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THE ENVIRONMENTAL CHALLENGE AND HEALTH SECURITY IN CHINA

ABSTRACT
China has achieved impressive rapid development over the past 30 years. But China also faces the challenge of environmental change resulting from rapid economic growth and the attendant risks to human health. In this paper we described the environmental change and health risk in China from evident fluctuation of China's climate, major changes in natural hydrological condition, raw materials and energy demand, changes of disease epidemic pattern related to climate change and ecosystem damage, new health risk raised by rapid urbanization and rural environmental quality degradation. The suggestion and countermeasures were discussed.

KEY WORDS: environmental change; health risk; governance

INTRODUCTION

Both the range and rate of anthropogenic activity caused geographical environmental change in China in recent 50 years have obviously exceeded any period in history. The resultant environmental problems have occurred and some of the environmental change is irreversible. Under the background of future global warming, China will face many challenges such as rapid urbanization, shortage of energy and mineral resources, water deficiency, cultivated land and food security. The environmental deterioration and health risk will be aggravated. Some of the unacknowledged potential threats would be even more serious. Social and harmonious development will bear greater pressure. In recent 100 years, China's annual mean temperature over ground surface has increased evidently with a range of about 0.5-0.8°C, though the current extent of warmness has not yet reached the highest level over the past 2000 years [National Assessment Report on Climate, 2007; Ge et al., 2002].

During 1956–2002, the mean annual precipitation anomaly throughout the country presented a small increasing trend, drought aggravated in most part of North China and southern part of Northeast China [National Assessment Report on Climate, 2007]. The water amount that has already been used made up one-fifth of the country's total annual mean water resources averaged over years, and the total amount of the extracted groundwater occupied one-eighth of the country's total annual mean amount, which resulted in serious ecological crisis [State Environmental Protection Administration of China, 2007]. The nationwide lake reclamation has led to a loss of more than 32.5 billion m^3 of freshwater storage, particularly a rapid shrinkage of inland and drainage lake surface area, even lake dried-up, bringing lake ecological disasters [Bai & Wang, 2003].

A great amount of raw coal, building materials, iron, food and freshwater resources would be consumed to satisfy the need of socio-economic development, currently, both output of mineral products and consumption in China rank among the first in the world. Of which the output of raw coal, iron, 10 kinds of nonferrous metal and cement ranks the first in the world, phosphorite and pyrite the second and third place, and crude oil the fifth place.

In the past 50 years, environmental pollution in some places has reached the ultimate limit. On the one hand, new environmental problems of dangerous wastes, trace organic pollutants and persistent organic pollutants (POP_S) occurred constantly. Of the waste gas emitted throughout the country in 2006, SO_2 emission amounted to 25.89 million ton and smoke dust 10.89 million ton, and one-fifth of the Chinese urban population lived in an environment with serious air pollution [State Environmental Protection Administration of China, 2007]. More and more natural water bodies have lost their proper function due to increasingly serious water environmental pollution. About one-third of the water body in China is unsuitable for fish survival, one-fourth unsuitable for irrigation, 50% of the urban water source fails to reach drinking water standard, 40% of the water source undrinkable and 60–70% of the total water deficiency in cities of southern China are caused by water pollution. In 2006, the transect of the seriously polluted seven major drainage systems (water quality over Grade IV) accounted for 54%, of which 26% was categorized as worst water quality of Grade V; among the 27 major lakes and reservoirs, water quality of 13 fell into the category of Grade V, 9 below Grade IV and only two were Grade II [Li, 2000].

Offshore sea water environment becomes increasingly deteriorated. In recent years the amount of various kinds of pollutants entering China's near waters reaches about 15 million ton every year, including mainly four types of chemicals: COD, NH_3, oils and phosphate. The occurrence of red tide in China's offshore becomes more frequent, it was 93 times in 2006, and the species of toxic algae increased. Of the 237 monitoring sites of offshore sea water quality, only 19.8% reached the State Grade I sea water quality standard [State Environmental Protection Administration of China, 2007].

Solid waste discharge increases every year. In 2006, the amount of national industrial solid waste reached 1.52 billion ton, an increase of 12.7% over 2005 [State Environmental Protection Administration of China, 2007]. The urban domestic garbage produced in the country was 0.15 billion ton with an annual increasing rate of 8–10%.

With rapid urbanization and urbanization process, both the number and size of China's cities have increased. Since 1990s, China's urbanization development has been out of the normal track due to relative poor planning, legislation and management, hence resulting in serious problems of resources waste, environmental pollution and ecological damage.

The rapid changing industrialization process and economic geographic framework in the past 50 years have led to even more significant land cover change in China. Since 1980s, land for non-agricultural usage has been increased drastically; a sharp increase in urban built-up area at a rate of 850 km^2 per year was witnessed during 1984–2000 [State Environmental Protection Administration of China, 2008]. The cultivated land was lost at a rate of 949,000 hectare per year averagely in China during 1996–2004, a total decrease of 5.84% [Liu et al., 2003].

China's environmental change took place under the background of global environmental change and rapid socio-economic development of the country. Climate warming, water crisis, land cover change, environmental quality deterioration, and ecological damage, all these unfavorable factors will not only make economic development bear great pressure, what is even more serious is the health problem

brought by various environmental changes and risky aggravation, hence building a well off society in an all-round way will face rigorous challenge.

THE POVERTY RELATED TRADITIONAL HEALTH RISKS STILL PREVALENCE

The impact of indoor air pollution on health in rural areas has been a hotspot attracting attention both at home and abroad. Burning inferior coal and biological fuel (straw, firewood, dried cow and sheep dung) is a main reason causing rural indoor air pollution. Coal burning can produce large amount of CO_2, SO_2, NO_x, CO, inhalable particles, smoke dust, harmful elements of F, Cd, Cr, As, Pb, Hg, Ni, Cu, Mn, polycyclic aromatic hydrocarbons (PAH), etc. In the process of burning biological fuel, large amount of CO, smoke dust and inhalable particles can be produced. It was warned that indoor air pollution could result in the deaths of 1.6 million populations in many developing countries every year by WHO and UNEP. Mortality of respiratory system disease is high in rural China, behind the mortality of cancer and cerebrovascular and cardiovascular disease. As shown in Figure 1, the overall distribution pattern of rural indoor air pollution induced health risk is high in northern China. Besides, coal contains high fluorine and arsenic contents in part of the provinces and autonomous regions, in addition to producing SO_2 and atmospheric particle matter, large amount of fluorine and arsenic are emitted in the process of coal combustion, leading to coal-burnt type fluorine poisoning and arsenic poisoning [Zhao et al., 2003].

The endemic disease closely related with primary environment is still prevalent. At present there are still over 800,000 Iodine Deficiency Disease; though Keshan Disease and Kaschin-Beck disease have generally been effectively controlled, they are

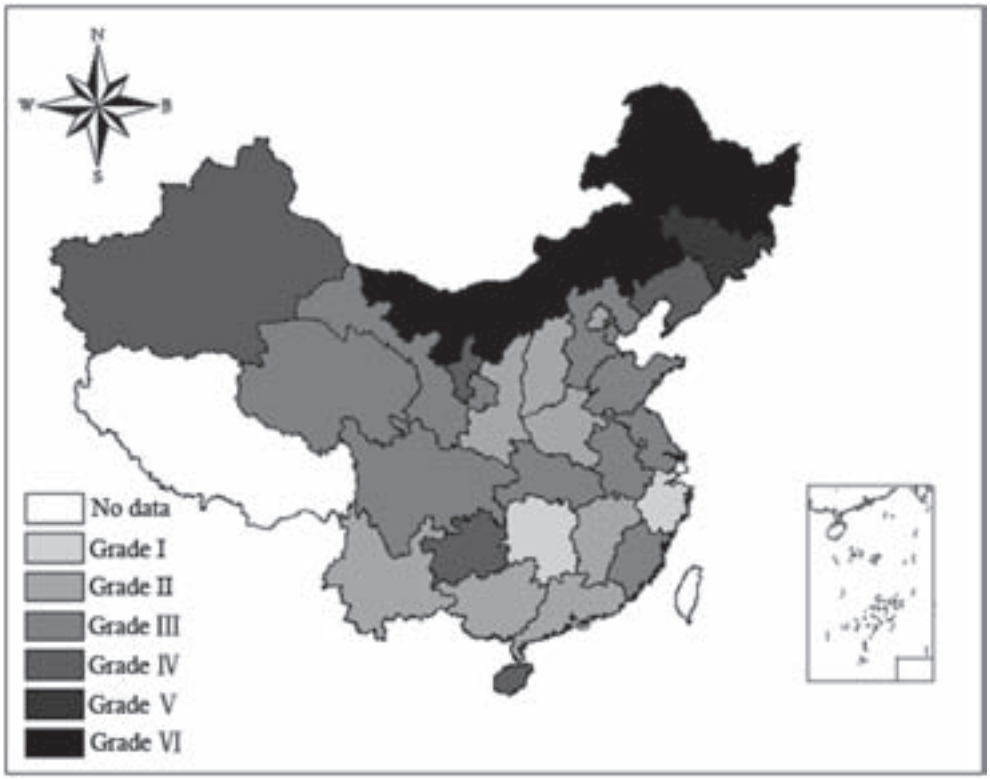

Fig. 1. Health risk of indoor air TSP in Rural of China

still serious in local areas, particularly in Southwest China. Drinking water type of endemic fluorine poisoning and endemic arsenic poisoning still endanger the health of up to one hundred million people in China, distributing extensively in 1063 counties with patients over 20 million, hence it is still an arduous task to control the disease [Ministry of Health of China, 2005].

Some of the traditional infectious diseases such as plague, malaria, schistosomiasis, brucellosis, visceral leishmaniasis, filariasis, epidemic encephalitis, epidemic hemorrhagic fever, cholera etc., mainly do harms to farmers. Besides, there are 5 million motility tuberculosis (TB) patients in China, of them about 80% of the patients come from rural area, moreover, the number of the economically less developed region in central and Western China is two times higher than that of the economically developed eastern coastal provinces.

China has basically solved the problem of hunger and adequate food and clothing. The national nutrient survey result of 2002 indicated that, in contrast to 1992, the diet structure of rural residents tended to be rational, but nutrient deficit diseases (mainly the imbalance of trace element nutrients iron, calcium and vitamin A induced anaemia, osteoporosis, malnutrition and cognitive injury) are still the main diseases harming health, especially in rural, poverty-stricken and remote minority nationality inhabited areas, they have become prominent "recessive hunger". Bradyauxesis and low weight rates of rural children under 5 years old are 17.3% and 9.3% respectively, in poverty-stricken rural area, they are as high as 29.3% and 14.4%. The rate of bradyauxesis for one year old group is the highest, being 20.9% averagely in rural area and in poverty-stricken area, as high as 34.6%. The rate of vitamin A deficiency for rural children of 3–12 years old is 11.2%, being about 3–7 times that of the urban; and vitamin A marginal deficient rate is 49.6%. As vitamin A deficiency for children under three years old is closely related with the susceptibility of diarrhoea and acute respiratory tract infection, the immunity of rural children has been seriously threatened. Moreover, diet structure is closely related with chronic disease like cancer, cerebrovascular disease and cardiovascular disease and diabetes, the change of diet structure in rural area has caused the rise of incident rate of rural chronic disease. Recent nutrient survey results indicate that high incident rate of high blood pressure in rural area has led to insignificant rural-urban gaps, but however, the rate of awareness, cure rate and control rate of human high blood pressure are still very low, being only 30.2%, 24.7% and 6.1% respectively.

HEALTH RISKS ASSOCIATED WITH RAPID ECONOMIC GROWTH AND EXPOSURE TO ENVIRONMENT POLLUTION

China's urban air pollution is still more serious [State Environmental Protection Administration of China, 2004]. The global environmental monitoring system of the WHO and UNEP once listed Shenyang, Xi'an and Beijing the top ten cities having the highest total suspended particle (TSP) concentrations in the world in 1996. In terms of the present status of the nation's cities, the air pollution generally belongs to the first stage coal type pollution. For the economically non-developed medium and small cities and the industrial cities taking coal as the main energy source, such a kind of pollution is particularly protruding. However, in the metropolis and economically developed large and medium cities, pollution began to shift to the second stage air pollution but still having both. The summary published by World Bank in 1997 pointed out that China's air pollution caused a relative high daily mortality. According to estimation there are about 111 000 excess deaths, hospitalized 220 000 people, emergency cases of 4.3 million person/time and 3 million "activity restricted days" due to pollution in China every year. The report by World Bank and the Ministry of Environmental Protection in 2007 estimated that untimely death and disease caused economic loss resulting from

air pollution in China in 2003 was 157.3 billion Yuan, accounting for 1.16% of the domestic total production output value. Among the total loss, the urban outdoor air pollution produced health loss ranked the first place, accounting for 1.6% of the urban domestic total production output value.

China is facing a dual effect of water resources shortage and water quality deterioration. On the one hand, the scope of water shortage expands constantly, while on the other, water pollution becomes more and more aggravated. More than 70% of the rivers and lakes have been polluted to different degrees, COD total discharge level was 40% higher than the environment bearing capacity, the undrinkable surface water due to pollution accounted for 40% of the total observed water bodies, 78% of the river reaches running through cities were unsuitable to be used as drinking water source; nearly 50% of the groundwater were polluted and more than 300 million people throughout the country drank unsafe water [Zhang, 2005], toxic element contents in drinking water for 0.19 billion people in rural area are exceed hygienic standard and nitrate content of 50% of the groundwater in North China are exceed hygienic standard. Though local water environmental quality has been improved after treatment, generally speaking, water environmental deterioration trend has not yet been thoroughly reversed and water pollution situation is still grim on the whole.

The industrial waste water and domestic sewage discharge of the country increased from 3.1 billion m^3 in 1980 to 6.8 billion m^3 in 2004, of which the sewage discharge into rivers reached about 5.33 billion m^3. About 61.5% of the cities had no sewage disposal plants, a considerable amount of cities have not yet set up sewage treatment charged system, sewage collection and treatment network construction lagged behind, of the existing urban sewage treatment works, only one-third can operate normally while one-third cannot operate at all. In addition to large cities, sewage has not been effectively treated in many cities and towns.

The increasingly deteriorated drinking water health problem has become "one of the most urgent survival crises in the present world". In order to remove some of the toxic substance in water, the most commonly adopted treatment method is to add chlorine in drinking water. However, as the reflection of added disinfectant such as chlorine with natural organism in water can produce various types of chlorinated sterilization by-products including trichloromethane and halogenated acetic acid [Bellar et al., 1974; Rook, 1974; Uden et al., 1983], it might cause the occurrence of various types of cancer [Carhman et al., 1981; Bull, 1982; Cantor et al., 1998]. Trihalomethane was detected from running water in 24 large and medium cities in China, and halogenated acetic acid was also detected from drinking water in some cities recently. Analysis of the trihalomethane and halogenated acetic acid contents in drinking water of China's typical cities indicated that trihalomethane in drinking water of Tianjin and Zhengzhou has exceeded the national standard. The high haloacetic acids content in Tianjin, Changsha and Shenzhen constitutes a health risk.

80% of the human diseases are related to water. The toxic substances in discarded materials such as garbage, sewage, insect pesticide and oil can easily enter the food chain through surface water and groundwater. The polluted animal and plant foodstuffs and drinking water can make people suffer from cancer and other diseases. The increase of environment toxic pollutants is the main reason for the increase of incident rate of various kinds of diseases in recent years.

The non-point source pollution caused by heavy use of pesticide and chemical fertilizer as well as sewage irrigation seriously affects soil and agro-ecosystem; hence food quality security is really something to be worried about. In recent 10 years the application intensity of chemical fertilizers on farmland throughout the country has been increasing. In 2005, the amount of application was 367 kg/hm^2, exceeded the upper limit of

the developed countries (225 kg/hm^2) by over 60%. The excessive amount can not be used by crops and absorbed by soils as wall, but lost along with the farmland surface runoff. China is a country producing and consuming large amount of pesticide. Since the 1990s, the total amount of pesticide applied and application intensity have been increasing. In 2005, the amount of application was 11.23 kg/hm^2, being 1.6 times of the average application intensity 7 kg/hm^2 of the developed countries [National bureau of statistics of China, 2006]. Of which high toxic pesticide applied occupied 70% of the total, and high toxic and high residual produced that the State forbidden to use was still produced and utilized in part of regions. Long time spray and touch pesticide can cause leukemia, and 40–45% of the leukemia patients are related with pesticide application in rural areas.

The heavy metal polluted farmland exceeded 20 million hectare in China; about 65% of the sewage irrigated farmland was polluted by heavy metals and organism to different degrees. In some of the cities of South China, 50% of the farmland was polluted by toxic heavy metals such as Cd, As, Hg and organism such as oils; in some of the cities of the Yangtze River Delta, continuous patches of farmland were polluted by heavy metals, causing 10% of the land basically lost productivity. The heavy metal polluted grain produced can be as high as over 12 million ton every year in China, of the main farm produce, exceed standard limit pesticide residual rate is as high as 16–20% [Yan et al., 2000; Hao et al., 2003].

The rapid urbanization process led to substantial increase in garbage. The annual average increasing rate of garbage is 8.42% in the world, but in China it has reached over 10%. China produces nearly 0.15 billion ton of urban garbage every year, accounting for about one-fourth of the world total. Up to now the urban domestic garbage has accumulated 7 billion ton throughout the country. Presently, China's 20% of the urban garbage are treated by filling and burying method, 20% by composting method, 5% by combustion and 5% other (piling in open air, recycling) method, harmless treatment rate of urban domestic garbage accounting for 52% in the country [Zhao, 2002]. The trouble of garbage filling and burying induced seepage pollution can not be underestimated. The current filling and burying method usually mixes large amount of toxic substance with domestic garbage, making multiple types of toxic elements concentrate and pollute soil and groundwater. The parasite and pathogenic bacteria in the polluted soil can cause human body pathogenesis.

With economy rapidly developed and food supply constantly enriched, people changed their behavior more and more obvious. The main reflections are: the increase of meat and oil consumption caused a rapid rise of supply-energy ratio of dietary fats, an apparent drop of cereal food consumption and high intake of salt.

The morbidity of human chronic disease rises constantly, and the prevalence of the corresponding danger factor becomes increasingly serious. This has not only seriously affected health of laborer population, making quality of living standard deteriorated but will also create great socio-economic burden. Of the total death of 58 million people in the globe in 2005, about 35 million died of chronic disease, of them 7.5 million Chinese died of chronic disease. In the next 10 years, the number of the disease will increase by 17% in the world. If no powerful measures are taken to control, the number of death will increase by 19% in China [Chinese Center for Disease Control and Prevention, 2006].

The proportion of death of chronic disease to the total death tends to go up constantly. At present the hypertension morbidity for adults at age of 18 or above is 18.8%, hypertension patients totals 0.16 billion, of with 0.11 billion are laborer patients at an age of 18–59. During the 10 years from 1991 to 2002, the hypertension morbidity increased 31% compared with that of the

20 years from 1959 to 1979, and the number of the patients increased more than 70 million [Chinese Center for Disease Control and Prevention, 2006].

Abnormal blood lipid level is an important danger factor of cerebrovascular and cardiovascular disease. In 2002 the number of adult blood fat abnormal patients was 0.16 billion with a total morbidity of 18.6%, among them the morbidities of hypercholesterolemia, hypertriglyceridemia and low blood high-density lipoprotein cholesterol are 2.9%, 11.9% and 7.4% respectively [Chinese Center for Disease Control and Prevention, 2006].

In 2002, morbidities of diabetes for adults at age 18 or above in large, medium and small cities and rural areas of China were 6.1%, 3.7% and 1.8% respectively. Compared with 1996, morbidity of urban patients in the 6 years went up by 40% in China [Chinese Center for Disease Control and Prevention, 2006].

Morbidity of human overweight and obesity went up rapidly. In 2002, about 0.3 billion people were overweight and obesity in China. Among them overweight rate of adults above 18 years old was 22.8% and obesity rate 7.1%. In the 10 years from 1992 to 2002, the number of residents overweight and obesity morbidity for adults at 18 or above accounted for 40.7% and 97.2% respectively [Chinese Center for Disease Control and Prevention, 2006].

CHANGE OF DISEASE EPIDEMIC PATTERN FROM CLIMATE CHANGE AND ECOLOGICAL DEGRADATION

Global warming changed climate pattern and caused even more frequent and more serious flood and drought, hence leading to rapid fluctuation of climate. Extreme precipitation events tend to increase and become more intensified throughout the country. Both average intensity of extreme precipitation and extreme precipitation value tend to intensify, especially in the 1990s, the proportion of extreme precipitation amount tended to increase. The amount of annual precipitation and extreme precipitation tended to increase in the Yangtze River and south of the Yangtze River region, and both extreme precipitation value and intensity of precipitation event intensified. Meanwhile, the frequency of drought event increased in northern China in recent over a dozen years. High temperature and heat wave increased in summer. The number of high temperature days with high temperature greater than 35 °C increased apparently after the mid-1990s. Upon entering the 1990s, the high temperature and hot summer weather occurred frequently in summer in China. In the summer of 2000, many places in North and South China were hit continuously by heat waves and heat wave process witnessed high temperature, long lasting duration and apparent increase in mortality [Qing, 2004].

The rainstorm induced flood and water logging disasters have the greatest impact with the fastest increase rate. The modern flood and water logging are characterized by high frequency rate, wide scope of influence, long duration and high affected intensity. The severe floods and water logging occurred in the Yangtze River basin (1991, 1998) and the Pearl River basin (1994, 1996) in the 1990s as well as extraordinary storm induced floods in Hebei Province in August 1996 both resulted in a direct economic loss over 10 billion Yuan. The 1998 flood disaster caused a direct economic loss of 255.1 billion Yuan. In 2005, the serious storm induced flood disasters occurred in Xijiang river, Minjiang river and Huaihe drainage basins and Hunan, Hubei, Sichuan and Liaoning provinces as well as severe autumn floods in Weihe and Hanjiang drainage basins affected about 0.13 billion people, caused a death of 1246 people and a crop affected area of 11 million hectare with a direct economic loss of over 77 billion Yuan. In 2008, 20 provinces, autonomous regions and municipalities were hit by flood disasters to different degrees. Up to June 17, the crop affected area reached 2.32 million hectare, the disaster affected area was nearly 1.13 million hectare, and impacted population reached 40.62 million, a death of 171 people and a

collapse of 133.900 rooms, with a direct economic loss of 27.7 billion Yuan [Tan et al., 2002].

Serious drought is also an extreme climatic disaster. In 2005, serious drought occurred continuously in autumn, winter and spring in southern part of South China, serious spring drought rarely seen in recent 50-odd years occurred in Yunnan Province, early summer drought took place in the middle and lower Yangtze River basin, summer and autumn continuous drought happened in northeastern part of Northwest China and Inner Mongolia, and autumn drought was obvious for a period of time in areas south of the Yangtze River and South China [Xiao & Xu, 2006]. According to estimation, the drought affected crop area was 16 million hectare, the disaster caused area 13 million hectare, the area having no harvest at all was 1.9 million hectare and 23.5 million people had difficulties in getting drinking water, the direct economic loss reached more than 20 billion Yuan throughout the country [Xiao & Xu, 2006].

Nowadays various kinds of new diseases occur frequently; some diseases that have already been eliminated or weakened become popular again and spread rapidly throughout the globe, constituting the new characteristics of epideictic of world diseases. China is a country with high incidence of numerous diseases, particularly with that of infectious disease of natural foci and the disease that human and animal commonly suffering from. With global warming and aggravation of human destruction on ecosystem, some old infectious diseases began to survive in China.

Plague (rat) is a typical natural focus-based infectious disease, and plague has been effectively controlled for a long period of time. However, as shown in Fig. 2, since the 1990s, plague cases have increased apparently and plague has spread risk.

Malaria has also spread risk, which is affected by climate and weather conditions. The abnormal weather, such as rainstorm can make mosquito propagate substantially and lead to epidemic outbreak. The distribution of malaria of China is shown in Fig. 3. The area south of 25 °N is high epidemic area of malaria. Meteorologists predicted that a rise of average 2 °C of temperature globally, the proportion of malaria affected population

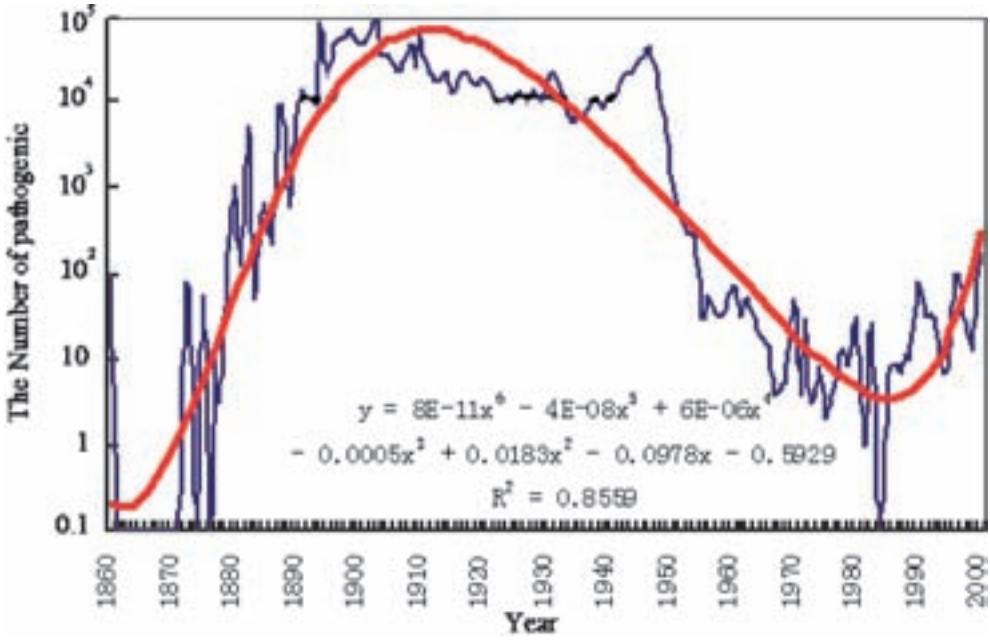

Fig. 2. Number of the incidence of plague in China

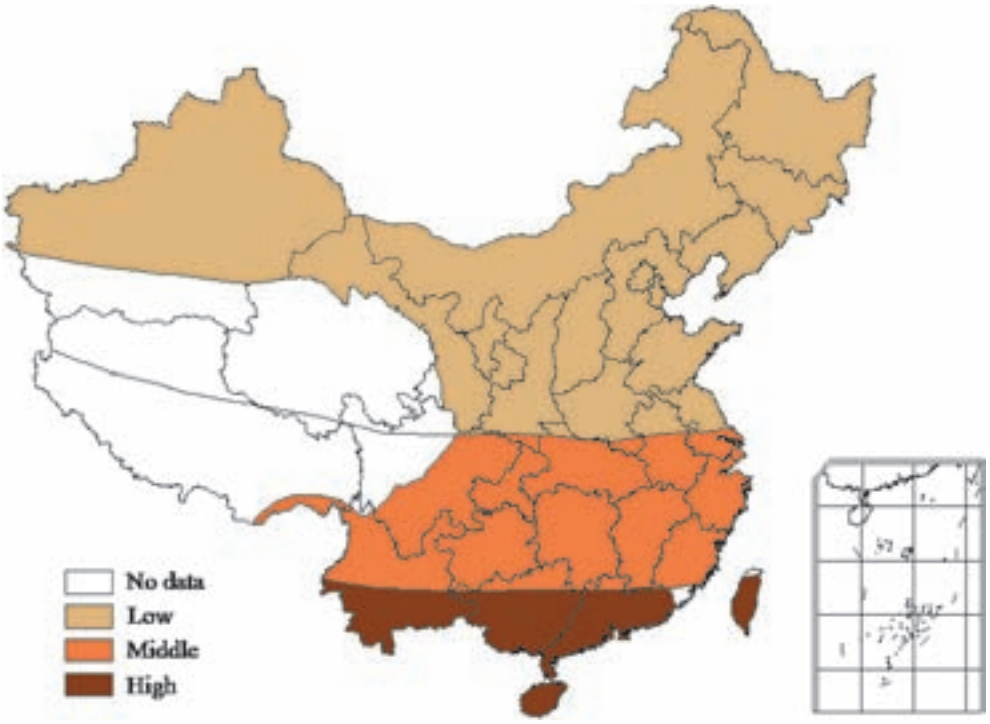

Fig. 3. The distribution of malaria in China

might increase from present 45% to 60%, an increase of newly added cases of 5 million to 8 million. Predictions of Yunnan and Guizhou provinces indicate that a rise of 1.7 °C will occur and cause the epidemic affected area extend towards north and high altitude. Besides, the frequent population movement will cause outbreak and prevalence of imported malaria from outside China. For instance, the import malaria increases every year in Guangxi and 103 malaria outbreak and prevalence points occurred in the border region of Yunnan during 1989–1996 [Jiao et al., 2006].

Schistosomiasis was prevalent in the Yangtze River Basin and 434 counties in 12 provinces (municipalities) and autonomous regions south of the Yangtze. The population in the disease affected area was 66 million, patients about 0.84 million, the scope of the affected area radiated and expanded constantly, hence part of the medium and small cities have been threatened by the disease [Ministry of Health of China, 2004]. One of the important factors to affect and control disease propagation is to change the eco-environment by converting cultivated land to lakes and leveling protective embankments in lakeside areas to divert flood water. The climate warming induced flood disaster increase is closely related with the epidemics of schistosomiasis. In recent 10 years, flood disasters happened frequently in the Yangtze River [Zhang et al., 2002].

The occurrence of SARS in 2003 and bird flu in many places of China in recent years relates closely with agricultural industry growth and rapid increasing of travel. Since early 2003, there have been many reports of outbreaks of avian influenza related with wild birds and domestic poultry in many countries. In China, the large amount of domestic poultry and pigs are close proximity to human with the fast agricultural industry expansion that resulting in exposure and transmitting virus from animal to human. At the same time, the rapid rising of travel in frequency and scale within China and in the world likely increases the infectious exposure of new emergent diseases to human such as SARS which of more than 8000 infected individuals, with over

700 deaths worldwide within just six months. These present great challenges for the control of outbreaks of new highly infectious diseases.

CONCLUSIONS AND SUGGESTIONS

China's environmental change and health problem is very complicated, characterizing mainly by the following aspects. First, China's environment and health problem was resulted from the global environmental change and China's rapid socio-economic development. Second, health harmfulness usually presents synthetic function of environmental multi-media and multi-factors. Third, environment and health problem has distinct regionality. Fourth, it is more difficult to evaluate and forecast the impact of environmental change. Fifth, it is lack of the multi-sector integrated coordination and management at present.

In order to cope with environmental change and health risk, the following suggestion and countermeasures are put forward.

To establish multi-sector high-level integrated coordinative governance mechanism to face challenge of environmental change and health risk

Environmental change can exert important impact on human health, which will not only aggravate problems concerning various aspects of public hygiene but also bring new and unpredictable problem on social sustainable development. Therefore, only by taking the impact of environmental change on human health as an important component of government management, formulating multi-sector integrated, coordinated and decision-making system and mechanism and identifying common target from the viewpoint of multiple layers of policy, education, the public, propaganda, technology and research, can effective management be formed.

The management of environmental change and health involves many sectors; hence it is not easy to perform effective management. The current China's administrative management system is still a highly traditional top down system, characterizing apparently by "block splitting and strip splitting". In light with such a kind of defect of "either centralization of power or dispersion" in management system, the state will implement a new round of reform on administrative management system. It is necessary for us to establish a new system and decision-making mechanism on environmental change and health management to strengthen inter-sectoral close coordination among various aspects of environment, hygiene and society, strengthen the linkage and dialogue among government (state and local various levels decision making departments), regions, trades, non-government organizations and public interest related personnel, and link environmental change with policies, measures and actions of health management organically.

Facing the new problem of global environmental change and health risk, it is necessary to manage the already existing and unpredictable environment and health problem from new angles and new preparations. In order to mitigate the possible impact on health due to environmental change, it is necessary to conduct disease monitoring and get to know changes of disease in geographic distribution; to strengthen environmental management; to be well prepared to cope with disasters; to improve early warning system and be ready to deal with prevalence of disease; to improve water quality and control air pollution; to enhance public education of individual behavior; and to train research workers and professionals on public health. The present urgency is to establish a high-level integrated coordinative management system and mechanism, raise the ability of the state in coping with environmental change, and directly promote the improvement of the national health level.

To improve national awareness and implement action plan on environmental change and health protection

With the progress of society, people have become more and more concerned about their own health. However, their awareness is

extremely weak in linking up environmental change with health impact, in standardizing their own behavior, and in connecting individual health with environmental change. To rise to the challenge of global environmental change, it needs the whole nation's participation, especially to standardize the whole nation's behavior with new ideological system, consciously using one's own action to mitigate global environmental change and health risk. To this end, it is specially significance to the establishment of environmental ethical viewpoint for sustainable development and raise of the nation's awareness to the challenge of global environmental change and health risk.

The core of the environmental ethical viewpoint for sustainable development is to set up truly equal and justice for human and human-nature relations, advocate harmonious development and survive and take honour together. The human equal principle required environment ethics includes intra-generation equality reflecting global common interest and intergeneration equality reflecting future interest. The principle of human-nature harmony is the fundamental principle for sustainable development.

The implementation of action plan on environmental change and health protection is an essential measure to raise the nation's awareness in dealing with environmental change and protecting health as well as to put into practice consciously. Citizens should actively promote and participate in the action, do it from themselves and protect the nation's health.

To energetically conduct research on environmental change and health risk

Global environmental change and health research is a multi-disciplinary integrated research, in light of the trend of global environmental change, the problems concerning environmental change and health research that should be solved urgently are: 1) to deepen the complexity and uncertainly of the relationship between environmental change and health; 2) to reveal the correlativity of environmental multi-media, multi-factor and multi-dose and synthetic health effect and its mechanism; 3) to set up synthetic risk evaluation system of environmental change and health security and reveal the characteristics of environmental change and key health risk areas; and 4) based on data sharing mechanism, to set up environmental change-health risk-socioeconomic relationship and the model system with prediction function and supplementary decision-making.

To establish scientific data sharing mechanism and new research method

At present, research on environmental quality and human health is restricted to the inadequacy of suitable data, sufficient material and deep data extraction. Data and materials on morbidity, mortality, population and various aspects on environment are available by the state, however, various government departments are independent of each other, and only responsible for the data of their own relevant trade and lack of data sharing and assemblage. Therefore, it is necessary to formulate jointly a data agreement to promote data exchange among various departments and set up a data sharing mechanism on environmental change and human health.

It is necessary to develop standard method for compiling environment-health data and through regular exchange between data collectors and data users to ensure the collected data possessing most useful information and spatio-temporal resolution. In order to estimate the health effect of the global environmental change, long term disease monitoring should be connected with environmental monitoring that has correlations with specific geographic positions. Meanwhile, biological and meteorological data should be collected simultaneously. The principal scientific data should include remote sensing data; long time series health data; disease propagation data; environmental, socioeconomic and

population statistical data matching health data; environmental change and biological species monitoring data; and biological effect indicators that can reflect global environmental change.

Research on environmental change and health needs to merge multiple research method including development of modeling method relating to various kinds of data and to carry out scenario analysis on environmental change and health at global and regional scales. In addition to the research method on traditional epidemiology and hygienics, it is even more necessary to have new research concept and method. To this end, seminars and training courses involving multi-disciplinaries should be held regularly to promote exchange of new ideas and concept and the development of integrated research method.

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