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The Soil and Environmental Sustainability

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Abstract: Currently, a globally popular fast developing endeavour and trend is environmental conservation or sustainability. The usual protagonists in articles, books, discussions, and lectures are the three famous and important natural elements: soil, water, and air. These are the prime materials in sustaining all life-forms of the planet and in actualizing a balanced ecological system. While sustaining life, however, they in turn need to be sustained. The author herein limits his concern to the soil—the most accessible, familiar, and friendliest of the elements.

The article revolves around the paradigm shift in the realm of agriculture or farming, the consequences of abandoning tradition in favour of chemical dependence and technological practices, the reasons why pursuing soil-wellness is an endeavour worth pursuing, and suggestions how this can be actualized by sharing the fundamentals of sustainable agriculture as discussed in Keith Mikkelson's Sustainable Agriculture in the Tropics (Philippines: Aloha House Inc., 2005). The basic claim of Mikkelson is "feed the soil, not the plant" and realizing this requires practicing the ten fundamentals of sustainable agriculture. These are: proper crop rotation; legume usage; companion planting; insect habitat; cover cropping; green fertilizers; minimal tillage; mulching; animal integration; and composting (this is Mikkelson's arrangement from the least to the most labor intensive).

The author concludes that pursuing this noble endeavour naturally starts from small beginnings and will hopefully prosper into becoming one that includes a wider range or scope. As an inspiring idea, encouraging the continuous pursuit of soil-wellness, he cites "The butterfly effect theory" that asks: "Does the flap of a butterfly's wings in Brazil set off a tornado in Texas?"

Key Words: Foliar; humus; inoculation; minimum tillage; sustainable agriculture

The soil and our issue

Currently, a globally popular fast developing endeavour and trend is environmental conservation or sustainability. The usual protagonists in articles, books, discussions, and lectures are the three important natural elements: soil, water, and air. These are the prime materials in sustaining all life-forms of the planet and in actualizing a balanced ecological system. While sustaining life, these elements need to be sustained. This article only limits its concern to the soil—the most accessible, familiar, and friendliest of the elements—due to space and time constraints.

We observe that ordinary linguistic usage of the term "earth" (Earth is our planet's name) also refers to the soil. We take this practice as a portrayal that soil is the most basic or fundamental elements; but, not necessarily insinuating that it is the most important. The soil is congenial, it is a constant companion to every human being. One cosmogonical account, made popular by Xenophanes—an ancient Greek thinker—identifies the earth as the origin of all things. On the other hand, one etymological explanation attempting to explain the origin and ultimate destiny of

humankind is expressed annually during the Ash Wednesday ritual. This suggests that everyone comes from dust (i.e., earth/soil) and shall return to dust! That is the extent of how the soil or earth can be so familiar to us.

The soil is accessible, friendly, and protective as well. On it, we build or establish the following: homes wherein we live; buildings and factories where we work; churches and temples where we worship; golf courses and playing fields to sweat it out; roads to travel; and, farms to produce food and livestock, among others. The soil protects us—either directly or indirectly—from cold weather, floods, rains, stormy winds, and summer heat. The soil's accessibility, friendliness, and protection suggest a unique type of altruism and openness.

The adjectives and adverbs we have ascribed to the earth or soil escape notice and are consistently overlooked. The reason is we ordinarily opine those descriptions are possessed only by live human beings. However, if we allow ourselves—only for this moment—to personify the soil, we realize that its congeniality, altruism, and openness reveal two admirable values or virtues—excellences—compassion and hospitality. At the moment we are made aware—by inference—that the soil, lifeless as it appears, is capable of giving comfort, company, food, and protection—meaning, life—to everyone. Soil (i.e., earth) means life. Due to the reasons given so far, we find it appropriate to consider the soil as amiable and treat it with utmost care as a manifestation of our gratitude. Others might retort how absurd we can get to even encourage caring for and loving a non-living entity.

The soil is non-living—an object, if we wish—but capable of giving life to the simplest microorganisms to the most complex life-forms. We want to argue at the moment that if human beings are capable of loving their beloved departed—or, continue doing so—then there will be no difference between that gesture and loving the soil. The phenomenon of death carries along with itself the concepts of disposal and decay; and, the common manner of realizing those concepts is through the burial or cremation rituals. Those rituals are processes allowing us to return and transform to the soil. After a few years our beloved departed are transformed to soil if buried and almost instantly transformed if cremated. The difference is, we think, a matter of belief and convention. We believe our loving departed guide and pray for the best of our intentions; while, knowing that the soil gives life. For the best of our intentions, we have to believe as well that the soil does the same in its own mysterious ways.

Given all of the above, an issue emerges along with its corollary. The issue at hand is whether the soil is being treated appropriately for the past half-century or so; and, its corollary is the question "Why so?"

Keith Mikkelson's position regarding the issue stated in his *Sustainable Agriculture in the Tropics* is clear: The soil has been continuously ill-treated since the formulation of the "modern agriculture" concept. This concept brings along with it the tractor and its implements (the mechanized plough and rotavator) plus the heavy reliance on chemicals, such as, fertilizers, fungicides, herbicides, pesticides, and retarders. Mikkelson's book imparts to the reader "valuable technologies and techniques that can empower food producers on this green planet to succeed." He adds that, "there is nothing new [in this book] that [has not] been said better elsewhere, except for my own personal experience and perspective. " (pp. 14-15)

Mikkelson begins with his observations about the on-goings in the agricultural sector as a result of practicing the modern agricultural methods. After that he presents an alternative—an older method preceding today's methods, practices, and technologies with some variations. He calls this alternative organic farming."[1] Finally, he interjects the ten (10) fundamentals to sustainable agriculture. These are the concrete means and ways of enhancing and appropriately treating the soil.

So far, the issue we presented above—whether the soil is being treated appropriately for the past half-century or so—has been resolved with a "No!" Now, we shall be addressing the question, "Why so?" attached to that issue.

Today's agricultural paradigm

The modern agricultural model "started out with the best of intentions." Mikkelson views this as an attempt to "produce more food for a

growing population while shifting the work force to more valuable sectors like industry, manufacturing, and high-tech jobs; [and, tooling-up developing nations] to produce more food with less effort." The best, however, stopped with intentions! Present conditions exhibit deterioration. We have to point out that there were improvements especially evident during the early stages of practicing the modern model. However, the present state of affairs and the overall consequence of this model are far from the overwhelming conceived idealized improvements expected before its practice. To emphasize this, Mikkelson says: "Food production [continues to be unreliable], more fragile, and increasingly toxic. Agriculture has been used to mortgage our future." The fad today is "high-tech, high-debt, mono-crop systems that have a built-in expiration date. The chemical industry...has taken its profits, but the farmlands are spent." (pp. 23-24) He strengthens the image of profits by citing the four-fold price increase of chemical inputs for agricultural purposes since 1998. (p. 11)

The soil's deterioration has a natural consequence. It entails risking the health and lives of animals—including human beings—and plants alike. If we wish, putting the health and lives of all living organisms—including the very minute ones vital for sustaining life, such as, the microbes—at risk. Mikkelson points out that we are facing a crisis that does not only concern the quantity of produce but the quality of the produce as well. He says, "the pollution from pesticides and herbicides contained in produce is well documented."[2] (p. 24)

Answering the question "what caused the soil's deterioration entailing the risk on health and lives of living organisms in general?" likewise addresses the corollary "why so" attached to the issue regarding appropriately treating the soil. At first sight and after the preceding discussions, the answer seems to suggest only one reason that can simply be expressed as "chemical use!" That is correct; but, chemical use is simply a consequence of a more underlying reason that is coupled with moral undertones.

In summary, Mikkelson's answer to the question is: Soil deterioration is due to the man-centered paradigm prevailing during these current times. This paradigm is based on the presumption that nature and those responsible for food production can be controlled. The story revolves around the vice called impatience. This vice is portrayed in the assumption and attempt to restrain nature to go through its destined processes for gain. His explanation is as follows:

> The modern theory of agriculture claims that plants are nothing more than chemical assemblies of basic inert ingredients. [It expounds] that we can isolate the chemicals and sell them to the farmer, and then they can feed the plant directly. The petroleum industry has done quite well with this approach, making food growers ever dependent on the large manufacturers of fertilizer inputs. This added cost has taken away the autonomy of the small hold farmer and forced many into endless debt cycles. These schemes cause farmers to increase land area and production so they can justify the mechanization and high cost of inputs. (p. 26)

Furthermore, Mikkelson implicitly suggests another vice the self-centered paradigm carries along. This vice is the excessive love for profit. In ordinary parlance this is called greed or rapacity. This human condition puts the future of the planet and next generations in jeopardy; and, portrays indifference to other life-forms helpful in maintaining Earth's ecological balance. His story is about

> *Farmers* who sit in board meetings and make decisions based on profitability studies or return on investment analysis run the largest farms in Europe and North America. Food quality and nutrition takes a back seat to satisfying investors and shareholders. Through this man-centered paradigm we have been trained to see the chemical side of growing food with almost total neglect of the biological side. We feed the plant directly with chemicals. The problem of nutrient run off, nutrient loss through volatilization and the destruction of beneficial microorganisms, insects, birds, and reptiles have been largely ignored. The biological processes in the soil and plant are rarely taken into consideration in this prevailing system. Farmers are trained to add more chemical when plants are struggling to survive. This is a post symptomatic approach to

> disease and pest management that makes farmers more dependent on their suppliers. (p. 26)

Finally, Mikkelson's opinion and conclusion suggests that this paradigm is a failure on the global level. Governments in developing nations can hardly bring to market the food needed, such as, rice in our case. He says this of the Philippine situation:

> The small hold farmer can no longer afford the hybrid rice seed, urea, complete fertilizer, [etc] and still cover his labor. By the time he harvests, he has no profit and little food surplus to live on. He needs a real job just to cover his full time hobby growing rice! The Philippines is host to IRRI, the International Rice Research Institute, and yet is importing rice from Vietnam. It has an annual short fall because of poorer yields in existing regions. This is also due to lower net production because fewer new farmers replace the farmers who give up on rice growing. (p. 27)

Mikkelson appears to be telling us that if circumstances continue to be the way they are then there is not much future to talk and think about. Something has to be done—that is, current methods and practices in place have to be altered. But the situation is not completely hopeless as it sounds. The alternative paradigm capable of rejuvenating soil currently in its death bed is organic farming. Mikkelson refers to it as sustainable agriculture.

The alternative paradigm

Currently, the only way to simulate the natural environment is through practicing the alternative paradigm. Mikkelson encourages this practice by writing: "It's time to get back to the fundamentals of agriculture, sustainable agriculture. Natural farming involves efforts to simulate the natural environment to stabilize our food production. The key is to build on sound, scientific principles that will increase fertility in the soil. This will bring about [healthy insect resistant] plants that will produce high quality food while feeding the worker, family, community, and world." (p. 27)

Practicing organic farming involves converting organic matter into humus. "If we feed the soil organic matter, then the microbes will feed the plant. Pest and disease management [is] obtained naturally. Building up the soil and managing the organic matter as it is converted into humus is an age-old method." (p. 31) Humus, says Mikkelson, "is the rich, sticky, yet crumbly substance found in healthy soil that is the world's greatest resource. It has to be properly managed, preserved, and can be increased through microbial activity that converts organic matter from roots, compost, manure, or crop residue mulched on the surface or plowed under as a green fertilizer." (p. 32)

What is microbial activity and how does this happen? Mikkelson teaches his readers the following:

> Practices such as minimum tillage and inoculating with beneficial microorganisms quickly build up effective soil systems that have the structure, nutrients, and microbial balance to produce food for generations to come. By adding organic matter in the soil and on the surface, the soil is fed. Actually it is the microbes in the soil that consume the sugars, nitrogen, complex carbohydrates, fats, and all the other goodies that accumulate [on] topsoil. They excrete amino acids, root dividing hormones, anti-oxidants, etc. This in turn is made bio-available to the roots in the rhizosphere (root zone) down in the soil. That's why we say: 'feed the soil, don't feed the plant'." (pp. 32-33)

In essence, the main principle of organic farming is feeding the soil and not the plant. Feeding the soil calls for discouraging rampant plowing since this disturbs microbial activity going on. Thus, minimum tillage is encouraged together with inoculation—"the means of quickly stabilizing [one's farming] system." (p. 65) Our reading of Mikkelson suggests that the concept of inoculation involves "co-infecting" achieved through composting. The impressive lesson we learn in his discussions on inoculation is the creativity observed in concocting compost materials. Some techniques are derived from old practices—still applicable due to their efficiency—and the others, though derived from old ones—come to us with a few variations,

such as, the use of molasses for fermenting. We are told that

> Ancient inoculation systems have been very useful for small-scale applications. Both Korean and Japanese farmers have been gathering soil from the forest floor and mixing it with rice bran. They utilize a process of fermentation for favourable composting and propagation of large numbers and varieties of microorganisms. This is anaerobic [that means, without air] composting without disease build-up or foul odors. They place the mixed soil and bran into clay jars for up to one month, and then use it in their farm system. They also make garlic and ginger extracts for insect control. Often referred to as KIMCHI farming, this method has proven the powerful effect microbes can have on a simulated natural environment. Their techniques have been utilized for their foliar sprays more than soil management. They have soil treatment with rice bran and microbes but for unknown reasons, it is not being promoted at this time. The Japanese word for fermented plant matter is BOKASHI. We have adapted a formula for use in the Philippines utilizing industrial wastes such as coconut (copra) meal, rice bran, charcoal, and manures. The formula is highly adaptable. (pp. 34-35)

Nowadays, fermentation is done by using molasses. The new technology found to be effective and efficient for both animals and plants is known as EM1 or Effective Microorganisms.[3] The preparation involves mixing the EM1 solution with the same amount of molasses then diluting this with un-chlorinated water and stored in a cool place to ferment for ten days. This fermented solution is again diluted with un-chlorinated water before using it on animals and plants. In the case of plants, it used as foliar (i.e., for spraying the leaves, barks, and stems) or simply for watering. It is also used as soil drench or sprayed on compost materials to shorten the process of decay. In the case of animals, it is used to supplement their feed and water.

There are numerous waste products from the farm that can be utilized to make bokashi. Some examples are carbonized (burned) rice hull, rice bran, rice hull, dried animal (cattle) manure, and charcoal powder. Molasses diluted in water—with or without EM1—is used to moist and ferment the mixture. The mixture is stored in air-tight covered drums for three weeks before using it as compost or side-dress. Those ancient Japanese and Korean farmers use garlic and ginger extracts for insect control. Today, this concoction is still popular among organic advocates; but, comes with a little variation—chopped ginger, garlic, chilli pepper, and neem leaves. Again, the mixture is fermented by using molasses and stored in air-tight containers for three weeks. After fermentation, it is diluted with water and sprayed on plants the way foliar is used.

After we have given a background about the alternative paradigm or organic farming, it is worth examining the "ten fundamentals" necessary in managing the soil. In other words, these are the ten ways to feed and manage the soil (p. 65), a process necessary to simulate the natural environment.

The ten fundamentals of sustainable agriculture

The ten fundamentals of sustainable agriculture occupy the bulk of Mikkelson's book (Cf., pp. 65-174) He prescribes these on the basis of his observations regarding the results attained after putting these into practice. These ways and means of simulating a natural environment all work for the best of our farming system; however, there is so much room for further improvement and even better results, perhaps. Mikkelson says: "Active experimentation and a keen eye for details help the organic grower identify the best formulas and practices for his project." (p. 66) The ten fundamentals follows the way the author numbers them:

Fundamental #1 (Proper Crop Rotation)

The older generations of farmers recognize the importance of crop rotation ; but, not many farmers today understand the benefits it offers. Mikkelson writes: "Proper crop rotation…is a forgotten age old method to assure the health of future crops. It is of the utmost importance to minimize nutrient loss for long-range success." (p. 73) He cites the case of the old farmers, especially in Luzon and Mindanao, recalling their fathers

growing peanuts or beans—legumes, particularly, between rice crops. This practice is common knowledge still but farmers "don't understand the full benefits of the concept and are no longer told to practice this principle. When people understand *why*, they are more likely to implement the method and realize the benefit from the effects of this fundamental." (p. 74) He further points out that this practice breaks the disease cycle. "Many diseases are not able to find a new host plant when the rotation utilizes a different family each time…We interrupt destructive insect cycles with crop rotation too." Rotation works best by growing plants of a different family each time; for examples, do not follow rice with corn for they are both of the grass family (p. 75) or tomatoes with potatoes for they belong to the same family, thus, sharing many pest problems. (p. 76) Cultivating a different crop each time improves the plants' natural resistance to diseases and pests.

Fundamental #2 (Legume Usage)

According to Mikkelson legumes help in nitrogen fixation. "Bacteria help the farmer by adding surplus nitrogen for the next crop. These microbes find the nitrogen in the air and soil, and then they capture [fix] it in small colonies on the roots of the peanut, soybean, pole beans, sitao, etc." (p. 81) These microbes are commonly called "rhizobium. [These] silent workers of the underworld come in thousand varieties. They need to be present to maximize your legume production and leave a surplus of fuel for future plantings." (p. 82)

Fundamental #3 (Companion Planting)

Companion planting is commonly known as inter-cropping. It is intended "for insect control, to make wind blocks, and they promote soil conservation. [Varieties intercropped with edible plants are used for compost and fed to livestock when harvested]." For example, a favourite weed these days is Marigold since it prevents a number of pests that infest flowers and vegetables. Mikkelson points out that "some plants give benefits that help others grow; [however], there is a huge range of opinions on which plants help or hurt each other… Sharp eyes and good notes help you learn what is going to work on your soil and climate with the crops you decide to grow." (pp. 91-92) Despite all the contrasting opinions, there can hardly be any mistake if we utilize legumes as we have already discussed. There is a popular shrub now that can be used as hedgegrow and incorporated within the farm system just like ipil-ipil and madre de cacao. It is fast-growing and its leaves are edible for animal feed; also, good for compost and mulch in the case of plants. It is called indigofera. Mikkelson adds that "companion planting works well because we increase the bio-diversity of our plants." (p. 95) This explains why he does not recommend mono-cropping.

Fundamental #4 (Composting)

Composting is perhaps the most important feature among the ten fundamentals. It is responsible for building up the precious component of the soil called humus. Mikkelson writes this about composting: "Compost [builds] up organic matter and [creates] humus for [on the] soil… Composting is a controlled process [that captures] a high percentage of nutrients from crop residue and returns it back to the soil in a [very nutritious form]. Composting is as much an art as a science by which we create an environment for the natural processes of nature to work efficiently." Again, he repeats his reminder: "Remember, we feed the soil, and the soil will feed the plant!" (p. 97)

There are at least two ways the process of composting is done: Aerobic composting and anaerobic composting. "Aerobic [with air] composting methods utilize the heat process from thermophilic bacteria to kill both pathogens and weed seeds. Carbon-to-nitrogen ratios need to be 30 parts carbon to 1 part nitrogen for best results." This balance, he says, is important for high quality production." (p. 98) On the other hand, "Anaerobic [without air] composting is a very efficient process of mixing beneficial microorganisms into materials to create powerful, yet inexpensive fertilizers. This process prevents the heat cycle and preserves energy. It is a more powerful finished product than aerobic compost because material is not decayed but rather fermented (pickled.)" (p. 103)

Today, the EM1 (Effective Microorganism) technology is a useful component of the composting processes. Mikkelson himself utilizes this and tells us: "We use Effective Microorganisms (EM1) to inoculate the pile and guide it away from disease

propagation. We use EM in the form of Bokashi. It is high in nitrogen and rich in beneficial bacterial growth." (p. 100-101) "We made our Bokashi [through the anaerobic composting process]… Bokashi is the Japanese word for fermented plant matter." (p. 103) "[It] is a great soil conditioner and works well for side dressing." (p. 104)

Another strategy for producing compost is by using the "angels of the earth"—earthworms, specifically the African Night Crawlers (ANCs). This is called vermiculture. Vermiculture is described as follows: "When compost and organic matter is fed to "manure" worms, they turn it into a more powerful end product called *vermicast*." It is in a form that bio is available, rich in beneficial microbial activity, and readily utilized by plants. (p. 110) Vermiculture's four important requirements, aside from the ANCs are air (oxygen, moisture, bedding, and feedstock. (p. 111)

Fundamental #5 (Green Fertilizers)

"Green Fertilizer…feeds the next crop efficiently. [Plowing] crop residue into the soil, [will eventually [produce] humus and fertilizer for [crops that are to be subsequently grown]. [Practicing the use of green fertilizers] is a form of composting [that does not need transporting materials] to a mixing/composting site. [It is called] field composting." Green fertilizers maximize the biomass and minimize nutrient and energy loss." (p. 125)

Fundamental #6 (Mulching)

"Mulching [conserves the] topsoil and moisture, as well as [provides] fertilizer. When straw or crop residue covers the topsoil, it holds it in place while stopping raindrops from compacting soil… It also slows down rain runoff so that moisture can penetrate down to the roots… When [mulching is practiced] the rain percolates gently into the soil and goes much deeper than when exposed to wind and rain." (p. 129) Furthermore, "mulching also prevents soil from splashing onto leaves thereby minimizing many disease problems from pathogenic bacteria in the soil." (p. 130)

Fundamental #7 (Cover Cropping)

"Cover cropping…is the technique of growing plants that protect the soil to conserve topsoil and moisture. [Plants used as cover crops] can be considered living mulch… [The advantages realized by cover cropping are the same as those realized by means] of mulching[—soil conservation, moisture retention, increased microbial activity, etc.—] but in addition, the canopy which covers and protects the soil is living and dynamic." (p. 137)

Fundamental #8 (Minimal Tillage)

"Minimal tillage…will preserve soil life and structure, save labor and increase profits. The soil food web is disturbed when continual plowing is practiced." Minimal tillage is the concept behind Mikkelson's discouraging frequent tractor use. His explanation is as follows: "As the soil compacts, a pan develops, where sub soil at the depth of the plow can form a barrier layer that roots cannot penetrate. The rainwater is kept from penetrating the ground and easily floods. The water is stuck at the upper levels of the soil, so are the earthworms." (p. 143) Thus, his prescription after initial plowing is "only use hand tools to add rice hull, charcoal, and compost into the soil." The practice of minimal tillage promotes the propagation of earthworms in the wild and helps solve flood prevention concerns. "Earthworms and roots will promote macro porosity, opening the soil for water absorption and microbial activity." Mikkelson recommends a strategy that promotes minimal tillage the easy way: He says, "We use raised beds that are 3ft wide. This allows us to reach in without compacting the soil." (p. 144)

Fundamental #9 (Insect Habitat)

"Insects populate and bring stability to your system if you allow the predators and beneficial species a place to live. Plant insect habitat for beneficial species and bait crops for the bad guys." "Many pest problems can be minimized with habitat that promotes predator insects." (p. 149) Aside from promoting predator insects, "Birds are very helpful in the ecology of your farm. Many bird species eat large quantities of insects every day." (p. 150) Conserving reptiles, such as salamanders, also curb the spread of undesirable insects in the farm.

Fundamental #10 (Livestock Integration)

"The best way to finish off your dream farm...is to balance it with a small livestock unit. Animal integration…will create a low cost high

quality fertilizer source as well as produce food to eat." "Livestock properly managed will bring the tropical farmer higher profits than some market vegetables and most grains. We raise goats, chickens, and hogs." Easy to manage and profitable as well are chickens, goats, and hogs. (p. 155) "Good breeds with good genetics are of utmost importance. Good breeds with bad genetics won't perform, and bad feed will stunt the best of genes." (p.171)

Conclusion

Our discussions—hopefully—exposed us to some circumstances and facts about our environment, particularly the soil. There is nothing that can stop anyone among us to try practicing some—or, better, all—methods and techniques of enhancing the soil. There is much to be expected and grateful for if we started in our own little corners and own little ways.

There are numerous individuals far removed from the nutritional details of the food and drink they consume. By starting out small via a little garden or plot, one experiences the pleasure of devouring one's produce, certain that it is healthy and safe. Proper and safe nutrition is overlooked if not taken for granted. Relating our own experiences and ordeals regarding our efforts to produce fresh and naturally grown fruits, vegetables, and livestock to others can encourage them to do the same. We will be better off than the *successful farmer* who owns vast tracks of land producing corn, rice, or sugarcane alone for s/he will have to make purchases from the supermarket to be able to eat. If we are willing to relate our stories and others are willing to listen then there will be changes—not necessarily right away—that will make a difference to the health and lives of our families, loved ones, and the planet.

This is precisely the point of Edward Lorenz's theory called the "butterfly effect theory." This theory wishes to point out that great achievements start with very small beginnings. Initial conditions may not be felt at all in the present; but, will have far-fetched consequences in the future. His celebrated paper called *Predictability: Does the flap of a butterfly's wings in Brazil set off a tornado in Texas?"* tells that a simple act of a butterfly can cause a disaster elsewhere. If all of us thought this way and believe that our everyday actions—as simple as practicing sustainable agriculture techniques—then it is not a far-fetched idea to contaminate a few in the beginning and the rest hopefully follow.

Endnotes

[1] Phrases like "natural farming," "nature farming," and "organic farming" all refer to sustainable agriculture. Mikkelson says, "There are subtleties that make them a little different, but the commitment is to safe, quality food production without chemical inputs. If we feed the soil organic matter, then the microbes will feed the plant. Pest and disease management [is] obtained naturally. Building up the soil and managing the organic matter as it is converted into humus is an age-old practice." (p31)

[2] Mikkelson tells that "As different feed-born pathogens devastate livestock in developed countries, people are growing concerned about industrial processes that are causing this problem. It is now also a problem in developing countries. The growing dilemma is affecting human health as witnesses in the rise of 'diseases of the rich'. As people in outlying communities become accustomed to the modern food packaging and distribution system, they are suffering from all the ailments of their richer city dwelling counterparts...rural folk who used to grow 90% of their food supply now specialize in only 1 or 2 commodities and buy their daily food stocks from the stores. This is increasing their health risk, as they gobble down large quantities of refined processed white sugar and fibreless white flour as well as high fat, high salt canned goods or completely processed meals." (pp24-25)

[3] Mikkelson tells us about Professor Teruo Higa's EM1. He says: "Professor Teruo Higa, at the University of Ryukyus, Okinawa, Japan, has studied and isolated the naturally occurring beneficials for large-scale utilization. His method is to group different families of microbes together to form a cohesive unit, a symbiotic consortium of compatible microbes that keep out disease and

efficiently convert waste into wonderful organic amendments, feed stock, and fertilizers. This is one way we build up our soil for the long run. [His] technology [EM1] contains hundreds of different beneficial species, with 3 main families of microorganisms. They are all naturally occurring and not modified at the genetic level (Non-GMO)...Completely safe, these little workers are like soil livestock. They are not chemicals but a living consortium of microbes that convert into plant food, root dividing hormones, amino acids, etc. This also works well for livestock." (pp. 36-37)

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