

IKALAHAN, STEWARDS OF SUSTAINABLE SYSTEMS

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Introduction

In this presentation I shall speak as a scientist who is a Christian and avoid theological terms in favor of scientific ones. After some introductory statements concerning the Biblical theology of creation, I will explain something of how God intended this world to function and in the process see why the world is presently having troubles. I will then make a few comments about how the Ikalahan people have handled their environment and what we can learn from them.

Systems and Responsibilities

Many people mistakenly read the first two chapters of Genesis as a record of the "things" that God created but God created systems, not just things and the systems were specifically designed to ensure the sustainability of the whole. The sun and moon are things but they are not static. They operate sustainably according to physical laws. He created living things but each of them was made to reproduce "after its kind" and each one performs one or more functions in the many inter-locking systems which He created.

People have spent much time analyzing the "things" God created but little attention has been given to their functions. God created the moon, for instance, to cause tides and waves to keep the ocean waters well mixed but His esthetic nature made it reflective to provide moonlight to make our evenings more romantic. The sun's primary purpose is to provide energy to fuel the entire biosphere. Secondarily it provides light so we can see what we are doing.

Before we continue, let me illustrate something. Some of you drive your own vehicles but do you thoroughly understand the mechanics of it? You undoubtedly know that fuel and air are needed and when they burn in the motor they somehow drive the pistons which somehow make the wheels turn. How many of you, however, could design a proper cam-shaft for your vehicle to maximize power output or explain why you have to shift gears? Even though you may not know those details, you do know enough to protect, lubricate, and maintain it properly so that it can function according to the way it was designed. If you do that, it will serve you well but if not, it will soon quit functioning and you will be on foot.

The earth is much the same as a vehicle except that we understand even less about how its systems function than we understand about the car. Unfortunately, many people refused to give the earth the same kind of respect that they give to their vehicles. Many are even foolish enough to cause the extinction of life forms before they know their function. (Would you allow your son to open the hood of your car and remove the wires that he did not understand?) The purpose for many things on the earth are not yet known because they have not yet been adequately studied. Is that God's fault? We were created with minds and instructed in Genesis to govern the earth but how can we govern it if we do not understand it? It is our responsibility to study both the things and the systems and the functions of both. It is also our responsibility to manage them so that they operate in the way that they were designed.

In Genesis 2 and 3 we are told that people are to "rule" or "supervise" the earth and the living things which God created. At first blush we seem to be truly dominant but if we study the Biblical concept of "govern" we discover that the authority is a stewardship under the supervision of higher authority. Look at Deuteronomy 17:14ff. The future kings of Israel are ordered to have their own personal copies of the scriptures to guide them in their stewardship of governance. There are quite a few other instructions given. Even a king's freedom to govern exists only within the framework which God established for people. The same is true of our freedom to govern the creation. We are free within the structures and systems which God has established but those systems will punish us if we violate them.

God's Systems — Water

Let's take a quick look at the most abundant "thing" on earth, Water. We know that the sun pumps water from the oceans and lakes into the atmosphere where it becomes clouds. This is the system called Evaporation. Winds drive the clouds toward the land and when they are pushed upwards by mountains they get cold and drop the water as rain. This is fine but what about the areas beyond the mountains. All the rain is likely to drop on the coastal mountains with nothing left for the interior. To solve this problem God has made another supplementary system called Transpiration.

After the soil is wet, this same sun stimulates the leaves to pull moisture from the soil through the roots and stem. Some of it is processed by the leaves into wood or fruit but much is released by the leaves into the air. Some plants such as bananas, have a very high transpiration rate and release a lot of water into the air. Others, such as cacti, transpire very little but the process, strong or weak, returns moisture to the atmosphere to make more clouds. These clouds are then pushed into new areas by prevailing winds to give rain to people downwind — people far from the ocean.

If my good friend, William Henry Scott, for instance, should become concerned about a lack of rainfall on his garden in Sagada, he should visit me in Imugan to help me convince our people to plant more bananas and other plants with high transpiration rates. We happen to be up-wind from Sagada but our mountains are so steep and high that when the prevailing winds from the Pacific Ocean bring the clouds, most of the water in them falls on us leaving little for William Henry. Masses of plants with high transpiration rates at our place would restore more moisture to the air and the winds would take it to Sagada and Bontoc. I cannot guarantee that the rain will fall there, but at least it would get there.

In His creation, God arranged that the mountains would be covered with forests so that when the rain hits the heavy mass of vegetation it will soak into the ground without disturbing it and come out later through the springs. This is called *percolation*. If the percolation rate is high little erosion can take place. If, however,

the vegetation is damaged, the water will hit the soil directly, knocking it loose and sending it into the rivers. Such erosion does not take place in significant amounts unless the system is damaged and percolation is curtailed.

God's Systems — Air

In addition to being a carrier of water, the air also contains nearly 20% oxygen, without which all animal life on this planet would cease. God purposely diluted it to 20% because in higher concentration it would be dangerous. Our lungs remove the oxygen from the air which we inhale, and send it to all parts of the body through the blood stream. On the return trip the blood brings carbon dioxide for us to exhale. That vehicle we talked about a little while ago is doing the same thing. It is sucking up air, and mixing it with fuel in the motor. As it burns it removes the oxygen and produces carbon dioxide which it spits out into the air again. Our kitchen fire does the same thing but it also produces heat which is why we lit it in the first place. Carbon dioxide is poisonous to animals. How can all of this poison be handled?

God has made a system for that also. The same sun energizes the green leaves to take in carbon dioxide from the atmosphere, break it down and use the carbon to make new wood or sugars and starches for the fruit. A little of the oxygen is added to the wood and fruit but most of it is released again to the atmosphere where it is available for your next breath. All green leaves perform this function but the amount accomplished in grasses and vegetables is quite small compared to the tropical rain forests. The extensive forests which God created, especially in the tropics, were more than enough to keep the amount of carbon dioxide very low and the oxygen level stable at 20%.

The most abundant gas in the air, however, is nitrogen which is essential for the production of proteins. Unfortunately, neither plants nor animals can utilize atmospheric nitrogen. It is good for diluting the oxygen in the air and it provides a huge reservoir but otherwise it is useless until it is changed into some other form which can be used. The task is huge but the solution is microscopic

— **Nitrogen Fixing Bacteria.** These creatures live in nodules on the roots of some plants such as narra, alder, beans and pigeon peas. The plants provide them with nutrients and in exchange, the NFB pull some of the nitrogen from the air, mix it with water from the soil and produce ammonia which it feeds to its host plant and also releases into the soil. The plants are able to use the ammonia to produce plant proteins. When animals eat the plant proteins their bodies process them into animal proteins which your children consume in huge quantities at the nearby Jollibee. Every time an animal defecates or urinates it puts some of the nitrogen back into the soil in a form which the plants can use. Dead plants also return small amounts of nitrogen to the soil when they rot.

In short, this is another one of God's sustainable systems. The animals He created use oxygen to stay alive and eat plant proteins to build their body tissues. The animals fertilize the plants while the plants provide more food for the animals. The trees provide food and protection. The waste materials from one part of the system become food for the next and the systems can continue indefinitely.

If the plants are burned, of course, the cycle is broken. The nitrogen then returns to the atmospheric reservoir to await the next NFB to catch hold of it and put it back into the soil. That could be a long time.

God's System — Soil

Let me touch on another system which God established. Fungi are very common on earth. One kind causes athlete's foot if it starts growing between your toes and another kind provides delicious and nutritious mushrooms for the dinner table. I am frequently bothered by the fungi on my computer disks if the air conditioning stops but I now know that I would go hungry if it were not for the mycorrhizal fungi that keep our plants producing.

I learned about these mycorrhiza only a few years ago and finally learned how to spell it last March. When my elementary school teachers taught me the parts of the plants they mentioned

the leaves, limbs, trunk, roots and "rootlets" but they did not have it right. What they called "rootlets" are not a part of the plant at all, but are fungi which attach themselves to the roots of the plant in a symbiotic relationship. These mycorrhiza gather nutrients from the soil, process them into improved nutrients for the plants and deliver them directly to the plants roots. They do this in exchange for food supplements and protection which the plants provide, another beautiful system.

There are many species of mycorrhiza, each one preferring a different host plant. There are usually enough mycorrhizal fungi spawn in the ground where plants are grown but sometimes, especially if the plant is new to the area, it is advisable to inoculate the soil with the spawn of the proper mycorrhiza when planting.

One Filipino oligarch tried to get richer by planting several hundred hectares of a fast growing tree species in a Northern Province. He had the best consultants and spent a large amount of money hoping to have mature trees to sell in six or seven years. At the end of five (5) years he left his Manila mansion to see his trees which, he assumed, would be almost ready to cut. He found thousands of spindly seedlings about the size of your finger. In anger he called his foresters and scolded them violently. "How can I sell lumber from trees that are not even big enough to make pencils," he ranted. After more research his foresters realized that they had brought seeds from a foreign country, and planted them in the Philippines which lacked the proper mycorrhiza to service that species. They had to send overseas to get a plane load of dirt from the natural forests of that species. They put it into holes beneath the trees and after another couple of years the trees began to grow properly. The trees could live but not thrive without the proper mycorrhiza. When the proper mycorrhiza had multiplied they eventually made a difference in the growth rate. The unhappy oligarch finally got his trees but they were very late and he lost money on the project. God's systems are not very forgiving.

God's System — Symbiosis

This introduces to us the principle of symbiosis. In some cases, such as the nitrogen cycle just mentioned, the waste products from

one activity provide raw materials for another activity and enable the total system to continue to operate without garbage. That is one type of symbiosis.

Decades ago I enjoyed watching the storks and carabao together in the fields in Isabela. The storks got much of their food by eating the insects which were attracted to the carabao. The storks were happy, of course, and the carabaos were also happy because the storks eliminated the bothersome insects. Another type of symbiosis.

Bees and flowers have a symbiotic relationship. The bees need the nectar from the blossoms to provide food for their young. The flowers need the bees for pollination. Neither could reproduce without the other. My father was an apiarist. He raised bees and collected money each year from the fruit growers who gladly paid him to leave his bees in their orchards for 4 to 6 weeks while the trees were in bloom. Their trees produced more fruit with the help of the bees and Dad got the honey. Come to think of it, my father was also a part of the symbiotic system.

Rattan has another type of symbiotic relationship. The Philippines used to have an abundance of rattan but it is now in such short supply that we import it from other countries. In Imugan we tried to propagate it but it is very difficult to make germinate because the seeds are so hard and waxy. I wondered at the time how the forests could produce so much but we could not. I finally discovered that monkeys were the answer.

The monkey enjoys the fruit and climbs to get it but the seeds are too hard to crack and too difficult to remove so he just swallows them whole. The hydrochloric acid in his stomach removes much of the waxy coating from the seed which passes on through his gut. When he defecates he is planting a processed rattan seed with a proper amount of fertilizer. Monkeys usually defecate when they are in a tree and they travel far. This ensures that the rattan plants will be spread throughout the forest and each rattan plant will have something to climb. If we want to increase our supply of rattan, we should increase the number of monkeys in the forests.

A member of one of our churches, by the way, has developed a large santol orchard near his house the same way. He did not have any monkeys so he had to do the work himself.

God's Systems — Energy and Filters

The sun, which provides the only energy input into the earth system, is actually a huge atomic reactor sending radiant energy to the earth. God knows that such a power source is extremely dangerous and so He put it far enough away to prevent its being a perpetual hazard on earth. It is much more comfortable having the atomic reactor up there than having it sitting on a fault line in Bataan. Its radiant energy can pass through the vacuum of the stratosphere and also through the atmosphere. This is convenient because it is a bit difficult to conceive of power wires that long.

The radiant energy is still, however, quite dangerous so God created several filters which blanket the earth and protect its occupants from the sun's damaging effects. The most important of these is probably the ozone layer which removes much of the ultra-violet light. This layer functioned well for hundreds of thousands of years until recently when people invented synthetic products called plastics and fluorohydrocarbons. For a few years these products seemed to be wonderful but more recently we discovered that they release chlorine and a few other similar chemicals into the air. When released, those gasses proceed to the upper atmosphere where they break down the ozone. At the present time there is a hole the size of the United States in the ozone layer above Antarctica and another is developing above the Arctic. In those areas it is no longer removing the damaging ultra-violet light. Scientists are worried and even the politicians at the United Nations are starting to worry but instead of stopping production of such chemicals immediately, they say that they will just slowly reduce production and hope that the earth can survive while they do some more research. It is a very risky decision.

God's System — Generosity

The systems which God has instituted on earth are very effective, as we have seen, but they can also be brutal. The scientists are finally realizing that Mother Nature is very educational but not very forgiving.

This system of recycling oxygen and carbon dioxide is balanced and self-adjusting through many feed-back systems. It can function indefinitely without our intervention. This is why, in Genesis 2:2 it is recorded that "God stopped working." He had made a sustainable universe. All of its inter-locking parts and systems, including mankind, were sustainable. What else was there for Him to do?

That is when sin entered the picture, however, so God had to go back to work to make learning opportunities out of our sins and mistakes. He probably feels that His new job is more difficult than creating the universe. All of our ecological sins bring punishments with them eventually, and the punishments are meant to teach but they are sometimes late. It took about 50 years on Leyte, for instance, but when the floods came to Ormoc City, they came with force. I wonder if we have learned the lesson. If not, we will have to keep repeating it until we do.

They say that the Pasig River was a refreshingly clean and living river a hundred years ago but a century's pollution has killed it. It is better now since Imelda tried to clean it up about 20 years ago but it is still dead. Whenever I bring a group of students from the mountains to Manila for an educational tour, I do my best to stop for a few minutes beside or above the Pasig and let the students "enjoy" the fragrance. They are much less likely to pollute our mountain rivers after the experience. If we learn from our sins and mistakes there is hope that we can keep this world operating properly, both physically and spiritually. If not...

Some of the brutality of God's systems, however, cannot be blamed on people. Typhoons, for instance, can be very damaging but they perform the important function of providing irrigation water if the forests are available to store it in the underground aquifers. The forests in north Luzon grow faster than those in

Mindanao because the typhoons regularly prune excess branches from the large trees enabling the sunshine to get to the forest floor and stimulate the growth of the wildlings. We can appreciate this here in a comfortable conference hall but it is not as easily appreciated when your house has just blown away and your farm damaged.

The earth has been increasing its temperature for several decades because of the "greenhouse" effect of too much carbon dioxide in the atmosphere. The eruption of Mount Pinatubo, however, sent huge amounts of fine ash aloft which has reportedly shaded the earth enough to cancel the effects of 40 years of global warming. This is good news to most people but will probably not be a satisfactory answer for the people of Zambales whose homes are under three or four meters of ash and lahar.

Much erosion has taken place over the past centuries and put tons of soil into the oceans. How can that soil be returned to the higher elevations again? God has a system for that also with the help of earthquake as the descending tectonic plates push up the ascending ones. This helps us to understand God's systems but I realize that it does not provide adequate comfort for the families of the 12 boys who died when slides buried the dormitory of our High School in August of 1990.

What has God done to alleviate the personal pain of people who suffer from the natural systems? His system for that is called "Generosity." He knows that the physical systems are often brutal but he also knows that they hit small areas while other areas are left unaffected. People in the unaffected areas are supposed to help those who are hurting.

I recall that Texas suffered a terrible drought several years ago and the farmers in Florida generously sent food to help them. The 1992 hurricane destroyed many homes and farms in Florida and it was Texas' turn to be generous in helping to rebuilding the homes and businesses of the people of Florida.

We, in Imugan, were devastated by the earthquake in 1990 and we appreciated the generosity of many people as we mourned our dead and struggled to rebuild our farms. We are preparing ourselves to be generous in case of future calamities elsewhere.

Bad Theology Produced Bad Science

I mentioned that governments desire to do research before they make decisions. As a researcher, myself, I appreciate this but I have some additional observations about research which are especially important in a conference such as this. There are always assumptions behind every research and behind every researcher. Let me just say that I feel the world has lost about 90 years of good research opportunities and wasted millions of man-days because of bad theology. Let me explain.

In the field of biology thousands of man-years of research have been done in trying to decide how this universe came into being but most of the researchers begin with the assumption that God had nothing to do with it. That, however, is a theological assumption not based on science.

Researchers who start with such an assumption are left with very few working hypothesis for the past three quarters of a century is known as the Organic Evolutionary Hypothesis. Researchers have already spent an inordinate amount of time and money on the problem of origins and the processes by which major inheritable changes can take place to make "Evolution" possible, but they are now recognizing that they are farther from the answer than they were in the beginning. I assume that all of you have studied Logic and know that if a basic assumption is false the conclusion can hardly be true.

If such biologists had been willing to assume, as I do, that an intelligent God purposely created the universe, they would have spent their time studying the systems that He created so that we could all cooperate more effectively with those systems. To return to my former illustration of the vehicle; we should study the gears and wiring in the vehicle very carefully and analyze their functions. Then we should be careful to grease those parts that need greasing, tighten the bolts that need tightening and otherwise support, by our maintenance, the designer's intentions.

In essence, if we had done this, ecology would have been invented a lot earlier and we could have discovered the ozone layer before it developed a hole. Now it may be too late. We might also

have realized that Leyte was seriously deforested. As it is, people did not complain about the deforestation of Leyte until hundreds of people drowned. I was called recently to Marinduque to research some of its environmental problems. After traveling its roads and rivers and hiking its mountains for a week I feel that the situation there is far more serious than in Leyte.

The science of agriculture experienced a similar problem. Many agriculturists began with the assumption that the soil was merely a place for the plants to put their roots so they would not tip over. Later, some scientists became interested in plant chemistry and discovered that plants need certain chemicals to thrive, especially Nitrogen, Phosphorous and Potassium. In order to force the soil to produce more crops they packaged these chemicals in the least expensive way and called them fertilizers.

Fifty years ago I studied the romantic descriptions of these technical breakthroughs in agriculture, especially hydroponics, which they said, would increase outputs and eliminate hunger. We don't hear about hydroponics anymore because it did not fulfill its promises. The IRRI has now had to revise its programs in the realization that the chemical fertilizers and pesticides which they pushed for so long have had serious and damaging side-effects which have caused sickness rather than health. A researcher in Laguna tested the milk from all lactating mothers in that province a few years ago. He discovered that all of the samples were so heavily contaminated with insecticides that they would be forbidden to commerce in any other container.

Now that some scientists have finally begun to study the systems operating in the soil, they have found that their assumptions about chemicals were very simplistic because they had ignored the trace elements and such things as the tilth of the soil which allows the plants to utilize some gaseous elements and compounds. They had also ignored the mycorrhiza and other microflora and microfauna which promote soil fertility. The chemicals which they expected to bring great wealth and eliminate hunger have, instead, destroyed extensive amounts of farm lands and hunger has become worse than in the past. Although it is true that much of the hunger is due to overpopulation, much is due to bad science based on bad theology.

Bad Science Creates Bad Agriculture

Having developed a defective philosophy of biology and agriculture, many scientists continued to depend on chemicals to solve their problems. Blight, for instance, which some of you have seen on carrots, potatoes or tomatoes is caused by a fungus. Following the reasoning of the so-called "scientific agriculture," fungus problems should be solved with a fungicide. The fungicide kills some of the blight but it also kills the mycorrhiza. The farmer temporarily solved one little problem but created a larger one.

The same thing happened when some agriculturists identified the plant disease now known as "bacterial wilt." They retreated to their laboratory and invented a chemical which would kill the bacteria which caused the "wilt." The problem is that any chemical which can kill bacterial wilt will also kill the nitrogen fixing bacteria. Another small problem was solved by creating a big one.

After the agriculturists had succeeded in eliminating God's two best methods for keeping the soil fertile, they retreated to their laboratories again to produce more chemical fertilizers to replace what had been destroyed. With heavy chemical inputs, the plants grew rapidly but were very susceptible to insect damage. The chemists returned to their laboratories again to create more poisons to kill the formerly benign insects which had suddenly become pests. Not surprisingly the insects soon developed resistance to the pesticides and the new varieties of insects were worse pests than their ancestors. It was a never ending cycle of destruction.

You might be interested in knowing that one of the reasons that Tuberculosis is still such a serious problem in the Philippines is that the tuberculin bacilli have developed resistance to the common medications used for the disease. Malarial mosquitos have done the same thing and malaria is making a come-back. Most scientists now recognize that a more effective approach would have been to work to prevent infection through good living habits and build up resistance through good nutrition rather than merely trying to kill the microorganisms that cause the disease.

Animal husbandrymen are caught up in the same problem. They discovered several decades ago that if they regularly fed antibiotics to their chickens, pigs and cows they could prevent many of the common animal diseases and speed animal growth. Because the cost of antibiotics was less than value of the added meat they began feeding them regularly. I admit that I did the same with my own pigs and chickens 30 years ago before I understood all the effects.

A few years ago a physician in the USA received a patient with a minor complaint, prescribed a simple antibiotic which should have cured it quickly but in just a very short time the patient was dead. Many other physicians in the same area had the same experience but they were all so ashamed to expose their failures that they did not, at first, mention it. When one finally did mention it, they realized that nearly all of them had the same experience so they sought a common factor and found that all of their ex-patients had been eating meat which had been raised on feed treated with antibiotics. These patients had unknowingly consumed large amounts of antibiotics and they had become immune. It took many funerals before they discovered the problem. Most commercial animal raisers in the Philippines, by the way, are still using this system although no one is recording the funerals.

Some Ikalahan Systems Of Dealing With the Environment

We have studied the creation in some detail, how do the Ikalahan react to it?

First, the Ikalahan have diligently fallowed their fields for centuries although they do not follow the Biblical instructions of six years of cultivation followed by one year of fallow. The Ikalahan cultivate for about 2 years and fallow for an average of 15 years. They do not bother counting years, of course, because they fallow the field when a certain white-flowered weed appears in it. Likewise, they know that when the trunks of the trees are as big as the calf of a man's leg and the soil smells right they can cultivate a field again.

When their camote develop too many leaves, usually after 8 months, few tubers develop. Then it is time to make a *gengen*. The women first remove all of the leaves and roots in an area about 3 meters square. They separate the stems that look like good planting material and shade them near the field. All of the tubers they take to their home. The good ones are for family food and the defective ones are for the pigs. All other leaves and grasses are buried in a contour trench dug across the face of the field. The result is a contoured hump filled with composting materials which returns fertility to the soil while preventing erosion. This is a second way the Ikalahan have of working with God's systems.

After the earthquake destroyed most of the farms in our area, the people applied a third technique called *day-og* which their ancestors developed for rehabilitating level lands. They dug out about 8 or 9 inches of the sand, gravel and dead soil which was piled on their fields and filled the hole with whatever vegetation they could get. They then returned the soil and planted their vegetables directly on top. Each *day-og* section is about 3 or 4 meters square and separated from the adjacent section by a canal. If they do it in a large area the result looks like a huge chess board. The result is a fertile and productive field in a very short time.

For more than 30 years, however, most of the Ikalahan neglected to follow these three very constructive methods of cooperating with God's systems because they had no land security. They felt that if they would improve their lands it would only make them more attractive to the land-grabbers. They only revived these ancient technologies after 1974 when they obtained their Communal Forest Lease, the first in the nation. Such labor and time investments are only worth while when a family can make long term plans.

Beyond their recognition of *hota nalagan hi-gatayo* (our creator) whom I discussed during this conference in 1992, I cannot say that the Ikalahan have a theological basis for these technologies. Their recognition of the creator, however, gives them a theological basis of respect for the creation and makes it easier for them to protect the total environment. It also enables them to go beyond their ancient technologies and develop improvements. This has been done at least twice during the past 10 years. Once, some of them,

mostly staff of our foundation, decided to promote some vegetative terracing which they call *balkah* (literally "belt"). It reduces the slopes and slows or prevents erosion.

The second innovation was made about nine years ago by one of our tribal elders who is also a Church leader. He planted small tree seedlings in his camote field while the camote were still producing. When it was time to fallow the field he had seedlings about 2 feet high. In six years the trees were mature enough to cut and he could recultivate the field. This reduces the needed fallow from 15 years to 7 years without loss of fertility thus doubling the agricultural land. Because he does not need more land, the extra became forests.

Please let me use one more illustration. If you were a town mayor and suddenly learned that ten violent criminals had gone into your public market and 10 of your policemen had gone in after them you would properly be concerned. You also know that there are 100 in the market. Would you then take an armalite and strafe the market to kill the criminals? I doubt it because you would not only kill the 100 innocent shoppers, you would also kill your own policemen, and you might not even get all of the criminals. The wisest thing to do would be to provide all possible support to your policemen and let them take care of the problem carefully.

Pesticides are like armalites. They kill 10 to 15 helpful or neutral insects for every pest that they kill. The worst is that some of the true pests will avoid death by various subterfuges or by developing resistance. The helpful insects seldom recover. The Ikalahan now approach the problem of pests in this way, by helping the "police!"

One of our gardeners, for instance, talked to some scientists and learned that aerobic fungi were the natural enemies of the anaerobic fungi that cause blight. Now, after each rain, we cultivate around the susceptible plants and we have very few problems with blight even though we do not use fungicides. With the other pests, we find the natural enemy and encourage its development. The only difficulty about organic gardening is that the farmer needs to be more intelligent than the worms.

Some Learnings For Us All

1. It should be clear that families will not protect or improve the environment without motivation. When communities are given authority and security, however, they will feel a vested interest and will make long-term plans which are much more likely to involve environmentally sound methods of resource utilization.

2. The church should not surrender so easily to the aura of invincibility which is usually presented by "science." Scientists are human. They make assumptions and they make mistakes. It is the responsibility of Christians to ensure that good theology supports good science to enable us to practice good agriculture.

3. All Filipinos must confront the problem of our forests. Every one of the millions of vehicles that runs on the highways, streets or mudholes of this world is releasing tons of carbon dioxide every year. The billions of people, and more billions of animals are also producing more tons of carbon dioxide. The millions of fires in factories, kitchens, back yards and cigarettes add to the problem. The recent decision of our government to produce electricity with more coal-burning generators, is going to increase the problem even more.

Even if our forests were in good condition, which they are not, they would have a hard time re-processing all of the carbon dioxide that is being produced. We really should plant two or three trees for every child who is born just to keep that child supplied with oxygen during its lifetime. Unfortunately, instead of planting, we usually cut down another tree to make the cradle and some more to make a bedroom and thus endanger the survival of that very child. When I arrived in the Philippines almost 40 years ago there were more than 6,000,000 hectares of closed canopy forests. Last April only 800,000 hectares remained. It is probably less than that now.

There is no substitute for the tropical rain forest. Its maintenance is not merely to improve the quality of life, and not primarily to provide lumber and plywood. It must be preserved to preserve life itself. Logging damages the forests but there is a valid alternative to logging. It is possible to assign the forests to

the forest communities and with the help of trained personnel let them regularly cull the defective or crowded trees and turn them into lumber. This method actually produces more lumber than the present logging technologies because it speeds up the growth rate of the forests very significantly without ever exposing the soil to erosion.

Conclusion

I began this lecture with a few observations found in the book of Genesis which is appropriate. May I now end it with an equally appropriate text from the book of The Revelation, chapter 11, verses 16 to 18.

"The twenty-four elders...fell on their faces and worshipped God, saying, We give thanks to you, Lord God Almighty...because you have taken your great power and have begun to reign. ...The time has come for judging the dead, for rewarding your servants...and for destroying those who destroy the earth."

God's creation was a labor of love. He made this universe sustainable, adequate and challenging and He has provided us with enough brains to understand His systems and coordinate our lives with them. Even with over-population, there are still more than enough resources on earth to provide a good sustainable livelihood for everyone if the resources are properly used. If we are going to keep it working, however, we need to recognize that we are only stewards of God's property and answerable to Him. If we don't do it, we and our grandchildren will suffer for our failure.

We said earlier that the systems will punish us if we violate them. That is still true but in case the systems don't get around to it during our lifetime, this verse from The Revelation reminds us that God, Himself, will finish the punishment on the judgment day. It is up to us.