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Indonesia, Factor 6: Sustainable Agriculture

### **Indonesia: Countering Unsustainable Agriculture**

Indonesia is a populous country in the tropics of south east Asia. This long archipelago encompasses lowlands, mountains, volcanoes, and rainforests and is home to over 17,500 islands; the Kapuas, Barito, and Mahakam rivers run through the country. Indonesia's rainforests are an extremely important resource for the country as they support a majority the country's diverse flora and fauna and protect Indonesia's ecosystems by naturally cleansing the soil and waterways. However, Indonesia's growing population requires increased food production, and in response rainforest land is being cleared for farming, harming Indonesia's environment. Additionally, unchecked farming practices of individual farmers and commercial farms contribute to this environmental degradation. However, sustainable agriculture could alleviate the effects of deforestation and allow ecosystems that rely on the forests to continue to flourish, while also meeting the food needs of the growing population. Indonesia, thus, is an appropriate country to understand the dynamics of sustainable agriculture for wide-ranging benefits.

Indonesia is a multi-ethnic and poly-religious country whose citizens have varying lifestyles. Indonesians practice Islam, Christianity, Buddhism, and Hinduism, among other religions. The dominant religion is Islam, which is practiced by about 87% of the population, followed by Christianity at about 10%. In this long archipelago, 250 different languages are spoken. The main language, however, is Bahasa Indonesia, also known as Indonesian, which is the language of commerce, education, and media. The second most popular language, spoken by about 70 million people, is Javanese. English is spoken in larger cities and considered the language of business. ("Languages of Indonesia"). The literacy rate for adults is 89% but the literacy rate in children is much lower. During their high school education, Indonesian children often face unwanted pregnancies, young marriages, and dire financial situations, affecting their education and resulting in lower literacy rates. One out of every four girls in Indonesia are married before eighteen and children are not well educated on safe sex practices resulting in poor health due to sexually transmitted infections and unwanted pregnancies. In the years 2010-2015, the infant mortality rate was a high 25% and life expectancy was 70.7 years. ("Indonesia"). Around 11% of people in Indonesia live in poverty and 40% are vulnerable to falling into poverty. The Indonesian diet mainly consists of rice, fish, meat, and vegetables. There is often limited access to protein because of high cost and supply problems, so Indonesians mostly eat grain and vegetables grown on their own farms.

Indonesia is a republic, headed by the President of Indonesia, who currently is Mr. Joko Widodo. Indonesian government has a single chamber legislature, made up of 500 members, that represents the people's voice. The people elect four hundred of the legislators and the President appoints the remaining 100 legislators. Indonesia has 34 provinces and many islands, prominent of which are Borneo, Sumatra, Java, Celebs, Bali, the Moluccas, Western New Guinea and Timor ("Indonesia: Government").

Indonesia sits on the equator and, thus, experiences a warm, tropical, and rainy climate. The country spans 3,000 miles east to west and over a thousand miles north to south. Indonesia is home to dense rainforests consisting of over 28,000 species of flowering plants, 2,500 species of orchids, and 600 species of medicinal plants. Indonesia's mild climate allows for the cultivation of many domestic crops as well. Most farmland is used for growing rice, however, farmers also raise livestock and grow vegetables for sale ("Food in Indonesia"). About 77 million acres of land in Indonesia is cultivated, with 40% of that cultivated land being devoted to the production of export crops, namely crops that are exported. Indonesia exports palm oil, rubber, rice, corn, soybeans, and peanuts. Some 60% of the country's cultivated land is

in the country's biggest island, Java, where most of the rice production takes place ("Indonesia: Stagnating Rice Production Ensures Continued Need for Imports").

The GDP per capita of Indonesia is USD 3,500, compared to the U.S. per capita GDP of USD 56,000 in 2015. In 2013, over 40% of Indonesians worked in agriculture and agriculture accounted for over 17% of GDP in that year. Many Indonesians work in agriculture and the majority of farmers work on small individual farms. The average size of a farm is between 0.5 – 1 hectare (1 hectare equals roughly 2.5 acres) and most individual farmers are poor ("Indonesia").

Although farming is a significant part of the Indonesian economy, the farming sector faces serious problems. Farmers often lack access to modern scientific methods in agriculture and their water supply is often contaminated making farming inefficient. Also, farmers often do not have enough capital to finance their farm operations. This lack of capital coupled with sub-optimal operations and resources leads to low farm incomes. Education in new agricultural techniques is often unavailable to farmers making it difficult for them to learn more efficient ways to work their land, become more productive, and conserve the land for the future. In fact, if Indonesian farmers improve their agricultural practices, it would not only benefit them, but also the whole world through healthier produce and better environment. To better understand the challenges that farmers face and the negatives effects of current agricultural practices, it will help to review them.

### **Traditional Agriculture and its Effects**

In an effort to increase their farm production, Indonesian farmers use many practices that are not sustainable and even counterproductive. Three common unsustainable practices used by these farmers are (1) heavy use of pesticides and fertilizers, (2) deforestation or clear cutting forests for farming, and (3) mono-cropping. These three techniques continue to be used by Indonesian farmers, even as they damage the land and leave farms less productive in the future.

Recently, Indonesian farmers began liberal use of pesticides and fertilizers because these chemicals can boost the production of their staple crops, especially rice. However, this practice is detrimental to the long term health of the farmland and the broader environment. In the first case, pesticides kill pests but also any beneficial organisms in the soil, leading to bigger pest outbreaks, soil degradation, and general damage to the soil ecosystem. As a result, if pesticides are used once, the dependence on those pesticides increases in the future. In the second case, because of the rainy and wet climate, excess fertilizers and pesticides mix with rainwater and this chemical runoff makes its way into Indonesia's waterways and natural lands. There is evidence that this toxic runoff is harming and even killing aquatic species in the waterways. In summary, heavy synthetic pesticides and fertilizers can destroy agricultural land's natural biome and cause damage to the surrounding ecosystems as well (Edwards).

Deforestation is a growing problem in Indonesia as the country's rainforest land is cleared to convert into agricultural land. Also, rainforest trees are being cut down due to the growing logging and commercial palm oil industries. By some estimates, about 70 million hectares were cleared from the beginning to the end of the 20<sup>th</sup> century. Deforestation in Indonesia has destroyed the habitat of endangered species like rhinos, elephants, tigers and orangutans. Additionally, it weakens the soil because tree roots no longer keep the soil intact and stable, causing increased floods, run-offs, and soil erosion ("Agriculture in Indonesia"). Furthermore, clear cutting of forestland and burning of peat moss increase global warming, which also eventually negatively affects Indonesia.

Additionally, Indonesian farmers utilize slash-and-burn farming to cheaply clear and fertilize their land. They use this practice because the ashes from the burned trees provide nutrients that help crops grow better without farmers having to pay for the fertilizers. In this illegal technique, farmers clear their land during harvest and then burn the remaining vegetation. The ash provides a nutrient-rich layer that helps fertilize crops in the future. This technique is especially popular in the palm oil industry ("Agriculture in

Indonesia”). However, this illegal slash-and-burn farming has resulted in many unintended forest fires and plantation fires in Indonesia, and the country has been attempting to contain these fires, especially on the islands of Sumatra and Kalimantan. Toxic hazes, or atmospheric phenomena caused by excess smoke and air pollution, have occurred in 1997, 2005, 2006, 2009, 2013, and 2015, when the deadliest haze killed dozens of Indonesians from respiratory illnesses and road accidents due to poor visibility. Many peat lands have gone up in flames due to clearing of land for agriculture by burning natural vegetation. Peat consists of partially decayed plants that accumulate in very damp areas often underwater. Indonesia is home to half of the world’s tropical peat land. When burned, peat releases 10 times more carbon than forest land. This carbon release is harmful for the environment and contributes to greenhouse effects. Further, the carbon that is released into air has made tens of thousands of people sick in Borneo.

Finally, Indonesian farmers often grow a single crop on their farms year after year. Usually, this crop is rice, a crop consumed extensively by Indonesia’s growing population as well as exported all over the world. The process of growing a single crop over and over on a farm is called mono-cropping. Mono cropping encourages quick infestation by pests and crop diseases. This is because the pests and diseases spread more easily through fields where only one crop is grown. Pest and pathogen buildup in agricultural land, leads to loss of soil fertility and long term sustainability of agriculture (“Monocropping”).

In summary, use of pesticides, deforestation, slash-and-burn techniques, and mono-cropping lead to unsustainable methods of farming in Indonesia. With growing population, if Indonesian farmers continue to use these traditional agriculture techniques, Indonesian agricultural land will continue to degrade, water bodies will become more toxic, and air quality will worsen. Given the challenges, it is imperative to explore alternative farming techniques for sustainable agriculture.

### **Sustainable Agriculture and its Benefits**

Given the challenges, sustainable agricultural practices may be the way forward for Indonesia. Sustainable agriculture is defined as the production of food, fiber, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare over the long term (Cunningham). Since farming is a large part of the Indonesian economy, the issue of sustainable agriculture is germane to all of Indonesia, and perhaps the world. Sustainable agriculture can make the difference between a country with spoiled land and waterways versus a continually regenerating land that continues to feed the growing population of Indonesia.

To restate, the main issues with agriculture in Indonesia are the overuse of pesticides and fertilizers, deforestation, hazing, and mono cropping. Deforestation and heavy pesticide use cause run-off of chemicals laden water into the waterways and degrade soil. Deforestation also hurts the native animals, weakens the soil, aid more flooding, and subsequently soil erosion. Hazing destroys trees that are essential to the environment and could kill animal and human populations too. Finally, mono cropping causes increase in pests and soil degradation. Sustainable agricultural practices offer better alternatives.

Generally, an alternative to the use of pesticides and fertilizers is to implement preventative pest management techniques. A comprehensive pest management system that (a) uses crop rotation and intercropping to reduce the buildup of the pests, (b) promotes agroforestry to spur natural ecosystem formation, and (c) newer technology that monitors and identifies pests before they are a threat. In addition, other small efforts can be made to reduce/prevent the use of pesticides. Plants and animals can be used as natural insect repellants, attacking both insects as well as pests. Weeding and trapping can be used for manual removal of pests. The thrust should be to either reduce the amount used or completely stop the use of pesticides. A comprehensive integrated system sounds complicated, but it involves simple steps that farmers can themselves take (“Sustainable Crop Production”).

Soil degradation caused by mono cropping can be countered by using multi-cropping, which means crop rotation and intercropping. Crop rotation involves alternating what is planted on a farm depending on the season. Intercropping is a method of planting two or more crops of differing traits close together to reduce

the number of weeds and avoid insects and pests. Mono cropping was shown to cause pest buildup and consequently reduce yields over time, intercropping expands plant diversity and thus improves yields. Technically speaking, diversity in a multi-cropping field causes species to interact, provides nitrogen fixations, and repels pests from the crops being grown (“Sustainable Crop Production”). Thus, these two techniques increase yield by rejuvenating the farmland.

Clear cutting of land removes the natural physical features of the land causing natural ecosystems to wither. One method to reestablish natural ecosystem is agroforestry, a technique of growing crops where there is (some) tree cover. Trees control runoff and soil erosion; they help in reducing loss of water, soil material, organic matter and nutrients. Trees also help with reducing soil toxicity by absorbing some toxins. Similar to multi-cropping, cover trees also help reduce insects, pests, and associated diseases due to the diversity of vegetation, insects and animals on the farm. The basic mechanism is that when a whole ecosystem is present, then pests are automatically controlled by different elements to maintain balance in the ecosystem. Furthermore, the decomposition of trees and pruning contribute to soil fertility thereby increasing crop yields and reducing need for expensive fertilizers (“Agroforestry and it’s Benefits”).

Some of the technology solutions proven to be effective elsewhere in the world (e.g., irrigation in Israel) that could solve unsustainable agriculture practices are smart irrigation and terrain contour mapping. Even more technologically advanced techniques would be self-driving and GPS enabled tractors and use of drones for farm operations (Kite-Powell). The terrain contour mapping technology can display overview shots of a field and provide information on where plants need more water/nutrients. Smart irrigation when combined with terrain contour mapping, can then deliver water and nutrients to plants in the field as and when needed without waste (Kite-Powell). Similarly, drones can be used for analyzing soils & fields, spraying & monitoring crops, irrigating fields and assessing plant health (Mazur). These are expensive systems, but would be worthwhile for some farms and crops. Drones, especially, are appropriate solutions for Indonesia because they are relatively inexpensive and economically viable because farmers can mutually share the expense of the drones to make them cost effective. GPS and self-driving tractors would automate many farming operations and reduce labor burden, but may not be cost effective for most farms in Indonesia. In summary, although most Indonesian farmers are poor and may initially find it difficult to afford the solutions mentioned here, through the help of aid from Indonesian government and perhaps foreign aid organizations, they may be encouraged to implement these techniques. Foreign aid to help with initial capital costs and educational opportunities to expand farmers’ understanding of sustainable practices would make an impact.

### **Benefits of the Proposed Solutions**

By implementing all the solutions identified above, the life of the farmers, people, and the farms will get better. The farmers will not be endangering themselves while dealing with the toxic chemicals, Indonesians will be able to eat healthier foods, and the environment will be cleaner due to the natural and ecofriendly practices. Sustainable agriculture will positively affect farmers because the life of the soil/farm will expand. Therefore, farmers can grow healthier crops over a longer period of time because of the extended life span of the farms. If the practices lead to reduction in deforestation, then it will be beneficial for the entire world as well. If no changes are made, the crops would continue to be of low quality and the quality of the farmland would decline.

A long-term benefit of extending the lifespan of a plantation would be lessening poverty. If the farms stay healthy, then the farmers do not need to their abandon farmland. Another long-term benefit would be to the Indonesian economy. It would get stronger through stable farm incomes, growth in exports, and successively better yields through technology, education, and investment. Finally, the most important long-term benefit is the increase of food security for Indonesians. However, most farmers today do not practice multi cropping, agroforestry, and crop rotation due to a variety of reasons including lack of knowledge, lack of capital, and other challenges.

## **Challenges in Adoption of Solutions and Methods to Overcome Them**

Indonesia farmers are not using the sustainable agricultural practices now, although the practices are achievable. There are many reasons for the lack of implementation including, a lack of the awareness of successful agroforestry, an unfamiliarity with the science & technologies, and the lack of financial resources. For example, agroforestry techniques would be new to farmers and the benefits of which would take several seasons to take hold. Knowledge of practical multi-cropping techniques is uniformly unavailable as well to the farmers. Pesticides and fertilizers are used excessively now because the farmers do not know that other techniques can be used to solve the same problems on the farm and they see their peers doing it (“Agroforestry”). Some of the technological solutions involve initial capital outlays that farmers may not have, even though they are aware of the benefits of the solutions. Thus, farmers face two additional hurdles—lack of knowledge and lack of capital for successfully implementing sustainable practices. Thus, educating the farmers of these techniques and procedures, and extending them initial financial help could turn the Indonesian agriculture in a healthier direction.

The government of Indonesia and foreign aid organizations can help in this regard. Recognizing that most Indonesian farmers are small and poor, but there are also large companies engaged in commercial agriculture, multiple solutions have to be developed by the government. The government can enact laws to discourage current practices and encourage sustainable practices, especially those of large commercial farming companies. Monitoring the activities of the large companies would be easier and possible for the government. However, reaching out to the smaller, uneducated, diffused group of subsistence farmers will be more challenging, when they are spread across a country that is 3,000 miles wide. Still, the government of Indonesia can take the lead in bringing together foreign aid organizations, banks, colleges/universities, and farmers’ groups to create an infrastructure for education, implementation of farming techniques, and capital to reach the farmers. In fact, the availability of mobile technologies and even Radio/TV can vastly reduce the cost of reaching and teaching the farmers. Examples from other countries (e.g., Bangladesh) shows that micro-lending to poor farmers results in huge benefits and that mobile technologies, again, help in the lending and the tracking of farmers.

Although the government can help in many ways, they are already helping by working with OECD, the Organization for Economic Cooperation and Development. The OECD helps countries improve in all areas including macroeconomic policy, tax, investment, regulatory policy, budgeting, financial education and financial affairs, education, agriculture, trade and anti-corruption. The OECD takes part in helping with food security as well. For example, they recently released a report called "Managing Food Insecurity Risk: Analytical Framework and Application" for Indonesia, providing a base of evidence to enhance discussions on food security and identify the best responses that can eliminate the issues of food security in Indonesia. Although OECD does not take action to help, they provide good ideas to implement in Indonesia to make sustainable agriculture a possibility. However, the government of Indonesia would benefit from taking action in addition to outlining the problem.

Foreign aid organizations can help by joining the government of Indonesia in providing their expertise in sustainable farming, their financial aid, and their volunteers. Bilateral aid (foreign aid given from one government to another) would be the most effective type of foreign aid for Indonesia (Agarwal). Foreign aid can provide the start-up money Indonesia needs to start reforming their agricultural processes. Once agriculture becomes stronger and the economy grows, Indonesia will not need foreign aid to keep the country going. A limitation of depending on foreign aid is that, often there is only limited and declining amount of aid available, but the list of worthy causes is long. Therefore, an additional challenge for Indonesian government or anyone concerned about Indonesia is to direct funding for agriculture. The governmental and non-governmental agencies could emphasize the primary importance of food and food security for fellow human beings when they seek aid. Another cause I care about, for example, is human trafficking. However, I would still put food security ahead of human trafficking because having food

security makes people less vulnerable to human trafficking. Therefore, sustainable agriculture, which increases food production and security over the long term is of primary importance.

Although the government of Indonesia would be primarily responsible for initiating improvements in farming practices, the farmers themselves, the foreign aid organizations, and other private entities in Indonesia (and elsewhere) can help too. To go it alone, though, Indonesia faces some barriers—lack of budgets, lack of other resources, and priorities (how important is it to help Indonesia’s agriculture as compared to other issues in Indonesia?). Some major other problems in Indonesia include poverty, lack of education, and the degradation of the environment. As my research shows, these problems are all tied into one another. These issues can be solved using the solutions I stated in the above paragraphs, but the solutions have to be part of a comprehensive package covering education, capital, and technology. The solutions must include multiple parties—the large commercial farmers, the small farmers, the government of Indonesia (in a leading role), the foreign aid organizations, and the universities & colleges in Indonesia.

The example of PISAgrO is very helpful in appreciating the value of the solutions offered. PISAgrO, a partnership between the government of Indonesia and private companies, is educating farmers in using technology effectively. It is transferring crop knowledge and technology to farmers via Corn Learning Centers. Farmers learn farming best practices using mobile technology (GAR). Strengthening the efforts of PISAgrO by replicating the learning centers and the services of PISAgrO would multiply the benefits.

## **Conclusion**

In conclusion, current unsustainable agricultural practices of Indonesian farmers call for concerted action to combat the ills—human and animal health degradation, shorter life spans, food insecurity, environmental damage. The issues of overuse of pesticides and fertilizers, deforestation, hazing, and mono cropping prevent the farmers, the farms, and the population from reaching their full potential in terms of the life span and pursuit of happiness. Improper and imprudent agricultural practices are harming the future. Multi-cropping, agroforestry, and integrated pest management will help Indonesia progress toward healthier farms, happier farmers, and sustainable economy. Multi-cropping attacks the issue of mono-cropping and soil degradation by diversifying the crops, keeping the soil healthier and stronger, and lessening the number of pests on the farms. Integrated pest management will attack the issue of the overuse of pesticides and fertilizers by using alternative paths to get rid of pests before needing to use pesticides and fertilizers therefore keeping the crops and plantation healthier and the farmers safer. Finally, agroforestry will address the issue of deforestation and hazing. Agroforestry utilizes trees to keep the soil strong, lessen the loss of water, and keep the soil effective and fertile. Implementation of these solutions will not be easy or immediate because of the changes farmers must make in their practices, the education needed to help farmers understand new practices, and perhaps support from government or non-governmental organizations in helping farmers transition. But if such solutions are adopted and implemented, then Indonesia will grow economically and agriculturally thereby positively affecting the citizens of Indonesia. In fact, my research shows that given the limitations of the farmers, effective solutions have to be initiated by the government of Indonesia, with assistance from foreign aid organizations and universities, in a comprehensive way. When I began my research project, I picked Indonesia and sustainable agriculture almost randomly, but I have come to appreciate the enormity of the issues involved and the big benefits that we all can reap by engaging in better sustainable practices.

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