IACEED2010

The method of urban rain-flood utilization based on environmental protection

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Abstract

The acceleration of urbanization and global warming are making urban rain-flood disaster more and more serious recently. Summing up the characters of urban rain-floods, the mechanism of urban rain-flood disasters is analyzed. Moreover, the main countermeasures to prevent urban rain-flood disasters are stated. Finally, the optimal method to utilize urban rain-flood comprehensively is put forward based on environmental protection.

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Selection and peer-review under responsibility of RIUDS

Keywords: global warming; rain-flood; mechanism; utilize; countermeasure; optimal method

1. The concept of urban rain-flood

The urban rain-flood disasters occured often recently, but here is not a clear definition about rain-flood in “Ci Hai”, a Chinese dictionary. The definition of “rainwater” and “flood” has multi-term. The explanations of “rainwater” are: 1) falling water such as rain; 2) the water form rain; 3) one of 24 festivals according to Chinese lunar calendar; 4) rain. The explanations of “flood” are: 1) water level rises up high enough and floods the fields; 2) the river level rises suddenly and sharply by reason of heavy rain storms or by melting snow, which often causes disaster; 3) flood.

Base on the definition of “rainwater” and “flood”, “rain-flood” can be understood as the flood beyond the storage capacity caused by high intensity rainfall and it can be used as resources and can lead to disaster either. The urban rain-flood disaster refers to the disaster produced by high intensity urban rainfall.

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2. The characters and the mechanism of urban rain-flood disaster

Urban rain-flood disaster has the obvious characters. If the rain-flood beyond the urban storage capacity caused by high intensity rainfall it may lead to intensive disaster. The main reasons are as follows:

1) The rain-flood is uneven. The distribution of rain is usually uneven and intermittent on time and space, which will cause high intensity rain-flood beyond the urban storage capacity and cause disaster;

2) The storage of rain-flood collecting system isn’t great enough. The jam-packed urban architectures become more and more, which make the urban area lack of enough region to save flood in time.

The mechanism of urban rain-flood disasters can be illustrated in figure 1.

If the intensity of rain-flood is higher than the up limitation it will cause flood disaster, contrarily, it will cause draught disaster if the volume of rain-flood is less than the down limitation.

Analysis the mechanism of urban rain-flood disaster shows that the utilization of urban rain-flood requires the whole use of water collection systems, water conveyance systems, water storage systems, water purification systems and to develop laws to resolve the problems concerning with rainwater collection, transport, storage, purification and management:

1) Water collection system. Aim at building a beautiful, clean, ecological integrity and modern city, the urban greening level was increased gradually, therefore the lawn can be used to collect rain-flood, purify water and supply the water resource; rain-flood collection and storage system can be built in the densely populated area of urban area, which can lead the rain-flood on roofs, courtyards, streets, squares and lawns into the rain-flood storage areas;

2) Water conveyance system. The existing drainage system should use reasonably in urban districts and the water pipelines should be equipped dedicatedly according to the actual situation, the different water conveyance systems should be planned based on geological conditions in new district;

3) Water storage system. The lower areas should be chosen to construct reservoirs, man-made lakes and canals to accumulate rainwater, especially the existing lake should be put into the city developing plan to lower the project’s cost;

4) Water purification system. The clean water plants, sewage treatment plants should be build in the city center and suburbs respectively, therefore, the rainwater can be accumulated, purified and made full use of;

5) The relevant laws. The relatively sound laws on rain-flood utilization should be established, the intelligent control system should be developed to overall control and partially grasp, or manual operating system, the scope of water-use from the chemical plant, agriculture, stock farm, fisheries, power,
entertainment and so on, should be expanded to monitor and manage the rain-flood transport, collection and storage, purification and output systems.

3. The main problems in urban rain-flood utilizing

Although the utilization of urban rain-flood can bring great benefits to economy, society and environment, the exploitation of urban rain-flood is influenced by the problems as follows:
1) The rain-flood is not durative. The distribution of rain is usually uneven and intermittent on time and space, which causes the exploitation rain-flood become seasonal and in local area scope, therefore, rain-flood can hardly be used as constant water supply;
2) Water collecting systems are normally deficient. Since most of the existing urban drainage systems are not unified, they can hardly gather the rain effectively and be used comprehensively in large-scale during the rain-flood collecting process;
3) The storage of rain-flood collecting system is not great enough. The jam-packed urban architectures become more and more, which make the urban area lack of enough region to save flood. The rain-flood resources of higher value exploitation are un-durative, short-term and paroxysmal, more ever, the insufficient of rain-flood saving region results in the storage capacity is not strong enough and difficult to ensure the urban rain-flood resources be used in large scale universally and chronically;
4) Re-pollute. Re-pollute means during the process of the runoff, the dissolvable pollutants or solid pollutants in large range are resolved by the runoff and enter the flood storage area, which causes water pollution;
5) Limited usage. The uses of urban rain-flood currently are just for flood control or domestic water. These kinds of narrow and single usage baffle the development of rain-flood;
6) The legal system is not sound enough. The study about the utilization of urban rain-flood is comparatively late and most of the research achievement are still in the stage of theory and cannot arouse widely communities’ concern; More seriously, the relevant encouraging and supporting policies are not enough and the relevant legislation are not strong enough, which seriously obstructed the development of the use of urban rain-flood comprehensively.

4. The method of urban rain-flood utilizing based on environmental protection

Because of the strong characters of seasonality, territory limitation and intermittence, rain-flood resources can hardly be used directly as a constant water supply. But after adopting related engineering measures, rain-flood can be used. The method of urban rain-flood utilizing based on environmental protection the main measures are shown as figure 2.
1) Improve the rain collecting system. In the urban crowd circumstance, the roofs are huge and can be used to store rainwater. Water pipes on all sides of walls can be established to conduct the rainwater into the underground tube or open channel, aim at leading the rainwater flow into lower reservoir to be used as unified savings. In addition, on the main street and square, on which the harden area are greater, the penetrative pavement can be spread and the collecting pipe can be set under the main street and square to induce the water to the underground collecting pipe into storage pool. The grass lawn can obstruct rain water and creates good living environment in the city. Although the grass area is built up higher than urban road normally, the paling should better be heighten and used together with open channel or underground ditch, to lead rainwater into the reservoir, which can not only alleviate the flood control burden of city area in flood season, but also store rain-flood and utilize it synthetically;
2) Enhance the efficiency of rain-flood transport. In the new extension area and reformation area the conduit can be merged directly into urban layout programming to service the rain-flood utilization. The conduit buried in advance can be divided as rain gathering pipe and sewage pipe according to the function.
The lightly polluted rain-flood, domestic and municipal waste water and heavily polluted chemical plant sewage can be transported respectively, which can simplify the coming water processing procedure and improve the water transport efficiency;

3) Enhance rain-flood storage capacity. Select relatively lower urban areas in each urban district and dig smaller pools to store rain-flood, through the underground branch pipes and canals (open channels). Canals should be built according to urban real terrain, geological conditions, building structure, reasonable human and environmental planning. In the relative lower place of city center, larger reservoir (man-made lake) can be dug deeply to connect the underground branch pipes and canals, in order to construct the whole water transport system to store the rain-flood effectively and deliver water smoothly. As to the whole flood control, the larger reservoirs which located in the lower suburb can be constructed to increase the urban storage capacity for rain-flood. Suburbs and the inner city’s reservoirs can be connected with the river outside the city to form the channel net which can enhance the flood control capacity and store more rain-flood under the worse condition;

4) Dispose the sewage respectively. The purification treatment plant can be built in the center of the man-made lake to collect and dispose the light polluted rain-flood, which can be used as life and municipal water after purification process treatment. The sewage treatment plants can be constructed in suburban reservoirs to dispose the heavily polluted water which can be used to meet the water demand of peripheral industry and agriculture, stock farm and aquaculture;

5) Utilize the rain-flood comprehensively. Deep man-made lakes can be dug in lower district meanwhile the man-made hill can be heaped up accordingly accompanying with water recreation places to developed the tourist scenic spots. On the hills the pumped storage power stations and man-made waterfalls can be built. In the lower suburbs and medium reservoirs the aquaculture, agriculture and stock farm can be developed sparsely;

6) Perfect the legal system. The government should fully exert the function and take all kinds of measures to establish the sound legal system, such as to set up special funds and establish favorable policies, mobilize the enthusiasm of urban constructers, developers and related enterprisers for rain-flood utilization. While the enterprisers and individuals who disobey the laws and regulations on rain-flood utilization should be punished.

Figure 2 the sketch of utilizing method for urban rain-flood based on environmental protection
5. Conclusions

The urban rain-flood disasters occur frequently recently under the unreasonable urbanization development and the global warming. If the intensity of rain-flood is higher than the up limitation it will cause flood disaster. The processes of collecting, transporting, storing, purifying and utilizing can be constructed synthetically to form the comprehensive system, by which rain-flood can be used optimally while the urban flood disaster can be controlled.

Acknowledgments

Project supported by the National Natural Science Foundation of China (Grant No.:50509008), the Scientific Research Foundation for the Returned Overseas Chinese Scholars by Ministry of Education of China (Grant No.[2009]1341), the Natural Science Foundation of Henan Province (2007B570002, 2009B570006 & 2009B570002), Foundation of Technology Innovation Talents in University of Henan Province (2009HASTIT025), Commonweal Research Project of China Water Conservancy Ministry(200701020&200901018), Senior Talents Foundation of North China University of Water Conservancy and Electric Power, etc.

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