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The Influence of National Water Infrastructure on the Happiness Index: Economic and Social Analysis, Case of Morocco.

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Résumé

Le bien-être des populations et la protection des ressources hydriques sont deux piliers principaux d'une gouvernance durable. L'intégration de ces deux préoccupations dans le processus de prise de décision politique est devenu indispensable afin d'atteindre les 17 objectifs du développement durable (ODD). Aujourd'hui, il est quasiment impossible de parler de bonheur sans intégrer la protection des ressources naturelles d'où la nomination du bonheur durable. Le stress hydrique est alors un des plus grands défis auquel il faut faire face pour atteindre cet objectif ultime. Dans cette étude nous proposons une approche orientée données pour démontrer l'impact du stress hydrique sur différentes dimensions du bonheur de la population marocaine. En se reposant sur une régression logistique et le test de Wald, nous avons définis les variables qui impactent le plus le bonheur des Marocains. Ce travail a pour objectif de quantifier et d'élucider l'impact de la raréfaction des ressources en eau sur le niveau du bonheur de la population marocaine. En outre, démontrer l'importance de l'implémentation d'une bonne gouvernance des ressources en eau afin de réaliser les 8 objectifs du développement durable concernés directement ou indirectement par la situation hydraulique du pays, et par conséquent atteindre un bonheur durable national.

Mots clés : Stress hydrique, Bonheur durable, ODD, Durabilité, Régression logistique, Maroc, Bien-être.

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Abstract

The population's well-being and the protection of water resources are two pillar principals of a durable and sustainable governance. The integration of the latter preoccupations in the process of political decision-making has become an undeniable priority in order to achieve the sustainable development goals (SDG's). Nowadays, it is no longer possible to address wellbeing without integrating the protection of natural resources, thus the nomination "Sustainable Well-being". Water scarcity is one of the biggest challenges that must be addressed to achieve this ultimate objective. This study, via a data oriented approach, demonstrates the impact of water scarcity on the well-being levels in Morocco. Based on a logistic regression and Wald test, we identified the water-related variables that affect Moroccan's well-being the most. This research aims to quantify and explain the impact of rarefication of water resources on happiness and well-being levels in Morocco and highlights the importance of implementing an adequate water resources strategy to achieve the eight sustainable development goals linked directly or indirectly to the national hydraulic situation, and therefore reach sustainable levels of wellbeing.

Keywords: Water Scarcity, Sustainable Well-being, SDG's, Logistic regression, Sustainability, Happiness, Morocco.

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Introduction

The overarching goal for every nation is to create a stimulating environment for their citizens to live in total prosperity and reach durable well-being. In this context, the United Nations elaborated a list of 17 objectives titled (SDGs: Sustainable Development Goals). These objectives aim to eradicate famine, protect the planet and its natural resources and ensure a minimum level of well-being for every individual. Sustainable well-being aligns with the SDGs in every aspect. According to the word happiness report (De Neve & Sachs, 2020) the happiness index is calculated via 20 indicators regrouped in four principal aspects:

1-Peace and security: war and peace, violent death, corruption, economic security, human security.

2-Freedom, democracy, human rights: democracy, press freedom, women's rights, child's rights, death sentence.

3-Life quality: GDP (Gross Domestic Product) per capita, GINI coefficient, life expectancy, suicides, pure air, health, environment.

4-Training, information, communication: Training (coefficient 2), journals, radios and TV, internet.

This indicates that, in a society, the process of achieving the SDG's is completely compatible with reaching sustainable happiness. In fact, each objective of the 17 SDG's contributes heavily to the enhancement of one or multiple panels of the regrouped indices cited earlier what impacts directly and positively the evolution of the world Happiness index.

In our generation, durability is one of the biggest challenges. The current civilization has reached a point where natural resources diminish significantly. It refers to a complex multidimensional phenomenon studied for more than a decade (Voytsekhovska et al.,2021). In

this day of age, different social concepts, such as durability, life quality, satisfaction, happiness and well-being are difficult and complex to define. Continually over time, Happiness becomes an increasingly more dominant global factor, since it determines directly a person's level of life satisfaction. In different contexts, it is proportional to the development of a particular country. This highlights the importance of measuring individuals' happiness levels and facing the already existent problems if the results are not positive. Multiple research projects tackled the

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problematic of happiness economics (Lakhdar., 2016) and the quantification of happiness levels in the Moroccan society (Krimis et al., 2022).

In the current access, it is imperative to integrate the protection of natural resources (especially water resources) in the process of quantification of national happiness levels and therefore reaching sustainable happiness and well-being. The phenomenon of water scarcity represents a major challenge in the process of achieving the 17 SDG's. Amongst these goals, many objectives are directly dependent on the national water resources situation. Consequently, if the latter is confirmed critical, it will jeopardize the nation's project of achieving the following 7 objectives of sustainable development (SDG's in action, UNDP) :

1.No poverty: The deceleration of the resident's economic wheel due to water scarcity and its impact on agricultural activities. (De Milly, 2015)

2.Zero Hunger: Low agricultural harvest, low livestock production etc. (Chahed et al., 2007)

3.Good health & Well-being: Anxiety, dehydration, water shortage.

6.Clean water and Sanitation: Nonfiltered and contaminated water consumption forms high health risks especially for vulnerable populations. (Chait, Moutaj. 2023)

8.Decent work and Economic Work: Drought cycles impact directly job opportunities and therefore the national GDP

15.Life on Land: High risk of forest fires, Limitation of natural photosynthesis, green ecosystem disequilibrium.

16.Peace, Justice and Strong Institutions: Water wars can trigger strong tensions between neighboring states.

17.Partnership for the goals.

Furthermore, the nations subject to water scarcity are obligated to adapt to its effects towards achieving all the SDGs and reaching sustainable happiness.

Subsequent to the second phase of industrialization, the world adopted catalyst modes of production to enhance its economy thereby compromising world water resources. Water, rare and nonsubstitutable, is the main victim of consumption society and its focus on economic gain.

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Unfortunately, the production ways held no interest in protecting water resources nor for the good or for the upcoming generation's good.

In the last decade, the global scientific community has rung every emergency bell in every international summit. Hence the emancipation of new responsible production mode who takes into consideration every aspect of the actual environmental situation. In this context, the introduction of the Integrated Water Resource Management (IWRM) within all economic sectors (Agriculture, Industry, Energy …) assert itself as the only solution to win the race against water scarcity.

The integrated water resource management (IWRMA) is the internalization of the externalities of a massive usage of water resources by adopting sustainable development principles to water sector. The IWRMA aims to incorporate all the stakeholders and build a consensus to strengthen the protection of water resources. In order to reach this consensus, it is obligatory to employ a participatory governance (Banouar, Bouslihim., 2023). Participatory governance is a pillar principal of effective governance, considering that it focuses on sharing, resource allocation and consolidating interactions within the process of decision-making. In addition, this governance emphasizes the contribution of every stakeholder (Government agencies, service users) in the different procedures of planification, creation and development of IWRM strategies and schemes.

On a national level, ranked 23th in the world in terms of water shortages, Morocco is one of the most impacted countries by water scarcity. In total, the national water resources count 22 billion m^3 thus only 700 m^3 per capita per year, which is inferior to the 1000m^3 per capita per year threshold and indicates a high scarcity (Ministry of Equipment and Water). This situation is explained by the existence of multiple factors such as water resources temporal and spatial disparities (Natural inequal distribution of precipitations north/west), an alternance of humid and arid sequences and a temporal intercalation of high hydraulicity and extreme drought.

National water resources are divided into two categories:

1- Superficial water evaluated to 18 billion m^3 per year.
2- Underground water represents 20% of the total national water resources with 103 aquifers holding a potential of 4.2 billion m^3 per year.

Morocco is currently comprised of 144 Big dams of which the maximal capacity is 18.67 billion m^3. Unfortunately, the average storage level is only 45% (verify old stats). In order to satisfy

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the needs of sectors that use hydraulic data, Morocco has implemented a hydrological network to gather and manage water related data. Using this network, we can find important hydrological indicators such as water levels, water flow, water sources and climatological indicators (temperatures, precipitations and evaporation rates). In terms of quality, the Ministry of Equipment and Water implemented gradually a network of surveillance of water quality. The latter network aims to closely monitor pollution sources, quantify damage and measure overall quality to contribute to the control and management of water quality deterioration. The most polluting sources in Morocco are led by domestic used water, industrial waste, solid waste and agricultural waste.

This research investigates the relationship between water scarcity and sustainable happiness levels in Morocco, in a larger scope between the sustainable development goals (SDG's) and the protection of natural resources. The principal objective of this study is to underscore, using a data oriented approach, the impact of water scarcity on individual happiness levels in Morocco by identifying the most significant variables that influences heavily the well-being. For this purpose, we exploited an online survey of 22 questions completed by collected data from the University Hospital Center of Marrakech, by analyzing them using a logistic regression model.

The research structure is organized in multiple methodological steps: Data collection from the online survey, Data cleansing and harmonizing, identification of dependent and independent variables and the transformation of qualitative variables into indicators, statistical analysis by logistic regression and finally interpretation of the results. This approach allows us to demonstrate that ameliorating the national hydraulic situation is strongly associated to an augmentation of well-being levels, thus emphasizing the importance of adaptation to water scarcity.

In the following section, we will discuss multiple scientific research projects that tackle our subject from different perspectives. Subsequently we will present our approach derived from our data collection and the analysis of its results. To conclude our work, we will outline a list of recommendations.

1. Related works

In the research work (Krimis et al.,2022), authors demonstrate results of a study conducted in Morocco that aims to measure trimestral happiness of the population grounded on four different online surveys with a 1 to 10 rating system. The study was enabled by simple random sample

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using mean, median and standard deviation and analyzed according to age, sex, profession, familial situation, place of residency and region. Throughout this analysis, the authors struggled with missing data and to overcome this issue they adopted a data imputation method. The remaining question here is: Will the integration of sustainability in the quantification of happiness change the results and therefore the indicator calculations?

Catherine O'Brien in the second edition of "Journal of sustainable happiness" (2021), define the concept of sustainable happiness as the search for a happiness that focus on global wellbeing of the society and individuals without jeopardizing its members, resources and future generations. According to this definition, happiness is the culminating point of politic actions, but it's important to not lose sight of other variables in the process and not impact them negatively. According to O'brien (2008), in a world where resources are limited, if a nation achieve a certain level of sustainable happiness and protected their natural resources successfully it eases the process of national durability.

(Aksoy & Bayram, 2019), specifies that the concept of sustainable development is the focus point of modern discussions. The ultimate objective of this sustainable development is to enhance quality of life for the world population. According to the authors, it is possible to score good levels of happiness and well-being, if and only if we reach sustainable development. Hence the importance of achieving the 17 sustainable development goals by 2030 elaborated by the United Nations in 2015. In this paper, the authors determined that the principal dimensions of sustainable development (Economic, social and environmental) are effective in explaining sustainable development which provides global well-being and prosperity for the population. The results underscore the positive correlation between sustainable happiness and the two last dimensions of sustainable development (Social and environmental) while the economic dimension has statistically no correlation with sustainable happiness. These results and previous research work findings point at the same direction, such as (Costanza & al.,2016) and (Cloutier & Ofeiffer,2015) and highlight the fact that sustainable development imperatively needs to be taken in consideration.

Gael Brulé in his book (Brulé,2014) states that the quest of happiness has a crucial importance in both individual life and government effectiveness. However, the criteria used to evaluate happiness are the results of various constructions that reflect the different conceptions of wellbeing, including the protection of living (Humans and environment). Occidental societies are often based on consumer mentality which is not compatible with current ecological

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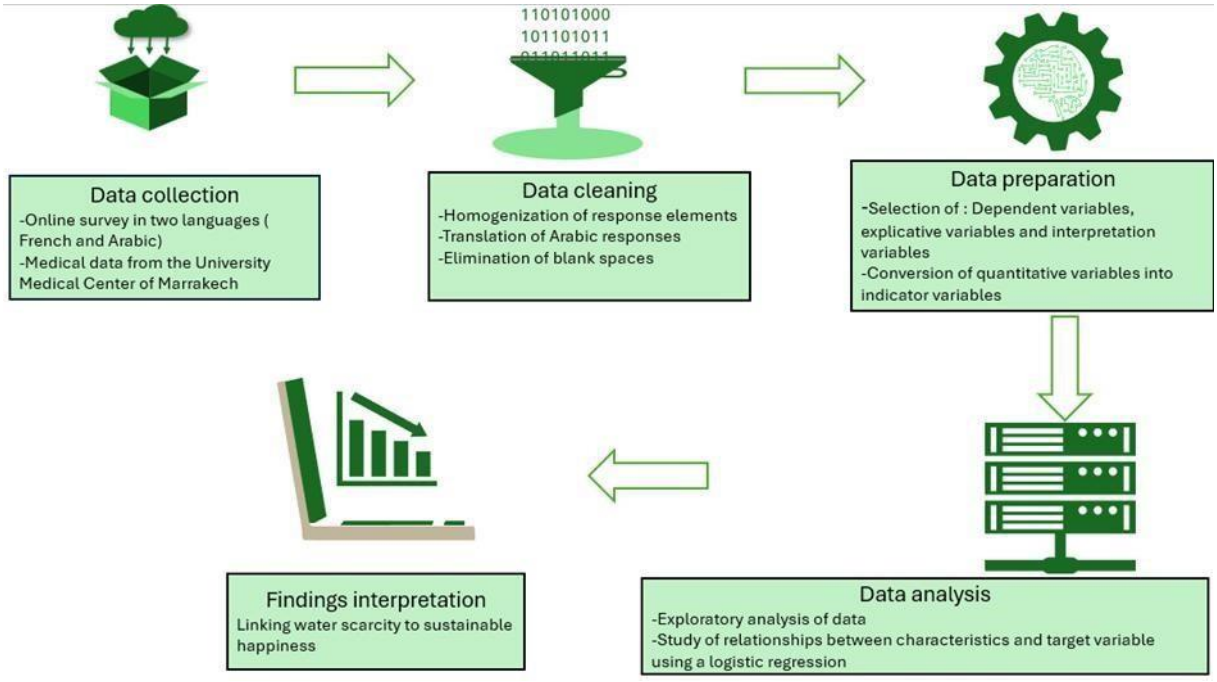
preoccupations. In this spirit, the author raises a crucial question: Is it possible to achieve happiness without taking into consideration our planet's limitations? The book explores this interrogation by examining the link between well-being measures and their impact on the environment. By scrutinizing this relationship, Gael Brulé highlighted how our well-being quest can have unsuspected repercussions on our interactions with living world.

2. Methods & Materials

This research adopts a positivist epistemological stance, aiming to analyze objectively the relationship between water scarcity and happiness levels based on empirical data. The study relies on a hypothetico-deductive reasoning that tests the following hypothesis; Water scarcity influence heavily the happiness levels of the Moroccan population. Therefore, a quantitative methodological approach based on a survey and logistical regression analysis was adopted to identify and measure the impact of explicative variables on national well-being levels.

Figure N°1 : Pipeline of the proposed approach



Source : Authors

2.1. Data collection

The main objective of the first step is to collect data that allows us to identify the link between sustainable happiness and water stress. We used an online survey of 22 questions, of which we

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collected150 responses in both French (104) and Arabic (46). These questions aimed to enumerate the population's opinions and list them the following six focal points:

- Their knowledge of the current national water crisis
- Their satisfaction level of drinkable water services and national sanitation and their impact on public health.
- Their perception of the evolution of hydraulic national situation.
- The impact of water scarcity on their economy.
- The impact of water scarcity on their well-being and happiness.

To complete the necessary data and quantify the impact of national drinking water and sanitation services, especially on vulnerable populations, we relied on data collected within the Marrakech Hospital Center MHC (Chait & Moutaj, 2023). The authors conducted a prospective study within the parasitology and Mycology department in the Military Hospital Avicenne Marrakech, lasting 3 months (Octobre to December 2022), which concerns cells sample of 40 children on HIV monitoring. The data collection was based on a pre-established operating sheet after parents' consent. The data collected for every child is as follows: age, sex, geographical origin, socio-economic situation depending on their parent's monthly revenue, educational level, drinkable water access, types of toilets at home, hygiene level and promiscuity.

2.2. Data cleansing

In order to conduct efficient analysis, the data collected needed imperatively cleaning tasks to ensure its conference and comparability.

-Amputation of missing data corresponding to the region field. When missing data presents a Missing at Random (MAR) mechanism it means that the probability of a missing value depends on other observed variables in the whole data set and not on the real missing value. In other words, the missing value can be explained by observed values in other variables and not by its actual missing value. The missing value in region field are MAR data and can be amputated from the complete field "Cities".

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-Translation of responses, since it was collected via two online surveys in two different languages (Arabic and French).

-Elimination of supplementary characters (example: years in the field Age).

-Elimination of blank spaces.

-Homogenization of responses in “cities” and “regions” fields.

2.3. Data preparation

- Variables extraction

We classified the explicative variables and interpretation variables. Explicative variables are independent variables that aims to describe and dissect if water scarcity negatively the happiness levels of our targeted variable which is the Moroccan population. Furthermore, the interpretation variables facilitate the assimilation of explicative variables according to the survey’s responses.

The following table regroups all the questions according to our classification. **Tableau N°1 : Questions/Variables of the proposed approach**

Notation	Target variable	Interpretation variable
Y	According to you, is the future projections of the national hydraulic situation impact your happiness level?	If yes, how?

Notation	Explicative variable	Interpretation variable
X1	Sex	-
X2	Age	-
X3	Region	-
X4	City	-

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X5	Are you aware of the current national hydraulic situation?	-
X6	From 1-10, what would you rate the current water resources status in Morocco? (1: Very critical. 10: Very good)	-
X7	Have you ever seen elements of sensibilization around the subject of water scarcity?	If yes, did it change your perspective on the subject?
X8	Have you noticed a drop in water flow rate in your home lately?	-
X9	Have you noticed a drop in water quality in your home lately?	If yes, on what level?
X10	Do you consume tap water?	If not, since when?
X11	Have you ever experienced health issues due to tap water consumption?	-
X12	How would you describe your experience with the local sanitation system?	-
X13	Are you taking any individual or collective actions towards adapting to water scarcity?	If yes, what actions?
X14	Does the current hydraulic resources situation impact your economy or that of a family member?	If yes, how?
X15	In your opinion, what will the future scenarios of water resources situation be in Morocco?	-
X16	Does the current water resources situation impact your happiness levels?	-

Source : Authors

Does the current water resources situation impact your happiness levels?

-Conversion of explicative variables into indicator variables.

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This step solely focuses on presenting categoric variables in the form of binary variables, which is primordial for running machine learning and analysis models. This mechanism is called One-Hot Encoding, in our study, we count 13/16 quantitative variables and 71 after conversion to explicative variables.

- Data Standardization

This step is very important in the process of data pre-treatment, where the value of different characteristics (variables) is adjusted so that they fall within a specific range.

2.4. Data Analysis

The analysis phase is based on two important steps. First exploratory analysis describes the data forms and its distribution using histograms. The second step, on the other hand, studies the link and relationship between water scarcity and sustainable happiness. Here, we used logistic regression in order to detect the contribution of our explicative variables X1 to X16 in our target variable Y (Water scarcity impact on sustainable happiness. This latter variable corresponds to a continuous binary variable (Yes or No), hence the usage of logistic regression.

Mathematically, for our data set n=150 observations and p=16 explicative variables (characteristics), the logistic regression model is presented as follows:

$P(Y=1|X)=1/(1+\exp(-z)$ $z=\beta 0+\Sigma \beta i Xi$ $i=1,\ldots,16$

-P(Y=1|X): Is the conditional probability of the appurtenance of the observation to a positive class (1) given the values of our explicative variables.

-βi Is the coefficients (weight) of the model to estimate.

-Xi Is the value of explicative variables for a given observation.

-The logistic function $1/(1+\exp(-z)$ transforms the linear combination z into an appurtenance probability to the class Yes (water scarcity impacts the happiness) or the Class Non (water scarcity doesn't impact the happiness).

The logistic regression results correspond to the coefficients and the p-values of our explicative variables Xi $i=1,\ldots16$. The variables with larger absolute coefficients are considered with the highest influence on the target variable prediction. The Wald test or likelihood ratio (p-values)

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is used to evaluate the statistical significance of every coefficient. The variables with a p-value inferior to the threshold 0.05 are considered significant.

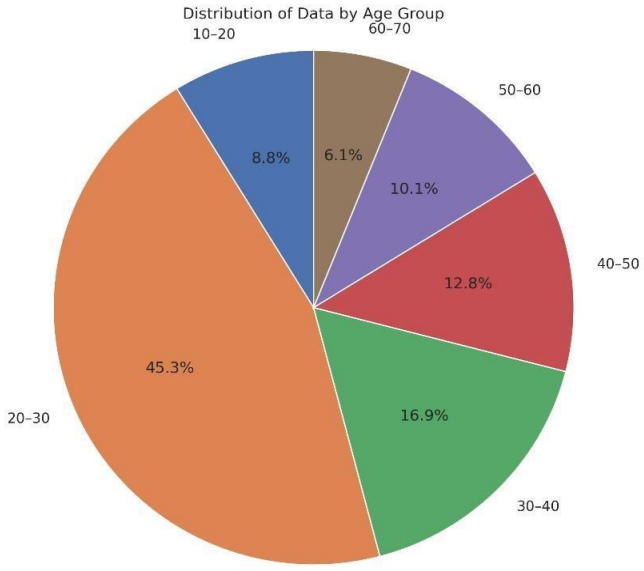
3. Results

3.1. Data exploratory analysis

Our sample is characterized by sex, age, region and city. The distribution given by these characteristics is as follows:

- The participant to our survey is 54.4% Females and 45.6% Males.
- The average age is 35 years old with a value range of 17 to 70 years old.
- The participants are distributed in 9 regions and 28 cities.

Figure N°1, 2 & 3: Distribution of data by age group, gender and region



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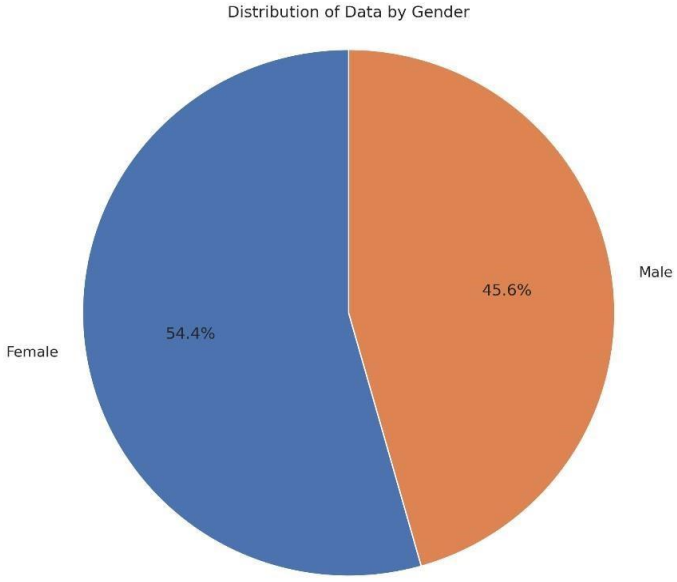

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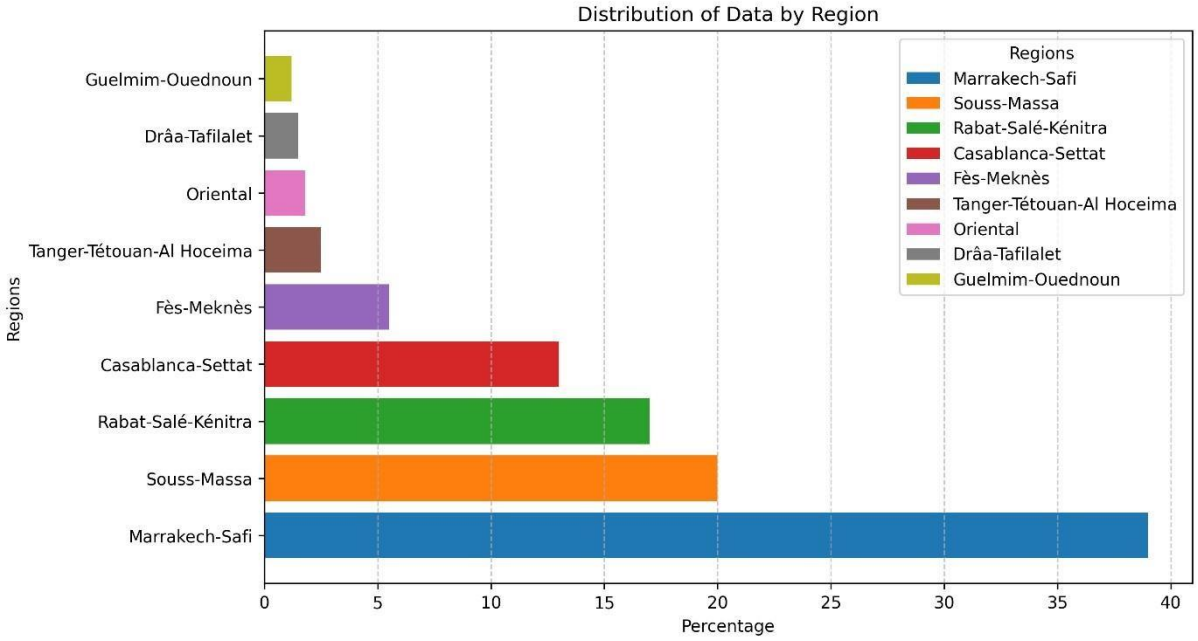

Source : Authors

The findings of our study emphasize the following points regarding the level of understanding of the current water resources situation amongst our sample:

- 89% of participants are informed of the national hydraulic situation
- The participants rated 3.7 out of 10 the current water resources situation in Morocco
- 16.1% of the participants were never exposed to a state awareness campaign.
- 4.7% of the participants have seen an awareness campaign other than those conducted by the government, and the most frequent response was via social media.

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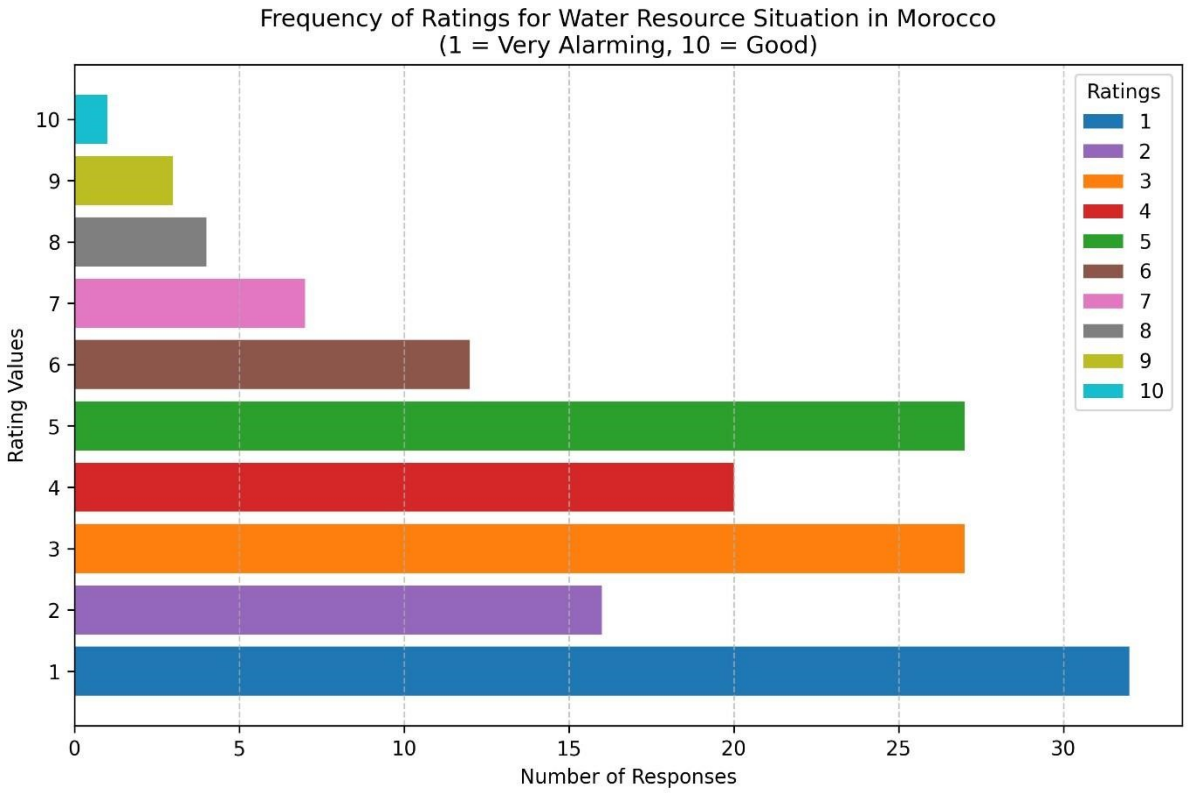
Figure N° 4: Frequency of ratings for water resource situation in Morocco



Source: Authors

The satisfaction evolution of the participant regarding the drinkable water and sanitation system points to several concerning elements.

Initially, 66.4% of participants noticed a significant decrease in water flow at their homes. In addition, 75.2% of participants observed a significant deterioration of water quality. This situation led to a reduction in tap water consumption for 50.3% of participants, in which 21.5% quit definitively drinking tap water. Alarmingly, 23.5% of participants indicated that they have encountered health issues due to tap water consumption.

These latter numbers reflect the particularly low satisfaction levels with only 18.1% of participants satisfied with the current sanitation services.

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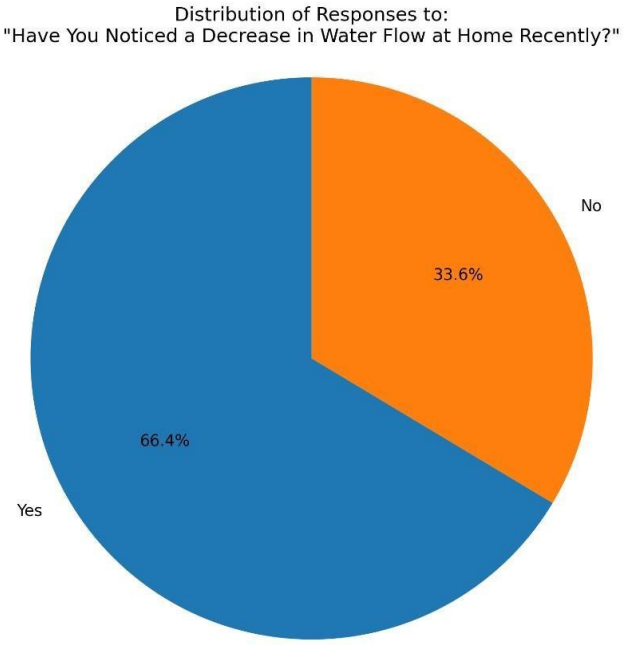
Figure N° 5-10: Distribution of responses about questions related to water flow and quality satisfaction



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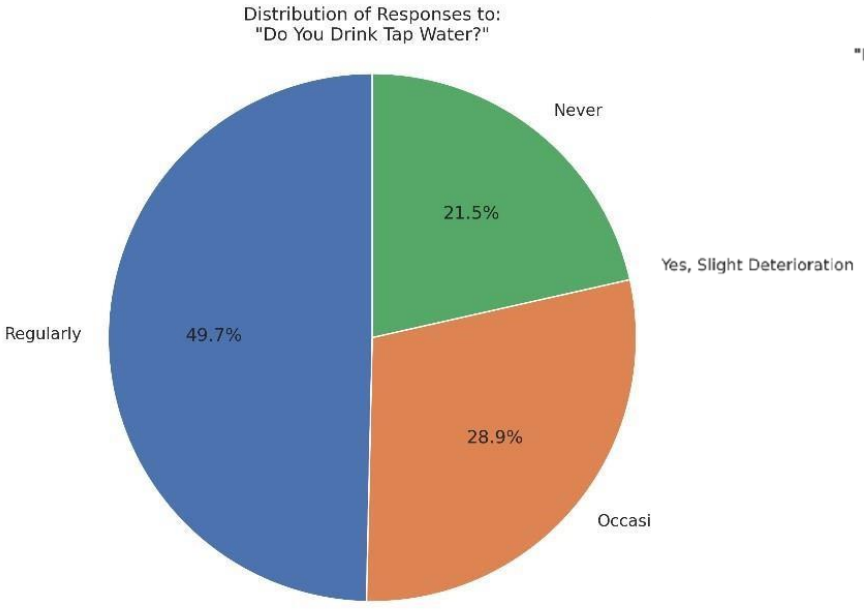

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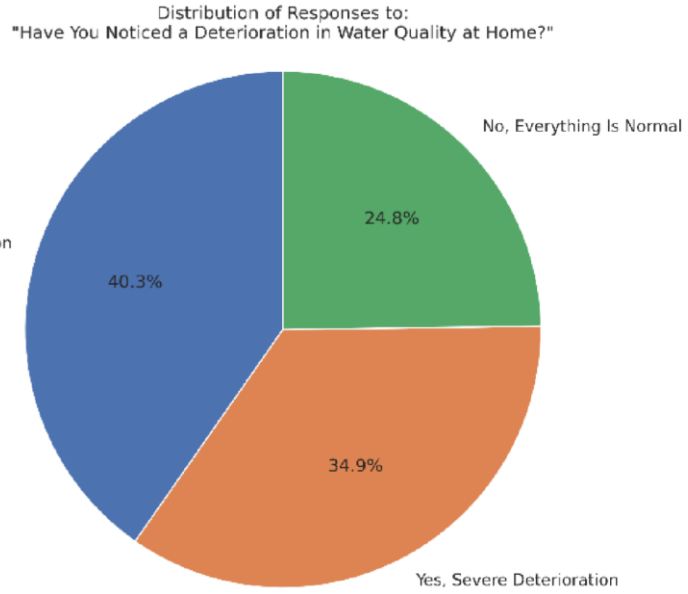

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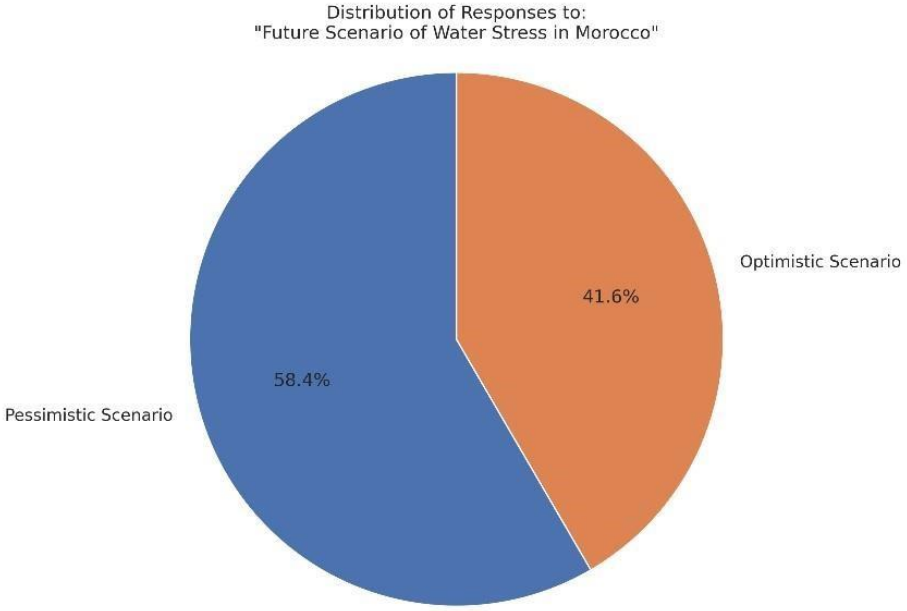

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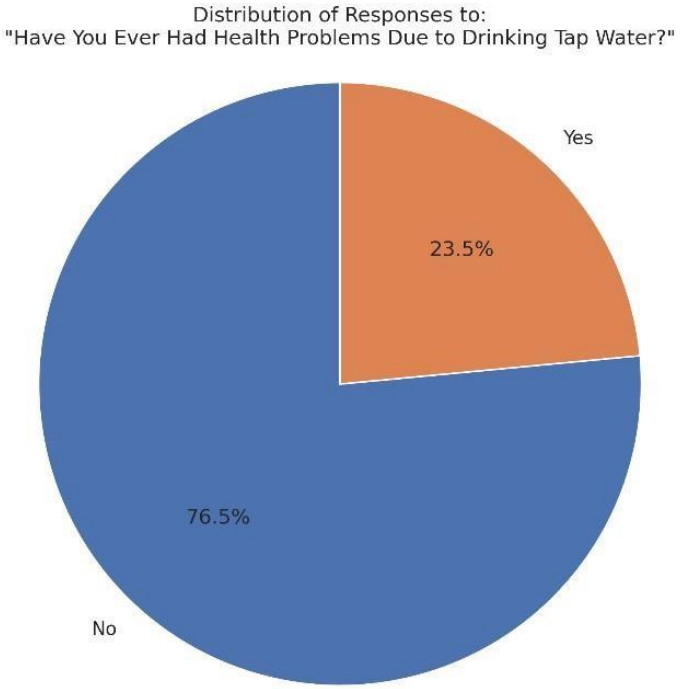

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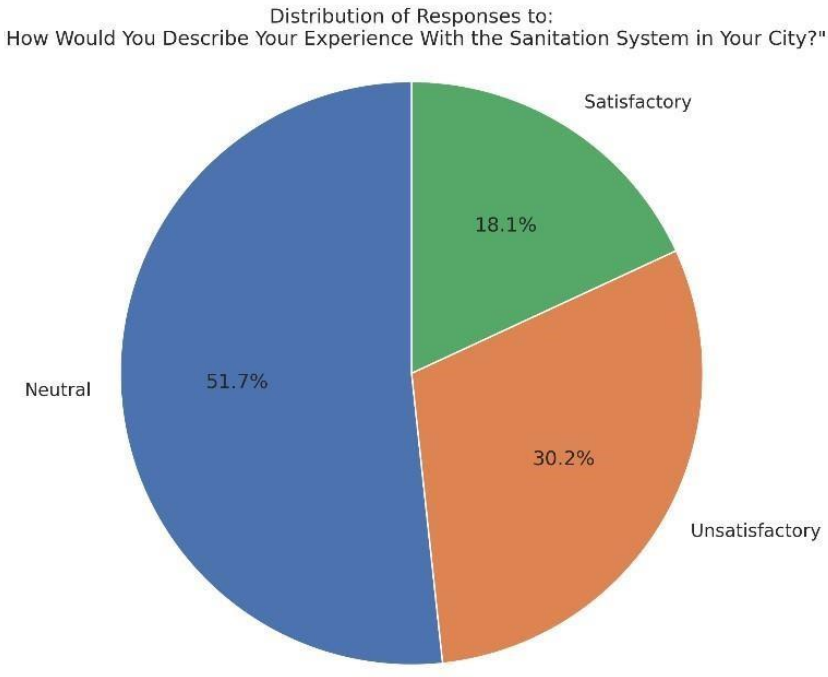

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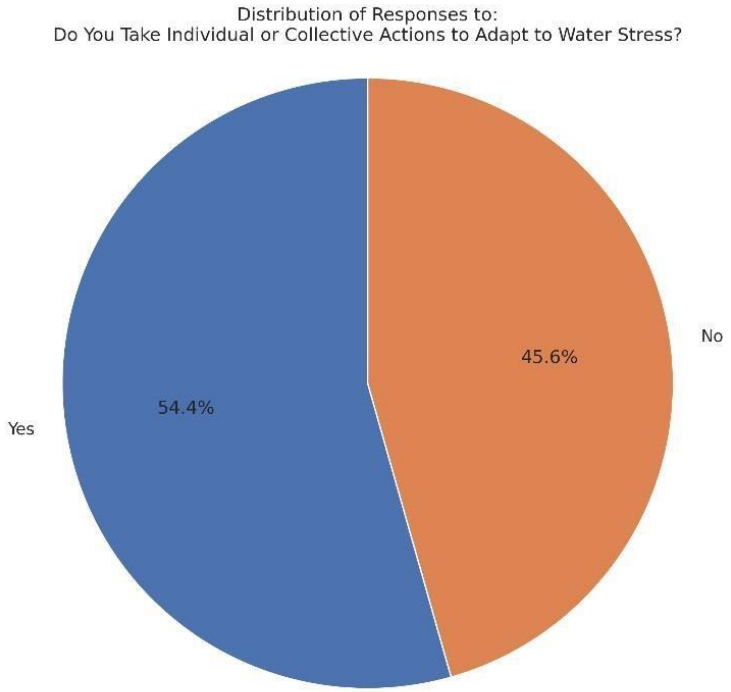
The generale future perception of the participants regarding the evolution of the national water resources situation can be summarized as follows:

- 58,4% of participants predict a pessimistic scenario.
- 45.6% of participants never adopted any individual or collective adaptation actions to water scarcity.

Figure N° 11: Distribution of responses to water scarcity adaptation



Source : Authors

The impact of water scarcity on the participants' economy is manifested by 32.2% of our sample declaring that water scarcity affects their economic situation or that of a close relative.

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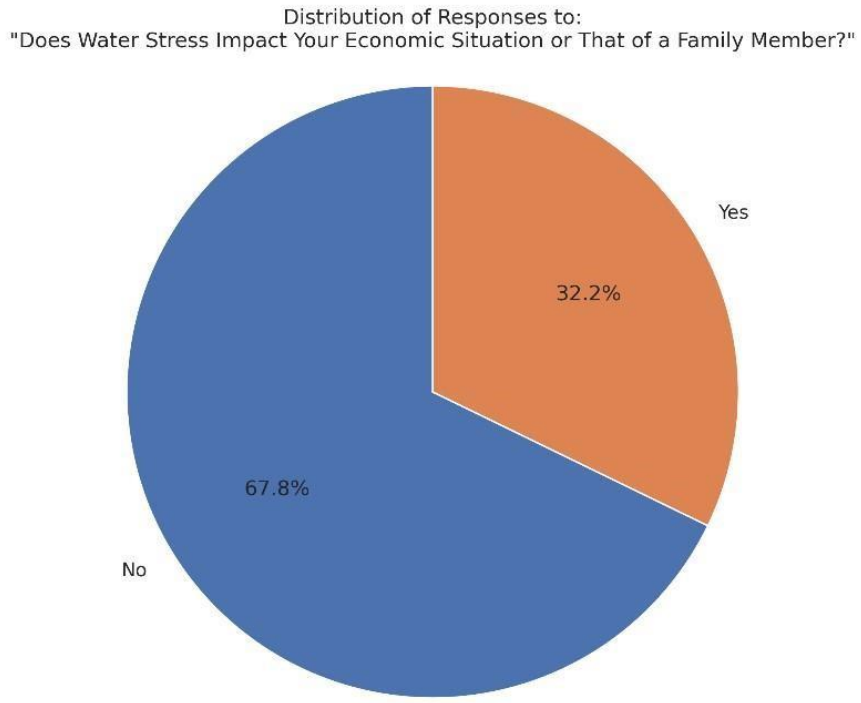
Figure N° 12: Distribution of responses to water scarcity economic impact



Source : Authors

The impact of water scarcity on the individual well-being of participants is presented as follows:

- 95.3% of participants feel anxious about the current national hydraulic situation.
- 77.9% of participants underscores the negative impact of water scarcity on their individual well-being and happiness levels.

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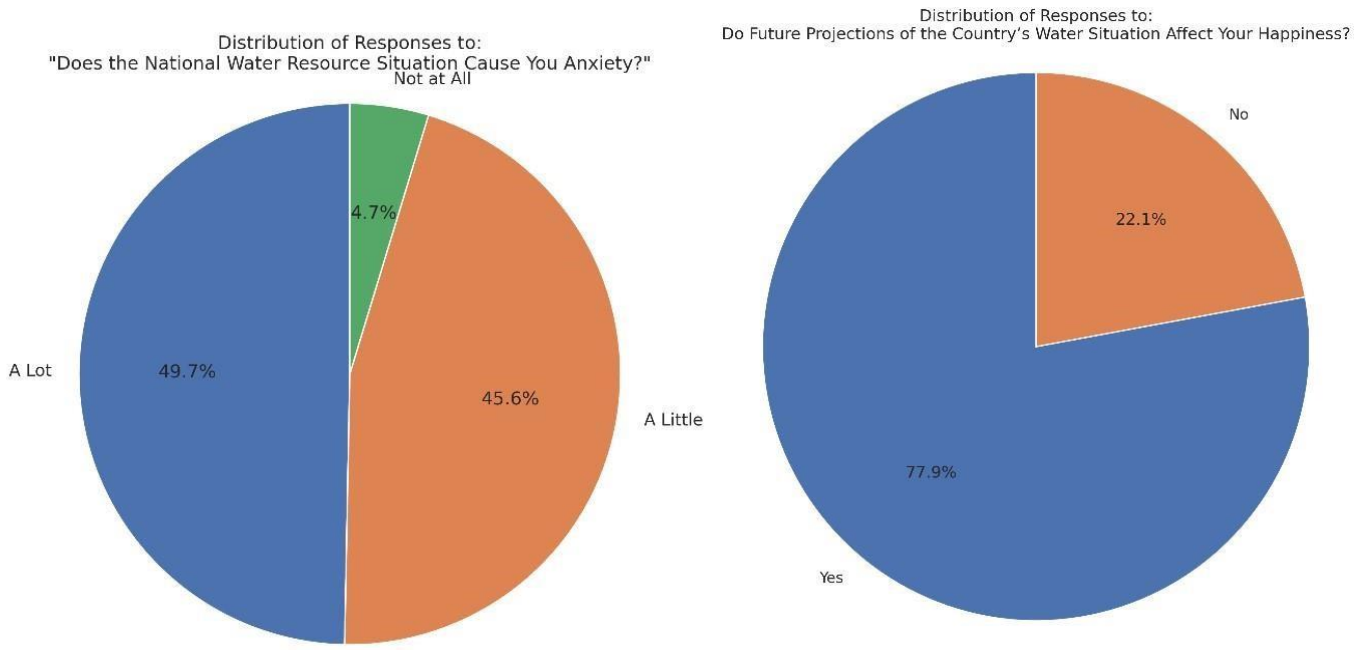
Figure N° 13 & 14: Distribution of responses to water scarcity impact on happiness



Source : Authors

4. Discussion

The objective of using logistic regression is to estimate the contributions of our 71 explicative variables on the target variable. The latter variable corresponds to two types of classes, the first one being the response YES and the second one being the response NO to the question: Do future projections of the country's water resources situation affect your happiness?

Our model represents an accuracy of 94%. Thus, it allows us to classify the participants as the ones whose happiness is impacted by water scarcity and those who are unphased by it depending on their given responses to 16 questions regarding the following points:

- ✓ Their understanding level of the national hydraulic situation
- ✓ Their satisfaction level of the current drinkable water and sanitation system and its impact on their health
- ✓ Their perception and prediction on the future of national water resources and its management
- ✓ The impact of water scarcity on their economic activities
- ✓ The exactitude is the relationship between the number of correct predictions and the total number of observations in the whole dataset.

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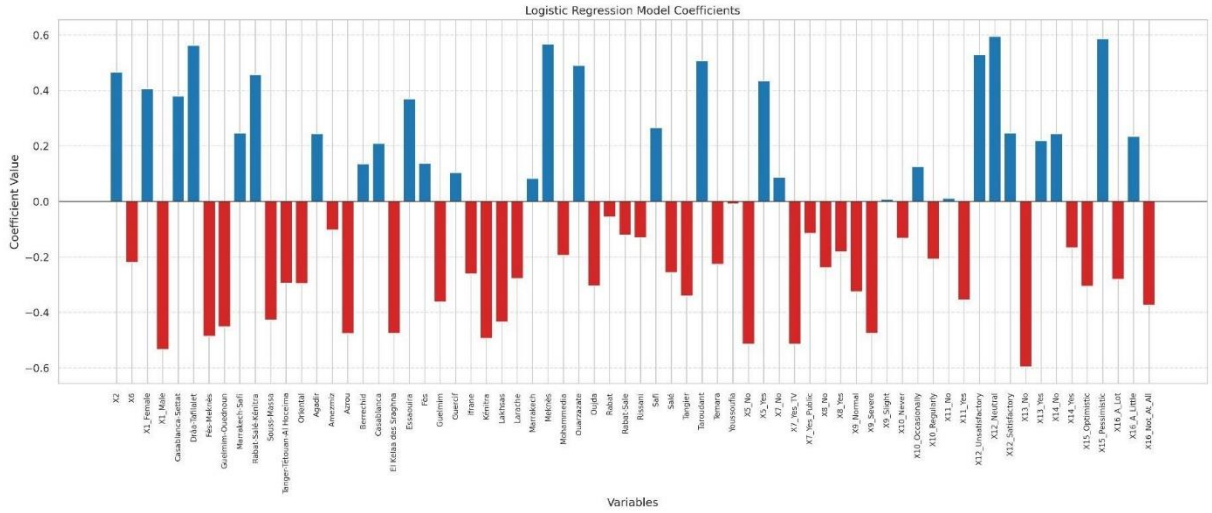
The contributions of all the variables are as follows:

Figure N° 15: Variables contributions on the target variable.



From left to right:

'X2', 'X6', 'X1_Women', 'X1_Men', 'X3_Casablanca-Settat', 'X3_Drâa-Tafilalet', 'X3_Fez-Meknes', 'X3_Guelmim-

Ouednoun', 'X3_Marrakech-Safi', 'X3_Rabat-Salé-Kénitra', 'X3_Souss-Massa', 'X3_Tangier-Tetouan-Al Hoceima', 'X3_l'Oriental', 'X4_Agadir', 'X4_Amezmiz', 'X4_Azrou', 'X4_Berrechid', 'X4_Casablanca', 'X4_El Kelaa des Sraghna',

'X4_Essaouira', 'X4_Fez', 'X4_Guelmim', 'X4_Guercif', 'X4_Ifrane', 'X4_Kenitra', 'X4_Lakhsas', 'X4_Larache', 'X4_Marrakech', 'X4_Meknes', 'X4_Mohammadia', 'X4_Ouarzazate', 'X4_Oujda', 'X4_Rabat', 'X4_Rabat ', 'X4_Rissani', 'X4_Safi', 'X4_Salé', 'X4_Tangier', 'X4_Taroudant', 'X4_Temara', 'X4_Youssoufia', 'X5_No', 'X5_Yes', 'X7_Other', 'X7_No', 'X7_Yes, public awareness signs', 'X7_Yes, public awareness signs and awareness advertisements on television', 'X7_Yes, awareness advertisements on television', 'X8_No', 'X8_Yes', 'X9_No, everything is normal', 'X9_Yes, significant deterioration', 'X9_Yes, slight deterioration', 'X10_Never', 'X10_Occasionally', 'X10_Regularly',

'X11_No', 'X11_Yes', 'X12_Unsatisfactory', 'X12_Neutral', 'X12_Neutral ', 'X12_Satisfactory', 'X13_No', 'X13_Yes',

'X14_No', 'X14_Yes', 'X15_Optimistic scenario', 'X15_Pessimistic scenario', 'X16_A lot', 'X16_Not at all', 'X16_A little'

Source : Authors

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The findings obtained demonstrate that the most significant explicative variables are in the following order:

1.Evaluation of the national hydraulic situation by participants X6

The coefficient associated with the variable X6 (-0.85), indicates a strong correlation between the participants' evaluation of the national hydraulic situation and their happiness levels. The strong negative correlation suggests that when the evaluation of the current hydraulic situation is positive, water scarcity appears to have less impact of citizen's well-being.

2.Economic impact of water scarcity on participants X14

The coefficient associated with the variable X14 (0.54), reveals that the impact of water scarcity on the participants' economic activities contribute heavily to the deterioration of their wellbeing and happiness levels. The participants who responded YES to the question relative to the variable X14 reported either practicing / having close relatives practicing jobs related to agriculture, or regular consumers of mineral/ table water.

3.Drinkable water X10

Regarding the coefficient of the variable X10 (-0.513), it indicates that the consumption of tap water is associated with a decrease in well-being and happiness levels of our participants. Indeed, the participants mentioned a significant deterioration in tap water quality (taste, color and smell). According to the answers collected via the variable X11, one quarter of the participants already faced health issues due to tap water consumption. Unfiltered water and contaminated by infectious agents present a great risk, especially for vulnerable populations. According to the results of the study conducted on immunocompromised children of the UHC Marrakech which represent to the most vulnerable population, it was found that children with no access to drinkable tap water have a parasitical frequency of 47% while the children with direct access to drinkable tap water have approximately the same frequency 44%, which shows the insufficiency of the tap water systems in providing clean drinkable water. This vulnerable population is also concerned with the type of sanitation used; the usage of septic tanks and collective toilets is associated with the highest parasitism value with high global parasitical frequencies 50% and 45%. This confirms the participant perspective, that the purification et connection to drinkable water needs to be updated. In the response elements of the X12 variable, only 18.1% of participants are satisfied with these services.

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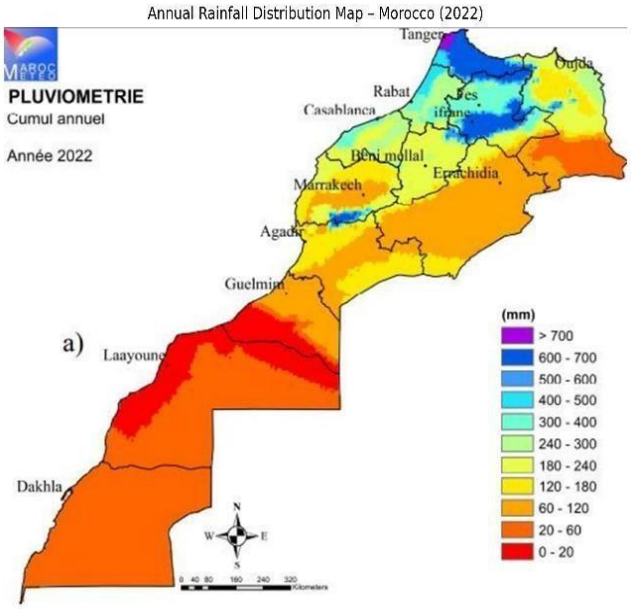
4. Cities X4

Figure N° 15: Annual Rainfall Map-Morocco 2022

The coefficient of the X4 variable, the residents of the cities: Ifrane (-0.492) and Kenitra (-0.477) seem to not feel the impact of water scarcity on their well-being and happiness levels. This is coherent with the fact that these cities benefits from a semi-humid climate characterized by an important rainfall frequency.

Source : "MOROCCO State of the Climate 2022"



According to the report of the ministry of equipment and water entitled "MOROCCO State of the Climate 2022", published in March 2023, Ifrane recorded an annual cumulative rainfall of 600/700 mm, while Kenitra recorded a frequency between 500/600 mm.

5.Water scarcity, anxiety factor X16

The coefficient related to the variable X16 (0.44), suggests that water scarcity is a triggering factor of anxiety for the participants.

6.Individual and collective contribution against water scarcity X13

The coefficient associated to the variable X13 (0.44) highlights that the participants who adopted individual or collective actions shows more preoccupation regarding the water resources situation in Morocco, what impacts negatively their well-being and happiness levels.

7.Awareness X7

Lastly, the coefficient of the variable X7 (-0.42) indicates that the current methods adopted to raise awareness failed to transfer the message and emphasize the urgency of the adaptation to water scarcity.

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The Wald test demonstrates the significance of selected variables. If a regression coefficient has a p-value inferior to 0.05 in the Wald test, then there exists a significant relationship between this explicative variable and the dependent variable. The latter analyses highlight the fact that the regression is significatively different from zero and that the explicative variable contributes significantly to explaining the variability of the dependent variable on the regression model.

Table N°2: Coefficients and P-value of the most significant variables

Variables		Coefficient	P-value
X6	The participant's evaluation of the national hydraulic situation	-0.8513	0.000023
X14	The economic impact of water scarcity on participants	0.537429	0.007515
X10	Drinkable water	-0.51276	0.010759
X4	Villes-Ifrane	-0.49244	0.014311
X4	Villes-Kenitra	-0.47798	0.017433
X16	Water scarcity- Anxiety factor	0.440708	0.028376
X13	Individual and collective contributions against water scarcity	0.439737	0.028726
X7	Awareness	-0.41951	0.036922

Source : Authors

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Conclusion

After the analyses of our findings, detecting and selecting the most significant explicative variables (Xi) in relation to the target variable (Y), it is obligatory to develop and implement an arsenal of adaptation actions to water scarcity effects and thus limit its negative impact on the Moroccan happiness levels. These actions fall under the selected significative variables.

- **Awareness campaigns**

- Implement audacious awareness signs in public places to draw more attention to the matter,
- Increase the frequency of awareness publicity in the national TV channels,
- Initiate awareness classes in schools for young students and their parents,
- Conduct awareness seminars in universities and higher education institutions,

- **Amelioration of the sanitation and drinkable water services**

- Accelerate and supply financially projects of the National Sanitation Program,
- Ameliorate the drinkable water connectivity rate in the rural areas,
- Install more epuration stations and expand the beneficiary population,

- **Promotion of individual and collective adaptation actions**

- Diffuse TV programs introducing the right actions to adopt to contribute to the adaptation to the negative effects of scarcity,
- Publish prevention guides in electronic and physical libraries,

- **Attenuation of the economic impact of water scarcity on Moroccan households**

- Train small farmers and initiate them into the principals and tips of a sustainable agriculture activity,

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- Subsidize all stakeholders contributing to the matter by adopting adaptation actions

(Irrigation, economical water systems, water recycling …),

- **Research and innovation**

- Encourage young researchers to tackles the subject in their publications and scientific research (academic scholarships, Hackathons, academic prizes…).

This paper had as an objective to quantify and elucidate the impact of rarefication of water resources on the well-being and happiness levels of the Moroccan population. Furthermore, demonstrate the importance of a good governance of national water resources and its implementation in order to achieve eight of the 17 sustainable development objectives linked directly or indirectly to the national hydraulic situation, and thus reach sustainable happiness. In conclusion, it is appropriate to say that sustainable happiness and water scarcity entertain a negative correlation. When water scarcity increases the national happiness levels and wellbeing decreases and vice versa. In the ultimate purpose of reaching sustainable happiness and wellbeing, the adaptation to water scarcity effects in indispensable. In this context, Moroccan governance is obligated to put into action a roadmap and implement multiple protection of water resources strategies without neglecting the importance of the contributions of every stakeholder in ameliorating the current national water resources situation by adopting collective and individual water-friendly actions. The adaptation to water scarcity is a race against the clock that must be led by every social actor.

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BIBLIOGRAPHY

De Neve, J.-E., Sachs, J. D., Helliwell, J. F., & Layard, R. (Eds.). (2020). World Happiness Report 2020. Sustainable Development Solutions Network.

Cataldo, R., Corrado, C., Grassia, M. G., Lauro, N. C., Marino, M., & Voytsekhovska, V. (2021). A methodological PLS-PM framework for SDGs system. Social Indicators Research. https://doi.org/10.1007/s11205-020-02271-5

Lakhdar, S. I. B. (2016). L'économie du bonheur, nouveau paradigme ou phénomène de mode? [The economics of happiness: A new paradigm or a passing trend?]. Sciences & Bonheur, 10.

Krimis, H., Banouar, O., Lakhdar, S. I. B., & Raghay, S. (2022). Collaborative filtering to quarterly index subjective well-being: Case of Morocco. Geopolitics and Geostrategic Intelligence, 4(1).

De Milly, H. (2015). Les Objectifs de Développement Durable : éléments d'analyses et impacts possibles pour les agences d'aide [Sustainable Development Goals: Analytical elements and possible impacts for aid agencies]. Techniques Financières et Développement, 121, 37–48. https://doi.org/10.3917/tfd.121.0037

Chahed, J., Besbes, M., & Hamdane, A. (2007). Water stress and food safety: An integral water vision. La Houille Blanche, 3. https://doi.org/10.1051/lhb:2007035

Chait, H., & Moutaj, R. (2023). Les parasitoses intestinales opportunistes chez l'enfant vivant avec le VIH au CHU de Marrakech [Opportunistic intestinal parasitoses in children living with HIV at the University Hospital of Marrakech] (Doctoral dissertation).

Saghouri El Idrissi, I., Kettani, R., Ferrahi, M., El Fechtali, M., Ziri, R., & Brhadda, N.

(2023). Journal of Agriculture and Food Research, 100863. https://doi.org/10.1016/j.jafr.2023.100863

Banouar, A., & Bouslihim, A. (2023). Integrated water resource management in the decisionmaking of large firms in Morocco: Case of Managem Group (Hydraulic Basin of Tensift Al Haouz). E3S Web of Conferences.

O'Brien, C. (2021). Sustainable happiness semester journal (2nd ed.).

African Scientific Journal
ISSN : 2658-9311
Vol : 03, Num 34 Février 2026

O'Brien, C. (2008). Sustainable happiness: How happiness studies can contribute to a more sustainable future. Canadian Psychology, 49(4), 289–295. https://doi.org/10.1037/a0013235

Aksoy, F., & Bayram, N. (2019). Evaluation of sustainable happiness with Sustainable Development Goals: Structural equation model approach. Sustainable Development, 1–8. https://doi.org/10.1002/sd.1985

Costanza, R., Daly, L., Fioramonti, L., Giovannini, E., Mortensen, L., Pickett, K., Ragnarsdottir, K. V., De Vogli, R., & Wilkinson, R. (2016). Modelling and measuring sustainable wellbeing in connection with the UN Sustainable Development Goals. Ecological Economics.

Cloutier, S., & Pfeiffer, D. (2015). Sustainability through happiness: A framework for sustainable development. Sustainable Development.

Dillenseger, L., & Vergnat, V. (2023). Le développement durable est-il le terreau du bonheur citoyen ? [Is sustainable development the foundation of citizen happiness?]. Sciences & Bonheur, 8, 30–54.

Brulé, G. (2024). Le coût environnemental du bonheur [The environmental cost of happiness]. Éditions Epistèmè.

Ministère de l'Équipement et de l'Eau. (2023). MAROC état du climat 2022. Direction générale de la météorologie.

Ministère de l'Équipement, du Transport, de la Logistique et de l'Eau. (2020). Guide d'assainissement durable en milieu rural marocain : Catalogue des techniques et outils d'aide à la décision.

Office National de l'Électricité et de l'Eau Potable. (n.d.). https://www.onep.ma

Organisation for Economic Co-operation and Development. (n.d.). https://www.oecd.org