Urban park's ecological and recreational aspects in developing country: evaluating the Bãngr-Weoogo Park in Ouagadougou

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Abstract

The recognition of recreational and conservation benefits of protected areas provides a usable economic rationale for their management. The value of recreational and conservation benefits of the Bãngr-Weoogo urban parks at Ouagadoudou in Burkina Faso is evaluated using choice experiment. We aim to see if visitors' preferences shared between recreation and biodiversity of urban park, at first views divergent, can be reconcilable in developing countries context by identifying trade-offs between the different characteristics of the park. Our results show that current Park is preferred and increase of biodiversity level is the feature able to improve the visitors' well-being. Likewise, modification of current recreational restrictions or the increase of relaxing areas reduces their welfare.

Highlights

- We study trade-offs between biodiversity conservation and recreational uses using choice experiment
- This is the first study applied to urban forest in developing countries
- We find that increase of biodiversity level improve visitor's welfare while alleviation of recreational restrictions reduce it

Key words: biodiversity management, choice experiment, developing country, recreation restrictions, urban forest

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1. Introduction

Recreation is certainly the most extensively studied among the many services that people obtain from ecosystems. This can be explained both by the fact that recreation is a service well identified by users and for which they can easily be questioned and express meaningful preferences. Urban and sub-urban forests are increasingly involved in recreational activities (Cole, 1996) and the type of Layouts affects probably the preference of visitors for these places of recreation (Tyrväinen et al., 2003). On the one hand, Layouts is combined with intensive use of forests and unfavourable growth conditions for some species, and, on the other hand, there is a strong demand for preserved areas for ecological reasons (Tyrväinen et al., 2003). The management of urban parks has been shown to being of real importance for the sustainability of large cities (Chiesura 2004; Brander and Koetse 2011). The issue is of even large interest for expending cities whose population increases at high rates in developing countries.

In this paper, we aim at enlightening several issues related to such a park in the urban area of Ouagadougou, the capital-city of Burkina Faso (West Africa). This old protected forest from the former "Mossi" kingdom, confirmed by the colonial administration, was recently reassigned to the city government that transformed it in an urban park, opened to the public for recreation purposes. The park is facing a fast growing frequentation. Strong protection of existing ecosystems and species, improvement of recreation facilities are among possible options and it is unclear to know which ones will have the most beneficial impact on population welfare. We address these issues by evaluating changes in visitors' well-being by a series of improvements to recreational facilities in forests by using choice experiment. Which brings us closer to the work of Christie et al. (2007) and providing operational management attributes (such as recreational restrictions), which brings us closer

work Juutinen et al. (2011), but in developing countries where environmental issues are often considered lower priority (Martinez-Alier, 2003).

For this study, we use the choice experiment in order to allow users of the park to express preferences related to various attribute of the park management. If travel cost method is widely considered as more robust than those based on stated preferences to valuate recreation (Hanley et al., 1998; Parsons, 2003; Shrestha et al., 2002), choice experiment allows studying more precisely management options. Thought described as the “holy grail” of valuation methods, choice experiment is able to highlight the trade-offs between many attributes especially when it comes to management policy including heterogeneous aspects of spatial organization.

2. Materials and methods

2.1. Study area

Ouagadougou urban park, Bãngr-weoogo is a natural forest dedicated to recreational and educational use. Formerly called “Bois de Boulogne”, in reference to the well-known urban park in Paris, this forest which is now coined in the urban area of the capital-city of Burkina, was classified in 1936 by the colonial forest administration according to Decree No. 2376/SE. In January 2001, as part of the decentralization process, this classified forest is reassigned, with the impossibility of alternative use of the site, to the city of Ouagadougou by the Ministry of Environment and Water, which renamed it “Bãngr-weeogo" ("forest of knowledge" in Mossi language). The overall objectives were to minimize the risk of damaging the Ouagadougou’s dams’ embankments, to establish a site convenient for the teaching of natural sciences, to develop a walking trail and relaxation area, and to create a "green lung" in the growing city of Ouagadougou.

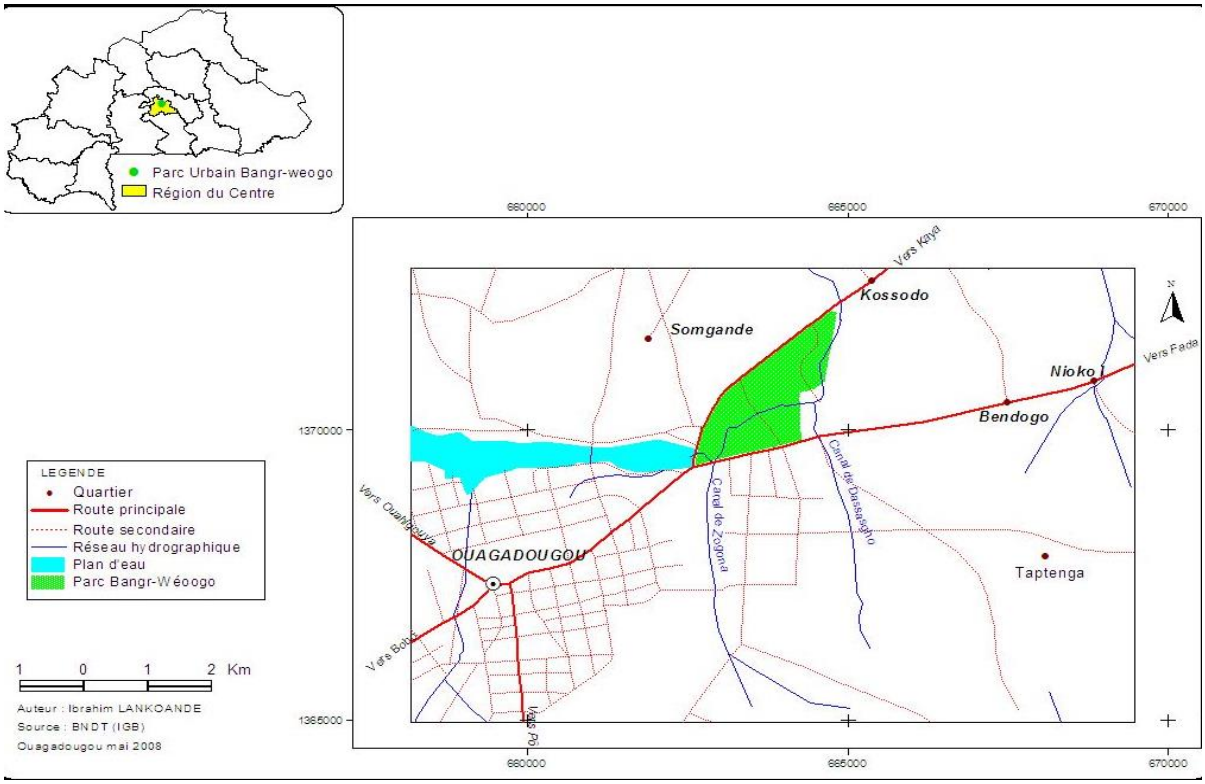
The park covers a total area of 265 ha of which 240 are arranged, and it is becoming increasingly important on several issues such as environmental education, research, medicines and ecological role such as the carbon dioxide storage (Gnoumou and al. 2008).

The park hosts several ecological formations where trees, woodland and bushland dominate, and also forest gallery along the river and some wetland (Dana, 1990). It is like an oasis in a desert due to the loss of vegetation cover around housing and the importance of its biodiversity: it contains more than 1000 plant species. It also

shelters 60 animal families and 225 species of birds. The use of this space, organized in educational units (zoo, nursery, botanical garden, museum), relaxation, leisure and business units are now well-known. However, this space in urban areas is subject to much different land pressure due to the increase of urbanization and misbehavior because of the importance of its frequentation (over 300,000 visitors in 2013) and bad practices. Indeed, the fauna and flora are victims of numerous attacks such as logging, bush fires, the presence of plastic waste on the ground and the current flow of motorized vehicles endangering not only animals' lives but also users.

It is thus important to find trade-offs between the park management, facilities development and biodiversity protection and economic valuation can help enlighten this case. Since the issue was to discriminate among management options, choice experiment appeared as an appropriate technique and was therefore implemented.

Figure 1: Urban Park Bãngr-Weoogo location

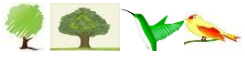


2.2. Survey design

The study began by interviews with the urban park manager and organizations which work with him to identify park's characteristics and develop the questionnaire. These people were used as a *focus group* and the resulting questionnaire has four sections.

The first part contains questions related to the environmental attitudes of respondents. The second and most important part contains the "choice experiment". Here, we give information concerning Bãngr-weoogo and the choice sets related to alternative management solutions. It includes descriptions of the five choice experiment's attributes, i.e. biodiversity, expected number of visits, relaxing areas, recreational restrictions and entrance fee. The attributes levels are shown in the table 1. The third part poses some fundamental questions related to the motivations of visitors for visiting place and activities; and the last section collects respondents' socio-demographic characteristics.

Table 1: Attributes and attribute levels

Attributes	**Level of attributes**
1. Number of plants and animals species over the next 5 years	Decrease  Stable*  Increase 
2. Expected visits number	Decrease 250.000 Stable* 300.000 Increase 350.000
3. Relaxing areas	0 1* 2
4. Recreational restrictions	**Without restriction** (cycling, motorized vehicles, levies, birds hunting and no forbidden zone access)  **Current situation*** (cycling and levies)  **Total restriction**
5. Entrance fees	0; 100*; 200; 300; 400; 500

*Current situation

According to the number of attributes and these levels, 486 profiles (3 * 3 * 3 * 3 * 6 = 486) were possible. To present profiles to the respondents in the questionnaire, we applied an efficient design protocol. The problem with this design is that it requires parameters beforehand and the very purpose of the assessment is the estimation of these parameters (ChoiceMetrics, 2012). Thus, we started a pilot survey with D-optimal design that allowed us to get first estimates of the parameters in order to create an efficient design. This first procedure resulted in 18 choice sets that we

considered too large for respondents. Thus we set up the final 3 blocks of 6 choice sets. Each respondent is faced with one of these three blocks, has finally 6 choice sets; each choice being made up of two alternative parks and the present situation (status quo).

The numerous existing definitions for biodiversity make its assessment complex (Christie et al., 2006). We must therefore define it in intelligible manner and Christie et al. (2006), through focus groups, held 4 attributes for the description of biological diversity: known species, rare or endangered species not yet known, the protection of habitats and species, and ecosystems process. The analysis showed that only a minority gives a particular value to biological resources as a species, habitat or ecosystem services (Christie et al., 2006; Pearce, 2001). In order to better define and present our attribute referring to biodiversity, we examined studies that used biodiversity attribute (see Hanley et al. 1998; Carlsson et al. 2003; Horne et al. 2005; Jacobsen et al. 2007; Christie et al. 2007; Birol et al. 2009; Jacobsen and Thorsen 2010; Juutinen et al. 2011). According to Pearce (2001) remark and after studies examination, a decision had to be made. What would be the description of our attribute referring to biological diversity? We could define biodiversity as rare or iconic or reproducing species, but sometimes they are not known or are so present in the citizens' live that making an evaluation become difficult. In addition, we were unable to identify a specific species or an "icon" to protect. This reinforce our conclusion to define the biodiversity attribute as the number of species of plants and animals and populations in these species as in Juutinen et al. (2011).

Example of choice set

	Park 1	Park 2	Park 3 (status quo)
Biodiversity			
Expected visits number	250.000	350.000	300.000
Relaxing areas	2	0	1
Recreational restrictions			
Entrance fee	500	200	100
	○	○	○

2.3. Data

The questionnaire was addressed to visitors in order to obtain operational results for park management. The survey was conducted on-site “Bãngr-weoogo” Urban Park during three weeks in June 2013. We used random sampling and face-to-face interviews, during weekdays as well as weekends at different opening hours. The total number of respondents was 500.

174 respondents consistently chose to maintain the current situation. Among them, 25 were removed from treatment. This choice was made according to follow-up question that asked respondents to give reasons for that choice. Of the 149 questionnaires retained, visitors advanced as a reason the fact that the current situation really suit them or that alternatives do not. As for the 25 questionnaires removed, respondents advanced as a reason the fact that it is not up to them to pay for the park or it is not up to them to decide how it should be managed, which is considered protest responses hence their removal.

The data base includes 475 respondents. Among them, there were almost as many men as women most of whom were nationals. 56% of respondents had a high education level and 40% a secondary level of education. Only 0.21% of them were illiterate. This is due to the fact that the park is located in the heart of the Burkina Faso capital.

Regarding employment status, 78% of respondents were students, followed by professionals (nurses, teachers ...) who represented 8% of the sample, and 2% were unemployed.

Concerning the main activity within the park, 37% of respondents picnic, 29% are studying, 27% of visitors are there for landscape and relaxation. Sport which occupies 4.84% comes last. The sample was representative, because the questionnaire was addressed randomly across the park and at different opening hours in working days and week-end, and the importance of the students reflects the fact that the park is situated not far from the university.

2.4. Models

Choice experiment is the Holy Grail of non-market goods assessment techniques (Bennett and Adamowicz, 2001). Morey (1981) showed that the value of leisure depends not only on its price (i.e. the consumer income) but also its quality (Hanley

et al., 2003). The theory of the characteristic value of Lancaster (1966) states that the value provided by a product can be decomposed into the sum of the value of its features taken separately (Adamowicz and Boxall, 1998).

$$\boldsymbol{U_{in} = U(Z_{in}; S_n)}$$

$\boldsymbol{U}$, is the utility provided by alternative i to individual n, $\mathbf{i} \in \mathbf{C}$ the set of alternatives, $\boldsymbol{Z_{in}}$, the attributes of I and $\boldsymbol{S_n}$ socio-demographic characteristics of n.

This theory was combined to the theory of random utility of Thurstone (1927) that states that it is not possible to identify all factors influencing preferences (Baltas and Doyle, 2001). The utility can thus be separated into a deterministic term ($\boldsymbol{V_i}$) which depends on the preferences and the described effect on the alternative level, and a stochastic term ($\boldsymbol{\varepsilon_i}$) that takes into account the unobserved determining (Bonnieux and Carpentier, 2007).

$$\boldsymbol{U_i = V_i + \varepsilon_i}$$

In these two theories, the utility provided by i can be written:

$$\boldsymbol{U_{in} = V(Z_{in}; S_n) + \mathcal{E}(Z_{in}; S_n)}$$

And the probability that an individual chooses the alternative i instead of j others alternatives is given by:

$$\boldsymbol{Pr(i|C) = Pr\left(V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn}, \forall j \in Cn, j \neq i\right)}$$

The economic model underlying this type of equation is intrinsically linked to statistical models (Hoyos, 2010). The specification of the econometric model is linked to the probability distribution of the error term.

Data from this survey was analyzed using conditional logit (CL) and latent class logit (LCM). The conditional logit (LC) is the model used for the analysis of data from the choice experiment (Birol et al., 2009). It assumes that the error term follows a Gumbel distribution and is independently and identically distributed (IID). This law respects the assumption of independence of irrelevant alternatives choices (IIA) which is necessary in the random utility theory (Hanley et al., 1998).

The probability that the individual chooses option i instead j others is given by:

$$\boldsymbol{Pr(U_{in} > U_{jn}) = \frac{exp(V_{in})}{\sum_{j \in C} exp(V_{jn})} = \frac{exp(\beta X_{in})}{\sum_{j \in C} exp(\beta X_{jn})}}$$

The latent class model is an alternative of CL which takes into account respondents' preferences heterogeneity. In this model, the population is represented as consisting of a finite number of segments or classes and we assume that heterogeneity affects preferences and we need to know the factors of this heterogeneity (Boxall and Adamowicz, 2002). Preferences are assumed to be homogeneous within each class, but are allowed varying between classes. The number of segments is determined endogenously by the data and the membership to a segment is linked to observable socio-economic characteristics.

The probability $\boldsymbol{P_{ins}}$ that individual n belonging to a segment S chooses the alternative i is given by:

$$\boldsymbol{P_{ins} = (P_{in/s}) * (P_{ns}) = \frac{exp(\beta_s X_{in})}{\sum_j exp(\beta_s X_{jn})} * \frac{exp(a_s Z_n)}{\sum_s exp(a_s Z_n)}}$$

Where $\mathbf{(P_{ns}) = \frac{exp(a_s Z_n)}{\sum_s exp(a_s Z_n)}}$ is the probability that the individual n belongs to the segment S.

3. Results

3.1. Estimation

All parameters from the conditional logit, except the expected number of visits and the increase of relaxation areas are significant at the 10% risk level. The alternative specific constant (ASC) which reflects the utility associated to the basic alternative is significant and negative. This shows that the status quo is preferred. Decreasing in biodiversity and relaxing areas reduce the probability of choosing an alternative however an increase in biodiversity level raises this probability. Decreasing or increasing recreational restrictions level reduces also the probability of choosing an alternative.

The latent class model allows to expressing the heterogeneity of preferences based on the choice of visitors and also on variables such as socio-demographic characteristics that make classes. To make coherent classes while limiting the number of classes, we have integrated several variables such as age, gender, visits

number, income and socio-professional category. It is possible to create a plurality of classes. To choose the appropriate number of classes and the most efficient model, we relied on the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) and the predictive quality of the model measures the probability that an individual belongs to the class actually attributed to him.

Table 2: conditional and latent class logit models quality

	Conditional Logit	Latent class model			
		2 classes	3 classes	4 classes	5 classes
Log likelihood	-2177.16	-2025.68	-1960.83	-1927.6	-1903.4
AIC	4374.31	4051.36	3921.65	3855.20	3806.78
BIC	4374.31	4051.36	3921.65	3855.20	3806.78
Predictive quality		0.90	0.88	0.83	0.83

The logit models' quality improves with the number of classes. The better is the model according to the maximum likelihood (log likelihood) and AIC and BIC (the best model is the one that has the lower AIC and BIC). However, increasing the number of classes actually decreases the predictive quality of the model from 90% for 2 classes to 83% for 5 classes. In order to keep the maximum number of significant variables, to facilitate interpretation of results, and to keep a good predictive quality of the model we have chosen to limit it to 3 classes.

Referring to the significance and the sign of the estimator associated to the ASC, visitors of Class 1 and 2 are indifferent to change (not significant ASC); those of Class 3, with more respondents prefer the current situation.

Table 3: Estimation results

	Conditional Logit	Latent class				
		Class 1		Class 2		Class 3
	N=475	N=67		N=131		N=277
Attributes	β	β		B		B
ASC	-0.855***	-		-		-2,164***
Biodiv-	-0.550***	-0.555**		-0,711***		-
Biodiv+	0.243***	0.388*		-		1,350***
Visit-	-	-0.698**		-		-0,760**
Visit+	-	-		-		0,807***
Areas-	-0.617***	-1.058***		-		-1,440***
Areas+	-	-				-
Without restriction	-0.901***	0.808***		-2,129***		-2,275***
total restriction	-0.314***	-1.193***		-		-0,854***
Entrance fees	-0.0006***	-0.002***		-0,0006*		-0,0008*
Classes membership parameters		RRR	P value	RRR	P value	Reference
Constant		-	0.971	0,436	0.000	
Age		0.858	0.000	-	0.773	
Male		1.374	0.000	0.556	0.000	
Visits' number		0.976	0.000	0.980	0.000	
Average income		-	0.507	-	0.639	
High income		0.125	0.000	1.368	0.004	
executive		-	0.960	0.436	0.000	
Professional or intermediate		-	0.967	0.282	0.000	
Students		-	0.967	0.149	0.000	

***Significant at 1% **significant at 5% *significant at 10% [-] not significant RRR: Relative Risk Ratios

The well-being provided by the various characteristics can be assessed through this table. It also helps to know the characteristics of each visitor's class and also to give their preferences over the current situation. The RRR coefficients make them easier to interpret (Cahuzac and Bontemps, 2008). Thus, the more visitors are young, more likely they belong to Class 1. Male have 1.154 times greater chance to belong to Class 1 rather than Class 3 compared to women. Individuals with annual low visits of park have a larger chance of being in classes 1 and 2 than in Class 3. Visitors with low income were more likely to belong to Class 1. Executives, students, and those who practice a liberal profession are as likely to be in classes 1 and 3. The unemployed are certain to be found in class 2.

3.2. Welfare analysis

Table 3 allows us to evaluate park visitors' preferences to different levels of attributes and through the willingness to pay.

$$\text{WTP}_{\alpha} = -\frac{dx_p}{dx_\alpha} = -\frac{\beta_a}{\beta_p} \ ,$$

where $\boldsymbol{\beta_a}$ is the parameter on the attribute α and β_p is the parameter on entrance fee according to the conditional logit estimation. For latent class model, willingness to pay is given by the formula:

$$\boldsymbol{CAP_{n,\alpha}} = \sum_{s=1}^{S} \boldsymbol{P_{n,s}} \left(-\frac{\beta_{a,s}}{\beta_{p,s}} \right) ,$$

where $\boldsymbol{\beta_{a,s}}$ is the parameter of the attribute α for the class S; $\beta_{p,s}$ the parameter on entrance fee for the class S and $P_{n,s}$ the probability that an individual n belongs to the class S.

Willingness to pay are shown in table 4.

Table 4: willingness to pay for attributes

	Willingness to pay			
	Conditional logit	Latent class model		
	N=475	Class 1 (N=67) Male, young, low income, low visits number	Class 2 (N=131) Female, high income, low visits number, unemployment	Class 3 (N=277) Older, average income, high visits number
ASC	-1408.33	-	-	-2705.00
Biodiv-	-916.66	-277.50	-1185.00	-
Biodiv+	405.00	194.00	-	1687.50
Visit-	-	-349.00	-	-950.00
Visit+	-	-	-	1008.75
Areas-	-1028.33	-529.00	-	-1800.00
Areas+	-	303.00	-	-
Without restriction	-1501.66	404.00	-3548.33	-2843.75
total restriction	-523.33	-596.50	-	-1067.50

Superscript – in link with attributes' name indicates a reduction and superscript + an increase compared with basic alternative.

According to the conditional logit model, basic alternative is preferred and an increase in the biodiversity level is clearly the characteristic which rise visitor's welfare. Remove or increase the recreational restrictions, decrease visitor's welfare. The current recreational restrictions level is by far the most preferred.

Notice that there is heterogeneity in visitors' preferences. Visitors of class1 and 2 are indifferent to change but those of class 3 are against it.

In Class 1 the visitors' welfare increases with biodiversity and relaxing areas augmentation. But a reduction of the biodiversity, the expected visitors number and the relaxing areas, reduce it. Notice that they have a willingness to pay for recreational restrictions suppression and have a willingness to receive for total restrictions (more than the willingness to pay and this bias is admit in scientific community).

Class 2 visitors are very specific. They don't care about biodiversity increasing but their welfare decrease with biodiversity reduction and recreational restrictions suppression.

Based on the signs of the estimators, Class 3 visitors preferences are almost similar that the average visitor. Welfare increases when biodiversity and expected visits number rise. All of other features decrease it and current recreational restriction is preferred.

4. Discussion

According to our study, the basic alternative in view of its characteristics is considered satisfactory by the visitors. Now let us discuss attribute by attribute.

Biodiversity

The feature able to improve the visitors' well-being is the biodiversity level increasing over the next 5 years. This remains consistent considering the results of previous studies (Deng et al., 2002; Horne et al., 2005; Juutinen et al., 2011).

Class 1 and Class 3 visitors prefer biodiversity increasing with a respective willingness to pay 194 and 1687 FCFA. This could well be explained by characteristics such as socio-professional category strongly linked to education level (we are more likely to find executives, professional or intermediate and students in these classes).

Expected visits number

An important feature is the expected visits number. A massive increase in the visits number creates congestion and pressure on resources (Clawson and Knetsch, 1969). This indicator is not significant for all visitors and those of Class 2. Firstly, its reduction reduces the welfare of Class 1 and Class 3 visitors. This is in agreement with the results of Shoji and Yamaki (2004) concerning the reduction of the number of visitors to 50%. On the other hand, its augmentation increases welfare of class 3 visitors. This result is contrary to that of Juutinen et al. (2011) shown. This could be explained by the fact that congestion is part of a psychological sensation and visitors at the moment do not feel it. This feeling is also mitigated by the construction of

secondary parallel roads to old tracks by the current manager. It is equally important to note the need for security, contact and highly social behaviour of some visitors.

Relaxing areas

Considering average, all visitors dislike relaxing areas increasing except those of class 2 whom is indifferent. On the other hand, relaxing areas increase is just preferred by class 1 visitors and tolerated by others. They can be installed in areas with few rare species where the vegetation is more tolerant.

Recreational restrictions

It is important to note the lack of correlation between recreational restrictions and the level of biodiversity. Hunting only affects birds. So, choose the suppression of restrictions is in no way contrary to an increase in the level of biodiversity. Generally visitors are against any form of change of current type of recreational restrictions. However, those of class 1 have their welfare level increase with restrictions suppression. It is important to note that the factor significantly decreasing the level of welfare is the removal of recreational restrictions. These remains consistent with that seen in the literature (see Adamowicz and Boxall 1998).

5. Conclusion

Through the use of choice modeling, we study the preferences of the visitors of the Bãngr-weeogo Urban Park for several management options. The current situation appears generally preferred. Visitors already feel well, which does not prevent positive willing to pay for some improvements. The most notable is probably the statement that visitors are willing to pay for an increase in the level of biodiversity compared to the current level. It is therefore possible to say which between biodiversity or recreation is preferred according to our results. While increasing biodiversity receives a WTP of 405 Fcfa, increased relaxing areas of is not significant and visitors are against the removal of recreational restrictions.

Visitors' preferences between ecological and recreational oriented intensive management, divergent at first sign can be reconciled in a city park in the context of developing countries as shown by our results. However, it is important to note the existence of a strong heterogeneity of preferences among park visitors. The socio-

professional situation and income level can explain preference heterogeneity regarding the increased level of biodiversity. It is important to consider in public policy as pricing policies for example. Visitors' willingness to pay estimated by conditional logit has the same signs as those of Class 3 gathering most visitors (277 among 475 respondents). This agreement could not exist. In this case, what should have been used, the results of the average or those of the majority, for the purpose of planning policies? To go further, we have to study who should finance these policies.

Acknowledgments

We thank Moustapha Sarr Bãngr-weoogo administrator, Laure Kuhfuss, Douadia Bougherara, Raphaele Preget, Drissa Traoré for helpful comments and suggestions. Financial support from french cooperation.

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