A model for assessing sustainability

A web-based decision support system for predicting and evaluating sustainability

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ABSTRACT. This work presents a web-based tool for predicting and evaluating sustainability with a case study in the framework of water delivery service project (WDSP). A decision support model is built, based on Multi-Criteria Decision Analysis (MCDA) and afterward implemented in Java EE platform for predicting and evaluating on-line the sustainability of WDSPs. An additive value function based assignment model is used to sort a WDSP to one of the ordered categories corresponding to various level of sustainability. The model allows to aggregate socioeconomic, technical, technological and environmental aspects in term of their impact on the sustainability. Knowing the sustainability level of a WDSP can serve as a basis for undertaking an intervention.

RÉSUMÉ. Ce travail propose un outil de prédiction et d'évaluation en ligne de la durabilité dans le cadre des projets de service d'approvisionnement en eau potable (PSAE). Un modèle de support d'aide à la décision basé sur l'aide multicritère à la décision (AMCD) est construit et ensuite implémenté sur la plateforme Java EE pour la prédiction et l'évaluation en ligne de la durabilité des PSAE. Un modèle de tri basé sur une fonction de valeur additive est utilisé pour affecter un PSAE à une des catégories ordonnées reflétant différents niveaux de durabilité. Le modèle permet d'agréger les aspects socio-économique, technique, technologique et environnemental en termes d'impact sur la durabilité. Connaître le niveau de durabilité d'un PSAE peut servir de base pour intervenir.

KEYWORDS : multicriteria decision aid, category assignment, additive value function based assignment model, Java EE platform, on-line sustainability assessment, water service delivery project.

MOTS-CLÉS : aide multicritère à la décision, catégories d'affectation, modèle de tri basé sur une fonction de valeur additive, plateforme Java EE, évaluation en ligne de la durabilité, projet de service d'approvisionnement en eau

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1. Introduction

The sustainability of a water delivery service project (WDSP) is, most of the time, the result of the impact on this WDSP of a series of complex and conflicting factors resulting from the socioeconomic context, the technic and technology used and the environment. Operational research disciplines such as Multicriteria Decision Analysis (MCDA [2]) are dedicated to handle complex and conflicting aspects in general. The need to have real time information on the state of sustainability of WDSPs involves the necessity of disposing web-support systems such as Java EE [16], on which dynamic web applications will be implemented and will allow on-line assessment of the sustainability of WDSPs. The literature shows a lack of examples in which MCDA methods are associated with web tools for tackling the sustainability of WDSP problem. In contrast, the present work is an example of how both MCDA and web tools can be used, in synergy, for structuring the problem and predicting or assessing the sustainability of a WDSP. The WDSPs of interest are located in the Greater Afram Plains Area of Ghana. Our aim is to evaluate the sustainability of an ongoing WDSP or to predict the sustainability of a WDSP before it starts. Knowing the level of sustainability of a WDSP, it is possible, for instance to review some aspects on the project in order to improve its level of sustainability. In the context of this work, sustainability means the capacity to be supplied with advantages in a continuous way in the time [27, 24]. Thus in the specific case of WDSPs, the sustainability expresses itself by a continuous enjoyment in the time of the advantages ensuing from WDSPs. This work is organized as follows. Section 2 describes the context of the study and our decisional aid process. Section 3 is devoted to the structuring of the problem, including the identification of the actors, the definition of the alternatives (WDSPs) and the relevant criteria. In section 4, we propose a model for assigning WDSPs to categories reflecting different level of sustainability and we set the model parameters. Validating the model is the main concern of section 5. Section 6 illustrates our model implemented in Java EE platform. Some conclusion and perspectives are presented in section 7.

2. Context and decisional approach

2.1. Context

Most of WDSPs implanted, for some years, in several regions of developing countries, stopped working. This means that these WDSPs have not been sustainable at all. To deal with this problem certain studies [17, 22] have raised out many conflicting socioeconomic, technical, technological and environmental criteria which must be satisfied simultaneously to guaranty the sustainability of a WDSP. Handling all these criteria may be fastidious if their number is important. The identification of relevant criteria to evaluate the sustainability could be a first challenge and to know how to aggregate them could be a second challenge when dealing with the assessment of sustainability of WDSPs. Usually, the person (authorities, donors, practitioners in the field of water) who want to evaluate the sustainability of a WDSP only want, a fast result of the evaluation without caring about the process, which remains the expert or analyst preoccupation, to get it. Even though a model to evaluate or to predict the sustainability of a WDSP can be available, a last difficulty which can occur is the use of this model which is most of the time complex for practitioners in the field of water. To satisfy all these preoccupations we propose a user friendly web-based decision support system for predicting and evaluating sustainability of WDSPs. Concerning the problem of sustainability of WDSPs , the literature mention three well recognised sustainability frameworks for the Water Sanitation and Hygiene (WASH) sector: the Triple-S building blocks [22], the FIETS sustainability approach [7] and the WaterAid sustainability framework [5]. We gained inspiration from these research work to elaborate the frame of sustainability of our case study. Boulenouar et al. [4] have made comparison between five sustainability assessment tools to support sustainable water and sanitation service delivery among which our decision support system (Tool for Planning Predicting and Evaluating Sutainability (ToPPES)). What come out of this comparison is that ToPPES is the most user friendly tool, capable to give in around one hour a report on the state of sustainability both for an existing or a planned project. Other particularity of ToPPES is the fact that the result on the state of sustainability of a WDSP can be obtained online via a web browser or offline. Beside of this comparison we can also raise out the mathematical theoretical foundation of ToPPES. The main weakness of ToPPES is that it has not yet been used in other context, although its structuring and its approach based on decision aid methods (see subsection 2.2 and section 3) could allow a readaptation with some additional efforts (see section 7).

2.2. Decisional approach

Practically, for a given WDSP, our approach output will consist in an assignment of this WDSP to a category reflecting its level of sustainability. This will constitute the basis for the exploration of sustainable and managerial policies guarantying continuous enjoyment in the time of the advantages ensuing from the concerned WDSP. Our approach is structured and participative:

– Structured: the assessment of the sustainability relies on the elaboration of a model involving hierarchy of criteria, associated to indicators which reflect the relevant aspect of the criteria and allow their assessment;

– Participative: all the concerned parties (local population, authorities, and experts) are associated to the assessment and their point of view is taken into account.

The problem of assessing sustainability of a WDSP appears as decision problem in which intervene many criteria reflecting different aspects to be taken into account. In our way of thinking about it, we wanted also to make sure that the elaborated decision support system be transferable to different regions and contexts. In view of this, we have gained inspiration from work done in the framework of impact studies on the environment [18] or landscape degradation [13, 14]. The latter work has the specificity of being based on the principles of MCDA [2, 13, 23], which views evaluation as the result of a process called “decision aiding”. The other specificity of the present work is its web-based oriented character. Java Enterprise Edition (Java EE, [16]), which is built on the Java language, is a platform well suited to implement dynamic web application. However, the current Java EE software packages, do not integrate, in their standard versions, developed multi-criteria treatment functionalities, which allow to rank or select WDSPs, or assign them to categories taking into account objective criteria (economic, for instance) and subjective criteria (social , for instance). To allow on-line assessment of a WDSP, a suitable MCDA method has been implemented in Java EE platform. In our case study, we will be specf-ically interested in MCDA methods for assigning alternatives, i.e. WDSPs, to ordered categories reflecting various level of sustainability. Among relevant MCDA methods, let us mention for instance an outranking method such as ELECTRE TRI [15, 19, 25], and total aggregation methods based on additive value function [11]. Generally outranking methods are more recommended to be used in environmental problem rather than total blind aggregation methods [12]. These methods have the capacity to handle conflicting criteria by avoiding a total compensation between them which could hide the importance of some among them. Furthermore they allow to aggregate the criteria, keeping each of them in its own scale. But some of their drawbacks come from the fact that they need more parameters to elicit. Also, they are more complex to understand and their application take much time. As we want a simple model which could quickly allow us to have the state of the sustainability of WDSPs, we have chosen to use a total aggregation method rather than an outranking method. In subsection 4.5 we will discuss about the way we have overcome some of their drawback, as the total compensation.

3. Structuring the problem

The issues that we shall address are the following. We first state the aim of this assessment study and formulate the problem. Then we elaborate a decision aid model in accordance with the problem statement.

3.1. Formulation of the problem

For a given WDSP, the general objective is to contribute to a suitable management of the service guarantying its sustainability. In order to achieve this general objective, an assessment of the current state of sustainability of the WDSP is required. Firstly it is necessary to determine who are the actors involved in the problem, secondly, which are the criteria that characterize the sustainability of a water delivery service and, thirdly, building up a multicriteria assessment model that integrates the influence of the various criteria on the state of the sustainability of the WDSP.

3.2. Identification of stakeholders

By stakeholders we mean people who are affected or concerned directly or indirectly by the WDSP. Generally, in a decisional process, we can mention three type of stakeholders: Decision Maker (one or a group of persons) who orders the project, the analyst who handles the decisional process and the target group who benefits from output of the project.

In this WDSP case, we worked with the mandate from African Intergovernmental Agency Water Sanitation for Africa. As this work was more a matter of evaluation than decision, no decision maker (DM) was really available, and the other co-author (of this paper) was involved as an expert in water and sanitation (WSE). He has very much played the role of the DM: for instance, the WSE provided information on the weighting of criteria, and on the preference parameters in the aggregation model.

The target part, that is to say the group who benefit from the action, are the local communities. Recommendation stemming from the evaluation process, built in interaction with all the involved stakeholders, could be the basis for further actions to be undertaken to guaranty sustainability of WDSPs.

Note that the context of our case study is a particular case of the context described in section 2.

3.3. Identification of criteria and indicators

The retained criteria and indicators stem from a framing in a hierarchical structure. In order to define the view points (i.e. criteria) to take into account and the indicators that assess the relevant aspect of these viewpoints, we first adopted a top-down approach [10] followed by a bottom-up checking. The top-down approach recommends that the DM first focuses on the definition of "fundamental objectives" to achieve w.r.t. the problem. So we built the chain Principles-Criteria-Indicators [20]. In our case study, the fundamental objectives have been formulated as principles of sustainability which encompass all aspects that were recognized as being relevant for the sustainability of WDSPs problem. Seven principles have been kept. Each principle is translated by one or several criteria. For each criterion, its indicators reflect the sustainability level of a WDSP w.r.t. this criterion. The bottom-up validation aims at checking the operational nature of the indicators which were proposed in the top-down scheme. Indeed, in each particular situation, the value of some indicators may be unavailable or the resources needed for obtaining them may be lacking. In such case, the construction of some indicators requires re-examination or, even, other elements of the assessment model must be revised. In our case study, nineteen (resp. twenty) criteria and fifty one (resp. fifty nine, i.e., the fifty one used for predicting plus eight new ones) indicators have been built for predicting (resp. evaluating) sustainability of a WDSP. Table 1 below shows the seven identified principles with their criteria and weighting. In this table we suppose that all of the seven principles are of equal importance. The star in front of a criterion or an indicator mean that it is relevant only for evaluating and not for predicting.

Principles	Principles' weight	Criteria	Partial Criteria weight	Criteria weight	Constraints of performance
1 Socio economic context	1/7	Water demand	0.4	0.056	≥ 2
		population growth	0.2	0.028	
		Socio economic benefits	0.4	0.056	≥ 2
4 Technology	1/7	Water supply technology	1	0.15	≥ 2
2 Service delivery	1/7	Accessibility	1	0.14	
3 Water resources and management	1/7	Quantity	0.33	0.0495	≥ 2
		Quality	0.34	0.051	≥ 3
		Environmental considerations	0.33	0.0495	≥ 2
5 Finance	1/7	Beneficiary contribution	0.4	0.056	≥ 2
		Payment	0.3	0.042	≥ 2
		Tariff	0.3	0.042	
6 Operation and Maintenance	1/7	Appropriate Community Management System	0.12	0.0168	
		Human resources	0.12	0.0168	
		Ownership and Management*	0.12	0.0168	
		Community WATSAN finance	0.13	0.0182	
		Maintenance responsibility	0.13	0.0182	≥ 2
		Maintenance plan	0.13	0.0182	≥ 2
		Capital maintenance plan and replacement	0.13	0.0182	
		Supply chain	0.12	0.0168	≥ 2
7 Institutional Support	1/7	Support to service providers	1	0.14	≥ 2

Table 1. *Principles-Criteria with their weight and constraints of performance*

Principle 1: Socioeconomic context			
criteria	**Indicators**	**Max/Min**	**Weighting**
1:Water Demand	Is the planned water source capable of serving the intended population according to national standard?	Max	0.6
	Is the water used only for domestic purposes?	Max	0.4
2: Population growth	Is the population of the project region and district growing significantly so that it may make use beyond sustainable levels ?	Min	1
3: Socioeconomic benefits	When the waterpoint was opened, was there any impact on health, children going to school, income etc?	Max	1

Table 2. *Criteria of principle 1 and their weighted indicators*

Table 2 presents the criteria of principle 1 with their weighted indicators. Column “Max/Min” refers to the sense of optimization of the corresponding indicator. For instance, the symbol “Max” in front of the indicator *Is the water used only for domestic purposes?* means that a “Yes” (resp. “No”) answer to this question is favorable (resp. not favorable) for the sustainability of the corresponding WDSP. In contrast, the symbol “Min” in front of the indicator *Is the population of the project region and district growing significantly so that it may make use beyond sustainable levels* means that a “Yes” (resp. “No”) answer to this question is not favorable (resp. favorable) for the sustainability of the corresponding WDSP.

4. Assignment to categories by means of an additive value function model

At this stage, a performance matrix was built in which, each of the water delivery service project is associated to a vector of evaluations on the criteria. We build a model based on an additive value function for assigning a water delivery service to ordered categories reflecting various level of sustainability. We start by briefly describing the additive value function based assignment model.

4.1. The additive value based assignment function

This model is based on the construction of an additive value function [11], which allows us to associate a value to each water delivery service project (WDSP); a WDSP is assigned to the hth category C_h if its value passes some threshold β_h but not the threshold β_{h+1} attached to the next category C_{h+1}. More precisely, let $(g_1(a), ..., g_m(a))$ denote the vector assessments attached to the WDSP a w.r.t. each criterion g_j. The value $u(a)$ of a has the following form:

$$u(a) = \sum_{j=1}^{m} w_j u_j(g_j(a)), \qquad [1]$$

Where the w_j are tradeoffs attached to the criteria

$$(w_j \geq 0 \text{ and } \sum_{j=1}^{m} w_j = 1) \qquad [2]$$

and the u_j are marginal value functions. In order to use such a model in our case, we need to go through the following steps:

– build marginal value functions u_j on each dimension j ;

– elicit the tradeoffs w_j ;

– elicit the thresholds value β_h associated with category C_h.

We will achieve this in next sections 4.2 and 4.3.

4.2. Computing the performances of a WDSP w.r.t. a criterion

We assume that each criterion is evaluated on a three levels scale: 1,2,3. We denote $T_{g_i}(a)$ The performance of the WDSP a w.r.t. the criterion g_i, i.e., the value stemming from the evaluation of a WDSP a w.r.t. the criterion g_i. I_{ij} $j = 1, ..., n_i$ represent the indicators of criterion g_i. p_{ij} is the weight of indicator I_{ij}; hence

$$T_{g_i}(a) = \sum_{j=1}^{n_i} \alpha_{ij}(a) p_{ij} \qquad [3]$$

where

n_i is the number of indicators of the g_i criterion

$$\alpha_{ij}(a) = \begin{cases} 1 & \text{if the WDSP } a \text{ satisfies totaly the indicator } I_{ij} \\ 0.5 & \text{if the WDSP } a \text{ satisfies partially the indicator } I_{ij} \\ 0 & \text{if the WDSP } a \text{ does not satisfy the indicator } I_{ij} \end{cases} \qquad [4]$$

$$\sum_{j=1}^{n_i} p_{ij} = 1 \;\; \forall\, i \in I = \{1, 2, ..., m\}, \qquad [5]$$

m denote the number of criteria.

4.2.1. Putting the value of a WDSP in a new common scale

$$\text{if } T_{g_i}(a) \leq \tfrac{1}{3} \text{ then} \begin{cases} T_{g_i}(a) \leftarrow 1 \\ \text{the WDSP } a \text{ is not sustainable w.r.t. } g_i \end{cases} \quad [6]$$

$$\text{if } \tfrac{1}{3} < T_{g_i}(a) \leq \tfrac{2}{3} \text{ then} \begin{cases} T_{g_i}(a) \leftarrow 2 \\ \text{the WDSP } a \text{ is moderately sustainable w.r.t. } g_i \end{cases} \quad [7]$$

$$\text{if } T_{g_i}(a) > \tfrac{2}{3} \text{ then} \begin{cases} T_{g_i}(a) \leftarrow 3 \\ \text{the WDSP } a \text{ is sustainable w.r.t. } g_i \end{cases} \quad [8]$$

The choice of this rather rough evaluation scale, distinguishing only three ordered levels as made above, is justified, on the one hand, by the fact that each level of the scale must translate a state of the sustainability and we want to avoid assessing weak differentiation with no impact on the sustainability, on the other hand.

4.3. Computing the value of thresholds β_h

In the context of assessing WDSP's, the β_h are called value of reference services of profiles limit (of sustainability) $b_1, b_2, \ldots, b_h$ associated to categories $C_1, C_2, \ldots, C_h$ with $C_1 \prec C_2 \prec \ldots \prec C_h$, i.e. C_{h+1} better than C_h in terms of sustainability; hence $\beta_1 < \beta_2 < \ldots < \beta_h$ and

$$\beta_k = \sum_{i=1}^{m} p_i T_{g_i}(b_k) \;\; k = 1, 2, \ldots, h \quad [9]$$

p_i is the weight of criterion g_i. $\beta_1, \beta_2, \ldots, \beta_h$ are also simply called "reference values".

4.4. Assignment rule for a WDSP to a category of sustainability

In our case study, we have decided to choose four ordered categories of sustainability $C_1 \prec C_2 \prec C_3 \prec C_4$. A WDSP a is assigned to a category as follows:

– if $\sum_{i=1}^{m} p_i T_{g_i}(a) \leq \beta_1$ then the WDSP a is assigned to the worst category (in terms of sustainability) C_1; i.e. the WDSP a is not sustainable;

– if $\beta_1 < \sum_{i=1}^{m} p_i T_{g_i}(a) \leq \beta_2$ then the WDSP a is assigned to the category C_2, i.e., the WDSP a is weakly sustainable;

– if $\beta_2 < \sum_{i=1}^{m} p_i T_{g_i}(a) \leq \beta_3$ then the WDSP a is assigned to the category C_3, i.e., the WDSP a is moderately sustainable;

– if $\sum_{i=1}^{m} p_i T_{g_i}(a) > \beta_3$ then the WDSP a is assigned to the best category C_3, i.e., the WDSP a is sustainable.

Note that the quantity

$$\sum_{i=1}^{m} p_i T_{g_i}(a) \qquad [10]$$

is called the value of the WDSP a .

4.5. Constraints on performances

According to the WSE some levels of performance must be satisfied on some criteria. These criteria are called critical criteria. If one of these levels of performance is not satisfied by a WDSP, then this WDSP is automatically assigned to C_1 category, i.e., this WDSP is not sustainable. Table 1 shows the constraints on performances in its last column entitled "Constraints of performance". As we used an assignment method based on a total aggregation method, there will be compensation between weak and high performances of a WDSP w.r.t. criteria when evaluating its global value via the formula 10. Without these constraints, the value of a WDSP could pass for instance the highest threshold, that is to say β_3, and consequently assigned to the sustainable category although it does not satisfy any of these constraints on performances. This is due to the fact that its weakness on critical criteria have been hidden by its high performances on other criteria. But in terms of sustainability, this kind of compensation is not allowed and the only way to overcome these weak performances is to undertake concrete actions to improve the performance of the concerned WDSP w.r.t. these critical criteria.

5. Validation of the model

This section addresses the question of the weighting of the principle, criteria, and indicators, the scale of criteria and also the choice of the categories limiting profiles in the context of our case study relative to WDSP's sustainability in Greater Afram Plains Area of Ghana (western Africa country).

5.1. Principles, criteria and indicators weighting

When the number of principles (resp. criteria or indicators) is important, much effort is needed if one uses a direct method to determine their weights. Indeed, generally it is difficult for the concerned stakeholders to give directly all the trade-off that ones needs for the weighting process. It is why indirect methods to elicit those trade-off fit more. Among these indirect methods, we can mention learning method [26] and Simos' method [8, 21]. For simplicity we have chosen to use Simos' method which is recommended for weighting process particularly in an environmental context [12]. So, in case the principles (resp. all the criteria of a principle) were not of equal importance, we have used Simos' method. With this method, the WSE is asked to rank cards on which the name of the criteria is written in increasing order of their importance. The expert can insert blank cards to emphasize the difference of importance between two criteria. The final step in the interactive questioning process about weights consists in asking the WSE to estimate the ratio “z”of the weights of the most important principle (resp. criterion of the principle) and the least important principle (resp. criterion of the principle). As previously observed in the literature [1, 14], this was the most difficult question in the whole process. The result of this process is the weighting of principle and the partial weighting of criteria (see table 1). The hierarchical tree analysis [3] allowed deducing the final weighting of criteria as showed in table 1. The weighting of indicators is done in the same way as the partial weighting of criteria. Note that when the number of criteria (resp. indicators) of a principle (resp. criterion) is not important one can do a direct weighting of the criteria (resp. indicators). For that purpose, it is important to do that in a participative approach, by inviting all the stakeholders to give their point of view and then try together to reach a consensus for the weighting to be kept.

5.2. Categories limiting profiles

Ordered from the worst to the best, the four categories of sustainability are the following: not sustainable (C_1), weakly sustainable (C_2), moderately sustainable (C_3), and sustainable (C_4). These categories are respectively separated by profiles b_1, b_2, and b_3. For $i \in \{1, 2, 3\}$, profile b_i represents at the same time the upper limit of category C_i and the lower limit of category C_{i+1}. Opting for a categorization in four classes instead of three classes (while all the criteria are assessed on a three level scale) stems from the will of avoiding an ambiguous median class, which would consist of WDSP’s that are not clearly categorized. Through the definition of profiles, that are viewed as WDSPs norms, the WSE considers that a WDSP belonging to categories C_3 and C_4 can be undertaken (in case of sustainability prediction) or pursued (in case of evaluating sustainability of an ongoing WDSP) without sensitive or not, while belonging to categories C_1 or C_2 requires major changes to be undertaken or pursued.

6. On-line use of the proposed model

Even though the proposed model is ready and has been shared and validated with different concerned stakeholders (see section 3.2), the general impression is that the model in its raw form will be too mathematically complex to use in the field. To simplify field practitioner’s interactions with this model, it was decided to put the model in web-based software. What follows gives outline of the proposed web-based tool for predicting and evaluating sustainability.

6.1. Implementing and web tools used

We implemented our model with Java language in Java EE [9] platform on the integrated development environment Eclipse following the “Model View Control”methodology.

The resulting web-based software is delivered as war (web archive) file which need to be deployed inside a server. For this reason we will use a local server tomcat [9] to illustrate our application.

6.2. Using the web-based tool for assessing sustainability

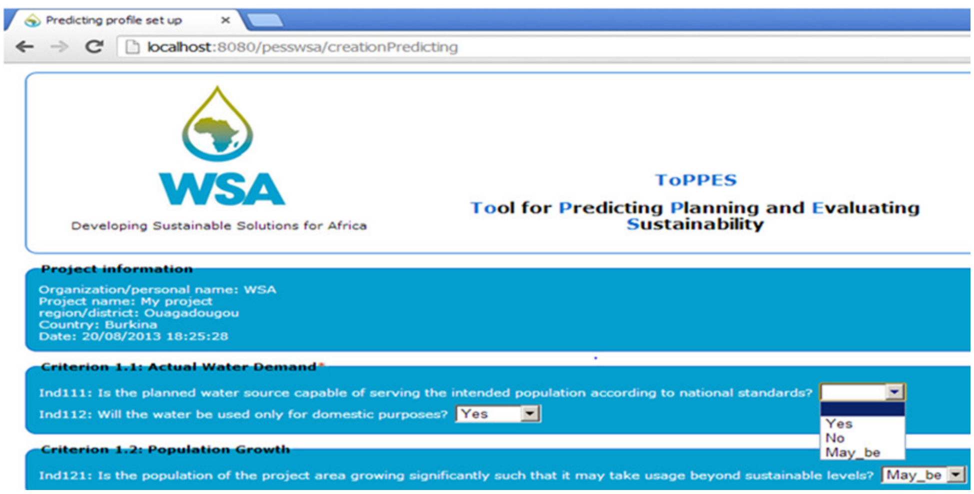

Figure 1. *Answer to indicators for Predicting the sustainability of a WDSP*

When using a local server (e.g. tomcat), "localhost:8080/pesswsa/creationPredicting" (resp. "localhost:8080/pesswsa/creationEvaluating") is the web address which allows you to reach the application in the case of predicting (resp. evaluating) sustainability of a given WDSP. Figure 1 shows what we get when seizing the mentioned web address on Google Chrome browser.

As showed in figure 1, to know the state of sustainability of a WDSP we need a "Yes", "No"or "May_be"answer to be chosen for each indicator of a criterion. The answer "Yes"(resp. "No") means that the performance of the WDSP is satisfactory (resp. not satisfactory) for the corresponding indicator. The answer "May_be"means that, for the corresponding indicator, the performance of the considered WDSP, in terms of favor the sustainability, is between the "yes" and the "No" answer. Note that every name of criterion followed by a red star, as we can see in figure 1, indicates that this criterion require a constraint of performance which must be satisfied (see section 4.5). After answering all the indicators according to the state of the concerned WDSP, we need to validate these information by pressing the button "submit" to see the report page (see figure 2) with

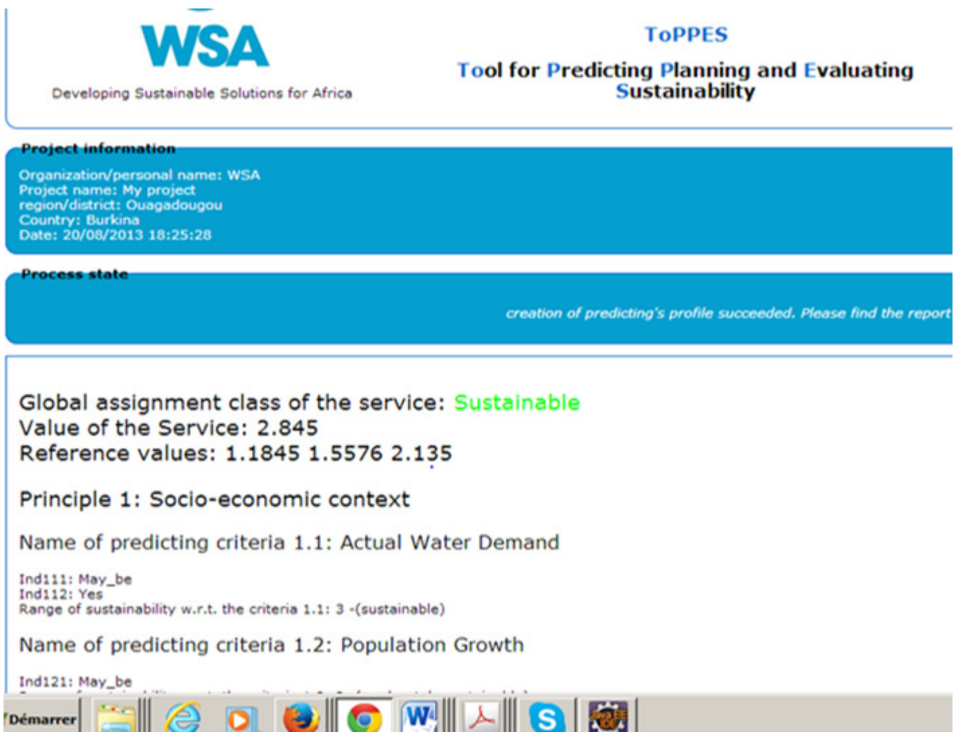

Figure 2. *A report page on the Predicting of the sustainability of a WDSP*

information on the global (resp. partial) level of sustainability of the WDSP w.r.t all the criteria (resp. each of criterion).

7. Conclusion and perspectives

The proposed model in its web-based form, has been tested with good result in the context of study of the sustainability of WDSPs in The Greater Afram Plains Area. Our approach allows us to build a hierarchy of criteria and indicators that is valid in a wide variety of context of evaluating the sustainability of WDSPs. Applying the same evaluation scheme to other regions for instance, would require some additional efforts [14] as our approach is clearly described and based on structuring and aggregation process of multicriteria decison aid. This effort will mainly concern the identification, through the proposed top-down and botton-up approach, of the relevant criteria and indicators, and also the determination of reference values β_h which fit better to the region on study. Furthermore the evaluation of the sustainability of the management of a natural resource (e.g.

soil, vegetation) of a given region could be done by the same approach. Some perspectives can be outlined. Firstly, it is the determination of thresholds (stemming from the profiles) of assignment categories. Their direct determination as we did with WSE is difficult. We can envision determining them by a learning procedure, on examples of assignment of WDSPs to categories. Indeed this could be a better way to reduce WSE's effort in the process of finding them. A way to do that could be an adaptation of the learning version of the additive value function based assignment model, UTADIS [6]. A second perspective could be to see, in our proposed approach, how to use outranking methods in an efficient way, as they give better results than total aggregation methods in such environmental context. Finally a third perspective could be the generalization of the usage of the tool for any context of evaluating the sustainability of the management of any natural resource.

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