CHAPTER 2

LITERATURE REVIEW

2 LITERATURE REVIEW

In this chapter, literature is reviewed from Abroad and India relevant to the research study like research paper, book, journals, report, power point presentation, news record, and flood manuals included.

2.1 Reviews for Research Paper at International Level

Hazrat Ali M.D. and Shui Leeteang have written a research paper (2002) on "Optimal Allocation of Monthly Water Withdrawals in Research Systems" where in this case studied the water balance equation was derived for performance of object. Moreover, Reservoir Simulation Model was developed and model storage capacities were compared with observed storage capacities. The optimal reservoir storage, optimal irrigation demand, optimal reservoir release were computed and it was observed that significant water saving was achieved.

Kumar D. Nagesh, Reddy M. Janga has written a research paper (2007) on "Multipurpose Reservoir Operation Using Particle Swarm Optimization." The term Particle Swarm Optimizers (PSO) are inherently disturbed algorithm, in which solution for problem emerges from interactions between many simple individual called perhaps but results demonstrated by Elihst-Mutated Particle Sworm Optimization(EMPSO) gave better result than PSO. EMPSO was come out for this case study at Bhadra reservoir system in India which serves multiple purposes namely irrigation and hydropower generation.

Ngo Long Le has written his Ph.D Thesis (2006) and research paper on "Optimizing Reservoir Operation" and presented a case study of Hoa Binh reservoir, Vietnam. The author made an application of optimization techniques to reservoir operation focusing on water resource planning and management. Mike 11 modeling system is adopted for simulating flow in river system including reservoir and shuffled complex evolution algorithm as implemented in AUTOCAL software is selected for optimization which further enhance flexibility of reservoir operation and improves the performance.

Afshar A., Sharif F. and Jalali M.R has written a research paper (2009) on "Non-dominated archiving multi-colony ant algorithm for multi-objective optimization: Application to multi-purpose reservoir operation. Here using a multi-colony ant algorithm and Pareto-front approach, a new algorithm, the

NA-ACO → Non-dominated Archiving Ant Colony Optimization was developed to solve a highly non-linear and non-convex multi-purpose reservoir-operation-optimization problem.

Celeste Alcigeimes Batista, Suzuki Koichi, Kadota Akihiro wrote a research paper (2008) on "Integrating Long-ant Short Term Reservoir Operation Models via Stochastic and Deterministic Optimization". This case study was for Etime Perfective which is lying on northern part of island of Shikoku, smallest of four major islands of Japan in Matsuyama city. In this paper, long-term (monthly) and short-term (daily) reservoir inflow forecast are assumed to be uncertain and reliable. The idea is first solve monthly operation model by an explicit stochastic programming approach and then use its information to guide daily operation, which is solved by deterministic optimization.

Afshar M.H and Shahidi M. wrote a research paper (2009) on "Optimal solution of large scale reservoir-operation problems: Cellular-automata versus heuristic-search methods". The author proposed the use of cellular automata approach for solution of reservoir-operation problems, and found to be more efficient and effective than heuristic-search method. So the proposed method are used to optimally solve the problem of water supply and hydropower operation of Dez reservoir in Iran over short, medium and long operation periods.

McMohan George F. and Farmer Michael C. wrote a research paper (2009) on "Rule-Based Storage Accounting for Multipurpose Reservoir Systems". The present case-study demonstrates practicality of rule-based storage accounting in complex reservoir system with complex operating rules and multiple consumptive and non-consumpti`ve uses of water. Moreover, approaches to sustainable resource management. So, this system promotes efficient and equitable distribution of benefits, cost, risk and sustainability of system operated to meet socio-economic and environmental objective.

Prof. S. Mohan; M.Anjaneya Prasad, Deca Paresh Chandra and Chandramouli V. presented a case study (2009) on "Fuzzy neural network modeling of reservoir operation" where they emphasized to assess application potential of dynamic programming optimization, system simulation, artificial neural network, fuzzy logic and Dynamic Programming Fuzzy Neural Network (DPFNN) in attaining reservoir operation objectives compared to other model.

Panigrahi D.P. and Mujumdar P.P. have presented a case study (2000) on "Reservoir Operation Modeling with Fuzzy Logic". The methodology is illustrated through case study of Malaprabha Irrigation Reservoir in Karnataka, India, where in this article, fuzzy rule based model is developed for operation of single purpose reservoir.

Wang Jinwen, Yuan Xiaohui, Zhang Yongchuan and Zhang Youquan have written/presented a research paper (2003) on "A reliability and risk analysis system for multipurpose reservoir operation" where in this to study risk and reliability analysis system for reservoir to be operated for flood control, energy generation, irrigation domestic water supply by making optimum use of decision making level, trade off analysis, Benefit Promotion, Sub-System (BPS), Operational Simulation Sub-System (OSS), Water Level to Alarm a more Severe Flood (WLASF) etc.

Zhao Bing and Tung Yeou-Koung have written research paper (1994) on "Determination of Optimal Unit Hydrographs by Linear Programming". In this paper, the objective functions in commonly used linear programming (LP) formulation for obtaining UH are (1) minimizing sum of absolute deviations (MSAD) (2) Minimizing Largest Absolute Deviation (MLAD) (3) Minimizing Weighted Sum of Absolute Deviations (MWSAD) (4)Minimizing Range of deviations (MRNG). It has been found that model MWSAD with properly weighing function would produce UH that is better in predicting DRH's.

Haith Douglas A. and Loucks Daniel P. have written a research paper (1973) on "Multi-objective Water Resource Planning". Here the writers have focused the discussion primarily on "decision-among choices" part of planning process. Emphasis is laid on decision making in public planning process i.e. process in which final selection of an alternative rests with elected or appointed decision makers or policy makers.

A. Ammari and B. Remini published a research paper (2009) in Journal of Indian Waterworks Association, April-June 2009 on "Estimation of river discharges based one Chiu's equation". In this research paper, the linear relationships (mean and maximum velocity) were deduced for the four hydrometric stations, the ratio of the mean velocity and the maximum one can be taken equal to 0.66 for totality, and the advantage of this parameter is that it does not change in time and space of the Y-axis where the maximum velocity appears. Among other things, the fact of having maximum velocity in the direct vicinity of the water surface, makes possible to have a continuous measurements of this velocity in the time (by acoustic or optical method), so a continuous measurement of the discharge in time, which is a very significant asset in the policy of management and mobilization of water resource in Algeria. The extension of the use of this method undoubtedly will make possible to cure the lack recorded in the discharges measurements, and to better estimate the liquid and solid discharges conveyed.

Frizzone, R.D.Coelho, D.Dourado-Neto, R.Soliani (1997) used "Linear programming model to optimize the water resource use in irrigation projects: an application to the senator Nilo Coelho project". In this research paper the model was suitable for

- The management of the SMCP cms.
- For 7424 ha of land and 66,644,500 m^3 of water available on a year base, the opportunity lost of these respectively, Vs $ 1,115.20 / ha US$ 281.60 / 1000 m^3
- For the total monthly water availability of 9,861,040 m^3, the total annual water availability of 66,644,500 m^3 effective restriction to the increase of the net income of production system in the SMCP
- Maintaining the total monthly water availability of 9,861,040 m^3, annual volumes lower than 88,338,983 m^3 fully to reach the optimal solution and that higher volumes than this limit, did not increase the net income
- The optimization model estimated a net income of 52.34% higher than the traditional cropping pattern use considering the agriculture year of 1992.

Nesal LLich published a research paper (2009) in Journal of Water Resources Planning and Management on "Limitations of network flow algorithms in river basin modeling". This research paper, examines the limitations of network flow algorithms to address non-network constraints using an iterative approach. Although the paper by no means includes all instances where an iterative scheme may fail, it can be generally concluded that any flow path restrictions that are updated through iterative calls of the NFA solver may fail to deliver reasonable solutions. The limitations are demonstrated using numerical examples with sufficient input data to allow independent verification with two reservoirs in series. Out of which is an elementary configuration common to most water resources systems. Another possible failure of the NFA-based (Network flow algorithms) iterative schemes is an example of a single reservoir with multiple outflows. Where flow limits in some of those outflows are governed by the outflow versus elevation curve. It has been documented that such configuration can cause failure for both the NFA solver and in some instances for full blown LP solvers (Ilinch 2008). It is believed that most water resources systems contain reservoirs in sequences, reservoirs with multiple outflows, or a combination of both. This paper questions the fitness of the final solution to which NFA models may converge for two or more reservoirs in series. While the other referenced publication (Ilinch, 2008) examines the use of NFA solvers on reservoirs with multiple outflows. Together, the two publications question the wisdom of using iterative schemes used with NFA models to handle non-network flow constraints. This issue deserves attention since many NFA models with built-in iterative schemes are still actively in use by various water resources practitioners around the World. Illich Nesa has written a research paper on "Limitations of network flow algorithms in river basin modeling". This paper deals with the models based on Network Flow Algorithms (NFAs). The writer here use to emphasize that these algorithms were at first considerably faster than standard simplex solvers, their handling of flow constraints were simplistic, which eventually led to the use of iterative schemes for handling non-network constraints.

Sulis Mavro, Marrocu Marino and Paniconi Clavdio has written a research paper (2009) on "Conjunctive use of a hydrological model and multicriteria decision support system" and demonstrated this at possible construction of a second, new dam on Caria catchment in Southern Portugal. This case study presents the improvement to SWAT's weather generator for future climate scenario, data processing and model simulation effort, use of various Decision Support System (DSS) to analyze three options (existing dam and reservoir, new dam with reservoir hydraulically connected to existing one, two reservoirs not hydraulically connected) and two scenarios (current and future climate).

Vieux Baxter E, Park Jin-Hyeog and Kang Boosik have written a research paper (2009) on "Distributed hydrologic prediction: Sensitivity to accuracy of initial soil moisture conditions and radar rainfall input". The study area consist of watershed areas that are influent to reservoirs in 967 km^2 Yongdam basin and 2,293 km^2 Namgang basic located on Korean Peninsula. The aim of this study is to evaluate prediction accuracy and sensitivity of a distributed hydrologic model. Accurate predictions of run-off are needed where reservoir operations are used to control flooding and to manage water resources.

Golembesky Kurt, Sankarasubramanian and Devineni Naresh have written a research paper (2009) on "Improved drought management of falls lake reservoir: Role of multimodel stream flow forecasts in setting up restrictions. Here a case study has been developed at falls lake reservoir in the Neuse River Basin. The customized reservoir simulation model was analyzed using JAS seasonal stream flow forecast, which would reduce uncertainty from individual model leading to better decisions and also could improve public confidence in utilizing seasonal stream flow forecast for water management application.

2.2 Reviews for Research Paper at National Level

Agnithotri P. G., Patel J. N., (2008), "Preparation of Flood Reduction Plan for Surat City and Surrounding Region (India)", WESEAS TRANSACTIONS on FLUID MECHANICS, issue-2, Vol-3, April-2008. The scope of improvement of flood forecasting in Tapi Basin has been discussed in the present research paper study. The improvement can be done by increasing warning time for Hathnur Dam and Ukai Dam by establishing more bases as well as establishing the new automatic rainfall measurement station in Tapi Basin and developing Rainfall-Runoff model using Artificial Neural Network (ANN) for better inflow forecasting of Hathnur Dam and Ukai Dam. Hydrodynamic model of the said basin can be developed by using appropriate boundary conditions in MIKE 11 for better forecasting. The following conclusions are drawn from this research paper.

1. Data related to stage-discharge of Burhanpur (base station) and Dedtalai (forecasting station) as well as Gopalkheda (base station) and Yerli (forecasting station) can be utilized to develop better correlation using ANN to forecast inflow at Hathnur dam.
2. Quality of forecasting can be enhanced by providing more rain gauge stations at Khedi up to Dedtalai, as well as Sagbara and Navapur up to Ukai in Tapi Basin.
3. The relationship between the outflow from Hathnur dam and inflow at Gidhade station can be established using ANN technique for better understanding of flood movement and present 12 hour warning time can be enhanced up to 24 hours.
4. Relationship between Kakrapar weir outflow and stage at hope Bridge in Surat can be established, giving due consideration to tidal level, using ANN which would be helpful in flood forecasting to user agencies like Surat Municipal Corporation.
5. Hydrodynamic modeling for Tapi River using MIKE 11 can improve the flood forecasting accuracy for Surat City.

Sawai, B.K., Shircase, and K.N. wrote a research paper (2008) on "Post Cities" presented a case study of post-disaster work of Ambernath Badlapur water supply within a week's period after great hard work from Maharashtra Jeevan Pradhikaran (MJP) in Journal of IWWA, Vol.XXXX No.2, Pg.No.85, April-June 2008.

Kuiry Soumendra Nath, Sen Dhrubajyoti, MISH, Bates D. Paul and Yan Ding; has presented a case study (2011) on "Application of the 1D-QUASI 2D model tin flood for flood plain inundation prediction of river thames" with their immense preservation. They developed numerical model "TINFLOOD" to predict extent of flooding at small reach of River Thames, U.K. This TINFLOOD model is seen to predict flood inundation extent satisfactorily with simple channel specification using Saint-Venant equation.

Jain S.K., Das A., Srivastava D.K. has presented a case study (1999) on "Application of Artificial Neural Network (ANNs) for reservoir inflow prediction and operation", where the Upper Indrāvati multipurpose project in Orissa State, India has been selected as focus area; where primary objective was to provide irrigation to 1, 28,000,000 ha of agricultural land and to generate 600 MW of electric power. This ANN has numerous real world speech processing, robotics and stock perseverance.

Prof.Mohan S. and Prasad M.Anjaneya have presented a case study (1990) on "FUZZY logic model for Multi Reservoir Operation" where they have used various artificial intelligence tools like Genetic Programming Artificial Neural Network and Fuzzy logic which mathematical model based on fuzzy role system and demonstrated with model on River Godavari located in South India.

Kothyari Umesh C. and Jain Sanjay K. have presented a case study (1997) on "Sediment Yield Estimation using GIS". Here, the spinal discretization of catchment and derivation of physical parameter related to erosion in cells are performed through Geographic Information System (GIS) techniques using Integrated Land and Water Information System (ILWIS) package and Universal Soil Loss Equation (USLE) in Journal "Hydrological Sciences Journal-des-Sciences Hydrologiques.

Vedula S. and Mohan S. has presented a case study (1990) on "Real-time multipurpose reservoir operation" where they developed a real-time operational methodology consisting of various modeling like Stochastic Dynamic Programming (SDP); Autoregressive Integrated Moving Average (ARIMA); for multipurpose reservoir operation for irrigation and hydropower generation with application to Bhadra Reservoir system in state of Karnataka, India.

Neelakantan T.R., Pundarikanthan N.V. have written a research paper (2000) on "Neural-Network-Based Simulation-Optimization Model for Reservoir Operation" where in this study back propagation neural network trained to approximate simulation model developed for Chennai city water supply problem. Both these water made their efficient attempts in making use of combined simulation – optimization models to solve reservoir operation problem efficiently, where they used a sub-model in Hooke and Jeeves non-linear programming model to find optimal policies.

Jain Sanjay & Goel M.K. have written a research paper (1998) on "Assessing the vulnerability to soil erosion of Ukai Dam catchments using remote sensing and GIS". The method is illustrated with a case study of sub-catchments immediately upstream of Ukai Reservoir located on River Tapi in Gujarat state, India. Here, several factors like soil type, vegetation, slope; topography, drainage density, form-factor, etc. were studied and were evaluated by satellite data and GIS system. This investigation further became selective approach to identify factors responsible for soil erosion, planning soil conservation and efficient conservation management programs. Moreover, writers used to determine vulnerability of catchment to erosion.

Yadav S.M. and Samtani B.K. published a research paper (2008) on "Bed load transport in Tapi River, India" in global journal of Environmental Research. In this research paper a new bed load transport relation for Alluvial River has been proposed. The relation is an empirical fit to the data of Tapi river are considered to represent the two limits of the spectrum of bed load transport rate observed in the field and computed. The unique feature of this model is the bed load transport rate is function of effective shear stress. The proposed bed load equation for Tapi river, monsoon season and for Sarankheda gauging station is Y = 0.26636 X 0.7649. The value of ripple factor obtained by above analysis is 0.26636 and the value of index is 0.7649. The root mean square error (rmse), inequality ratio and discrepancy ratio suggest good agreement between computed and predicted bed load for Tapi River, India.

Patel Dhruvesh P., Patel Chandresh G., Dr.Dholakia M.B., Dr.Sherasia N.K. published a research paper (2010) on "River hydraulics analysis and remedial measures of Tapi at LTB". In this research paper software has been developed in Microsoft Excel for finding out maximum carrying capacity of the river which gives very reliable results. The river hydraulic data are very useful for analysis, narrowing of the Tapi river is revealing one. 40 years back it could carry 28310 m^3/S (10 lacks cusec) of water. It has been reduced to 9910 m^3/S (3.5 lac cusecs). Analysis shows that after the flood of 2006 safe carrying capacity of river near Surat is reduced to 4531 m^3/S to 5660 m^3/S (1.60 to 2.0 lac cusecs). Right side embankment of the river Tapi from section RD20 to RD83 is very low in height; west zone is developed in this reach and affected severely in recent 2006 flood events.

Patel Dhruvesh P. and Dr.Dholakia M.B. published a research paper (2010) on "Identifying probable submergence area of Surat city using digital elevation model and geographical information system". In this research paper high-precision DEMS model studied to asses in advance the dangers in areas exposed to potential inundation. Use of GIS provides supplementary data in hydrology for analysis and make easy to interpret and to understand flood phenomena and its characteristics. DEM can be effectively used for simulation to get a complete model of Surat city area has accuracy of 0.5 m interval and has been used for analysis of delineation of flood prone areas. West zone and south west zone of Surat is highly flood prone while east zone is least also studied in this paper.

Patel Dhruvesh P. and Dr.Dholakia M.B. published a research paper (2010) on "Feasible structural and non-structural measures to minimize effect of flood in lower Tapi basin" in WSEAS transaction on fluid mechanics, ISSN: 1790-5087, issue.3 Vol.5, July 2010. In this research paper describes the flood potential of Varekhadi watershed group by application of Soil and Water Assessment Tool (SWAT) model, using Remote Sensing (RS) and Geographical Information System (GIS). In order to minimize the effect of flood in and around Surat city, feasible structural and non-structural measures suggested as under

- Timely validation of the SWAT model is essential to predict the flow at Ghala station.
- Learning lessons from the past flood events. Modifications are necessary in the rule curve of the operation of Ukai dam.
- Possibility of history floods in Surat, if quite high run-off from Varekhadi and discharge from Ukai, met at same time. Such, undesirable condition must be taken into account and cannot be ignored to save the Surat city against flood. To avoid such venerability, river gauging and discharging stations must be established.

Patel Dhruvesh P., Patel Chandresh G., Dr.Dholakia M.S. published a research paper (2009) on "Urban flood hazardous mapping by HEC-Georgas and HEC-RAS hydrological modeling". This paper model had been validated by comparing the actual flood depth of August 2006 at various point of study area i.e. (Shyamdham Society, Rameshvar Industry, Dabholi Road, Diamond Park, Bus Stand, Shigma School Kadarsaninal, Khoja Masjid, S.T.Compound Wall Nr.Gate) with model result, which gives less than 10 % variation, compared to the actual depths. The outputs are a digital flood plain map that shows both extent and depth of inundation. The variation or difference in results of model due to error of data or measurement of depths or in accuracy of river cross-section and straight line cross-section assumption for this HEC-RAS model i.e. straight-line assumption means cross sections are perpendicular to the flow lines in both the flood waves and main channel. As a result, land surveys of river cross sections take the perpendicularity requirement into account.

Singh, Dr. Anupam K. and Sharma Arun K. published a research paper (2009) on "GIS and a remote sensing based approach for urban flood plain mapping for the Tapi catchment, India" in IAHS publication, Page no.331, Sept.2009. In this paper, research study demonstrates the utility of high resolution remote sensing images combined with field data on river hydraulics in delineating the flood prone area. The quantification of the area vulnerable to floods of different frequency of occurrence has been studied. The future scope lies in applying the methodology for preparing the flood risk for the whole of Surat city under varying scenarios.

2.3 Review of Flood Level Estimation Studies by CDO Gujarat

The detailed review of the studies carried out by Central Design Organization (CDO) Gujarat is presented as explained earlier these studies were carried out in HEC-2 model for 1998 flood discharge of 19057 m^3/s (6.73 lac cfs) and 28315 m^3/s (10 lac cfs). Studies were carried out for two different reaches separately. Nehru Bridge to Kathor Bridge were the two reaches considered for these studies. The studies were steady state backwater computation with constant level on downstream and a fixed discharge on upstream. The tidal water level effect has not been considered. The Tapi reach from mouth to Magdalla Bridge has not been considered in CDO studies. Consideration of this reach was essential along with tidal boundary at river mouth for better predictions in the reach between Magdalla to Singanpur. Also the studies should have been carried out in a single model for the entire reach from mouth to some distance upstream of Kathor Bridge. For better predictions the flood discharge going through the canal near Bhata to the Tena creek and looped channel network around Kaid Island should have been reproduced with a model capable of handling unsteady flows in multiply connected channel network as was done for CWPRS studies. The basis for assuming the water levels of 9.88 m at Magdalla and 13.95 m at Nehru Bridge as downstream boundary for the two reaches for the discharge of 28315 m^3/s (10 lac cfs) has not been explained. These water levels appear to be high. The comparison of result of studies by CWPRS and CDO Gujarat is given in Para 9.2 and comparison of predicted water levels is shown in Table IX. The Table IX shows that for 1998 flood simulation studies. The CWPRS results are more close to the observed values at Magdalla Bridge, Nehru Bridge, Singanpur weir and Kathor Bridge where the gauges were installed. For studies with 28315 m^3/s (10 lac cfs) water levels at Magdalla and Singanpur, predicated by CDO Gujarat are higher than the CWPRS predictions. For the reach upstream of Singanpur weir CWPRS water levels are higher by about 0.3 m. The flood level prediction studies carried out by CDO Gujarat had following limitations;

- Limited to study backwater computations when the requirement was for unsteady flow situation.

- Tidal effects were not considered.

- Studies carried out for constant flood discharges instead of flood Hydrographs.
- Studies were carried out only for the reach between Magdalla to Kathor Instead of considering entire reach from river mouth to some distance of upstream of Kathor Bridge. Also the studies were carried separately for the reaches upstream and downstream of Nehru Bridge.
- Looped channel network around Kadia Island and Nala connecting. Tapi River and Tena creek was not reproduced in this model

2.4 Reviews for Flood Protection Works Proposed by Surat Irrigation Circle

On the basis of 1998 flood levels and the studies carried out by CDO Gujarat for 19820 m^3/s (7.00 lac cfs) and 28315 m^3/s (10.00 lac cfs) the Surat Irrigation Circle had prepared a comprehensive plan for flood protection works in Lower Tapi Basin. The proposed flood protection works include completion of remaining works of embankments and sluice gates of the ongoing protection scheme, additional protection works proposed in view of 1994 and 1998 floods and works to be carried out at the cost of Surat Municipal Corporation and Hazira Industrial Area authority. In view of avoiding flooding of Hazira Industrial Area around ONGC and flooding on right back at Bhatpur, Bhata, Adajan, Pal, Singanpur, following suggestions /modifications were suggested in the proposed comprehensive plan

- A protection wall from Nehru Bridge to Bhatpur is proposed to avoid flood overflow from the river bank in the reach with levels between 6.5 m to 4.5 m. This wall must be continued up to Magdalla Bridge. Considering the predicted HFLs of 10.66 m at Bhata and 9.0 m upstream of Magdalla Bridge the embankment top levels need to be decided at different locations.
- In the proposed plan no provision of protection wall has been made along right bank in the reach downstream of Magdalla Bridge. Considering the predicated flood levels between 8.0 m to about 6.0 m in the reach from Magdalla Bridge to KRIBHCO jetty and right bank levels of the order of 4.5 m of 5.0 m in this reach, the possibility of flooding of the Industries along right bank cannot be denied in spite of provision of flood embankment from Bhata to Magdalla Bridge. Therefore, provision of the flood embankment is essential in this reach also if the alternative measures such as effective operation of Ukai reservoir to restrict the outflows and diversion of Tapi flood are not found feasible.
- Construction of Singanpur weir has resulted in rise in flood levels along the upstream river reach. The work of rising of flood embankment of either bank is included in proposed flood protection

plan. This work should have been completed along with Singanpur weir. Also at many locations (between Nehru Bridge to Kathor) along right bank the incomplete works of flood embankments and sluice gates planned in original proposal of 1971 have resulted in entry of flood water. This flood water ultimately found its way towards Bhata drain and Tena creek due to natural ground lopes. It is necessary to execute all above works in totality so as to avoid flooding of Hazira Industrial Area as well as township between Bhatpur to Singanpur.

- In view of the PMF of 72490 m^3/s (25.6 lac cfs) for the Ukai reservoir (as per the CWPRS technical report No. 3417 of May 1997) there is need to take review of Ukai reservoir operation/strategy. Even with the present operation rules it was experienced in the September 1998 flood that the incoming flood of 29820 m^3/s (10.53 lac cfs) was moderated to some extent and about 19820 m3/s (7 lac cfs) was released on downstream as the reservoir level was above FRL (105.16 m i.e. 345 feet) by about 0.3 m. It may be mentioned here that the Ukai reservoir design inflow peak flood of 49500 m^3/s (17.5 lac cfs) is expected to be moderated to about 24000 m^3/s (8.5 lac cfs) as per the reservoir operation policy. The operation of utilizing the storage volume between FRL and MWL should be tried considering the emergency situation and experience of flooding in 1994 and 1998. Keeping in view experience of September 1998 flood when it was clear that with present situation any discharge higher than 8495 m3/s to 9911 m^3/s (3 to 3.5 lac cfs) will lead to flood situation. It is felt that the Ukai reservoir operation policy needs to be reviewed. The report for proposed protection work is silent on this aspect Studies. For reservoir Ukai operation need to be taken up freshly keeping in view flood of 1994 and 1998 as well as revised value of PMF. Apart from seasonal operation policy, the policies to handle emergency situation as that of 1998 need to be devised through detailed reservoir operation studies. CWPRS is equipped with sophisticated models for such studies. Some preliminary studies carried out by CWPRS have already been discussed. Which indicate how the floods with Ukai inflow up to 28315 m^3/s (10 lac cfs) could be moderated up to 8495 m^3/s to 11327 m^3/s (3 to 4 lac cfs) by keeping reservoir level below MWL.

2.5 Summary - Literature Review

Flood problem in India have been described dividing the country into regions, pointing out specific phenomena related to flood in the regions indicating the regional variability of the problem. Some special flood-problems, like dam break flow and flood in the Tal areas, have also been mentioned. Various measures for flood management in India have been presented including both structural and non-structural measures. Non-structural measures are found to be more effective for the flood management. Thus, a combined approach may be adopted considering structural as well as non-structural measures together. Short term as well as long term strategies is required to be evolved to combat the floods so as to minimize its detrimental effect on the society. The use of modern tools like remote sensing and GIS may be increased for preparing the maps of flood hazard, flood risk and flood plain zones etc. There is a need for developing the decision support system to provide the knowledge and information about the areas to be submerged due to flood water in real time. It will helpful for the administrators in preparing the evacuation plans during the flood period to save the lives and properties of the people affected due to floods. Cooperation and coordination between the scientific communities and appropriate local government and civil agencies for developing effective, workable response plains to flood disasters.

According to literature review research done up to the year 2000. So, Ukai reservoir operation policy decisions, decision models, are very old and may not applicable after severe Tapi River flood in the year 2006 at Surat city.

2.6 Drawbacks, Disadvantages and Limitations of Existing Models and Policies

2.6.1 Drawbacks and Limitations of Existing Distorted Physical Distorted Model at GERI, Gotri, and Vadodara

- Long time span require constructing this type of 0.5 km. long distorted physical model (2007 to 2013 and still incomplete).
- Costly expenditure of Rs 5.5 crores required to prepare this model.
- Experts and skilled labors required to run this type of model.
- Tidal wave generating effect machinery to show Arabian Sea not installed in this model.
- As there is change in cross section of Tapi river and sediments deposition, result gain from this model consider as pilot project means on trial basis.
- Part of the river reach from Nehru Bridge to Kathor Bridge which is not affected by the tide has been considered without reproduction of tide.
- During 2006 flood of 9.1 lac cusecs, there were breaches in low level embankments due to overtopping, also not reproduce.
- Since embankment top levels in the model were as per raised levels of 2009 the spills in the reach from Amaroli Road Bridge to Nehru Bridge were not reflected in model.
- However major spills near Amaroli Bridge, Kapodra and Nana Varacha were simulated.

2.6.2 Disadvantages and Limitations of CHARIMA Mathematical Model at CWPRS at Khadakwasla, Pune

St. Venant Hypothesis for water flow is assumed (i.e. uniform velocity and horizontal distribution, applicability of steady state resistance law for unsteady flow and small bed slopes).

- Channel network pattern assumed (i.e. total no. of channels, and their inter- connections) must remain same during a particular simulation.
- Cross sections are assumed to rise or fall without changing its shape.
- Effects of bends cannot be accounted in present formulation.
- Continuous lateral flows not considered. However, in additions due to rainfall could be represented by channel joining at regular interval.
- Other restrictions / assumptions associated with sediment routing processes (i.e. those required for sorting, armoring sediment discharge, friction prediction etc).
- This model consider vertical straight line Water surface profile at any obstruction to Tapi River flow like Kakrapar weir and Singanpur weir actually that line must be horizontal with slight curvature passing over that hydraulic structure.