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Birth of Agriculture and Its Development Caused by Population Pressure

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Birth of Agriculture and Its Development Caused by Population Pressure

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Abstract

Capital is Marx's most important achievement and publication. While this is true, he also prioritized the analysis of pre-capitalistic modes of production and left a note on this work. This note was found in 1939 in the Soviet Union and subsequently published as the title of Pre-Capitalistic Economic Formations. In this note, we can find numerous new (at that time) academic contents. This implies that Marx was devoted to study the newest archaeological and historical findings. He believed that these researches, as well as the content of Volumes 2 and 3 of *Capital*, are very important.

Therefore, "Marxian economics" should also be updated with associated archaeological and historical scientific knowledge in the twenty-first century, and we should update our understanding of pre-capitalistic economic systems. For this purpose, here, we want to provide a clear definition of agricultural society including slavery system and serfdom using Boserup's theory of population pressure.

Key words

The Agricultural Revolution, population pressure, slavery system, serfdom, Intensive Farming

Great Leap in Production by the Agricultural Revolution

Agricultural society includes stages such as the last phase of the primitive communism, the slavery system, and serfdom. All these systems have their own special characteristics, but first we explain the essential identity that is common to these systems as part of agricultural society. The development of agriculture approximately 10,000 years ago was a huge leap for human society. Here, we term this the "Agricultural Revolution," and its significance was much larger than the influence and importance of the Industrial Revolution in terms of productivity and civilization.

This significance can be understood by imagining the very low productivity and

living standard in the hunting-gathering society, which was overcome by the Agricultural Revolution. For example, in North Borneo, there was a hunting-gathering society with very low productivity, and by the middle of the twentieth century, the society developed a special population-control system in the form of the head-hunting culture. In that society, grooms in hunting-gathering tribes like the Iban hunted the male heads of other villages before getting married. This ritual signified that only the strong males could have their own descendants, thereby restricting their population growth. In other words, low productivity led to the special culture. Thus, productivity determined superstructure; however, what must be noted is that the hunting-gathering society had rather limited productivity and population[1]. For example, consider how many rabbits needed to be hunted in a year to keep one family alive, and how large an area needed to be occupied by one family to catch that many rabbits. Maybe, one small mountain was not sufficient for this, and this condition determined the population density.

However, the invention of agriculture changed the entire society. For example, in the holy land of the Iban, North Borneo, English colonialists brought Chinese farmers from the southern part of China to create a balance among the natives, Chinese, and the colonialists in the late nineteenth century. This colonialist policy was successful due to the rapid population growth of the Chinese farmers and agricultural development. Even if the number of immigrant farmers was small and their occupied land areas were marginal, Chinese farmers were able to support many children owing to agricultural productivity. This was the basic difference between Chinese farmers and the hunting-gathering society, and for this reason, the Chinese population was able to catch up to that of the natives. In 2000, in the Sarawak Province of North Borneo, the population balance between the Malay, Chinese, Iban, and Bidayuh was 22:26:29:8. The population of the Chinese farmers caught up with that of the native Iban, although the Iban have a longer history in this area. Such is the power of agriculture.[2]

In fact, human history is replete with cases in which agricultural people overtook

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[1] Each primitive society had its own special culture for restricting population. For example, the Australian Aborigines cut a part of the penis for birth control, and the Japanese relegated the elderly to the mountains. Additionally, the population of nomadic societies did not increase as they lacked the ability to care for infants as the elders of the settlement society did.

[2] Bidayu was also a hunting-gathering tribe, but less prevalent than the Iban. On the other hand, the Malay has maintained a certain population size because they enjoyed relative wealth as merchants. Therefore, we focus on the population balance between the Chinese and Iban and/or Bidayuh, because our main interest is in the difference of productivity between agricultural and hunting-gathering societies.

the former hunting-gathering inhabitants. In the third century BC in Japan, the Yayoi came to the islands from the Chinese continent and brought with them developed agriculture; they occupied the islands by pushing out the natives known as the Jyomon or occasionally by uniting with the natives. Although the Jyomon also had agriculture, but it was very primitive and the main food source was hunting-gathering activities.

Another example was the Thai people who had lived in the southern part of China in the ancient days. They brought water rice to the Thai plains, where the former inhabitants were engaged mainly in primitive fishing. Therefore, the present majority of this plain comprises latecomers, but they managed to occupy the plain due to the higher productivity of developed agriculture. We can find an almost similar history in Vietnam where a different people lived before the present dominant population arrived there. The history of humanity is replete with such replacements of people.

Agricultural Society as the Land-accumulating Society

It must be noted that plant cultivation—agriculture—began approximately 10 thousand years ago in the Near East, and in this sense, we must understand that almost all human history comprised the hunting-gathering society. If human history is considered from the time of the evolution of *homo erectus* one million and several hundred thousand years ago, the agricultural era is under one percent; and even if consider it just from the emergence of the *homo sapiens*, it is under one-tenth. Thus, from the historical perspective, it is evident how difficult the development of agriculture was.

For example, let us consider the first crops that were planted in the ancient Near East. They were wheat and beans, which could be eaten only by boiling or roasting. In this sense, the ability to manipulate fire was the precondition for agriculture, and the human being had to be farsighted and have a great imagination ability to gather very primitive crops whose seeds were limited, thereby making plant breeding a long process. Furthermore, the agricultural revolution required another condition: a sedentary society. All farmers needed to do was to ensure appropriate harvesting of crops and prevent theft.

In fact, there were some special cases that created sedentary societies like many small communities near the shell mounds. The North-American Indians in the Northwest coast had a special condition that enables them to live a sedentary lifestyle by engaging in plenty of salmon fishing. There is a possibility that some pastoral societies were antecedents of agricultural societies as sedentary societies. Fagan (2004) asserted that global climatic changes forced the people to plant crops to maintain the

population that had grown before the climate change.[3] At that time, maintaining the population was a big task not only due to climate change but also due to seasonal shortage in the winters. [4]

All these explanations are very interesting, because the abovementioned special natural products like marine products were like "fortune gifts"; similarly, European countries took advantages of other type of fortune gifts in the form of gold and silver inflow from the new continent for their primitive accumulation. Furthermore, the effect of climate changes in forcing the people to adapt measures for agricultural revolution is also interesting, because the industrial revolution was also accelerated in some late industrializing countries by certain exigencies such as wars or invasions in many cases. Finally, livestock farming can be regarded as a type of "farming" in the sense that the food (here, meat and milk) is available for consumption only through growing or breeding of livestock. That is, livestock farming and agriculture are both roundabout production systems. In this context, we can include the "invention of livestock farming" in the "invention of agriculture."

In fact, as roundabout production systems, products of agriculture and livestock farming can be used as means of production as well as means of consumption. Seeds can be invested and consumed, and cows can either be raised and fed to give birth to calves or can be eaten. However, agriculture has a rather important means of production: land for cultivation. While modern industry requires machines for production, agriculture needs land for production; therefore, "capital accumulation" has continued after the Industrial Revolution, and "land accumulation" has continued after the Agricultural Revolution. Further, it must be noted that fishing should not be regarded as hunting or gathering, because it generally requires sophisticated tools/equipment and is a highly skilled activity. Just as the current marine fishing industry uses IT to search for fish shoals, a smoking technology was used in primitive salmon fishing to preserve fish for off-season. We can find such traditional technology among Northwest Indians in North America and the Ainu in Hokkaido, Japan.

However, there is an opinion that "land" can be a means of production from nature without the need for land improvement and, therefore, "land accumulation" is not an appropriate term. Furthermore, Marx's terms "absolute rent" and "differential rent I" do not involve land improvement. Of course, Marx knew the importance of land improvement[5], but his perspective of land cultivation might be different from ours.

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[3] Refer to Yasuda (2004).

[4] Refer to Nishida (2007).

[5] Differential rent II is created by land improvement. Furthermore, according to Marx,

In my opinion, this difference has come from the difference in the landscapes between Europe and Asia. European farmland could be transformed easily into grazing land by two enclosure movements, while Asian land could be made cultivable only by cutting or burning trees and digging up tree roots. This difference directly has come from the difference in the density of trees, but in a much deeper sense, from the difference in the amount of rain in the two regions.

If we focus on Asian agriculture, the difficulty of reclaiming water rice fields is an important aspect. Water rice fields should be leveled at 100% horizontally, and have a good irrigation and drainage system. For example, it is understandable that reclaiming terrace rice fields in mountainous areas was a difficult task. In southern China and some plains in Japan, a good drainage system has been rather difficult to arrange; for this purpose, the people first made ponds or creeks and secured small lands free from excessive water. In other cases, constructing tall levees was very effective to secure cultivating lands that would be protected from floods. While low levees could secure only small lands, tall levees could secure large areas for cultivation. This implies that the construction of levees can be considered a concrete form of "land accumulation."

Thus, cultivable land is considered a man-made means of production, at least in Asia. It is the most important factor of production in agriculture[6], and agricultural society has always prioritized "land accumulation" over any other activity. Some nations took over cultivable land from other nations through wars, while some nations made land cultivable by their own efforts. All efforts have been for "land accumulation" like capital accumulation after the Industrial Revolution.

Agricultural Evolution to Intensive Farming Caused by Population Pressure

The aspect of agricultural society that we examine here is the internal difference between primitive and developed agriculture. For example, water rice farming is different from primitive farming in terms of intensity and formed its own superstructure. Therefore, our next task is to analyze the different stages of

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"extractive industries, such as mining, hunting, fishing (and agriculture, but only in so far as it begins by breaking up virgin soil), where the material for labor is provided directly by nature" (Marx, Karl, *Capital,* Vol. I (Dietz edition, p. 196), English translation by Samuel Moore and Edward Aveling, 1887). This description indicates that Marx knew the importance of land improvement in agricultural production after "breaking up virgin soil."

6 While the most important factor of production is machines in capitalism, the most important factor of production in agricultural society was cultivable land.

agricultural societies, and discuss what caused the agricultural evolution. Based on Boserup (1965), we explain that the cause was the population pressure.

In the same manner in which Agricultural Revolution was necessary to maintain increased population before the global cooling and drying about 10 thousand years ago. Boserup (1965) insists that the agricultural evolution occurred due to population pressure. Boserup examined the African experience of transferring intensive agricultural technology, and concluded that intensive agriculture is not applicable everywhere without considering population density. In other words, she realized that extensive agriculture is more suitable for areas with a low population density, while intensive agriculture is preferable in a high population density area. This new idea can be expressed by the following model.[7]

First, we introduce an agricultural production function under the assumption that land area is constant and only population is growing.

$$Y = (1 - c\,\beta)L^{\beta}.$$

Here, Y and L represent agricultural production and labor input (population) respectively, and we assume diminishing return to labor, that is, $0 < \beta < 1$. Further, β express labor intensity. A higher β implies higher labor intensity, and lower β implies lower labor intensity. Furthermore, " $c\,\beta$ " expresses that the production cost goes up in accordance with the rise in β. Therefore, $c > 0$, and under these assumptions, we can show that the optimal labor intensity increases in accordance with the population growth. First, we differentiate the above production function with respect to β.

$$\frac{\partial Y}{\partial \beta} = L^{\beta}\log L - cL^{\beta} - c\,\beta\,L^{\beta}\log L.$$

Therefore, the optimal β can be obtained by putting the above equation equal to zero, and the result is

$$\frac{1}{c} - \frac{1}{\log L} = \beta.$$

This shows that the labor intensity of agricultural production should rise in accordance with population growth; this was what Boserup emphasized. In addition, we can introduce per capital production as

$$\frac{Y}{L} = c(\log L)^{-1} L^{\frac{1}{c} - \frac{1}{\log L} - 1},$$

and again, we differentiate it with respect to L in order to check the effect of population

[7] Boserup's idea was first modeled by Robinson & Schutjer (1984).

growth. Therefore,

$$\frac{d\left(Y/L\right)}{dL} = (\log L)^{-1} L^{\frac{1}{c}-\frac{1}{\log L}-2}\left\{(1-c)-c(\log L)^{-1}\right\}.$$

Whether this result is negative or positive is dependent on the value of $(1-c)-c(\log L)^{-1}$. However, remember our assumption—0 < β < 1, and it implies

$$0 < \frac{1}{c} - \frac{1}{\log L} = \beta < 1.$$

This condition can be transformed into $(1-c)-c(\log L)^{-1} < 0$. Therefore,

$$\frac{d\left(Y/L\right)}{dL} < 0.$$

That is, population growth leads to a decrease in per capita production if other conditions are constant. According to Boserup, intensive agriculture that is brought about by population growth leads to a fall in per capita income.

Productivity Growth by "Land Accumulation": Slavery System and Serfdom

However, the abovementioned income decrease has not occurred homogenously, even if African primitive agriculture suffered, and it must be noted that our original standpoint is that cultivating land is not constant, but land is being accumulated. Therefore, here, we introduce the above-mentioned concept of "land accumulation," and show the course of income increase in accordance with the intensification of agricultural production.

For this purpose, first, we assume that "land accumulation" occurs in accordance with population growth, but land input diminishes with population because new land can be assumed to be less productive than old land. Therefore, the cultivating land area A can be expressed as

$$A = L^k \quad 0 < k < 1.$$

Here, it must be noted that A expresses not only quantity but also quality, for example, the quality of soil. In this case, the former production function can be transformed into

$$Y = (1 - c\,\beta) A L^{\beta}.$$

Therefore,

$$Y = L^{\beta+k} - c\beta L^{\beta+k}.$$

Then, we do the same calculations as earlier. The first step is to differentiate the new production function with respect to β, and putting the result equal to zero yields

$$\frac{1}{c}-\frac{1}{\log L}=\beta .$$

Since this result is the same as the former one, we can assume that $0 < \beta < 1$, and therefore, $c < \log L < \frac{c}{1-c}$ again. However, Y/L becomes a little different:

$$\frac{Y}{L}=c(\log L)^{-1}L^{\frac{1}{c}-\frac{1}{\log L}+k-1},$$

and then,

$$\frac{d\,Y/L}{dL}=c(\log L)^{-1}L^{\frac{1}{c}-\frac{1}{\log L}+k-2}\left\{(1+ck-c)-c(\log L)^{-1}\right\}.$$

Therefore, depending on whether $\left\{(1+ck-c)-c(\log L)^{-1}\right\}$ is negative, zero, or positive,

$$\text{if } \frac{c}{1-c(1-k)}<\log L<\frac{c}{1-c},\quad 0<\frac{d\,Y/L}{dL},$$

$$\text{if } \log L=\frac{c}{1-c(1-k)},\quad 0=\frac{d\,Y/L}{dL},$$

$$\text{if } c<\log L<\frac{c}{1-c(1-k)},\quad \frac{d\,Y/L}{dL}<0.$$

This result is very interesting, because the effects of population growth on per capita production depend on the size of population. If the population is small, population growth leads to a decrease in per capita production. After population reaches a certain level, population growth leads to an increase per capita production. Therefore, we can identify the following three stages of an agricultural society:

1) Stage of very extensive and primitive agriculture under extremely low population density.
2) Stage of transition between extensive and intensive agriculture.
3) Stage of intensive agriculture[8].

These three stages might correspond to the following three stages given by Marx:

1) Stage of the so-called “clan community” or “agricultural community” where class and state are still in the process of formation.

2) Stage of the slavery system.

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[8] This differs slightly from Boserup’s method of dividing into various stages. While Boserup provides five stages, we provide only three.

3) Stage of serfdom.

If a society wants to form class and state, it needs surplus products. However, society in the first stage could not produce sufficient surplus; therefore, no class and state could be formed. For example, even if such a community took slaves from other communities by means of war, such slaves could not produce any surplus, and in this sense, such no-use slaves were killed and eaten. In this sense, there was no slavery system in such a low stage of society.

The difference between the second and third stages based on the degree of agricultural intensity is also very important. While slavery system required direct control of slaves, serfdom needed only rules governing land (in this sense, they are called as "landlords") if cultivating land was fruitful. This is because serfs did not want to run away from their landlords and pay tax if allocated lands were sufficiently fruitful, and intensive land in the third stage met this condition.

In summary, we have three criteria for identifying the slavery system and serfdom.

① Degree of agricultural intensity.

② Degree of (personal) freedom.

③ Land property system.

The third criterion was indicated by Nakamura (1977) by identifying the special land ownership system in serfdom, where both lords and serfs had double land property rights: upper property right and lower property right. This is known as the double land ownership system. Nakamura (1977) also identified such double ownership system in a certain slavery system, but the pure double slavery system had been established only in serfdom. Marx, in the chapter on primitive accumulation in volume one of *Capital*, explained the process of the two enclosure movement and almost-independent farmers in England. These farmers were seemed to be independent, but strictly speaking, they were merely serfs with much stronger property rights than regular serfs.

In fact, such a clear definition of the slavery system and serfdom is very important, because this definition expands the application of the categories of the slavery system into some other ancient social systems apart from the ancient Greek and Roman one. For example, the "land occupation slavery system" and the "state slavery system" were based on extensive agriculture. Furthermore, this new definition of serfdom expands the application of the category of serfdom to include some other systems such as "state serfdom" apart from the feudal serfdom that was prevalent in Europe in the Middle Ages, Japan, and Tibet until 1959.[9] The "state slavery system" and "state serfdom" are

[9] Middle age Europe, Japan, and Tibet (occasionally including the Indian Zamindari system) are referred to as "feudal serfdom," which is defined as the system in which

categories given by Nakamura (1977) and have become a theoretical origin of the category of "state capitalism" defined by Onishi (1992).

If so, one possible question related to these categories is of when China experienced the serfdom system. In my opinion, the great leap from extensive agriculture to intensive agriculture was realized by the introduction of iron-made farming implements and ox-drawn plows. As such plows and oxen are types of "capital," this leap can be regarded as a change in the factors of production from land and labor to land, labor, and capital. In particular, in north China, where the soil is very hard, ox-drawn plows are very important to cultivate land well, and this system was invented in the Spring and Autumn Period and popularized by the Han Dynasty. Therefore, this great leap in productivity was expressed through China's population growth, which reached 60 million in 4 A.D. at the end of the former Han Dynasty. Before that time, China had a population of only 10 million, and even if China's population repeatedly fluctuated due to wars and famines, the figure of 60 million had been surpassed by around 1600 AD when China introduced corn from the New Continent. This implies that the same stage of productivity continued throughout that period. Therefore, to answer the question is whether population or productivity led to the other, it is very important to know that there was a big difference in the periods before and after the Han Dynasty.[10]

Another possible question related to the above definition of serfdom is whether North America underwent serfdom; this question is very important because the New Continent did not have iron before Columbus. However, we know that the Aztec Civilization was so sophisticated and created many big constructions based on its economic power; therefore, our question can be translated into the question of how the civilization enjoyed such high productivity without iron. The answer is that it was based on a special agricultural technology known as "Chinampas" where farmers scooped up mud from the bottom of lakes using baskets and served the mud for intensive agriculture. That civilization was on a big lake that was reclaimed after the invasion, and this technology did not need iron only but baskets. This was the secret of why there

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serfs were ruled over in private manors. Marx called this "pure feudalism." According to our understanding, "feudalism" expresses personal dependency in human society, and is therefore used to represent apprenticeship in small manufacturing crafts before the Industrial Revolution. That is, such apprenticeship involved personal dependency, but that dependency was completely different from the human relations in the slavery system. In this sense, we can provide a much detailed history of human relations from strong dependency through less freedom to pure freedom. This is a field of Marxian Historical Materialism known as "history of human dependency," which was first described in Marx's *Grundrisse*.

[10] Miyazaki (1968) insists that the most important leap occurred in the Tang and Song Dynasty. As this understanding is very strong in Japan, we need to study more.

was particularly high productivity without iron. Furthermore, what should be noted here is that such fruitful cultivating lands were developed by the state, and the state delivered them for the farmers. In this sense, this system can be defined as a kind of "state serfdom."[11]

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Fagan, Brian(2004), *How Climate Changed Civilization,* Basic Books.

[11] Generally speaking, after achieving a certain level of "land accumulation," each society experienced the Industrial Revolution and began capital accumulation with a speed determined by the achieved level of land accumulation. This problem was studied in Roxiangul & Kanae (2009) by building a model whose production function has three factor of production: labor, capital-1, and capital-2; in this case, we can regard agricultural lands as capital-1 and machines as capital-2. This result is shown in the next figure, and it indicates that after the Industrial Revolution there should have been a "zero-consumption period" for a certain period of time (from m to m + i). Of course, "zero-consumption" is impossible, but it should be close to this ideal situation. In the level of calculation, it is because the model first seeks the balanced accumulation process among the two types of "capital"; therefore, mature agricultural economies need a much longer time for capital-2 to catch up to the already achieved level of land accumulation. However, it also implies that after this catching up, more such matured economies have much developed industrial economies. That is, the degree of agricultural development determines the degree of industrial development; in this sense, it is difficult for less-developed countries to catch up to much-developed countries. Each country must develop step-by-step.

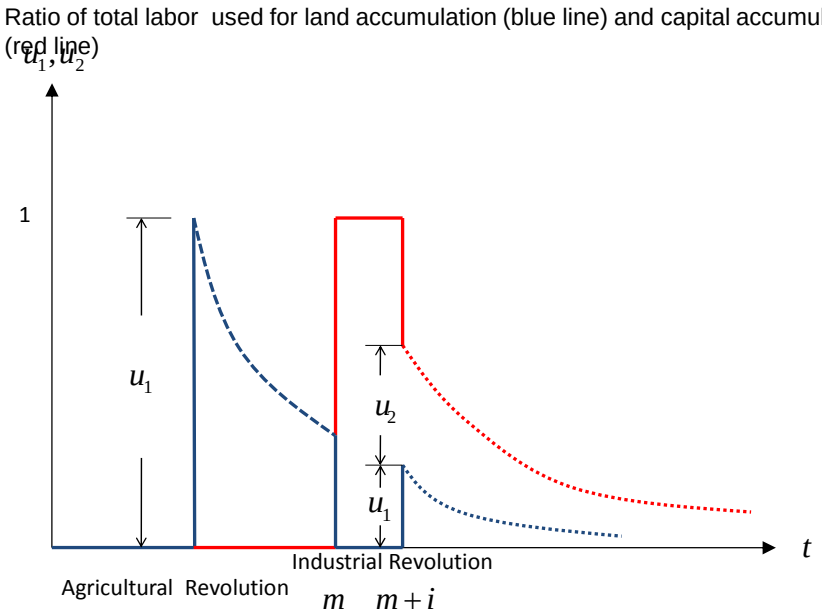

Figure Industrial Revolution in the Process of Land Accumulation

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