ANALYTIC HIERARCHY PROCESS FOR DEVELOPMENT DECISIONS: PROSPECTS AND PROGRESS IN NEPAL

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Summary: *A need of strong decision making tool and appropriateness of AHP in development decisions in developing countries is highlighted. AHP application in development governance analysis, comparison of ranking of hydropower projects, suitability for urban water supply and drainage option assessment in Nepalese context are main features of the paper. And AHP promotion in developing world to apply it in real life development decision has been sought.*

1 Introduction

Development decisions are increasingly becoming complex task. Constituency of professionals in development and interest groups with conflicting objectives are broadening. At the same time, information and communication technologies enabling to generate broad spectrum of decision variables. Proper handlings of socio-cultural aspirations and values, equity, transparency and sustainability are critical success activities in a development process. Therefore, integrated approaches in development decisions are needed, especially to address cross cutting issues in water and sanitation, energy, agriculture, health, education, micro-credit, empowering women and marginalized group. Poverty alleviation intervention has perceived lack of proper decision making approach to demonstrate good governance.

Nepal is small economy country with poverty focused activities are being implemented. There is a flux of lending agencies with varied interest area to support as well as there are multiple agencies involved in a single sector. Prioritization, ranking, equity, allocation, distribution, transparency, trade-off, governance, participatory process, informed decision making, consensus building and conflict resolution are commonly used in development dossier. Development professionals view that social factors including cross-cutting issues are equally important and put in the top of their discussion agenda. Another burning issue is that the most of the development project supported by development partners in Nepal to alleviate poverty also not able to reach to poorest of the poor. In Nepal slow decision making has been increasingly a key issue to impede development projects implementation. Matching the local to central and central to local, development decision making needs two way approach, bottom-up as well as top-down. External factors, central governments policy and technical condition to be matched with the grass root requirements, served as bottom up inputs in the development planning and decision making process. Appropriateness of AHP for integration of top-down and bottom-up decision making process is highlighted, while addressing sustainable development in South Asian countries and need of Multi Criteria Decision Support System (MCDSS) (Markus S. et al., 2002).

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Nepal has used log frame analysis in its Tenth National Development Plan (2002 – 2007) for its monitoring and evaluation. Till now government agencies including National Planning Commission are commonly using vertical and horizontal scoring systems to prioritize national projects and programs. But these approaches lack to integrate other concerns of developments, which include sustainability; operation and maintenance; fiscal resource; development partners' agenda; and integration of national strategy with local strategy.

Currently, prioritization of projects and programs are the main issue in Nepal. Every development partners lobby for projects and programs they have supported. In this case, government faces difficulties to justify their decisions. This shows governments' lack of capacity to address multiple criteria decision problem and awareness on application of available Multi Criteria Decision Making (MCDM) tools. This also implies to international consultants working in Nepal under the development project supported by development partners. Development projects currently being implemented are still using classical optimization and weak ranking tools.

Observing the critical need of decision making tools in development, the paper in its second section discusses various applications of AHP and its appropriateness in development decision analysis in Nepal. Lack of awareness on availability of powerful multi criteria development decision making tool including AHP, even among the consultants is illustrated briefly in the second section. Lastly, at the end of the paper, attention is drawn among the community who are working for the promotion of AHP, to focus on developing world and to take it forward at development professionals' level.

2 Brief Description of Application of AHP for Development Decisions in Nepal

The following section of the paper presents cases of AHP application. The first case presents, possibility of AHP application for development governance analysis, taking an example of hydropower development in Nepal. In the second case, ranking of hydropower projects in Nepal is compared with AHP ranking. The ranking work compared with The World Bank financed Medium Scale Hydropower Development Project (MHSP), which was conducted by international consultant. In the third case, drainage development project options assessment conducted by local consultant is briefed, where the author worked as Multi-Criteria Analyst and used AHP. The fourth case briefs an academic exercise to analyze industrial location in Nepal. Finally, fifth case is on recently completed component of Melamchi Water Supply Project. In which, requirement of Multi Criteria Analysis (MCA) tool and appropriateness of AHP is discussed to meet the project objectives.

2.1 Hydropower Development and Governance Analysis in Nepal

As extension on the authors' research (Bhattarai, 1997) to evaluate most appropriate scale of hydropower development in Nepal, governance for hydropower development in Nepal is analyzed. The earlier research addressed conflict and controversies seen on the scale of development with involvement of public in decision making process and applied AHP taking into account of all the major actors' judgments regarding various factors and sub-factors influencing the alternatives of range of the scale of development. Literature on governance with specific reference to development is further reviewed. Elements of good governance considered on literatures and governance on lending agencies' perception are focused. Governance situation for hydropower development in Nepal is demonstrated in the analytical framework with the various elements considered necessary.

2.1.1 Governance

Broadly, the governance constitutes the democratic institutions (political parties), civil society (NGOs, interest groups) or people's participation and the government. Governance is a way of thinking about how things happen in a polity (March and Olsen, 1995). In the modern views on governance has been related with the decision making from the perspective of individual action as well as institutional perspective. The decision-makers collective action has been addressed with the governance (March and Olsen, 1995).

Governance has been defined as "The exercise of political, economic and administrative authority to manage a nation's affairs. It is the complex mechanism, processes, relationships and institutions through which citizens and groups articulate their interests, exercise their rights and obligations and mediates their differences" (UNDP, 1997b). Governance may be good or bad, the good governance situation is explained as "public resources and problems are managed effectively, efficiently and in response to critical needs of society" (UNDP, 1997b).

In accordance to an electronic discussion forum (UNDP, 1997a), there seems a clear demarcation between two school of thoughts, one advocating on governance include activities solely conducted by government, and the others justifying the governance includes activities of other social entities, e.g. NGOs, public and private and external donor organizations. Confined definition of good governance can be seen as the function and exercise of power of government and considered as necessary for the reform of the state. The wider definition of good governance, on the other hand articulates that the civil society defines the principles by which people are governed, not the vice-versa. Therefore, good governance is the result of the members of society working in connection with each other.

The key words used while defining the good governance/governance includes power/exercise of power; resources/distribution of resources; redistribution; government/government officials; private sector; citizens; NGOs; international donors; project; genuinely to improve condition; accountability; transparency; predictability; clarity; autonomy; voices of the poorest; empowerment; traditional systems; decision making/decision making circle; players; local; federal; democracy; society; organization; individual; participatory process and interest. (UNDP, 1997a), (UNDP, 1997b), (Sobhan, 1998), (Shrestha, 1998), (March and Olsen, 1995), (Lam, 1998), (ADB, 1998)

Work on governance using analytical tool is considered to be a new contribution in the field (Sobhan, 1998) at the same time shortage of studies to demonstrate the condition of good governance has been indicated (Tornquist, 1999). The former literature discusses issues of governance and development, and the later one politics and development. A tool based integrated approach of governance analysis, which takes account of social, economic, environmental and technical issues by involving political institutions, civil society and other stakeholders is perceived to be an innovative approach towards development governance analysis.

2.1.2 Governance and Development

Central point on the issue of governance has been focused on development. Governance for development is the effort currently seen from the various bilateral and multilateral agencies (Sobhan, 1998). Peace, political stability and good governance are the basic prerequisite elements for development (The Rising Nepal, 1999). Political stability is considered under the situation of good governance while performing governance analysis of hydropower development in Nepal. Need of good governance for development have been addressed (Shrestha, 1998) while discussing on the private investment for hydropower development in Nepal.

2.1.3 Governance for Hydropower Development

Nepal currently generates around one percent of its hydropower potential. The country has been investing for hydropower development projects in the last few decades. There is no concrete end product resulted so far due to controversy and conflict while trying to implement specially larger projects such as Arun III in eastern Nepal. The reason for this is lack of good governance between the decision making circle that is to say conflict and controversies within the governing system (Bhattarai, 1997).

2.1.4 AHP Model for Governance Analysis

The AHP model consists of five levels, objective at the top and the three alternatives (range of scale of development) at the lowest level. Actors, factors, and sub-factors are constituted in the second, third, and fourth level of the hierarchy, respectively.

The single objective, which preserves the national interest and gives the spirit of the overall planning, is the overall benefit to the society. The seven stakeholders/actors or the decision making circle considered are (1) Business People, (2) Energy Experts, Energy Interest Groups (3) Government, (4) Environmentalists, (5) Politicians, (6) Donor or Lending Agencies, (7) General People. Box 1 shows the decision-making circle classified into the governance components and various factors and sub-factors considered in the hydropower development governance analysis framework.

Box 1: Actors and their Conflicting Factors and Sub-factors

The Decision Making Circle / Actors	Factors	Sub-factors
Civil Society / Peoples Participation Business People Energy Experts / Interest Groups Environmentalists General People	**Environmental**	Nature People Culture
Democratic Institutions Political Parties Politicians Government	**Socio-economic**	Reliable energy Cheap power Political stability Private investment Foreign energy trade Regional economic balance
Multilateral/Bilateral Agencies Upstream/Downstream riparian Countries Local and Foreign Donor/Lending Agencies	**Technical**	Risk Infrastructure development Technology, Know-how
	International	National independence Impact on other countries International conflict

2.1.5 Analysis for Good Governance

The judgment made by the various players resulted numerous information for appropriate scale of hydropower development. The results of governance are observed from sensitivity of the factors and the players with the scale of development. The sensitivity analysis demonstrated the good governance situation of development of medium scale hydropower projects in Nepal.

Medium scale development is always stayed as first priority; it is not sensitive with the importance of other factor. Nevertheless, the second preference changes with the increase in the importance to the Socio-economic factor. Higher the importance given to the Socio-economic factor higher will be the importance of the Large-scale development. The sensitivity analysis in-group of various decision making circle / players is made to see which actor is most sensitive to change the alternative ranking. From the result of the analysis, it is clear that the first ranking alternative, the Medium Scale development is not sensitive at all. However, the second ranking will be changed from Small to Large when Government and Political players' influence is increased by thirty percent at the same time. Alternative ranking is not sensitive with any of the actors, when they govern alone.

2.1.6 Observations

AHP is found to be an appropriate tool for governance analysis. The approach of application of tool in governance analysis is new, even having its high usefulness in the public involvement in decision-making, and transparently resolving conflicts. Hence, the use of AHP to address governance in hydropower development in Nepal is suitable method in accordance to the problem nature as well as from contribution of cases in the field from application point of view.

The study concluded to open horizon for the future planners of water resources development for subjective evaluation of importance of various factors and sub-factors to the various actors involved in the development process. The approach is applicable to other issues of infrastructure development decision analysis. The study is expected to act as a contribution to infrastructure planning, development and decision-making milieu in Nepal.

The result observed on the study is being validated as there are very less or no conflict and controversies while implementing the medium scale hydropower projects. More than half dozen medium scale hydropower projects are already completed in the country.

2.2 Comparison of AHP with Tool used in Ranking of Hydropower Projects in Nepal

In this case, the author made an attempt to evaluate work on ranking of hydropower projects by Medium Hydropower Study Project (MHSP) with the use of appropriate tool for hydropower development decision analysis. It is worthwhile to note here "when there is large demand of electricity as well as significant potential, where environmental dimension is added to the usual economic, technical and political criteria, demands the utilization of very powerful decision aid technique" (Georgopoulou, 1997).

The choice of multicriterial decision aid (MCDA) model for ranking of water development projects has been addressed (Al-Shemmeri et al., 1997) and short-listed the MCDA technique for water development projects are PROMETHEE, ELECTRE, AHP, JAS (a modified version of AHP) and multicriteria Q-analysis (MCQA). AHP approach is found to be a fairly new tool for multicriterion decision analysis in the field of hydropower development management and appropriate in the context of Nepal (Bhattarai and Fujiwara, 1997; Bhattarai, 1997).

2.2.1 Medium Hydropower Study Project (MHSP)

MHSP is a World Bank financed Power Sector Efficiency Project (PSEP) in Nepal and implemented under Nepal Electricity Authority (NEA). The PSEP has been designed in three phases, containing Phase I - Screening and Ranking of 10-300 MW projects nation wide, Phase II – Feasibility and EIA study of up to seven projects and Phase III – Detail Design of two projects. Discussions are made only on the Phase I of the PSEP. Screening and ranking of hydropower sites of 10-300 MW capacity ranges are based on as follows (MHSP, 1997), (Pradhan, P.M.S, 1997):

- an update of the nation-wide inventory of sites suitable for medium-scale hydropower projects;
- a two stage review of the technical/economic and environmental/social parameters of potential projects for the sites, and recalculation of parameters on a consistent basis;
- use of technical/economical and environmental/social screening and ranking criteria developed in a consensus-reaching process; and
- provision of open consultation and information sharing with government, stakeholders, the professional community, NGO and the general public on each step in the Screening and Ranking (S&R) process.

The inventory of the MHSP project, ranging the capacity of 10-300 MW, included a total of 138 sites, which were reduced to 43 site from course screening. The 43 sites were then considered for coarse ranking basket. Then from the coarse ranking, the top 24 projects were considered for the Fine Ranking. The six main steps in the Phase-I Screening and Ranking (S&R) process is presented in Table – 1. In this part of the paper, work of MHSP in the Step-6 of the Phase-I is compared with AHP based ranking and discussed.

Table 1: Main Steps in Phase I Screening and Ranking (S&R) Process

No.	Steps	Number of Sites/Projects
1.	Compilation of the Project Inventory	138 hydropower projects
2.	Course Screening	138 projects
3.	Course Ranking	43 projects
4.	Site Visits	24 projects
5.	Fine Screening	24 plus 7 licensed projects
6.	Fine Ranking	24 projects

Source: MHSP, 1997.

2.2.2 Preference Ranking Method used in MHSP

In the preference ranking method, score generated from two multiple utility functions are plotted in a matrix for various alternatives. The alternative with the highest utility value is placed in the uppermost right corner of the matrix, and is considered as the best in term of the other alternatives.

Development of ranking criteria and scoring system for each criterion is carried out from the technical/economic and environmental/social perspective. In this context, the Criteria, their definitions, and the scoring system for the criteria and weights application to each criterion were discussed with stakeholders and then the individual project scores for various criteria were determined. This was based on two composite attractiveness or preference scores calculations involving (i) the technical/economic preference score (CTPS), and (ii) the composite environmental/social preference score (CEPS). For the environmental and social ranking, a composite environmental impact (CEI) score on the scale of 0-100 was calculated for each project. Composite environmental preference score was calculated by deducting CEI from 100. These scores were plotted in a preference-ranking matrix, in which along the horizontal axis of the matrix CTPS and along the vertical axis CEPS score were plotted. Projects plotting on the upper right portion of the preference matrix exhibited a higher degree of relative attractiveness, while the projects plotting on the lower left portion of the preference matrix exhibited to be less attractive.

Separate preference matrix were used for 10-50 MW, 50-100 MW, 100-300 MW and Storage Projects. Other two sets of plotting were also developed. Of which, one shows the preference matrix on the relative attractiveness vis-à-vis the potential adverse impacts; and the other set shows attractiveness vis-à-vis the effect of potential enhancement measures. The matrix was used as a graphically visible tool and utilized for different stakeholder audience.

The MHSP team carried out strategic site visits and assembled the data to be used to generate the score on various criteria and sub-criteria. The other sources were, Checklists, Project reports, Maps, Secondary data sources.

2.2.3 Evaluation AHP Model, Input-data and Extent of Comparative Study in AHP

This study has been carried out for fine ranking stage of the MHSP. The AHP ranking was conducted by project groups of type/category with a normal AHP prioritizing model. The grouping of the project as per MHSP is presented in the Table 2.

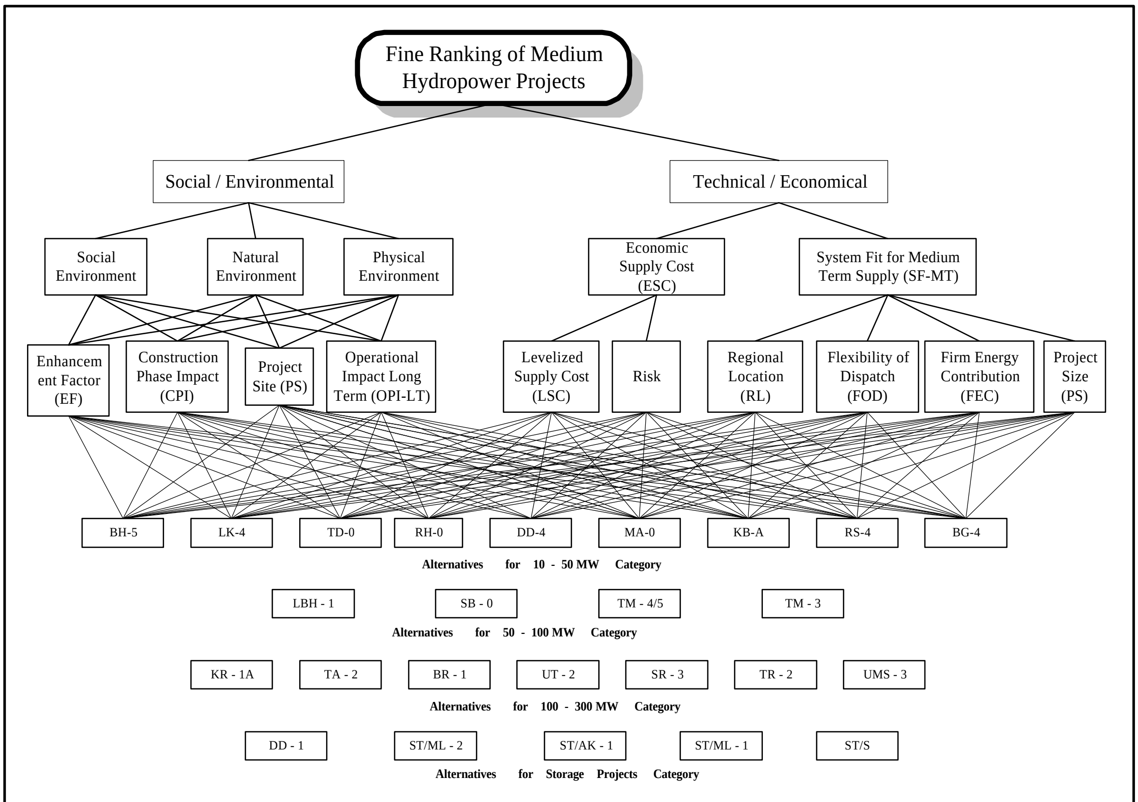
The AHP model used for the Project Groups of Type/Category contained five levels. The first level of the AHP model is the Goal, which is the Fine Ranking of Medium Hydropower Projects. In the second level, the main factors namely, Social/Environmental and Technical/Economic have been placed. In the third and fourth levels, the Sub-factors under the main factors are considered. The last level of the model is the names of the projects considered for fine ranking by MHSP. The AHP hierarchy is presented in Figure–1.

Table 2: Grouping of Projects

10–50 MW	50–100 MW	100– 300 MW	Storage Projects
Bhote Kosi-5 (BH-5)	Lower Bhote Koshi-1 (LBH-1)	Upper Karnali (KR-1A)	Dudh Koshi-1 (DD-1)
Likhu-4 (LK-4)	Simbuwa Khola (SB-0)	Tama Koshi-2 (TA-2)	Mailoop-2 (ST/ML-2)
Thulo Dhunga (TD-0)	Tamur-5 (TM-4/5)	Bheri Babai-1 (BR-1)	Andhi Khola (ST/AK-1)
Rahughat Khola (RH-0)	Tamur-3 (TM-3)	Upper Trishuli-2 (UT-2)	Mailoop-1 (ST/ML-1)
Dudh Koshi (DD-4)		Seti-3 (SR-3)	Sarada Storage (ST/S)
Modi Khola (MA-0)		Tila River-2 (TR-2)	
Kabeli-A (KB-A)		Upper Marsyangdi-3 (UMS-3)	
Rosi Khola (RS-4)			
Budhi Ganga-4 (BG-4)			

Source: MHSP, 1997.

Initial weights were considered as derived by the MHSP with expert opinion solicited on it from the professional observers. Sensitivity analysis conducted on the AHP model to see the effect of changes in the ranking of the project with change in the weights to various factors, criteria and sub-criteria as well as to see the effect of absence of proper group aggregation procedure in MHSP work.



Hierarchy for Fine Ranking of Medium Scale Hydropower Projects

Figure 1: The AHP Model

2.2.4 Observation on the comparative study

The major difference observed on MHSP work with AHP approach is that the later approach could handle all the factors in a single decision framework and generate ranking of projects. The method of derivation of weight used by the MHSP to the factors and sub-factors is also observed to be critical part, because the ranking of alternatives were very sensitive to the weights. It is also observed the level of sensitivity with various factors and sub factors are varied with the category of the hydropower projects (Storage, Run-of-the River of various installed capacities). The weight derivation in MHSP work comes from the separate questionnaire results and simple arithmetic mean is taken to synthesize the judgments for calculation of preference ranking scores. To get a consensus reaching result, the group aggregation process should be integrated with the decision model, which is absent in MHSP work. Similarly, there is no consideration for the decision hierarchy in the MHSP work, and it fails to duly accommodate the contribution of weights from top to bottom while allocating the ranked scores to the alternatives as used in the AHP method.

2.3 Informed Decision Making in Drainage Management

Planning and design of drainage system in developing countries with increasing stakeholders are becoming a complex task (Reed, B. et. al, 2001). An exercise was undertaken to address the complexity of decision-making process for drainage development project at Biratnagar, second largest city in Nepal (Bhattarai and Neupane, 2000). In the study, stakeholders and their concerns were brought within a single framework. This project demonstrated that any water supply and drainage development intervention requires consideration of a multitude of decision-making variables. Use of AHP in the project confirmed that AHP is a very affordable and judgment based methodology. The project utilize AHP based multi-criteria analysis in two stages – in the first stage, a master plan was prepared to identify various options and its selection; and, in the second, strategy for implementation was prioritized. The AHP based decision analysis resulted numerous insights into the sensitiveness of various stakeholders towards the drainage development preference.

2.4 Industrial Location Analysis

Industrial location analysis in Nepal (Sharma, L. 1995) used AHP. The study considered the various factors such as use of resources, socio-economic development and conservation of environment in addition to the actors of industrial development, government and private parties. The study also focused on urban stresses resulted from locating of industries.

Main factors used in the AHP hierarchy model were: resources use; socio-economic; and environment; sub-factors used under the resources use were accessibility, utilities, land cost, land availability, labour cost, labor availability and linkage effect. Human development index, value addition and economically active population were used under the socio-economic factor and forest coverage, agricultural production, air, water and heritage were covered under the environment factor. The alternatives of the locations were the various available options in Nepal. The model also considered two major actors of the decision making: government and private parties. Ministry of Industry officials were used as government actors and private sector promoters and officials of Nepal Industrial Development Corporation were used for private parties.

The study concluded that the most appropriate location reduces the sign of urban stresses faced by the cities and also found to be a consensus option, as the private industrialists are setting up their industrial parks as identified appropriate by the research.

2.5 Urban Water Supply Option Assessment

The Melamchi Water Supply Project (MWSP) is an inter basin water supply project which supplies water from snow fed Melamchi river in the Kosi basin to the Bagmati basin in Kathmandu, the capital of Nepal. The Project is financed by a number of international banks with total estimated cost of about half a billion US dollars, planned to complete in 2008. The Project is designed to solve the chronic water supply shortage in the Kathmandu Valley with the diversion of 170 MLD water from the Melamchi River through a 26 km long tunnel. Optimizing Water Use in Kathmandu Valley (OWUKV) project is a component of MWSP conceived for Urban Water Supply Management for per and post MWSP scenario.

The OWUKV project with the objective of "developing and managing water resources in Kathmandu valley on a long term sustainable basis" is a multiple criteria decision problem requiring quantitative and qualitative information analysis to reach at concrete priorities of alternatives under the main target of pre and post Melamchi situation. The OWUKV project used hydrological simulation tools (Mike She and Mike Basin) and optimized numerical information, which were observed to be necessary but not sufficient. The author observed the lacking in the project and commented on the approach (Bhattarai, S., 2003) and suggested the project OWUKV needs to incorporate other objective (in addition to hydrological) and subjective information. Further, the author commented that the OWUKV project should look for an appropriate Multi Criteria Analysis (MCA) tool, for deciding consensus options, especially for the period of without MWSP in the Kathmandu valley. AHP based MCA for evaluating the urban water supply options is observed to be the most appropriate (Mei *et al.*, 1989) and recommended the same.

3 Concluding Observations

Appropriate decision making in development is observed to be the critical need for developing countries like Nepal. Development workers are unaware about the availability of powerful and appropriate tool for development decision making including AHP. It is observed that, in practice, use of any other powerful multi criteria decision making is not present compared with AHP. Henceforth, author recommends that there is a strong need to promote AHP among international and domestic consultants, at the same time there is need for creating awareness among development practitioner and governments of developing countries on availability of such a powerful and relevant tool for development decision analysis.

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