2023 "Huashu Cup" International Mathematical Contest in Modeling

MCM

Problem A: Yarlung Zangbo River comprehensive development plan

Background

The Yarlung Zangbo River is the longest plateau river in China and one of the highest in the world. Originating in the northern foothills of the Himalayas, it flows from west to east, then turns south and flows towards India. The Yarlung Zangbo River in China is 2,057 km long and is divided into upstream, midstream, and downstream. The riverbed drops more than 4,000 meters from upstream to downstream, with a large drop in water level and abundant hydro energy reserves.

The development and utilization of the Yarlung Zangbo River is relatively controversial in academic circles. Some scholars believe that in order to achieve "carbon peaking" and "carbon neutral", it is necessary to significantly reduce thermal power generation and increase hydropower generation. It is necessary to make full use of the advantage of large water level difference in the main stream of the Yarlung Zangbo River to build a series of multi-step hydropower plants. But opponents argue that building multiple hydropower plants in the Yarlung Zangbo River would break the fragile environment. Moreover, the construction cost and transmission cost are large, and it is better to directly divert water to western China in terms of economic input and output. The famous "Red Flag River" project to bring Tibetan water into the borders is currently being discussed enthusiastically.

Requirements

You are invited to consider the next 50 years and examine the following questions.

1. The construction of a hydroelectric power station requires consideration of various factors, both in terms of input and revenue, geological and hydrological conditions, as well as environmental costs. Please choose a location on the main stream of the Yarlung Zangbo River and discuss the feasibility of building a

hydroelectric power station there.

2. If multiple hydropower stations are to be built on the main stream of the Yarlung Zangbo River, from the perspective of maximum energy, how many hydropower stations can be built on the main stream of the Yarlung Zangbo River and what is the potential total power generation capacity?

3. The "Red Flag River" project is a water diversion project that will not only improve the water shortage in the northwest but also improve the local natural environment if water from the Yarlung Zangbo River can be transported to northwest China. However, this project is a huge investment and there are many factors to consider. Please discuss the feasibility of the construction of this project from the point of view of economic benefits.

4. Some scholars believe that the construction of hydropower stations on the Yarlung Zangbo River and the diversion of water to northwest China can be comprehensively considered and coordinated. Please design a comprehensive utilization plan of the Yarlung Zangbo River water resources to maximize its value.

5. The comprehensive development of the Yarlung Zangbo River, which flows into India, is bound to cause concern in India. Please consider this factor and adjust your integrated development plan.

6. Based on your research and conclusions, please provide no more than one page of policy recommendations to Chinese government.

Your PDF solution of no more than 25 total pages should include:

- One-page Summary Sheet.
- Table of Contents.
- Your complete solution.
- Reference List.

Note:The MCM Contest has a 25-page limit. All aspects of your submission count toward the 25- page limit (Summary Sheet, Table of Contents, Reference List, and any Appendices). You must cite the sources for your ideas, images, and any other materials used in your report.