Integrated Flood Management based on Sustainable Regional Policies dealing with Extreme Weather

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Abstract

The contributing factors of precipitation's extreme change in recent years are mainly due to the impact of global warming. Daily extreme changes in the weather are recognized from "abnormal weather"to "extreme weather". For the damage of excessive precipitation through the Japanese archipelago, the conventional flood-control plan made the shift to new flood-control plan with climate change adaptation.

The philosophy of the flood disaster prevention/mitigation which proposed new concept on the Report to the Prime Minister of the Reconstruction Design Council in response to the Great East Japan Earthquake has popular usage towards the countermeasures of flood-control plan.

On the designing the solution of flood plan based on climate change adaptation should be examined today's extreme weather.

As new phase of the extreme weather disaster, the limitation of the fragility of stormwater drainage on the sewerage system was exposed. To overcome some of the barriers to the sewerage system, sustainable flood control management which should be implemented with due consideration of river basin management system.

The meaning of the rainwater storage and infiltration technology is recognized by the all interest groups, to evaluating method of the effects is new paradigm of flood control management.

Based on the premise of river basin flood control management system which reduce the threat the extreme weather disaster, the spirit of "Self-help, Mutual help, Public help" should be create as a social system to reduce the threat of damage of flood.

Integrated flood management system is encouraged to shift away from traditional flood management system, such as "Storage and Infiltration of Rain Water

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System(SIRWS)".

Key Words: IWRM, IFM, Climate Change, Storage and Infiltration of Rain Water System, Public Acceptance

1. Global Warming and Extreme Meteorological Phenomenon in Japan

The Meteorological Agency reported that after 2000's heavy rain set a new record in the Japanese archipelago rapidly increased.as follows[1].

The characteristics of the extreme weather disaster are analyzed following three points.

① The expression of heavy rain/wind set a new record after 2000 is appeared in a continuous way, especially after 2008 almost disaster were named "「The intitule weather by JMA」" by The Meteorological Agency[2]. It means extreme weather disaster influence social impact, therefore the disaster scale should be transmitted disaster from one generation to the next.

② The area where the extreme weather disaster occurs will take place across-the-country, especially urban area increased in recent years

③ The timing of the appearance of heavy rain set a new record concentrate from June to September.

Linking climate change and water impacts and responses were reported on the "Climate Change and Water. Technical Paper of the IPCC" as follows[3].

① The most dominant climate drivers for water availability are precipitation, temperature and evaporative demand (determined by net radiation at the ground, atmospheric humidity and wind speed, and temperature).

② The total annual river runoff over the whole land surface is projected to increase, even though there are regions with significant increase and significant decrease in runoff.

③ Especially related floods, an increase in the risk of a very wet monsoon season in Asia was also projected (Palmer and Räisänen, 2002)[4]. According to Milly et al.(2002)[5], for 15 out of 16 large basins worldwide, the control100-year peak volumes of monthly river flow are projected to be exceeded more frequently for a CO2-quadrupling.

A Resilient Approach related Global Warming was examined by JICA (Japan International Cooperation Agency)[6]. The report entitled "Handbook on Climate Change Adaptation in the Water Sector A Resilient Approach that Integrates Water Management and Community Development" proposed the "Conceptual Differences regarding Flood Risk Management Projects" as shown in Fig.1

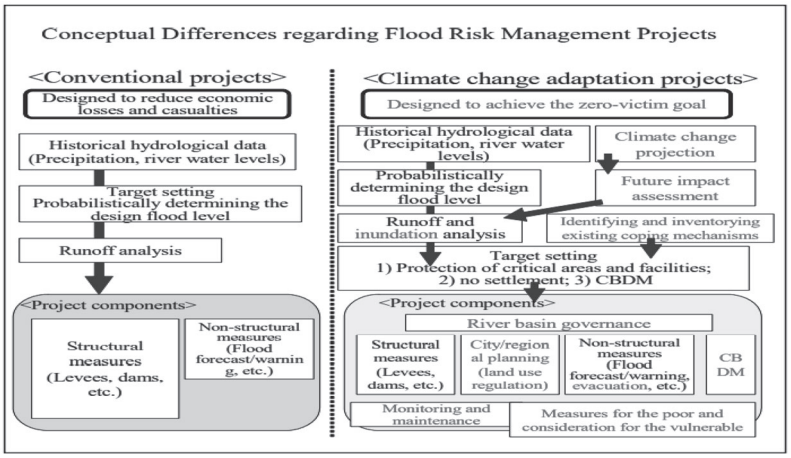

Fig.1 Conceptual Difference regarding Flood Risk Management Projects

Ref: Japan International Cooperation Agency (March 2010),Summary

The most worthy of remark is "Target Setting" which composed of 1) Protection of critical areas and facilities, 2) no settlement and 3)CBDM: community-based disaster management.

The Ministry of Land, Infrastructure, Transport and Tourism, in order to cope with growing external forces because of climate change, is now starting to implement multilayered adaptation measures consisting of a combination of adaptation measures[7].

2. Adaptation Towards Climate Change and IWRM

The Japan Meteorological Agency[8] reported the annual precipitation (for land areas only) in 2017 was +49 mm above the 1981 – 2010 (average), and the figure has fluctuated periodically since 1901,and the annual anomaly of precipitation in 2017 was +30 mm in Japan. Annual precipitation over Japan shows no discernible long-term trend.

The risk of disaster due to heavy rain could also increase, class A rivers

throughout the country predicts the probability of floods exceeding the rivers' prescribed target flood safety levels to be 1.8 to 4.4 times the current value[9].

To create strategic adaptation towards climate change, the concept of the Integrated Water Resources Management (IWRM) should be considered .

The famous definition of IWRM by Global Water Partnership[10] is "Integrated Water Resources Management (IWRM) is a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment.".

The history of the epoch related IWRM is shown in Table 1, and the effectiveness of IWRM is reconsidered after 2000.

Table 1. History of Epoch related IWRM

Year	Topic
1933	Establishment of Tennessee Valley Authority (TVA)
1955	Harvard Water Program
1957	IRBD to UN
1977	International Water Conference (in Mar del Plata)
1992	International Conference on Water and Environment (in Dublin)
2000	The Global Water Partnership
2004	Asit K. Biswas ; Integrated Water Resources Management: A Reassessment

The water crisis will be become result in immense harm compared with today's phenomenon , we should face a problem squarely with a new paradigm for the sake of avoidance.

The framework of Strategic Adaptation is systematized the individual adaptation, it contributes the strategic decision for the execution of individual adaptation for the water crisis[11].

Actual adaptation is composed following three factors.

(1) Scientific and Technology
   (a)Science: To analyze the scientific mechanism of the occurrence of water crisis
   (b)Technology: To examine the technological aspect for the adaptation for the water crisis
   (c)Information: To arrange the required information for the water crisis
(2) Economic Institution
   (a)Finance and Investment: To estimate the finance and investment for the

water crisis

(b)Economic Effect: To estimate the economic effect be the executing the adaptation for the water crisis

(c)Finance: To examine the financial system for the adaptation for the water crisis

(3) Administrative Institution

(a)Government: To examine the government's policy for the adaptation for the water crisis

(b)Company: To examine the Private investment system and the cooperation system for the adaptation for the water crisis

(c)PPP: To examine the cooperation system between government and private for the adaptation for the water crisis

In order to execute the policy initiative towards water crisis, the important point is what kind of position or status is guaranteed in the comprehensive plan of on the national or local government. In order to get this situation, the usual providing of infrastructure, and also human capability training are required, which to renovate the system which evaluate the level of a strategic adaptation based on the regional vulnerability.

The strategic adaptation should be arrange executing the individual adaptation. This method is inconclusive, but also alternative way for the avoidance of water crisis.

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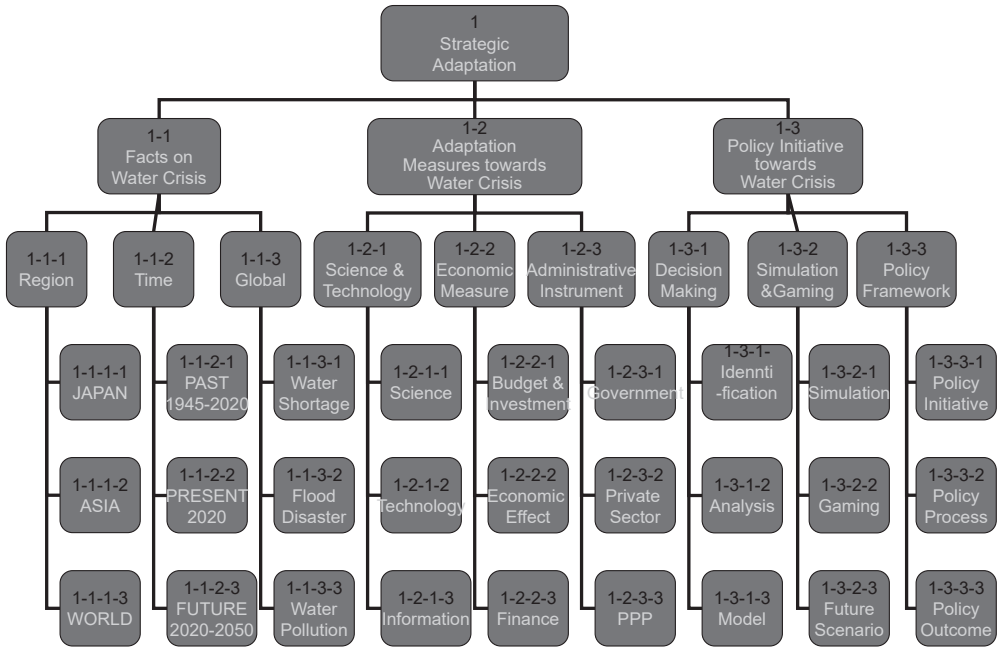

Fig.2 Framework of Strategic Adaptation

3. Philosophy of Flood Disaster Prevention/Mitigation

As we engage in reconstruction, a concept of "disaster reduction" will be paramount. Such a concept should not be based on the premise that a large-scale natural disaster can be completely contained, but rather that the damage from such a natural disaster should be minimized. Based on this concept, we must make preparations for disaster from the perspectives of prioritizing efforts to ensure that even if disaster strikes it will not result in the loss of human life, and also working to minimize economic damage as much as possible[12].

The agenda of the comprehensive flood control of the basin should be push on with IWRM.

Integrated Flood Management (IFM) is a process promoting an integrated – rather than fragmented – approach to flood management. It integrates land and water resources development in a river basin, within the context of IWRM, and aims at maximizing the net benefits from flood plains and minimizing loss to life from flooding.

The rationale for this integration is that the use of land has impacts upon both water quantity and quality. The three main elements of river basin

management – water quantity, water quality, and the processes of erosion and deposition – are inherently linked and are the primary reasons for adopting a river basin-based approach to IFM[13].

Strategies and options generally used in any flood management approach are given in Table 2.

Table 2. Strategies and Options for Flood Management

Strategy	*Options*
Reducing Flooding	Dams and reservoirs
	Dikes, levees, and flood embankments
	High flow diversions
	Catchment management
	Channel improvements
Reducing Susceptibility to Damage	Flood plain regulation
	Development and redevelopment policies
	Design and location of facilities
	Housing and building codes
	Flood-proofing
	Flood forecasting and warning
Mitigating the Impacts of Flooding	Information and education
	Disaster preparedness
	Post flood recovery
	Flood insurance
Preserving the Natural Resources of Flood Plains	Flood plain zoning and regulation

Ref. The Associated Programme on Flood Management(2004)

Strategies are likely to be appropriate in a particular river basin are the climate, the basin characteristics and the socio-economic conditions in the region. Taken together, they determine the nature of the floods that are experienced and their consequential effects.

On the strategy of flood management,"Reducing Susceptibility" showed many alternative options, and "Housing and building codes " is worthy of remark.

On the chapter of "Putting Integrated Flood Management into Practice" of this report, point out the necessity to "The challenge is to find ways of coordinating and co-operating across institutional boundaries, to achieve IFM through decisions at the basin level with the complete involvement of local level institutions and implementation through these institutions.",

On the conventional IWRM, to resolute the conflict of the water issues, technological integration and political integration are mainly adopted, on the IFM always showed clear and objective policies supported.

Living on flood plains involves risk, and for this there is a price to pay. The cost of living on flood plains is borne by flood plain occupiers, by way of economic losses and reduced opportunities, and taxpayers, through government funded protection measures and relief and rehabilitation activities.

This policy emphasis to find several ways to sustainable a living on flood plains , it require a certain amount of resolution the conflict related interest groups which pursue the participatory approach incorporated decision making system of IFM.

4. Sustainable Flood Management and Social Implementation of IWRM

To implement the Integrated Flood Management from stand points of view local inhabitants, rain storage and infiltration technology is widely accepted.

The implementation of control measures related stormwater runoff categorize to rain storage, rain infiltration and land use based on in a well-planned and emphasized manner.

Storage and Infiltration of Rain Water System(SIRWS) summarize as Run-off Control Facility, On-Site Storage divide On-Site Storage/Storage Facility and On-Site Storage/Infiltration Facility as follows[14].

On-Site Storage/Storage Facility

- School Ground Surface Storage
- Park and Green Space
- Car Parking Area
- Pitch of Building Area
- Individual Houses
- Underground Storage
- Roof Storage

On-Site Storage/Infiltration Facility

- Permeable Trench
- Permeable Connection Box
- Inter-locking Block Pavement
- Plate Block Pavement

Regarding the Run-off Control Facility, various kinds of technology are developed from 1980 years, the facility grow in social demand as the result of the performance[15].

The SIRWS lead to the emergence of the manner of resolution water influence caused by urbanization. It's technology is Japanese traditional manner based on the wisdom of "Land and Water".

The concept of the SIRWS emphasize the notion of small scale-distributed treatment system based on natural water cycle and combination with soft technology. SIRWS maintain a mutually complementary relationship with present sewerage system. However, until the project is done, huge budget and ultralong-duration construction period are required, therefor demand impossible to meet current heavy rain, and eventual failure of resolution by the present system.

Present day's administrative circumstances and local inhabitants's needs could not accept traditional Rain Water Treatment System, because of the effectiveness the system.

To resolute this controversial point, more flexible SIRWS will be accepted. SIRWS offer many advantages such as a) short construction period, b) less cost and c) small project unit and early-stage achievement.

For the sake of social acceptance of SIRWS, the conversion of local inhabitant's consciousness is need with engineering, institutional and financial examination.

The conceptual framework of social acceptance of SIRWS will be shown as Fig.3[15].

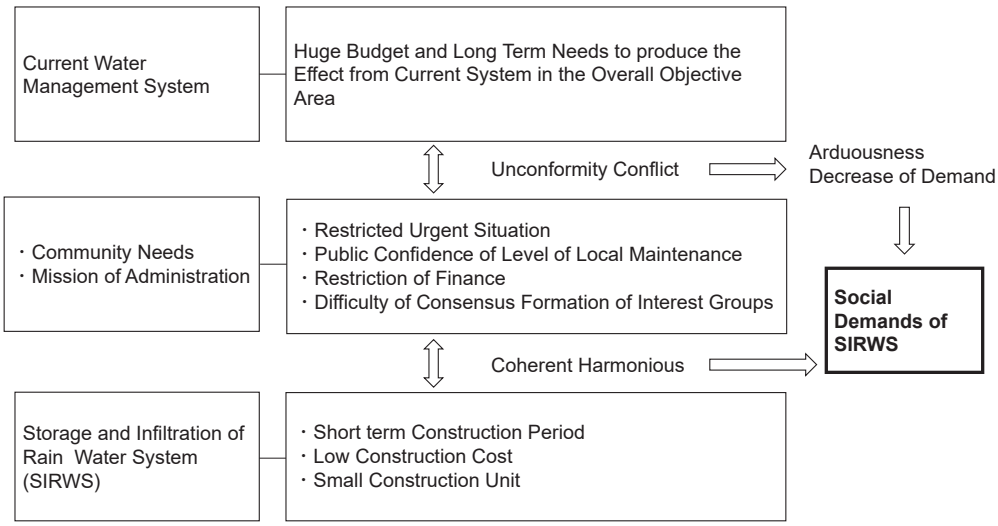

Fig.3 The Social Acceptance of SIRIWS

The necessity of the SIRWS in urban area is proposed as the wisdom of "Land and Water", which meets corresponding water cycle change caused by urbanizartion[16].

The countermeasure manual is following 4 points of attention.

① The beginning rain will be underdrain usual way and could not lead water to the Run-off Control Facility.
② To lead water to the Run-off Control Facility will start, when the capacity will be over the limits of disposal capacity.
③ To set the Run-off Control so as to produce an effect on the peak-time.
④ After peak-time, water will be underdrained gradually.

To accept this SIRWS by the local inhabitants with sustainability, the conditions of environmental, economic and social sustainability should be incorporated.

Environmental Sustainability: The monitoring of environmental impact caused by the facility

Economic Sustainability: The promotion of the subsidy system aimed to spread among people

Social Sustainability: The construction of local network aimed to accept the facility

The elements of the sustainability factor of social acceptance on RSIT is summarized Table 3.

Table 3 Sustainability Factor of Social Acceptance on SIRWS

	Planning	Construction	Maintenance
Environmental Sustainability	Recognition of Recycled Water Cycle by SIRWS	Environmental Impact on Construction	Environmental Load of River Cased by Facility of SIRWS
Economic Sustainability	government subsidy system CBA	Installation Cost	Maintenance Cost
Social Sustainability	Recognition of SIRWS	Public Acceptance of SIRWS	Social Activity of Maintenance System

SIRWS is community-based disaster management which consider all kinds of options to Integrated Flood Control Management and more practical method, therefore it should be examined more effective implementation method and created the social acceptance system.

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