

# Water-Soil Matrix of the Open Steady Earth and the Role of Human Economy to Nourish Ecocycle

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## *Beyond Expansive Development*

Petroleum civilization, today prevailing in many regions worldwide, cannot exist without high-speed, long-distance and large-scale transport of underground resources. Against the belief in infinite economic growth largely found in this civilization, we can interpret the second law of thermodynamics (the entropy law) in the socio-economic context as an expression that any human activity in production and consumption results in an irreversible increase in waste heat and matter.

When commodities are transported in a most efficient way, a particular region as an economic center can easily attract goods, information and people on a mass scale and generate huge volume of waste heat and matter. On the other hand, peripheral regions begin suffering from depopulation and resource depletion. Moreover, wastes generated in the center are often dumped in these regions. In this paper, this kind of situation is referred to as “expansive development”. Expansive development accompanies cultural problems, too. That is, a way of life everywhere becomes standardized into what prevails in an urban center. To put it in another way, peripheral regions, economically and politically powerless, are forced to accept cultural poverty or standardized culture of a powerful urban center. For example, peripheral regions have no choice but to accept the situation one cannot cope with without an automobile and give up a self-sustaining economy.

As seen above, while it may appear to let people enjoy freedom and diversity, expansive development actually results in standardized and monotonous society. However, there exist serious counterproposals against expansive development, where sea and mountain are intended as ultimate disposal sites for waste heat and matter. Sharing a powerful sense of fulfillment, people have begun efforts in various regions countrywide and worldwide to undermine petroleum civilization. Theories of “endogenous development” and “economic devolution” are among those to support these efforts.

With the view of Japan as a “great economic power”, some wish for further expansive development involving countries in Southeast Asia and even all over the world. For this goal, Tokyo is expected to function as a global center of finance and communication. By contrast, in the Edo period (1603-1867), theories of regional development were constructed in several feudal states in Japan. These theories are fertile in valuable implications for the efforts to counter the policy of expansive development and to achieve endogenous development in each region in Southeast Asia and economic devolution in Japan.

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The purpose of this paper is to focus on theories of water-soil matrix in the Edo period, and explore the linkage between this traditional view and the contemporary theory of the Earth as an open steady system.

### **Sankai (*Mountain-Sea Matrix*) and Suido (*Water-Soil Matrix*)**

In the mid Edo period, Join Shaku wrote about the water-soil matrix (*suido*) in Akita and Sempoku, in his voluminous work: *Uyo-Shuhoku Suido-Roku* [On the Water-Soil Matrix in the Uyo-Shuhoku Region]. Join (1727 or 1728 - ?) was then the head priest of Gempukuji Temple at the town of Asamai in Hiraka County in Ugo (currently part of Akita Prefecture). The Uyo-Shuhoku district belonged to the Akita feudal state and was governed by the Satake family. Under the wise administration led by Masamitsu Shibue (1574-1614), the district was once known as a fertile country. By Join's age, however, many rice paddies had been abandoned, and the five cereals (rice, barley, beans, and kinds of millets) had become in short supply. People were severely suffering from poverty. Various figures, wise and foolish, then visited the district one after another making proposals of many kinds. According to Join, however, these people were "strangers not rooted in this district and unfamiliar with its land-water systems, and therefore nothing helpful resulted from their theories and proposals."

As for proposals based on economic theories, Join writes as follows, perhaps having in mind *Keizai-Roku* [Political Economy] by Shuntai Dazai (1680-1747): "Dazai, for example, was familiar with economic theories and discussed politics and administration from that aspect. It is, however, not worth while reading his book carefully because he was unfamiliar with the theories and practical knowledge concerning *seichi* (regional water-land systems), which should be a crucial component in policy formation and decision-making." Join thus emphasizes the importance of being well informed of *seichi*, claiming that it is not enough to be well versed in economic theories for forming an effective policy for regional development. The term *seichi* is seldom used today. Its direct meaning is agricultural fields, usually connoting the water-land system of each region. We could even interpret this term as ecology.

Join often employs the term "*keikai-seichi*" in his argument. This term articulates that we cannot obtain a perspective for endogenous development lacking our balance in knowledge between economy and ecology. In order to achieve this balance, it is indispensable to be well informed of *suido* or water-soil matrix. Join Shaku begins his argument about *suido* with the concept of *sankai* as follows: "*San* means mountain and *kai* means sea. Mountain and sea together form the basis of everything under the sun. Without the benefits of *sankai*, it would be impossible for humans to make a living and form a state." As for the benefits of mountain, Join continues: "Mountain yields a great national fortune, namely, all of the four treasures (gold, silver, copper and iron)", and it as well supplies "water, which is indispensable for raising the most valuable five cereals. People could not go even a day without these cereals." Furthermore, "it is also mountain that makes it rain, benefiting everything in nature, and generates winds and clouds." "Good timber, firewood and brushwood are all from mountain, too."

As for the benefit of sea, Join points out: "... great sea holds the beneficial principle of its own, and is itself an entity of virtue. It yields gold, silver and other treasures, and various kinds of marine products such as sea plants, fish, turtles and salt, without which people could never go even a day. It never refuses discharges of millions of rivers, and keeps itself from rise and fall, thereby promoting marine transportation and interregional trade. Interregional transfer of commodities helps each state cope with the shortage of a particular product, develop its economic flexibility, prosper and make fortune. These benefits all result from the virtue of great sea..."

It deserves attention that Join distinguishes the welfare of a feudal state from that of ordinary people. We should pay attention to his argument that water is most beneficial to a daily life of ordinary people while gold, silver, copper and iron to a feudal state.

The health of *suido* thus presupposes sound *sankai*: "*Sui* means water systems and *do* means land systems. Water brings moisture and land gives subsistence. Therefore, everything alive on the earth, both humans and non-humans, could not exist and reproduce without the benefits of *suido*, and is thus deeply embedded in *suido* without any exception." Consequently, the fundamental of *keikai-seichi* are conservation efforts for the *suido* described above, especially efforts to conserve and manage headwaters of major rivers.

Join describes water as follows: "Water does not have a body of its own. When it is warm or hot, water evaporates into the air; in other occasions, water vapor in the air transforms back into liquid water, first forming a drop of water then tons of it. Water volatilization from mountains and rivers, here and there on the ground, is also its transformation, and creates a new source of liquid water. Water circulates between heaven and earth. It precipitates forming rain, dew, fog and snow, and comes down onto the ground. It then stays in the ground for several days, and flows as river water and feeds various kinds of water systems such as lakes, ponds, marshes and wells. Underground water sometimes appears on the ground gushing sphere, this does not necessarily mean that water can be sufficiently supplied for agricultural use. Join emphasizes that it is important to understand this: "Water is abundant in the physical sphere circulating between heaven and earth, and the land is virtually filled with water. If forests and groves are recklessly logged only for a short-term interest, however, mountains and forests become unable to store water any more. Dams and channels then lose water and the land turns dry. If people neglect to remove sediment and aquatic plants from rivers, reservoirs and irrigation channels, these water systems will be buried into wasteland." Join also says that: "Since water is the essence of yin and yang (the cosmic dual principles) and a product of the universal virtue, the total volume of water has been kept constant from the very beginning of the universe. In the absence of human wisdom and efforts, however, mountains and water systems cannot store enough water for irrigation, and paddy fields are destined to turn dry and be abandoned."

Join's argument seen above may be summarized as follows. The total volume of water stays constant, following the law of conservation of matter. Water circulates between heaven and earth changing its form. Heat is a basic factor of the three phases of water: gas, solid and liquid. Water, having come down on mountains and plains as rain, stays in soil for a while, and in due course of time forms rivers, lakes and marshes or runs as underground currents. The water in these systems, under good management, ensures a good harvest. What is important is that human wisdom here plays a crucial role. When people recklessly log trees in mountains and plains, the land loses its capability to store water. When people neglect the maintenance of water systems -removal of sediment and aquatic plants from reservoirs and channels, for example- these systems will be buried and the land will be dried up and become infertile. Consequently, in order to achieve a fertile region with abundant harvests of five cereals on the basis of knowledge in economics and ecology, the fundamentals should be conservation of forests and maintenance of water systems.

Related to this, Join discusses how his feudal state should be administered: "This state is endowed with large agricultural land, but only modestly populated. Actually, the land is not fully exploited, some agricultural land is left uncultivated, because of a shortage of labor force engaged in farming. Under these circumstances, how can the state be benefited by making many people engaged in tax collection? This is definitely unreasonable in neglecting necessary measures to keep the agricultural land productive, and is sure to put the state on the decline." That is to say, although a state ruler tries to exploit farmers to an unreasonable extent so as to build up a state fortune, this is sure to work otherwise and result in the decline of the state. Join is also critical of the national policy known as *sankin-kotai* adopted by the Tokugawa shogunate. Under this policy, an alternate-year residence in Edo (currently Tokyo) was required of each feudal lord (*daimyo*). Luxurious marches between Edo and a fief along with expenses in Edo were a heavy burden to a feudal state. This policy was adopted mainly for the purpose of keeping feudal states from obtaining a great economic power and discouraging their revolts against the central Tokugawa government. Join criticizes *sankin-kotai* as follows: "When a march of the lord falls on busy seasons in farming, it constitutes a severe hindrance to farming because labor force-both human and animals-are requisitioned. The state government, therefore, should manage to set a march avoiding critical seasons for agriculture. Even when central government orders a march in spring or autumn, state government should go as far as negotiating with Edo to change the date. Good government understands the toil and moil of the ruled, and should go this far."

In the above argument, Join implies that it is one thing to induce endogenous development in a feudal state while it is another to strengthen the power of the Tokugawa central government. The former is what Join seriously wishes for.

What we have seen above is only introductory fragments of the voluminous work, *Uyo-Shuhoku Suido-Roku*, but it seems to have already become clear that the theory Join constructed for achieving a regional revival based on the concept of water-soil matrix is rich in valuable implications to us living in the late twentieth century.

Join Shaku, a Buddhist thinker in the mid Edo period, thus left impressive arguments on the benefits of *sankai* and *suido* with emphasis on conservational management of mountains and rivers. He, though, did not explicitly touch on the role of soil in the system of *suido*, or in an ecocycle. As seen later in this paper, the contemporary theory of the earth as an open steady system makes it possible to understand the significance of *suido*, or water-soil matrix, more clearly.

### *Japan under Coal Civilization*

Even in the Edo period, waste (or garbage) were being generated according to the scale of human activity. In those days, however, people usually did not have to worry waste problems seriously. This is because waste disposal was not all a problem at that time. Actually what people did was simply to leave garbage on the ground or dump it into a river nearby. As the saying goes, "Any water is purified as it flows down just three feet." What was dumped into a river was eaten up by aquatic life or was decomposed by microorganisms in the riverbed. Human and animal excretions were taken to farmland as organic fertilizer, indispensable for rich harvest of five cereals and kinds of vegetables.

A squadron of coal-fueled vessels under the command of Commodore Perry appeared off Uraga in 1853, and again off Shimoda in 1854. These visits shook the seclusion policy of the Tokugawa shogunate, as the well-known satirical poem made fun of it: "Just as we cannot sleep at night with four cups of *jokisen* (extra good tea), only four *jokisen* (steam vessels) have broken the long peaceful sleep of the country and keep it from falling back to sleep again." Before long, the country ended seclusion, and in 1868 it experienced the Meiji Restoration. Despite this great change of the country, the ecological link seen above (human-waste-river-soil) did not readily change in a major way. Around the Meiji Restoration, the population of Edo (soon renamed Tokyo) decreased because families of *samurai* (the warrior class) left the capital for their fiefs, but it began to increase soon again. Even in Tokyo under coal civilization, let alone other regions, human excretions were taken to the suburbs and utilized as fertilizer. The Bay of Tokyo, which was conveniently kept eutrophic by the discharge of waste water from the town, went on supplying various kinds of edible fishes and sea plants.

Japan, in the Meiji period (1868-1912), hoping to catch up with the Great Powers, engaged in the Sino-Japanese and the Russo-Japanese Wars, and devoted itself to invading other Asian countries beginning with the annexation of Korea. In the mid Showa period (Showa covers from 1926 to today), Japan transformed itself into a military state, more inhumane than ever, and rushed headlong into the Pacific War (1941-1945).

It may sound paradoxical, but it is why Japan was successful transforming itself into such a military power, despite the delay of the arrival of coal civilization, that the country was fertile in *suido* (water-soil matrix) productive enough to support wars of aggression. Until the end of the World War II, Japan was a nation characterized by reckless and inhumane exploitation of human beings (as symbolized by a *kamikaze* corps or suicide corps) as well as that of the country's natural environment.

### *The Earth as an Open Steady System*

In the period of the postwar rehabilitation, the overexploitation of water-soil matrix stopped for some time. Mountains and hills were reforested on a nationwide scale and development of agriculture and forestry was promoted utilizing animal power and small-scale water power. Petroleum civilization, however, soon rose and prevailed in the country. In terms of energy consumption, it was around 1960 that imported petroleum overtook domestic coal. It was also around that time that the supply of industrial goods passed the domestic demand, and the country soon began exporting industrial products increasingly. Correspondingly, the import of agricultural, forest and marine products soared as well as that of mineral products, notably, crude oil and iron ore.

Some of the South-East Asian countries became major suppliers of forest and marine products. Resource development in these countries caused serious problems, one after another. For example, tropical rain forests were destroyed extensively, which further resulted in grave problems such as soil erosion and breakdowns of fishing villages. In short, the water-soil matrices in many regions in South-East Asia were extensively destroyed under the name of "Pax Economica", not by direct military operations.

In Japan, on the other hand, the autonomy of countryside willages was severely undermined as the whole country developed its dependence on imported products of agriculture, forestry and fishery. Furthermore, the extensive dependence in agriculture on heavy machinery, herbicide/insecticide and chemical fertilizer degraded topsoil and polluted water. In urban areas, the land was so extensively covered with concrete and asphalt that rain water was prevented from penetrating into the ground. For this phenomenon, the term “urban desert” was created.

Part of the country’s coastline was occupied by nuclear power plants. The construction and operation of these plants were enforced without full consent and a threat of radioactive contamination has loomed up over the entire country. Nevertheless, even the researches on nuclear fusion for power generation are today going on.

A rationale for nuclear power generation (fission and fusion) is that it can perform the principal role to replace petroleum as a major energy source. Against this sort of argument, since the mid-1970’s it has been repeatedly made clear by several researchers, including the author, that nuclear power generation is essentially dependent upon petroleum and cannot replace it. As a counterproposal against nuclear power generation, Atsushi Tsuchida advocates the utilization of what is called “renewable” energy resources. This proposal logically necessitates explaining the concept of “renewability”, which may seem incompatible with the second law of thermodynamics or the law of irreversible increase in entropy within a closed system. Tsuchida’s response to this problem can be summarized as follows.

Entropy is a measure of the disorder of heat or matter (on a molecule level). Intuitively, it is akin to the concept of “filthiness.” For example, entropy  $\sigma$  of heat, with a heat value of  $q$  kilocalories and at  $T^\circ\text{K}$  - Kelvin is the scale of absolute temperature; approximately  $(x + 273)^\circ\text{K} = x^\circ\text{C}$  (degrees centigrade), is represented by the following equation:

$$\sigma = q / T \text{ (kilocalorie/Kelvin).}$$

When the earth is regarded as single system, nothing is macroscopically transferred between this system and the outside space in terms of matter - with minor exceptions such as the cases of meteoritic bombardment. That is, the earth is a closed system in terms of matter. On the other hand, the earth receives energy mainly from the sun and at the same time releases energy to outer space. That is, the earth is an open system in terms of energy. Within the earth system, various atmospheric phenomena and the activities of ecosystems are constantly generating entropy, besides what is created by human activity, notably, burning large volumes of coal and petroleum.

What is important here is that at least before the arrival of petroleum civilization almost the same things repeated each year, although weather conditions and states of ecosystems were constantly changing at each moment. In a sense, a kind of “homeostasis” existed in the earth system. This is called “steadiness” in physics and economics.

As seen above, we can regard the earth as an open steady system. While entropy is constantly generated, it does not accumulate within the system, and the value of entropy is kept constant. There must be some mechanism involved in this process, getting rid of the amount of entropy equivalent to what is newly generated within the system. As shown below, Tsuchida showed that the water cycle (together with part of air convection) in the atmosphere is performing that crucial role.

According to geophysicists and other scientists, the amount of heat that comes from sun to remain on the surface of the earth is approximately 77 kilocalories per square centimeter per year. The ground surface receives this energy ( $q$ ) in the vicinity of absolute temperature  $T_1 = 288^\circ\text{K} = 15^\circ\text{C}$ . This influx of heat into the earth system therefore accompanies the influx of entropy  $\sigma_{in}$  as shown below:

$$\sigma_{in} = q / T_1 = 77/288 = 0.267 \text{ (kcal/deg . cm}^2 \text{ . y).}$$

Water and air on the ground surface are warmed by this solar energy and the water evaporates. This created water vapor and warm air, being lighter than the surrounding air, goes up as an updrift making a low pressure or an atmospheric depression. The water vapor, having arrived at a high altitude, transforms into tiny ice particles forming clouds through the physical process of adiabatic expansion and cooling down. The warm air also cools down. In this process of cooling down, the water and the air release the heat  $q$ , which they have absorbed at the ground surface, into outer space, namely, out of the system of the earth, in the form of infrared radiation. The air, now cooling down, begins to descend this time making a high pressure. As seen above, water and air release energy into outer space at the average temperature of  $T_2 = 255^\circ\text{K}$  ( $-18^\circ\text{C}$ ). Therefore, by releasing heat, entropy  $\sigma_{out}$  is also removed from the system:

$$\sigma_{\text{out}} = q / T_2 = 77/255 = 0.308 \text{ (kcal/deg} \cdot \text{cm}^2 \cdot \text{y)}.$$

In brief, the entire process described above creates the difference in entropy  $\Delta \sigma$  as shown below, which takes a negative value:

$$\Delta \sigma = \sigma_{\text{in}} - \sigma_{\text{out}} = -0.034 \text{ (kcal/deg} \cdot \text{cm}^2 \cdot \text{y)}.$$

The earth disposes of entropy more in quantity than what flows into the earth system accompanying the incoming solar energy. It is this difference that can be identified as the very source of the renewability observed on the earth.

In another expression, where  $\sigma_{\text{gen}}$  is the entropy generated within the system, the open steadiness of the earth is represented by the following equation:

$$\sigma_{\text{in}} + \sigma_{\text{gen}} = \sigma_{\text{out}}.$$

The sum of the incoming entropy and the internally generated entropy and the internally generated entropy is equal to the outgoing entropy. The value of the generated entropy can be therefore obtained as follows:

$$\sigma_{\text{gen}} = \sigma_{\text{out}} - \sigma_{\text{in}} = 0.034 \text{ (kcal/deg} \cdot \text{cm}^2 \cdot \text{y)}.$$

The activities of various forms of life, including human beings, certainly contribute to the internal generation of entropy. The same is true of the repeated renewal of low-entropy sources in nature such as rain and cool air. Books on physics for lay readers often give such an explanation that solar radiation has “negative entropy” (or negentropy), which makes it possible for the life on the earth to maintain a low level of entropy by nullifying the increase in entropy. This is one of the examples to show that various fields of natural science have been permeated with the human psychological tendency to regard the great sun as the fundamental benefactor for the life on the earth. Entropy in physics, however, never takes a negative value by definition, and it is illogical and does not make sense at all to employ “negative entropy” in an argument. The theory of the earth as an open steady system, for the first time showed that we cannot get an accurate idea about life and atmospheric phenomena until we understand the role complementarily performed by the sun and the water cycle of the planet.

As mentioned above, in the mid Edo period, Join Shaku constructed his argument for fertile human life on the basis of his minute analytical observations of water circulating between heaven and earth and the relationship between water - constantly changing its form - and trees. In the light of the contemporary entropy theory, it is safe to say Join Shaku was a man of most acute discernment who left scientifically accurate observations.

### ***Topsoil Sustaining an Ecosystem as a Cycle***

In the previous section, we saw how entropy is disposed of in the water planet earth, which is unique in character in the solar system. In this section, we consider the role of soil sustaining an ecosystem, where human society is embedded. An ecosystem basically has three components: These three components are closely related to compose a cyclic structure, where nutrients are transferred for plants to animals, from plants and animals to soil and from soil back to plants. Each component has been repeatedly renewed over a very long period of time.

In biology, plants, animals and soil are usually called producers, consumers and decomposers, respectively. In economics and sociology, on the other hand, decomposition remains an unfamiliar concept while the concepts of production and consumption are often employed. At least in economics, the lack of the decomposition concept seems to show the unreasonable neglect of the role of soil, though this may sound a hasty conclusion. Topsoil, along with water, is a crucial component of *seichi*, farmland or more broadly, a regional water-land system. Soil thus deserves special attention, as Join Shaku articulated that even with good understanding of economics it was impossible to form and implement a policy to transform wasteland and abandoned farmland into fertile fields without knowing of *seichi*.

Every plant withers and dies in due course of time. Animals, supported by water and plants, release kinds of excrements into environment, and leave their bodies on the ground or in the sea when they die. It is soil that accepts all these organic wastes. Soil here, in its broad sense, means what is composed of innumerable earth microorganisms (bacteria), and soil in the sea represents an entire congregation of various kinds of aquatic microorganisms (bacteria).

Soil decomposes these organic wastes into inorganic nutrients and waste heat. Microorganisms obtain energy in the process of decomposition. While nutrients are absorbed by plants as indispensable aliment, waste heat is absorbed by water stored in soil, which evaporates and joins the ascending vapor seen earlier in this paper. In brief, the renewal of animals and plants is just impossible without soil performing the crucial role as a decomposer.

Join Shaku and Banzan Kumazawa (1619-1691), a scholar of the Wang Yang-ming school and theorist/practitioner in forestry in the early Edo period (to be seen later), seem to have identified the basis of life systems in water-soil matrices, without knowing what is made clear by contemporary theories of ecology and entropy. Under the feudal regime of the Tokugawa shogunate, those thinkers, wishing to achieve regional endogenous development in their fiefs and counties, not expansive development in the interest of the powerful central government, managed to develop theories of water-soil matrix on the basis of rather modest ecological understanding in those days. Their ideas and theories may be directly related with the contemporary entropy theory that has been developed in Japan and today's ecology movement deepening on a global scale. This obviously deserves special mention.

### *Toxic Chemicals Never Returning to Soil*

Japan in the Edo period was different from what it is today in many ways. At that time, since the country's economic policy was based on seclusionism, it was out of the questions to expand overseas, for example, invading Southeast Asia. Expansive development, therefore, did not go beyond concentration of rice and power in Edo, thereby preventing other feudal lords from obtaining political/economic power enough to overturn the Tokugawa shogunate. In diplomacy, on the other hand, the central government established a trading house at Hirado in Nagasaki in order to absorb knowledge and information from the Dutch, while eagerly inviting messengers from Korea in order to get information about the latest circumstances in East Asia. The government was also largely tolerant of drifters washed ashore and attempted to collect information on foreign affairs from them. That is, in case of Japan, seclusionism meant an isolation merely in terms of commodities, and in terms of people and knowledge the country was considerably open to the rest of the world. For example, quite a few scholars were encouraged to study Western sciences those days by means of the Dutch language.

Although some regions experienced environmental pollution resulting from mining, contamination remained local in the Edo period because mines were developed mainly by human power supplemented by animal and water power on a small scale. Except mining, there were no economic sectors to generate a large amount of wastes that cannot be decomposed and reutilized in an ecocycle. Environmental degradation at that time, therefore, designated mainly deforestation caused by reckless logging.

By contrast, Japan today is firmly connected with the rest of the world under the regime of what can be called "Pax Economica". The linkage between Japan and the world is symbolized by the transfer of underground resources. Under this regime, it is most difficult to keep current situation from further deepening. For example, the relationship of Japan with Southeast Asian countries, which is characterized by the exchange of motorcycles and automobiles with forest and marine products, is actually being more and more consolidated. The presence of Japan itself with gigantic industrial power is the very principal to undermine the basis of life for the people living in various regions in southeast Asia.

Within the country, the initial sign of the Minamata Disease (toxicosis caused by organic mercury compounds) already appeared in the 1950's, when Japan transferred from coal civilization to petroleum civilization. The sixties saw the Kanemi Oil Disease injuring and killing many people in Kyushu who used vegetable oil containing polychloride biphenil (PCB). It is highly unlikely that such poisonous substances as organic mercury compounds and PCB are decomposed into nonpoisonous matter in short period by aquatic and earth microorganisms (bacteria). In the 1970's and 1980's, dioxin, contained in pesticide/herbicide or generated in a trash burner, became a social problem, and human-made and human-

made radioactive substances, generated day and night at a nuclear power plant, began looming heavily over the nation as long-life toxic matter that can affect even distant future generations. Dioxin and nuclear wastes also belong to what can hardly return to soil or be made nonpoisonous in an ecocycle. To put it shortly, environmental pollution resulting from underground resources has today become a serious social problem.

If we do not stop generating poisonous substances that soil does not accept to decompose, we will likely enforce a policy to dump these wastes on peripheral regions, far from urban centers. Actually, as for nuclear wastes, the national government has begun this political “terrorism” planning to store and dispose of wastes at the dairy town of Horonobe in Hokkaido and the fishing and farming village of Rokkasho in Aomori.

It would not be surprising at all, even if some people would go a little farther to propose dumping these toxic substances somewhere in Southeast Asia or the South Pacific. As Japan attempted to seize underground resources - petroleum, for example - in Southeast Asian countries in World War II, the “economic giant” is now beginning to regard those countries as dumping sites for these wastes. This is what expansive development means for Japan today. By contrast, one of the conclusions we can readily obtain from the theories of *suido* and entropy is that we must stop generating poisonous substances never returning to soil right now and keep what has already been generated from being transferred to a distant place either within or out of the country.

### *Smaller-Japan Doctrine in Agriculture*

In modern Japan, the term “great” has been repeatedly used in naming a national program: for example, the “Greater East Asia Co-Prosperty Sphere” and a “great economic power.” On the other hand, however, the tradition of the smaller-Japan doctrine has been as well deeply rooted in the country. This tradition helps us formulate a meaningful counterproposal against expansive development or the greater-Japan doctrine. Already in the Taisho period (1912-1926), the statesman Tanzan Ishibashi (1884-1973) gave a warning against the “illusion of the greater-Japan doctrine” worrying about the country’s transformation into a great military power. As one of the attempts to develop Ishibashi’s smaller-Japan doctrine in the context of contemporary society, *No-Teki-Sho-Nihon-Shugi no Susume* [Toward the Smaller-Japan Doctrine in Agriculture] by Takashi Shinohara was published in the mid 1980’s.

If Japan tries to achieve further expansive development enhancing the secondary sector and the information industry, the nation will have no choice but to give up agriculture, forestry and fishery in return. Some may argue that the Japanese can depend on the United States for agricultural, forest and marine products, but actually that policy will likely result in the country’s further dependence on Southeast Asia, inducing severer destruction of water-soil matrices there. What has actually happened these ten or twenty years supports this argument. Japan, a major importer of timber, may seem to purchase timber mostly from the United States and Canada, but in reality quite a large amount of tropical timber is imported from Southeast Asia. As for fruit, while American grapefruit and orange keep our attention, we actually consume a vast amount of bananas imported from the Philippines. Though not raised exclusively for Japan, sugarcane in monoculture is also extensively causing erosion of tropical soil.

Shortly stated, if the Japanese wish to associate on an equal footing with peoples in Southeast Asia, they have no choice but to make efforts to achieve endogenous development conserving the water-soil matrix in each region throughout the country while people do the same in each region of Southeast Asia. The smaller-Japan doctrine advocated by Shinohara is one of the expressions for this kind of approach.

Infinite growth may seem to be promised to the secondary sector and the information industry in Japan, but this is not the case in reality. International trade friction is one of the typical restraints, and there are many potential constraints as well. Although some advocate increase in domestic consumption responding to the request from overseas, we cannot expect rapid increase here in Japan, already flooded with industrial goods and information processors. Under the present circumstances, it is the most realistic and important to conserve and manage water-soil matrices in such a way that agriculture, forestry, fishery and handicraft manufacturing can ensure happy human life. In the transition to post petroleum-civilization, existing technology under petroleum civilization can be employed in such a way as imposing no substantial cost on environment.



Any land highly capable of storing water and fertile in crops is always supported by forests. Prior to Join Shaku, Banzan Kumazawa (1619-1691) in Okayama feudal state gave radical arguments about such significant problems as the relationship between forests and human life and the return of the warrior (*samurai*) class to farming in his works after his retirement; notably in *Shugi Gai sho* [Miscellaneous Discussions] and *Daigaku Wakumon* [Questions and Answers]. Banzan once occupied an important office in the feudal state government under Mitsumasa Ikeda, and these books were written on the basis of his experience as a high government officer. In the early Edo period, when these books were written, deforestation became a serious problem in the Chugoku district (the west end of the main island), where Banzan served the government, as well as in other regions. With this background, Banzan's works are rich in valuable insight and implication that can help us develop measures against today's deforestation problems in Southeast Asian countries, Nepal and North African countries. These works are also worth referring to when we construct a counterargument against the advocacy of giving up the primary sector in the best interest of the secondary and tertiary sectors.

*Daigaku Wakumon* gives the following set of question and answer: "Why are mountains more and more badly denuded and rivers made shallower and shallower in spite of regulatory ordinances? The answer is that, though it is officially prohibited, villagers are so poor in want of food and firewood that they have no choice but to log trees in secret for today's living even if this may result in their being beheaded tomorrow. Village headmen and senior leaders are so well aware of the situation that they simply shut their eyes to such doings."

Would restrictions on logging result in serious loss of jobs for those engaged in forestry? What could poor farmers do to make their living if they would be driven out of forests? Banzan answers these questions as follows: "Logging should be stopped in Yoshino, Kumano, Kiso and other mountain areas, and state government should support those woodcutters who have lost their means of living with a surplus of the rice collected as land tax. In farming villages located near hills and mountains, where people have depended on forests for firewood, villagers should be advised to cease their dependence on woodland. Those people can use crop husks and straws in place of firewood. Currently poverty drives them to sell straws, and they are forced to visit hills and mountains for firewood. If state government provides those farmers with rice thereby discouraging them to sell straws, many of them will stop stealing trees and bushes from forests."

The above is one of the proposals made by Banzan to prevent reckless logging at the same time ensuring farmers and woodcutters from poverty, and as for reforestation of denuded mountains and hills he argues as follows: "We can successfully reforest denuded hills without any grass and trees. If the denuded area is too large, we can begin reforestation with just a single peak or valley. First we have to know the size of the land, and then simply scatter millet seeds according to the land size and cover the seeds with dry grass. Before long, various kinds of birds visit the site for the millet seeds leaving droppings containing tree seeds. These tree seeds are most likely to germinate. Dry grass cover makes it more difficult for birds to peck millet seeds out thereby attracting them for a longer time. Furthermore the cover also prevents millet seeds from being washed away in the rain. It is also desirable that millet germinates and grows up on the site. In thirty years or so, the site is covered with young trees. When young trees are abundant, villagers nearby can make use of them as firewood. They no longer have to log mature forests. Wisely managed, the reforestation area becomes more thickly wooded to provide firewood permanently." Shortly restated, we can transform denuded mountains into fertile woodland that can meet villagers' demand, with assistance of birds carrying tree seeds. This proposal, based on an insight into the symbiotic relationship of birds, trees and human beings, is of great interest.

As for forest management deep in mountains, Banzan states that: "Japanese cedars and cypresses (*sugi* and *hinoki*) should be planted in the denuded valleys and peaks deep in mountains of, for example, Yoshino and Mt. Kongo. Abundant cedar and cypress seeds are said to be available in the eastern and northern provinces. Professional foresters, if employed, can easily help reforest denuded mountains in various ways. When mountains are thickly covered with cedars, cypresses and other trees, we frequently have showers in summer because of active transpiration and suffer little damage from a drought even without many reservoirs. Those mountains are free from soil erosion and rivers deepen as time goes by. Then we do not have to worry about a flood. In this way, we can expect uncountable benefits for people's living from good management of mountain areas."

The water-soil matrices in Japan differ in nature from those in other Asian countries. Therefore, Banzan's prescription may not necessarily be transferable to those countries. Still, however, Banzan's thoughtful remarks on reforestation seem largely worth consideration.

Today in Japan, putting aside plains heavily industrialized and densely populated, cedars and cypresses are thickly planted everywhere, even on small hills near villages and towns, to say nothing of mountain areas, while Japanese larches (*karamatsu*) are instead planted in northern districts. Petroleum, fuel gas and electricity are used for daily life and people do not need a deciduous coppice for firewood and charcoal any more. That is, in highly industrialized Japan, mountains and hills are unnaturally covered with evergreen forests.

A considerable part of this green is somehow unsound. Japan has purchased lumber and wood chips (material for paper) from Southeast Asia and North America at a low price, and as a result the domestic forest sector is suffering depression and reforested land is left in serious need of trimming. Ironically the national government has been eagerly promoting the program known as "expanded reforestation" (*kakudai zorin*) since the 1960's, replacing a broadleaf coppice with a coniferous forest. In mountain villages, sufficient labor force no longer exists for what is necessary for sound silviculture - undergrowth removal, pruning and thinning, for example- and high wage level makes it difficult to employ forest workers out of the region. When vines and creepers are left covering an entire forest, ground vegetation dies out in the shade and consequently a landslide is easily triggered once it rains heavily.

While mountains and plains are recklessly deforested in China, Nepal, Southeast Asian and North African countries, daily living is made so far away from woodland in Japan that mountains and hills are becoming degraded, though the country may look rich in green vegetation at the first glance.

Large-scale storage dams, being constructed one after another, make the problem worse.

### ***Restore Farmland and Woodland in Urban Areas***

As for urban areas in Japan, especially the megalopolis Tokyo, some today claim that what we should do is simply to let these urban areas fulfill their functions as business and political centers and therefore we should give up people's daily life in farming, forestry and fishery in the best interests of business and industry. This argument is quite misleading. As already seen in this paper, an urban center has alienated its regional primary sector to such an extent that it develops overall dependence on Southeast Asia for food and lumber, and this is the very reason that a regional water-soil matrix has been devastated.

In *Daigaku Wakumon*, Banzan Kumazawa points out that most of those belonging to the warrior class were formerly farmers, though the Tokugawa shogunata sharply distinguishes the class from the other three, that is, farmers, artisans and tradesmen. He advocates a program to set agrarian warriors and a reform of the system of *sankin kotai* (an alternative-year residence in the national capital Edo required of each feudal lord). Banzan argues that: "If the policy of *sankin kotai* is revised so that each *daimyo* (feudal lord) is required to go to Edo every three years and stay there only fifty of sixty days as in the Kamakura period (1192-1333), a feudal lord with a fief yielding 300 thousand *koku* (*koku* is approximately equivalent to 5 U.S. bushels) of rice can meet the requirement spending no more than five thousand *koku* of rice". According to Banzan, the length of the residence in Edo should be shortened, and "furthermore, warriors should be made to go back to farmland and the land tax on farmers should be lightened by ten per cent. Warriors should be encouraged to settle in a farming village."

As for reforms of the national capital Edo, Banzan claims that: "The expenses for the Edo castle should be pared. The donjon and the secondary center suffice the castle. The residential are for the warrior class should be scaled down by ninety per cent. The farming fields thus reclaimed will yield extra crops beneficial both to the ruler and the ruled. A government officer who is to leave the castle residence should be granted a large site in town. A quick hedge of bamboos should be put in front of the residence, and mulberries should be planted on the borders of the site so that his family can be engaged in sericulture." Banzan continues: "... Families of high-ranking warriors today waste time for silly entertainment and distraction, and low-ranking families are just busy making meaningless efforts. Under a stable regime, where people think much of decency, low-ranking warrior families gain calmness and enjoy leisure and high-ranking ones enjoy female arts and crafts. Under such circumstances, people should plant mulberries on site borders and empty land so that they can be engaged in sericulture. Since they are noble people

who do not worry about economic returns, they take time and successfully develop special skills to produce any silk textile they wish.”

If such a policy is implemented, “a great number of vacant lots will be made in Edo by removing residences of the warrior class. Most of these lots will probably be made into rice paddies and vegetable fields, taking advantage of natural water supply. Since the land is flat and good for rice culture, the agricultural policy known as *Seiden-Seido* may be implemented. Under this policy, every married male of full age will be granted an equal section of rice paddies with a relatively light land tax. When warriors are encouraged to return to farmland and everlasting peaceful society is achieved under the policy of agrarian warrior, minor feudal lords will also likely wish to leave Edo for their fiefs.”

As seen above, Banzan is characterized by his radical anti-centralism and regionalism based on the theory of water-soil matrix. For such advocacy, later in his life, Banzan was confined at Koga in Shimofusa (currently part of Ibaragi Prefecture) by a national government order, where he passed away. Tokyo today may look most prosperous under the slogans of “Great Economic Power” and “Techno-Nation” and many people do not take second thoughts on the road the country has taken after the World War II. On the other hand, the country’s *suido* and those of Southeast Asian countries, the very basis of peoples living, are constantly undermined. Banzan’s arguments and proposals, made as soon as the early Edo period with a keen insight into the ecological relationship between *suido* and human beings, seem worth paying more attention today.

The Indonesians have the term “*tanah air*”, which is equivalent to the term *bokoku* (motherland) in Japanese. *Tanah* means land and *air* means water. A direct translation of this term into Japanese therefore may be *suido*. *Suido* (water-soil matrix), as an existing entity in reality, is unique to each region, and its uniqueness is the very starting point of endogenous development in each region. On the other hand, *suido*, as an idea or a conceptual framework, is endowed with universality beyond the uniqueness of each region, as this Indonesian term shows.

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