

Distribution of Benefits and Risks in Inter-Basin Water Transfers: The Case Study of NCT I from Upper Tana Basin to Nairobi City

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ABSTRACT

Inter-Basin Water Transfers (IBWTs) introduce complex socioeconomic, hydrological, ecological, and institutional impacts that are instrumental to decision-making. However, since most studies focus on the hydrological and ecological aspects of IBWTs for the development of sustainable water resources, it is necessary to investigate the distribution of risks (costs) and benefits of IBWTs among stakeholders. This study aimed to identify and categorize stakeholders, their relationships, and the distribution of risks/costs and benefits in the Northern Collector Tunnel phase I (NCT 1) IBWT using a stakeholder analysis method. The Athi Water Works Development Agency (AWWDA) and the Ministry of Water and Irrigation (MoWI) played a central role in the project. However, most stakeholders found the devolved units Water Services Providers (WSPs), Water Resources Authority (WRA), Water Resources Users Associations (WRUAs), and Murang'a County as the most critical institutions. Public participation in NCT1 was not inclusive but only done to meet the statutory project requirements. Significant risks of the project emerged, such as reduced river flows, drying of the springs, and Murang'a residents' ability to meet their water needs. Therefore, it is necessary to compensate for diverted water through a water levy to cover environmental externalities and catchment conservation. The increase in water supply for Nairobi City was perceived as the main benefit for the recipient basin, but an improved water levy with adequate cross-subsidies was pointed out as an instrument to catalyze water savings by the urban water utility.

Keywords-benefits; inter-basin; risks; stakeholder analysis; water allocation

I. INTRODUCTION

Water demand is increasing in many parts of the world while the available freshwater resources remain constant, especially in regions with rapid economic development and

high population growth. Arguably, these regions are often cities, which become strategic regions politically. Thus, when the water demand exceeds the supply, the solution is often supply-oriented strategies [1]. Some of the approaches have been Inter-Basin Water Transfers (IBWTs) from regions

deemed to have "surplus" water resources. By hydraulically connecting two or more river basins, a new dependency between communities is created, evoking the interests of different groups of stakeholders [2]. Consequently, some IBWT systems face resistance from local communities in the donor basin [2-6]. Unlike dams, where in 2000 the World Commission on Dams (WCD) proposed a framework to equitably share benefits [7], IBWTs have no such explicit provisions and may be complex, especially when the donor and recipient basins are in different administrative units.

NCT 1 is expected to transfer 140,000 m³/day from the Upper Tana basin in Murang'a County to Nairobi City in the Athi basin [8]. The project was financed by the World Bank and the French Development Agency (AFD) through MoWI and implemented by AWWDA. The project faced some resistance from Muranga County residents during its construction stage, as it raised concerns that their water resources would be diverted to Nairobi without tangible benefits. There is consensus among scholars that IBWT systems introduce both benefits and risks that are different between different stakeholders [2, 9-10]. Although this issue has attracted much attention, there is limited scientific research on the distribution of benefits and risks among water users/stakeholders in IBWTs. Most studies have focused on the biophysical and ecological impacts of IBWTs [11-14]. This study aims to investigate the distribution of benefits and risks in IBWTs through a stakeholder analysis in the NCT 1 project in Kenya, aiming to (i) identify and categorize stakeholders with their roles and interests, and (ii) investigate the distribution of benefits and risks among them in NCT 1.

II. METHODOLOGY

A. Study Area

This study was carried out in the Upper Tana basin located in Muranga County, Kenya, which has served as a source of water for Nairobi City since the 1950s [8]. The study focused on the stakeholders who played a role and/or were affected by NCT 1. In 2012, AWWDA conducted a master plan for the development of water sources for Nairobi City and its satellite towns, recommending NCT 1 as a viable water source. AWWDA, through MoWI, obtained funding of approximately KES 6.8 billion (US 65 million) from the World Bank and AFD to implement NCT 1. The project involved a 12 km concrete tunnel, 3 m in diameter, from the Maragua, Gikigie, and Irati rivers to the Thika dam for use in Nairobi City [15].

B. Data and Methods

This study used stakeholder analysis that involved (i) identifying and (ii) categorizing stakeholders and (iii) investigating their benefits and risks following the guidelines in [16-18], adjusted to the study case. Figure 1 shows the process that involved a literature review, snowball sampling, semi-structured interviews, and a Focused Group Discussion (FGD) to identify and categorize stakeholders. Qualitative content analysis was used to identify the benefits and risks of the project for stakeholders [17, 19-21]. Initially, stakeholders were identified through a review of policy documents, project design reports, and academic papers derived from various government websites and personal communication. The interviewees were

asked to mention and provide contacts to other possible stakeholders relevant to NCT 1. Semi-structured interviews were conducted to identify the roles, relationships, benefits, and risks of stakeholders in the project using an interview guide. Additionally, an FGD was held to gather additional in-depth information on the topics. In total, 25 interviews and an FGD were conducted with a representative of the identified stakeholders. Data collection was carried out in February, March, and April of 2023.

C. Data Analysis

The interviews were analyzed with the Nvivo software, commonly referred to as software-assisted Qualitative Content Analysis (QCA). This method follows a guideline to ensure an objective interpretation of qualitative data that is primarily in text format [20, 22-23]. The stakeholders were classified according to their level of importance-influence matrix to illustrate the power interactions of the stakeholders [17]. Furthermore, in terms of benefits and risks, the interview data were coded in Nvivo and themes were developed from the research questions.

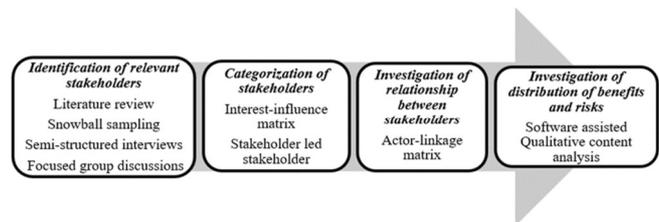


Fig. 1. Methodology steps for undertaking stakeholder analysis in the NCT 1 project, Upper Tana Basin, Kenya.

III. RESULTS

A. Stakeholder Identification and Roles in NCT 1

Figure 2 and Table I show the identified 7 categories of 27 stakeholders that have a role in NCT 1. MoWI with the support of the World Bank and AFD oversaw the financing of the project under the Water and Sanitation Service Improvement Project (WaSSIP) additional financing investment loan. The Water Sector Trust Fund (WSTF) was not involved in the NCT 1 project however, it funded the WRUAs for catchment conservation measures in Aberdares Forest. The WRA oversaw water allocation by issuing water abstraction permits for the Maragua, Gikigie, and Irati rivers. AWWDA was the implementing stakeholder in charge of design and construction. There were three Water Services Providers (WSPs) in the study area: Kahuti Water & Sanitation Company (KAWASCO), Muranga South Water & Sanitation Company (MUSWASCO), and Muranga Water & Sanitation Company (MUWASCO). Although WSPs play an important role in water provision, they were not actively involved. There were two WRUAs in the study area, Upper and Lower Maragua, formed in 2015. The involvement of WRUAs and the community was also limited, and they considered the project political. The National Environment Management Authority (NEMA) oversaw the licensing of NCT 1 to ensure environmental protection. The Murang'a County government's role was to ensure the sustainability of the project in terms of sharing benefits and

eliminating environmental risks. Although meetings were held between Muranga County government officials and AWWDA, resulting in a consensus agreement, the sitting administration,

which came to office in August 2022 was not involved in the project at the time. Most of the other stakeholders had supportive and/or informative roles.

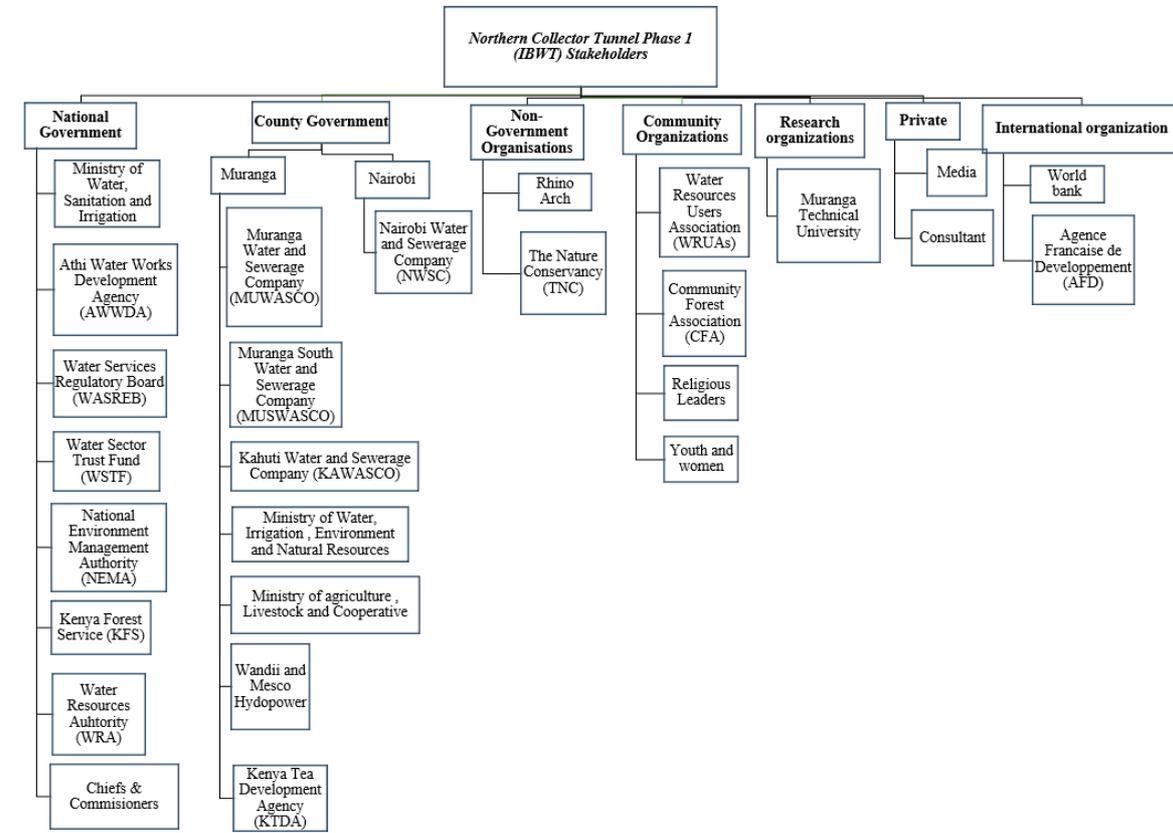


Fig. 2. Stakeholder identification and categorization in the NCT 1 Project, Upper Tana Basin, Kenya

B. Stakeholder Characterization based on an Importance-Influence Matrix

Figure 3 illustrates the stakeholders on a 2x2 importance-influence matrix, showing those who were likely to be affected by the project (importance) and those whose decisions affected the direction of the project but were not necessarily affected by it (influence). WRA, AWWDA, and Muranga County were classified as key players. AWWDA had the power and influence to make decisions in the NCT 1 project as it was the implementing agent. Muranga County was a key player in the donor basin because it was able to influence the design review of the project to abstract flood water and lobby for the development of off-shoot water supply projects for local communities. To abstract water from the three rivers, the project had to obtain water abstraction permits from the WRA, thus it was a key player in the project. MoWI, NEMA, and Media and International donors were classified as context setters, as their decisions affected the direction of the project, although they were least affected by the impact of their decisions. WSPs, youth and women, chiefs, and consumers such as KTDA and KENGEN were classified as "subjects" because they were the most likely stakeholders to be affected by the project, but their power in decision-making was limited.

KFS, CFA, Rhino Ark, and TNC were classified as external stakeholders because they had little interest and were also not affected by the project. However, they influenced aspects of the project through funding catchment conservation activities.

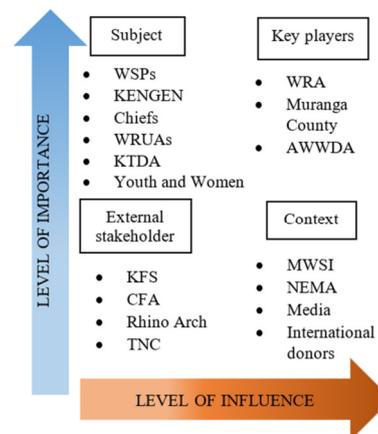


Fig. 3. Stakeholders' position based on their level of importance and influence in the Upper Tana NCT I Project, Kenya.

TABLE I. STAKEHOLDERS' ROLES BASED ON THEIR MANDATE AND EXPERTISE

Stakeholder	Role/Mandate
MoWI	Support the acceleration of water reforms. Mobilize resources for the sustainable development and management of water resources.
WSTF	Provide grants to manage and develop water services in marginalized areas. Provide funds to WRUAs for catchment conservation activities.
Water Resources Authority - Upper Tana	Regulate and authorize the NCT I water transfer project.
Water Services Regulatory Board	Approve tariffs and license water service providers.
AWWDA	Develop the NCT 1 project infrastructure along with the treatment plans.
NEMA	Issuance of NEMA certificate and supervise the project on environmental issues through the Muranga office.
KFS	Conservation of the Aberdare water towers through the Gatara Forest Station.
Muranga County	Represent Muranga residents on environmental and water resources concerns.
MUSWASCO	Provide water and sanitation services to Kandara, Kigumo, and Muranga South sub-county.
MUWASCO	Provide water and sanitation services to Muranga town and its environs.
KAWASCO	Provide water and sanitation services to Kangema and Kahuro sub-counties.
Kengen (Wanjji and Mescio hydropower station)	Hydropower generation using Mathioya and Maragua rivers.
Kenya Tea Development Authority (KTDA)	Small-scale tea farmers' company.
Chiefs and Commissioners	Support the project through liaising with the community for any concerns.
NWSC	Provide water and sanitation services to Nairobi County residents.
Rhino Ark Foundation	Provide funds/grants for Aberdare water towers conservation activities through collaboration with KFS.
WRUAs - Upper and Lower Maragua catchments	To authorize the abstraction of water from the Maragua, Irati, and Gikigie rivers for NCT 1. Collaborate with WRA in illegal abstractions monitoring. Collaborate with WSTF for the conservation of the catchment.
CFA	Assist KFS in planting trees and scouting services.
World Bank & AFD	Provide credit facility for NCT 1 Project.
Consultants & Contractors	Design and construction supervision of the NCT 1 project components.
Media	Provide information on the project.
TNC - Upper Tana Nairobi Water Fund	Support water and soil conservation measures.

C. Perceived Benefits and Risks

1) Risks

There was a consensus among stakeholders on the risks of reduced flows in the rivers or the viability of the project if they abstract flood waters. To ensure adequate water supply, residents were promised off-shoot community water supply projects. However, the projects did not target areas that were adversely affected by water shortages in the county and several of the projects have not been completed, so residents still face

severe water shortage. Furthermore, some of the off-shoot community water projects became a source of water conflict with WSPs. Increasing water demand in both the donor and recipient basins and climate variability are predicted to reduce water levels in the rivers, thus continued diversion may lead to over-abstraction. Therefore, the Aberdares Forest needed to be conserved to ensure sustained flows to the rivers. However, the NCT 1 project does not have a plan or a budget for conservation activities. AWWDA acknowledged the importance of the preservation and restoration of Aberdares Forest, however, noted that it was not within their mandate but that of the KFS. Another risk was future abstractions for Muranga residents, in addition to the drying of springs and wells along the tunnel during the construction period. AWWDA constructed six monitoring wells (piezometric boreholes) in 2016 to monitor changes in groundwater flows. However, the analysis has not been conducted and therefore no information has been shared to date with the communities.

2) Benefits

There was a consensus that NCT 1 would increase the water supply to Nairobi residents. Furthermore, locals were employed in Muranga County during the construction phase of the project. Spoil from the tunnel was used to improve weathered roads and provide better access to the community. However, most of the stakeholders in the donor basin did not see the benefits of the project and advocated for part of the money from the water bills to be returned to the basin to invest in water for domestic and agricultural use and conservation measures. Based on a similar process in the Karimenu Dam in Kiambu County, Kenya, 15% of the water fees go to operation and maintenance and 75% to loan repayment, leaving only 10% for water abstraction permits and conservation activities. Furthermore, the price of abstracting raw water was KES 0.5/m³ (0.0047 USD) compared to the opportunity cost of KES 45/m³ (0.43 USD) if the water was used for agricultural activities in Murang'a County [15]. The regulation of raw water abstraction is a standard fee for all water abstractors, whether it is for small-scale agriculture or urban water supply, and there are no special provisions for IBWTs.

IV. DISCUSSION

The current study identified different categories of stakeholders and their roles in the NCT 1 project. MoWI and AWWDA played an active role, as they were the promoters of the project. WSPs and WRUAs had a high interest in the project, although their involvement was limited. Similarly, although official documents show that an agreement was signed between the AWWDA and the Murang'a County government back in 2015, the current administration had a limited role in the project. Most of the stakeholders in the Upper Tana basin (donor basin) had a minimal role in the NCT 1 project and considered it a national project. Like in other countries, IBWTs are greatly pushed by a coalition of engineers, politicians, and financiers for the most economically and politically strategic recipient regions [9, 24]. As noted in [25], since water allocation in IBWTs is largely determined by economic consideration and political will, interests for the ecosystem and less powerful communities are rarely considered. Public participation is a prerequisite for big

projects such as NCT 1 in the Kenyan constitution, however, the mechanism of the process is not adequately provided. Effective public participation depends on the legal framework that provides clear guidelines on the process, political goodwill, and social awareness, i.e. community initiatives for water issues in the region [26]. In the NCT 1 project, although there was good political will, the process lacked clear guidelines and the WRUAs were in their infancy, as they were formed in 2015.

Like many other IBWT systems, residents of Murang'a County were concerned about the drying of their rivers, over-abstractions, and future water needs [14]. Although NCT 1 was designed to abstract only flood flows, there were some doubts because flood flows occur only a few times in a year or none, especially during dry years. In [27-31], it was found that most IBWTs are sensitive to climate variability, especially during dry periods when water demand in both basins is high and supply is low. In addition, IBWTs are based on current and future water balances between the two basins (donor and recipient) however, the future is muddled in uncertainties [32]. Although there was a need to conserve the water towers and river flows, the promoters of the project did not plan to fund conservation activities. Most of the conservation works were carried out by the CFA, WRUAs, and KFS through NGO funding and WSTF. Nairobi city residents have direct benefits from water transfer however, they do not bear the total costs of water resource regeneration. This is because some proportion of the water price (opportunity cost and externalities) should be paid to the donor basin. Therefore, the recipient basin may be paying only the supply cost and not the full cost of the project, denying the donor basin the full value (sustainable) of the water resources. For economic sustainability, all the societal costs and benefits of a project must be explicitly made public and accounted for. One way is to shorten the scale of development so that solutions are localized to improve the efficiency of projects [33]. Another way is by compensating people who bear the risks of present and future losses by creating a water transfer fund from water taxes [34-35]. For instance, in NCT 1, a water fund from the water diversion could be used for conservation activities of Aberdares Forest and other externalities in Murang'a County, the donor basin. Payment of ecosystem services is more elaborated in the tourism sector in Kenya, as in the case of Narok County, where the county receives approximately 70% of its revenue from the Maasai Mara National Reserve.

V. CONCLUSION

This study presented a comprehensive stakeholder analysis of the NCT 1 water transfer project in the Upper Tana basin, Kenya. Literature review, semi-structured interviews, and FGD were used to identify and categorize stakeholders. Additionally, QCA was used to analyze the perceived benefits and risks of the project by stakeholders. A total of 25 stakeholders were identified, where AWWDA and MoWI were the promoters of the project with the highest power and influence in the decision-making process. Although WSPs and WRUAs had a high interest in the project, their participation was limited. There is an initial written consensus and agreement between the Murang'a County government and AWWDA however, the

county had limited engagement in the project implementation which impacted the agreed interventions.

The risks of the project were reduced river flows, spring drying, and generally the ability of Murang'a County residents to access water in the present and future. Benefits from the project were water supply to Nairobi city residents, employment opportunities for Murang'a County residents during the construction of the IBWT infrastructure, and a nominal water levy to the donor basin (Upper Tana). In addition to being a low annual permit fee, the water levy does not take into account the opportunity and externalities (socioeconomic/environmental costs) of the water transfers, thus not offering full/sustainable water value to the donor basin. The low water abstraction costs could be among the reasons for the high non-revenue water consumption by users in Nairobi City (recipient basin). The project did not have any conservation plan or a respective budget, therefore most of the activities were carried out by WRUAs, KFS, and CFA through local and international grants. Most stakeholders expressed the need for improved cooperation in Aberdares Forest conservation measures, as this would be beneficial for both the recipient and the donor basins. The findings suggest that most of the risks were borne in the donor basin, while the benefits were in the recipient. To balance the distribution of benefits and risks, an improved water levy to cover environmental externalities and catchment conservation would ensure sustainable value and use of water resources in both recipient and donor basins.

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