



Climate Policy 4 (2005) 249–268

RESEARCH ARTICLE

Statistical analysis of CDM capacity-building needs

Lubomir Nondek¹, Anne Arquit Niederberger^{2,*}

¹ *Environmental Consultant, Prague, Czech Republic*

² *Policy Solutions, 333 River Street (1228), Hoboken, NJ 07030, USA*

Received 28 July 2003; received in revised form 29 September 2004; accepted 28 October 2004

Abstract

This article presents statistical analysis of a selection of data collected under a World Bank survey on Kyoto Protocol capacity-building needs in 16 potential clean development mechanism (CDM) host countries. It focuses on three interrelated issues: perceived barriers to the implementation of the CDM, expert judgment regarding the human, institutional and systemic capacity that must be built to overcome these barriers, and views on the most urgent steps that need to be taken to facilitate CDM implementation. The analysis reveals that in many countries there is a wide diversity of opinion across the group of respondents, which could be caused by a number of factors, including the inherent complexity of the Kyoto flexible mechanisms, limited understanding of their basic functioning and potential in the local context, and the differing needs and interests of stakeholder groups. Despite this, many statistically significant preferences can be identified at the national level. Among nations, two broad groups of countries emerge, which can be traced back to their overall level of capacity development. The statistical analysis presented in this article lends credibility to qualitative conclusions drawn from previous interpretations of the survey data and has implications for the design of capacity-building efforts. However, in evaluating capacity-building needs and the readiness of countries to engage in CDM deals, potential investors and providers of capacity-building services will need to consider not only the results of this type of opinion-based needs assessment, but also the practical experience gained through CDM transactions.

Keywords: capacity-building; Clean Development Mechanism; statistical analysis

Introduction

At the Seventh Conference of the Parties (COP-7) to the UN Framework Convention on Climate Change (UNFCCC) held in Marrakech at the end of 2001, Parties were able to finalize the basic operational rules for the Kyoto Protocol, including the Kyoto mechanisms. The Kyoto carbon markets promise to facilitate global action to limit greenhouse gas emissions, contribute to sustainable development in host countries, and reduce mitigation costs for industrialized countries,

* Corresponding author. Tel.: +1-201-963-4647; fax: +1-201-963-5354.
E-mail address: policy@optonline.net

while not placing an unfair burden on developing countries and countries with economies in transition to a market economy. In the meantime, the Protocol has been ratified by 141 Parties and entered into force on the 16 February 2005. This international regulatory regime – on which the well-being of the global population depends as an initial step towards meeting the ultimate objective of the UNFCCC – can only succeed if we are able to implement the market-based Kyoto mechanisms effectively and efficiently.

However, Kyoto markets cannot develop without immediate action to remove supply-side capacity constraints (World Bank, 2003). Without urgent, well-planned attention to capacity building in clean development mechanism (CDM) and joint implementation/international emissions trading (JI/IET) host countries, the Kyoto mechanisms cannot make a significant contribution to cost-effective climate change mitigation in the first commitment period and will also fail to unfold their full potential to contribute to sustainable development in host countries.

During the last several years, a number of surveys have been undertaken to gain a better understanding of the capacity-building needs of non-Annex I and Annex I EIT Parties under the UNFCCC and/or Kyoto Protocol (Arquit Niederberger, 1998; Arquit Niederberger and Graf, 2001; Buchman et al., 2001; GEF/UNDP, 2000; Klarer et al., 1999; Levina, 2002; UNITAR, 2001), and the UNFCCC secretariat compiled inputs by Parties (UNFCCC 2000a, 2000b), which contributed to the definition of the “scopes of capacity building” contained in the UNFCCC frameworks for capacity building. However, only a few of these surveys addressed the needs associated with the Kyoto mechanisms explicitly and in any detail, and those that did had a geographical focus on EIT countries.

In order to get a better grasp of its client countries’ Kyoto-related capacity-building needs, therefore, the World Bank commissioned local experts to conduct in-depth surveys in 18 potential host countries in August/September 2002.¹ In each country, approximately 15 representatives of local stakeholders reasonably knowledgeable about the UNFCCC and Kyoto mechanisms from government, the private sector and nongovernmental organizations (NGOs)/civil society provided qualified input regarding:

- the country’s state of readiness to engage in Kyoto mechanisms
- an assessment of priority capacity-building needs, ranging from systemic to individual
- the design and implementation of effective capacity-building programs
- priority actions needed to implement the Kyoto mechanisms.

The in-country surveyors first compiled factual background information on their country and then conducted a series of stakeholder interviews, based upon a detailed questionnaire.² The results of the survey are discussed in a series of individual country survey reports³ and in aggregated form in the full workshop report (World Bank, 2003).

Overview of methodological approach

The survey questionnaire was designed by a team of regional experts involved in the negotiation, design and implementation of the Kyoto mechanisms – under a mandate from the World Bank – in consultation with the Program of National CDM/JI Strategy Studies (NSS) team. The World Bank contracted local experts (for the most part, individuals who had served as coordinators of their respective NSS studies) to select appropriate interviewees (based on guidance the bank



provided) and to perform the interviews and report on the outcomes. A series of country survey reports provide greater detail on the survey process in individual countries (see link to the reports provided in Note 3). Face-to-face interviews of approximately one hour's duration were conducted. Results of interviews were compiled by the World Bank under the supervision of a Regional Expert Group into a Microsoft Excel spreadsheet (primary data) including the responses of each individual expert. In some cases (e.g., detection of statistical outliers), the primary data have been checked in consultation with individual national experts. The original survey included data on 18 countries, including the Czech Republic and Slovakia, but we have excluded these two countries from our analysis because they are expected to meet the requirements for JI Track 1 with their participation in the EU Emission Trading Scheme. This does not mean that capacity building is not needed in these two countries, but that the challenges facing these countries may be quite different from the remaining 16 surveyed countries (which are non-Annex I countries that are potential CDM host countries), thus complicating the interpretation of the statistical data. To render the results statistically comparable, the data have been aggregated at the national level and normalized (averaged) to the number of respondents in each national group, as the number of respondents varies from 9 (Sri Lanka) to 16 (China).

One part of the survey asked interviewees for their opinion regarding the next urgent steps (within next six months) needed to implement the CDM in the surveyed country. Respondents were asked to indicate the **three top priorities** (P1–P5) chosen from the following menu:

- P1 Awareness raising for key decision makers in public and private sectors
- P2 Training in project formulation and market behavior for sectors with CDM potential and responsibilities
- P3 Preparing financing sources to support and finance CDM/JI activity
- P4 Implementing a national CDM/JI approval office
- P5 Modifying legal and regulatory frameworks to permit efficient functioning of CDM/JI.

For the purpose of this analysis, the rankings have been assigned points as follows: Rank 1 (most urgent) = 3 points, Rank 2 (second most urgent) = 2 points, and Rank 3 (third most urgent) = 1 point. The final aggregated counts have been recalculated (normalized) taking into account the number of experts per country. The resulting scores were used in cluster and correlation analysis. The aim of cluster analysis was to determine whether NSS countries fall into different groups with respect to their immediate capacity-building priorities (P1–P5). Nationally aggregated rankings (Table 1) were used after normalization.

In another question, interviewees were asked to identify up to **five major barriers** for the Kyoto mechanisms in their country. The following options (B1–B7) were suggested as choices in the questionnaire:

- B1 Country risks (e.g., poor investment climate; corruption; lack of investment protection)
- B2 Existing domestic legal/institutional frameworks (e.g., energy subsidies; state ownership of enterprises; bureaucracy; lack of transparent decision-making procedures; regulatory regimes)
- B3 Lack of development of international Kyoto markets (e.g., Protocol ratification; anticipated low international carbon market prices; accreditation of operational entities)
- B4 Lack of domestic legal/institutional framework (e.g., lack of title to emission rights)
- B5 Lack of local/regional financing sources to execute CDM projects

Table 1. Normalized ranking of P1–P5

Country	P1 Awareness raising	P2 Project training	P3 Financing schemes	P4 JI/CDM office	P5 Legal/regulatory framework
Colombia	1.8	2.1	1.6	0.5	0.1
Chile	2.07	1.47	0.47	1.53	0.47
Uruguay	2.25	1.42	1.33	0.83	0.17
Guatemala	1.82	1.82	1.54	0.54	0.27
El Salvador	1.6	1.6	0.8	1.4	0.6
Peru	1.92	1.77	1.23	0.46	0.62
Bolivia	1.42	1.33	1.25	1.17	0.83
Honduras	1.4	1.4	1.33	0.73	1.13
Egypt	1.21	1.43	1.07	2.0	0.29
South Africa	1.46	1.15	0.38	2.62	0.38
Uzbekistan	2.13	1.07	0.93	1.13	0.73
Kazakhstan	0.8	1.0	0.67	1.40	2.13
Sri Lanka	1.89	2.0	0.89	1.11	0.11
China	1.47	1.6	0.4	1.6	0.8
India	2.38	1.31	0.92	1.31	0.08
Uganda	1.92	1.77	1.0	1.0	0.31
Global average	1.706	1.508	0.998	1.147	0.550
Group 1	1.64	1.33	0.71	1.62	0.69
Group 2	1.80	1.70	1.27	0.79	0.44
NACDM countries	1.80	1.64	1.24	0.87	0.46

Aggregated ranking scale: 3 = most urgent, 2 = second most urgent, 1 = third most urgent, 0 = no priority given.

B6 Limited capacity among various stakeholders to formulate and develop CDM projects

B7 Limited understanding of the opportunities that CDM-JI represent for the country.

Respondents were also asked **what capacity must be built** in their country as a priority in order to implement the Kyoto mechanisms (CDM or JI/IET). They were able to select up to five of the options (C1–C11) proposed in the questionnaire:

- C1 Further research/analysis on key issues such as abatement costs
- C2 Capacity to identify and prepare CDM/JI project proposals
- C3 Capacity to maximize local benefits of CDM or JI projects
- C4 Legal systems to ensure property rights and ownership of Kyoto tradable “currencies”
- C5 A National Authority for the CDM or JI and procedures for project approval that involve local stakeholders
- C6 In-country operational entities
- C7 Expertise on project financing and risk management
- C8 National systems for GHG inventories
- C9 National registries for JI/IET transactions
- C10 Capacity of in-country financial sources to understand, support and finance CDM/JI projects
- C11 Other.

Due to the diversity and limited number of responses to C11, this option has not been taken into account in the statistical analysis.

Table 2. Normalized ranking of B1–B7

Country	B1	B2	B3	B4	B5	B6	B7
Colombia	0.90	0.40	0.80	0.90	0.80	1.00	0.10
Chile	0.13	0.47	0.53	0.6	0.67	0.53	0.67
Uruguay	0.08	0.38	0.69	0.54	0.85	0.54	0.62
Guatemala	0.91	0.64	0.73	0.82	1.00	0.73	0.09
El Salvador	0.40	0.60	0.80	0.90	0.70	0.80	0.40
Peru	0.62	0.69	0.85	0.62	0.38	0.46	0.77
Bolivia	0.75	0.58	0.75	0.50	0.67	0.83	0.42
Honduras	0.73	0.53	1.00	0.73	1.00	0.80	0.47
Egypt	0.06	0.75	0.81	0.75	0.94	0.75	0.63
South Africa	0.13	0.67	0.67	0.67	0.27	0.73	0.60
Uzbekistan	0.47	0.60	0.60	0.67	0.87	0.80	0.47
Kazakhstan	0.40	0.67	0.87	0.47	0.53	0.47	0.80
Sri Lanka	0.33	0.56	0.67	0.67	0.78	0.78	0.78
China	0.06	0.50	0.88	0.50	0.63	0.69	0.31
India	0.36	0.57	0.71	0.43	0.36	0.50	0.43
Uganda	0.15	0.23	0.62	0.85	1.00	0.92	0.92

Table 3. Normalized ranking of C1–C10

Country	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Colombia	0.60	0.40	0.30	0.40	0.40	0.30	0.60	0.30	0.20	0.80
Chile	0.60	0.73	0.27	0.60	0.73	0.40	0.27	0.07	0.33	0.73
Uruguay	0.25	0.83	0.75	0.58	0.75	0.25	0.08	0.00	1.00	0.83
Guatemala	0.40	0.90	0.30	0.90	0.60	0.30	0.70	0.10	0.00	0.70
El Salvador	0.10	1.00	0.60	0.90	0.80	0.10	0.30	0.20	0.20	0.50
Peru	0.46	0.77	0.69	0.77	0.31	0.46	0.08	0.23	0.00	0.69
Bolivia	0.50	0.83	0.42	0.75	0.58	0.33	0.50	0.17	0.08	0.67
Honduras	0.53	0.93	0.27	0.87	0.80	0.40	0.27	0.07	0.07	0.80
Egypt	0.47	0.87	0.40	0.53	0.67	0.33	0.60	0.13	0.07	0.67
South Africa	0.27	0.73	0.53	0.40	0.87	0.40	0.20	0.47	0.00	0.47
Uzbekistan	0.53	0.67	0.40	0.53	0.73	0.20	0.60	0.40	0.13	0.60
Kazakhstan	0.40	0.67	0.27	0.60	0.73	0.13	0.53	0.33	0.53	0.60
Sri Lanka	0.32	0.78	0.78	0.22	0.67	0.45	0.56	0.10	0.10	0.69
China	0.56	0.62	0.01	0.56	0.50	0.56	0.47	0.25	0.00	0.33
India	0.50	0.79	0.43	0.43	0.79	0.57	0.36	0.07	0.07	0.57
Uganda	0.46	1.00	0.62	0.38	0.46	0.08	0.23	0.62	0.15	0.62

Aggregated results are given in Tables 2 and 3. Because both sets of questions (barriers; capacity gaps) solicit binary responses (i.e., each suggested barrier or gap will either be selected or not), it is possible to use the same statistical criteria and to look for correlations between individual options. The response to each option (B1–B7 and C1–C10) by individual experts is defined as a statistical event, which has two mutually exclusive outcomes (yes/no). If such statistical events occur N times in an independent way (respondents are expected to answer independently), then a binomial distribution can be used to determine the probability of obtaining r positive answers (“successes” in statistical terminology) in the N cases (trials). The binomial probability for obtaining r successes in N trials is:

$$P(r) = N! / (r!(N-r)!) p^r (1-p)^{N-r} \quad (1)$$

$P(r)$ is the probability of exactly r successes, N is the number of events (responses),⁴ and p is the probability of success on any individual trial (here $p = 0.5$). This formula assumes that the events are dichotomous (fall into two categories only), mutually exclusive, independent and randomly selected. This model therefore enables to identify outcomes which could be generated randomly.⁵

To test for the statistical significance of the information gained in the survey, a random response model (Monte-Carlo) was used to generate individual responses for comparison with the actual data. This depends on whether the individual responses converge to express a collective prevailing opinion for the group as a whole. The simple model has been used to generate samples of aggregated data at national level (number of respondents, $N = 9$ – 16) and global level ($N = 212$, 16 countries) by means of an Excel spreadsheet and a generator of random numbers. A binomial distribution has been used to determine statistically significant ($P(r) = 0.01$) answers at national and global levels. This enables us to classify the options into three categories: “one of the top priorities”, “not (statistically) significant”, and “not one of the top priorities”.⁶

In Monte-Carlo experiments, the randomly chosen answers and their aggregates are almost in rank of “not significant” at $P(r) = 0.01$. One must be aware, therefore, that the chosen binary system of ranking (0, 1) does not generate a continuous scale of preferences (only the three above categories).

We have also examined diversity of opinion at national level. The opinions expressed by a group of respondents making independent choices can be distributed in a narrower or broader way. Various diversity indices are described in literature (Pielou, 1975; Baczkowski et al., 2000) and several of these have been tested in this study. We have used the diversity index H (see Eq. 2), as proposed by Shannon (1948) in the mathematical theory of communication,

$$H = - \sum p_i \ln p_i \quad (2)$$

where p_i are proportions (frequencies) of individual answers.⁷

Cluster analysis, which has been used to quantify differences between surveyed countries, is based upon a spectrum of mathematical methods used to assign objects to groups (Everitt, 1993). Group members (countries) share certain properties (variables) and the resulting classification can provide some insight into their similarity. The results are always dependent upon the particular method used. We have therefore tested several methods⁸ (hierarchical clustering, dendrograms, medoid partitioning, fuzzy clustering, and K-means) to test preliminary results against information contained in individual country survey reports. In this article, results based on a fuzzy clustering technique are reported. Fuzzy clustering enables us to calculate for each country the probability (membership) that it will group into a specific cluster, and to optimize the number of clusters.

In correlation analysis, we have calculated pair correlation coefficients for barriers (B), capacity gaps (C) and priorities (P) to find statistically significant relationships. Spearman’s rank correlation coefficients have been used as a robust measure, since the variables under consideration are partially ordinal ones. Correlation coefficients have been compared with tabulated critical values ($P = 0.05$).

Results and discussion

Existing level of capacity development

Based on the experience of the World Bank Program of National CDM/JI Strategy Studies (NSS) since its launch in 1997, the bank has developed a schematic NSS capacity development model

(World Bank, 2003, p. 43), which illustrates the growing level of advancement/readiness of host countries over time (Figure 1). According to this diagram, three phases of capacity development can be distinguished:

Phase I: Understanding CDM/JI concepts/methods and preliminary analysis

Phase II: Establishment of Kyoto mechanism policy, strategy and institutional prerequisites

Phase III: Implementation of CDM/JI projects.

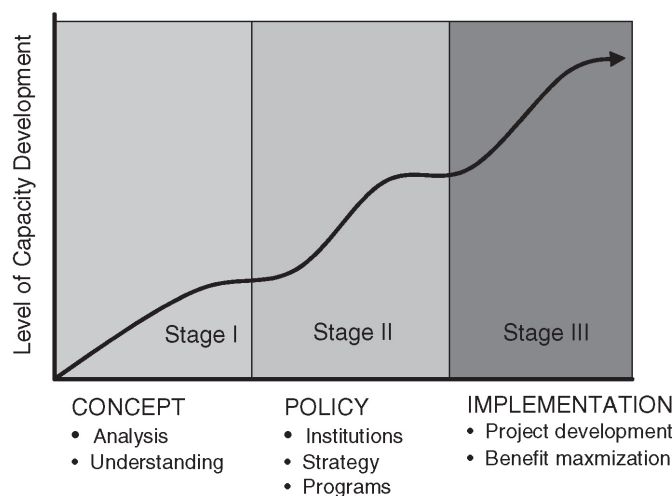


Figure 1. Capacity development continuum (adapted from World Bank, 2003)

To assess the validity of this qualitative model of the capacity development process, we used the survey data to test the hypothesis that a country's overall existing level of capacity development will determine its preferences in national capacity development priorities (chosen by stakeholders). We used cluster analysis of responses regarding immediate capacity-building priorities (P1–P5) as a tool in classifying the countries into two overlapping groups.

The clustering is based upon differences in P2–P4, while P1 and P5 do not play an important role. When a Monte-Carlo model is used to generate random values instead of the survey data, only one broad cluster is formed, which is accompanied by two to three outliers. This means that purely random responses would not result in distinct clusters of countries. In contrast, the NSS survey data yielded two distinct clusters, with which five of the 16 countries are only loosely associated. It must be kept in mind that the resulting structure is based only upon interviewees' perceptions of immediate capacity-building priorities for the next six months (at the time the survey was administered in August/September 2002) and consists of two broad groups of countries with core members (strong membership) and more loosely categorized members:

- **Group 1:** Chile, China, El Salvador, India, Kazakhstan, and South Africa as core members
These countries span the entire globe. They give priority to more awareness raising for key decision makers in the public and private sectors, as well as to a mix of Stage 2 (implementing national CDM approval offices) and Stage 3 (training in project formulation and market behavior

for sectors with CDM potential and responsibilities) capacity development issues.

Kazakhstan is a unique case, with overwhelming priority given to modifying legal and regulatory frameworks to permit efficient functioning of the CDM/JI, because it is pushing for inclusion in Annex I of the UNFCCC.

- **Group 2:** Colombia, Guatemala, Honduras, Peru, and Uruguay as core members

This group has a core of Latin American countries, three of which have already notified the UNFCCC of their National Authority for the CDM (NACDM), namely Colombia, Peru and Uruguay.⁹ Countries in this group give priority to awareness raising and Phase 3 training and capacity development activities, namely training in project formulation and market behavior for sectors with CDM potential and responsibilities and preparing the domestic financial services sector to support and finance CDM activity.

The remaining countries (Bolivia, Egypt, Sri Lanka, Uganda, and Uzbekistan) do not associate strongly with either group (Membership < 0.7). “Global average” and “NACDM countries” served as reference cases to check the clustering process. The differences in the average ranking for P1–P5 calculated for the Groups 1 and 2 are obvious from Table 1.

Clustering demonstrates that differences between individual countries do exist and the clusters (groups) are therefore broad. Taking into account additional information included in the country survey reports regarding the readiness of these countries to engage in CDM and the discussions that took place at the NSS Sigriswil capacity-building workshop, we can interpret these two groups of countries according to the different levels of capacity development illustrated in Figure 1:

- **Group 1** consists of countries whose stage of capacity development, as perceived by the interviewees in each country,¹⁰ can be characterized as transitional between Stage 1 (conceptual understanding, analysis) and Stage 2 (strategy/policy formulation, institutional prerequisites) of the capacity development continuum. These countries generally do not have all of the necessary CDM institutions and procedures in place to process CDM project proposals, although some countries have adopted ad hoc or provisional arrangements to facilitate some pilot transactions prior to the entry into force of the Kyoto Protocol.¹¹ Individual respondents in many of these countries are judged to have a good grasp of the CDM, but a critical mass is lacking. Some have undertaken extensive analyses and capacity-building efforts to lay the foundation for CDM/JI policies and institutions. Most of these countries are working toward establishing the basic prerequisites for undertaking CDM projects and progressing to Stage 2 of the capacity development continuum. However, respondents in some countries commented that the economic incentives are insufficient to justify a substantial capacity development effort at the present time. Economic incentives are the driving force for the Kyoto mechanisms, not only for investors, but also from the perspective of host countries, which face human and financial resource constraints. It is thus important even in Stage 1 for countries to conduct basic cost–benefit analysis, balancing expected CDM sustainable development benefits against the up-front costs related to capacity building and institutional and policy development. The prospects for CDM must be judged realistically, taking into account the country investment climate and transaction costs, which may lower the competitiveness of CDM projects, particularly small-scale projects (e.g., Nondek et al., 2001; Michaelowa and Stronzik, 2002). This is particularly important, given the real prospect that the Russian Federation and Ukraine will flood the carbon market



with emission allowances that cost nothing to generate (Korppoo, 2003; Loschel and Zhang, 2002), which will certainly have a negative effect upon carbon prices and the economic attractiveness of many CDM projects.

- **Group 2** countries form a core group of the most advanced Latin American countries that have (or will soon have) the institutional prerequisites to engage in actual CDM deals and have therefore progressed to Stage 2 of the capacity-building continuum (institutions and policies more or less in place). At the time of this analysis, three of these countries had formally established an NACDM and notified the UNFCCC accordingly. As a result, these countries put a greater emphasis on Stage 3 capacity development interventions (e.g., carbon price negotiations), and some are actively pursuing CDM investment promotion activities.

It is important to keep in mind that this analysis is based on a combination of factual data and interviewee perceptions. Subjective perceptions might not hold up to objective scrutiny in all cases. Country investment risk and corruption as barriers to the CDM are in certain cases clearly underestimated (see Table 2), and a more objective ranking of the host country (see, for example, the approach adopted by Fankhauser and Lavric (2003)) might give quite different results. Conversely, many of the countries in Group 1 have done a great deal of preparatory work and pilot projects and may get off the block faster than some in Group 2 once they appoint their NACDM and the Kyoto Protocol enters into force. Interestingly, despite the lack of the required approval authority, five of the six countries at the core of Group 1 have either concluded Emission Reduction Purchase Agreements with the PCF (i.e., Chile, South Africa), or have contracted offsets with Senter International on behalf of the Dutch Government (China, El Salvador, India).

Diversity of opinion at the national level

The following analysis of national respondent behavior is based on the assumption that there should be some convergence of opinion regarding key barriers and capacity-building needs at the national level. Factors that could influence diversity of expert opinion at the national level include:

- interviewees' level of knowledge of the subject matter (subject competence)
- interviewees' sphere of activity/experience (perspective)
- interviewees' own needs/interests (special political/economic interests)
- design and appropriateness of the questionnaire (e.g., formulation of questions, language barriers)
- role of interviewer (e.g., neutrality, experience, subject matter expertise).

In addition, respondents belong to three different stakeholder groups (public, private, and civil society), and their interests may differ in a legitimate way, as pointed out by Dutschke and Michaelowa (1998). Unfortunately, the limited number of respondents in the different stakeholder groups (six or fewer persons) made it impossible for us to test this hypothesis statistically at the national level.¹²

Diversity of opinion is statistically summarized in Table 4. We have tried to compare diversity of views on major barriers (B1–B7) and corrective actions (C1–C10) with country population, decision sphere understanding of KP mechanisms, number of respondents in each national group and their preference for planning of capacity building at national level.

Table 4. Selected statistical data

Country	Population of country in millions of inhabitants*	Number of respondents, N	Opinion diversity $H(B)$	Opinion diversity $H(C)$	Decision sphere understanding (1=low, 2=medium, 3=high)	Designated NACDM	Preference for planning (0–1)
Colombia	42.1	10	1.823	2.208	1.46	Yes	0.58
Chile	15.2	15	1.876	2.170	1.17	No	0.73
Uruguay	3.3	12	1.828	2.041	1.13	Yes	0.85
Guatemala	11.4	10	1.840	2.063	1.07	No	0.91
El Salvador	6.2	10	1.905	2.056	1.26	Yes	0.50
Peru	25.9	13	1.916	2.063	1.20	Yes	0.54
Bolivia	8.3	12	1.922	2.176	1.53	Yes	0.58
Honduras	6.4	15	1.913	2.072	1.28	No	0.73
Egypt	67.8	15	1.832	2.155	1.31	No	0.75
South Africa	44.0	15	1.844	2.115	1.13	No	0.75
Uzbekistan	24.9	15	1.921	2.215	1.15	No	0.80
Kazakhstan	15.6	15	1.908	2.222	1.44	No	0.40
Sri Lanka	18.6	9	1.916	2.143	1.32	No	0.66
China	1275.2	16	1.803	2.162	1.63	No	0.63
India	1016.9	14	1.917	2.140	1.04	No	0.71
Uganda	23.4	13	1.805	2.136	1.50	No	0.92

* For population of countries (year 2000), see <http://esa.un.org/unpp/>.

The minimum value of the diversity index H is 0 (all respondents choose only a single identical priority) and the maximum value is given by the formula $\ln(1/n)$ in the case of an equal distribution of preferences among n options. The maximum diversity of opinions (H) is therefore 1.946 with respect to barriers (B) and 2.303 for views on capacity gaps (C). Comparing those limit values with Table 4, it is obvious that all national groups express a comparably wide spectrum of opinion. There are no statistical outliers detected; all groups behave similarly. As a result, only in a limited number of cases are interviewees' nationally aggregated preferences statistically significant, as explained in the following section. There is no correlation between H estimated for B and C and other variables in Table 4.

Analysis of responses at the national level and globally

Monte-Carlo experiments confirm that aggregate responses at the national level may give random-like answers for some questions. Statistical significances of aggregated results at the country level are tabulated in Tables 5 and 6. What Table 5 shows is the statistical significance of the top five CDM barriers, with "yes" representing a "barrier that is one of five major hurdles" and "no" representing a "barrier that is not one of the five major hurdles". Blank cells are not statistically significant. These results thus indicate the main barriers perceived in each country, with some countries' experts identifying a limited number of key hurdles (collective responses in Bolivia, China, El Salvador, for example, suggested only a single priority), and others pointing to multiple problem areas (e.g., Egypt, Honduras, Uganda). Only in Sri Lanka did the survey fail to provide statistically significant information, due at least in part to the smaller sample size in that country. Responses aggregated at the global level (16 countries, 212 respondents) identify four statistically significant CDM barriers (Table 5), fully consistent with the initial qualitative assessment (World Bank, 2003, p. 16):

Table 5. Key barriers to CDM implementation (B1–B7) characterized at $P(r) = 0.05$

	Country risks	Existing laws/ institutions	Lack of Kyoto market development	Lack of domestic CDM frameworks	Lack of local/ regional financ- ing	Limited CDM project develop- ment capacity	Limited under standing of CDM opportunities
Colombia	Yes			Yes		Yes	No
Chile	No						
Uruguay	No				Yes		
Guatemala	Yes			Yes	Yes		No
El Salvador				Yes			
Peru			Yes				Yes
Bolivia						Yes	
Honduras	Yes		Yes	Yes	Yes	Yes	
Egypt	No	Yes	Yes	Yes	Yes	Yes	
South Africa	No				No	Yes	
Uzbekistan					Yes	Yes	
Kazakhstan			Yes				Yes
Sri Lanka							
China	No		Yes				
India			Yes				
Uganda	No	No		Yes	Yes	Yes	Yes
Global	No		Yes	Yes	Yes	Yes	

- Lack of development of international Kyoto markets (e.g., Protocol ratification; anticipated low international carbon market prices; accreditation of operational entities)
- Lack of domestic legal/institutional framework (e.g., lack of title to emission rights)
- Lack of local/regional financing sources to execute CDM projects
- Limited capacity among various stakeholders to formulate and develop CDM projects.

The corresponding results regarding perceived gaps in human capacity to implement the CDM are shown in Table 6. In contrast with responses regarding CDM barriers, respondents' views on priority capacity-building actions were more conclusive, particularly when it came to singling out types of capacity building that, for whatever reason, are not regarded as being among the top five priorities (note the preponderance of 'yes' answers in Table 6).

As this particular question in the NSS survey questionnaire was posed to both Annex I and non-Annex I countries, two of the choices were mainly pertinent for Annex I countries (national systems for greenhouse gas (GHG) inventories; national JI/IET registries), which explains the overwhelming opinion that these issues are not a top priority for the subset of non-Annex I CDM countries whose responses we analyze in this article (World Bank, 2003, p. 33).

Based on discussions at the World Bank Sigiswil workshop and the information contained in the country survey reports, we can speculate why other areas for capacity building were not assigned priority. We believe that the suggested need to build capacity to support further research and analysis on key issues was too general and therefore not seen as essential to implement the CDM. Perhaps even more important is the fact that the sample of NSS countries targeted in the survey represents countries that have already had the opportunity to undertake basic analysis of Kyoto market dynamics, domestic offset potential, legal and institutional arrangements, and

Table 6. Priority capacity-building needs (C1–C10) proposed at $P(r) = 0.05$

Country	Further research/ analysis	CDM project preparation	Local benefits maximization	Legal systems to ensure property rights	NACDM/ project approval procedures	In-country opera- tional entities	Project finance & risk management	National systems for GHG inventories	National JI/IET registries	Financial services understanding of CDM
Colombia		Yes								
Chile			No				No	No		
Uruguay		Yes					No	No	Yes	Yes
Guatemala		Yes		Yes				No	No	
El Salvador	No	Yes		Yes		No				
Peru		Yes		Yes			No	No	No	
Bolivia		Yes						No	No	
Honduras		Yes	No	Yes	Yes		No	No	No	Yes
Egypt		Yes						No	No	
South Africa	No				Yes		No		No	
Uzbekistan						No			No	
Kazakhstan						No				
Sri Lanka								No	No	
China								No	No	
India		Yes			Yes			No	No	
Uganda		Yes				No			No	
Global	No	Yes		Yes	Yes	No	No	No	No	Yes

potential CDM/JI costs and benefits, and have taken a political decision to engage in the Kyoto mechanisms. As a result of the NSS program, these countries might conclude that they have an adequate analytical basis to move forward with establishing institutional prerequisites and engaging in CDM/JI projects.

Training in-country operational entities and building expertise in project finance and risk management were also not regarded to be top priorities. With respect to operational entities, although these are required for CDM project validation and certification, it is not imperative that they be domestic enterprises or involve local experts. In addition, as part of their normal business practices, many certification companies have already begun training local experts to perform greenhouse gas certification services, so it could be perceived as a waste of scarce resources to duplicate the effort of the private sector to build this capacity.

The corrective actions that do represent statistically significant priorities at the global aggregate level are:

- Capacity to identify and prepare CDM/JI project proposals
- National Authority for the CDM or JI and procedures for project approval that involve local stakeholders
- Legal system to ensure property rights and ownership of Kyoto tradable “currencies”
- Capacity of in-country financial sources to understand, support and finance CDM/JI projects.



The initial discussion of the survey data (World Bank, 2003, p. 32) also identified a lack of capacity to identify and prepare CDM/JI project proposals as the top capacity-building priority and the other three capacity gaps as additional priorities. Furthermore, the workshop report interpreted these results to suggest that there is no single deficit to tackle, but rather that progress must be made on a number of fronts in parallel (World Bank, 2003, p. 33). We found that “capacity to identify and prepare CDM/JI project proposals” correlates positively with the group of above interlinked barriers, which validates this earlier conclusion and may serve as proof of a rational choice of the more knowledgeable respondents. Clearly, the training of individuals must be accompanied by building of institutions and preparing/modifying legal frameworks to optimize use of the Kyoto mechanisms. This should decrease transaction costs, which are prohibitive for many potential CDM projects, especially small-scale ones.

Comparing the global statistical significance of preferences with results obtained at the national level, we observe that the “global” structure of preferences does not correspond with problems and needs identified by individual countries in all cases¹³ (Tables 1–3). This means that capacity development efforts must be based on local needs assessments to be effective, although countries at a similar level of capacity development may have similar generic needs.

We found no statistically significant differences in national perceptions of key barriers or key capacity gaps between those five Latin American countries (Group 2) that have an NACDM in place and the rest of the countries. This result means that our hypothesis that groups of countries at the same level of capacity development will share common capacity-building challenges, and that these will be distinct from challenges faced by more or less advanced countries, is not supported by the perceptions of interviewees who participated in the NSS survey. Our data alone cannot explain this result, but it would be important to clarify it. Again, it is essential to recall that the survey data reflect perceptions, which are only one subjective measure of barriers and needs.

In this part of the analysis, we correlate previously calculated capacity-building priorities (Table 4) with ranking frequencies related to barriers and capacity gaps (Tables 2 and 3).

The formulation of each question and the design of the questionnaire must be taken into account while interpreting positive or negative correlations. There are statistically significant negative correlations between pairs P1–P5 (-0.5298) and P3–P4 (-0.8012), which means that the urgency and priority assigned to those options (awareness raising versus modifying legal and regulatory framework, respectively implementing CDM/JI office versus preparing financial sources) are mutually exclusive in a significant proportion of the responses aggregated at national level. These differences may influence the formation of the basic clusters (Groups 1 and 2). Those respondents who see awareness raising as an immediate priority do not believe that the state of Kyoto market development (B3) is a critical barrier, whereas those who give immediate priority to training in project preparation (P2) view inadequate legal/institutional frameworks as a major hurdle.

When preparing financial sources for CDM/JI is viewed as an immediate priority, this is positively correlated with an interrelated set of perceived barriers, namely country investment risks, lack of local/regional financing sources to execute projects and limited in-country financial sources to understand, support and finance CDM/JI projects. This “complex” of problems is characteristic for countries that have achieved Stage 2 capacity development, or are in transition to Stage 3 (Group 2). They have established an NACDM, but still face problems with financing. Modifying legal/regulatory frameworks is an immediate priority which correlates positively with the need for an improved legal system that can ensure ownership and transactions of CERs.

These correlation results demonstrate that a significant number of respondents have chosen a rational, logically consistent combination of options across barriers, capacity gaps and resulting urgent capacity-building needs.

Another coherent problem complex links the barriers B4, B5 and B6, and the barrier B5 correlates positively with the capacity gaps C2 and C10. It means that lack of domestic legal/institutional framework often combines with lack of financial resources and human capacities (identification, formulation and implementation of projects). It is therefore evident that respondents are aware of complexity of the linkages and synergies between the basic prerequisites to make CDM operational.

Not surprisingly, the perceived level of knowledge of the Kyoto mechanisms among decision makers is inversely correlated with views on the need for awareness raising for key decision makers in the public and private sectors P1 ($r = -0.5228$). This knowledge is generally very low across all countries surveyed – even in those countries where the cornerstone of national implementation systems (NACDM) has been established (Stage 2). Finally, a lack of local/regional financing sources (B5) is positively correlated with opinions on the utility of national capacity development action plans ($r = 0.5814$); limited resources require careful planning, especially in this case.

At a 95% level of probability ($P = 0.05$) correlations between individual variables must be interpreted with caution. Despite the fact that other plausible explanations could be formulated in the above cases, the existing relationships between preferences at the national level may serve as an indicator of coherency, which in some cases is weakened by the seemingly random choices of the less knowledgeable respondents. It would be interesting to repeat at least the key parts of this survey after some time to see whether there is a clear trend that would indicate the successful movement of the “NSS family” along the capacity development continuum (Figure 1), from limited understanding of basic principles to a more advanced implementation stage.

Conclusions and implications for capacity-building activities

Summary of key findings

Globally averaged data provide an overall indication of the perceived major barriers to Kyoto mechanism implementation and related capacity-building needs, but cannot be assumed to apply to individual countries.

We were unable to validate our hypothesis that countries at the same stage of capacity development – according to a modified capacity development continuum developed originally by the World Bank – will generally face the same CDM/JI barriers and will therefore have similar capacity-building needs, at least based on the perceptions of those interviewed in the survey process.

The aggregated national results can serve as a rough indicator of country-specific capacity-building needs and the major negative factors (barriers) influencing the willingness/ability of the host to take part in the utilization of Kyoto flexible mechanisms (CDM/JI). However, in evaluating capacity-building needs and the readiness of countries to engage in CDM/JI deals, potential investors and providers of capacity-building services will need to consider not only the results of this type of opinion-based needs assessment, but also objective indicators and the practical experience gained through Kyoto transactions. They will also need more detailed information on the specific needs of different target sectors and audiences.



In the 16 countries we analyzed, the respondents were often able to characterize national barriers and propose appropriate corrective actions that were statistically significant. In other cases, their diversity of opinion was wider. There are three possible reasons for this:

- *Multiple barriers and capacity-building needs:* There are multiple barriers and resulting capacity development needs, so it is objectively difficult to single out and agree on the top priorities, as our statistical analysis has shown that many are interrelated; in this case, assessment tools other than multiple choice questionnaires, such as multi-criteria decision analysis or the analytic hierarchy process, might be more instructive.
- *Not all respondents are equally well informed about the Kyoto mechanisms:* Interviewees not familiar with details of KP process might tend to exhibit a broader range of opinions, as they are less able to judge priorities in an informed way.
- *Particularly well-informed stakeholders might have more nuanced opinions on priorities:* People who understand the intricacies of the Kyoto mechanisms may have had experience designing CDM/JI policies or developing offset projects. As a result, they will draw on that experience, as well as taking into consideration their own special Kyoto-related needs and interests, when considering key barriers and priorities, with private sector respondents likely putting more emphasis on different barriers and capacity development priorities than, for example, government respondents. The Sigriswil workshop report (World Bank, 2003) looked into this issue at the global aggregate level; given the small sample size (number of interviewees per country), however, we were unable to break this analysis down to look at differences in responses among the three stakeholder groups at the national level, which would have been quite instructive.

The statistical analysis presented in this article lends credibility to qualitative conclusions drawn from previous interpretations of the survey data and has implications for the design of capacity-building efforts.

Our analysis focused on what we believe to be key questions from among the 12 general and 15 sector-specific questions posed in the NSS survey. Similar, country-level, statistical analyses of the other survey data could provide insights on additional issues, such as high-priority sectors for CDM/JI investment, target sectors and groups for capacity building, strengthening local institutions to provide capacity-building services, and views on the most effective and accountable approaches for determining potential CDM project impacts on local sustainable development.

Validation of previously reported NSS survey outcomes

In the previous section, we were able to validate the statistical significance of the initial findings of the global analysis of NSS survey results as reported by the World Bank (2003) regarding: (i) key barriers to Kyoto mechanism implementation and (ii) the priority capacity building needed to implement the Kyoto mechanisms.

The initial analysis of the NSS survey outcomes (World Bank, 2003, p. xvii) also contains recommendations of an Expert Group appointed by the World Bank regarding the next steps that should be taken to facilitate the implementation of the UNFCCC frameworks for capacity building in order to enable host countries to engage in the Kyoto mechanisms. Here we comment on the implications of our statistical analysis for a number of these recommendations:



- *Situate capacity building to implement the Kyoto mechanisms in the broader context:* This recommendation was aimed at consistency between Kyoto and broader sustainable development training efforts (World Bank, 2003, pp. 74–75). Whereas our data shed no light on this aspect, we would like to emphasize in an even more general sense that capacity building is only one tool to address Kyoto implementation issues, and may not be the most appropriate response in all cases. Needs assessments should consider both training and non-training interventions to address the key barriers, before embarking on Kyoto-specific capacity-building programs.
- *Be inclusive, but take a modular approach:* Our analysis supports this conclusion, because it has shown that global data give a good indication of the major modules that would need to be developed to provide assistance to countries at all three stages of the capacity development continuum. A modular approach can be tailored to the unique needs of each country.
- *Give consideration to the NSS survey outcomes at the national level:* Our analysis has shown that it was not possible to consider the views of the different stakeholder groups independently, as the sample size was too small. A national dialog process would give a better idea of the needs of different target audiences. It would also provide an opportunity to validate the opinion survey outcomes with on-the-ground realities and to discuss coordination and burden-sharing for capacity development among key players.
- *Establish a network of regional Kyoto mechanism research and training institutes:* We have validated the finding that global data provide a good indication of the major challenges and generic types of capacity development that countries grapple with as they advance along the capacity development continuum. Instead of each country having to recreate the wheel as it progresses, regional CDM centers of excellence that cover the whole spectrum would be in a position to assist all countries with their individual needs. This would conserve scarce resources for the training of local providers of capacity-building services, based on the cumulative experience and lessons learned under the regional umbrella. Statistical analysis has shown that Latin American countries build a particularly advanced and relatively coherent regional group, so a CDM institute in this region could even focus its activities to serve countries in Stages 2 and 3 of the capacity development continuum.

Finally, this analysis has shown that there is no significant relationship between awareness raising and other urgent priorities, barriers and capacity gaps; on the contrary, raising awareness is seen as an urgent need in many countries in both Groups 1 and 2. In reality, awareness raising is an iterative and dynamic process, which over time broadens and deepens a country's individual capacity, as the country as a whole moves from the conceptual/analytical phase (Stage 1) to policies/institutions (Stage 2) and finally to implementation (Stage 3). Many countries with CDM institutions already in place (Stage 2) therefore stress the need to expand the pool of knowledgeable private-sector decision makers through awareness-raising activities in order to stimulate interest in CDM project development. This result suggests that the capacity development continuum derived by the World Bank based on its almost six years of experience with Kyoto mechanism capacity development (World Bank, 2003, p. 43) should be modified slightly, so as to capture the idea that awareness raising is a continuous task, rather than a characteristic function of Stage 1 capacity development alone (see our modified capacity development continuum in Figure 1).



Implications for needs assessment and design of capacity-building interventions

Outcomes from this statistical analysis have implications for the design of both future needs assessment activities and Kyoto mechanism capacity-building programs. Our results underline the importance of professional needs assessment as an initial crucial step in any capacity development effort. Future needs assessments should be designed and conducted in keeping with best professional practice in the field of adult training. There is no need for Kyoto experts to recreate the wheel when it comes to the principles and theory of adult training and in conducting the crucial needs assessment process.

One principle to keep in mind is that not all CDM/JI barriers can be effectively addressed through training, so it is important for potential CDM/JI host countries to consider non-training interventions in those cases. Otherwise, scarce resources can be wasted on training that either may not achieve the intended results or cannot be applied effectively on-the-job and therefore be sustained over time. One example would be countries that are currently unable to attract foreign direct investment, which has been suggested as a partial indicator of potential CDM flows. It might not be effective for such countries to invest human and financial resources in training efforts to establish the institutional prerequisites to engage in the Kyoto mechanisms and to improve project identification skills, unless attention is also paid to improving the overall attractiveness of the country and key CDM/JI sectors to foreign investors (see below), or finding innovative ways to lower the country-specific risk of CDM/JI projects to potential investors.

The NSS survey, which was the first serious attempt to structure and compare capacity-building needs of a wide spectrum of CDM/JI host countries (NSS family), shows that more detailed analysis of those needs must be done at the level of individual countries in order to find the most efficient way to use donor assistance. As we have demonstrated through the statistical analysis in the previous section, although global average data can be helpful in assessing the overall scope of CDM barriers and capacity development needs worldwide, it is misguided to rely on such aggregate data to design individual capacity-building interventions, as specific local circumstances may deviate significantly from the global average. These results suggest that providers of CB services that want to assist a broad range of countries should adopt a modular approach that can offer a menu of programs/options to clients with different capacity development needs. To deliver added value, regional approaches should also adopt this approach and capitalize on opportunities for learning by sharing.

In performing needs assessments, expert opinion derived from surveys needs to be complemented with additional information. Quantitative indicators for the readiness of countries to engage in CDM/JI deals should be developed that will allow objective benchmarking of countries related to:

- *institutional prerequisites* (e.g., formal designation of a national authority for the CDM (countries listed on the UNFCCC Secretariat website at <http://cdm.unfccc.int/DNA>); publication of specific procedures and institutions for project approval by the NACDM; the number of projects that have been validated by an operational entity and registered with the CDM Executive Board)
- *human capacity to identify and implement projects* (e.g., number of professionals with competence in CDM-PDD preparation; number of project hosts that have successfully implemented CDM projects; capacity-building services offered by local providers)



- *the cost and availability of CERs/ERUs* (e.g., marginal abatement cost data and potential offset volumes in different sectors; additional fees associated with host country project approval; other transaction costs associated with the project approval and/or implementation phases)
- *the attractiveness of countries and sectors to foreign investors*.¹⁴

Finally, we believe that CDM capacity needs assessment should be viewed as an iterative process that must be repeated periodically to evaluate the success of capacity-building efforts and to inform future programs. Thus, needs assessment should be viewed as an integral part of the quality assurance provisions of Kyoto mechanism training programs and should be fully integrated into the overall strategic management function by host countries and providers of capacity-building services (Arquit Niederberger and Yiu, 2003). We therefore encourage the World Bank and other institutions to integrate the needs assessment function into future programs, perhaps supporting host countries in their efforts to establish performance-based management systems for capacity development and training activities, and to budget adequate resources for such assessment and analysis activities in the future.

Acknowledgment

The authors are grateful to the World Bank NSS Program (P. Kalas, A. Mathur) for permission to use the 2002 NSS survey data. We thank the national experts who conducted and participated in the survey process, including P. Gwage, who also provided valuable comments on the manuscript, as well as the anonymous peer reviewers.

Notes

- 1 The survey program provided input for the World Bank/WBCSD workshop “Capacity Building for the Kyoto Protocol”, which took place in Sigriswil, Switzerland, on 23–25 September 2002 (see World Bank (2003) for the full workshop report).
- 2 See World Bank (2003) for the full text of the questionnaire.
- 3 See [http://lnweb18.worldbank.org/ESSD/envext.nsf/46ByDocName/CountrySurveyReports-NSSWorkshoponCapacityBuildingfortheKyotoProtocolSigriswillSwitzerlandSeptember2002PDF2299KB/\\$FILE/SigriswillWorkshopPart2CountryReports.pdf](http://lnweb18.worldbank.org/ESSD/envext.nsf/46ByDocName/CountrySurveyReports-NSSWorkshoponCapacityBuildingfortheKyotoProtocolSigriswillSwitzerlandSeptember2002PDF2299KB/$FILE/SigriswillWorkshopPart2CountryReports.pdf)
- 4 $N! = N \cdot (N - 1) \cdot (N - 2) \cdot (N - 3) \dots$ 3.2.1 is known as the factorial of N .
- 5 See, for example, Krishnamoorthy (2000).
- 6 Respondents were asked to choose up to five options from lists of seven barriers and ten capacity gaps.
- 7 $\ln p_i$ is the natural logarithm of p_i .
- 8 Software NSS 6.0.21, released May 1996 (copyright J. Hintze) was used.
- 9 The only other countries in our sample that have notified the UNFCCC Secretariat of their NACDM are Bolivia, which is loosely associated with Group 2, and El Salvador.
- 10 Note that this self-perception might not hold up to objective scrutiny in all cases; many of the countries in Group 1 have done a lot of preparatory work and pilot projects and may progress faster than some in Group 2 countries once they appoint their NACDM and the Kyoto Protocol enters into force.
- 11 In this context, El Salvador is an exception, as it has already notified the UNFCCC of its NACDM.
- 12 At the aggregate global level, there were clear differences of opinion between different stakeholder groups on some issues, such as the role of the private sector in delivering capacity-building services. See the World Bank workshop report for analysis of the aggregate data (World Bank, 2003).
- 13 This is caused, in part, by various sizes of statistical samples, which ranged from 9 to 16 at national level and 212 at global level: Samples with $N < 7$ do not allow testing for statistical significance if the above binary system is used. If, e.g., $N = 9$,



then 78% of respondents must have the same opinion; while in the case of a group of 220 respondents, only about 55% must choose the same option (see Table 1).

- 14 Fankhauser and Lavric (2003) identify four dimensions of the overall quality of the environment for conducting business in EBRD (European Bank for Reconstruction and Development) client countries: (i) the general business environment (ranking based on qualitative opinion surveys), (ii) country risk (composite ratings produced by specialized agencies), (iii) the state of the energy sector, as most JI projects in EBRD client countries are expected to be energy projects (EBRD's own power sector transition indicator, tariff levels, cash collection rate); and (iv) the general investment climate (foreign direct investment, World Economic Forum growth competitiveness index, aggregate score of the EBRD's transition indicators, which measure progress in privatization, liberalization, enterprise performance, and financial sector reform).

References

- Arquit Niederberger, A., 1998. Capacity building needs identified under the Swiss–World Bank Collaborative Initiative on National AIJ/JI/CDM Strategy Studies. Paper presented at the UNFCCC Workshop: Capacity-building for Project-based Mechanisms, Abidjan 17–18 September 1998 (see Swiss AIJ Pilot Program website http://www.admin.ch/swissaij/internal/art_capacitynss.htm).
- Arquit Niederberger, A., Yiu, L., 2003. Management systems for capacity building. *Joint Implementation Quarterly* 9(3), 8–9.
- Arquit Niederberger, A., Graf, E.O., 2001. Mid-Term Evaluation of the World Bank National Strategy Studies Program. Swiss State Secretariat for Economic Affairs, Bern (see Swiss AIJ Pilot Program website http://www.admin.ch/swissaij/pdf/NSS_evaluation.zip).
- Baczkowski, A.J., Joanes, D.N., Shamia, G., 2000. The distribution of a generalized diversity index due to Good. *Environmental and Ecological Statistics* 7, 329–342.
- Buchman, A., Baumert, K., Rizzo, F., 2001. Complying with the Kyoto Protocol Requirements: Capacity Needs in Central and Eastern Europe. Regional Environmental Center for Central and Eastern Europe, Szentendre, Hungary (can be ordered free from the REC website http://www.rec.org/REC/Publications/pubs_orderform.html).
- Dutschke, M., Michaelowa, A., 1998. Interest Groups and Efficient Design of the CDM. HWWA-Diskussionspapier 58, Hamburg.
- Everitt, B.S., 1993. *Cluster Analysis*, 3rd edition. Edward Arnold, London.
- Fankhauser S., Lavric, L., 2003. The investment climate for climate investment: Joint Implementation in transition countries. EBRD, Working Paper No. 77, London.
- GEF/UNDP, 2000. Country Capacity Development Needs and Priorities: A Synthesis. Global Environment Facility – United Nations Development Program Strategic Partnership (see GEF website http://gefweb.org/Site_Index/CDI/Synthesis_Report.doc).
- Klarer, J., Kolehmainen, O., Swisher, L., 1999. Synthesis Study of the National AIJ/JI/CDM Strategy Studies Program: A Review of National AIJ/JI/CDM Strategy Studies in the Czech Republic, Slovak Republic, Russian Federation and Uzbekistan. Swiss AIJ Pilot Program / World Bank / Ministry of Environment (see Swiss AIJ Pilot Program website http://www.admin.ch/swissaij/pdf/cb_nss_synthesis99.pdf).
- Korppoo, A., 2003. Forging alliance with Russia: the example of a Green Investment Scheme, *Climate Policy* 3, 67–76.
- Krishnamoorthy, K., 2000. *Statistical Distributions with Applications and StatCalc Software*. Etext.net Publisher, Venice, CA (available at <http://www.etext.net>).
- Levina, E., 2002. Climate change capacity building in Annex I EITs: issues and needs. Draft paper (dated 6 May 2002) presented at the OECD/IEA/IETA Workshop: National Systems for Flexible Mechanisms: Implementation Issues in Countries with Economies in Transition, Szentendre, Hungary.
- Loschel, A., Zhong Xiang Zhang, 2002. The Economic and Environmental Implications of the US Reputation of the Kyoto Protocol and the Subsequent Deals in Bonn and Marrakech. Paper presented at the International Workshop on Climate Policy in Asia, 17–18 December 2001, Tokyo 2002.
- Michaelowa, A., Stronzik, M., 2002. Transaction Costs of the Kyoto Mechanisms. HWWA Discussion Paper No. 175, Hamburg.
- Nondek, L., Maly, M., Splitek, V., Pretel, J., 2001. Joint Implementation in the Context of European Union Accession: The Case of the Czech Republic. PCFplus Report 7, Washington, DC (see http://prototypcarbonfund.org/docs/JI_and_EU_Accession.pdf).
- Pielou, E.C., 1975. *Ecological Diversity*. Wiley, London



- [Q5]Shannon, C.E., 1948. Mathematical theory of communication. *Bell System Technical Journal* 27, 379–423.
- UNFCCC, 2000a. Compilation and synthesis of information on capacity-building needs and priorities of developing countries (non-Annex I Parties). FCCC/SB/2000/INF.1 (see UNFCCC website <http://unfccc.int/resource/docs/2000/sb/inf01.pdf>).
- UNFCCC, 2000b. Compilation and synthesis of information on capacity-building needs and priorities of Parties included in Annex I to the Convention but not included in Annex II. FCCC/SB/2000/INF.2 (see UNFCCC website <http://unfccc.int/resource/docs/2000/sb/inf02.pdf>).
- UNITAR, 2001. Who Needs What to Implement the Kyoto Protocol? An Assessment of Capacity Building Needs in 33 Developing Countries. UNITAR with the Consortium for North-South Dialogue on Climate Change, Geneva.
- World Bank, 2003. Capacity Building for the Kyoto Protocol (Sigriswil, Switzerland, 23–25 September 2002). Workshop Report. World Bank Program on National CDM/JI Strategy Studies, Washington, DC.