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RESEARCH AND MODEL CONSTRUCTING OF THE YELLOW RIVER ESTUARY

Xining LI, Lijuan SUN & Xiangwen MENG
Yellow River Shandong Bureau, Yellow River Conservancy Commission, Jinan, China;
Tel: 86-531-6987259; E-mail: sunlj@sdhh.gov.cn

Abstract: The Yellow River Estuary is an important component part of the Yellow River. The evolvement of estuary directly influences the sediment transport in the Lower Yellow River. The scientific research is far behind of the request of the estuary harnessing. In order to do it well we must intake some physical model experiments, analyze the observation results and calculate the evolvement with mathematical model.

Key words: Estuary, Physical model, Scientific research

1. NEED OF HARNESSING, DEVELOPING AND SCIENTIFIC RESEARCH OF THE ESTUARY

The estuary is an important composing of the Yellow River. The evolvement of estuary directly influences flood and sediment transport in the Lower Yellow River. The comprehensive governing of the estuary is one of the pivotal parts to realize the aim, "the river bed dose not rise", so we muse pay much attention about it. Estuary seashore is the important part of the "Global System" composed with geosphere, hydrosphere, airshpere and biosphere, and it's the most sensitive and active belt of interaction. And now days the research of land and sea interaction has become a fashion task of the global change researches. But our harnessing of the Estuary can't catch up with the social economic development. So we have no other choice but take up comprehensive control of the Estuary.

Meanwhile, as the technical foundation, the scientific research has gotten far behind the request of the estuary control. In the past several years, the condition of water and sand inflow has changed a lot, it indicates some new points about the estuary evolvement, some old attitudes towards the estuary can't fit in with the requirement the estuary governing. We have no in-depth and systemic study in many fields, such as the sand transfer capacity of the ocean power, the sand transfer regulation in the coastal area, the impact on the estuary evolvement of the upstream following with the water and sand inflow changing, the influence of adjustment in the downstream on the eroding and silting of the outlet, relationship between biological environment change and water and sand inflow condition of the estuary, measures of dealing with the sand and sediment of the estuary, the reasonable service age of the present Qingshuigou river path and optimal opportunity to change the old river path, and measures to comprehensively govern of Hekou section of the Yellow River. There are many reasons, things like, without perfect research methods, lack of inter-experiment between the theory and practice and powerful validation of controlling projects, and difficult to transfer the research achievement into production.

The evolvement and environment of the Yellow River estuary are quiet complicated, for example, the hydrodynamic coupling between flow-up and ocean is a low correlation one, meanwhile the sand inflow is quiet large, the sand transferred with the flow is very thin, besides, it appears both muddy water and saltwater wedge at the same time. It has the very typical feature of along-shore resersing current whereas weak tide. The growth of the seashore

is much affected by the sand inflow, meanwhile, the speed of extendability and erode is very fast, the delta is very wide however the bank and bottomland of the flow has weak anti-scour ability. All this special natural geography and environment conditions make the Yellow River estuary evolvement appears a lot of special regulations compared with the other river, in addition, it is lack of whole and systemic observation data about the estuary, and the mathematic model now is not very perfect to simulate all these phenomena above. So we have to use the model-experiment method in order to begin the research about the Yellow River estuary, and effectively resolve all the problems above.

There have already been estuary models in several famous rivers such as the Yangtze River, Pearl River and Qiantang River, but no in the Yellow River. The task to govern the Yellow River is pretty complicated and has great relation with many kinds of things. Because of this, we have no other choice but to build a ontic model, so that we can display visually the different control and development schemes with the simulative experiment, and make the decision-making more scientific, quick and precise.

2. THE ESTUARY DEVELOPMENT PROBLEMS

There are still a lot of problems on the estuary development despite many marked achievements. First, the flood-control engineering is not quite perfect, it's possible to meet the median year flood disaster. Second, the sediment of the riverbed becomes even serious, the capability of water and sand transfer in the river road and the bankfull water discharge declines very much. Third, it is pretty possible that the flood rolls in the river or trains the dike because of the increasing lateral gradient, and now the second-hang river is indicating day by day. Forth, the gap between the supply and need of the water resources is getting more severe, and there is no enough water for the need of the entironment. Fifth, the estuary research work gets far behind the request of the governing task. Sixth, the estuary controlling speed is so slow that it can't keep pace with the social economic development in the Yellow River estuary area. The water and sand inflow has changed a lot following with the changeful climate and increasing human activities since 1980s, therefore many new situation and problems about the estuary evolvement appeared, things like increasing bank eroding, serious riverbed atrophy, and entironment worsening.

2.1 REQUIREMENT TO COGNIZE THE BASIC REGULATION OF THE YELLOW RIVER

We have made great achievements since the people managed the Yellow River, and created the great magic of safety during the flood season of summer and autumn floods in more than half one century. All these achievements guaranteed the safety of people's lives and property, improved the development of the society and the economy, and changed the environment better. We have accumulated some basic data and research achievements through observation and analyze during governing, harnessing and managing the Yellow River estuary. But the condition of the Estuary is pretty complicated with so many features such as ocean power, sand, river, tide, etc. In recent years, there came many new problems including sharper conflict about water resources need and supply, more serious river bed atrophy, flood flowing capacity declining, severe second-hang river, and entironment worsening. All these gave more difficulties to control and harness the estuary. It is quiet not enough only to analyze and research the prototype observation data.

Throng the promotion of the ontic model, we can simulate the prototype Yellow River estuary and do some experiments to research the relationship including all the features about the estuary, and separate the features so as to recruit the experiment data, find the inner regulation of the prototype Yellow River estuary.

2.2 MANAGEMENT AND SCIENTIFIC DECISION-MAKING REQUEST

Scientific management and decision-making are the most important things. And they need a verified achievement or designed plan by advanced and credible methods. In the past days, we governed the estuary by guiding theories and practical experiences without verification, so that sometimes we couldn't get the ideal controlling result. For example, some sections after renovation still couldn't control the flood flow effectively, the river road adjustment couldn't accomplish. Multi-aim management and decision-making come more and more popular following the the Hekou section social economy development and conflict among flood prevention, water supply and environment protection. Many engineering harnessing plan can't meet the request of the estuary management and decision-making.

With the ontic model, we can practice the design harnessing scheme time after time following our request, observe, analyze and estimate the scheme, then we can optimize the location of the engineering and adjust the running-condition, supply a harnessing scheme directly verified by simulation experiment for the prototype estuary harnessing, manage and make decision scientificly.

2.3 REQUEST OF FLOOD FORECAST

The decision-making about flood prevention must have good ageing. The safety of the Yellow River is very important to the whole society, especially in the estuary area, there are many factors endangering the safety of the people's lives and property who live in the bank area, the production of the oilfield, even the safety of the dikes, such as the river bed rising following the sediment increasing, severe second-hang river, possibility of flood fulfilling the bank, happening transverse river, inclined river or even rolling river.

We can preview and forecast the possible flood happening in the future using the given boundary condition if we have an ontic model. For example, we can play some preparatory experiments according to different grades flood flow, observe and realize the situation of the flood running, water level, river path, bank submerging and critical engineering, every year before the flood season, so as to give some suggestion to make the preparatory flood prevention scheme, supply useful methods for the rescue of the people in the bank area, prepare enough flood prevention materials at the critical points to guarantee the safety of flood prevention and lives and possessions of the people.

2.4 THE REQUEST OF KNOWING THING WELL AND WHOLE

We still have quiet a lot of things to know about the observation because of the imperfect management system about the estuary and poor technical and economical condition. So we are blocked to know basic evolvement regulation well. But the construction of the ontic model could help us know the evolvement of the estuary well and whole.

2.5 REQUEST OF THE "DIGITAL YELLOW RIVER" AND THE YELLOW RIVER HARNESSING PLAN

The digital Yellow River is the simulative contrast of the prototype Yellow River, according to it, we can simulate, analyze and study all kinds of the harnessing plans with the methods such as strong systemic software and mathematic model and so on. In order to construct the mathematic model, we must own enough, whole and statistic observation data. Meanwhile, the present data are too limited and couldn't meet the request of the time and space, affect the precision and utilization and hold the development and advancement of the mathematic model at a certain extend. The construction of the ontic model can supply us some physical parameters for the construction of the digital Yellow River. According to the research of the ontic model's elements, we can get some basic theories for the construction of the mathematic model and advancement of the control equation. So that we can make the digital Yellow River construction advanced and completed gradually. At the same time, being

the inter-experiment of the harnessing plan, the ontic model can help us not only improve the simulative technique of the mathematic model but also optimize the Yellow River harnessing plan.

In one word, to realize the the great targets of harnessing, development and management of the estuary in the new century, we have to face an urgent task to construct an ontic model engineering with a rational system, opening and effective operation and completed experiment equipments.

3. DIRECTION OF THE ESTUARY CONSTRUCTION AND IMPORTANT RESEARCH

The Yellow River estuary is a sedimentary estuary with weak tides, a lot of sand and changeful channel. The sediment extending is one of the important reasons to make the downstream gradient declined and deposit toward the source, meanwhile it affects the capability of flood releasing and sand flushing in the lower river channel. Hence, according to the regulation of "decreasing the basic level altitude doing good to release flood and flush sand into the sea", the key point to harness the estuary is to solve the problems such as sand and silt depositing, holding the estuary extending and making the current river path relative stable. All above are the requirement not only for the long-term security in the lower Yellow River but also the sustainable development of economy. With the economy development in the estuary delta, water resources and environment safety has become the essential block. But for the Yellow River estuary harnessing and developing, there are some main contractions and essential problems that we have to face and solve at present and even in a long period, they are following ones:

3.1 ENVIRONMENT REGULATION RESEARCH OF THE QINGSHUIGOU RIVER PATH

To simulate and analyze the growth process and condition in different stages is the foundation and precondition to study and make estuary harnessing schemes. We should pay much attention to the stages such as changing the bank into slot by deposition, scouring and depositing extending, and study the inner regulation of the growth and variation of the river path in every stage. Under different water and sand conditions and boundary, we can simulate the distribution situation of scouring and depositing along the river, state adjustment, change of flood releasing and sand flushing, land-creating velocity and sand barrier evolvement characteristics, etc, then find out the relative relationship among them.

3.2 SAND TRANSFERRING EFFECT OF THE OCEAN POWER IN THE ESTUARY

The main research points are following, sand and silt affecting range in both Dongying Port and Guangli Port, the quantitative relationship between the deposition and erosion of the seashore according to different water and sand inflow, the sand transfer capability according to different conditions including water and sand, boundary, and ocean power, the critical water and sand factor of the scouring and depositing homeostasis in Diaokou River and Qingshuigou estuary seashore. We have to decide to what we should do to deal with the rest sand and silt depositing in the estuary section except for the maximum part is transferred in the sea by the ocean power.

3.3 HARNESSING MEASURES AND SERVICE AGE OF THE PRESENT QINGSHUIGOU RIVER PATH

There are two main sides to research, one is to research the action and effect of the river path harnessing methods, stressed on cutting branches to enhance the mainstream, training dyke construction, river regulation engineerings(including distribution scheme, river regulation parameters, plane construction structure, etc), dredging river reinforcing dikes,

sand barrier dredging, delivering sea water to flush sand and decrease the river bed level, transferring tide to flush sediment, water and sand harnessing engineering constructing, etc. The second is to put forward the optimized controlling measures and comprehensive harnessing scheme with physical model according to the basic research above, and forecast the reasonable service age of the Qingshuigou river path besides the developing trend in the future according to the sand transferring capability of the ocean power, and the given condition of water and sand inflow.

3.4 COMPREHENSIVE HARNESSING AND PROGRAMMING RESEARCH OF THE YELLOW RIVER ESTUARY

In the current Qingshuigou path, the main study content when the water level reaches 12 meters(Dagu) while the designed flood-protection flow up to 10,000m^3/s is the utilization of Diaokouhe river path and sea area and feasibility study, adjustability verifying of the regulation scheme, and comprehensive harnessing scheme by dealing with the sand in the estuary, slowering and holding the sand depositing and extending in the delta shore line.

3.5 STUDY OF ESTUARY DEPOSITING AND EXTENDING EFFECT ON THE SCOUR AND DEPOSITION IN THE LOWER YELLOW RIVER

With the river channel model completed, we should research the estuary deposition extending, channel changing effect on the scouring and depositing evolvement in the downstream Yellow River, including effect course and range, etc.

3.6 FEASIBILITY RESEARCH ABOUT USING QINGSHUIGOU PATH AND DIAOKOUHE PATH IN TURN

In the recent 10 years, the annual mean sand inflow reaches 390 million tons, by research, we know the annual mean of critical scouring and deposition balance sand inflow is 245 million tons. Part of the rest sand can be transferred in the deep sea by the ocean power, the other can be used to make up the seashore erosion. We should study the feasibility of the two channels to use in turn, and find out the optimized age between the two service periods of each river channel.