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Differences in Risk Perception of Water Quality and Its Influencing Factors between Lay People and Factory Workers for Water Management in River Sosiani, Eldoret Municipality Kenya

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Abstract: This study evaluates the differences between risk predictors and risk perception regarding water pollution. Specifically, it focuses on the differences in risk perception between factory workers and lay people situated in textile industries near the River Sosiani in Eldoret, Kenya. The lay people are divided into two groups. The respondents living downstream are situated mostly in town centers and at the mid/lower parts of the river, and the respondents living upstream are mainly found at the upper parts of the River Sosiani. Data were obtained from 246 participants using questionnaires. Several factors influencing risk perception were selected to evaluate the degree of perceived risk amongst the groups. Descriptive statistics, mean score and correlation analyses, and multiple linear regression models were used to analyse the data. The one-way ANOVA results showed statistically different levels of risk perceptions amongst the groups. The partial and bivariate correlation analyses revealed the differences in scientific knowledge between respondents upstream and downstream. The multiple linear regression analysis showed that each group used different variables to determine risks in the region. In the factory group, 56.1% of the variance in risk perception is significantly predicted by sensorial factors, trust in the government's capacity to manage water pollution and the impact of water pollution on human health. About 65.9% of the variance in risk perception of the downstream inhabitants is significantly predicted by sensorial factors, the possibility of industries generating water pollution, and previous experience with water pollution. For the respondents located upstream, age, sensorial factors, trust in the government and the possibility of being impacted by water pollution factors significantly predicted 37.05% of the variance in risk perception. These findings indicate that enhanced public participation in water governance amongst the residents of Eldoret town is needed, along with an understanding of the different characteristics of the respondents in the region during risk communication. This will boost awareness in the region and promote the adoption of better practices to minimise the adverse effects of water pollution faced by the region.

Keywords: public participation; risk perception; water quality; risk; water pollution

1. Introduction

The assessment of water quality is a critical activity in the face of the current decline in freshwater quantity and deteriorating water quality of the remaining available water resources across the globe [1]. At present, 47% of the global population reside in areas that experience water scarcity for at least one month

each year [2]. Water quality is threatened by continuous population increase, economic developments, industrial and agricultural activities and climate change. These activities and increased water pollution have significantly threatened the hydrological cycle. Water pollution continues to increase, mostly as a result of large-scale industrial and agricultural production. Such activities typically generate large amounts of wastewater, which when untreated and disposed in water bodies contribute to massive water pollution.

The major culprits in the industrial sector are textile industries, which use large amounts of water and complex chemicals during textile processing [3]. These industries use huge amounts of dyes that are necessary in almost all stages of the process, and these constitute a high percentage of the effluents generated by these industries. Such effluents comprise one of the most problematic types of wastewater to be treated, not only for their high chemical and biological oxygen demands, total suspended solids and content of toxic compounds, but also for their colour [3]. The unsafe polluted waters generated by these industries can spread diseases such as cholera and typhoid, among other water borne diseases, amongst the people who use it for food production, washing, cooking, bathing, or other basic daily activities. There is also a high risk of contamination of groundwater, water supplies from wells and users of agricultural water sources [4]. Based on these risks, water pollution monitoring and water quality assessment are essential activities to help water management practices address the aforementioned challenges.

When addressing the risks posed by declining water quality and water pollution in order to promote better water management practices across the globe, public participation in governance issues regarding water resources has been emphasised in the last two decades [5]. Local people's perceptions of water quality are an important aspect of the management of water resources as they inform the dialogue between government officials, who are usually the proponents of remediation projects, and water service providers, environmental agencies and community leaders [6]. Public participation highlights the public's perception of perceived risks, their thought processes and responses with regards to water quality [6–8]. However, little attention has been paid by the government and other institutions such as environmental organizations involved in decision-making regarding environmental risks when promoting public participation [9]. In this regard, the expertise and judgement of other stakeholders guide the decision-making process even though the local people are the direct recipients of the impacts of deteriorating water quality and the poor management of resources [10,11]. This situation has resulted in a disconnect between the public and the decision-makers, leading to poor communication, lack of collaboration, increased environmental problems and lack of long-lasting solutions to address the problematic issues [6]. To be effective in addressing the risks around water quality, understanding the needs and perceptions of the public is vital. It is therefore imperative that policymakers and researchers engage in an effective public participation process, especially in situations in which public behavioural changes are required to manage water resources [12,13].

Research on risk has attracted much interest in the last few decades, specifically the study of the differences in risk judgement among different groups of people [14–18]. The prior literature has concluded that different groups of people perceive and react to risks differently based on their location and proximity to a hazard or risk, and their understanding of risk, based on different cultures and knowledge [14]. Some studies have also suggested that the general reaction of the public to potential risk could be impacted by social and psychological aspects that are beyond the capabilities of standard technical risk assessments [17,19,20]. Most of the studies on risk perception have employed either convenient or population samples of experts with certain skill sets [21–23]. Studies to elucidate the differences in risk perception between groups have been conducted mostly between the public and expert groups, and in highly technical fields, such as nuclear power, as illustrated by Kanda et al. (2012) [21], nanotechnology (Siegrist et al., 2007) [22], biotechnology and genetically modified organisms (Perko, 2014) [23] and other fields, such as industrial safety [19]. The findings of these studies reveal that experts generally have lower risk perceptions than lay people, which suggests that greater communication efforts directed at the public are required for effective risk management.

Within the factory context, the existing literature that has attempted to highlight risk perceptions has focused mainly on evaluating the use of personal protective equipment (PPE), occupational safety and accidents [24–27]. To the best of our knowledge, no study has attempted to investigate whether or not working for particular industries can influence risk judgements, especially in cases in which industries are responsible for certain environmental issues, and there is a difference in risk perception between these workers and the public. Investigating such a relationship is important because in order to have effective solutions for different risks faced by a society, an analysis and understanding of the different ideologies underlying the risks from all viewpoints is important. For example, important insights can emerge through investigating if, and to what extent, working in certain industries and corporations taints the workers' perspectives with respect to the organisations' activities. In situations in which the true feelings of individuals may be overlooked based on their affiliations or jobs, it is important to understand if a natural bias may develop, which may hinder or slow down problem-solving activities when such institutions are involved. Furthermore, this knowledge is imperative because employees constitute an important target group in the research on risk perception, since they work in situations in which their own actions are likely to have consequences on the actual risks they are exposed to, and to which the public is also exposed [28]. Moreover, knowledge about these relationships and viewpoints is important because, if the workers have erroneous conceptions of the risks their actions pose to the community, leaving the risks unchecked can cause unintended damage to both them and the community at large. It is therefore important to improve their knowledge and that of the public [28]. Importantly, the adoption of different risk perception perspectives involves the collaboration of multiple stakeholders, including the government, environmental and other private organisations, consultants and local residents. This acknowledgment of the different risk perceptions of diverse stakeholders within the water sector is vital to facilitate the adoption of sustainable water use and systems, such as the wastewater treatment of industrial water before discharge in the area. Based on this idea, the current study sought to investigate the following research questions:

1. Is there a difference in risk perception between factory workers and lay people?
2. Do the two groups (i.e., factory workers and lay people) use different factors to determine risk perception?

In the water sector, there has been little examination of the role of risk perception in relation to advancing more sustainable practices in the water management of centralised and decentralised systems with multiple sources [29]. Recognising and understanding the mix of risk perceptions can lead to the development of a more effective water management system, through collaboration of all parties and stakeholders aiming to adopt sustainable practices. Thus, the water industry should accommodate multiple risk perspectives in the implementation and management of water bodies and wastewater treatment systems, such as sewage treatment plants and common and combined effluent treatment plants (CETPs). The current study is different from other studies conducted on the River Sosiani, which mostly addressed issues of water quality [1,30–32] and water pollution [33–35] of the river and its environs, with few or no studies focusing on risk perceptions and the local factors influencing these. Therefore, this study aims to bridge this gap in the literature. Furthermore, given the strategic importance of the River Sosiani among the residents of Eldoret, its linkages to crucial basins, such as the Nile River through Lake Victoria, and the rapidly declining water quality of the river, this study is critical and necessary. The objective of the study is to provide empirical insights into the factors that influence the risk perceptions of the people living around the River Sosiani based on its decreasing water quality and the resulting adverse effects. This work also aims to gain a better understanding of the differences in risk perceptions between factory workers and lay people through an exploratory analysis of survey data. Investigating these issues will highlight opportunities for increased public participation around environmental projects in the area. Such participation is necessary to improve the risk governance and management in the area, and to better understand the needs and perceptions of the community around the River Sosiani, which is important in providing solutions that are tailored to that particular region. In addition, the findings from this study can facilitate behavioural changes

among the industries in the region through the adoption of potential low-cost technological options to treat their wastewater before discharge in the river in order to minimise the adverse effects of industrial water pollution in the area. For example, the use of locally available options, such as cactus and diatomaceous earth for wastewater treatment as adsorbents which have been proven to be equally as effective as activated carbon, which is the most widely used adsorbent in the treatment of industrial and municipal wastewater, can be adopted by industries in the region [36–39]. Also, given the minimal success of previous environmental restoration efforts in the River Sosiani area, there is a need to identify the type, scope and scale of engagement and the corresponding possible methods for inducing behavioural changes in the people in order to gain insight into the public perception of risk [40–42]. Therefore, a more effective communication process is necessary to gain a detailed understanding of risk perception and the factors affecting risk judgement to ensure long-term successful projects and effective water quality management [43].

2. Literature Review

2.1. Risk Research in the Water Sector

Within the water sector, many studies focusing on technical risk assessment have mainly highlighted the issues pertaining to public health risks, since this is the most direct and noticeable effect of water pollution or declining water quality. In addition to technical risk assessments, a few studies have tried to discriminate what risks and types of health risks are perceived to be associated with drinking water [44]. In a Canadian survey, the respondents identified infectious diseases, gastrointestinal disorders, cancer, contamination and intoxication as the potential risks resulting from water pollution [45]. However, the relative significance of the risks relating to water is likely to vary with the type of water system, water source, extent of personal contact and intended water use. For example, the perceived risk of using river water may be low for irrigation but high for drinking. Thus, there should be explicit consideration of the full range of specific risks, about which the respondents might have subjective responses, in order to prevent potential conflicts within technical assessments. In most cases, however, direct experiences of adverse effects of the risk are most effective when making judgements about risk perceptions [44]. In relation to the analysis of public perception of water quality, with the aim of increasing public participation in water quality restoration, research has been conducted into many successful river management projects, especially in the developed countries [13,46–48], such as the Murray River in Australia [13] and the Rhine in Europe [49]. Furthermore, it is interesting to note that most published studies reported above have taken place prior to planning an intervention, which is the case especially in water-related studies. These public risk assessments of water quality are equally as important as the experts' technical assessments to ensure complementary decisions that organise the responses to degradation, implement risk management policies, minimise risks and allocate resources [11,29,50]. Understanding the way a particular society perceives risk is vital for pinpointing the existing vulnerabilities of a water-related occurrence, and appraisals of environmental risks that include all stakeholders are an integral part of promoting environmental sustainability [51].

2.2. Risk Perception and Risk Communication

Identifying local people's perspectives and judgement of risks is a crucial step in fostering sustainable governance and providing solutions to water problems. Perception is the principal form of cognitive processing between humans and their surroundings [52], and it is thus a key component in understanding human behaviour [5]. Thus, a clear comprehension of how people perceive risk is necessary when attempting to design and implement solutions that require changes in behaviours and actions in the management of natural resources [53]. In order to do this, however, we must be able to determine the risks, interpret them appropriately and understand the subjective judgements, which are commonly referred to as 'risk perceptions'.

Risk perceptions arise from uncertainties and are based on a person's subjective evaluations and judgements about risks and risk-related choices [54]. Early risk perception studies were founded on the idea of a knowledge gap between the public and the experts [55,56]. These studies implied that, if the public could comprehend and access all the evidence around a particular situation, their perceptions of its risks would be similar to those of the experts [57–60]. However, such an idea has been dismissed in the realisation that risk perception is a complex product of innate factors and that knowledge is just one of several factors that determine risk perceptions (i.e., other risk perception predictors) [59,60].

A major factor which influences the public perception of water quality is the risk communication process [43]. Risk communication refers to the process of interaction and exchange of information between experts and the affected communities about a risk in order to enable them to make informed decisions and protect themselves [61]. As in risk management, the main problem that can arise in the risk communication process is the lack of or inadequacy of the interaction phase [43]. According to Canter et al. (1992–93) [43], risk communication can be enhanced if the interpretation of the information presented during the risk communication process is viewed as the most important element, rather than the accuracy and detail of the information being presented. Some critical issues to consider during risk communication include variation in the reception of information among different communities; the local context in which the risk situation is embedded, i.e., attitudes, beliefs and culture of the community; the medium and the person delivering the message and if the messenger is trusted or distrusted by the recipients of the message; and the knowledge levels of the people involved. For example, the lack of knowledge of toxicology by most participants involved in the risk communication process may result in problems with translating, communicating and comprehending highly technical risk information, which might, in turn, delay or hinder the risk communication process [43,61]. Any miscommunication or mistrust in the people's concerns or understanding of risks could create a gap between the community and the authority in charge of risk communication, which could obstruct successful policy implication. A comprehensive risk assessment process should thus encompass an integrative model that involves all the stakeholders and undertakes both a vigorous technical risk assessment and a risk communication process that takes into consideration the different risk perceptions of all the stakeholders involved. The benefits of an integrative model during risk assessment in the water sector include the identification of new areas vulnerable to hazards, which require further analysis; an opportunity to cross-check available data as a form of verification; communication of hazardous conditions based on local knowledge; and direct participation of the public in monitoring the risk condition [11].

2.3. Factors that Influence Risk Perception

The factors that influence risk perception are considered risk perception predictors [55]. Although much research and many theories, such as the psychometric paradigm and cultural theory [10], pertaining to risk perception and its predictors have been proposed since the 1970s, these have been criticised and modified over the years. For example, according to Sjöberg [62], the size of the community, and education, income and gender variables, which are not included as predictors in cultural theory or in the psychometric methods of risk perceptions, are actually significant predictors of risk. In addition, trust factors and the influence of mass media have been found to be significant predictors of risk perception. The perception of water quality risks is largely influenced by the same cognitive-emotive processes that affect risk perception in general [44]. Therefore, from the psychometric and cultural theories perspective, a conceptual framework can be developed based on a number of factors that influence risk perception, as shown in Figure 1. Discussed below are some of the factors influencing risk perception that were included in this study.

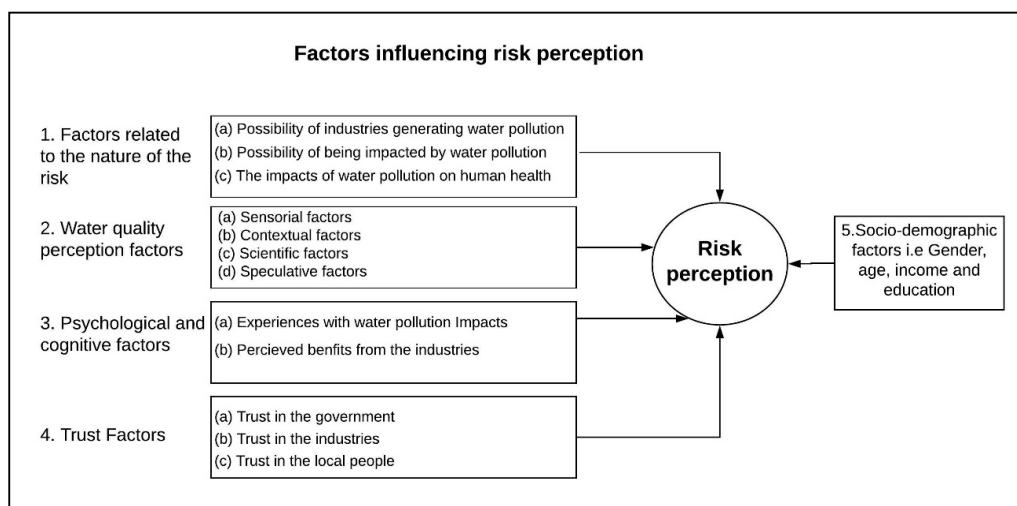


Figure 1. Conceptual framework of the present study.

Several studies have found the potential influences of socio-demographic factors on risk perceptions. Gachango et al. [34] and Hodge and Reader [63,64] found that age influenced the likelihood of farmers adopting the technologies and schemes they were introduced to, in that older farmers were more likely to adapt to such technologies than younger farmers. In contrast, Giovanopoulou et al. [65] determined that younger farmers are more likely to adopt certain technologies compared to older farmers. Previous studies have also found that income levels, education and gender significantly predict risk perceptions [66–69]. Based on the inconsistency of the socio-demographic characteristics, some studies [68] used these factors as predictor variables when conducting risk assessments. In the current research, these were also used as predictor variables.

Furthermore, trust plays a critical role in people's behaviours and perceptions towards risk [70]. In the current study, 'trust' is defined as the level of trust the respondents have towards an entity—be it regulatory, industrial or their own community—to minimise and manage risks, as well as the potential impacts of water pollution in the area. This trust may or may not be dependent on the level of capacity that various parties presumably have. Trust has been identified as playing a significant role in the judgement of risks by the public in prior research, which asserted that confidence in the authorities, especially regulatory ones, strongly influences the degree of the public's acceptance of risks [62,70–73].

Water quality assessment and judgement influences attitudes towards risks, and the formation of such judgement depends on certain factors and the attributes of the water quality. Several factors may influence public perception of water quality and risk, such as bad odour, unusual taste, or change in colour, which may be interpreted as implying poor water quality and health risks [74]. Of the factors that rely on the human senses, colour is used mostly when making a judgement on water quality, and this is combined with the psychological effects of previous events and experiences, which are internalised through a person's cognitive responses to dangers [11]. Other factors, such as past experiences, trust in water service providers, health risk perceptions and demographic variables also impact people's perceptions of water quality [6]. For rivers and lakes, contextual factors, i.e., symbols that are close to water but not part of it, such as those that indicate the cleanness of the river banks or the presence of or lack of aquatic life, as well as the availability of external information from the media, have been found to influence the public's perception and estimation of risks [74]. In their study of the River Yamuna, India, Withanachchi et al. [11] stated that the aesthetic qualities of taste, colour, smell and clarity were considered when assessing water quality. They also found that sensorial factors are used more when making judgements on the river's water quality than other factors, such as contextual factors and scientific factors relating to the presence of harmful chemicals [5]. While this might be the common way of making water quality judgements, emphasis should nevertheless be placed on using

classification methods, such as the water quality index, to ascertain the actual composition of various elements present in the water bodies being assessed [75,76].

The factors related to the nature of risks have also been demonstrated to influence individuals' risk perceptions. The nature of a risk requires a certain level of technical understanding of the risk, and, when lay people have access to information, this can influence their risk perception [75]. To explain the influence of the nature of a risk to risk perception, Janmaimool and Watanabe [10] based their argument on the axiomatic risk approach that explains that an individual's perceived risk is influenced by the probability of occurrence and likelihood of a negative outcome, and they arrived at a similar conclusion. Sung and Hanna [76] also concluded that differences in risk tolerance and acceptance could vary depending on an individual's understanding of the nature of risks, thus underscoring the importance of these factors when understanding risk perceptions. Meanwhile, the psychological and cognitive factors associated with perceived benefits and previous experiences with risks, as elaborated by the psychometric framework, have been applied in previous studies to determine risk perception [10]. Importantly, perceived benefits have been identified as factors that influence one's attitudes towards risk [77–82]. In their study on the acceptance of gene technology in food production, Sparks et al. [83] argued that one's attitude towards risk is affected by perceived benefits. Based on economic status and financial differences between the upper class and lower class in Kenya, this factor cannot be ignored. People's struggles to meet their basic needs and survive are at the forefront, especially in Kenya, and may well have an impact on their risk perceptions. The previous research has centred on income when analysing perceived benefits [78,84–86]. To further explore this factor, the present study considered the term 'benefits' to capture not only the expected income from industries but also other elements, such as job security and other possible opportunities created by the presence of industries in the area. All the factors discussed above have been shown to have an impact on risk perception [10]. Thus, it is imperative to assess the relationship between these factors and assess how they can help shape decision-making and risk communication in the area.

2.4. Study Framework and Hypothesis

On the basis of the literature review of previous studies that are mainly based on the psychometric paradigm and cultural theories [10,43,87,88] that identify the scope of factors that influence public perception and response to risk, a conceptual model was formulated for this study. This included applying a structure that can provide a hypothetically thorough outline of the key determinants of risk perceptions amongst different groups and highlight risk levels with regards to water quality [6,88]. These determinants were organised into five categories, as shown in (Figure 1). The first category included the nature of environmental risks, such as the possibility of industries generating water pollution, the possibility of being impacted by water pollution and the impacts of water pollution on human health. The second category included factors influencing public risk perception of water quality, namely, (a) sensorial factors, (b) contextual factors, (c) scientific factors and (d) speculation and feeling factors. The third category consisted of psychological and cognitive factors, such as previous experiences concerning the impacts of water pollution and the effects and perceived benefits of industry. The fourth category included trust factors, which included trust in the government and local industries, and the local people's capacity to manage water pollution. Finally, the fifth group of socio-demographic factors consisted of the respondent's gender, age, and income and educational levels.

The following research hypotheses were proposed:

- (1) People working for industries and people living in different locations of the River determine risk perception differently.
- (2) Risk perception is influenced by trust factors, socio-demographic characteristics, water quality perceptions, the nature of the risks involved and psychological and cognitive factors.

3. Methodology

3.1. Study Area

The study was conducted in July–October 2019 along the River Sosiani (00° – $03'$ S and 00° – $55'$ N; 34° – $50'$ E and 35° – $37'$ E), a sub-catchment of the River Nzoia, which is a sub-basin that drains into Lake Victoria [35]. The River Sosiani is located in Eldoret (Figure 2), a town in the Rift Valley region of Kenya, which serves as the Uasin Gishu County's capital. It is located at latitude 0.514277 and longitude 35.269779 with the GPS coordinates of $0^{\circ}30'51.3972''$ N and $35^{\circ}16'11.2044''$ E [35]. As of 2019, the reported population was 475,716 [89]. The area receives an average rainfall of around 1055 mm, with an average temperature of 16.8°C . The land in Eldoret rises from the Sosiani River Valley. The Sosiani River Basin covers an area of approximately 647 km^2 , with a length of approximately 67 km. The River has two main tributaries, the Nundoroto and Ellegeni, which are located in the upper basin and are characterised by a steeper gradient. The main activities within the River Sosiani catchment are wheat, maize and animal farming in the upper zone, which stretches between the plateau and flax areas; the midstream zone consists of human settlements, industries and hospitals; and the downstream zone is an urban environment, which includes the Central Business District (CBD), road networks, garages and car washes as well as other industries. Many industries in the area have mushroomed over the years (Figure 2), and the main industries mostly deal with the production of consumer goods, such as plastic, furniture and textiles, food processing, oil refining and cement production. The primary goods found in this area include machinery and transportation equipment, textiles, petroleum products, iron and steel [90].

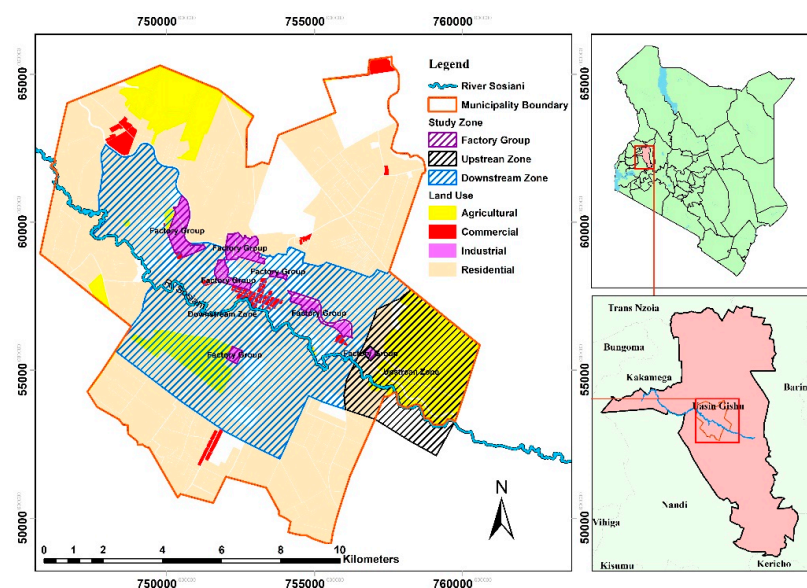


Figure 2. Study area and the selected regions in the area.

Over time, the catchment of the River Sosiani has experienced massive water pollution because of rapid population growth, industrial development, inefficient agricultural practices, as well as poor land-use planning and solid waste management systems in the area [91]. The industrial effluents discharged in the River Sosiani from industries in the nearby areas account for a large percentage of water pollution, which has led to a decline in water quality and quantity [92]. To meet daily water demands, residents rely on piped water, borehole water, river water and water sourced from the lakes and ponds. Apart from water shortages in the area, the population also faces large outbreaks of diseases, such as cholera and typhoid, which are often associated with poor and unsanitary water practices.

In the past, the Government of Kenya has initiated rehabilitation activities, such as solid waste management, tree-planting activities, regular inspections, law enforcement and environmental

awareness initiatives in the catchment areas of the River. The main outcome of these efforts was the development of the Nandi Park Rehabilitation Project. However over time, these activities failed to revive the almost dead river, which still faces major water pollution issues [34]. Moreover, experts warn of a possible complete drying up of the river if the current trends in the area persist [90,93,94]. Hence, in addressing the relevant issues in the area, these studies have suggested enhancing public participation in order to achieve long-term results.

3.2. *Methods Used for Data Collection*

This study used a mixed research approach with questionnaires and informal interviews. A pilot survey involving 50 respondents was conducted to determine the effectiveness of the questionnaire in meeting the objectives of the research, determine whether the selected variables and factors selected to represent risk and risk perception were comprehensive, and ascertain whether the target respondents could understand and interpret the questions easily. The pilot survey results indicated that there was a need to administer the questionnaire in the local language (Kalenjin (The Kalenjin language is a southern Nilotic language spoken in Kenya, mostly by the Kalenjin tribe)) or the national language (Kiswahili) in cases where there was difficulty in reading and writing in English. After the pilot survey was completed, the actual survey was conducted, and a total of 350 questionnaires were administered randomly to the communities residing along the River Sosiani and to the workers in factories along the river. In total, 246 questionnaires (70.2%) were returned fully completed and were used in the data analysis. The participants included in the study were divided into three groups. The first group comprised respondents located midstream and downstream around the town area where the factories were located, who throughout the study are referred to as downstream inhabitants/respondents. The second group consisted of respondents upstream, whose main activities involved agriculture and farming, and they are referred to as upstream inhabitants. Finally, the factory group comprised respondents working in the factories throughout the region. The selection of factories was made based on their proximity to the River Sosiani, and only major textile industries in the region were surveyed. The factories selected were both private and government-owned, as long as they allowed the study to be conducted within their premises; in total, three factories agreed to participate in the study. For the inhabitants located upstream and downstream, the questionnaires were randomly distributed, while the questionnaires administered in the factories were dropped off at the trainers' offices, to human resource managers, or at the factory gates, as instructed by the administration. The survey forms were collected after one week or as advised by the responsible personnel. Accordingly, follow-up was done to collect any unreturned questionnaires.

3.3. *The Questionnaire Design*

The questionnaire was developed based on selected variables and factors obtained from previous studies and investigations on risk perception [6,37,39]. In order to compare different groups, each respondent received the same set of questions. Where relevant, additional questions were added which were specific to one group (e.g., the number of years working in the industry). Items related to collecting general socio-demographic information included gender, age, educational level, occupation and income. Additionally, information about the number of family members working for the local industries in the area, the name of the industries, the position held and the number of years working in the industry was collected. A five-point Likert scale, using a single select method ranging from 'Not at all' = 1 to 'Very high' = 5 was employed to measure the variables to the questions discussed below.

In terms of risk perception, a total of eight questions were used to determine the degree of risk according to the respondents. The set of questions was based on the pilot survey that contained in-depth discussions and interviews to help determine the questions that could be used to measure risk perception of respondents in the area, unlike previous research in which relevant characteristics and rating scales have been based on a literature review. Furthermore, some of the selected questions had been applied in previous research to measure risk perception. These questions included the impacts of

industrial activity on their careers; their health; worry about their future life as a result of increased industrial activities in the area; potential diseases, such as cholera, typhoid and cancer caused by the poor water quality in the area; and the potential nuisances caused by the smelly and noisy activities of the industries, congestion and traffic jams. The respondents were also asked a direct question aimed at measuring the degree of perceived risk based on the water quality in the area, i.e., perceived level of risk based on the quality of water, which was measured using a Likert scale ranging from 'None' = 1 to 'Very high' = 5. The results from all the variables were summed up and calculated as a mean score representing a degree of risk perception, with higher scores indicating higher perceived risks.

Information on the main source of water for daily use was collected to determine the water usage in the community. To determine the importance of the river to the residents, a dichotomous question with a 'yes' or 'no' response was used. To assess the factors affecting the respondents' perception of water quality, four factors were assessed, namely, sensorial (factors based on the basic senses), contextual (factors based on a particular context), scientific (factors based on evidence) and speculation (factors based on opinion, intuitive judgement or guessing). All the parameters in each of the factors were summed up and calculated as a mean score representing each variable. The respondents were asked to rate the level of importance of these parameters when making judgements about the water quality of the River Sosiani. The parameters for each of the variables were as follows: (a) sensorial factors based on the taste, colour and smell of the water, as well as the age of the different types of pipes (visual aspect of sensory factors); (b) contextual factors based on the presence of refuse in the water and along the riverbank, the presence of fish in the river and the presence of sewer lines nearby; (c) scientific factors based on knowledge of water-polluting chemicals in the river through hearing or reading about scientific findings proving that the water is not clean; and (d) speculation and feelings based on observed changes in water quality, an intuitive sense that the water is not clean and hearsay regarding people becoming ill after using the water.

To measure trust factors, the respondents were asked to rate the degree of trust they had in, and the perceived ability of, the following: (1) the government and its capacity to control risk through water pollution management in the area, (2) the industries' capacity to protect and manage water pollution in the area and (3) the local people's capacity to manage and control risks in the area. In terms of the last factor, the question was set to gauge the level of control the community members felt towards managing water pollution in the area through collective actions, such as riverbank clean-up, and sustainable practices concerning water management. Higher scores indicated greater trust in the selected institution's ability to manage risk in the area. Three questions were used to assess the effects of factors related to the nature of the risk. The respondents were asked to rate the following: the possibility of industries generating water pollution, the possibility of being affected by water pollution and the impacts of water pollution on human health, i.e., when judging risks. For the psychological and cognitive factors, two items were used, namely, the perceived benefits from industries and previous experiences with water pollution in the area.

3.4. Statistical Analysis

In order to understand, compare, characterise and draw conclusions about the three groups, multiple statistical methods were used to analyse the data. Analysis of Variance (ANOVA) was applied to identify significant differences in risk perception among the three groups and determine what group had higher risk perception scores. Mean scores analysis was used to characterise the inhabitants of the three groups and provide possible explanations for the results obtained. For further characterisation, Pearson correlation analysis was conducted to identify the relationship and direction of the dependent variables (risk perception) and the independent variables i.e water quality perception factors, trust factors, psychological and cognitive factors, nature of environmental risk and socio-demographic factors (see Figure 1). Thereafter, partial correlation analysis was conducted to identify the relationship between risk perception (dependent variable) and all the other independent variables, without the influence of sensorial factors. This is because sensorial factors were the only significant

risk predictor common among all the three groups and understanding the contribution of the other independent variables would help in further characterising the groups. These analyses helped provide an understanding of the groups and why certain predictor variables were selected by each group. Multiple regression analysis was then conducted to identify the factors determining risk perception (dependent variable) among the selected predictive factors (independent variables), such as water quality perception factors, trust factors, psychological and cognitive factors, nature of environmental risk and socio-demographic factors (gender, age, income and education levels). The regression analysis helped to make conclusions about the characteristics of the groups, and possible explanations for why certain predictor variables were dominant for each group were highlighted and described in detail. Finally, based on these results and in-depth discussions, recommendations for including public participation in risk communication were provided.

4. Results and Discussion

4.1. Descriptive Statistics of the Respondents

The overall ratio of male to female respondents was 124 (50.4%) males to 122 (49.6%) females. Gender did not vary significantly amongst the three groups as shown in Table 1; however, there was a slightly bigger difference in the ratio for males vs. females for upstream inhabitants compared to the other groups. There was a notable difference in educational levels amongst the groups: there were three and one respondents from the downstream and upstream respondents respectively without education, whilst in the factory group had no count for the no education level category meaning that, all of the respondents had some level of education. The factory group also had the highest number ($N = 45$) of respondents who had tertiary education compared to downstream respondents ($N = 30$) and upstream respondents ($N = 25$), as presented in Table 1.

Table 1. Summary statistics of demographic characteristics.

	Factory Group		Upstream Inhabitants		Downstream Inhabitants	
	Count	%	Count	%	Count	%
Female	46	51.7	30	42.3	46	53.5
Male	43	48.3	41	57.7	40	46.5
Education:						
No education	0	0	1	1.4	3	3.5
Primary school	7	7.9	8	11.3	18	20.9
Secondary school	37	41.6	37	52.1	35	40.7
Tertiary Level	45	50.6	25	35.2	30	34.9
Age						
(20–29)	43	48.3	31	43.7	26	30.2
(30–39)	35	39.3	33	46.5	41	52.3
(40–49)	7	7.9	5	7.0	12	9.3
(50–59)	2	2.2	0	0	3	3.5
(60+)	2	2.2	2	2.8	4	4.7
Income in Ksh ¹						
(No income)	2	2.2	17	23.9	25	29.1
1–20,000	59	66.3	42	59.2	35	40.7
20,001–40,000	17	19.1	8	11.3	16	18.6
40,001–60,000	6	6.7	2	2.8	5	5.8
60,001–80,000	2	2.2	1	1.4	0	0
80K+	3	3.4	1	1.4	5	5.8
Observations	89		71		86	

¹ Ksh—Kenyan shilling, the currency used in Kenya.

The largest variation in the sample was found in average household income. In general, the highest incomes ranged between 0–20,000 Ksh (Kenyan shilling: the currency used in Kenya—1USD= 100.3 Ksh) amongst 73.2% of the population surveyed. In the no-income category, downstream ($N = 25$) and upstream ($N = 17$) had the highest numbers, whilst there were only two respondents in the factory

group. These two respondents were registered as attachés in their occupation, which explained their lack of earnings. The findings suggested that a significant population of the respondents did not have any income and still lived below the poverty line (US \$1.90 per day in 2011 purchasing power parity PPP). Whilst the monetary and non-monetary poverty indicators of Kenya show that Kenya performs better than most Sub-Saharan countries, given the overall income levels and poverty rate, human development indicators are still relatively high, indicating that Kenya performs better on non-monetary dimensions of poverty. To cope with this challenge, the population resorts to acquiring casual jobs, such as laundry cleaning and manual labour, which are not steady. When these jobs fail to provide any consistent income, they rely on growing crops to feed their families and to purchase food and other daily necessities, as evidenced by the results.

Table 2 presents the distribution of families with members working in local industries in the area. As can be seen, upstream inhabitants had the highest number of families ($N = 55$) with no members working in the local industries. The count for downstream inhabitants was $N = 35$ families, whilst the factory group had at least one family member working for local industry, as expected. This count included respondents working for local industries as well as any other family member of the household. Another notable difference amongst the groups was the varied response in the factory population on the numbers of year lived in the community. Most of them indicated that they lived temporarily in the region or had just relocated based on job opportunity, with no intention of staying in the region for long periods of time. For downstream and upstream respondents, most of the respondents had lived in the area their whole life.

Table 2. Number of people working in local industries per family in different groups.

Count	Number of Family Members Working for Local Industries							Total (N)
	0	1	2	3	4	5	6	
Group								
Factory	0	71	11	5	1	1	0	89
Downstream	35	23	16	9	2	0	1	86
Upstream	55	7	5	3	1	0	0	71
Total	90	101	32	17	4	1	1	246

4.2. Characteristics of the Different Groups of Respondents: Mean Scores Analysis

To further determine the characteristics of each group, mean scores and standard deviation analysis of the independent variables was conducted (see Table 3). From the mean scores, the following conclusions about the three groups can be derived. First, the respondents in the factory group had experiences of water pollution in the area based on the mean scores for experiences with water pollution ($M = 3.966$, $SD = 0.804$). However, despite these experiences, they rarely felt that their health was threatened based on the low mean scores for the variable impact of water pollution on human health ($M = 3.112$, $SD = 1.172$). This could be attributed to a number of factors, such as their limited experiences of water pollution given that most of them could be living outside the region and only working seasonally in the area. For example, expert skilled workers are hired occasionally and would only live in the area temporarily. Such situations would lower their experience of water pollution in the area. Furthermore, the possibility of a stable income and the ability to afford basic utilities, such as clean water, cannot be ignored. This is because members of this group mostly generate stable incomes and can afford better health and water services. Second, the factory group respondents felt a sense of responsibility in managing risks in the area based on the trust mean scores: despite the high placement of trust in the government's capacity ($M = 4.247$, $SD = 1.376$), compared to that of industry ($M = 4.169$, $SD = 1.236$), this group felt that industries should also manage risks in the area and possess some capacity to manage the risks.

Table 3. Mean scores and standard deviations of risk perception and influencing factors.

Variables	Factory Group N = 89		Downstream Inhabitants N = 86		Upstream Inhabitants N = 71		Overall N = 246	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Risk perception	4.354	0.365	4.606	0.371	4.039	0.389	4.351	0.436
Gender ¹	1.48	0.503	1.47	0.502	1.577	0.497	1.500	0.501
Age	31.22	8.602	34.21	10.011	32.056	9.339	32.510	9.378
Income	22000	23400	21700	35900	13100	16400	19300	27200
Education ²	3.427	0.638	3.070	0.837	3.211	0.695	3.240	0.742
Sensorial factors	4.581	0.508	4.314	0.840	4.394	0.677	4.434	0.694
Contextual factors	3.966	0.641	3.616	1.070	3.662	1.133	3.756	0.968
Scientific factors	3.772	0.961	3.597	1.261	3.923	0.607	3.754	1.003
Speculative factors	4.266	0.493	3.837	0.987	4.042	0.662	4.052	0.764
Trust in the government	4.247	1.376	4.163	0.824	3.817	1.324	4.090	1.203
Trust in the industries	4.169	1.236	4.326	0.789	3.887	1.076	4.140	1.061
Trust in the local people	3.573	1.658	3.558	1.369	3.451	1.556	3.530	1.527
Possibility of industries generating water pollution	3.966	1.283	4.279	0.929	3.056	1.698	3.810	1.402
Possibility of being impacted by water pollution	3.112	1.172	4.395	0.858	2.958	1.292	3.520	1.283
Impact of water pollution on human health	3.483	1.407	4.407	0.742	3.789	1.158	3.890	1.201
Experiences with water pollution	3.966	0.804	3.884	1.522	4.085	1.432	3.972	1.276
Perceived benefits from industries	3.910	1.379	3.756	1.564	3.634	1.376	3.780	1.444

¹ Gender is a dummy variable that takes the value of 1 when the subject is male and 2 when female. ² Education is a dummy variable that takes the value of 1 for no education, 2 for primary school, 3 for secondary school and 4 for tertiary level.

The findings suggest that the adverse impacts of water pollution in the area are felt by the respondents downstream. This is based on the highest mean levels for the following variables: the possibility of industries generating water pollution ($M = 4.279$, $SD = 0.929$), the possibility of being impacted by water pollution among the three groups ($M = 4.395$, $SD = 0.858$) and the impacts of water pollution on human health ($M = 4.407$, $SD = 0.742$). Although the mean levels for the variables of experiences with water pollution and the impacts of water pollution on human health had slightly lower mean scores compared to the two other groups ($M = 3.884$, $SD = 1.522$), the high standard deviation suggests that the result was not a generalised feeling. Based on the trust scores for industries ($M = 4.326$, $SD = 0.789$), these findings also imply that the respondents in this group placed the responsibility for managing the water problems on industry, with whom they assumed the responsibility lay. Given that industries had been identified as major polluters in their area, the people may well have expected them to manage the situation.

From the analysis of the upstream inhabitants, we can see that the effects of water pollution in the area cut across all sections of the river, not only the industrial zones. The variable experiences of water pollution had the highest score among the groups ($M = 4.085$, $SD = 1.432$), thus supporting the main observations stated above. This is because the respondents in this group are located mostly upstream, where a combination of other factors not necessarily industry-related could be responsible for water pollution, for example agricultural sources and domestic sources of water pollution. This finding is a potential indication that urgent action is needed to remedy the water pollution problem in the river. Furthermore, this finding suggests an opportunity to find a common ground of understanding among the three groups and provides a starting point for collaboration, while understanding the background of the main stakeholders, which is critical in promoting public participation. Notably, scientific factors ranked the highest among the respondents in this group ($M = 3.923$, $SD = 0.607$), thus asserting the importance of having better scientific knowledge and understanding of these factors. The overall analysis demonstrated that sensorial factors had the highest mean scores ($M = 4.434$, $SD = 0.694$) in all the groups, thus emphasising the importance of these factors in the formation of public perception of water quality. These findings agree with those reported by Sharma et al. [5], who also found that, in the independent variables in their analysis, these factors emerged as the most important factors in the formation of public perception of water quality in the areas surveyed. Moreover, de França Doria [44] found that sensorial information has an important role in quality perception and risk perception when assessing water quality. In the current study, the overall results for speculative factors, trust in the government and trust in industry were high, as indicated in Table 3.

4.3. Risk Perceptions amongst the Groups

As presented in Tables 4 and 5 the three groups exhibited high risk perceptions. The results of the Pearson's correlation analysis (Table 5) also revealed that most of the perception variables were positively correlated with one another. The Bartlett's test of sphericity and the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy analysis revealed high correlations amongst the variables ($KMO = 0.635$, Bartlett's test of sphericity = 310.819, $df = 28$ and $p = 0.000$). The sampling is deemed sufficient or adequate if the KMO value is larger than 0.5 [95] or if the value is 0.6 and above [96]. Therefore, these variables could be used to analyse risk and indicate a degree of risk perception.

Table 4. Results of Tukey's post-hoc analysis showing differences in risk perception amongst the groups.

Group	N	Mean	SD	Mean Difference (Comparison within the Groups)		
				Factory	Downstream Inhabitants	Upstream Inhabitants
Factory group	89	4.3539	0.36504	-	0.25217 *	−0.31520 *
Downstream inhabitants	86	4.6061	0.37107	−0.25217 *	-	−0.56737 *
Upstream inhabitants	71	4.0387	0.38936	0.31520 *	0.56737 *	-

Notes: Tukey HSD (Honestly significant difference) $F = 44.688$, $p = 0.000$. * The mean difference is significant at the 0.05 level.

Table 5. Correlation coefficients of risk perception variables.

	Variable	1	2	3	4	5	6	7	8
1	What is the perceived level of risk to your life, based on the water quality in the area?	1							
2	Have industrial activity in the area impacted your career in anyway?	0.017	1						
3	As a result of industrial development do you feel worried about our health?	0.015	0.565 **	1					
4	As a result of industrial development do you feel worried about your future life in the area?	0.254 **	0.162 *	0.018	1				
5	Has water quality in the area led to water related diseases amongst the residents?	0.042	0.336 **	0.314**	0.12	1			
6	Has water quality caused several kinds of cancer amongst the residents?	0.02	0.094	−0.043	0.009	0.171 **	1		
7	Have industrial activities in the area led to nuisances such as noise, smell, etc.?	−0.022	0.154 *	0.007	0.084	0.356 **	0.360 **	1	
8	Has the current condition of the community caused nuisances, such as traffic jam, congestion, etc.?	−0.151 *	0.306 **	0.468 **	−0.043	0.306 **	−0.022	0.077	1

Note: * $p < 0.05$. ** $p < 0.01$.

The mean scores of risk perception exhibited by the three groups were compared (Table 4), and the differences were statistically proven. Based on the one-way ANOVA between groups, there was a statistically significant difference amongst the three groups ($F(2, 2243) = 46.482, p = 0.000$). Tukey's post-hoc test also revealed a statistically significant difference amongst the groups, concluding that the three groups assessed risk perception differently based on their locations and other factors. Respondents located downstream had a significantly higher risk perception compared to respondents located upstream and the factory group, as shown in Table 4. These results suggest that risks perceived by the respondents are related to the degrees of water pollution in the area, as indicated by the experts [90,93,94].

4.4. Multiple Regression Analysis and Correlation Analysis

The Pearson correlation method was used to measure the correlations between the dependent variable risk perception and the independent variables presented in Table 6. The partial correlation analysis between risk perception and the independent variables, (gender; age; education; contextual, scientific and speculative factors; trust factors; the nature of environmental risks; and psychological and cognitive factors as controlled by sensorial factors) was conducted to determine the strength and direction of the linear relationship between risk perception and all other independent variables without the effect of sensorial factors. This is because, amongst all the variables, sensorial factors are the only variables that predicted risk in all the groups; thus, there is a need to determine the influence of other factors on risk perception after eliminating the sensorial factors. All these hypothesised predictors of risk perception were also analysed based on linear regression. The ENTER method of variable selection was adopted during the regression setup, and the multi-collinearity was examined based on the extracted variance inflation factors (VIFs) (Table 7). All the VIFs obtained were less than 5 (i.e., the acceptable threshold was 10 [97]); thus, we concluded that the selected variables exhibited acceptable multi-collinearity.

Meanwhile, the results of the multiple regression analysis showed that the three groups used different predictor variables to determine risks in the area. In the factory group, the results showed that sensorial factors, trust in the government's capacity to manage water pollution and the severity of the impact of water pollution explained 56.1% of the variance in risk perception ($F(16, 72) = 5.745, p < 0.000, \text{adj } R^2 = 0.463$). For downstream respondents, sensorial factors, the possibility of industries generating water pollution and previous experiences with water pollution were significant predictors that explained 65.9% of the variance in risk perception ($F(16, 69) = 8.346, p < 0.000, \text{adj } R^2 = 0.580$). For respondents located upstream, 37.05% of the variance in risk perception ($F(16, 54) = 1.980, p < 0.032, \text{adj } R^2 = 0.183$) was accounted for by risk perception predictors, including age, sensorial factors, trust in the government and the possibility of being impacted by water pollution. Of the

predictor variables used, the nature of environmental risk factors and perception of water quality factors were significant predictors in all three groups. Meanwhile, psychological and cognitive factors were significant predictors of respondents located downstream.

Table 6. Bivariate and partial correlations of the three groups.

	Bivariate Correlation	Partial Correlation	Bivariate Correlation	Partial Correlation	Bivariate Correlation	Partial Correlation
	Factory		Downstream inhabitants		Upstream inhabitants	
Risk perception	1	1.000	1	1.000	1	1.000
Gender	0.017	0.022	0.103	0.078	−0.016	−0.020
Age	0.011	−0.049	0.006	0.021	−0.259 *	−0.254
Income	−0.175	0.077	−0.124	−0.101	−0.149	−0.121
Education	0.167	−0.086	−0.066	−0.176	−0.128	−0.130
Contextual factors	0.149	0.061	0.079	0.026	0.01	0.025
Scientific factors	−0.018	−0.114	−0.113	−0.322	−0.076	−0.124
Speculative factors	0.292 **	0.083	0.031	−0.198	0.16	0.091
Trust in the government	−0.199	−0.355	−0.043	−0.062	−0.156	−0.357
Trust in the industries	−0.134	−0.147	−0.416 **	−0.325	−0.028	−0.011
Trust in the local people	−0.085	−0.245	0.111	0.152	−0.003	−0.007
Possibility of industries generating water pollution	−0.017	−0.250	0.208	0.267	0.167	0.152
Possibility of being impacted by water pollution	−0.097	−0.099	0.213 *	0.291	0.085	0.088
Impact of water pollution on human health	0.366 **	0.314	0.05	0.070	0.046	0.042
Experiences with water pollution	−0.273 **	−0.118	0.048	0.158	0.18	0.178
Perceived benefits from industries	−0.148	−0.226	0.081	−0.016	0.027	0.011
Sensorial factors	0.599 **		0.704 **		0.146	

Note: * $p < 0.05$. ** $p < 0.01$.

Table 7. Results of regression analyses of predictor variables for environmental risk perception.

Independent Variable	Factory Group			Downstream Inhabitants			Upstream Inhabitants		
	Beta	Std. Error	VIF	Beta	Std. Error	VIF	Beta	Std. Error	VIF
Gender	0.028	0.067	1.385	0.058	0.059	1.295	0.021	0.096	1.301
Age	−0.077	0.004	1.318	0.003	0.003	1.318	−0.298 *	0.005	1.185
Income	0.127	0	1.243	−0.057	0	1.319	−0.199	0	1.679
Education	−0.062	0.051	1.287	−0.128	0.036	1.317	−0.058	0.079	1.713
Sensorial factors	0.554 **	0.081	2.104	0.692 **	0.036	1.323	0.566 *	0.136	4.811
Contextual factors	0.166	0.078	3.073	0.082	0.03	1.499	0.256	0.066	3.178
Scientific factors	−0.197	0.064	4.693	−0.109	0.032	2.369	−0.076	0.107	2.407
Speculative factors	0.116	0.101	3.042	−0.094	0.034	1.7	−0.125	0.118	3.433
Trust in the government	−0.224 *	0.024	1.325	−0.003	0.047	2.204	−0.538 **	0.046	2.108
Trust in the industries	−0.108	0.025	1.19	−0.174	0.046	1.955	−0.065	0.044	1.289
Trust in the local people	−0.058	0.037	4.532	−0.073	0.026	1.88	−0.296	0.069	6.443
Possibility of industries generating water pollution	−0.176	0.046	4.243	0.207 *	0.033	1.419	0.169	0.028	1.27
Possibility of being impacted by water pollution	0.206	0.024	1.359	0.048	0.039	1.665	0.256 *	0.037	1.269
Impact of water pollution on human health	0.037 *	0.028	1.37	0.041	0.049	1.935	0.227	0.093	6.616
Experiences with water pollution	−0.045	0.044	1.568	0.174 *	0.02	1.412	0.217	0.038	1.691
Perceived benefits from industries	0.105	0.045	4.669	0.03	0.018	1.171	0.06	0.063	4.313
R ²	0.561			0.659			0.37		
F	5.745			8.346			1.98		

Notes: * $p < 0.05$. ** $p < 0.01$. Std.Error = Standard error

Among the water perception factors, sensorial factors were risk predictors in all three groups. These results are consistent with previous studies, which emphasised the idea that sensorial factors

mostly based on visual characteristics greatly influence people's perceptions when making judgements on water quality [5,98]. In as much as contextual, scientific and speculative factors may have been presumed to have an influence on risk perception [5], these factors did not significantly predict risk perception in any of the three groups in the current study. The Pearson's correlation analysis results (Table 6) of the variables (sensorial factors, contextual and speculative factors) indicated positive correlations with risk perception. On the other hand, scientific factors were negatively correlated with risk perception and also had a negative beta coefficient in the regression analysis (Table 7), implying that increased scientific knowledge led to decreased risk perceptions amongst the respondents in all the groups. Additionally, for scientific factors, when sensorial factors were controlled in the partial correlation analysis, there was a notable difference in the coefficient changes for downstream respondents and upstream respondents (Table 6). For the downstream inhabitants, there was a significant increase in the absolute values for the correlation coefficients of scientific factors. Contrastingly, difference in change for scientific factors and education was smallest for the upstream respondents. The results indicate that differences in change could possibly indicate a difference in the interpretation of scientific factors between the respondents in the two groups, specifically suggesting that upstream respondents understood or interpreted these factors much better compared to downstream respondents. Based on the location and characteristics of respondents located upstream, such as consistent practices of agriculture coupled with the use of chemicals, which require some level of scientific understanding, this observation is not surprising. This difference in understanding of scientific knowledge underscores the importance of effectively educating the public and promoting scientific knowledge when conducting environmental awareness programs and promoting public participation activities.

The nature of the risk factors was also significantly related to how the respondents made risk judgements. Similar to the findings of Janmaimool and Watanabe [10] and Barseghyan et al. [99], the nature of the risk highly influences the public's risk perception; hence, the respondents may use self-appraisal to judge and perceive risks [10,99,100]. Respondents located downstream judged risks based on the perceived possibility of water pollution generated by industries. A possible explanation for this could be the fact that downstream respondents are located in the town centre where many industries that pollute the river are located, thus influencing their judgment and risk perceptions. Furthermore, the correlation analysis for the possibility of being impacted by water pollution is significantly correlated with risk perception, and for the partial correlation analysis the correlation coefficient for this variable increases significantly. This finding indicates that their interaction with water pollution adversely affects their lifestyle, possibly through the contamination of drinking water, loss of aesthetic value of the river and health impacts, thus explaining their overwhelming experiences of water pollution in the area.

Meanwhile, respondents located upstream judged risks on the probability of being impacted by water pollution, whilst the factory group judged risks by considering the impacts of water pollution on human health, whose variable was also significantly correlated with risk perception. Based on the correlation analysis results, these findings indicated that respondents in this group were worried about their health and had higher risk perceptions, as indicated by the negative correlation coefficients of the possibility of being impacted by water pollution and the possibility of industries generating water pollution.

The risk perceptions exhibited by downstream respondents were not only determined by factors related to the nature of environmental risk but were significantly influenced by the psychological and cognitive factor of having experience of water pollution. A plausible explanation for the selection of this variable would be that, because the river flows in this area, the collected waste upstream from agricultural activities (amongst other activities) and the water pollution generated by the industries result in extreme pollution. Hence, downstream inhabitants had more experiences of possible adverse effects compared to upstream inhabitants.

Meanwhile, the perceived benefits from industries were not significant predictors of risk perception in any of the groups. These findings are in contrast to those of previous studies, which found a significant relationship between perceived benefits and risk perception, revealing that perceived benefits may result in greater acceptance of risk [72,83,101,102]. A possible explanation for these discrepancies would be that respondents in these regions do not simply accept risks based on any possible benefits they obtain from the industries in the region but are rather rational in their risk judgement formation.

The regression analysis for trust factors revealed that trust in management authorities, especially in the government, had a high influence on risk perception for the upstream respondents and the factory group. This variable was negatively associated with risk perception in both groups, thus suggesting that increased trust in the government lowered the risk perception of the respondents. Additionally, this variable was negatively correlated to risk perception (Table 6). These findings are similar to those of Ross et al. [103], who determined that increased trust in the fact that authoritative bodies, such as the government, can deliver better water services was generally associated with lower risk perception. In addition, other studies also identified trust as a characteristic of risk perception in various forms [68]. In fact, trust in authorities could also be attributed to other factors, such as expectation of government action against risks and confidence in the government's capacity to manage risks. Other factors, such as knowledge, could also influence trust factors. According to Siegrist et al. [16], the higher the knowledge of the respondents, the greater the insights they have into the effectiveness of the actions performed by the authorities to protect them against risks. With the factory group containing the majority of educated people in the sample, i.e., the highest number of respondents with tertiary education and no respondents with no education (Table 1), this would explain why risk perceptions of the respondents in this group were influenced by trust in the government variable. Additionally, higher levels of scientific knowledge and better understanding of these factors amongst the upstream inhabitants explains their selection of this variable.

For respondents located downstream, trust factors were not significant risk predictors. A plausible interpretation of this result could be that adverse experiences of water pollution without any changes over time have led to a sense of hopelessness, resulting in misplaced trust or no trust at all in the idea that they can be protected against the perceived risks. The results indicating that the people basically trust the government to manage and regulate risks in the area, especially the respondents located upstream and in the factory group, can provide an opportunity for the government to advocate for better water practices in the region, especially amongst the locals and those working in the industries, in order to alleviate the current crisis. There is no doubt that higher trust in regulators results in the ready acceptance of policies, changes or technologies [73,104–106] when proposed or initiated by such regulators.

Meanwhile, age was only a significant risk predictor in one group (i.e., upstream) in which it exerted a significant negative effect on the respondents' risk perception: the older respondents had lower risk perceptions compared to the younger respondents. This finding is significantly consistent with those presented in previous research [107,108], which indicate that an individual's age influences his/her risk perception. In the correlation analysis in the current study, age was also significantly correlated with risk perception amongst the upstream respondents.

5. Implications for Promoting Public Participation

In prior studies on risk and risk perception, risk perception was identified as a complex process that is influenced by a myriad of factors, as has been highlighted in this research. For risks to be effectively managed, proper risk communication that involves widespread consultation is vital; however, it can only be effective if the contributions of the affected public, other stakeholders and experts are considered and better communication strategies are developed to communicate the risks [87]. In this way, the different viewpoints of each party can be comprehensively assessed and understood. The results of the study suggest that the perception of the sources of pollution among the groups is

largely based on personal experience and that their preferences vary geographically. This highlights the necessity of undertaking surveys and focused group discussions, in order to acquire useful insights into knowledge, public perceptions and preferences before planning any interventions in the area. As revealed in the discussion section, each of the three groups had different characteristics that uniquely influenced their interpretation and perception of risks. For instance, respondents located downstream have had multiple experiences with water pollution, making them more desperate than others. However, the upstream inhabitants seem to understand the causative pollutants of the river in their region according to different age groups and to have a better understanding of the effects of their actions and their implications on the ongoing water pollution in the river. The factory group also seems to understand and acknowledge water pollution in the area. However, they are more worried about their health and are inclined towards letting the government handle the issue at hand. In accordance with these findings, an understanding of the perceptions of each group could help authorities address the major issues in the area based on the needs of the particular community. Perceived risk among the groups was hardly uniform; the respondents situated downstream and closer to the industries exhibited the highest risk perception among the three groups, while unexpectedly the community located upstream exhibited a relatively higher risk perception, indicating pollution of the river across all sections. This finding underlines the urgency for remediation and river clean-up in the area. The prior assumption that only downstream sections of the river need urgent action was proven false in the study, as the results show that river pollution upstream is an issue of concern to those residents as well. Therefore, during the planning process, the whole river should be considered. The risk view of the factory workers added an interesting corollary to the narrative, as they appeared more concerned with their health and less about the repercussions of their actions on the environment, despite the small sense of responsibility in aiding risk management in the area displayed by the correlation and mean score results discussed earlier. With industrialisation on the rise in Kenya as countries are encouraged to be self-sustaining economically, the magnitude of environmental problems, such as industrial pollution, agricultural runoff, deforestation and flooding has increased. This industrial development has produced numerous severe problems, and exposure to environmental risk has particular significance since, if left unchecked, these problems will result in undesirable, possibly catastrophic, effects. The divergent views on industrial water pollution in this study highlight the key issue of what role public perception and participation should play in shaping risk management efforts. Understanding the patterns of risk perception among stakeholders is important because public perceptions of risks routinely influence the priorities and expenditure of regulatory agencies responsible for environmental oversight [109]. Therefore, for risk management to succeed, public participation and the collaboration of all stakeholders is necessary [9,110]. Furthermore, the understanding of and emphasis on the distinct characteristics of each group can be useful in designing solutions for the community. Another opportunity for the government and environmental agencies lies in encouraging behaviour change in the residents in the area. This is possible based on the fact that the results indicate that the populations surveyed have some knowledge and idea of the poor conditions in the River Sosiani and they have a clear understanding of the causes and effects of water pollution. Thus, based on this understanding, the residents in the area would be likely to be amenable to behavioural change that would benefit them.

Another critical issue lies in the differences in the interpretations and perceptions of risks among the three groups. Some studies agree that knowledge and familiarity [22] help to explain the differences in risk perception among groups, especially those between experts and lay people. The results of this study revealed that public perceptions regarding water quality are primarily based on sensorial parameters, which underscores the primacy of aesthetic factors in risk perception. On the other hand, the inability of the respondents to perceive water quality based on scientific factors could lead to the misestimating of the risks [5,53]. As highlighted by the correlation analysis, there was a difference in scientific knowledge among the groups, such that the respondents upstream seemed to be more scientifically aware of water quality parameters than the other two groups. Therefore, outreach and

communication personnel attempting to communicate risks in the area should consider fostering a holistic understanding of the issues affecting water quality, with additional emphasis placed on the promotion of scientific knowledge through the use of compelling communication means and more comprehensible language. The study further suggests the sharing of existing scientific information about the water quality problem in the region with the residents to ensure that the community has a firm understanding of the scientific evidence related to the issues at hand. This would encourage the public to participate in activities aimed at addressing the issues affecting them. In conclusion, assessment and planning, experts' opinions, inclusive communication practices and public participation are all vital components of a successful risk management programme.

Another key consideration would be to engage influential actors, such as religious groups, local elected officials and community leaders, in promoting positive behavioural change among the community members. This would help in the community members being more able to relate to and accept proposed interventions, as opposed to relying only on the authoritative bodies to enforce behaviour change. Furthermore, for effective risk communication, community level engagement cannot be ignored [53].

It is also important to note that, particularly in risk perception studies, some reported results might be sensitive to the hazards and variables selected for each specific study. As neither the whole region was covered in the study nor all the factories and factory workers employed therein, caution should be made when extending the results to other specific groups or regions, who are unlikely to have the same types of knowledge, cultural characteristics, or backgrounds as the sample in this study.

6. Conclusions

This study examined the factors that influence risk perceptions of water quality and whether there were distinct risk perceptions amongst different groups of people. Unlike previous studies, this study considers the possibility that working in certain industries has an impact on risk perception in general.

A set of predictor variables was used to assess the difference in risk perceptions and determine what each group of respondents used when determining such perceptions. As highlighted by previous studies, different groups of people determine risks in varying ways based on a number of factors. In this study, on the one hand the concept of 'experts' was redefined as workers in industry with some level of expertise because of their environment. The term 'lay people,' on the other hand, was redefined to mean all other residents not working for industry but residing within the region.

The results of this study revealed significant differences in risk perceptions among the three groups, with the residents located in the downstream area, characterised by many industries, registering higher risk perceptions compared to the other two groups. Similarly, in determining the risk perceptions in all the groups, the study found that each group used different predictors to assess risks in their water quality perceptions and in the nature of the environmental risk factors. Moreover, trust factors were significant predictors in the upstream and the factory group, while psychological and cognitive factors were significant predictors among the downstream inhabitants.

These findings imply the need to include the public in the decision-making process on issues affecting them. The common practice is to engage institutions and experts based on the industry's ease of access to these people; hence, fact-based decision-making has been the trend in relation to current projects in the country. To create long-term successful results, however, public participation and effective risk communication should be vigorously pursued in the area in order to ensure that multiple risk perspectives are taken into consideration in the implementation and management of water resources in the area. Furthermore, such collaborative efforts can lead to a deeper understanding of the perceptions of the community, which is critical to the process of risk management and decision-making, because members of the communities are the end receivers of the decisions made and the actions taken. In the long run, environmental reclamation activities should strive to promote good environmental practices that are both sustainable and inclusive.

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References

1. Achieng, A.O.; Raburu, P.O.; Kipkorir, E.C.; Ngodhe, S.O.; Obiero, K.O.; Ani-Sabwa, J. Assessment of water quality using multivariate techniques in river sosiani, Kenya. *Env. Monit Assess* **2017**, *189*, 280. [[CrossRef](#)] [[PubMed](#)]
2. WWAP (World Water Assessment Programme) UN-Water. *The United Nations World Water Development Report 2018: Nature-Based Solutions for Water*; UNESCO Publishing: Paris, France, 2018.
3. Afanga, H.; Zazou, H.; Titchou, F.E.; Rakhila, Y.; Akbour, R.A.; Elmchaouri, A.; Ghanbaja, J.; Hamdani, M. Integrated electrochemical processes for textile industry wastewater treatment: System performances and sludge settling characteristics. *Sustain. Environ. Res.* **2020**, *30*, 2. [[CrossRef](#)]
4. Imandoust, S.B.; Gadam, S.N. Are people willing to pay for river water quality, contingent valuation. *Int. J. Environ. Sci. Technol.* **2007**, *4*, 401–408. [[CrossRef](#)]
5. Sharma, P.; Kansal, A.; Tarannum, F. Understanding public perception, knowledge and behaviour for water quality management of the river yamuna in India. *Water Policy* **2018**, *20*, 266–281. [[CrossRef](#)]
6. Ochoo, B.; Valcour, J.; Sarkar, A. Association between perceptions of public drinking water quality and actual drinking water quality: A community-based exploratory study in newfoundland (Canada). *Environ. Res.* **2017**, *159*, 435–443. [[CrossRef](#)]
7. Fischhoff, B.; Bostrom, A.; Quadrel, M.J. Risk perception and communication. *Annu. Rev. Public Health* **1993**, *14*, 183–203. [[CrossRef](#)]
8. Slovic, P. Perception of risk. *Sci. Total Environ.* **1987**, *236*, 280–285. [[CrossRef](#)]
9. Frewer, L. Risk perception, social trust, and public participation in strategic decision making: Implications for emerging technologies. *Ambio* **1999**, *28*, 569–574.
10. Janmaimool, P.; Watanabe, T. Evaluating determinants of environmental risk perception for risk management in contaminated sites. *Int. J. Environ. Res. Public Health* **2014**, *11*, 6291–6313. [[CrossRef](#)]
11. Withanachchi, S.; Kunchulia, I.; Ghambashidze, G.; Al Sidawi, R.; Urushadze, T.; Ploeger, A. Farmers' perception of water quality and risks in the mashavera river basin, georgia: Analyzing the vulnerability of the social-ecological system through community perceptions. *Sustainability* **2018**, *10*, 3062. [[CrossRef](#)]
12. Hu, Z.; Morton, L.W. US midwestern residents perceptions of water quality. *Water* **2011**, *3*, 217–234. [[CrossRef](#)]
13. Larson, S.; Stoeckl, N.; Neil, B.; Welters, R. Using resident perceptions of values associated with the Australian tropical rivers to identify policy and management priorities. *Ecol. Econ.* **2013**, *94*, 9–18. [[CrossRef](#)]
14. Fischhoff, B.; Slovic, P.; Lichtenstein, S. Lay foibles and expert fables in judgments about risk. *Am. Stat.* **1982**, *36*, 240–255.
15. Flynn, J.; Burns, W.; Mertz, C.; Slovic, P. Trust as a determinant of opposition to a high-level radioactive waste repository: Analysis of a structural model. *Risk Anal.* **1992**, *12*, 417–429. [[CrossRef](#)]
16. Savadori, L.; Savio, S.; Nicotra, E.; Rumiat, R.; Finucane, M.; Slovic, P. Expert and public perception of risk from biotechnology. *Risk Anal. Int. J.* **2004**, *24*, 1289–1299. [[CrossRef](#)] [[PubMed](#)]
17. Slovic, P.; Fischhoff, B.; Lichtenstein, S. *Facts and Fears: Understanding Perceived Risk. Societal Risk Assessment*; Springer: Berlin/Heidelberg, Germany, 1980; pp. 181–216.
18. Slovic, P.; Malmfors, T.; Krewski, D.; Mertz, C.; Neil, N.; Bartlett, S. Intuitive toxicology. II. Expert and lay judgments of chemical risks in Canada. *Risk Anal.* **1995**, *15*, 661–675. [[CrossRef](#)]
19. Morgan, M.G. Choosing and managing technology-induced risk. In *Readings in Risk*; Glickman, T.S., Gough, M., Eds.; Resources for the Future: Washington, DC, USA, 1990; Volume 17–28, pp. 17–28. [[CrossRef](#)]

20. Slovic, P.E. *The Perception of Risk*; Earthscan Publications: London, UK, 2000.
21. Kanda, R.; Tsuji, S.; Yonehar, H. Perceived risk of nuclear power and other risks during the last 25 years in Japan. *Health Phys. Soc.* **2012**, *102*, 384–390. [[CrossRef](#)]
22. Siegrist, M.; Keller, C.; Kastenholz, H.; Frey, S.; Wiek, A. Laypeople's and experts' perception of nanotechnology hazards. *Risk Anal.* **2007**, *27*, 59–69. [[CrossRef](#)]
23. Perko, T. Radiation risk perception: A discrepancy between the experts and the general population. *J. Env. Radioact.* **2014**, *133*, 86–91. [[CrossRef](#)]
24. Leiter, M.P.; Zanaletti, W.; Argentero, P. Occupational risk perception, safety training, and injury prevention: Testing a model in the Italian printing industry. *J. Occup. Health Psychol.* **2009**, *14*, 1. [[CrossRef](#)]
25. Kakaei, H.; Mirzaei Alavijeh, M.; Mahboubi, M.; Maghsodi Moghadam, R.; Zinat Motlagh, F.; Farasaty, F. Factors related to personal protective equipment use between factory cement employ in Ilam, the west of Iran: Application of BASNEF model. *Sci. Todays World* **2014**, *3*, 56–59.
26. Ellaban, M.; Rady, M.; Hebat Allah, G.; Mostafa, N. Risk perception and occupational accidents among a group of egyptian construction workers in a construction company in cairo. *Med. Integr. Stud. Res. J.* **2018**, *1*, 9–18. [[CrossRef](#)]
27. West, P.; Locke, R. Occupational risks from infectious diseases in the water industry. *Water Environ. J.* **1990**, *4*, 520–523. [[CrossRef](#)]
28. Sjöberg, L.; Drott-Sjöberg, B.M. Knowledge and risk perception among nuclear power plant employees. *Risk Anal.* **1991**, *11*, 607–618. [[CrossRef](#)] [[PubMed](#)]
29. Dobbie, M.F.; Brown, R.R. A framework for understanding risk perception, explored from the perspective of the water practitioner. *Risk Anal.* **2014**, *34*, 294–308. [[CrossRef](#)]
30. Amadi, E.K. Nutrient loads and heavy metals assessment along sosiani river, Kenya. *Chem. Mater. Res.* **2013**, *3*, 14–20.
31. Ontumbi, G.; Nyabero, C.; Sang, C.C. An assessment of water quality variation on human health in the river sosiani catchment, Kenya. *Int. J. Innov. Res. Educ. Sci.* **2015**, *2*, 63–68.
32. Chibole, O. Lead Levels in the Sosiani. In *Proceedings of the International Conference on Advances in Engineering and Technology*; Elsevier Science Ltd: Amsterdam, The Netherlands, 2006; pp. 722–729. [[CrossRef](#)]
33. Ogindo, B.A. Heavy metal pollutants and their concentrations in fish (barbus species) in sosiani river, Kenya. *Discov. Innov.* **2001**, *13*, 178–183. [[CrossRef](#)]
34. Ontumbi, G.; Obando, J.; Ondieki, C. The influence of agricultural activities on the water quality of the river sosiani in uasin gishu county, Kenya. *Int. J. Res. Agric. Sci.* **2015**, *2*, 2348–3997.
35. Kipyego, S.; Ouma, Y. Analysis of nonpoint source pollution loading on water quality in an urban-rural river catchment using GIS-PLOAD model: Case study of sosiani river watershed. *J. Civ. Environ. Res.* **2018**, *10*, 70–84.
36. Semião, M.A.; Haminiuk, C.W.I.; Maciel, G.M. Residual diatomaceous earth as a potential and cost effective biosorbent of the azo textile dye reactive blue 160. *J. Environ. Chem. Eng.* **2020**, *8*, 103617. [[CrossRef](#)]
37. Vijayaraghavan, G.; Sivakumar, T.; Kumar, A.V. Application of plant based coagulants for waste water treatment. *Int. J. Adv. Eng. Res. Stud.* **2011**, *1*, 88–92.
38. Al-Ghouti, M.; Khraisheh, M.; Allen, S.; Ahmad, M. The removal of dyes from textile wastewater: A study of the physical characteristics and adsorption mechanisms of diatomaceous earth. *J. Environ. Manag.* **2003**, *69*, 229–238. [[CrossRef](#)]
39. Zhi-qiang, C.; Chang-yong, W.; Fang, L.; Su-hua, W. Study on the technology of treating municipal sewage with diatomaceous earth. *Water Wastewater Eng.* **2006**, *32*, 66–68.
40. Clay, D.; Ren, C.; Reese, C.; Waskom, R.; Bauder, J.; Mesner, N.; Paige, G.; Reddy, K.; Neibauer, M.; Mahler, R. Linking public attitudes with perceptions of factors impacting water quality and attending learning activities. *J. Nat. Resour. Life Sci. Educ.* **2007**, *36*, 36–44. [[CrossRef](#)]
41. Dobbie, M.; Green, R. Public perceptions of freshwater wetlands in Victoria, Australia. *Landsc. Urban Plan.* **2013**, *110*, 143–154. [[CrossRef](#)]
42. Tran, K. Public perception of development issues: Public awareness can contribute to sustainable development of a small island. *Ocean Coast. Manag.* **2006**, *49*, 367–383. [[CrossRef](#)]
43. Canter, L.W.; Nelson, D.I.; Everett, J.W. Public perception of water quality risks-influencing factors and enhancement opportunities. *J. Environ. Syst.* **1992**, *22*, 163–187. [[CrossRef](#)]

44. De França Doria, M. Factors influencing public perception of drinking water quality. *Water Policy* **2010**, *12*, 1–19. [CrossRef]
45. Levallois, P.; Grondin, J.; Gingras, S. Evaluation of consumer attitudes on taste and tap water alternatives in Quebec. *Water Sci. Technol.* **1999**, *40*, 135–139. [CrossRef]
46. Le Lay, Y.-F.; Piégay, H.; Rivière-Honegger, A. Perception of braided river landscapes: Implications for public participation and sustainable management. *J. Environ. Manag.* **2013**, *119*, 1–12. [CrossRef]
47. Lepesteur, M.; Wegner, A.; Moore, S.A.; McComb, A. Importance of public information and perception for managing recreational activities in the peel-harvey estuary, western Australia. *J. Environ. Manag.* **2008**, *87*, 389–395. [CrossRef]
48. Tunstall, S. Public perceptions of the environmental changes to the thames estuary in London, UK. *J. Coast. Res.* **2000**, *16*, 269–277.
49. Buijs, A.E. Public support for river restoration. A mixed-method study into local residents' support for and framing of river management and ecological restoration in the Dutch floodplains. *J. Environ. Manag.* **2009**, *90*, 2680–2689. [CrossRef] [PubMed]
50. Renn, O. The role of risk perception for risk management. *Reliab. Eng. Syst. Saf.* **1998**, *59*, 49–62. [CrossRef]
51. Whyte, A.V.; Burton, I. Environmental risk assessment. 1980. Available online: <https://scholar.google.com> (accessed on 7 August 2020).
52. Efron, R. What is perception? In *Proceedings of the Boston Colloquium for the Philosophy of Science 1966/1968*; Cohen, R.S., Wartofsky, M.W., Eds.; Springer: Dordrecht, The Netherlands, 2012; Volume 4, pp. 137–173, December 6.
53. Larson, K.L.; White, D.D.; Gober, P.; Harlan, S.; Wutich, A. Divergent perspectives on water resource sustainability in a public-policy-science context. *Environ. Sci. Policy* **2009**, *12*, 1012–1023. [CrossRef]
54. Williamson, J.; Weyman, A. Review of the public perception of risk, and stakeholder engagement HSL/2005/16. In *Health Saf. Lab.*; 2005. Available online: https://www.hse.gov.uk/Research/hsl_pdf/2005/hsl0516.pdf (accessed on 7 August 2020).
55. Hilgartner, S. The dominant view of popularization: Conceptual problems, political uses. *Soc. Stud. Sci.* **1990**, *20*, 519–539. [CrossRef]
56. Irwin, A.; Wynne, B. *Misunderstanding Science? The Public Reconstruction of Science and Technology*; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2003.
57. Hansen, J.; Holm, L.; Frewer, L.; Robinson, P.; Sandøe, P. Beyond the knowledge deficit: Recent research into lay and expert attitudes to food risks. *Appetite* **2003**, *41*, 111–121. [CrossRef]
58. Kane, I.O.; Vanderlinden, J.-P.; Baztan, J.; Touili, N.; Claus, S. Communicating risk through a DSS: A coastal risk centred empirical analysis. *Coast. Eng.* **2014**, *87*, 240–248. [CrossRef]
59. Touili, N.; Baztan, J.; Vanderlinden, J.-P.; Kane, I.O.; Diaz-Simal, P.; Pietrantoni, L. Public perception of engineering-based coastal flooding and erosion risk mitigation options: Lessons from three European coastal settings. *Coast. Eng.* **2014**, *87*, 205–209. [CrossRef]
60. Pidgeon, N. Risk assessment, risk values and the social science programme: Why we do need risk perception research. *Reliab. Eng. Syst. Saf.* **1998**, *59*, 5–15. [CrossRef]
61. Fessenden-Raden, J.; Fitchen, J.M.; Heath, J. Providing risk information in communities: Factors influencing what is heard and accepted. *Sci. Technol. Hum. Values* **1987**, *12*, 94–101.
62. Sjöberg, L. Factors in risk perception. *Risk Anal.* **2000**, *20*, 1–12. [CrossRef] [PubMed]
63. Gachango, F.G.; Andersen, L.M.; Pedersen, S.M. Danish farmers' perception of water quality, nutrient reduction measures and their implementation strategy. In *Proceedings of the International Conference on Sustainable Water Resources Management*, Coruña, Spain, 15–17 June 2015; WIT Press: Southampton, UK, 2015; pp. 435–446.
64. Hodge, I.; Reader, M. The introduction of entry level stewardship in England: Extension or dilution in agri-environment policy? *Land Use Policy* **2010**, *27*, 270–282. [CrossRef]
65. Giovanopoulou, E.; Nastis, S.A.; Papanagiotou, E. Modeling farmer participation in agri-environmental nitrate pollution reducing schemes. *Ecol. Econ.* **2011**, *70*, 2175–2180. [CrossRef]
66. Carlton, S.J.; Jacobson, S.K. Climate change and coastal environmental risk perceptions in Florida. *J. Env. Manag.* **2013**, *130*, 32–39. [CrossRef]
67. Karki, S.; Niraula, S.R.; Yadav, D.K.; Chakravartty, A.; Karki, S. Risk perception towards healthcare waste among community people in Kathmandu, Nepal. *PLoS ONE* **2020**, *15*, e0230960. [CrossRef]

68. Wang, L.; Watanabe, T. Factors affecting farmers' risk perceptions regarding biomass supply: A case study of the national bioenergy industry in northeast China. *J. Clean. Prod.* **2016**, *139*, 517–526. [CrossRef]
69. Jingchao, Z.; Kotani, K.; Saijo, T. Public acceptance of environmentally friendly heating in Beijing: A case of a low temperature air source heat pump. *Energy Policy* **2018**, *117*, 75–85. [CrossRef]
70. Poortinga, W.; Pidgeon, N.F. Exploring the dimensionality of trust in risk regulation. *Risk Anal. Int. J.* **2003**, *23*, 961–972. [CrossRef]
71. Löfstedt, R.; Cvetkovich, G. *Social Trust and the Management of Risk*; Routledge: Abingdon, UK, 1999.
72. Siegrist, M.; Cvetkovich, G. Perception of hazards: The role of social trust and knowledge. *Risk Anal.* **2000**, *20*, 713–720. [CrossRef] [PubMed]
73. Viklund, M. Trust and risk perception in western Europe: A cross-national study. *Risk Anal.* **2003**, *23*, 727–738. [CrossRef] [PubMed]
74. de Franca Doria, M.; Pidgeon, N.; Hunter, P. Perception of tap water risks and quality: A structural equation model approach. *Water Sci. Technol. A J. Int. Assoc. Water Pollut. Res.* **2005**, *52*, 143–149. [CrossRef]
75. Larkin, C.; Lucey, B.M.; Mulholland, M. Risk tolerance and demographic characteristics: Preliminary Irish evidence. *J. Financ. Serv. Rev.* **2013**, *22*, 77–91.
76. Sung, J.; Hanna, S.D. Factors related to risk tolerance. *Financ. Couns. Plan.* **1996**, *7*, 11–20. [CrossRef]
77. Liu, A.H.; Bui, M.; Leach, M. Considering technological impacts when selecting food suppliers: Comparing retailers' buying behavior in the United States and Europe. *J. Bus. Bus. Mark.* **2013**, *20*, 81–98. [CrossRef]
78. Yang, X.; Wang, F.; Bento, C.P.; Meng, L.; van Dam, R.; Mol, H.; Liu, G.; Ritsema, C.J.; Geissen, V. Decay characteristics and erosion-related transport of glyphosate in Chinese loess soil under field conditions. *Sci. Total Environ.* **2015**, *530*, 87–95. [CrossRef]
79. Siegrist, M. The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk Anal.* **2000**, *20*, 195–204. [CrossRef]
80. Georgiou, S.; Langford, I.H.; Bateman, I.J.; Turner, R.K. Determinants of individuals' willingness to pay for perceived reductions in environmental health risks: A case study of bathing water quality. *Environ. Plan. A* **1998**, *30*, 577–594. [CrossRef]
81. Keraita, B.; Drechsel, P.; Konradsen, F. Perceptions of farmers on health risks and risk reduction measures in wastewater-irrigated urban vegetable farming in Ghana. *J. Risk Res.* **2008**, *11*, 1047–1061. [CrossRef]
82. Toze, S. Reuse of effluent water—Benefits and risks. *Agric. Water Manag.* **2006**, *80*, 147–159. [CrossRef]
83. Sparks, P.; Shepherd, R.; Frewer, L. Gene technology, food production, and public opinion: A UK study. *Agric. Hum. Values* **1994**, *11*, 19–28. [CrossRef]
84. Park, E.; Ohm, J.Y. Factors influencing the public intention to use renewable energy technologies in south Korea: Effects of the Fukushima nuclear accident. *Energy Policy* **2014**, *65*, 198–211. [CrossRef]
85. Chen, M.-F.; Lin, Y.-P.; Cheng, T.-J. Public attitudes toward nanotechnology applications in Taiwan. *Technovation* **2013**, *33*, 88–96. [CrossRef]
86. Khan, M.; Mahmood, H.Z.; Damalas, C.A. Pesticide use and risk perceptions among farmers in the cotton belt of Punjab, Pakistan. *Crop Prot.* **2015**, *67*, 184–190. [CrossRef]
87. Reid, S.G. Perception and communication of risk, and the importance of dependability. *Structural Saf.* **1999**, *21*, 373–384. [CrossRef]
88. De França Doria, M.; Pidgeon, N.; Hunter, P.R. Perceptions of drinking water quality and risk and its effect on behaviour: A cross-national study. *Sci. Total Environ.* **2009**, *407*, 5455–5464. [CrossRef]
89. Kenya National Bureau of Statistics. *2019 Kenya Population and Housing Census*. November 2019. Available online: <http://housingfinanceafrica.org/documents/2019-kenya-population-andhousing-census-reports> (accessed on 7 August 2020).
90. Ontumbi, G.M. The Influence of Landuse Activities on Water Quality. Master's Thesis, Kenyatta University, Kiambu county, Kenya, July 2015.
91. Chibole, O.K. Modeling river sosiani's water quality to assess human impact on water resources at the catchment scale. *Ecophysiol. Hydrobiol.* **2013**, *13*, 241–245. [CrossRef]
92. Masakha, E.J. Longitudinal and seasonal variations in physicochemical and microbiological properties of water quality of sosiani river, Uasin Gishu County, Kenya. Ph.D. Thesis, Egerton University, Nakuru county, Kenya, 2019.
93. Sharon, C.W. Impact of Urban waste on seasonal water quality of Sosiani River, Eldoret municipality, Uasin-Gishu County. Bachelor's Thesis, Kenyatta University, Kiambu county, Kenya, 2014.

94. Correspondent, N. Pollution threatens river sosiani, experts warn. *Daily Nation*. 2014. Available online: <https://www.nation.co.ke/counties/eldoret/Pollution-River-Sosiani/1954186-2330416-10b9t81z/index.html> (accessed on 7 August 2020).
95. Andy, F. *Discovering Statistics Using Spss for Windows: Advanced Techniques for the Beginner*; Sage: Newcastle upon Tyne, UK, 2000.
96. Pallant, J. *SPSS Survival Manual*; McGraw-Hill Education: Berkshire, England, 2013.
97. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E.; Tatham, R.L. *Multivariate Data Analysis*; Prentice Hall: Upper Saddle River, NJ, USA, 1998; Volume 5.
98. Anadu, E.C.; Harding, A.K. Risk perception and bottled water use. *J. AWWA* **2000**, *92*, 82–92. [[CrossRef](#)]
99. Barseghyan, L.; Molinari, F.; O'Donoghue, T.; Teitelbaum, J.C. The nature of risk preferences: Evidence from insurance choices. *Am. Econ. Rev.* **2013**, *103*, 2499–2529. [[CrossRef](#)]
100. Scherer, C.W. Communicating water quality risk. *J. Soil Water Conserv.* **1990**, *45*, 198–200.
101. Gregory, R.; Mendelsohn, R. Perceived risk, dread, and benefits. *Risk Anal.* **1993**, *13*, 259–264. [[CrossRef](#)]
102. McDaniels, T.L.; Axelrod, L.J.; Cavanagh, N.S.; Slovic, P. Perception of ecological risk to water environments. *Risk Anal.* **1997**, *17*, 341–352. [[CrossRef](#)] [[PubMed](#)]
103. Ross, V.L.; Fielding, K.S.; Louis, W.R. Social trust, risk perceptions and public acceptance of recycled water: Testing a social-psychological model. *J. Environ. Manag.* **2014**, *137*, 61–68. [[CrossRef](#)]
104. Bronfman, N.C.; Vázquez, E.L.; Gutiérrez, V.V.; Cifuentes, L.A. Trust, acceptance and knowledge of technological and environmental hazards in Chile. *J. Risk Res.* **2008**, *11*, 755–773. [[CrossRef](#)]
105. Irwin, K. Prosocial behavior across cultures: The effects of institutional versus generalized trust. *J. Adv. Group Process.* **2009**, *26*, 165–198.
106. Ormerod, K.J.; Scott, C.A. Drinking wastewater: Public trust in potable reuse. *J. Sci. Technol. Hum. Values* **2013**, *38*, 351–373. [[CrossRef](#)]
107. Aziz, S.N.; Boyle, K.J.; Rahman, M. Knowledge of arsenic in drinking-water: Risks and avoidance in Matlab, Bangladesh. *J. Health Popul. Nutr.* **2006**, *24*, 327.
108. Dosman, D.M.; Adamowicz, W.L.; Hrudey, S.E. Socioeconomic determinants of health-and food safety-related risk perceptions. *Risk Anal.* **2001**, *21*, 307–318. [[CrossRef](#)]
109. Slovic, P. Public perception of risk. *J. Environ. Health* **1997**, *59*, 22–25.
110. Baggett, S.; Jeffrey, P.; Jefferson, B. Risk perception in participatory planning for water reuse. *Desalination* **2006**, *187*, 149–158. [[CrossRef](#)]



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