

Great Water Project Will Change the Face of China

by Mary Burdman

China will soon begin constructing its massive “Move South Water North” project, Vice Minister of Water Resources Zhang Jiyao announced at a Beijing press conference Nov. 25. In what will soon be, by far, the world’s largest water diversion project, the nation will create three new, man-made “rivers.” As the project is completed over the next 50 years, they will bring some 45 billion cubic meters of water a year to northern China. This is equal to the flow of China’s famous Huanghe, or Yellow River.

This enormous undertaking is essential for the future of the Chinese economy and nation. The plan, which is to take water from the vast Changjiang River system (known outside China as the Yangtze) to the arid northern region, is being carried out as “a mega-project that is strategically aimed at realizing the optimal allocation of water resources” in China, Zhang Jiyao announced.

The cost of constructing the two eastern-most of the artificial rivers will be over \$20 billion; total costs will be greater than those of the Three Gorges Project, the world’s largest flood-control and hydroelectric project, now being built on the Changjiang.

Sine Qua Non, Not Only for China

Transferring water on this scale is a highly complicated process. The proposal has been under consideration for at least 50 years, from the early period after the 1949 revolution. It has been debated intensely and widely in China ever since.

Water will flow in the three new “rivers,” through canals, lakes, reservoirs, and pipelines, from the Changjiang, the longest river in Asia, and third in the world after the Amazon and the Nile. The eventually much-improved water resources in the North will directly benefit 300 million Chinese, and indirectly, the entire nation. Without solving its water crisis, China cannot continue to develop as a modern nation. As a November 2000 report by the Ministry of Water Resources stated, the “hidden disasters of the Chinese nationality” are the flooding and water logging of the South, and drought of the North.

The overall concept of the plan will use the “four transverse rivers and three longitudinal routes” as the calligraphic strokes of a vast, nationwide “character” to create a national water system. The four transverse strokes are the Changjiang,

and the three northern rivers it will feed: the Huanghe, Huaihe, and Haihe. (*He* is Chinese for river.)

Water has long been a strategic issue in China’s development. In real economic terms, the lack of sufficient water is a *more critical* problem, than the size of its great population of 1.3 billion. Already, lack of water in the northern and western regions of the country is beginning to choke economic growth, and the situation will become more acute very rapidly.

This is not just a problem for China. In the vast Eurasian hinterland, the nations of Central Asia, water is a more precious resource than oil. There, also, the shortage, and especially the very uneven distribution of water, is a real growth-limiting problem. Tensions exist among the Central Asian nations, with Russia, and increasingly, with China, over use of regional water resources. These are problems which much be solved to ensure development of the Eurasian landmass. Without water, there is no life.

Vernadsky’s Biosphere

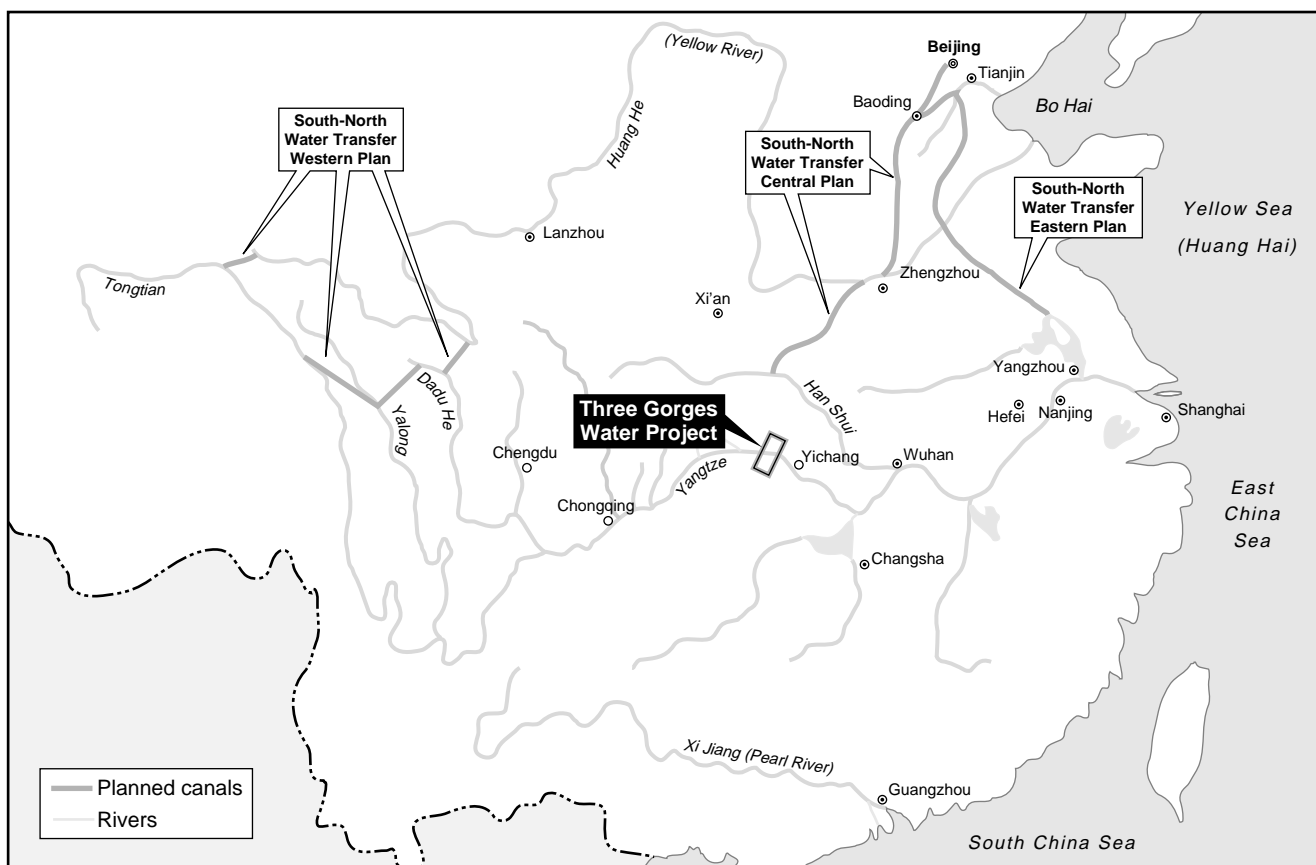
The answer to the problem, is not simply a matter of sending water from one place to another. Such measures can generate more and new difficulties, as demonstrated by the drying up of the Aral Sea in Central Asia, due to over-extraction of water for irrigation. Mankind must transform whole regions of the Earth, a big undertaking. This can only be done, by using concepts grounded in the thinking of the great Russian scientist V.I. Vernadsky, to deliberately *create* a new, potentially much more productive living space.

Terrestrial waters and soils, Vernadsky wrote, are highly complex “bio-inert” bodies, in which living bodies play a fundamental role. Using and improving soil and water is therefore a complicated undertaking. Genuinely to improve the conditions of life in northern China, for example, requires that “natural conditions,” including soil quality, water purity, forest and general vegetation, and eventually climate, be developed simultaneously with the human activity of productive cultivation and industry.

Such a process requires generations, a perspective for vast geographical areas, and study of the Earth’s conditions over many millennia. National governments, working in their own *and* their neighbors’ interests, must take leadership

FIGURE 1

China's Great Water Management Projects



of this process.

To some degree, this is being done in China.

Redrawing the Map

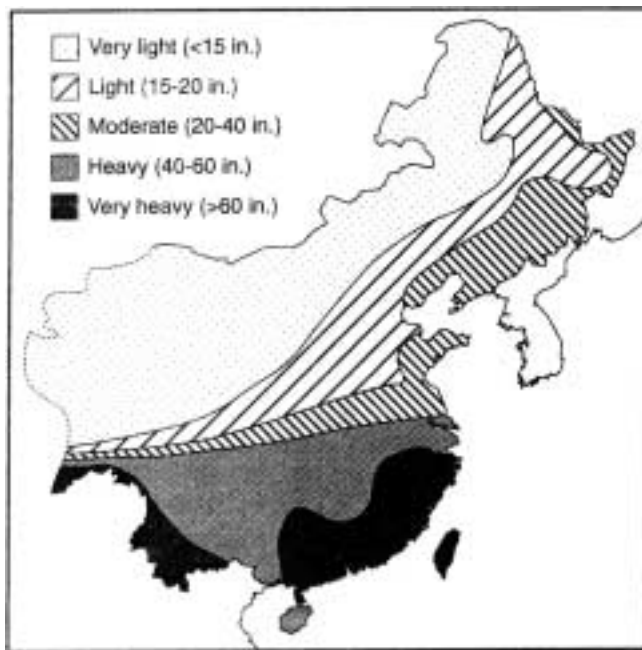
The grand economic policy of the Chinese government, outlined in the Tenth Five-Year Plan of March 2001, is to “Re-Draw China’s Economic Division Map.” Four projects will become nation-crossing “strokes”: the south-to-north water diversion plan; the west-to-east gas pipeline project; the west-to-east power transmission grid; and completion of the railway from Qinghai to Tibet, the “horizontal” crossing the already finished “vertical stroke” made by the Beijing-Kowloon railway.

South-to-north water diversion will mean “overall strategic restructuring” of water resources, the Five-Year Plan stated. Although China has built many long-distance water-diversion projects over the past half century, it has done nothing on this scale. The “water-rich South” and “water-deficient North” problem, remains unsolved. Northern China has struggled with desertification for millennia. The Huanghe was the cradle of Chinese civilization; evidence of civilization

dating back 8,000-10,000 years has recently been discovered in Gansu province, on the upper Huanghe. The “Gansu-Hexi Corridor” along the river, has long been densely populated—Xi’an, an ancient capital and eastern terminus of the Silk Road, was a city of 1 million people during the European “Middle Ages,” when Paris, then by far the largest city in Europe, had a mere 100,000 people.

A recent study by the Chinese Academy of Sciences, in cooperation with Australian and U.S. scientists, indicates some of the long-term pattern of climate in northern China. Over recent centuries, the deserts have moved three degrees latitude—about 300 kilometers—to the south, back to where they had extended during the last maximum glacial period, 21,000-13,000 years ago. Currently, China’s climate is influenced by the Summer monsoon, which brings the rainy season. The monsoon was weakest during the last Ice Age, and deserts expanded. However, during the following, Holocene period, 10,000-5,000 years ago, a much stronger monsoon pushed the deserts north, and turned northern China into well-watered grassland and forest. This was when the Huanghe became the “cradle of Chinese civilization.” Archeologists

FIGURE 2

Annual Precipitation in Eastern China

Rainfall in China's populous eastern regions is heavily concentrated in the South, with wide northern areas threatened by chronic drought and desertification; but the majority of arable agricultural land is actually in the drier regions, one of several reasons the nationwide water-transfer "great projects" are critical.

are now finding more and more evidence of dense settlements, in areas which are now desert.

Today, while the monsoon remains strong, the deserts are advancing south again. Over the past 3,000 years, intense cultivation, and—even more—periods of frequent warfare, such as during the middle and late Tang Dynasty in the Eighth and Ninth Centuries, laid large areas to waste. However, this process can be reversed, as the Chinese Academy study noted, since the monsoon climate, which produces 200-to-400 mm of rainfall a year, makes it possible to "treat" the expanding desertification, and restore vegetation.

Now, the once-torrential Huanghe, no longer even flows to the sea for many weeks each year. This is a cultural, as well as economic, tragedy for China. For many centuries, the Huanghe was the inspiration for Chinese poets and painters; now, in its lower reaches, it is little more than a stream.

Water Shortage Choking Growth

The shortage of water in northern China is beginning to choke Chinese economic development. With the nation's rapid economic growth since the 1980s, the water crisis has become ever more acute. In mid-2001, the Ministry of Water

Resources in Beijing reported that China's water shortage would hit the "danger" level by 2030, when the population will reach 1.6 billion people. Hard hit are the great northern cities; water for industry is far too limited, and agriculture in China's northern grain belt is also threatened. By 2030, China will need another 65 billion cubic meters of water for agriculture, if it is to ensure national grain security. Farmers who cannot afford to drill very deep wells, are being forced to abandon irrigation and return to less-productive and less-reliable rain-fed agriculture.

While China is the fifth-richest nation in water resources in the world—after Brazil, Russia, Canada, and the United States—with a total of 2,810 trillion cubic meters of water; that is just 2,200 cubic meters per person, only 25% of the world average. By 2030, per-capita water resources will only be 1,700 cubic meters, a "shortage" level.

The second problem is the very uneven distribution of water. China is deeply divided geographically. The big rivers run from west to east, rising in the central plateau of Tibet, the 4,500-meter-high "roof of the world." They flow east and south in watersheds divided by high and rugged mountains. Over 80% of China's water flows either into the Changjiang basin, which cuts the country through the center, or further south. The Changjiang has an annual flow of 956 billion cubic meters; even during dry years, the flow to the sea is 600 billion cubic meters.

Almost 55% of the population live here, most in the Changjiang Valley, but this region has just over 35% of China's arable land.

In the northern plain, is 60% of China's farmland and almost 45% of the population—but this region has only 15% of China's water. The worst affected areas, are the Huanghe, Huaihe, and Haihe basins. Here is concentrated 39% of the farmland; 35% of the population—and just 7.7% of the China's water! Per-capita water is only 500 cubic meters, a dangerously low level.

Finally, China is a developing nation. Much of its industrial technology is inefficient. As a result, water consumption per industrial product is 5-10 times higher than that of industrialized countries, and China only recycles 20-30% of its industrial water. Irrigation is also inefficient. Just 25-30% of irrigation water is used effectively; at the same time, some 2.5 million tons of grain are lost each year due to water shortages.

In November 2000, the Ministry of Water Resources published a paper on the "Basic Readiness of Preparation Work for South-to-North Water Transfer Project." Diverted water is to go first to cities and industry; then to agriculture and other uses. Water use in agriculture will be improved by increasing efficiency of irrigation; regional water which had been diverted to cities and industry, must be returned to the countryside. In all, a mere 5-6% of the flow of the "mighty Yangtze"—the Changjiang—will need to be sent to the North.

Recent Drought Across Asia

A series of bad droughts began in 1997, when the Huanghe did not flow to the sea for a record 267 days, causing serious problems for industry and agriculture in Shandong province. In 1999, large areas of Eurasia, extending from the Korean Peninsula to Afghanistan, and including northern and western China, were struck by the worst drought in 50 years. Millions of people and more millions of livestock, in the countryside and in cities and towns, did not have enough water even for drinking. The effects on sanitary and health conditions, are obvious. Better rainfall has improved conditions in some areas by this year, but drought persists elsewhere.

Yet, typical of the extreme contrasts in China's conditions, 1998 was the year of the catastrophic "century floods" in the Changjiang and some far-northern rivers, which also caused extreme damage.

Already, 400 of the 600 largest Chinese cities have serious water shortages, which cause economic losses amounting to more than 120 billion yuan (\$14.5 billion) annually. Water exploitation in the Huang-Huai-Hai region, is much higher than 40%, the world-wide recognized "rational" limit.

In 2001, as drought continued for the third year, it was announced that the preparation work of the South-to-North Water Transfer Project has met technical requirements, and construction could begin in 2002. Since Spring 2002, the continuing severe drought has left 8 million farmers and over 6 million livestock desperately short of drinking water. Drought conditions are so bad in Shandong Province, that in December, it was announced that 9 million farmers will not have enough grain this Winter. Public granaries will be opened for all those too poor to buy government grain.

The cities of northern China—including the capital Beijing and its port city, Tianjin—are heavily over-extracting groundwater, about 8 billion cubic meters in recent years. This makes further problems. Much of the groundwater is seriously polluted. Also, groundwater tables are falling fast: In Beijing, water tables go down by 1.5-2 meters a year. Around Tianjin, so much water has been pumped out of the ground, that large patches of ground have sunk by over 2 meters, and underground "funnels" are appearing in many other areas along the northeast coast, due to water extraction.

Another phenomenon is the sudden and severe increase



Severe erosion on the famous "loess plateau" in Gansu province. Gulleys like that on the right, are now being planted with fast-growing shrubs, and culverts are being built to end the washing away of the soil.

in bad dust storms which have struck Beijing, the Korean Peninsula, and farther east. The dust storms originate in central Asia's and northwestern China's deserts. They had been very frequent in the 1950s and 1960s, but lessened since—until 1999.

History and Priorities of the Water Scheme

In 1958, the Huanghe and Changjiang Commissions began to study the possibility of sending water north, and the idea has been studied for the following 40 years. The "foundation" was laid already in 1972, with construction of the Danjiangkou Reservoir on the Hanjiang, the longest tributary of the Changjiang.

The three routes now decided upon for transfer of water to the North—the East Route, Middle Route, and West Route—were selected from among 50 alternatives. By 2001, it was decided, with adoption of the "Tenth Five-Year Plan for National Economic and Social Development," to focus on construction of water projects, transportation, energy, and other infrastructure. In September 2000, a preparatory national forum was held in Beijing. Municipalities which would receive the water, were told to begin planning water distribution systems, and, finally, the Ministry of Water Resources completed the general plan.

The strategic perspective of this project, as the Ministry reported, is that the "bearing capacity of water resources will be strengthened, allocation efficiency of resources will be enhanced, and the strategic restructuring of the economy will



Intensive cultivation in Gansu province, on the upper Huang He (Yellow River), in the northern region to which water will be transferred by the great project. Trees are extremely rare here.

be accelerated. It is of great importance to enlarge domestic demand, to create new job opportunities, and to sustain high-speed development of the national economy. . . . Through the improvement of water resources conditions, the potential productive force will be mobilized for economic growth. In addition to greatly improving the quality of drinking water, and national health, the constraint of urbanization in the northern area due to water shortage will be alleviated; the process of local urbanization will be accelerated. The eco-environment and the natural landscape will be improved, satisfying the increased requirement of the people for higher living standards."

A key part of the project is the "three priorities": to save water before diverting it; treat pollution before diverting water; and protect the environment before injecting more water.

These measures are essential. Much of China's water supply, sewage, and irrigation systems are wasteful. Pollution is an extreme problem, destroying large amounts of usable water, and endangering national health. If serious water wastage is not ended, the scale of the project would become too big to handle. China cannot divert water, at great cost, to waste it. However, good advances have been made in the main receiving areas for the Middle and Eastern routes. It would also be a disaster to divert badly polluted water. Pollution is an especially serious problem for water users along the Eastern Route, which will use the ancient Beijing-Hangzhou Grand Canal. Water taken from the Changjiang must be of good quality.

China pollutes about 60 billion tons of water a year, and over 80% of it drains directly into rivers and lakes. Construc-

tion of the "Move South Water North" project will be used as an opportunity to improve water quality along the Eastern Route to a "Class III" standard, which is drinking-water quality. Over 100 new sewage plants will be built in the cities. Eventually, the target is to reach zero discharge of polluted water into the main canals, and make the Eastern Route a "clear water passageway."

Three Transfer Routes

"Move South Water North" will be built in three routes, in the east, middle, and western regions. All three, will be built in three phases. The routes will become new economic growth areas, especially in the western regions.

The "Eastern Route," which will be the first completed, will take water from the lower section

of the Yangtze, northward along the Beijing-Hangzhou Grand Canal, through rivers and lakes, to southern Shandong. Water will also be pumped through a tunnel across the Huanghe—which, for the last 800 kilometers of its route, runs between dykes some 4-6 meters *above* ground level—in the vicinity of Dongping Lake in Shandong Province, to eastern Hebei Province and Tianjin.

Some 50 pumping stations will be needed to move the water northwards, since much of the route is at an altitude higher than the Changjiang. The water will pass through 13 different levels; at Dongping, it will be 40 meters over the Changjiang surface. Water should be arriving in Shandong already by 2005; full construction for this and the middle route will take 15 years. This artificial river will be 1,150 km long; it will eventually carry about 15 billion cubic meters of water a year.

The "Middle Route," 1,246 km long, will take water from the Danjiangkou Reservoir on the upper Hanjiang River, a tributary of the Changjiang, to Beijing and Tianjin, as well as cities along the Beijing-Guangzhou Railway in Hebei and Henan provinces. This route is the only one which will involve resettlement of people, but will also mean real economic improvements in areas it passes through. The first step will be to dig new channels from the Danjiangkou reservoir, and then increase the height of the dam, first built in 1966, to send the water north. Eventually, the flow will be about 13 billion cubic meters a year.

The "Western Route" is by far the most difficult to build; it is likely to be the most challenging water diversion project in the world. Water will be taken from the Dadu, Yalong, and

Tongtian rivers, along a 3,600 km canal, to the upper Huanghe in the Ningxia Hui and Inner Mongolia regions, and Shaanxi Province.

New technologies make the project feasible; it could not have been done when it was first considered in the 1950s. Construction of the Western Route will cost over 300 billion yuan (about \$36 billion), but eventually, it will take about 17 billion cubic meters of water a year to the dry Northwest. A long section will have to be built in the extreme geological and weather conditions of the Qinghai-Tibet plateau, which lies 3,000-4,500 meters above sea level.

When “Move South Water North” is finished, it will allow overall and diverse water management for all of China. The supplies from the Eastern and Middle routes will lessen the strain on the lower Huanghe, until the Western Route is completed. Once that is done, the increased flow along the upper Huanghe would make it possible to compensate for any temporarily lessened flow from the Middle Route, if there were a shortage of water in its source, the Hanjiang. In years when there is enough rainwater, water from the diversion project can be used to “recharge” depleted aquifers and rebuild groundwater and lakes.

China’s ‘New Deal’

This water project will be built as part of China’s “New Deal” policy. Since early 1998, Beijing has carried out a huge national investment program—its funding led by government bonds—to ensure construction of badly needed infrastructure and the growth of the domestic economy. This has been China’s “insurance policy” against the turmoil in the international economy, as demonstrated by the 1997-99 Asian economic crisis, and the subsequent crash of the U.S.-led “new economy”-“high tech” bubble.

Cornerstones of this national investment, are: the “Develop the West” campaign for the interior, launched in 1999; and essential water-management projects, including the construction of the Three Gorges Dam and reinforcing the dykes along the Changjiang in the wake of the devastating floods of Summer 1998. Heavy flooding occurred again in Summer 2002—but this time, the dykes held, and a second catastrophe was prevented.

Now, funds can be re-directed to water diversion. The central government will finance the main waterways, at about



The famous “Half Moon Lake” in Xinjiang. This lake, a natural phenomenon, lies amidst sand dunes. Its water level had fallen, but there is a project to restore it, as well as other lakes in Xinjiang.

60% of total costs, via a limited liability company responsible for construction, operation, and maintenance. Local governments which receive the water, will pay for the connecting canals. Up to 30% of national investment will be loans from domestic banks; but no foreign funding will be used, since interest rates on such loans are too high.

State-supported water prices will certainly rise in northern China, especially in the cities, at least in the short term. Eventually, prices may be brought down again; meanwhile, inexpensive loans and other measures will be available to cushion the effect on users.

In August 2001, Beijing’s State Development Planning Commission carried out a national study which concluded that the water shortage was a “severe restraint” to the potential for sustaining national economic growth. Over 100 cities across China suffered water shortages in 2000, affecting both living standards and industry.

The same study found that rapidly advancing desertification is causing China economic losses of 54 billion yuan (\$6.5 billion) a year. Already, 1.7 million square km of land—18% of Chinese territory—have turned into desert, and the damage is spreading by 3,500 square km a year. The problem is worst in the western interior. In a country already very short of arable land, the expansions of deserts have sharply reduced usable land and made already-impoverished farmers and herdsman even poorer.

Desertification is very difficult to reverse. Not only is vegetation lost, but also the soil’s structure and ability to

retain moisture are destroyed. Programs to curb desertification had treated almost 9 million square km by end-2000, but land is being destroyed faster than it can be saved.

China also has one of the world's worst soil-erosion problems. Up to 5 billion tons of fertile soil are lost each year, and some 70,000 hectares of cultivated land damaged. Erosion control has been a top priority since 1991, and concern grew much greater in the wake of the terrible 1998 floods, which showed how much damage had been done by loss of vegetation along the Changjiang. Strict bans were imposed on logging; at the same time, the effort was sped up to plant 20 million hectares of "green shelter belts" of trees throughout the northern regions and along the entire course of the Changjiang.

In north China, less than 7% of the land is forested, although the goal is to increase that to over 20% by 2010. For China as a whole, forest land is only 16.5%, and the goal is to increase that to 20% by 2010 and 25% by 2050. China already has one of the largest man-made forests in the world, covering in total 47 million hectares.

Another project is an effort to end the cultivation of marginal land, and returning it to forest and grassland, eventually moving farmers and herdsman off this land. This, however, is a big social issue. Some 80 million households in rural China cultivate sloping or otherwise marginal land; in some areas, this is an ancient practice. A project has been launched to give farmers eight years' compensation for reforestation. However, a critical problem will be to maintain living standards when the compensation ends, and to ensure that the peasants do not return to cultivating the marginal land.

Creating Water in Eurasia

While exploitation of natural forests has been reduced, and large areas of sloping land successfully restored to forest or grassland, both state forestry workers and many peasants have been hit hard economically by these programs. Government subsidies have made food prices cheaper, undermining the incomes of peasants still working the land. "Fine tuning" of the whole project is urgently needed, allowing controlled logging, forest development, and livings for many millions of people.

A smaller, but important achievement in water management, has been restoring water flow in the 1,321 km Tarim River in Xinjiang. This river, which gave life to ancient cities along the Silk Road, was being over-used for irrigation; as a result, one-third of its length had dried up. A program was launched at the end of the 1990s, to save the river, and a several-hundred-kilometer-long "green belt" of poplar trees which had been planted to curb the expansion and possible merging of the Taklamakan and Kum Tagh deserts. This program, conducted on an emergency basis, has now restored Taitema Lake, which had vanished in 1972. However, Xinjiang needs much more water. Larger



The Upper Huang He, the once-mighty Yellow River.

measures, including exploitation of the large underground water reserves of the area, estimated at twice the volume of the Huanghe, must be undertaken for more permanent solutions.

Ultimately, "Move South Water North" should be just an initiating phase of transforming China's water resources. China requires water cooperation with the nations of Central Asia, Russia, and the Indian Subcontinent, to meet the needs of Eurasia. And new water resources must be created.

Some in China have this idea in mind. In Summer 2001, Qinghua University, China's leading institution of science and technology, announced that it would supply nuclear technology to launch a seawater-desalination project in Shandong. When finished, this project will produce 160,000 tons of urgently needed fresh water a day. Nuclear energy will be used both to reduce the costs of desalination and increase production capacity, Qinghua officials announced. Such technologies and projects are the wave of the future for Eurasia's 4 billion people.