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Prioritization of strategies for protected area management with local people using the hybrid SWOT-AHP analysis: the case of Kakum conservation area, Ghana

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A B S T R A C T

The contribution of protected areas towards conservation and protection of biodiversity cannot be over emphasized. Likewise, the dependence of local communities on forest and natural resources cannot be overlooked. Hence for the long term viability of forest reserves and wildlife protected area, the relationship of local people living close to these areas are of key importance if conflict of use can be mitigated. Admittedly, decision-making with respect to forest resource use and protection are complex due to the multiple interests of the major stakeholders. Stakeholder involvement in the planning, management and policy analysis can help resolve conflicts, and increase the commitment of local people to support conservation of protected areas. In this paper, we employ the SWOT-AHP methodology, with the aid of the Priority Estimation Tool (PriEsT), to evaluate and prioritize three management strategies for the Kakum conservation area in Ghana, as a means to facilitate conservation while ensuring benefits to local people. Considering the management objectives of the conservation area, seventeen SWOT sub-factors were identified and used in rating the three alternative management strategies. Among the strength sub-factors, enforcement of protection regulations (S4) is the most important. Similarly, limited funds for patrolling and outreach programs (W3), local people's interest in alternative livelihood (O4) and the presence of illegal activities (T3) are the most important weakness, opportunity and threat sub-factors respectively. The management strategy "institute village committees to support monitoring and protection of resources" (A1) has the highest priority rating, indicating that management authorities must pay more attention to collaborative management. We propose that to improve on protected area management in Ghana, more management strategy studies must be conducted. However, these studies may apply the fuzzy AHP technique since it is supposed to have a better capacity to handle uncertainties in human judgments during decision-making.

1. Introduction

The need to conserve and sustainably manage Ghana's wildlife heritage has resulted in the creation of numerous protected areas to protect representative species of all the ecological zones of the country (Fiagbomeh, 2012). The official establishment of forest reserves and wildlife protected areas in Ghana

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evolved during the era of the colonial administration. Hence according to Kotey et al. (1998), the majority of reservations took place in the 1920s and 1930s.

Since human influences at both the national and regional levels are of key importance in considering the long term viability of forest reserves and wildlife protected area, the relations with local people living close to these protected areas are of paramount importance. That notwithstanding, the needs and aspirations of local people have often been overlooked in the initial planning of protected areas. The management usually take minimal consideration of local communities' needs and mechanisms to cope with ensuing conflicts are commonly non-existent or inadequate. Therefore many areas are now suffering from acute pressure from local exploitation as resources outside the protected areas have been depleted.

Although the reservation of protected areas in Ghana was effected by negotiations with traditional authorities who originally owned the lands, earlier wildlife policies failed to recognize the socio-cultural, and utilitarian values that the Ghanaian societies placed upon the resources. The policies were developed to focus on "protecting" wildlife from rural people (Adams & McShane, 1997). To address the shortfall, the most current policy document, the 1994 Forest and Wildlife Policy, lays the foundation for collaboration with key stakeholders (local people) to ensure conservation and sustainable development of the nation's forest and wildlife resources for the maintenance of environmental quality and perpetual flow of optimum benefits to all segments of the Ghanaian society. In spite of the current forest and wildlife policy, wildlife protected areas still face numerous challenges which include poaching and land conversion due to expansion in agricultural activities around them. Poaching continues due to the demand for game and other non-timber forest products for the sustenance of livelihood. In other cases, the killing of wild animals occurs as a result of human-wildlife interactions, particularly the destruction of food and cash crop farms (UICN/PACO, 2010; World Bank, 2006), thus defeating the objective of wildlife conservation and sustainable local area development.

It is increasingly recognized that protected areas cannot be managed as biological islands but must be integrated within a broader ecological and human framework (Western, 1982), aiming at collaborative management. Earlier studies in the Kakum conservation area (KCA) indicated local people's interest to participate in protected area management (Fiagbomeh, 2012). This paper therefore employs the hybrid SWOT-AHP analysis to assess the current management practices and rank alternative management strategies to facilitate strategic collaborative sustainable management while taking the needs of the local communities into consideration.

2. SWOT-AHP analysis for protected area management

Strategic management, according to (Yüksel & Dağdeviren, 2007) can be understood as the set of decisions and actions taken to determine the long-term activities of an organization. There are many approaches and techniques that can be used to prepare for strategic management processes from which the SWOT-AHP has been adapted and used as a method in forestry and forest management planning. A compendium of its general applications in scenarios of forest and natural resources management in published literature has been provided by (Schmoldt, Kangas, & Mendoza, 2001).

Originally, SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis is an important brain-storming tool for decision-making, which is used to analyze an organization's internal and external environment (Kangas, Hokkanen, Kangas, Lahdelma, & Salminen, 2003; Kurttila, Pesonen, Kangas, & Kajanus, 2000). SWOT analysis is a simple yet useful planning tool to understand the 'Strengths', 'Weaknesses', 'Opportunities' and 'Threats' as part of a strategic planning process. It is often employed when monitoring or evaluating a specific program, service, product or industry and exploring measures for improvement (Steve R. Harrison, 2002). Kotler (1994) explained that during the planning process

various factors influencing the operational environment are diagnosed in details and decomposed into a hierarchy (Fig. 1) with the aid of the analytic hierarchy process (AHP).

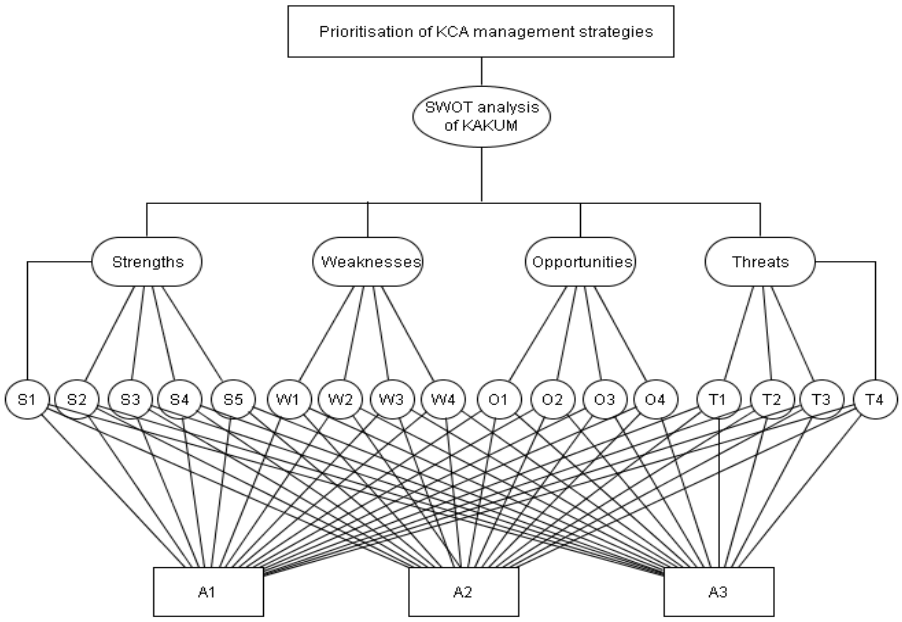

Fig. 1. Hierarchical SWOT-AHP model

2.1 The analytic hierarchy process

The Analytic Hierarchy Process (AHP) approach developed by Thomas Saaty is a mathematical theory of value, reason and judgement, based on ratio scales which has become very popular in its application in assessing criteria weightings in various multi-criteria decision-making (MCDM) problems across many fields, including planning and resource allocation and in conflict resolution (Saaty, 1977, 2001; Wolfslehner et al., 2005). It involves decomposing a complex MCDM problem into a hierarchy, consisting of an overall goal, a set of criteria which are also decomposed into sub-criteria, with the lowest level of the hierarchy being the decision alternatives to be evaluated (Fig. 1). The AHP is based on pair-wise comparison to assess the relative importance of the decision criteria, comparing decision alternatives with respect to each criterion, and determining an overall priority for each decision alternative in order to generate an overall ranking for the decision alternatives (Wang, Luo, & Hua, 2008). The pair-wise comparisons are based on relative importance where the decision maker expresses the preference between two elements on a ratio scale from equally important to absolute preference of one element over the other (Saaty, 2001).

2.2 A multi-attribute evaluation method: AHP

The Analytic Hierarchy Process (AHP) is a comprehensive framework which is designed to cope with intuitive, rational, and the irrational aspects when multi-objective, multi-criterion, and multi-actor decisions are to be made, with or without certainty, for any number of alternatives. Its basic assumption is the functional independence of the groups (objectives and criteria) in the hierarchy, and of items in each level of the criteria and alternatives (Lee & Kim, 2000). AHP thus provides well structured, systematic decision making analysis and support, incorporating both qualitative and quantitative attributes. In this respect it can be considered as a general theory of measurement based on mathematical and psychological foundations (Kurttila et al., 2000). It further helps in analyzing complex problems with all their relevant interelations. Due to its usefulness in decision-analysis, the technique has been applied in cases dealing with strategic planning, including marketing applications (Wind & Saaty, 1980), as well as in the design and evaluation of business and corporate strategy (Wind,

1987). In applying the technique for decision making, a hierarchy of the problem or issue is constructed from which a matrix of pair-wise comparisons (Eq. 1) is obtained (Saaty, 1980). In a comparison matrix, the element $a_{ij} = 1/a_{ij}$ so that when $i = j$, $a_{ij} = 1$. The value of weight w_i may also vary from 1 to 9, where 1/1 indicates equal importance while 9/1 indicates extreme or absolute importance.

$$A = (a_{ij}) = \begin{bmatrix} 1 & w_1/w_2 & \dots & w_1/w_n \\ w_2/w_1 & 1 & \dots & w_2/w_n \\ \vdots & \vdots & \dots & \vdots \\ w_n/w_1 & w_n/w_2 & \dots & 1 \end{bmatrix} \quad (1)$$

In performing the pair-wise comparison, some inconsistencies may occur. In the situation where **A** contains inconsistencies, the estimated priorities can be obtained using the matrix as shown in (Eq. 1) as the input using the eigenvalue technique expressed in (Eq. 2) (Saaty, 1980).

$$(A - \lambda_{max} I)q = 0 \quad (2)$$

where λ_{max} is the largest eigenfactor of matrix A of size n; q, is its correct eigenfactor; and I is the identity matrix of size n. The correct eigenfactor, q, constitutes the estimation of the relative priorities of the factors. In order to satisfy the necessary and sufficient condition for consistency, Saaty (1977) demonstrated that λ_{max} should be equal to n. In this instance, inconsistency may arise where λ_{max} deviates from n due to inconsistent pair-wise comparisons. It is therefore required that the matrix A be tested for consistency using the consistency index CI (Eq. 3) provided as follows (Saaty, 1980).

$$CI = (\lambda_{max} - n) / (n - 1) \quad (3)$$

CI estimates the level of consistency with respect to a comparison matrix. Then because CI is dependent on n, a consistency ratio CR is calculated, which is dependent on n (Eq. 4)

$$CR = CI/RI \quad (4)$$

where CI is the consistency index; RI is the random index generated from a random matrix of order n, and CR is the consistency ratio. As a general rule, CR ≤ 0.1 should be maintained for a matrix to be considered consistent.

3. Materials and method

3.1 Description of study area

The Kakum conservation area is a remarkable 360km² protected area located within the Central Region of Ghana. It is about 30km north of the regional capital, Cape Coast. The area falls within the Assin and Twifo Heman Lower Denkyera Districts and lies between latitude 5°20’ – 5°40’ North and longitude 1°15’ – 1°30’ West. The greater part of the reserve however falls within the Assin District (Agyare, 1995; Wildlife Department, 1996). The area represents one of the last vestiges of the Upper Guinea forest ecosystem stretching from Guinea to Togo, which is categorized as one of the eight African biodiversity “hotspots” by Conservation International (Critical Ecosystem Partnership Fund, 2000). The conservation area was reclassified and gazetted in 1992 through the Wildlife Reserves Regulations (LI 1525) under the administrative jurisdiction of the Wildlife Division of Ghana (Adu-Nsiah, 1996; Agyare, 1995; UICN/PACO, 2010).

The Kakum Conservation Area was selected for this case study because the local people had some use rights and depended on the conservation area for various non-timber forest products (NTFPs) to sustain their rural livelihoods before the administration changed from the Forestry Division (FD) to the Wildlife Division (WD). The use right was withdrawn on the assumption of management by the WD. The local residents were to accrue some benefits from the enforcement of conservation regulations and the implementation and management of ecotourism activities through active participation and benefit

sharing arrangements. That has however not been the case in practice and is met with few challenges. With over 52 village communities and hamlets around the Kakum conservation area, the severity of poaching is the highest among the wildlife protected areas in the country (UICN/PACO, 2010). The situation thus offers an opportunity to assess management strategies to ensure conservation of natural resources, while supporting the livelihoods of local people within the conservation area.

3.2 Utilizing AHP in SWOT analysis

The incorporation of AHP within a SWOT framework allows for a systematic evaluation of SWOT factors and their relative intensities. The SWOT approach, in combination with the analytic hierarchy process, provide a quantitative measure of importance of each factor considered in the decision-making (Saaty & Vargas, 2012). There are four steps involved in conducting a combined SWOT and AHP analysis outlined by (Kurttila et al., 2000) as follows:

3.2.1 Step 1. Perform SWOT analysis

Identify the relevant factors of the external and internal environment in SWOT analysis matrix. When standard AHP is applied, it is recommended that the number of factors within a SWOT group (strengths, weaknesses, opportunities or threats) should not exceed 10 because the number of pair-wise comparisons needed in the analysis increases rapidly (Saaty, 1980). Thus, the results of the comparisons are quantitative values expressing the priorities of the factors included in the SWOT analysis.

3.2.2 Step 2. Carry out pair-wise comparisons between the SWOT factors within every SWOT group

In making the comparisons, the questions at ask are: (1) which of the two factors compared has a greater potential to achieve the set objective; and (2) by how much greater is this potential, using the 1 – 9 scale (Saaty, 1990). With these comparisons as the input, the relative local priorities for the factors are computed using the eigenvalue method. These priorities reflect the decision maker's perception of the relative importance of the factors involved.

3.2.3 Step 3. Perform pair-wise comparisons between the four SWOT groups:

At this stage, the factor with the highest local priority is chosen from each group to represent the group. These four factors are then compared as described in Step 2. They become the scaling factors of the four SWOT groups which are used to calculate the global priorities of the independent factors within them. This is done by multiplying the factors' local priorities (defined in Step 2) by the value of the corresponding scaling factor of the SWOT group. The global priorities of all the factors sum up to one.

3.2.4 Step 4. Utilize the results in the strategy formulation and evaluation process

The contribution to the strategic planning process comes in the form of numerical values for the factors. Following the derived priorities, new goals may be set with respect to the defined strategies and subsequently, plans for implementations can take into close consideration the foremost factors.

3.3 The strategic management assessment process

The SWOT-AHP analysis for the KCA is aimed at prioritizing management strategies, based on the identified strengths, weaknesses, opportunities and threats, according to the following objectives outlined by the Ghana Wildlife Division as their management guidelines:

i. To actively protect and conserve all natural resources and aesthetic features;
ii. To integrate the conservation area into the district and regional development process, especially into that of the surrounding communities, to ensure their cooperation and support for the conservation of the resources (Wildlife Department, 1996).

Essentially, these objectives culminate to sustainable non-consumptive use through strict protection while providing benefits to the local people in the surrounding communities. The effective execution of the management strategies and activities to achieve these objectives is therefore necessary to ensure the active participation of the local people in the protection of the area.

The SWOT factors in Tables 1 were derived from empirical data (community surveys, group discussions, interviews and observations) collected during field studies (Fiagbomeh, 2012). Additionally, some of the factors were obtained through secondary sources including official documents and reports on protected areas management in Ghana. The SWOT factors listed are not exhaustive. However, since there are too many possible factors that can be analyzed, the following analysis will be selective and concentrated on those factors that are critical for achieving the above listed objectives of the Ghana Wildlife Division.

Table 1
A SWOT Analysis of Biodiversity Protection in the Kakum Conservation Area

	Positive	**Negative**
Internal	**Strengths** S1. High diversity and species of conservation interest S2. No permanent settlements within the boundaries S3. Acceptance of the importance of the conservation area by local people S4. Enforcement of protection regulations S5. Well demarcated and undisputed boundaries	**Weaknesses** W1. Lack of formal and active involvement of local communities (people) in management W2.Limited number of patrol personnel (quantity and quality of expertise) W3. Limited budget for patrol and community outreach activities W4. Deficiency in law enforcement
External	**Opportunities** O1. Local people's interest to participate in management O2. Support of traditional authorities O3. Introduction of environmental education in local Schools O4. Local people's interest in alternative livelihood	**Threats** T1. Dependency of local people on forest resources T2. Wildlife-human conflicts (crop raiding) T3. Presence of illegal users (poaching) T4. Expansion of agricultural activities close to boundaries

4. Results

The pair-wise comparison matrices among the SWOT groups and their sub-factors are presented in Tables 2 - 6. Using the Priority Estimation Tool (PriEsT), a decision making tool for analytic hierarchy process (Siraj, Mikhailov, & Keane, 2013), the pair-wise comparison matrices and the priorities of the SWOT groups and sub-factors were generated and summarized in Table 7. The consistency ratios represent whether the decision makers were consistent in assigning the scores in the pair-wise comparisons. A CR $\leq$ 0.10 signifies that the pair-wise comparison matrix is consistent. The overall priorities of the factors are calculated by multiplying the priorities of the group with the individual factors within the group.

Table 2
Priorities of SWOT groups (CR= 0.6%)

With respect to the goal	Strengths	Weaknesses	Opportunities	Threats
Strengths	1	5	3	4
Weaknesses	1/5	1	1/2	1
Opportunities	1/3	2	1	2
Threats	1/4	1	1/2	1

Table 3
Priorities of Strengths criteria (CR = 0.8%)

With respect to strengths group	S1	S2	S3	S4	S5
S1	1	1/2	1/3	1/7	1
S2	2	1	1	1/2	2
S3	3	1	1	1/2	3
S4	7	2	2	1	6
S5	1	1/2	1/3	1/6	1

Table 4
Priorities of weaknesses criteria (CR = 3.3%)

With respect to weaknesses group	W1	W2	W3	W4
W1	1	2	3	4
W2	1/2	1	3	3
W3	1/3	1/3	1	3
W4	1/4	1/3	1/3	1

Table 5
Priorities of opportunities CR = 0.8%)

With respect to opportunities group	O1	O2	O3	O4
O1	1	3	2	1
O2	1/3	1	1	1/3
O3	1/2	1	1	1/3
O4	1	3	3	1

Table 6
Priorities of threats criteria (CR = 0.8%)

With respect to threats group	T1	T2	T3	T4
T1	1	2	1	2
T2	1/2	1	1/3	1
T3	1	3	1	2
T4	1/2	1	1/2	1

From the overall priority weights of the categorized sub-factors (Fig. 2), the strengths and opportunities factors predominate and for this analysis, there are no threat or weakness factors that have the potential to ruin the strategic options for sustainable management of the Kakum conservation area. In Fig. 2, the ranking of sub-factors is ordered from the least important to the most important sub-factor. Among the sub-factors of strengths (S), S4, “enforcement of protection regulations” (Table 7) is the strength with the highest priority (0.248). This factor is the main sub-strength that will ensure the sustenance and success of protection and management of the conservation area at present. “Limited budget for patrol and community outreach activities” (W3) is the most important weakness (W), followed by “limited number of patrol personnel” (W2). These weaknesses need to be urgently resolved. “Local people interest in alternative livelihood” (O4) is the most important opportunity sub-factor, alongside “local people’s interest in management” (O1). The most important threat (T) however is “Presence of illegal users engaging in poaching activities” (T3), followed by the “dependency of local people on the forest resources” (T1).

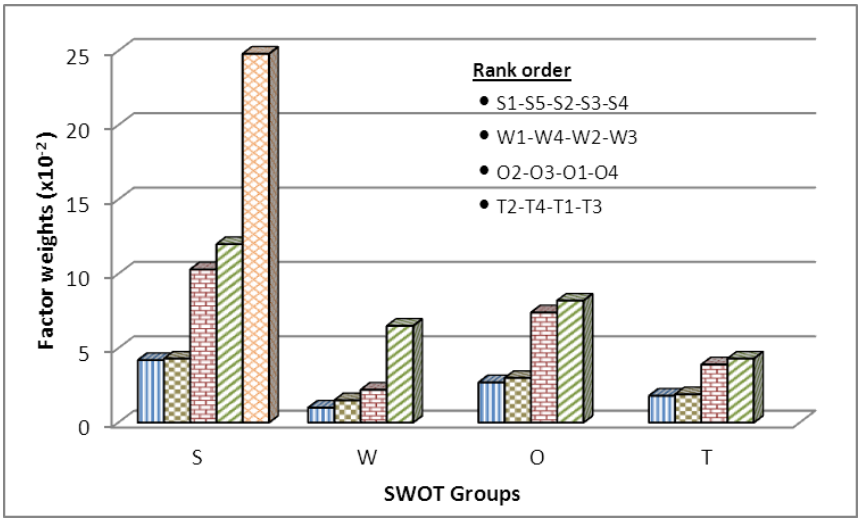

Fig. 2. The overall priority weights of the categorized SWOT sub-factors

The ranking of the sub-factors based on the priority of the groups and priorities of the factors within the group gives an overall priority of factor ranking as S4-S3-S2-O4-O1-W3-S5-T3-S1-T1-O3-O2-W2-T4-T2-W4-W1, indicating that "enforcement of protection regulations" (S4) is the most important sub-factor overall (Table 7).

Table 7
Priorities and consistency ratios of the SWOT groups and factors

SWOT Group	Priority of group	SWOT factors	Consistency ratio (CR)	Priority of factor within group	Overall priority of factor
Strengths	0.556	S1. High diversity and species of conservation interest	0.8%	0.076	0.042
		S2. No permanent settlements within the boundaries		0.185	0.103
		S3. Acceptance of the importance of the conservation area by local people		0.215	0.120
		S4. Enforcement of protection regulations		0.446	0.248
		S5. Well demarcated and undisputed boundaries		0.078	0.043
Weaknesses	0.112	W1. Non-involvement of local communities	3.3%	0.091	0.010
		W2. Limited number of personnel		0.195	0.022
		W3. Limited budget for patrol and community outreach activities		0.577	0.065
		W4. Deficiency in law enforcement		0.137	0.015
Opportunities	0.214	O1. Local people's interest in management	0.8%	0.348	0.074
		O2. Support of traditional authorities		0.128	0.027
		O3. Environmental education in local Schools		0.142	0.030
		O4. Local people's interest in alternative livelihood		0.383	0.082
Threats	0.119	T1. Dependency of local people on forest resources	0.8%	0.326	0.039
		T2. Wildlife-human conflicts (crop raiding)		0.148	0.018
		T3. Presence of illegal users (poaching)		0.363	0.043
		T4. Expansion of agricultural activities close to boundaries		0.163	0.019

The consistency ration of the comparison between four SWOT groups is 0.6%

After calculating the priorities of the groups and each sub-factor within the group and the overall priority of the sub-factor, the next stage is to prioritize the possible conservation area management strategies with respect to each group and each sub-factor of within a group. So, the next step is to define the possible conservation area management strategies.

4.1 Possible alternative management strategies for the Kakum conservation area

The possible Kakum conservation area management strategies are the alternatives (A1, A2, and A3) for the AHP model above (Fig. 1). A focus on these management strategies will deliver more and better protection for the conservation area while rendering sustainable benefits to the local people in the fringe communities around the conservation area. Implementation of these strategic alternatives will encourage local people's participation in protected area or biodiversity conservation in the local areas. The under stated strategic management alternatives were derived from the mentioned field study in consultation with the management authorities and the leadership of the local communities in the Kakum conservation area (Fiagbomeh, 2012).

4.2 Institute village committees to support monitoring and protection of resources (A1)

The enforcement of protection regulations through foot patrols by wildlife guards deters people from undertaking massive extraction of resources. However, there is a deficiency in law enforcement as a result of inadequate number of patrol staff. The patrol efforts have so far not been able to completely curtail illegal activities within the protected area. The control and eradication of illegal activities could be better handled with the active involvement of the resident local people who have expressed their willingness and interest to participate and help with protection of the forest resources if the Wildlife officials would involve them (Fiagbomeh, 2012). The local people in the surrounding villages know the terrain and also know themselves; they can easily identify who lives in which community and can serve as a check on each other to prevent people to infiltrate the protected area to poach. Therefore, creation of local committees with defined roles to support the monitoring and protection of the forest resources would greatly increase patrol efficiency and reduction in illegal activities.

4.3 Support and implement alternative sustainable livelihood programs in local communities (A2)

The creation of protected areas often deprives local residents the access to resources they depended on for the sustenance of their livelihoods. Therefore provision of alternative sources of livelihood to compensate for reserving part of the land for conservation purposes is important to ensure the sustainability of the protected area. The failure and discontinuation of alternative livelihood projects in the neighboring communities in the Kakum conservation area has taken away the incentive for conservation. Hence there is not enough motivation for some of the local people to participate in conservation initiatives that could facilitate the enforcement of use restrictions among members of neighboring communities or to guard the forest and wildlife resource from people infiltrating the conservation area from distant communities. Considering that tourists have requested for additional recreational options, the management authorities and tour operators could plan for trips to include farm visits and participate in activities performed in the local communities (Fiagbomeh, 2012). Operationalizing these opportunities could be an avenue for generating sustainable income for the local communities, and thereby involving them in the planning and management of the conservation area.

4.4 Research and develop mechanism to resolve wildlife-human conflicts (A3)

The expansion of agricultural activities close to the protected area boundaries is increasingly isolating the protected zone, and converting it into an ecological island. Such development is problematic for wildlife species that require vast habitat ranges. Since the protected area is completely surrounded by food and cash crop farms, wildlife species that stray or move across the boundary line end up in cultivated farms and cause damage to the food and cash crops. This further escalates the human-wildlife conflicts within the area (Lamarque et al., 2009; Monney, Dakwa, & Wiafe, 2010). Wildlife raiding farms result in economic losses and therefore must be considered as a disincentive for the local people facing such challenges. This can trigger negative attitudes towards wildlife and forest conservation. Some disgruntled local people resort to killing wild animals as a result of human-wildlife interactions,

particularly the destruction of food and cash crop farms (UICN/PACO, 2010; World Bank, 2006). This could eventually affect conservation objectives negatively depending on the status of the target species and the scale of the killing. Hence, there is the need to develop mechanisms to resolve wildlife-human conflicts in the conservation area.

4.5 Evaluation of management strategies in the Kakum conservation area

Taking the hierarchy in Fig. 1 into account, this section will determine the importance of weights of the conservation management strategies. For every sub-factor in the hierarchy, the strategy alternatives will be pair-wise compared. The strategy with the highest weight should be implemented or be given adequate attention. In Table 8, the pair-wise comparison matrices of alternative strategies with respect to the strengths detailed in the SWOT analysis are given together with the consistency ratios. With respect to sub-factor "high diversity and species of conservation interest" (S1), the strategy with the highest priority is "instituting village committees to support monitoring and protection of resources" (A1). This observation is equally true with respect to "no settlements within the protected zone" (S2), "enforcement of protection regulations" (S4) and "undisputed boundaries" (S5). With respect to the acceptance of the importance of the conservation area (S3) however, the strategy with the highest priority is "development of effective mechanism to resolve wildlife-human conflicts" (A3). The pair-wise comparison of the alternative strategies with respect to the strength sub-factors fulfilled the condition of $CR \leq 0.10$.

Table 8
The pair-wise comparisons of alternative strategies with respect to the strength factors

With respect to S1	**A1**	**A2**	**A3**	**Consistency ratio**	**Priorities of alternatives with respect to S1**
A1	1	5	6	0.025	0.667
A2	1/5	1	2		0.222
A3	1/6	1/2	1		0.111
With respect to S2	**A1**	**A2**	**A3**	**Consistency ratio**	**Priorities of alternatives with respect to S2**
A1	1	2	4	0.021	0.570
A2	1/2	1	3		0.333
A3	1/4	1/3	1		0.097
With respect to S3	**A1**	**A2**	**A3**	**Consistency ratio**	**Priorities of alternatives with respect to S3**
A1	1	1/3	1/4	0.008	0.126
A2	3	1	1		0.416
A3	4	1	1		0.458
With respect to S4	**A1**	**A2**	**A3**	**Consistency ratio**	**Priorities of alternatives with respect to S4**
A1	1	4	5	0.005	0.691
A2	1/4	1	1		0.160
A3	1/5	1	1		0.149
With respect to S5	**A1**	**A2**	**A3**	**Consistency ratio**	**Priorities of alternatives with respect to S5**
A1	1	1	4	0.008	0.458
A2	1	1	3		0.416
A3	1/4	1/3	1		0.126

Table 9
The pair-wise comparisons of alternative strategies with respect to the weakness factors

With respect to W1	A1	A2	A3	Consistency ratio	Priorities of alternatives with respect to W1
A1	1	4	6	0.016	0.710
A2	1/4	1	1		0.155
A3	1/6	1	1		0.135
With respect to W2	A1	A2	A3	Consistency ratio	Priorities of alternatives with respect to W2
A1	1	4	6	0.008	0.701
A2	1/4	1	2		0.193
A3	1/6	1/2	1		0.106
With respect to W3	A1	A2	A3	Consistency ratio	Priorities of alternatives with respect to W3
A1	1	2	1/2	0.008	0.297
A2	1/2	1	1/3		0.163
A3	2	3	1		0.540
With respect to W4	A1	A2	A3	Consistency ratio	Priorities of alternatives with respect to W4
A1	1	7	3	0.006	0.669
A2	1/7	1	1/3		0.088
A3	1/3	3	1		0.243

As in Table 8, Table 9 also presents the pair-wise comparison matrices of alternative strategies with respect to the weaknesses and together with their consistency rations. With respect to W1, the strategy A1 has the highest priority. With respect to W2, W3 and W4, the strategies with the highest priorities are A1, A3 and A1 respectively. The maintenance of CR $\leq$ 0.10 was also achieved in the pair-wise comparison of the management alternatives with respect to the weakness sub-factors.

Table 10
The pair-wise comparison of alternative strategies with respect to the opportunity factors

With respect to O1	A1	A2	A3	Consistency ratio	Priorities of alternatives with respect to O1
A1	1	3	4	0.016	0.625
A2	1/3	1	2		0.238
A3	1/4	1/2	1		0.136
With respect to O2	A1	A2	A3	Consistency ratio	Priorities of alternatives with respect to O2
A1	1	2	3	0.016	0.550
A2	1/2	1	1		0.240
A3	1/3	1	1		0.210
With respect to O3	A1	A2	A3	Consistency ratio	Priorities of alternatives with respect to O3
A1	1	1/2	2	0.008	0.297
A2	2	1	3		0.540
A3	1/2	1/3	1		0.163
With respect to O4	A1	A2	A3	Consistency ratio	Priorities of alternatives with respect to O4
A1	1	1/4	1/2	0.016	0.136
A2	4	1	3		0.625
A3	2	1/3	1		0.238

Likewise, in Table 10, the pair-wise comparison matrices of alternative strategies with respect to the opportunities are given together with their consistency ratios. With respect to the sub-opportunities O1, O2, O3 and O4, the strategies with the largest priorities are A1, A1, A2 and A2 respectively. In Table 11, the pair-wise comparison matrices of alternative strategies with respect to the threats are given together with the consistency rations. Here, with respect to the sub-threat factors, T1, T2, T3 and T4,

the strategies with the largest priorities are given as A3, A3, A2 and A2 respectively. The above results were obtained using the PriEsT software. These results take into consideration the priorities of all the main and sub-factors of the SWOT analysis. The final rank order of the KCA management strategies, taking into account the cumulative effects of all the factors, is A1 (0.446) - A2 (0.322) - A3 (0.231) (Fig. 3). Thus, the strategy "institute village committees to support monitoring and protection of resources" (A1) has the largest priority that the managers and stakeholders of the Kakum conservation area must take care.

Table 11
The pair-wise comparisons of alternative strategies with respect to the threat factors

With respect to T1	A1	A2	A3	Consistency ratio	Priorities of alternatives with respect to T1
A1	1	1/4	1/5	0.005	0.100
A2	4	1	1		0.433
A3	5	1	1		0.466
With respect to T2	**A1**	**A2**	**A3**	**Consistency ratio**	**Priorities of alternatives with respect to T2**
A1	1	1	1/4	0.005	0.160
A2	1	1	1/5		0.149
A3	4	5	1		0.691
With respect to T3	**A1**	**A2**	**A3**	**Consistency ratio**	**Priorities of alternatives with respect to T3**
A1	1	1/4	2	0.021	0.200
A2	4	1	5		0.683
A3	1/2	1/5	1		0.117
With respect to T4	**A1**	**A2**	**A3**	**Consistency ratio**	**Priorities of alternatives with respect to T4**
A1	1	1/6	1	0.002	0.121
A2	6	1	7		0.764
A3	1	1/7	1		0.115

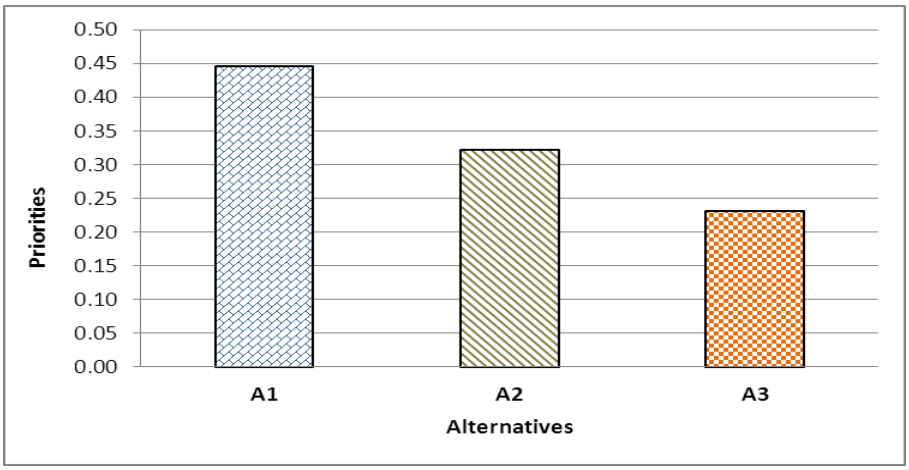

Fig. 3. Priorities of strategic management alternatives

5. Conclusion and outlook

The analysis based on SWOT-AHP techniques has been applied in several fields including hospitality, engineering and resource management. Using these techniques, the SWOT groups and sub-factors could be prioritized to determine which factors of SWOT must be given attention at first, but not neglecting the other factors in the decision-making and implementation process. This analysis has the ability to determine both the priorities of SWOT factors and the strategic management alternatives for the Kakum conservation area. It also presents the opportunity to determine the effect of any change in

the importance of main factors and sub-factors on which alternative strategy should be given the highest priority.

Collaborative protected areas management is no longer just an option but a necessity for countries aiming for better protection of natural resources, particularly in developing countries where many of its people are heavily dependent on the biological or forest resources under protection. People and policies play the primary role in making protected areas management a success. The framework explained in this article provides a direction for the consideration and evaluation of alternative collaborative conservation management strategies.

The case study of the Kakum conservation area provides an illustrative reference for management strategy evaluation of conservation areas in Ghana. This model would be beneficial for evaluating any other national protected area management strategies and also comparing its priority with the other biodiversity conservation strategies in the country. The selection of various SWOT factors depends on the nature of the protected area, the protected area managers, and the profile of the local people in the surrounding communities. It should be noted that the qualitative analysis of these factors and strategies is highly subjective and may differ from one expert to another. This analysis concludes that among the SWOT sub-factors, 'enforcement of protection regulations' turned out to be the most important strength sub-factor followed by 'acceptance of the importance of the conservation area by local people'. The strategy alternative A1, 'institute village committees to support monitoring and protection of resources' was found to be the most important for the sustainable management of the Kakum conservation area, followed by A2, 'support and implement sustainable alternative livelihood programs in the local communities'. Given the ranking of the management strategies in Fig. 3, it is recommended that the management authorities focus their attention on strategy A1. However, the second and third strategies (A2 and A3) must also be pursued to allow for a comprehensive management that would be beneficial to both the local communities and biodiversity conservation in the Kakum conservation area. The three strategies included in this analysis are not exhaustive. New strategies relevant to the peculiarity of the conservation area may be proposed and added to future SWOT–AHP analysis. For further research to improve on protected area management in Ghana, the fuzzy AHP technique may be applied since it is supposed to handle vagueness and uncertainties in human judgements in a better way.

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