Citarum Cascade Reservoirs Operation in Support of Water Supply for Drinking Water, Irrigation and Domestic Municipal and Industry

by:
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Abstract:

The three reservoirs are all situated on Citarum River, West Java. Ir. H. Djuanda reservoir, which already exist since 1967, is the most downstream one. The next upstream reservoir is Cirata which was operated in 1987. Saguling reservoir is the most upstream one and operated in the course of 1985. Downstream of Ir. H. Djuanda reservoir, two weirs across Citarum River divert water into three main canals which are West Tarum, East Tarum and North Tarum.

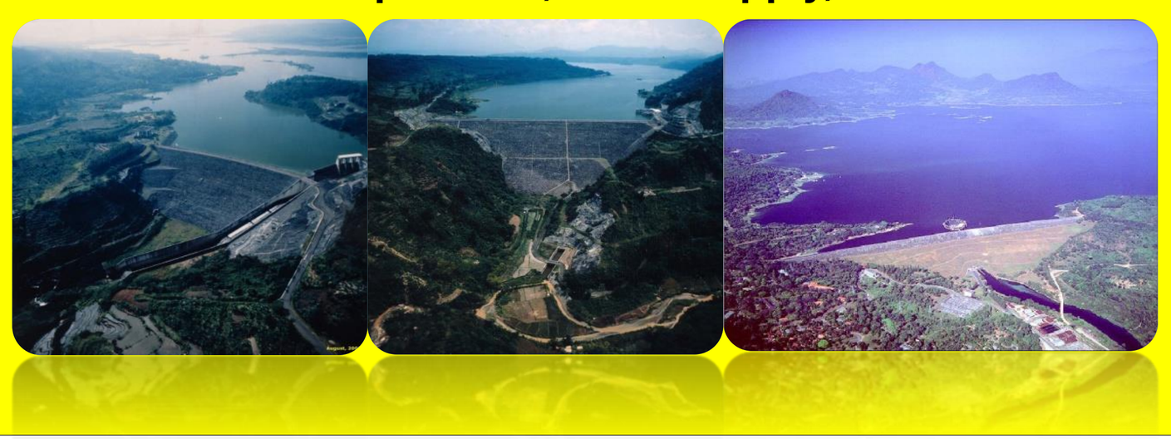
Citarum River Basin (CRB), where Citarum plays as the main river, is an integrated hydrological part of upstream and downstream which is considered as one of the vital national assets. Preservation of this asset, either business or social, should be supported by the participation of all stakeholders, especially in provision of water and infrastructure services to users.

More than 20 million people are depending on Citarum with its three reservoirs for irrigation (240,000 ha), water supply for domestic, municipal and industry (800 million m^3/year), electricity (3,200 MW), flood control and environmental flow. Therefore, optimized operation of three reservoirs is necessary for maximizing dependable water to meet several needs with existing limitation.

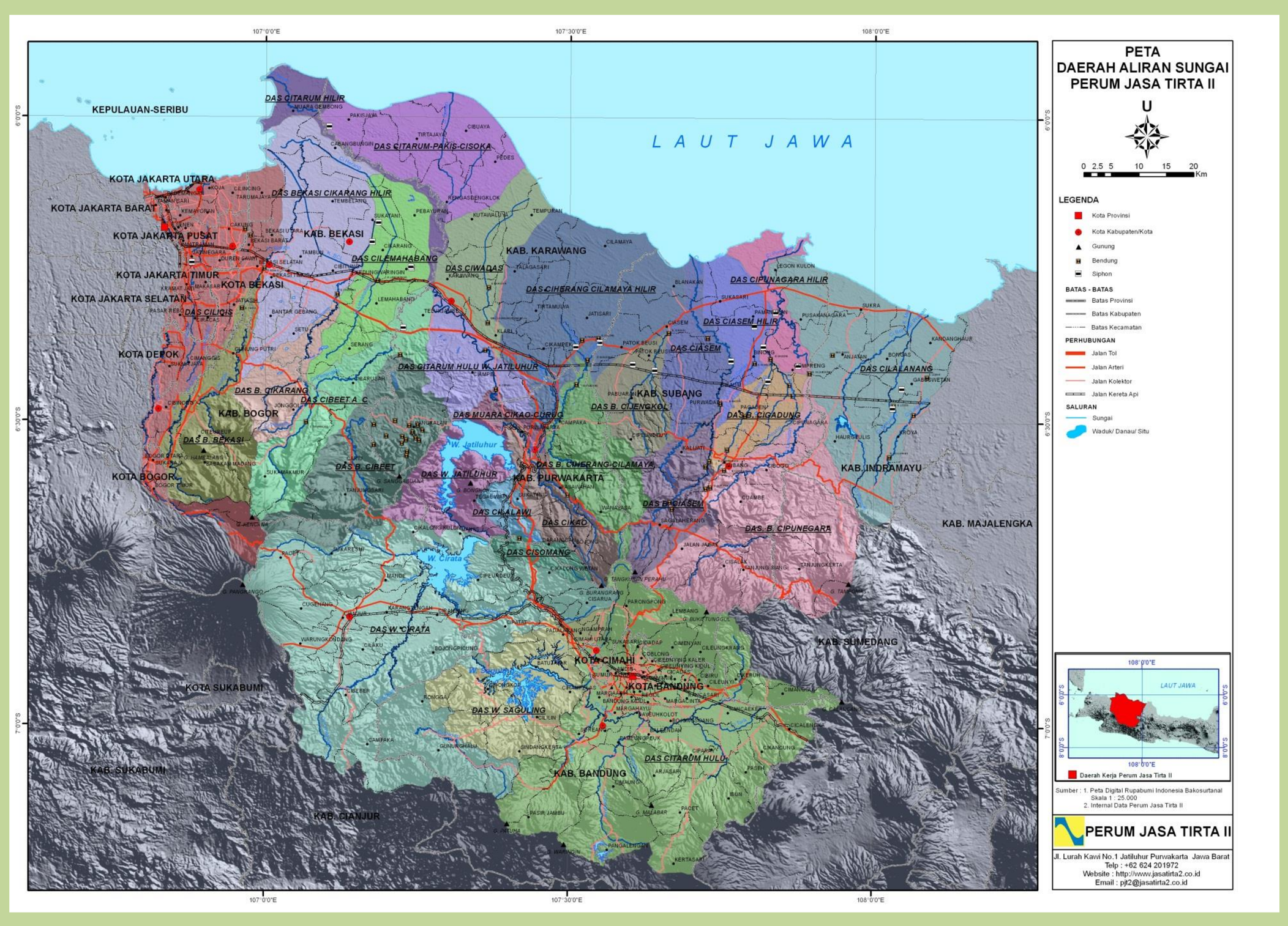
Annual operation of Citarum cascade is made by estimating water requirements, statistical data stream that flows into the reservoirs, and total energy produced by the system. It is optimized with priority based on meeting the needs of downstream Ir. H. Djuanda reservoir. The need for water in the downstream of the reservoir is mainly for raw water supply to meet the basic needs of daily living (raw water to Jakarta and districts/cities), irrigation, and other industries.

With so many interested parties in this cascade operation, then its annual operation constantly evaluated and updated monthly, through a mechanism of coordination meetings, arranged by the secretariat of coordination committee - the administration of Citarum water (SPK-TPA Citarum).

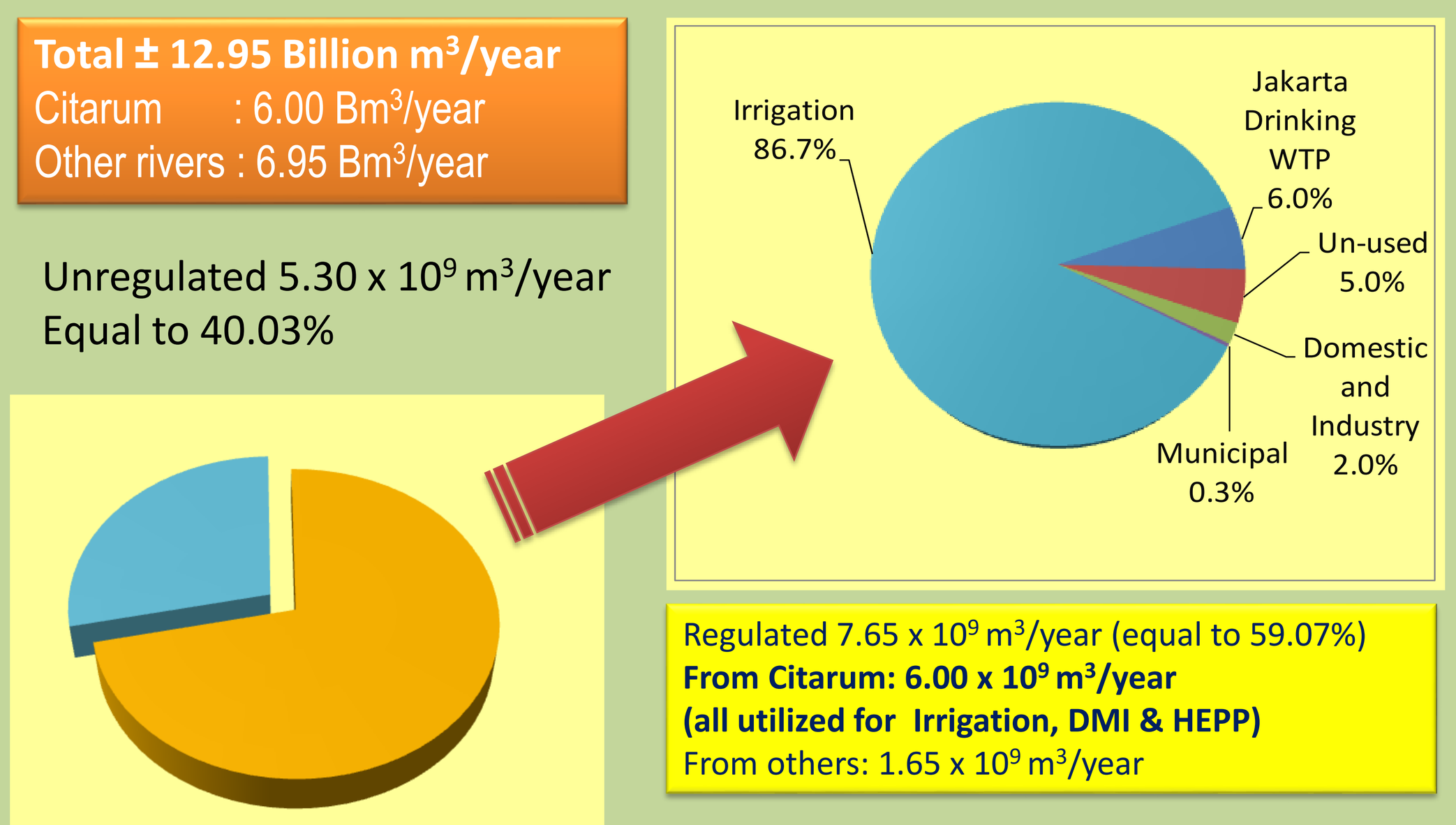
Keywords: Cascade reservoir operation, water supply, coordination



Citarum River Basin covers an area of about 12,000 km^2. It includes river basin of Citarum (area of 6,600 km^2) and a number of independent basins such as Cilamaya/Ciherang, Cijengkol, Cigadung, Ciasem, Cipunegara and Cilalanang, and a number of small sub-basins. It extends from Cibeet River in the west part, to Cilalanang River in the east side. It is bordered by Java Sea on the north side and Tangkuban Perahu mountain and mountainous regions of Bandung in the south side.

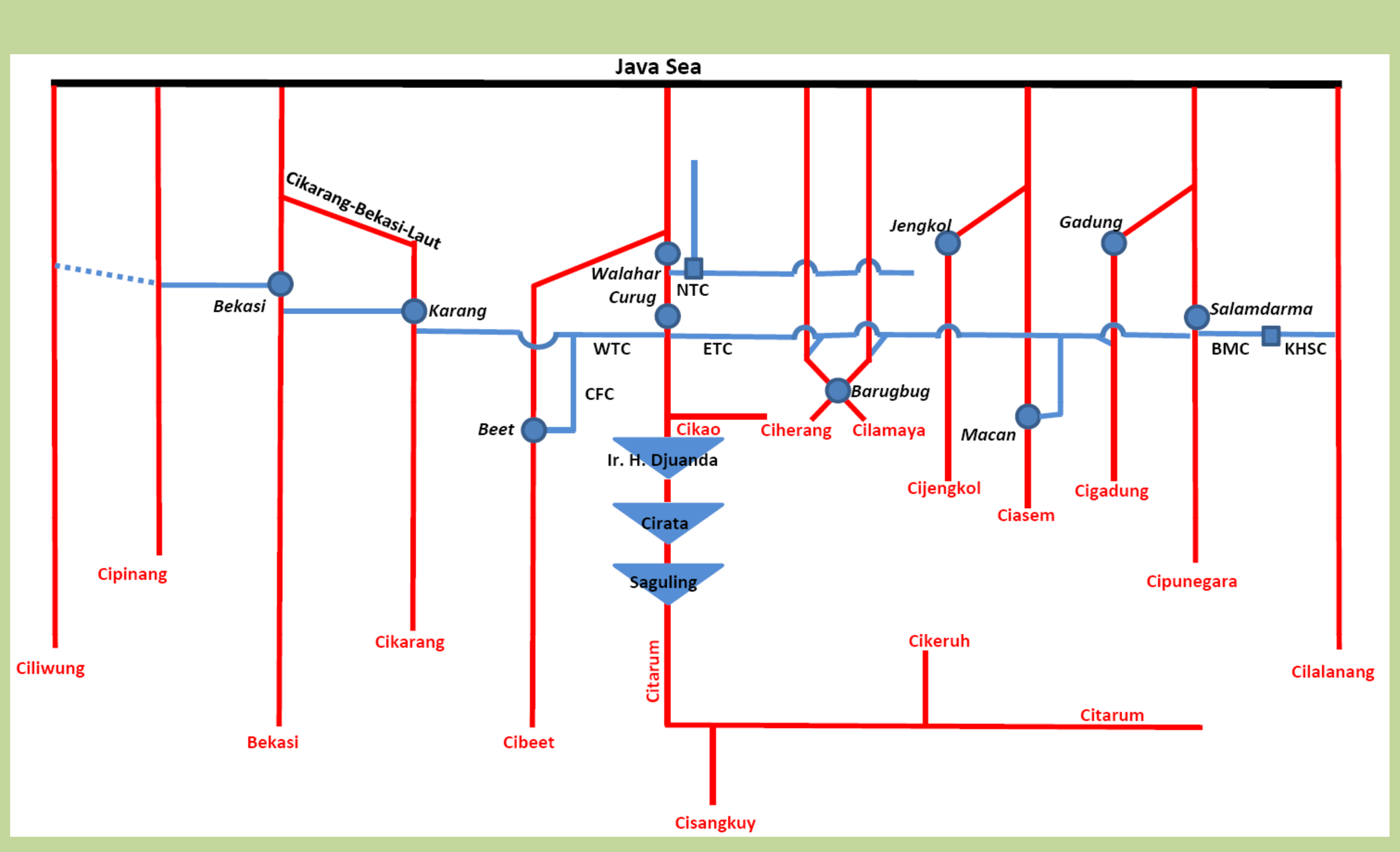


Citarum River basin has average annual flow of 12.95 billion m^3, out of which 6.0 billion m^3 flows in Citarum River and 6.95 billion m^3 flows in the other rivers in the basin. By employing water resources infrastructures in the basin, water that could be regulated is about 7.65 billion m^3 per annum and the rest is wasted flows to the sea. Utilization of water by far is goes to irrigation of 6.0 billion m^3 (equal to 78%) and to domestics, municipalities, and industries of 800 million m^3 (equal to 22%).



Water resources potential and water uses composition in the Citarum River Basin

Downstream of Jatiluhur Reservoir, two weirs across Citarum divert water into three main canals: the West Tarum Canal (WTC), the East Tarum Canal (ETC), and the North Tarum Canal (NTC). WTC and ETC tap Citarum at Curug weir, while the NTC gets its water at Walahar weir. The WTC serves an area under irrigation of 47,301 ha at present. The canal also transports water for the drinking water treatment plants of Jakarta, the capital city of Indonesia. The ETC area comprises 92,479 ha and the NTC area is 87,209 ha in size. Thus the total irrigation area served under the Jatiluhur reservoir is 226,989 ha. It is the largest contiguous irrigation system in Indonesia and is a major rice production area.



Water resources configuration

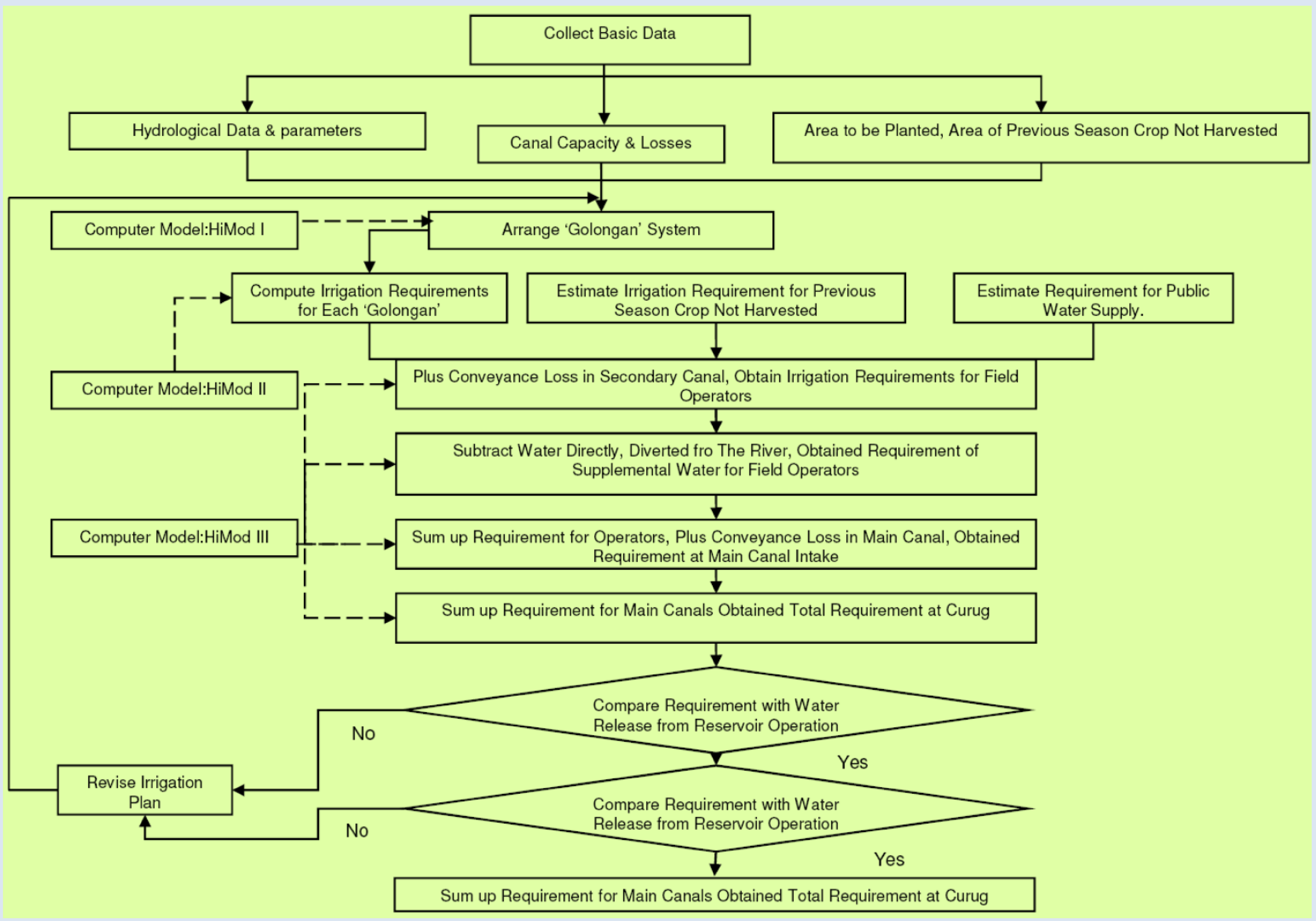
Demand of the system can be generalized into three parts:

(i) irrigation water supply to the North, East, and West Tarum areas

(ii) raw water supply to drinking water treatment plants for districts and municipalities in the corridor of the canals, including Jakarta

(iii) to industrial zone along the corridor from Capital District of Jakarta to Indramayu, including the region around Bekasi, Karawang, Purwakarta, Subang district

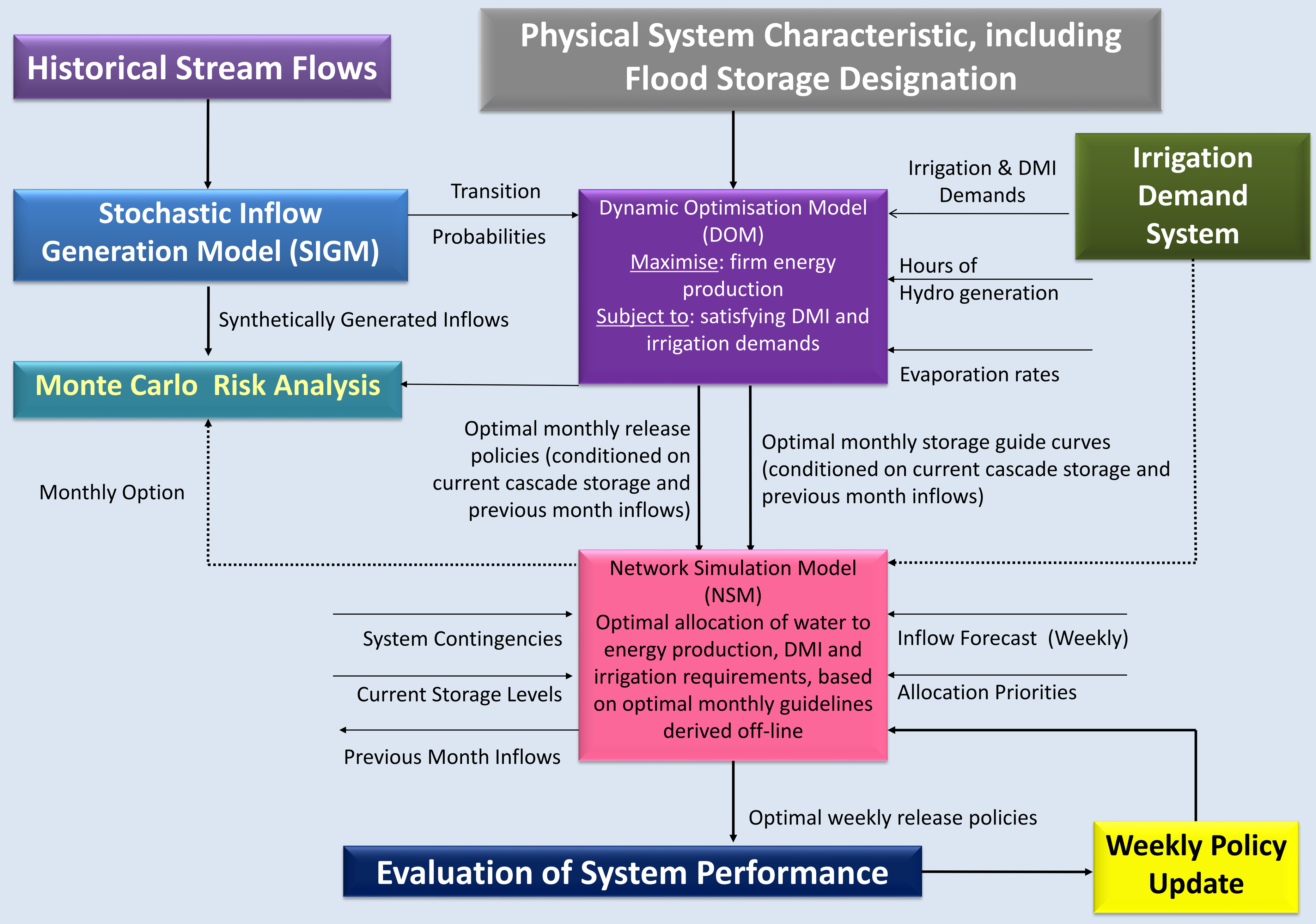
To cope with the available water resources, the irrigation plan is prepared as major input for Citarum cascade reservoirs operation.



Procedure for preparation of irrigation plan

In this plan, the total energy of the system is maximised subject to a number of conditions:

- Demands at Jatiluhur reservoir should at least be met
- Upper and lower rule curves for the reservoirs should be observed as much as possible
- At the end of the year (or planning period) certain reservoir levels should be met
- Maximum water level at the end of rainy season
- Provide two times of annual flood intercept and retain falling water and to control the flood periodically which released from Cirata reservoir (peak load)
- To prevent drastic monthly changes in individual reservoir levels, relative net storage of each reservoir, with respect to total net storage in the system, should be kept constant



Hierarchical approach for developing optimal normal reservoir operation policies

Conclusion

Analysis and optimization of the annual operation plan by spreadsheet is both very flexible and easy to do, with the built in solver. From the annual operation plan analysis by spreadsheet, it has been shown that operational principles have a large influence on the generation of (firm) power. In particular, a noticeable difference in result exists, between so-called shared and non shared operation.

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