changes in land use, climate conditions, population growth, and related management factors could influence water availability and water demand over time.

The Reference Scenario was used as the baseline condition and assumed no major changes in land use, climate, or population growth. This scenario provided a benchmark against which the other scenarios were compared. The High Growth Scenario represented a situation of rapid population and economic growth, resulting in substantial increases in water demand across the major sectors. In contrast, the Medium Growth Scenario reflected moderate increases in population and water demand, together with less pronounced changes in land use and climate-related conditions. These scenarios provided a basis for examining possible future trends and for identifying appropriate water allocation and management strategies under different development pathways.

2.4 Determining water allocation

The WEAP model was executed under the predefined scenarios to simulate the outcomes of different water allocation strategies across the Middle Nzoia River Catchment. The model output provided insights into how water resources would be distributed under various conditions, considering both supply and demand factors.

Optimization: To enhance the efficiency and sustainability of water resource management, the WEAP model's optimization tools were employed. These tools were used to identify optimal water allocation strategies that would balance the competing demands for water within the catchment. By adjusting allocation parameters and testing different management options, the optimization process provided data-driven recommendations on how best to allocate available water resources, ensuring equitable distribution while maximizing the sustainability of the catchment's water supply.

3 Data Analysis

3.1 Model development

3.1.1 Definition of the study area and time frame

The study area for this analysis was clearly defined as the Middle Nzoia River Catchment, including all its tributaries and the associated sectors that depend on water resources. The temporal scope of the analysis encompassed both historical and projected data. Historical data spanning the last 40 years was collected to establish a baseline understanding of water availability and demand, while projections of future scenarios accounted for anticipated changes in land use, climate patterns, and population growth, which could significantly impact water resources in the catchment.

3.1.2 Creation of the current accounts

Current accounts were developed by integrating the collected hydrological, water quality, and demand data into the WEAP model. This step involved inputting historical flow data, water quality parameters such as temperature and pH, and detailed information on water usage from key sectors: agriculture, domestic, industrial, and agricultural. These current accounts provided the model's baseline representation, which was essential for evaluating the water availability and demand under present conditions. They served as the reference point for comparing future scenarios and assessing the model's sensitivity to various factors influencing water resources.

3.1.3 Creation of scenarios

Several future scenarios were formulated to simulate potential changes in the catchment's water dynamics. These scenarios included shifts in land use patterns, climate variability, population growth projections, and potential policy interventions. Each scenario was constructed to explore the impacts of these changes on water supply and demand, offering a comprehensive view of how the catchment's water resources may evolve under different conditions.

3.1.4 Evaluation of the scenarios

The developed scenarios were assessed using the WEAP model to determine their impacts on water availability and demand. This involved running simulations for each scenario to analyze changes in key indicators, including flow rates, water quality, and water allocation requirements. The simulation results were then compared to the