# Plan C: China's Development under the Scarcity of Natural Capital

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**Abstract:** The critical issue of China's modernization is whether it can free itself from the traditional modernization plan based on the relatively abundant natural capital, and innovatively create a developmental model of a large country under the scarcity of natural capital. This is why China is so keen on circular economy and economical use of resources. Focused on this issue, this paper summarizes the theoretical elements of the development under the scarcity of natural capital, points out that Plan C is the strategic choice for China's future development, emphasizes that China needs to enhance the new industrialization, new urbanization and new modernization based on the restriction of natural capital, and discusses the technological and mechanistic support required to realize the development under the scarcity of natural capital.

**Key words:** natural capital, circular economy, Plan C

## 1 Prelude

From circular economy to resource saving society, it has gradually been realized that the economic and social development in China is facing the challenge of severe restriction of natural capital. With such understanding, we can surely find out that one of the critical issues of China's modernization is whether we can innovatively create a developmental model of a large country under the scarcity of natural capital, as opposed to the traditional modernization plan based on the relatively abundant natural capital. This, in turn, will bring systematic and mechanistic cognition of such current problems as circular economy and resource saving. At present, further theoretical research and political analysis are required. This paper presents some opinions for discussion from three aspects: theory (why), strategy (what), domain and channels (how).

## 2 Developmental theory under the scarcity of natural capital

Since the reform and opening up policy, China's economic and social development is, to a great extent, under the influence of economic theories dominated by New Classical Economy. However, can such currently mainstream economic theories guide China's economic and social development severely restricted by natural capital, and thus establish a development theory under the scarcity of natural capital? The assumptions of mainstream economics are not based on the scarcity of natural capital. On the contrary, we should pay more attention to eco-economists' opinions, which have arisen since the 1980s (to understand their core opinions, please refer to *Beyond Growth* written by Daly, an American scholar, which was translated by myself and published by Shanghai Translation Publishing Company in 2001). This foreign eco-economic theory, which is quite different from China's eco-economics, has been regarded as the transformation of mainstream economics. From their in-depth criticism of the traditional economics and innovative conception of eco-economics, some important theoretical elements can be discovered under the scarcity of natural capital.

### 2.1 Natural capital has become the restrictive element of economic development

The eco-economic theory accurately points out that mankind is currently facing a historical moment: the restriction on mankind's further prosperity is not the scarcity of human capital, but the scarcity of natural capital. In the 18th century when the industrialization movement began, the scarce resources in the world were mainly humans and human capital. Natural resources were not scarce. That is why the objective of industrialization was to replace humans with machinery, and to greatly improve the productivity. Today, over 200 years after the industrialization movement, humans and human capital are no longer scarce resources, and what is scarce has shifted to natural resources, to be more exact, natural capital including natural resources and ecological capacity. This is a reverse scarcity model. In this sense, the principles of economics are still accurate, but the major contradiction regarding the allocation of scarce resources is changing. When natural capital becomes the internal variable of economic development, the duration of economic growth begins to be restricted by

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natural capital. For instance, fishing capacity is restricted by aquatic resources. Previously, fishing output would improve, and so would GDP, as long as the mechanical productivity improved, while nowadays, fish resources are continually exhausted. It will not help at all even if the mechanical productivity is higher. Today, all over the world as well as in China, people can often perceive the restriction of natural capital on economic development.

I think that such economic theory, with natural capital as the restrictive element, is of fundamental significance in understanding and studying China's development. On the one hand, the per capita natural capital in China is far less than the average level in the world, which means that China's economic development is restricted by its own natural capital from the very beginning; on the other hand, there is less and less opportunity to obtain natural capital from other countries, since the scarcity of natural capital is a worldwide problem. This is different from the industrialization period, when countries with limited natural capital can resolve the problem in the worldwide market. Moreover, it is difficult to supplement natural capital, such as land, water, and environment capacity, from outside a country's own territory. Therefore, China's current emphasis on circular economy and resource saving society should not be regarded as a partial, expediential or tactical issue, but an integral, long-term and strategic one. In other words, since natural capital is the major restrictive element on China's economic and social development, China's modernization has to follow a development path different from the former industrialization route of Western countries. In this sense, the traditional economics, which lacks cognition of the scarcity of natural capital, is of no use in establishing China's developmental model, while the current conceptions of circular economy and resource saving society provide the opportunity for China to study a green developmental model.

### 2.2 The scale, efficiency and equity of economic development

When natural capital has become the restrictive element, it is necessary to review the basic questions concerning the scale, efficiency and equity of economic development. As for size, different from the assumption of mainstream economics that material size can be infinite, eco-economics advocates that the material size of economic growth is not infinite, and that the proper development should be the enlargement of social welfare on the basis of the given material size. As for efficiency, different from the mainstream economics' emphasis on the improvement of such traditional elements as labor productivity and capital productivity, eco-economics puts more premiums on the productivity improvement of such scarce natural resources as land, energy, water, etc. As for equity, different from the mainstream economics' neglect of the social distribution of natural capital, eco-economics emphasizes that given the material size, its distribution needs to flow from surplus to shortage, and only in this way, can the overall social welfare be improved. It has the implication that developed countries need to cut down on over-consumption, and provide more developmental space for developing countries to satisfy their basic material needs.

The idea of eco-economics about size, efficiency and equity brings us important enlightenment regarding China's development under the scarcity of natural capital. First of all, China must pay great attention to the resource productivity of land, energy sources, water and important raw materials in its economic development. The core issue in China's economic and social development is how to improve people's living quality with limited natural capital. Second, the supply size of natural capital for China's economic and social development needs to be considered. For instance, what should be the largest land supply in China's urbanization? What should be the greatest energy consumption level in its industrialization? What should be the greatest water resource consumption rate to improve China's consumption level? The key is to improve the resource productivity based on the adaptability of economic and social development goals with the carrying capacity of natural capital. Third, the significance of social equity under the scarcity of natural capital in China should be taken into consideration. Externally, rational development rights in terms of the demand for natural capital should be the aim. Internally, rational allocation of natural capital in different areas with different development levels should be weighed. Only in this way, can we manage to constitute a developmental strategy consistent with the current world situation and China's situation.

## 3 Plan C is the strategic choice of China's future development

Based on the theoretical elements just discussed above,

we may further think about China's strategic model in future economic development. China has set the economic objective that the per capita GDP in the year 2020 is four times of that in the year 2000. In this sense, what will be our resource consumption and environmental pressure? This is a question worth careful research under the scarcity of natural capital. Generally speaking, there are three models for China's development to the year 2020. I think Plan C is the most suitable one for China's current development.

### 3.1 Model A, which is a highly material-based model with high resource consumption and high environmental pollution, is not feasible

The phrase "Model A" originated from an American scholar, Lester Brown's Plan B: Rescuing a Planet under Stress and a Civilization in Trouble (DongFang Publishing House, 2003). This material-based model involves synchronous economic development and increase in environmental pressure. While the GDP grows larger, the environmental pressure is greater. This is the traditional economic growth model. Today, both developed and developing countries are staying with Model A, but the difference lies in the fact that the problem for developed countries like America is over-consumption, and thus their economic development and environmental pressure increase synchronously, while the problems in many developing countries are mainly related to the deficiency in eco-efficiency, which means that GDP increase depends on the increase in gross resource input on the one hand, and causes the increase in gross pollution output on the other hand.

In the past, China's economic development has basically followed Model A. Nowadays, we pay more attention to circular economy and advocate resource saving. The purpose is to break away from such a developmental path that exhausts resources and destroys environment. When I attended the research on National Long and Mid Term Scientific Technology Strategic Planning, I did some calculations with relevant experts. If China continues with the current resource use model and pollution generation levels, then in 2020 when the population keeps growing and economic growth is four-fold, the environmental impact on future economic and social development could be four or five times of today's level. Obviously, such a model not only predicates severe social instability and serious resource and environmental problems, but also undermines the growth of economic development itself.

### 3.2 Plan B, opposite to Model A, is an ideal developmental model, which de-links economy from environment

This is a future development model advocated by Lester Brown in his book Plan B which requires large-scale dematerialization along with economic growth, and the objective is to realize zero increase and even negative increase in environmental pressure, while keeping positive economic growth, thus de-linking economic development from environmental pressure. In the long run, such an objective is necessary in both developed and developing countries, and contains the true connotation of green modernization or ecological modernization. However, at present, it is most likely to become the objective of developed countries, because the mature economy (their material size is relatively stable), with basic needs satisfied, is capable of de-linking economy from environment through the improvement of eco-efficiency. For example, we have seen European countries raise development objectives of a "multiplier of 4", and even a "multiplier of 10" in terms of eco-efficiency. A "multiplier of 4" means that with economic growth doubling, the material consumption and pollution generation can be reduced by half.

However, can this development objective be applied to China's development over next 15 years? My answer is negative. According to my rough calculation and estimation, if by the year 2020, we want to increase economic growth by four-fold, without bringing apparent increase in environmental pressure, we will have to improve the resource productivity by four or five times. And if we expect to greatly reduce the environmental pressure (for instance by half), the resource productivity has to been improved by eight to ten times. This objective is definitely inspiring, but based on China's current technological capacity and managerial level, it is fairly hard to achieve this development model. If it has to be achieved, China's economic objective must be adjusted. From another perspective, this will negatively influence Chinese people's living standard and living quality.

### 3.3 Plan C is the resource productivity improvement model most adaptive to China's current developmental stage

Shortage of natural resources and severe restriction of environmental pressure forces China away from the traditional Model A. While restricted by China's current developmental stage, Plan B, which fits the higher developmen-

tal stage, can not be applied immediately either. Therefore, I put forward a development model adaptive to China's development over next 15 years, abbreviated as Plan C (China). According to Plan C, China's economy will keep growing according to the given objective, while resource consumption and pollution generation will experience a slow increase first, and then tend to keep stable.

Plan C can be regarded as a multiplier 1.5–2 model. That is to say, by the year 2020 when China's economy increases by four-fold, resource consumption and pollution generation may double at most, but pollution emissions must be subject to strict control. No more than twice of natural capital is used to exchange for the four-fold economic growth and corresponding social welfare. This model provides a 15–20 year buffer for China's economic and social development, and hopefully, with such an adjustment to the growth mode over a period of time, a relatively stable stage of dematerialization can be ultimately achieved. From the above-mentioned view of social equity of the eco-economic theory, such development is acceptable to both China and the world at large. On the one hand, it greatly reduces the resource consumption and pollution generation by half compared with the traditional Model A. On the other hand, it accords with the equity principle of eco-economy, providing reasonable growth space for 1.3 billion people to improve their life, and at the same time it creates a more secure living environment for the world. After the year 2020, China may be able to realize "multiplier 4", a further green developmental strategy, which means that the economic size will be four times the 2020 level, while resource consumption and pollution generation will be reduced by half, thus enabling China to realize the de-linking of economic growth from environmental pressure. As for those southeast coastal areas like Shanghai, Beijing and Guangdong, since they lead other areas in terms of the developmental stage, they should also take the lead in implementing the dematerializing strategy, so that they may realize modernization based on the win-win outcome from both economic and environmental perspectives.

## 4 New industrialization, new urbanization and new modernization

As for China's development under the scarcity of natural capital, we need not only to theoretically illustrate the question of why to choose this model, but also to answer the practical question of how to design the path to realization. The ideas of Plan C and the improvement of resource productivity should be incorporated into various aspects of China's development. When talking about circular economy, Chairman Hu Jingtao said, "We should quicken the transformation of the economic growth pattern, apply the idea of circular economy to the regional economic development, urban and rural construction and product manufacturing, so as to make the most efficient use of resources." This differs from the popular understanding that circular economy is just limited to the manufacturing area. I think, in China's development under the scarcity of natural capital, the enhancement of resource productivity and the so-called "dematerialization movement" should be applied to three areas including new industrialization, new urbanization and new modernization.

### 4.1 Different from traditional industrialization, China needs to explore the macro-potential of resource productivity improvement from its industrial structure through new industrialization

First of all, we should note that the development of the tertiary industry based on labor service is beneficial to the dematerialization. For example, we find that America's GDP today is five times that of 50 years ago, while the material usage has not increased much. The major reason here is the increased proportion of the tertiary industry. Currently, China's economic and social development is characterized by an obvious bias towards heavy industries. There have been heated disputes over the necessity of a heavy industry stage, but from the perspective of resource saving and environmental friendliness, in China and especially in big cities, the proportion of the tertiary industry should be increased whenever possible. Key cities like Shanghai desperately need faster development of the tertiary industry. At least, its development rate should not be lower that its average economic growth rate. Especially, we should spare no effort to enhance the development of those high-level knowledge-driven tertiary industries, which are the backbone industries of a world city, as well as high value- added industries with the characteristics of dematerialization. Next, we need to rebuild those high consumption, high emission secondary industries into dematerialized types, and advocate the development of clean manufacturing and ecological industries in the secondary industry sector. Shanghai's economic growth will still heavily rely on the secondary industry for a long period of

time. However, besides the concern about the reduction of business cost on manufacturers' entry into Shanghai, we should also take the reduction of its material consumption and pollution cost into full consideration when developing its manufacturing industry. Moreover, we should vigorously develop the so-called "vein industry" which covers the reprocessing and reusing of wastes after manufacture and consumption, and translates the pressure on resources and environment into the dynamics of economic activities.

### 4.2 Different from traditional urbanization, China needs to explore the mid-level potential of resource productivity improvement from its urban space through new urbanization

On the one hand, China's urbanization should be established in a development plan characterized by land saving, energy saving, water saving, material saving and compact space expansion. If in the next 20 to 30 years, we can develop several relatively compact urban areas (city belts) around metropolitan cities that serve as the centers of certain regions, and have these city belts absorb about 400 to 600 million Chinese population, and then China will be able to realize its urbanization with relatively effective use of land resources and space resources. On the other hand, we should pay attention to two kinds of dematerializing ecological clusters in urban construction. One is the ecological industrial park that enables the close-looped material flow among different enterprises, or industrial groups that provide intensive use of energy, water, material and centralized pollution processing. The other is the ecological residential area that is featured by the maximum reduction of material consumption and waste emissions. The former helps to change one enterprise's waste to another enterprise's production material, thus facilitating the dematerialization and decontamination process of the production system. The latter helps to reduce the consumption of energy, water and land through ecological design, and recycle and reuse the waste including daily water and living waste.

### 4.3 The key to modernization is the improvement in the quality of life

Different from traditional modernization, China needs to explore the micro-potential of resource productivity improvement from products' functions through new modernization and sustainable consumption. One way to do this is to encourage the manufacture and use of more durable products for daily use and urban infrastructure. As for a city's individuals, higher quality and more durable products should be used to replace low quality or disposable products, so that the length of useful service can be prolonged. The deluge of disposable products is responsible for the material-biased economic growth. In China's effort to construct a resource saving society, we should reduce the reliance on disposable products to a great extent. The next step is to encourage the use of products and urban infrastructure that can be shared. In a city's public areas, over-reliance on private products is disadvantageous to the dematerialization of urban economy. For example, in terms of city transport, public transport with high capacity is more resource saving and environmentally friendly than private cars. As a matter of fact, new modernization implies the transformation of our consumption pattern and life style. It requires that the whole society shifts its attention from owning materials to realizing the function of materials, and radically changes the modernization pattern of traditional society characterized by high production, high consumption, high exploitation and high emission.

## 5 Improve resource productivity by both technological means and support mechanisms

Further thought about how to improve resource productivity leads to the functions of technology and the mechanism of this pursuit. When we extend Plan C's development objective to production methods, consumption patterns, and urban models to facilitate China's new industrialization, new urbanization and new modernization, we especially need to improve the resource productivity in these areas through technological innovation and mechanical integration. I'd like to expound the following opinions.

### 5.1 In scientific technology, both technological upgrading and structural betterment are needed to improve resource productivity

Usually, such technological innovation involves four stages or four methods. The first stage is "process innovation", which means the improved manufacture of the same products. Some examples are the substitution of raw materials, continuous casting of steel and adoption of cleaner production techniques. Generally speaking, such technol-

ogy can improve the resource productivity by twice at the micro level. The second stage is "product innovation", which means to manufacture the same products or products of the same value with less input. For example, traditional cars are replaced with land rovers, and vacuum tube radios with transistor radios. Such innovation includes the improvement in component functions, recycling rates, disassembly, and reusability. Generally speaking, such technology can improve the resource productivity by five times at the micro level. The third stage is "product substitution", which involves the innovation of product conception and function exploration, and thus provides society with different kinds of products and services with the same function. Common examples is to communicate with email instead of paper and to replace private cars with public transportation. Briefly speaking, substitutes are used. Such technology can improve the resource productivity by ten times. The fourth stage is "systematic innovation", which means the innovation of the social system and the pursuit of structural and organizational changes, such as renting a surf board instead of buying, organizing transport in a more sensible way and ultimately realizing the shift from the production economy to the functional economy. Such technology can improve the resource productivity by 20 times. Among these four methods, the first two are generic technological improvements, and the last two are systematic structural reformations. In China's economic and social development, we expect to improve the resource productivity by a large scale, so we must pay more attention to the two methods of structural reformations, namely "product substitution" and "systematic innovation", and cultivate our technological innovation capacity. Only in this way can we realize the multistage development in terms of the relationship between environment and growth.

### 5.2 In terms of mechanisms, both administrative promotion and systematic promotion are needed to improve resource productivity

Currently, we tend to emphasize the government's role in the development of circular economy and resource saving society, but neglect the systematic solution on the mechanistic platform. Governments, taking the market's place, may produce very nice circular economy rules or resources saving plans, but only to find them rejected by the market and society. Therefore, in China's effort to develop Plan C based on the improvement of resource productivity, we need to change from the previous practice with governments as the only subject, to a linkage system by which governments, enterprises and the public can all be relied upon. To be specific, according to the policy matrix recommended by the World Bank, we need to reinforce and perfect governments' control over resources and environment through clearer standards and stricter statutes. We need to realize the market-based resource management and environmental management by creating and utilizing the market, and we also need to motivate the public to participate in the resource management and environmental management through information disclosure and public participation. Combining these three policies with input, process and output, three elements in the material flow, we can systematically improve the resource productivity in China's economic growth, and realize both the economic-social objective and resource-environmental objective under Plan C.

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