main obstacle to protecting environmental values and achieving more equitable social outcomes as palm oil production expands. Thus there are three principle recommendations that would make the largest contribution to sustainably oil palm production: (1) promotion of yield intensification to reduce the requirement for area expansion; (2) good governance relating to smallholder tenure security and forest conservation; and (3) promotion of smallholder organizations to redress the balance of power in negotiated agreements with commercial estates and milling companies. Oil palm expansion is ultimately driven by the consumer. Consumer behavior can, and has, shaped the emergence of a more socially and environmentally aware industry. While there is still a long way to go, and many improvements to be made, the rate at which goals of equity and sustainability will be achieved is ultimately a function of consumer behavior and, as the Convention on Biological Diversity has acknowledged, a societal choice (Sayer et al., 2012: 118).

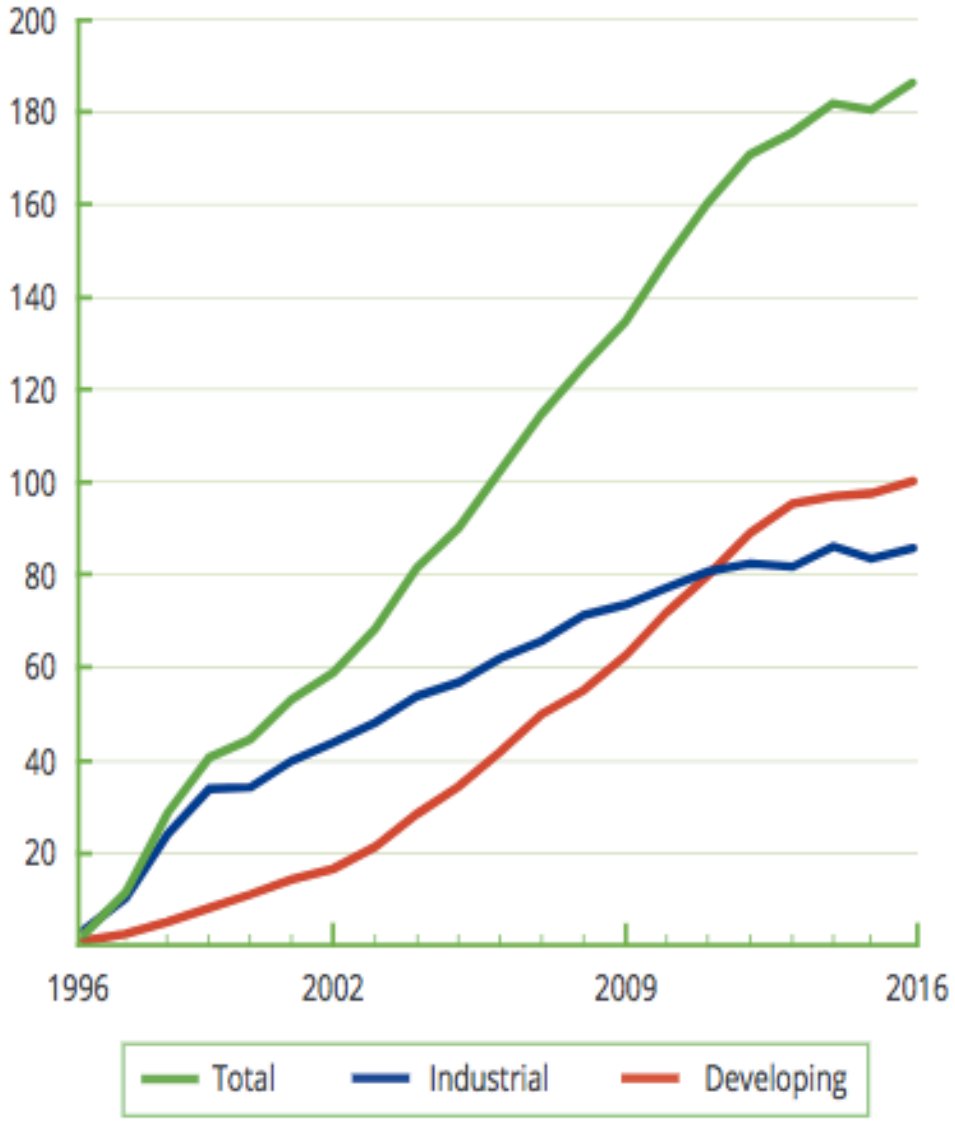
CONCLUSION

While it may seem quaint to attempt to return to the hunter and gatherer historic time, it may be feasible to preserve those cultures that still maintain such a way of life. This may be achieved, especially in parts of Africa and Borneo, by reducing and limiting the exploitation of these lands for farming of arguably, unsustainable crops and foodstuffs. Other solutions include the use of tiny beads of engineered resins that can absorb phosphorous. Other ideas include the use of substances inserted into tiles under the soil on farms to remove phosphorous before it reaches the rivers (Maher, 2018). Reluctantly, we may have to accept the use of GMO pest resistant crops to minimize the use of fertilizers.

Palm oil cultivation as a foodstuff for many products has been noted earlier. Furthermore, it is critical to development of some Southeast Asian economies, especially Indonesia and Malaysia. One critical dilemma is that much of the land that palm oil cultivated is on centuries old peat soil. When the peat soil is "disturbed" for planting, carbon is emitted into the environment. Also, as clear cutting of forests is employed to make land available for palm oil planting, trees are sometimes felled and left drifting, and thus clogging the rivers. Sometimes, fires are used to facilitate the clearing of the forests that results in the burning of peat below the forest floor. This has caused environmental disasters through pollution across Southeast Asia.

Ultimately, a balance needs to be achieved, albeit incrementally, balancing the development and environmental needs, a definition for sustainable development. This can be achieved with cooperation of the various constituencies of indigenous people, government policy makers, environmental agencies, and consumers. Therein, a sustainable solution will exist for palm oil production and consumption.

Figure 1. Global Area of Biotech Crops, 1996 to 2016: Industrial and Developing Countries (Million Hectares)



Source: ISAAA, 2016

Figure #2

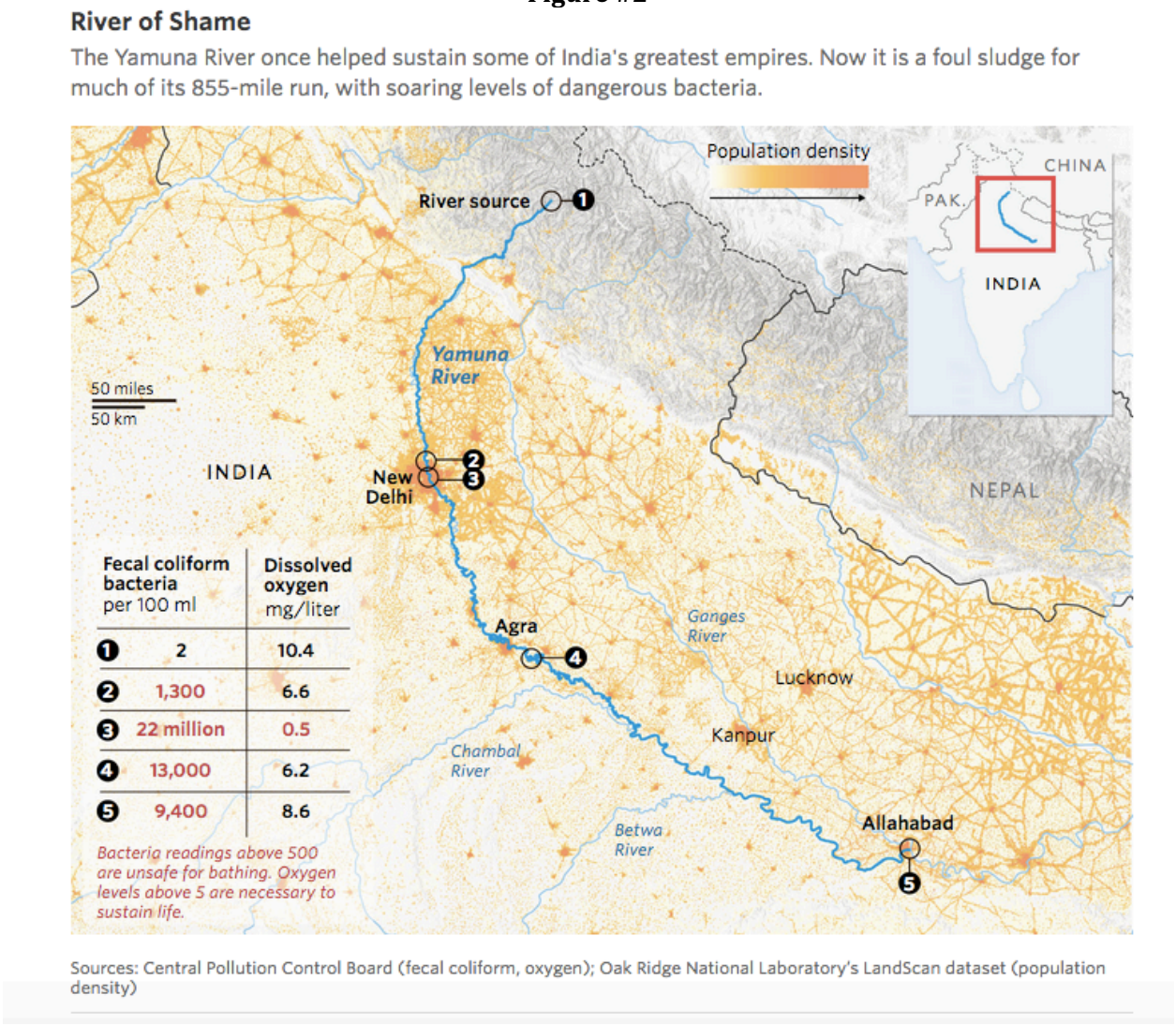


Figure #3: Uses of Palm Oil Byproducts and Biomass in Food and Manufacturing Industries (Source: Fairhurst & Mutert, 1999)

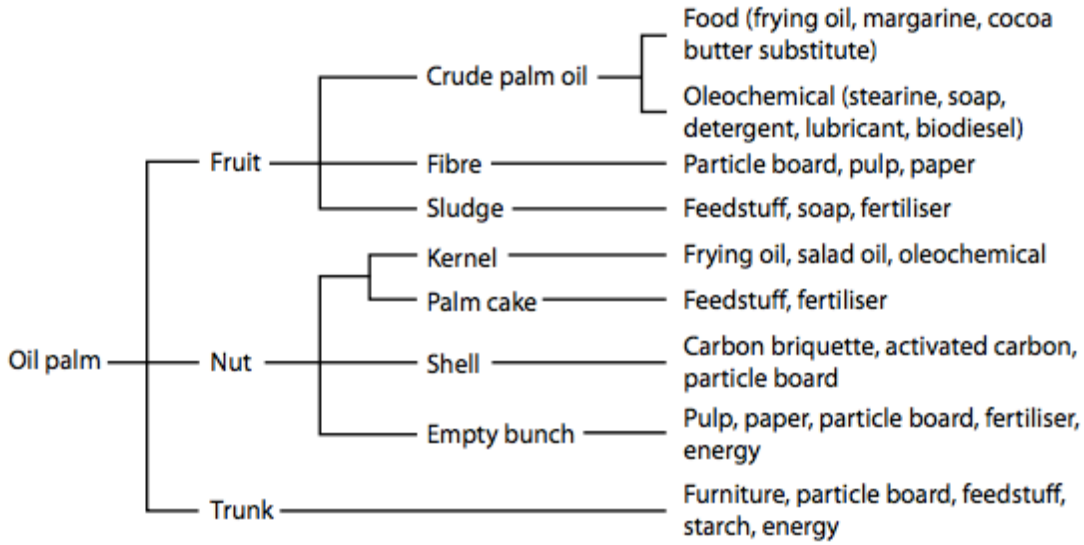


Figure #4

Dayak in full war regalia: hornbill feathers, shield, blowpipe, leopardskin vest, and head-hunting sword. (Collection Nationaal Museum van Wereldculturen. Coll.no. TM-60033041)

Figure #5

Figure #6 Rajang River, Sarawak, Malaysia
(Source: hornbillunleashed.wordpress.com/2010/10/08/10352/)

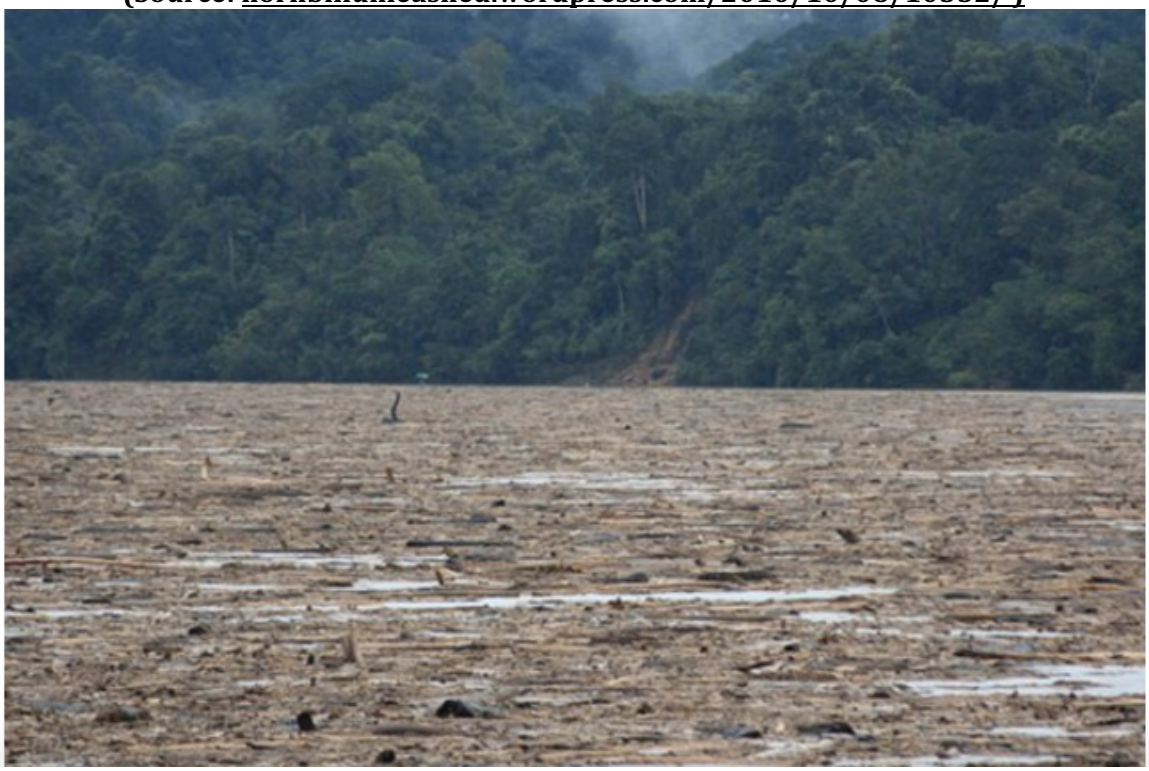


Figure #7 (Source: Cochrane, 2018)

Forest on Borneo abutting an oil palm plantation. Researchers say deforestation has been a significant driver of the orangutan's decline. Marc Ancrenaz

Figure #8

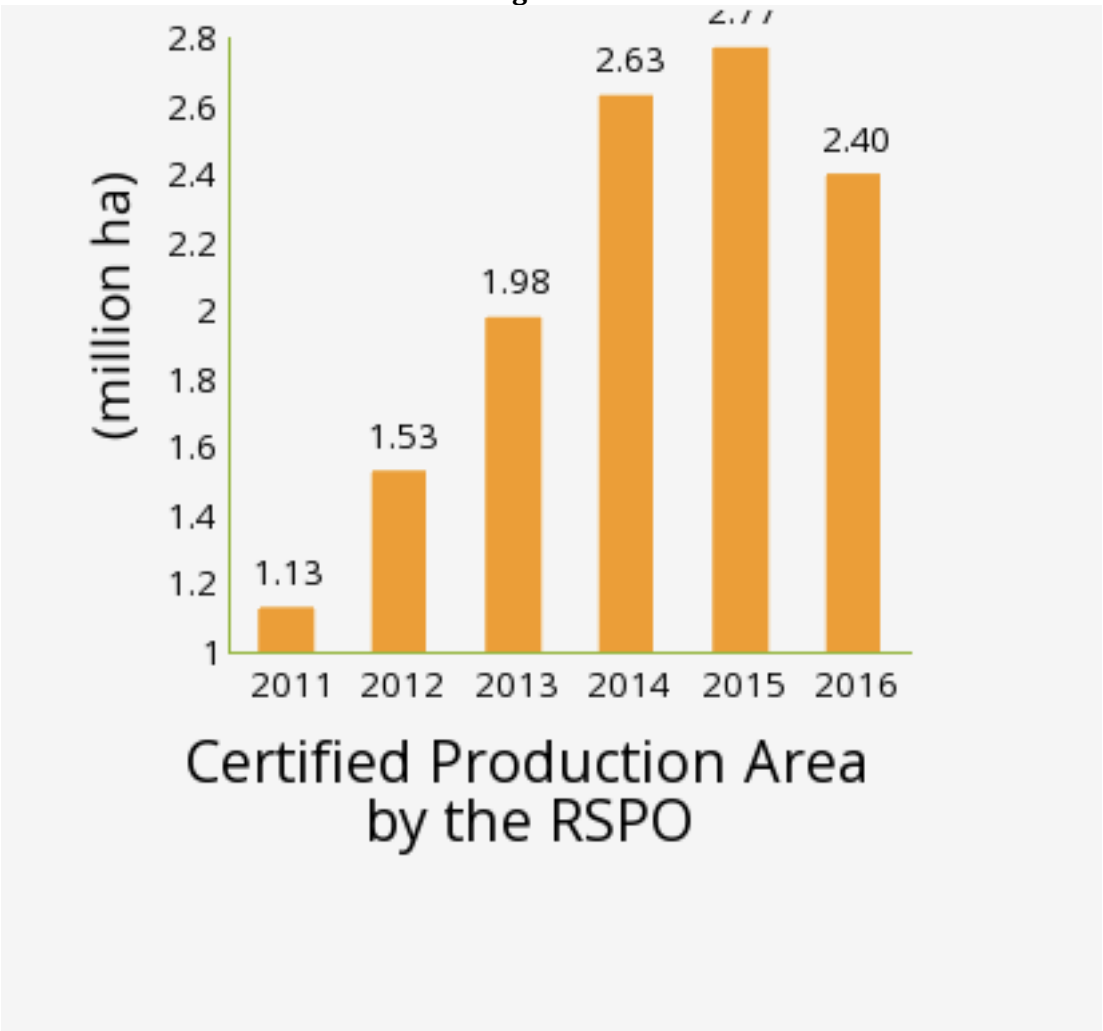


Figure #9 Key Palm Oil Areas in Malaysia and Indonesia

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