Geog

Chapter 5

East Asia

Joseph Whitney

The countries of China, Korea and Japan which comprise the East Asian region today contain some seven percent of the world's cultivated area but support some 25% of its population. This high ratio of population to cultivated land, which is the hallmark of the East Asian traditional resource management system, is not a modern development but one that has existed over the centuries. It has permitted densities and levels of urbanization to exist there that were not equalled or exceeded in the rest of the world until the advent of the industrial revolution.

These high population densities and food surpluses needed to support large urban centres were purchased at the cost of prodigious inputs of labor and the almost complete transformation of natural ecosystems to serve the needs of lowland agriculture. Although such transformation often resulted in deforestation, severe soil erosion, floods and droughts, one of the main organizational achievements of East Asian societies was that they were able to maintain their resource system and population in a state of unstable equilibrium with the environment over long periods of time without any widespread eco-catastrophe occurring.[1]

This achievement resulted from a common cultural heritage throughout the region that gave those who gained a livelihood from the environment a rather accurate ethno-scientific understanding of the flows of energy, water and minerals passing through natural and man-made ecological systems and the ways in which those flows could be manipulated on a long term basis without seriously affecting the harmonious man-nature relationship. There was also a clear recognition of the fact, only recently appreciated in the West, that most so-called natural hazards have their origins in man himself through unwise locational choice, greedy resource management practices or from poor government or social organization that neglects the maintenance of irrigation systems or flood control works.[2]

Because of China's dominant role in the cultural and resource management traditions of East Asia, the discussion that follows will be illustrated primarily from Chinese examples. Except where noted in the text, it is to be assumed that such resource management practices were common to both Korea and Japan.

THE RESOURCE BASE

The East Asian region is defined by certain physical and cultural attributes. Physically it comprises the collision zone of three great tectonic plates: the Pacific, the Eurasian and the Indian. During the last 300 million years or so, the collision of these plates has produced most of the major relief forms of East Asia and has distinguished it from the rest of the Eurasian continent as a distinct geomorphological entity. The checkerboard pattern that has arisen from the collision of the plates has had a profound impact on East Asian society and resource management giving rise to a strong sense of regionalism and the relative isolation of different economic areas.[3]

A further feature that has affected the setting of East Asian civilization is the thick mantle of fine yellow wind and water-borne dust called loess, that covers much of North China to a depth of hundreds of feet in many places.[4] The soil produced from the loess, if properly farmed and watered, is highly productive and provided the resource base for the development of early Chinese civilization.[5] Under poor farming practices and when the vegetation covering is removed, however, it is easily eroded and much of the landscape of Kansu, Shensi, and Shansi and the uplands parts of Honan have been carved into fantastic networks of gorges and gullies by this kind of erosion. A more serious problem has been that caused by the eroded material being washed into the river systems of North China. The silt-laden waters cause the river to raise its bed year by year. Dikes and levees then have to be heightened to compensate for the decreased volume of the channel, and the rivers eventually flow in courses that are many feet above the level of the surrounding lowlands. When the dikes have broken and flooding occurs, the ground becomes waterlogged for long periods of time since the water cannot flow back into the river channels again under gravity. Thus, to the problem of flooding is added the damage done to crops from long periods of waterlogged soils—in many respects a more severe problem than the flood itself. Because of these characteristics, the rivers of the North China plain have frequently affected major crop growing and populated areas, and have disrupted the Grand Canal—the essential supply link for the grain deficient cities of the North.[6]

The peninsula of Korea is essentially a continuation of the checkerboard pattern of China. It comprises part of a single "block" that has been upthrust on its eastern edge and tilted towards the west. This has resulted in longer rivers flowing towards the west and broader alluvial valleys developing there than on the eastern precipitous coastline.[7]

The rapid uplift of the Japanese islands and their constantly changing and unstable crust has produced a landscape characterized by marked and abrupt changes of slope and elevation. Rivers are short, swift, and braided. Only around Tokyo, Nagoya, and Osaka do narrow alluvial plains separate the sea from the mountains by more than a few miles. Even in the lowland regions, the rapid uplift of coastal plains has caused the older alluvium to be elevated above the present stream levels and it now forms board terraces of infertile soil known as diluvium, which, until recently, have been little used for agriculture.[8]

The region of East Asia also forms a distinct cultural area whose society, written language, agriculture, and government have been profoundly influenced by Han civilization—a culture that originated in the middle part of the Yellow River basin and gradually spread until it occupies most of the contemporary territory of China.[9]

THE ENVIRONMENTAL SETTING: POTENTIAL AND HAZARDS

Over the millennia, climate and landforms have interacted to produce distinct patterns of soils, plant associations and plant productivity. The natural ecosystems, before man disrupted them, had achieved equilibrium with their climatic, nutrient and moisture environment and had developed special mechanisms to deal with such hazards as flood, drought, insect pests, and disease.

The primary determinants of the climate of East Asia, the most important abiotic component of any ecosystem, can be summarized briefly. A high pressure system in winter builds up over East Siberia producing cool dry weather over most of the area except where the outwardly spiralling winds cross water bodies, such as the sea of Japan, and bring some of the heaviest snowfalls in the world to western Japan. In summer, the low pressure that replaces the high over eastern Asia causes warm moist conditions to be experienced in all coastal areas. But inland, the air dries out and rainfall declines rapidly to the northwest.

However, neither rainfall nor temperature are particularly good indicators, in themselves, of the resource potential of a climate. Provided that nutrients are available, the major determinant of plant growth is the amount of solar energy available for photosynthesis and the availability of water to satisfy the transpiration requirements for optimal growth. If the moisture required for such optimal growth is lacking, a condition of moisture stress or drought exists that will cause plants to grow more slowly or wilt completely. In these latter areas the predominant biome is usually shrub or grassland and since the movement of moisture in the soils is upwards and since most of the plant mass is underground in the form of bulbs and roots, the soils here tend to be rich in organic matter and nutrients (Figure 18). If on the other hand, moisture is in excess of what can be transpired, run off occurs and forest biomes become predominant. In these regions, particularly where there are high summer temperatures, very different soils develop. Since most of the mass of vegetation is above ground, the plant litter which falls is rapidly decomposed and leached by the heavy rain. Hence, the soils are acidic and infertile and the greater part of the nutrient stock is tied up in the vegetation rather than in the soil itself. Hence, when destruction of that vegetation takes place, the fertility goes with it.

The productivity of the natural biomes growing under different energy and moisture regimes gives some indication of what ecosystems in a state of equilibrium with their environment will yield and provides some measure against which the productivity of traditional farming systems can be judged. The productivity of biomes ranges from 4 metric tons per hectare per year (4 mt. $ha^{-1} yr^{-1}$) [1.6 tons per acre per year] in the north, to over 37 mt. $ha^{-1} yr^{-1}$ [14.8 tons per acre per year] in Hainan Island in the South (Figure 19).[10]

While the climatic environment provides potential for plant growth, there are also

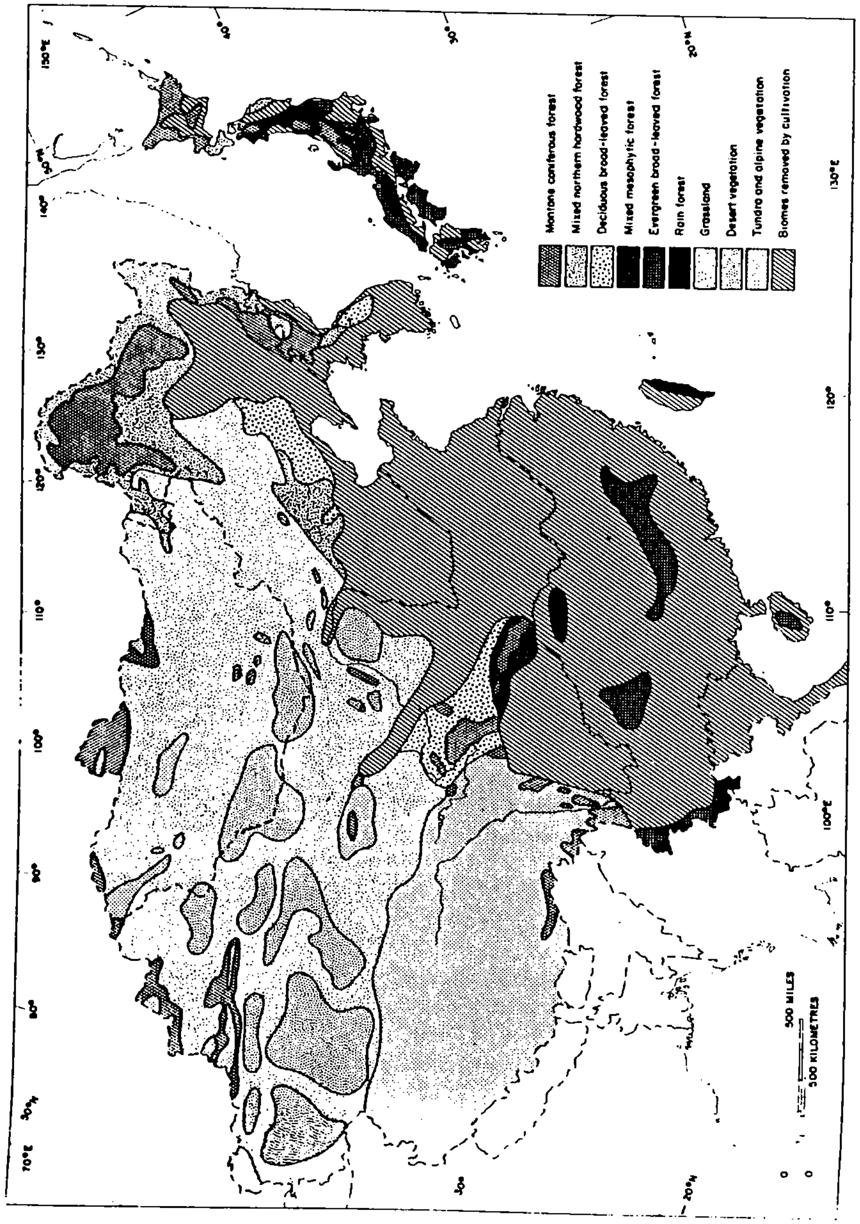

Fig. 18. The Biomes of East Asia.

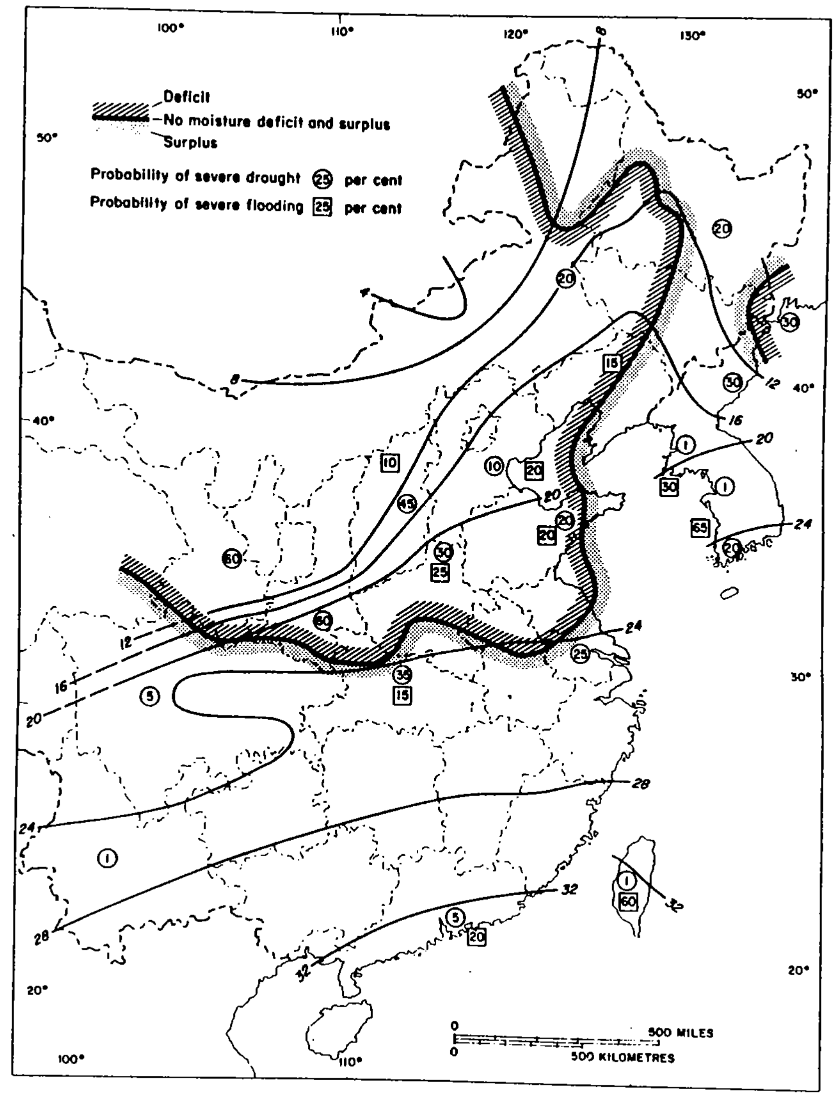

Fig. 19. Moisture stress and the annual net productivity of biomes (tonnes $ha^{-1} yr^{-1}$ dry weight).

natural ecosystems have developed devices for coping with these hazards, but in man-modified ecosystems, such as agriculture, most of these devices have been destroyed and man himself has to substitute for them.

The line separating areas that experience moisture stress from those which do not is crucial for man and crops (Figure 19). Apart from a very small area in northeastern

Korea, the major area experiencing such stress lies in north and northwest China.

From the point of view of agriculture and man, it is not moisture stress alone that is a hazard, but the frequency and intensity of its occurrence. Hence, on the map the circled values indicate the probability (number of years in one hundred) when a serious shortfall in crop production will result from moisture stress.[11] In the more easterly parts of North China, serious drought will occur in one out of five years; further west, in the Huang Ho basin and the loess region, the situation deteriorates, and six out of ten years will experience potential famine conditions unless irrigation is practiced. Although the possibility of drought, due to lack of rainfall, does occur in other parts of East Asia, there is usually sufficient soil moisture available to tide crops over the worst of the dry period.

Severe flooding (as indicated by the probabilities in the square boxes) also occurs in the area. This is especially serious in coastal areas subject to typhoon activity. However, the greatest damage to crops and man occurs in parts of North China also subject to drought. It is particularly severe here, because, as indicated earlier, rivers flow above the plain and the poor drainage results in extensive waterlogging. Indeed, the combination of drought and flood in this area makes the changes of a good farming year occurring less than 50% of the time.[12]

THE EVOLUTION OF THREE RESOURCE TRADITIONS

Three major, man-made ecosystems have been created in East Asia as ways of balancing populations against the carrying capacity of land and climate: shifting agriculture; peasant gardening with a wet-field and a dry-field variety; and nomadic herding.[13] Not only are there many variations within each system, but contained in each area, may be smaller portions of the others. Although the three systems have many different characteristics, they all represent attempts by man to channel the flows of solar energy, moisture, and nutrients into food crops rather than into plants of no human value. Each system, too, attempts to balance crop productivity with the demographic and cultural demands that the society makes. Arrangements also have to be made to deal with the problem of fluctuations in the moisture, nutrient, and pest environment.

Shifting Cultivation

Shifting cultivation societies once made up most of the oriental world and, indeed, much of the other continents as well. They represented one of the most advanced cultures of their day, replacing as they did the more primitive and declining hunting and collecting societies. In Asia, today, they are confined to the southwest of China, upland areas of the southeast, and scattered parts of the highlands of Korea and remote parts of Japan. In China, shifting agriculture is practiced primarily by minority groups such as Miao, Yeo and Lolo who have been forced into less favorable farming land of the southwest by the advancing Han people practicing peasant-garden cultivation.

Shifting cultivation in East Asia is man's labor-saving response to an environment where soil fertility is low and where most of the nutrients are tied up in the woody tissues of forest vegetation.[14] It is an environment, too, of heavy rains and high temperatures

that leach exposed soil of its nutrients and degrade the structure so that air, moisture and nutrients cannot circulate freely throughout it.

The strategy used by shifting cultivators is to use fire to release the nutrients stored in trees and to make them available for a few years for crops which are planted in forest clearings. At the end of two or three years most crops have extracted all the soil nutrients and yields fall quickly. There are other reasons for abandoning the land besides declining fertility. The growth of new vegetation increasingly cuts off light from crops, and plant diseases and pests invade the area. New fields are cleared and the abandoned fields are left to forest fallow so that the nutrients that have been dissipated through cultivation, are gradually accumulated again (Figure 20).

Because of the need to put large areas into forest fallow for a couple of decades, the overall carrying capacity of the shifting cultivation system in East Asia is low, varying between ten and a hundred persons per square mile (4 to 40 persons km^{-2}). However, moderately high densities of up to 200 to 300 people can be supported per square mile of cultivated land (78 to 117 persons km^{-2}).

When shifting cultivators practice a system where population pressure does not shorten the period of rotation, little environmental destruction results.[15]

The Peasant-Gardening Ecosystem

Almost a billion people in East Asia, or one-quarter of the world's population, are supported by the peasant-gardening ecosystem. The high, and ever increasing, levels of crop yields, produced century after century, and the rural and urban populations more dense than any found in the world before the industrial revolution, have created a profound transformation of the natural landscape.

In the peasant-garden system certain management techniques were used to save both space and time so that more crops can be grown. Landscapes were also realigned so that flows of moisture, energy, and nutrients were continuously channeled into a relatively small area of cultivated land.

The principal characteristics of the system were as follows:

(1) The permanent use of the same plot of land for crop production. The lack of fallow land was a primary cause for the relatively few draft animals.[16]

(2) Wherever possible, irrigation was practiced not only to satisfy the transpirational needs of rice, the most productive of all grain crops known to traditional East Asia, but to iron out the lesser annual and season fluctuations of precipitation. Irrigation also cools down ambient air and root temperatures thus reducing carbohydrate loss and enhancing higher growth rates. Nutrient-rich waters fed to fields through stream and irrigation systems help maintain the fertility of paddy soils.[17]

(3) In many wet-field areas where there is an approximate simulation of natural vegetation systems that gave them higher productivity and resistance to pests and disease (multiple-cropping, intercropping, nursery beds).[18]

(4) Labor intensive composting and fertilization techniques, closely linked to pig raising and aquaculture speed up the rate of decomposition and return nutrients more rapidly and with fewer losses to the soil for further crop growth.[19]

(5) The integrated spatial management of the nutrient sources of hillsides and water bodies adjunct to the cultivated lands and the channeling of these nutrients into the

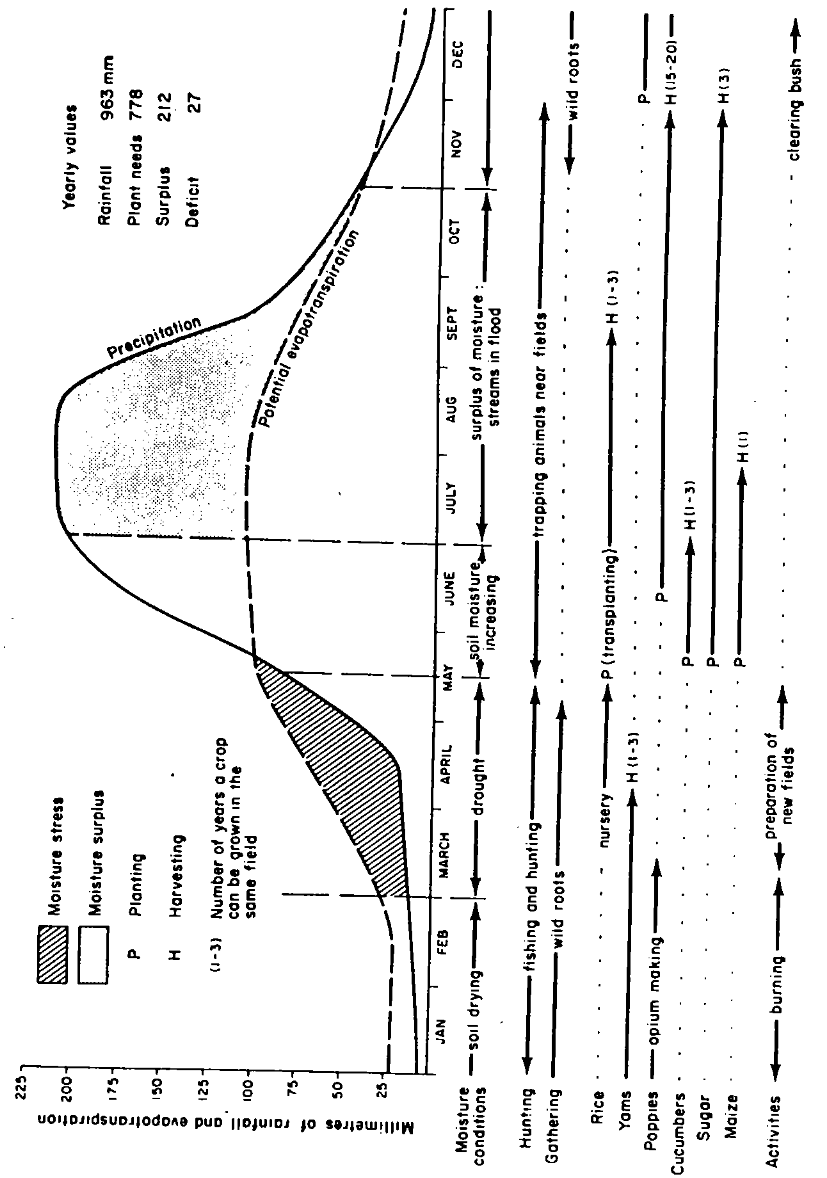

Fig. 20. The yearly cycle of work in shifting agriculture.

fields through the burning of hillsides, and the collection of wood and grass for fuel, fodder and fertilizer. Fertile muds and aquatic weeds from channels and irrigation ponds are also applied. The major "leaks" in this integrated nutrient system are through exports to urban centres. These were "plugged" through a massive system of spatial nutrient cycling in the form of the nightsoil trade. Where there were net exports of nutrients, fertility migration occurred (Figure 21).[20]

The hillsides, apart from playing the important role of supplying nutrients, also provided fuel and grazing lands for those farm animals that could not be fed entirely from the non-edible parts of the farm crops and were thus vital adjuncts to the maintenance of the lowland farm systems. The intensive use of the upland areas, however, was not conducive to forest growth, and their overuse contributed seriously to problems of soil erosion and flooding. One of the many benefits of the increased use of commercial fertilizers in East Asia since the 14th century, and the more recent use of fossil fuels, has been the fact that much of the pressure has been taken off the hill lands and has allowed programs of reforestation to succeed.[21]

The solution to the problem of low fertility of soils in the shifting agriculture system was to trade time for space by allowing the regrowth of natural vegetation over a long period to do the work of nutrient regeneration, and to move cultivation to some other area while that work was being done. The solution to the problem in the peasant-gardening system was to save both time and space by realigning the landscape so that flows of moisture, energy and nutrients were continuously fed from uncultivated areas to farm fields.

But this saving of space and time could only by purchased through the prodigious application of human labor. For not only did the infrastructure of heavy agriculture—the terraces, graded fields, irrigation systems—have to be constructed, but by profoundly modifying the natural ecosystem in the farmed areas and in the uplands, man seriously modified the free services of flood control, moisture retention and protection from pests and diseases that that system would have provided.[22] Further human effort was required, therefore, to replace these free services. A rough approximation of what these expenditures of labor were and what output of food energy resulted is given (Table 14).

It will be seen that, despite the high yields of the shifting system, its carrying capacity is about ten times lower than the dry-field and about twenty times less than the wet-field, since only 10% of the land is under crops at any one time. The price that the wet-field system pays for this intensive saving of space and time is an increase of work that is eight times greater than in shifting agriculture.

The most important thing about the peasant-gardening system, however, was the fact that it could generate sufficient surpluses to support large non-agricultural populations in urban centres.[23]

The Nomad-Herder Ecosystem

The carrying capacity of the nomad-herder ecosystem is easily the lowest of the three systems considered. In the late 19th century it is estimated that some five million people, or one percent of the population of East Asia, were minority group, nomadic herders. This small population, however, required for its support a land area of some 4 million

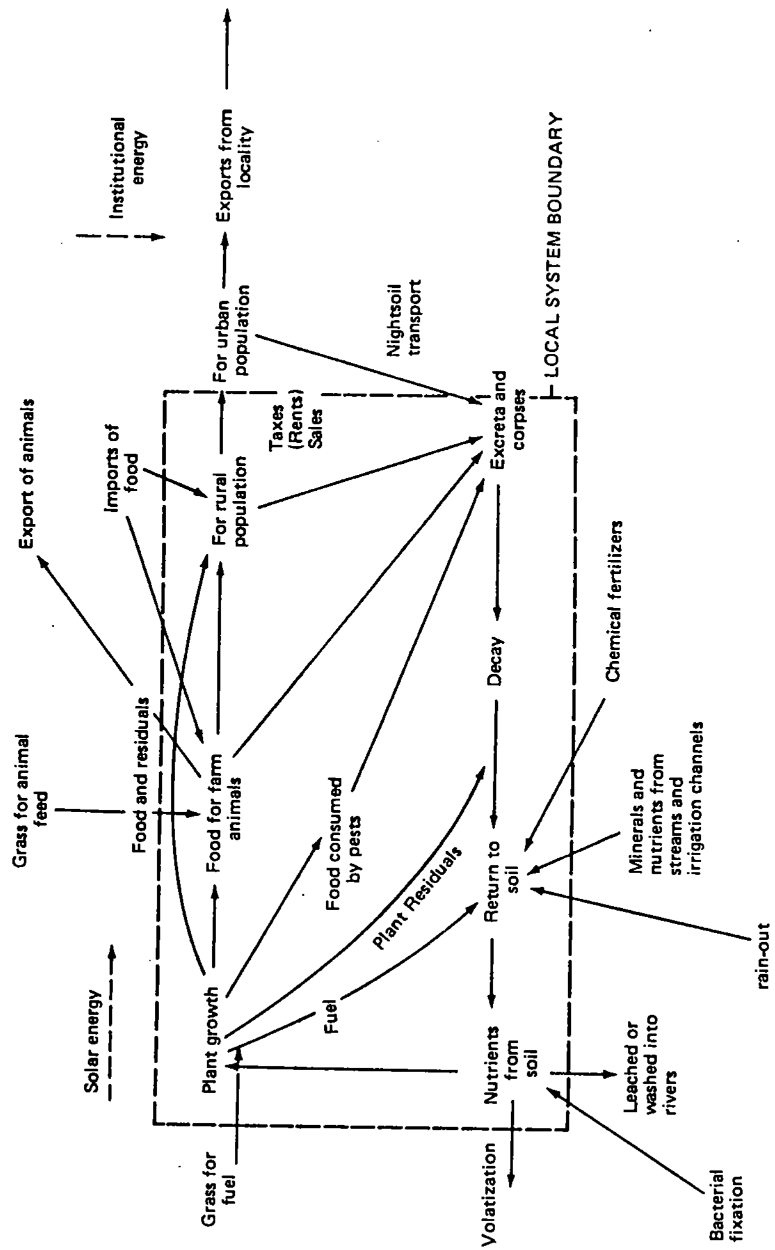

Fig. 21. The flow of nutrients in East Asian farming systems.

Table 14. Comparison of Energy Use and Production in Four East Asian Farming Systems[a]

System	Farm work	Food yield	Ratio Work:yield	Theoretical pop. km^{-2}	Surplus non-farm population	Area to support city, 100,000 km^2
Wet field	168	964	1:5.7	1205	133	750
Dry field	62	456	1:7.3	570	51	2000
Shifting	20	400	1:20	(500)→50	nil	nil
Hong Kong[b]	1166	1525	1:1.25	1900	1650	60

Notes:

[a]In early 20th century. All valves are in millions of k.cal.km^{-2}.

[b]Data for 1971. Based on K. Newcombe, "Energy Use in the Hong Kong Food System," *Agro-Ecosystems, 2* (1976), pp. 253-276.

square kilometers (1.6 million square miles) or 40% of the region. Although small in total size, the nomadic populations of central Asia have played a role in East Asian history out of all proportion to their numbers.[24]

In the steppes, the basic problem of balancing population against food supplies is made more difficult by the fact that there is insufficient moisture to grow crops and man has to lengthen the food chain and depend on a variety of herbivores for his sustenance. The herbivores–sheep, goats, cattle, horses, camel, yak–depend, in their turn, on the abundance and spatial and seasonal distribution of grass. In the high steppe, in parts of Sinkiang, Tibet, and Chinghai, the abundance of grass is primarily dependent on the length of the growing season; on the low Mongolian steppe, the abundance is largely a function of moisture availability.[25]

It has been estimated that a nomadic family of four can be completely self-sufficient with a herd of 300 sheep equivalent (five sheep to one bovine).[26] In the moist parts of the steppe, the grasslands have a carrying capacity of about 50 sheep per square kilometer (128 sheep mile^{-2}) and, in the drier parts, about 27 (70 sheep mile^{-2}). Thus, in the former region, the herd of a single family would have to graze an area of some 6 square kilometers (2.3 sq. miles), and, in the drier parts, some 20 square kilometers (7.8 sq. miles). Population densities would, therefore, be about 0.6 per square kilometer (1.5 mile^{-2}) in the moist steppe and about 0.2 (0.5 mile^{-2}) in the dry areas. Because of these low densities and because of the fact that annual migrations over hundreds of kilometers occurred in search of new pastures, few permanent settlements developed.[27]

The high mobility of the steppe people made them formidable enemies for the peasant-gardening societies, since the latter were tied to fixed settlements, immobile lands, and grain storage facilities. The nomadic tribes, on the other hand, were practically impervious to conquest, since they had no fixed settlements and their fields and granaries were "on the hoof."[28]

DEVELOPMENTS IN TRADITIONAL RESOURCE-USING SYSTEMS

Each of the traditional resource-using systems described above has survived down to the present time, although each has changed in significant ways.

The system of shifting agriculture has suffered greatly where population pressures have risen or where the shifting cultivators have been pushed back into land with less and less carrying capacity. In these cases the forest fallow period becomes shortened, less plant cover remains to prevent soil erosion, and nutrient depletion accelerates, causing serious environmental degradation.[29]

Most shifting cultivators in China belong to ethnic minorities, living apart from Han populations, and having their own socio-political structures and controls. Because of the low carrying capacity of the land and the small agricultural surpluses, shifting cultivation has not stimulated the growth of urban centers–most farmers living in small settlements ranging from a dozen to a couple of hundred units.[30] Because of their very different ethnic, social and economic organization, the Chinese government over the centuries has never incorporated these groups into its regular administrative structure. Today, most of these tribes are organized into autonomous counties, districts and provinces. In 1953, some 15 million people or 2.5% of China's population are estimated to be shifting cultivators.[31]

The nomadic-herder system has also suffered greatly with the passage of time. In the 19th and 20th centuries, for example, as Chinese farmers, backed by railways and by the political and military power of a government anxious to colonize, began to penetrate the steppe, the great territorial range necessary to make the nomad ecosystem function effectively was decreased and nomadism, as a way of life, has been declining in most parts of Asia since that time.[32]

The wide ranging movements necessary for the successful functioning of the nomadic system have also been curtailed by the "hardening" of international boundaries across which the herders made their annual crossings and by the attempts of governments to collectivize the herders and relegate their activities to more circumscribed territorial boundaries.[33]

Of the three ecosystems, only one, the peasant-gardening, could rise above the natural carrying capacity of the local environment and could initiate a cycle of events that can best be described as a kind of pre-modern take-off to sustained economic growth. Neither shifting agriculture nor the "fields on the hoof" had surpluses large enough to support large elite groups, let alone whole urban populations. Yet the peasant-gardening system, through ever intensifying techniques for saving space was, as mentioned above, able to support nearly one-half of the world's urban population.

Those areas that were able to mobilize their rural populations and extract their surpluses for the construction of water resource management projects and water transportation networks–the wet-field regions–achieved greater comparative political, social and economic advantage than areas that lacked this ability.[34] Such regions were characterized by high population densities, high yields, large cities, a denser urban network and a higher degree of commercialization of the economy (Figure 22).[35] As wealth accumulated, local elites financed further resource management projects, and all of these, through a process of circular causation, mutually reinforced each other to give such wet-field areas a permanent and increasing comparative advantage over all other regions.[36]

The close relationship between the wet-field type of peasant-gardening and urbanization can be clearly seen (Table 15). Not only does each square kilometer of cultivated land in the wet-field system support an urban population that is three to five times larger than in the dry-field system, but the density of large cities is also higher. This is

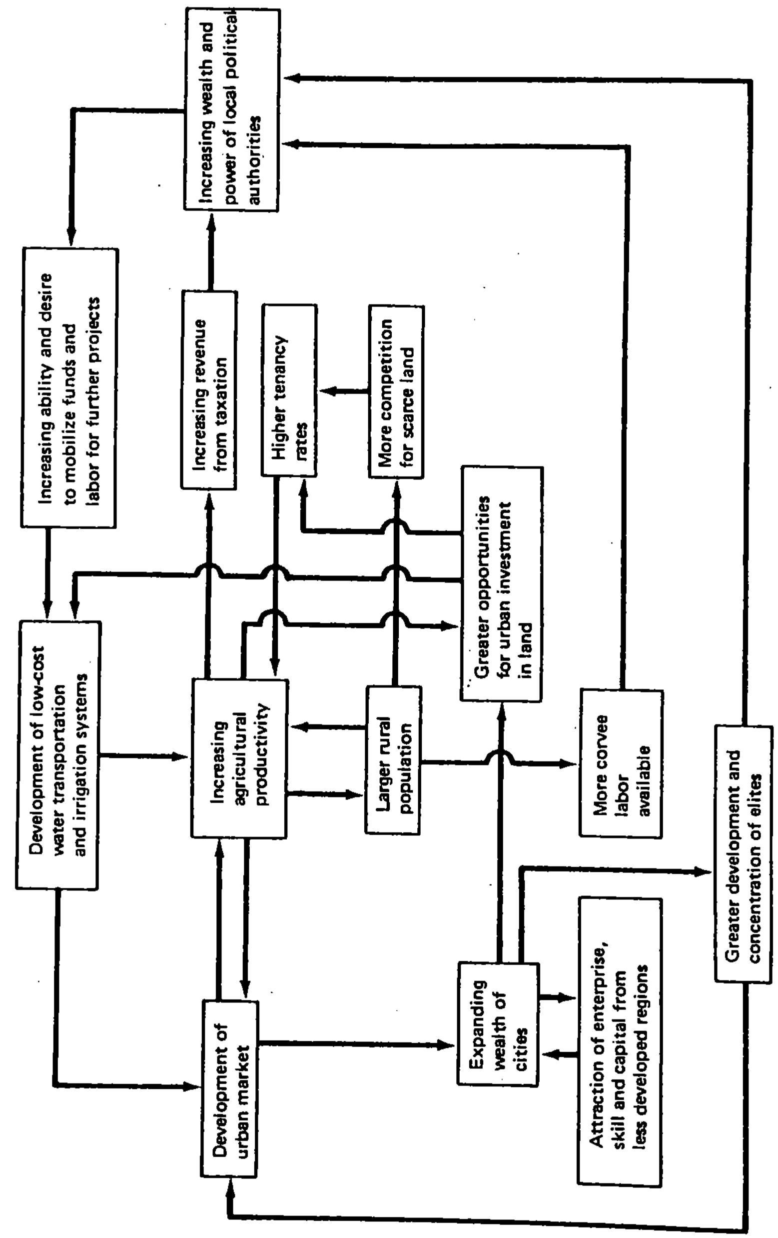

Fig. 22. The creation of developed areas in traditional East Asia.

Table 15. Urbanization in Wet and Dry Field Areas of East Asia in Mid-19th Century

Indices of population and cities	"Backward" dry-field areas N. China[a]	"Advanced" wet-field areas	
		S. China[b] (Developed)	Japan (Most developed)
Density of population per sq. km. of cultivated land[c]	414	788	621
Urban population supported per sq. km. of cultivated land[d]	19	60	96
Index of urban population density supported per sq. km. of cultivated land adjusted for population density (N. China = 100)[e]	100	180	339
Number of large cities per 100,000 sq. km. of cultivated land[f]	8	25	43
Index of number of large cities per 100,000 sq. km. adjusted for population density (N. China = 100)[g]	100	168	370
Number of small cities per 10,000 sq. km. of cultivated land[h]	256	592	360
Index of number of small cities per 10,000 sq. km. adjusted for population density (N. China = 100)[i]	100	121	93
Percent of total population in cities[j]	4.5	7.5	16.5
Percent of urban population in large cities[k]	36	59	55

Notes and sources:

[a]N. China refers to the provinces of Chihli, Shansi, Honan and Shantung.

[b]S. China refers to Fukien and Kwangtung.

[c]Data based on Dwight H. Perkins, *Agricultural Development in China, 1368-1968* (Chicago: Aldine, 1968), p. 212.

[d]Urban population from Rozman (*see note 35*) pp. 199 and 272.

[e]The influence of different densities of population on the levels of urbanization is removed by using the following index:

$$\text{Index of urban population density} = \frac{\dfrac{\text{wet-field urban density}}{\text{dry-field urban density}}}{\dfrac{\text{wet-field population density}}{\text{dry-field population density}}} \times 100$$

[f]These are the 1-3b level cities of Rozman's hierarchy (*see* pp. 109, 205, 239 and 272).

[g]This index is constructed in the same way as above in note *e*.

[h]These are the 4-7 level cities of Rozman (*see* references in note *f* above).

[i]Index constructed as described above.

[j]Rozman's data on pages cited above.

[k]Ibid.

Table 16. Representative Labor Requirements and Yields of Traditional, Transitional and Modern Peasant Gardening Resource Systems

System	Man-days per hectare of cultivated land	Yield (kg. man-day^{-1} ha^{-1})[c]
Traditional		
Dry farming	119[a]	4-6
Wet farming	347[b]	6-8
Contemporary		
Traditional	550[c]	2-4
Transitional	1200[d]	6-9
Modernized	102[e]	40-60

Notes and sources:

[a]Based on data for Hopei province in J. Lossing Buck, *Land Utilization in China* (Nanking: University of Nanking Press, 1937), Statistical Volume, Section vii, Table 9. The labor requirements are weighted for sown area data in Hsin-i Chang, *Chung-kuo nung-yeh kai-k'uang ku-chi* [An Estimate of China's Farms and Crops] (Nanking: 1933), Table 5.

[b]Based on data for Kuangtung province and calculated in the same manner as for note *a*.

[c]J. Whitney, *China, Development and Challenge*, 1979, in press.

[d]Ibid.

[e]Japan, Ministry of Agriculture and Forestry, *Statistical Yearbook* (Tokyo: 1975), p. 171.

due mainly to the smaller food surpluses of the latter areas and the higher transportation costs incurred in carrying food to the larger centres. Small urban centres, on the other hand, with lower support costs to maintain them are more equally distributed between the two areas.

Thus, long before the advent of the West and "modernization," there were already developed and underdeveloped regions of East Asia even within a single resource system such as peasant-gardening. By the 1930s the advanced areas of the peasant-garden system had reached productivity levels of over 50% of the natural biomes of the area, whereas the backward dry areas were able to attain only 20 to 30% of the natural systems' productivity.[37]

Three stages of development can be observed in the peasant-gardening system today: traditional, transitional, and modernized. The major factor that differentiates each is the labor input required for farming (Table 16).

Traditional Peasant-Gardening

This remains essentially the same as described earlier, except that, in the case of China, the small farms based on individual household ownership have been replaced by production teams of thirty to forty families and large communes embracing several square miles and populations running into the thousands.[38] Although there may be a few modern inputs such as mechanical pumping of irrigation water and some chemical fertilizers and pesticides, the major part of the farm work is still carried out in traditional ways and primarily with human labor. The latter, however, under the commune system can be mobilized more effectively to help cope with peak labor demands and to carry out winter-works projects.[39]

Table 17. Labor Requirements During Peak Demand Period[a]

Crop	Input	Man-days per hectare
First	Harvesting	19
	Carrying	7
	Threshing	16
	Drying	6
	Storage	4
Second	Ploughing	5
	Harrowing	7
	Transplanting	20
Total for peak period		84
Total for double rice crop		305

Note:
[a]Double rice-cropping area.
Source: Buck (*see Table 16, note a*).

In the northern and more arid part of China, such remaining traditional systems will probably still be limited to one major crop per year because they lack the ability to tap underground or distant surface sources of water. In the south, where water is available, inability to introduce multiple-cropping will be due primarily to the bottleneck of labor shortages at peak periods. Buck's survey of traditional Chinese agriculture carried out in the 1930s shows that in many areas potentially capable of growing two or three major crops per year, multiple cropping was not practiced because of peak-period labor shortage.[40].

Large labor inputs for the critical period from harvesting the first rice crop to planting the second were required (Table 17). Nearly 28% of the total man-days to cultivate the two rice crops was concentrated into a matter of 15 to 20 days. If the planting of the second crop were delayed, the growing season for the second crop would be reduced and hence yields lowered.

Undoubtedly, in many of the traditional areas, despite attempts to rationalize farm labor on a commune basis, a similar situation still exists, inhibiting the planting of second or third crops.

Transitional Peasant-Gardening

The transitional sector has greatly increased input of labor above those of the traditional or modern systems, and this may seem paradoxical until the nature of the modernization occurring in the transitional system is examined (Table 16). The key to the understanding of this phenomenon is found in the role that the introduction of mechanical irrigation plays, particularly in those areas where water must be pumped from deep underground aquifers.[41]

Irrigation triggers off the following labor demanding activities:

(1) The introduction of multiple-covering (crops raised successively during a single year from the same plot of land);

(2) Greatly increased demand for organic fertilizers to be collected from hillsides, irrigation channels, pig raising and estimated to occupy 45% of all labor activities compared to some 9 or 10% in the traditional system;[42]

(3) Moist fields, well supplied with nutrients, increase weeds, pests, and diseases which must be controlled;

(4) The infrastructure for storing and distributing water must be constructed and repaired.

Thus, the modernization of the traditional system that is now going on in China and which occurred in Japan half a century or so earlier, while saving labor through mechanization in such activities as mechanical irrigation, and cutting down on peak labor demand through the use of transplanting machines and mechanical threshing, generates a demand for even more labor. Hence, even in a transitional farming system, traditional activities for recycling nutrients are more important than those of chemical fertilization (Figure 23).

The nutrient budget for a small farm area in North China shows clearly the important role played by such adjunct hill-lands which provide over 80% of the gross nutrient supply in contrast to chemical fertilizers which supply over 13%.[43] If hillside sources were cut off, in this example, nutrients from chemical supplies would have to be increased six-fold. There is indeed a modest annual net gain to the available N, P, and K soil nutrients of 6, 21, and 3% respectively, largely derived from hillsides, thus allowing for another round of crop increased in the following year. However, in areas where adjunct hills are not available or where there is insufficient labor and/or enthusiasm to collect organic manures (applied at the rate of over 100 tonnes $ha^{-1} yr^{-1}$ [40 tons $acre^{-1} yr^{-1}$]), it can be expected that yields will be lower or that, if they are not, soil fertility reserves are being depleted. This process, judging from the available nutrients in the soils of the budget example, could be completed in a matter of a year or two.

REGION IN TRANSITION

As has been demonstrated above, the initial impact of the modernization of the traditional farming system is to intensify many of the traditional labor intensive farming practices while reducing or eliminating others, the net result being a greatly expanded demand for labor particularly in those dry farming regions where irrigation is introduced for the first time. The modernization of the traditional resource sector also affects the relationship between the lowland farming system and the upland adjuncts as described earlier. In the first place many upland areas that were formerly used for fuel and fodder can now be turned into terraced cultivated lands. Secondly, while still relatively unimportant in many areas, the pressure on the hillsides to produce nutrients for lowland farming is being reduced through alternative sources of organic or chemical fertilizers. Thirdly, the provision of electricity and other sources of fuel for domestic purposes reduces the demand made on the hillsides to provide energy for lowland use. It also means that more of the crop residues formerly used as fuel can be composted and returned to the land.

The net result of this reduction in the demand made on hillside resources has enabled

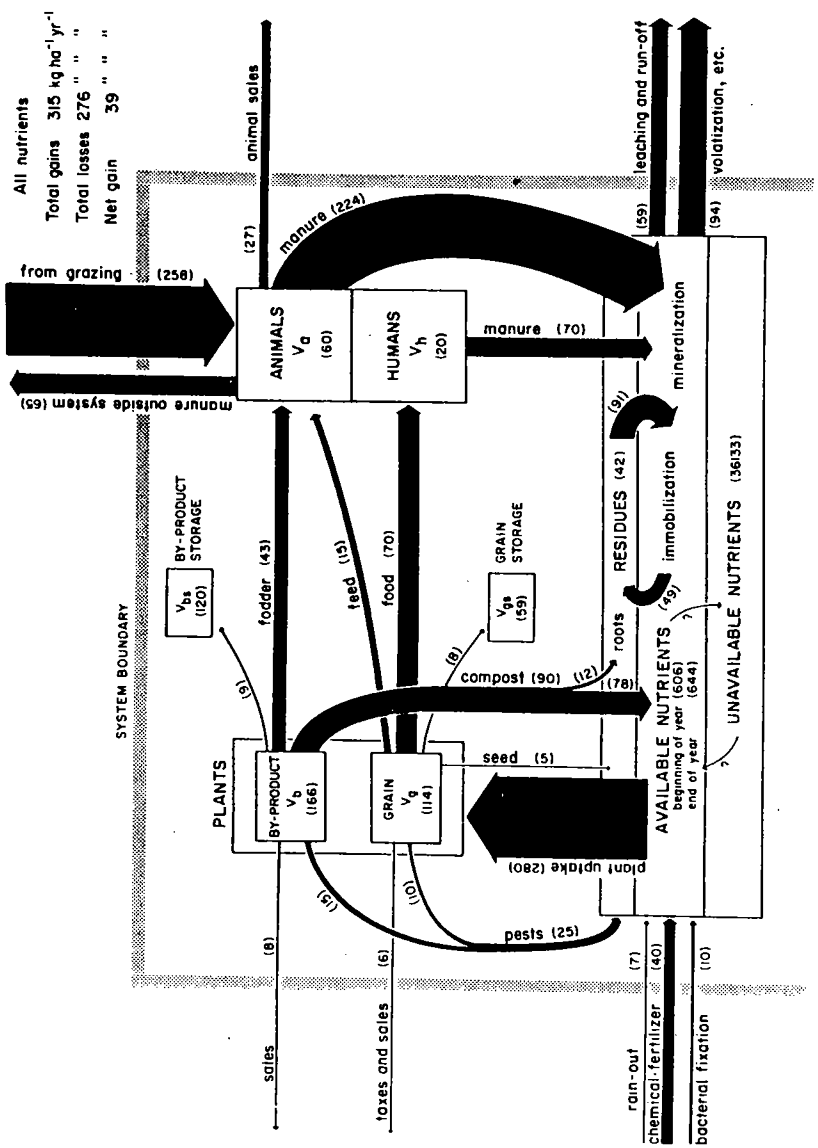

Fig. 23. The flow of nutrients in a transitional farming system.

Table 18. Increase of Part-Time Farming in Modern Peasant Gardening in Japan

Household indices	1950[a]	1976[b]
Farm households as percent of total households	37	15
Percent of farm households		
fully dependent on farm income	50	13
partly dependent on farm income	50	87
who gain over 60% of income from farming	57	24
who gain over 60% of income from other sources	43	76
Percent of total Japanese households gaining over 60% of income from farming	29	5

Sources:
[a]*Japan Statistical Yearbook, 1958*, p. 99.
[b]*Japan Statistical Yearbook, 1977*, p. 121.

reafforestation of the slopes to be accomplished, whereas in the traditional system even when it was perceived as being desirable it was often unfeasible for the reasons stated above.

The Modern Peasant-Gardening Resource System

While the traditional and transitional forms of peasant gardening result in an intensification of cultivation, labor inputs and the channeling of regional natural resources to the agricultural sector, the modernized form of the system as now practiced in Japan shows striking differences. In the first place, the labor requirement per unit of cultivated land for crop production is greatly reduced, amounting to one-tenth of the transitional system (Table 16). This, of course, is due to the fact that the modern sector is now heavily subsidized with fossil fuels in the form of energy, chemical fertilizers, pesticides, and herbicides.[44] This reduction in the demand for agricultural labor has had profound impacts on the whole fabric of Japanese rural life (Table 18).

By the 1970s those earning most of their income from farming comprised a mere 5% of the total population 66% of the farm households derived most of their income from sources other than farming. The primary reason for this is that the majority of farms are too small to provide an adequate income for farming families and that there are higher paying jobs in the urban-industrial economy.[45]

Dramatic changes have also occurred in farming land use. Whereas, in the traditional and transitional sectors, the trend is to greater intensity of land use through intercropping, multiple-cropping and transplanting, in the modern system of Japan the trend is toward a single crop grown once a year; thus in 1976, 93% of farm families practiced monoculture and between 1956 and 1976 the multiple-cropping index (sown area/cultivated area X 100) showed a decrease from 160 to 103%.[46]

These trends can be attributed to the fact that the crops that follow rice (whose production is subsidized by the Japanese government) in the multiple-cropping system such as wheat and barley can now be imported from abroad more cheaply than they can be produced at home.[47]

As labor costs in Japan rise, less and less attention is paid to the labor intensive practices of the traditional and transitional systems with the result that many environmental problems are being exacerbated. Instead of the recycling practiced in the traditional system, the modern one has devised a "once-through" path for its nutrients which does not utilize the waste organic products of crop and animal farming or of human wastes and thus creates pollution of land and water bodies.[48]

CONCLUDING REGIONAL ASSESSMENT

The traditional East Asian resource system, particularly its wet-field variety, had the capacity, as we have seen, not only to give employment to large numbers of people, but to produce further increments of food with each additional labor unit without appreciable diminishing marginal returns occurring.[49] This characteristic, called involution by Clifford Geertz, means that peasant gardening is the only productive system outside of the labor intensive industrial system developed at the beginning of the 19th century that is able to respond to a rapidly growing population associated with demographic transition (i.e., a population having high birth rates and falling death rates). Moreover, unlike the latter system, peasant gardening is not only able to provide economically efficient employment, but it is also able to feed, in addition to those in the agricultural sector, those in other parts of the economy as well.[50] Thus, for capital-short developing countries, experiencing the economic and social disruption caused by the period of demographic transition, the peasant-garden system enables a country to span this phase of its development with the minimum of dislocation since it continues to maintain a large and flourishing rural sector of society, conserving many of the traditional virtues and vices.[51]

In the case of China, between the 1930s and 1975, the peasant-gardening resource system was able to absorb some 135 million people into its labor force, and by the 1990s an additional 73 million workers can be accommodated.[52] At an earlier period, during the latter part of the 19th century the Japanese peasant-gardening system experienced a similar though less dramatic development.[53]

Although the peasant-garden system functioned on sound ecological principles, it was, nevertheless, in a condition of unstable equilibrium with its environment. As we have seen, the effectiveness of the system depended on the massive submission of all other resource systems to the needs of agriculture, through the diversion of their nutrients, energy and moisture for the needs of crops. As mere adjuncts to farming these other ecological systems suffered severe damage from vegetation and soil removal with the result that the free services of flood control and drought amelioration which they would have naturally provided were seriously curtailed.[54] However, through an untutored understanding of the basic ecological principles at work, the farmers of the peasant-garden system were able to combat a great many of these problems partly through the judicious imitation of natural ecosystems in such practices as inter-cropping, multiple-cropping, nutrient recycling, and predator pest control and partly through additional inputs of labor directly applied to combatting the environmental damage.[55]

The traditional peasant-gardening system has demonstrated its resilience in the face of environmental and social change over the centuries and this resilience was due not only to the massive labor inputs required to keep the system in equilibrium with its environment, but also to the care and understanding that generations of peasants developed in relation to their plants.[56]

The modern system of peasant gardening, while apparently as productive and less labor-demanding than its traditional counterpart is potentially much more fragile than the latter, since it relies heavily on inputs of fossil fuel sources of energy and nutrients.[57] While it is true that modern inputs have taken the farming pressure off adjunct ecological systems, urban-industrial developments present a large and ever-growing threat. Moreover, because monoculture is economically more efficient for the farmer to practice, most of the ecological farming practices of the traditional system have been lost, and the threat of diseases and pests is an ever potential and growing one that can be remedied only through the application of greater quantities of pesticides, herbicides and fertilizers—resulting in a further decline of environmental quality.[58]

The Future of the Past

Some of the principal practices and techniques of the traditional peasant-gardening system can be utilized in the transitional and modern variants without reducing yields provided that labor demands can be met (Table 19).

The table shows that throughout the greater part of the region the majority of the traditional practices are being continued in an even more intense form in the transitional system. Indeed, the Communist Chinese planning principle of "walking-on-two-legs" (the use and popularization of both traditional and modern methods to achieve economic development) is an indication that many traditional practices will be retained for some time to come despite the current frenetic efforts to modernize the economy.[59] Moreover, if additional employment cannot be found for the increasing labor force in the urban-industrial economy, and/or, if the undesirable effects of total reliance on fossil fuel farming should become widely apparent in the near future, it is quite possible that many of these practices would be carried on far into the future.

There are, however, some situations where modern technology cannot be replaced by labor without retarding yield increases.

Mechanical pumping. Particularly where deep ground water supplies are available even massive inputs of labor cannot pump the water up.

Cement lining of irrigation canals. In more arid regions, it is essential that there be no leakages from irrigation canals into the surrounding soils since this gives rise to salinization and hard-pan formation which is detrimental to agriculture.[60]

Mechanization to reduce peak load labor demand. As indicated earlier, there were many areas of the traditional resource system where multiple-cropping could not be practiced because the labor supply could not meet the demands for harvesting one crop and planting a second in a sufficiently short time. Thus, mechanization to replace labor at peak periods should be encouraged. This would include such devices as mechanical transplanters, threshing machines and small tractors for ploughing and harrowing.

Chemical fertilizers. For continued increases of crop yields there must be a blending of traditional and modern fertilization techniques. Chemical fertilizers with their high nutrient content in relation to weight can save a great deal of labor. Of greater importance is the fact that they can supply nutrients that might otherwise have to be supplied by

Table 19. A Selection of Techniques and Practices in the Traditional Resource System and Modern Applications

Technique or practice	Comment	System: Traditional	Transitional	Modern
	Cropping			
Nursery beds (small plots to grow young plants)[a]	Saves time and space. Easy to control for low temperature, pests, and weeds.	⊙	⊙	⊙
Black ash on nursery beds	Warms soil to increase germination of seeds.	⊙	⊙	○○[b]
Inter-cropping (different crops planted in same field at staggered intervals)	More effective use of solar radiation for photosynthesis. Facilitates transfer of soluble plant nutrients.	⊙	⊙	○○
Straw mulching dug into ridges of furrows	(1) Conserves moisture. (2) Allows aeration of soil (3) Ash elements in straw leached directly to crop roots. (4) Straw and soil constitute a compost.	⊙	⊙	●○
Dwarf fruit trees	Ease of picking and pest control	⊙	⊙	⊙
Multiple cropping	Two or more successive crops in same field.	⊙	⊙	●○
Root-zone fertilization	Economizes on fertilizers. Prevents pollution of water bodies.	⊙	⊙	●○
Ridging (after two crops of rice, soil banked into long ridges 1 meter wide to grow vegetables)	Permits ill-drained soils to be used during winter.	⊙	⊙	○○
Close-deep furrowing	In areas of heavy intermittent rain prevents flooding of crops. Moisture and nutrients conserved in troughs.	⊙	⊙	⊙

Table 19 (cont'd.)

Technique or practice	Comment	System: Traditional	Transitional	Modern
Assymetrical ridging	Used in north-facing mountain areas to enable crops to receive maximum insolation.	⊙	⊙	⊙○
Biological insect control	Natural predators control insect pests.	⊙	⊙	○○
	Landscape changes			
Terracing	(1) Increases cultivated area. (2) Retains runoff and prevents erosion. (3) Increases nutrient retention in the soil. (4) Permits irrigation.	⊙	⊙	●○[c]
Trenching	The trenches retain moisture and nutrients washed off cultivated area for subsequent crop use.	⊙	⊙	○○
Embankment round fields	Conserves moisture and prevents nutrient loss during heavy rain.	⊙	⊙	○○
Ponds[d]	(1) Retain water for irrigation. (2) Act as nutrient sinks for surrounding fields. (3) Fertilized by waste materials from settlements. (4) Fertile mud applied to fields.	⊙	⊙	●○
	Fertilizing			
Urban sewage (nightsoil)[e]	Transported to surrounding agricultural lands.	⊙	⊙	○○
Irrigation and stream mud	Mixed with organic material to form compost. Rich in plant nutrients.	⊙	⊙	○○

Table 19 (cont'd.)

Technique or practice	Comment	System		
		Traditional	Transitional	Modern
Exchange of soil between rice fields and mulberry	Soil developed under each crop complements nutrient requirements of the other.	⊙	◉	○?
Composting with canal mud, clover, human and animal manure, and ashes	Releases immobilized plant nutrients and provides them in soluble form for plant use.	⊙	◉	○◯
Green manure from hills		◉	◉	○
Floor soil	The compacted soils used to construct floors when dampened over long periods of time produce nutrients in soluble form.	⊙	●	○
Dried human and animal manure	Used in N. China. When pulverized the powder easily mixes with the soil providing soluble plant nutrients. Health hazards reduced.	◉	●	○◯
Chinese clover (medicago denticulata)	Used in inter-cropping or multiple-cropping with rice or barley followed by cotton. Increases nitrogen in soil.	⊙	◉	●◯
Water hyacinths and lotus	Harvested for compost. Reduces nutrient wastes in canals and streams.	⊙	◉	○◯
Aquaculture[f]	(1) Fish provide high yield of protein per unit area. Cause rapid breakdown of organic materials fed to them.	⊙	◉	●◯
	(2) Blue-green algae in rice fields convert atmospheric nitrogen into forms soluble by plants.	⊙	◉	○[g]

Key to symbols:
⊙ Important
◉ Very important
● Decreasing importance
○ Not important
◯ Could be retained in modern system without reducing yield if sufficient labor available

Notes:
[a]See figure 24.
[b]Replaced by plastic covers.
[c]Except for tea and fruit (mandarin and orange in Japan).
[d]See Aquaculture below.
[e]See Figure 25.
[f]See Ponds above.
[g]Killed by herbicides.

adjunct hill lands and thus contribute to soil erosion. Nevertheless, traditional fertilization techniques should also be retained since they improve soil structure, help to retain moisture, and facilitate the aeration of soils. Moreover, the removal of nutrients from streams and other water bodies through aquatic weed harvesting and the dredging of mud reduces eutrophication problems and enhances water quality for other uses.[61]

In the modern system as practiced in Japan the traditional experience has for the most part been overthrown. The Japanese farmer, so financially involved with the farm machinery and chemical manufacturers, and, unable to afford the high price for farm labor, cannot afford to practice traditional techniques any longer.[62] Moreover, having lost most of the protective ecological devices of the traditional system, modern peasant gardening has now become even more dependent on the industrial sector in the fight

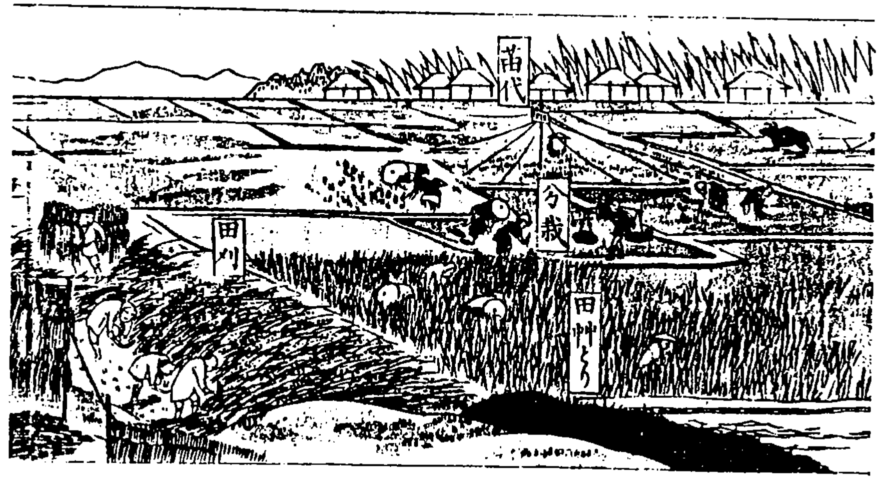

Fig. 24. Traditional peasant gardening rice cultivation scene, showing stages of cultivation from ploughing to harvesting (*Source: Kyoso* [1873]).

Fig. 25. Farmland around traditional Chinese city benefits from urban sewage.

against crop disease and pests. Lastly, it is likely that the experience and skills associated with the traditional resource system will die with the present generation of older farmers and will be difficult to acquire by their successors. Even if economic conditions became ripe for more labor intensive agriculture the experience required to employ that labor effectively would be lacking.

In the East Asian resource system, as in many other parts of the world, the past continues to live in the present and is likely to remain for some time to come. Not only does it survive but its many traditional practices continue to support over one-quarter of the world's population.

NOTES

[1] Yi-fu Tuan, "Discrepancies Between Environmental Attitudes and Behaviour: Examples from Europe and China," *The Canadian Geographer*, Vol. 12, No. 3 (1968), pp. 176-91; and Ping-ti Ho, *Studies on the Population of China 1368-1953* (Cambridge, Mass.: Harvard University Press, 1959), pp. 137-41.

[2] Derk Bodde, *China's Cultural Tradition* (N.Y.: Holt, Rinehart & Winston, 1957), pp. 37-39.

[3] Joseph E. Spencer and William L. Thomas, *Asia East by South* (N.Y.: John Wiley, 1971), pp. 120-72.

[4] George B. Cressey, *Land of the 500 Million* (N.Y.: McGraw-Hill, 1955), pp. 255-69.

[5] Owen L. Lattimore, *The Inner Asian Frontiers of China* (Boston: Beacon Press, 1962), pp. 279-374; and Ping-ti Ho, "The Loess and the Origin of Chinese Agriculture," *American Historical Review*, Vol. 75 (1969), pp. 1-36.

[6] Jung-pang Lo, "The Controversy over Grain Conveyance During the Reign of Qubilai Qaqan, 1260-1294," *Far Eastern Quarterly*, Vol. 13 (1954), pp. 263-85.

[7] Shannon McCune, *Korea's Heritage, A Regional and Social Geography* (Vermont: Charles Tuttle, 1956).

[8] Glenn T. Trewartha, *Japan: A Geography* (Madison: University of Wisconsin Press, 1965), pp. 25-38.

[9] Herold J. Wiens, *China's March Toward the Tropics* (Hamden, Conn.: Shoestring Press, 1954).

[10] The empirical work upon which these calculations are based is L. E. Rodin and N. I. Bazilevich, "Geographical Aspects of Biological Productivity," *Soviet Geography*, Vol. 12, No. 4 (1972), pp. 293-317.

[11] The probabilities are based on the study by Augustine Y. M. Yao, *Characteristics and Probabilities of Precipitation in China* (Washington, D.C.: U.S. Department of Commerce, 1969).

[12] Shan-yu Yao, "The Geographical Distribution of Floods and Droughts in Chinese History, 206 B.C.-A.D. 1911," *Far Eastern Quarterly*, Vol. 2 (1947), pp. 357-78.

[13] Joseph E. Spencer, *Oriental Asia: Themes Toward a Geography* (Englewood Cliffs, N.J.: Prentice-Hall, 1973), pp. 68-86.

[14] J. E. Spencer, *Shifting Cultivation in Southeastern Asia* (Berkeley, 1969).

[15] Spencer, op. cit., note 13.

[16] The relationship between population pressure, fallow land and farm animals is discussed in the seminal work by Ester Boserup, *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressures* (Chicago: Aldine, 1965).

[17] F. H. King, *Farmers of Forty Centuries* (London: Jonathan Cape, 1949), pp. 238-65.

[18] Matthias U. Igbozurike, "Ecological Balance in Tropical Agriculture," *Geographical Review*, Vol. 61, No. 4 (Oct., 1971), pp. 495-529.

[19] Joseph B. R. Whitney, "Ecology and Environmental Control in China," in Michel Oksenburg, ed., *China's Developmental Experience* (N.Y.: Praeger, 1973), pp. 93-109; and D. D. Tapiador, et al., *Freshwater Fisheries and Aquaculture in China* (Rome: FAO, 1977).

[20] James Thorp, *Geography of the Soils of China* (Nanking: National Geological Survey of China, 1936), pp. 430-32.

[21] This point is discussed in Thomas C. Smith, *The Agrarian Origins of Modern Japan* (N.Y.: Atheneum, 1966), pp. 101-04; and in Edward A. Ackerman, *Japan's Natural Resources and their Relation to Japan's Economic Future* (Chicago: University of Chicago Press, 1953), pp. 330-53.

[22] Clifford Geertz, *Agricultural Involution* (Berkeley and Los Angeles: University of California Press, 1968), pp. 1-37.

[23] Joseph B. R. Whitney, *China: Area, Administration and Nation Building* (Chicago: University of Chicago Press, 1969), pp. 58-61.

[24] Owen Lattimore, *Studies in Frontier History* (London: Oxford University Press, 1962), pp. 469-91.

[25] Robert B. Ekvall, *Fields on the Hoof: Nexus of Tibetan Nomadic Pastoralism* (N.Y. and London: Holt, Rinehart & Winston, 1968), pp. 4-8.

[26] Ibid., pp. 18-19.

[27] Elizabeth E. Bason, "Types of Pastoral Nomadism in Central and Southwest Asia," *Southwestern Journal of Anthropology*, Vol. 10 (1954), pp. 44-68.

[28] Lattimore, op. cit., note 24, pp. 415-420.

[29] Spencer, op. cit., note 13, p. 72.

[30] Hugo A. Bernatzik, *Akha and Miao* (New Haven: Human Relations Area Files, 1970), pp. 460-492.

[31] Spencer and Thomas, op. cit., note 3, pp. 254-256.

[32] Isaiah Bowman, *The Pioneer Fringe* (N.Y.: American Geographical Society, 1931), pp. 267-95.

[33] Lattimore, op. cit., note 24, pp. 415-426.

[34] A full examination of this theme is found in Ch'ao-ting Ch'i, *Key Economic Areas in Chinese History* (London: George Allen & Unwin Ltd., 1936).

[35] Gilbert Rozman, *Urban Networks in Ch'ing China and Tokugawa Japan* (Princeton, N.J.: Princeton University Press, 1973), pp. 4-45.

[36] G. William Skinner, *The City in Late Imperial China* (Stanford, Calif.: Stanford University Press, 1977), pp. 211-351. Also Dwight H. Perkins, *Agricultural Development in China 1368-1968* (Chicago: Aldine, 1969), pp. 118-25.

[37] Joseph B. R. Whitney, "Temporal and Spatial Changes in the Flow and Storage of Energy and Nutrients in Chinese Farming Systems in Relation to Crop Yields," in Frank King, et al., eds., *China: Development and Challenge* (Hong Kong: Hong Kong University Press, 1979), Vol. 2 (in press).

[38] Gargi Dutt, *Rural Communes of China* (London: Asia Publishing House, 1967), pp. 1-63.

[39] Kenneth R. Walker, *Planning in Chinese Agriculture 1956-1962* (London: Frank Cass & Co. Ltd., 1965), pp. 1-19.

[40] John L. Buck, *Land Utilization in China* (Nanking: University of Nanking, 1937), pp. 295-303.

[41] Thomas G. Rawski, *Industrialization, Technology and Employment in the People's Republic of China* (Washington, D.C.: The World Bank, 1978), pp. 60-92.

[42] Ibid., p. 70; Buck, op. cit., note 40, Statistical Volume, Ch. VIII, Table 10.

[43] All calculations based on the elemental composition of the fertilizer, rather than compound weight.

[44] K. S. Sum, "Japanese Agriculture in Transition and its Trend," *Science Report of the Tohoku University*, 7th Series (Geography), Vol. 26, No. 2 (1976), pp. 183-203.

[45] Akira Ebato, *Postwar Japanese Agriculture* (Tokyo: International Society for Educational Information Press, 1973), pp. 97-103.

[46] Japan, Statistics and Information Department, Ministry of Agriculture and Fisheries, *Statistical Yearbook, 1975-76*, Table 4, p. 10, and Table 36, p. 125.

[47] Michael W. Donnelly, "Setting the Price of Rice: A Study in Political Decision-Making," in T. J. Pempel, ed., *Policymaking in Contemporary Japan* (Ithaca: Cornell University Press, 1977), pp. 143-200.

[48] Shigeto Tsuru, "Environmental Pollution Control in Japan," in S. Tsuru, ed., *Environmental Disruption: A Challenge to Social Scientists* (Tokyo: International Social Science Council, 1970), pp. 325-48.

[49] See Geertz, op. cit., note 22, and for a dissenting view, Mark Elvin, *The Pattern of the Chinese Past* (Stanford: Stanford University Press, 1973), pp. 285-316.

[50] Economically efficient in the sense that there are no significant diminishing marginal returns on additional labor invested.

[51] Smith, op. cit., note 21, pp. 87-107.

[52] J. B. R. Whitney, "Performance of Chinese Farming Regions," in North Ginsburg and C. K. Leung, eds., *Perspectives on the Geography of China* (Chicago: University of Chicago Press, forthcoming).

[53] Smith, op. cit., note 21, p. 107.

[54] Walter H. Mallory, *China: Land of Famine* (N.Y.: American Geographical Society, 1926).

[55] Rhoads Murphey, "Man and Nature in China," *Modern Asian Studies*, Vol. 1 (Oct., 1967), pp. 313-333.

[56] King, op. cit., note 17, gives the best account of the traditional East Asian farming system.

[57] For a discussion of this point see Ken Newcombe, "Energy Uses in the Hong Kong Food System," *Agro-Ecosystems*, Vol. 2 (1975), pp. 253-76.

[58] Ibid., pp. 270-274.

[59] Charles Hoffman, "The Maoist Economic Model," *Journal of Economic Issues*, Vol. 3, No. 2 (1971), pp. 12-27.

[60] Thomas R. Tregear, *A Geography of China* (Chicago: Aldine, 1965), pp. 37-38.

[61] King, op. cit., note 17, pp. 171-190.

[62] Susan George, *How the Other Half Dies* (N.Y.: Penguin Books, 1976), pp. 158-91.