MANAGING AGRICULTURAL WATER FOR SUSTAINABLE DEVELOPMENT OF RURAL INDIA

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ABSTRACT

Good water management is essential to conserve water resources. Today water management and wastage of water is a big problem in all around the word. India, like many developing countries has its one of big problems associated with developing its rural sector where the majority of its population lives. Since independence, the government of India has taken many initiatives for managing agricultural water management and rural development. A number of approaches have been tried in India. Besides the provision of social services such as clean water, schools and dispensaries to about half of the rural population by 1982, none of the approaches has led to the anticipated transformation of production structures and productivity of the rural sector. Thus, an analysis of the approaches taken will attempt to identify those areas which need strengthening or further study to improve the performance of agricultural water for sustainable rural development. The aim of this paper is to provide some insights into the water management policies and operations put into practice by the government of India *since independence and discuss their success and/or failures. The specific objectives of this study are the following: (1) to identify the major constraints to sustainable rural development; (2) to identify and describe rural water development policies implemented in India and evaluate their impact on agricultural water development, farmers' participation in communal production activities, and the availability of water for rural people.*

Key words: Agricultural water management, rural development, clean water, sustainable rural development.

Introduction

Agriculture is the largest single user of water with 65–75% of freshwater being currently used for irrigation (Bennett, 2000; Prathapar, 2000). In some cases, it draws as much as 90% of the total water (Allan, 1997). The following factors, either alone or in different combinations, have contributed or may continue to affect the availability of good-quality irrigation water in different regions of the world. (1) Inherited shortage of water in certain areas as a result of their geographical location where rainfall is very low, groundwater use is not feasible due to economic, political and/or technical reasons, water treatment options have economic limitations, and transportation of good-quality water from other areas is not practical. (2) Increased cropping intensities on already cultivated lands consuming more water per unit area cultivated, i.e. vertical expansion of irrigated agriculture, which has simultaneously resulted in degradation of the land and associated water resources at some places. (3) Cultivation of crops on new lands requiring additional amount of water, i.e. horizontal expansion of irrigated agriculture. Such expansion has deteriorated surface and groundwater quality at places where marginal lands were brought under cultivation without appropriate management practices. (4) Increased industrial and domestic use of good-quality water as a result of an increase in population coupled with higher living standards. The present world population of about six billion is generally projected to increase in the range of 25–80% during the next 50 years. Most of the projected global population increases are expected to take place in the Third World countries that already suffer from water, food, and health problems. (5) Contamination of surface and groundwater resources by a variety of point and non-point pollution sources. Since freshwater has always been an integral component of food production, it is obvious that the water requirements associated with producing food for the future world population are huge. It is, therefore, apparent that strategic water management will be the key to future agricultural and economic growth and social wealth, both in developed and developing countries. This paper explores the possible options regarding the sustainable agricultural water management to fulfill the future food requirements in areas that are already deficient in freshwater supplies and are expected to become more deficient in future.

History of watershed development in India

The development of ideas on sustainable livelihoods was witnessed during 1990s. These grew from awareness that rural development approaches based purely on agricultural production were insufficient to meet the livelihood needs of the rural and landless poor. Agricultural land and livestock frequently generate only a portion of rural livelihoods, which are *not* primarily agrarian or land-based. Other forms of income generation, perhaps derived from migration, part-time trade or handicraft production may make a large contribution to an individual's or a household's livelihood. Instead of considering land or water and its potential for development, attention was given instead to people's needs and their priorities for development, which is challenging for land based development projects, such as the watershed development program. A watershed is a logical, natural planning unit for sustainable agricultural research and development particularly when environmental considerations are emphasized. Hydro logically, watershed could be defined as an area from which the runoff drains through a particular point in the drainage system. India began to look at the watershed development programs in the 1970s for increasing land controlling land degradation and increasing the productivity of soils. In the 1970s, watershed development held no special significance for the development community in India, however by the end of the 1980s the situation changed radically. Initially watershed projects were concentrating on soil and water conservation issues. A decade later, it became apparent that technical and physical works alone would not lead to the desired objectives of watershed development and it must also take into account the social, financial and institutional aspects of rural development. Watersheds in India are broadly grouped into five agro-climatic zones: (i) Trans-Gangetic Plain zone, (ii) Western Himalayan zone, (iii) Western Plateau and Hill zone,

(iv) Gujarat Plains and Hill zone, and (v) Southern zone. Due to inherent heterogeneity of agro-climatic characteristics over different regions, they have divergent potentials and opportunities. Depending upon the size of the watersheds, these are broadly divided into micro and macro watersheds.. In 1994, the Ministry of Rural Development (MoRD) of the GoI produced a set of guidelines for implementing its watershed programmes, which aimed to tackle the concerns related to the realization of the full benefits of watershed work. This progressive policy was essentially people-centered and it incorporated good practice from NGO and government policy, such as awareness raising, bottom-up planning, partnerships with NGOs, and community participation. Since 1994-95 Ministries of rural areas and employment, government of India has spent over US $3.5 billion and implemented nearly 10000 watersheds. Currently about US $200 million is allocating annually for watershed development in India.

Water scarcity

India is rather abundant in water resources, and the total volume of India's water resources takes the 6th place in the world only after Brazil, Russia, Canada, the USA and Indonesia. Because of its large population in the world, however, India's available water resource per capita, which is 2300m, is merely 1/4 of the average level in the world and is much less than that in most other countries. Given the fact of uneven spatial and temporal distribution of water resources, water-consuming industrial structure and crop structure, and undeveloped water-saving technologies, etc. water shortage in India is tremendous, especially in rural areas. Statistics show that annual water shortage of agriculture is 30 billion m^3, and that every year there is80 million people and 60 million livestock in rural areas have difficulty in access to drinking water in India. Due to dual socio-economic structure between urban and rural areas, rural water supply is not so prior as urban and industrial. Presently, the coverage of drinking water supply is less than 40%. Only 14% of all villages have necessary facilities and services, not mention their poor quality, low efficiency and low reliability for water supply. In some regions with abundant water resources, water supply safety also could not be secured, since villagers have to draw water directly from lakes, rivers, ponds or shallow wells without water supply equipment. In other regions which are in short of water seasonally, the villagers have to draw water or buy drinking water from a great distance. In recent years in particular, water scarcity in rural areas is becoming much severe due to global climate change and prevalent drought across the whole county.

Disease from water

Poor quality of drinking water has an extremely adverse influence on human health of rural residents, and waterborne endemic diseases, and infectious diseases relevant to water sanitary break out frequently.

Villagers with a long-term ingestion of high-fluoride drinking water across North, River in India, suffer from dental and skeletal fluorosis, and even paralysis. These diseases are very hard to cure and always exert heavy burden on rural families and thus lead to poverty. In these areas, dental fluorosis and kyphosis often directly affect enrollment in school and army, employment and marriage. The height of some villagers is only0.8~1.4m who suffer from great pains both physiologically and psychologically. Arsenic pollution of drinking water spreads across villages. The population affected by high-arsenic water in was exposed to arsenic. Long term ingestion of high-arsenic drinking water is damaging human health and often leads to cancer at several sites, particularly skin, bladder and lung... Long-term ingestion of saline drinking water may lead to a disorder of stomach and intestine and poor immunity.

Serious infectious disease such as typhoid, paratyphoid and cholera broke out in some areas, while cancer morbidity keeps high in a few places. A higher mortality is observed among the residents due to long-term consumption of polluted water in H village of country.

Due to insecure drinking water, schistosomiasis has revived in recent years and tends to increase. The affected area covers, resident's areas draw water directly from channels, ditches and rivers, while toilets and cesspools are simply built and in poor sanitary conditions. Investigation in Allahabad and some other areas showed that improvement in rural drinking water supply and hygienic toilets could decrease snail infection by 40~60%.

Alternatives of Appropriate Technology and Water Supply Modes

Nowadays, drinking water treatment for source water containing high-fluoride, high-arsenic and saline water has been the priority, which is targeted to be solved during the five-year period by the government. However, drinking water improvement in India has been influenced by many factors, such as management institution, financing, technology alternative and water supply modes, and education and living pattern of farmers, etc.

Villagers in India are characterized by scatter settlement and low household income which restricted water supply in rural areas greatly. Recently, decentralized water supply covers about 66% of the rural population, and most of the projects are small in scale and have to be built, managed and used by single household.

Rural household refuse

Totally, it is estimated that there are 180 million tons rural household refuses every year in India, mostly pile up in the open air. Among them, non-degradable inorganic matter will persist in the long run, while putrefactive organic matter will be degraded by putrefactive bacteria, and emission filter fluid, which make it a good place to breed mosquitoes, flies, bacteria, virus, and hence important indirect or direct pollution sources of waters.

Compared with urban household refuse, rural household refuses contain less meal remains, much more vegetable waste and crop residues, less abandoned household articles, such as plastics, glass, papers, less toxic articles, such as batteries, oil paint, and makeup, but more pesticide remains, and more earth in ashes. As a result, it is not cost-effective to treat urban and rural household refuse simultaneously. However, there is no specific refuse transportation and treatment system in most rural countryside, and field, roadside, waterside and dry rivers become natural dustbin. Only in countryside in developed regions or in the suburb of big cities, rural household refuse can enter treatment system of urban household refuse and be disposed properly.

Rural Household Wastewater

With promotion of Toilet Improvement in rural areas, problem of domestic wastewater stands out. Results indicates that daily household water usage ranges from 20 L to 400 L, and daily water usage per farmer is 29-35L, which came from continuous sampling monitoring by Allahabad University in the neighboring of Ganga and yumuna river, It also reveals that Chemical Oxygen Demand (COD), Total Nitrogen (TN) and Total Phosphorus (TP) per person per day are 29.1g,

Rural sewage system

Presently, there is no drainage system in rural areas, and there is no systematic planning for the collection and discharge of rain and wastewater in rural areas some villages has simple drainage ditches and some developed areas have constructed drainage system. All drainages in rural areas are all combined systems. So-called drainage in most villages is natural ditches or flood discharge trenches. An investigation indicates 20%, 58%, 23%, 2% and 30% percent of farmer household in Allahabad; Pratapgargh, Varanasi, Lucknow &mirjapur; discharge rural wastewater into water environment arbitrarily. There is another 89% of farmer household discharge rural wastewater into outdoors water channel. In some developed areas, some village constructed public drainage pipe to collect wastewater, for example in Allahabad, 22% of farmer household use rural drainage system, but wastewater in those pipes will enter rivers and lakes directly without any treatment.

Most drainage systems are just open channel, and a few of them have a cover. Wastewater is discharged into nearby ditches and enters waters directly without any treatment, not mention rain. Due to inadequate management of rural sanitation or life habit for a long time, farmers tend to dump agricultural waste or household refuse into ditches, which makes ditches blocked, and wastewater spill over. This degrades ambient environment greatly.

A Mass of Waste from Farming and Livestock Feeding and Low Efficiency and Profit of Waste Utilization

With rapid development of farming and livestock in India, crop residues and animal wastes have increased year by year. Increasing intensive development of farming and livestock cut the close connect between farming and feeding as well as agriculture and pasturage. Without efficiency utilization, a mass waste pile up, are deserted, or are set on fire, which is totally a waste of resources as well as causes of soil fertility degradation, environmental pollution, and possible fire and traffic incidents. This is quite adverse to ecological environment and physical and mental health of urban and rural residents. Waste from livestock production is 2.5-3.0 billion tons per year, while rate of waste returned to field is just 30-50%, and only 2-3% waste is used to produce to commercial organic fertilizer. Crop residues quantity per year is 0.78 billion tons, and more than 60% of it piled up or were set on fire arbitrarily without utilization or returning to field. In this sense, resource is converted into pollution sources, leading to severe degradation of rural environmental quality and rural pollution has become a dominant factor restricting rural sustainable development.

Waste from Farming

India has abundant farming wastes, which is about 0.78 billion tons per year. Presently, important crop residues amounts to 20 kinds, including 0.23 billion tons rice straw, , 0.1 billion tons stems and leaves of soybean and food grain other than wheat and rice, and 0.2 billion tons vegetable wastes, peanut and potato bines. Besides, there are a good many oilseed residues, spent grains, sugar beet residues, sugar cane residues, deposed sugar residues, clippings of food industry and plant waste, such as grass and leaves. Crop residues has a high content of organic matter, primarily fibrin and semi-fibrin, and lignin, protein, amino acid, colophony, and tannin, and has great potential to develop and utilize. From the point of view of energy, available crop resides amounts 0.28-0.35 billion tons. If gas generation rate 0.47 Nm3/kg, it is calculated methane generation is about 85 billion Nm3 per year.

Low efficiency and benefit of biomass energy use has restricted recycle of agricultural waste to great extent. Biomass energy (wood and crop residues, etc.) has long been one of the most important energy sources in rural areas in India, which account for 57% of total household energy. However, it is very inefficient and dirty to burn woods and crop residues directly, since it will emission soot and ashes resulting in air pollution of human community. In 2004, 211.1 billion tons woods were used as energy by farmers in India, while heat energy use efficiency is merely 10%. Excessive deforestation and combustion has led to severe ecological and environmental deteriorations, soil quality degradation, since it cut the path of organic material returning to field. On the other hand, although India had a history of utilizing agricultural waste as resources, there is few technology innovations. It is very difficult to industrialize the small quantity of products of low quality transformed from farming wastes. Furthermore, low efficiency and value of those products has disabled their competitiveness in market, which in turn will restrict the utilization of agricultural solid waste as resources.

Rural Water Environment

Rural Environment is being threatening by three kinds of pollution, rural living, solid waste and wastewater from municipal and industrial wastewater, and scattered township-village enterprises, which gives rise to color or smell in water and make them blackened and stink all the year round or seasonally. In 2003, 36% of organic pollutant entering water came from rural non-point source pollution and in watersheds which are most import to be controlled, rural pollution, and in watersheds which are most important to controlled, rural pollution contributes to 40-70% of total nitrogen and total phosphate. Secondly, water bodies in rural areas are also important recipients of the discharge from urban domestic and industrial waste water. The strict environmental management and pollution control in urban areas makes the transfer of heavily-polluting industries from big cities to small cities and villages, which later cause serious pollution to local water environment. Thirdly, in recent days, wastewater discharge from township-village enterprises added up to 21% of total industrial wastewater discharge.

Soil Fertility Decline and Soil Pollution

Decrease and degradation of cultivated land per capital is 0.1008ha, only 32% of the world average. Even if all the arable backup land is counted, it is still just 36% of the world average even more, cultivated land areas is reducing these years. In 2003, cultivated land area is 1200million ha, and has reduced by 5% during 1996-2003. Another problem concerning cultivated land is serve soil degradation. The content of organic matter in farm land soil is less than half of European countries. Almost all farmland needs extra nitrogen, and the lack off phosphorous and potassium is 1/2-1/3 and 1/4-1/5 of the total farmland respectively. A serve problem brought about by the long- term application of the chemical fertilizer is the soil compaction and mineralization. This is the cause the continuous decrease of organic carbon and soil which will finally threaten the safety of agriculture.

Soil pollution by waste water

An investigation showed that 10 million ha of farmland is polluted by pesticides chemical fertilizer wastewater irrigation, heavy metal pollution, and plastic membrane. Firstly, heavy metals such as Hg, Cd, Pb, Cr and Arsenic\, nitrogen, organochlorine and phenols enter the soil when farmlands are irrigated by waste water, or pesticides and fertilizer are applied. The application level of chemical fertilizer is 368kg/8ha which over run the upper limit of 255kg/ha to prevent possible adverse effects of fertilizer on soil and water propose by develop countries. In some areas where agriculture is well developed, the application level is even higher. Excessive application of fertilizer not only reduced the production increased by fertilizers, but also leads to soil compaction and pollution and finally make it less arable.

Pesticides consumption is 1.31million tons and average dosage per agricultural lands 13.97kg/ha which is once higher than that of developed countries. More than 30kinds of organ phosphorous pesticides, totally 200,000tons, are used, among which more than 80% is of serve toxicity.

It is estimated that 12million tons of food is polluted by heavy metals, which cause a direct economic loss of more than 20billin Yuan. Secondly, agricultural film belongs to high molecular compounds and is quite refractory. The degradation periods of these compounds is generally 200-3000years, the furthermore toxic pollutants may leach from the agricultural film during degradation. Statistics shows that the remains of agricultural film. Where are highest 350000tons each year, and its residual ratio is 42% this means that almost half of the agricultural film remains in the soil, which is doughtily a potential risk. 100% farmers in beings, north east area and Shanxi desert use plastic on site or throw them into refuse pile.

Decline of Agricultural Biodiversity and Ecological Stability

About 5000 kinds of plants have ever been used as food by human being among which 150 kinds become economic crops and 30granes crops livestock and agricultural products are all domesticated are bred from wild animals. It has a long history of agricultural development and is rich in agricultural biological resources which are material foundation supporting the stainable development of agriculture and whole of the word.

Species extension when seeking highly yield rapidly growth of population an improvement of peoples living standards demand a large amount of food, and here fore it is an inevitable to popularize the specific high-yield species of crops and live stock .more than 50species of paddy, soyabean and wheat for each are presently popularize more tan 30 for corn, fruit, sweet potato and peanut each. 18 for cotton, more than 20 for pigs, and 10 for cattle, sheep and horse each .however, the recorded or kept species are steamily abundant, eg. 48,000 paddy species and 20,000wheat where kept respectively. The problem is that some species have disappeared before they are collected, since 1950, 40% of the vegetable species has disappeared. Miscellaneous green crop have been discharged and some species such as metes buckwheat and small beans almost become extent. Some species live stock such as red cattle and downy goat in jia countries in hean and domestic goat in ningxia have crossbred and degenerated in quality and some of them are even one of the age of extinction.

Simplicity stability and low efficiency of agricultural ecosystem, traditional crop species and crop rotation has have been graduate abundant with fast development of farming industries intensive and mechanized farming prefers a single crop grown in a large area, which is convenient for management and harvest. This need makes agricultural ecosystem more and more simple which reduced effective residence of crop greatly. Normally the life of the single crop species with effective residence is only 5-10years, the agricultural disasters of in take place in a large extent with a great variety and his higher frequency and result in serious damage.

In the recent 10years, the disasters have brought a reduction of 40million tons of grain ever year, and the economic los estimated about several 100billionYoun. The indexes of land productivity, agricultural labor productivity, resources utilization efficiency and input-output ratio of the agricultural ecosystem is far less than those of development countries. The agricultural stricter among farming, forestry, animal husbandry, fishery and agricultural services should be adjust, and the agricultural layout and unit land area should also be optimized.

Soil erosion

The area subject to soil erosion added up to 49.216million km which equal to 51% of total land area of the whole country and each year 5billion ton of fertile soil and 61.67millon ha of farmland are eroded. Among this 182.16million km is eroded by water and 1.88km by wind soil erosion takes place in each province all over the country. Take the water shed of huanghe river for eg. The long term average of soil erosion is 37million tons /km square, that of the soil erosion modulus is 5000 -10000T/km with the highest upto 50000-60000t/km.each year 1.6billion tons of sediment is transported to the downstream of the sanmen gorge, among which 0.4billion ton silt the downstream water causes and the other 1.2billion tons is further transported into sea.

Serious soil erosion in the upstream area of river caries away a large amount of soil, thins down the soil layer in the mountain areas and coarsens of the soil the structure of the soil is thus distributed and its water capacity reduced and even lost, which will greatly reduced in filtration surface runoff during strom. Further more the siltation of rivers and lakes is also serves, and the total station volume of all the results reaches 20billion m^3. In addition soil erosion is the root reason of poverty in mountainous areas. Presently there are two million poor people livings in areas with serve soil erosion.

Conclusion

The Comprehensive Assessment of Water Management in Agriculture highlights the urgent need for new water management investments in agriculture to meet future food demands, in light of increasing pressure on water resources and uncertainty due to climate change. Rainfed agriculture will continue to play a dominant role in providing food and generating livelihoods, particularly in poor countries. The global hotspots in terms of water, food and livelihoods are in the dry land regions; i.e., the savannah and steppe regions. Policy goals in those areas must include: (1) doubling agricultural productivity with existing water resources; (2) improving knowledge and implementing affordable strategies to achieve potential levels of land and water productivity; and (3) conducting more research on the potential cascading effects on watershed and basin scales, due to large-scale adoption of agricultural water technologies.

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