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A systematic analysis of enabling conditions for synergy between climate change mitigation and adaptation measures in developing countries

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ABSTRACT

There is a growing quest for synergy between mitigation and adaptation due to concerns of inefficiency and ineffectiveness of the compartmentalized approaches to climate change. However, little has been done to explore the necessary enabling conditions for synergistic design and implementation. This paper proposes an analytical framework to assess enabling conditions for synergies at the national level and applies it to developing countries to explore the potential move toward synergy. Four enabling conditions for integrating adaptation and mitigation, i.e. policies and strategies, programs and projects, institutional arrangements and financial mechanisms, were used to score developing countries relative to each other. We hypothesized that low income and vulnerable countries might more likely pursue synergy given the urgency for both adaptation and mitigation. Despite the relative infancy of the synergy concept, about half of countries studied exhibited good synergy potential, 80% of which were middle-income developing countries. The assumption of vulnerability as a precursor for pursuing synergy was supported by the fact that small island states possessed relatively high synergy potential. Income was weakly associated with the synergy potential with least developed countries having low synergy scores. Emerging economies possessed strong synergy potential which might be associated with better capacity available and/or potential for shaping their global images due to their growing emissions. In sum, the proposed analytical framework could be useful to identify areas of emphasis to promote holistic and efficient climate policies. As this study largely focused on the enabling conditions, further studies are needed to scrutinize and manage the mitigation-adaptation balances in countries possessing good synergy potentials.

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1. Introduction

Climate change is a risk for people and the planet, and two lines of defense have been defined: mitigation (reducing emissions of greenhouse gas (GHG) and enhancing sequestration) and adaptation (reducing vulnerability and enhancing resilience). Though both are now necessary to address climate change issues, they remain separate priorities in the way they are addressed. Mitigation so far dominated global climate change policy discourse with adaptation largely considered a responsibility for individual countries (Ayers and Huq, 2009). Despite increasing adaptation challenges, developed countries continue to focus on mitigation while adaptation is a key priority for more vulnerable developing countries. This pattern may have resulted from the past belief that mitigation as a first line of defense could be sufficient to address climate change (van Noordwijk et al., 2011). International climate policy has also focused on mitigation options such as the Kyoto Protocol, LULUCF (Land Use, Land-Use Change and Forestry), NAMA (Nationally Appropriate Mitigation Actions) and REDD+ (Reducing Emissions from Deforestation and forest Degradation) with adaptation policies, such as NAPAs (National Adaptation Programs of Actions) limited to the least developing countries. Even in countries where both policies exist, they remain nested in separate sectors (Huq and Grubb, 2007; Ayers and Huq, 2009). Financing mechanisms for adaptation and mitigation are also segregated with a dominant role for mitigation. For example, 96% of global climate finance (350 billion USD) in 2010/11 was allocated to mitigation activities alone (Buchner et al., 2012). This dichotomy is inefficient and ineffective in the land-use sector due to several overlapping potentials of mitigation and adaptation measures (Dang et al., 2003; Verchot et al., 2007), especially in the developing world.

Many authors have suggested that a more integrated approach to mitigation and adaptation (hereafter referred to as M + A) would be desirable, as it can be more effective and efficient (Dang et al., 2003; Klein et al., 2007) and reduce tradeoffs between the two (Kane and Shogren, 2000). Moser (2012) advocated for such a holistic approach stating that the overlap of M + A ''demands a long-term, life-cycle, and systems perspective''. This has potentials for promoting sustainable development more effectively especially in developing countries (Dang et al., 2003; Swart and Raes, 2007). There are emerging thoughts that the synergy approach may form the basis of future climate policy (Tubiello et al., 2008). Klein et al. (2005), representing the small, but growing literature on synergy, expressed ''synergies in climate policy are created when measures that control atmospheric GHG concentrations also reduce adverse effects of climate change, or vice versa. Such measures have ancillary benefits, which produce win-win situations''. Emphasis is therefore placed on the system as a whole rather than on climate change measures as isolated interventions (Kane and Shogren, 2000; Warren, 2011). Synergy between M + A is therefore an approach in which both measures are addressed without prioritization, mainly undertaken within a systems-thinking context to address climate change issues.

This paper focuses on the national level where international mitigation discourse and policy meets the national adaptation realities of many developing countries. The national level allows for the integration of strategies given that both measures rely on a similar set of parameters. This allows governments to consider the entire system and act to enhance synergy (Klein et al., 2007). Furthermore, the achievement of synergy is especially beneficial within specific sectors such as land-use and forestry (Swart and Raes, 2007). By examining climate policy at this scale, we could understand why countries pursue the climate strategies they do.

Despite the promising potential of the synergy concept and the salient need for synergistic approaches for addressing climate change issues, knowledge on how the approach is being implemented ''on-the-ground'' and the necessary enabling conditions to make it possible are generally lacking. An appropriate framework to analyze synergy and its enabling conditions at the national level is therefore required. In an effort to contribute to the identified knowledge gaps, this study aims to:

(1) Develop a comparative framework for analyzing the state of enabling conditions for synergy at national level;
(2) Identify and describe the institutional, policy and strategic options for enabling synergy and;
(3) Explore factors associated with possible explanations for the relative performance of countries and country-groups with respect to synergy.

2. Methods

2.1. Data

This study relied on a combination of qualitative and quantitative research methods using a review of National Communications (NCs) submitted to the UNFCCC (United Nations Framework Convention on Climate Change) and an online survey questionnaire carried out to address its objectives. The NCs were analyzed in the following two areas: (1) how M + A were addressed; (2) indications of a move toward synergy as captured in existing policies, instruments, and mechanisms. The NCs were obtained from the UNFCCC website (www.unfccc.int) and were considered appropriate for review because they were: (1) the most comprehensive national-level documents addressing climate change issues that are globally comparative; (2) official documents prepared by the highest responsible bodies for addressing climate change in the countries; and (3) standardized documents relied on by the UNFCCC to assess climate change actions across countries. Fifty-three NCs mostly from non-Annex I countries and available in the English language were selected for review (See Supplementary materials for details). The extracted data was analyzed using basic descriptive statistics with Microsoft© Excel 2010.

The online survey, conducted using the Surveymonkey© online survey tool, focused on similar issues as the review of the NCs though here individual views of the respondents toward the synergy approach to M + A was given emphasis

too. The online survey was posted on/distributed to Climate-L, Forest-L and other institutional websites and retrieved a total of 30 responses.

To address the third objective which explores factors associated with the synergy score of countries, we selected two indices (GDP per capita and Human Development Index (HDI) 2012) that are related to the development endeavors of the country and eight indices that strongly associate with the vulnerability context of a nation. The eight variables used were: Long-term Climate Risk Index (CRI) score 1992–2011, trend of CO_2 emission per unit GDP, Environmental Sustainability Index (ESI) 2005, Environmental Performance Index (EPI) 2012, Climate change index from EPI, Ecological Footprint of consumption 2007, Total Biocapacity 2007 and Ecological Reserve/Deficit 2007 (Global Footprint Network, 2010). See Table A1 (Supplementary materials) for the detailed description of the variables. The association between the above indices and synergy score was examined using a one-tailed correlation test.

2.2. *Analytical framework*

2.2.1. *The enabling conditions*

Given that the synergy concept considers a holistic approach rather than segregated measures, we examined criteria that might provide insights on how M + A measures could be addressed within a common frame. To achieve this, four major enabling conditions were identified for synergy to happen: (1) planned and/or existing national laws, policies and strategies; (2) existing and planned financial means and measures; (3) institutional arrangements in the country with specific reference to climate change issues; and (4) planned and/or existing plans, programs and initiatives in the country. The first three mainly comprise planning processes that take place at higher levels (e.g. national level) while the fourth one, i.e. programs and projects deals with operationalization. The brief review below formed the basis for selecting the above-mentioned conditions.

Klein et al. (2007) state that effective climate policies should have diverse portfolios of adaptation and mitigation measures if the risks associated with climate change are to be reduced. Parry et al. (2001) also highlight the need for a blend of M + A practices to tackle climate change problems effectively. Klein et al. (2007) emphasize that such moves to effective climate polices may require the availability of technological, institutional and behavioral options and policy and economic instruments. Appropriate climate policies are therefore necessary for the realization of synergies.

Recent figures on climate finance, compared to the 96% for mitigation in 2010/2011 quoted above, reveal a slight increase for adaptation, with approximately 77% of global climate finance spent on mitigation (mitigation in general (69%) and REDD+ (8%)) in 2013 and adaptation garnering 15% of the pool (http://www.climatefundsupdate.org/themes). The institutional gap between the two measures has also made it difficult to design finance options that consider them simultaneously even though emphasis has been placed on boosting the financing of adaptation activities in past international negotiations. There is growing proof (e.g. Tol, 2005; Kane and Yohe, 2000) that addressing M + A measures within an integrated policy direction reduces the likely resource competition among the measures and increases the cost effectiveness of climate policy (Klein et al., 2005). Any move by countries toward such integrated financing mechanisms for climate change measures bolsters the move toward synergy.

A major challenge highlighted by Klein et al. (2005) in integrating adaptation and mitigation is the institutional complexity that may emerge given the various actors involved. The institutional divergences between adaptation and mitigation measures also became obstacles in moving toward integrated climate policies at various scales (Tompkins and Neil Adger, 2005). Countries with institutions that address adaptation and mitigation have therefore taken a promising step toward synergy. It is worth noting that in cases like the land use sector where there are strong resource complementarities among adaptation and mitigation measures, handling the two within the same institution contributes significantly to the resource-use efficiency (Matocha et al., 2012). Having the right institutions also forms the basis for the operationalization of programs and projects that capture both M + A measures.

One way to assess progress toward the implementation of the integrated approaches to climate change is to examine the presence of programs and projects that address both M + A measures. Their presence indicates that some planning, designing and operationalization processes were employed to implement the integrated approach. Through this process, considerable skill and experience could have been acquired relative to countries yet to embark on moving toward synergy.

For each enabling condition, we specified indicator(s) that could guide the assessment of progress made toward synergy (Table 1). Information about the indicators was gathered by

Table 1 – Enabling conditions with their respective indicators used to determine countries' synergy potentials.

Enabling conditions	Indicators used for each of the enabling conditions for synergies
Policies and strategies	Does the country have a climate policy that addresses both M + A?
	Is there a common climate strategy/action plan for both M + A?
	Has the country submitted NAMA (Nationally Appropriate Mitigation Actions)/REDD+ R-PP (Readiness Preparation Proposal) and/or NAPA to the UNFCCC?
Institutional arrangements	Is there a national-level committee addressing both M + A?
	Is there an implementing body (institution/agency/department/unit) addressing M + A together?
Financing (funds)	Is there a common climate fund for both M + A?
Programs and projects	Is there a joint program addressing M + A?
	Are there subnational projects addressing both M + A?

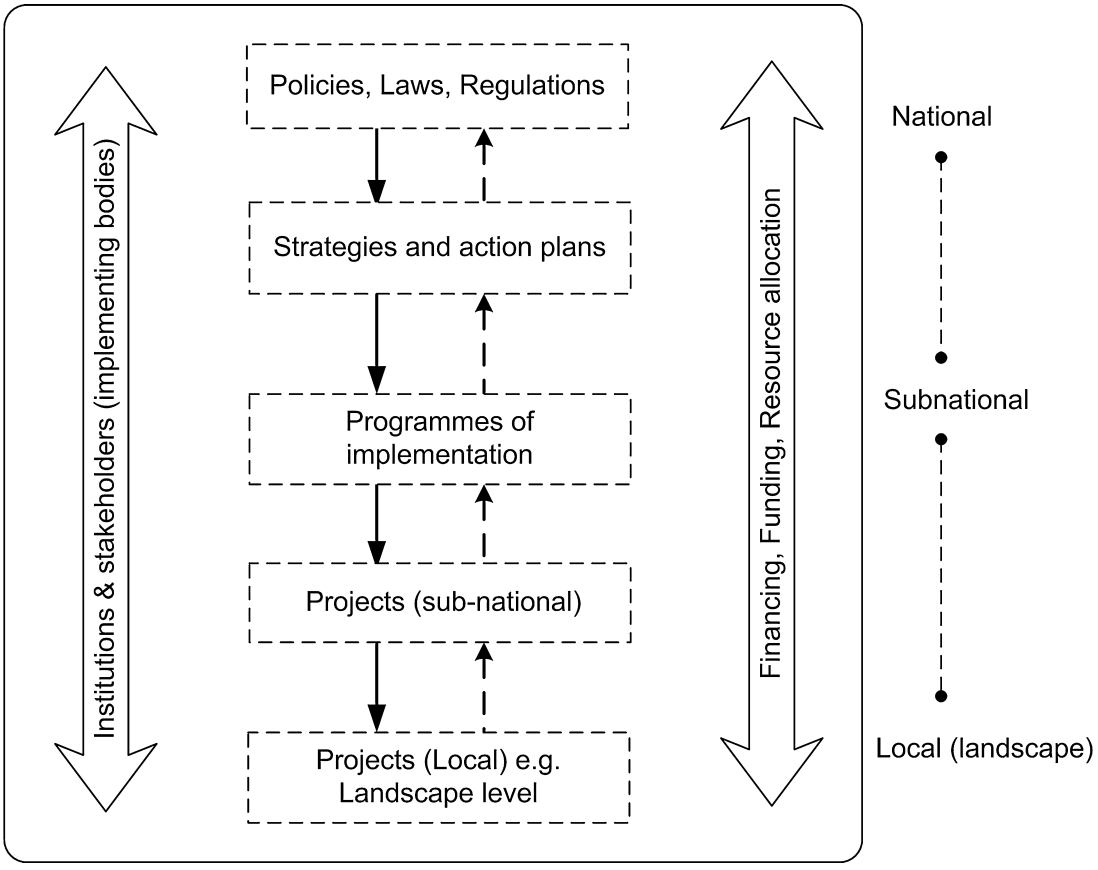

Fig. 1 – A generalized schematic representing key elements for the analysis of enabling conditions for synergy. Financing mechanisms and institutions and stakeholders are considered to cut across all scales.

reviewing the NCs and by analyzing the survey responses. A country which fulfilled a given indicator was given a value of 1 and otherwise 0 (Table 1). To simplify the analysis, we assigned an equal weight for each of the indicators given limited understanding on how to effectively weight them. As much as possible efforts were made to make the indicators mutually exclusive.

Though the above context is only for analytical purposes, the reality of how the enabling conditions (and also some indicators) feature and interlink across the various scales is shown in Fig. 1. This schematic framework considers the basic conditions necessary for a cross-sectoral policy to be implemented through hierarchical procedures from national to subnational to local levels.

2.2.2. *The computation of the synergy potential*

The sum score across all eight indicators was used to assess the levels of potentials for synergy within a specific country. We termed this summed value the 'synergy score' and used it to compare the relative position of countries in their move toward synergies between M + A. To consider a country as having promising synergy potential, the minimum threshold of the score was set at 4 (halfway from the maximum possible value of 8). This however does not mean countries with synergy score less than 4 are excluded from the analysis. To ease comparison between the four enabling conditions across countries, we averaged out the values of the indicators per enabling condition. Hence, the maximum possible value for each enabling condition after adjusting for the number of indicators is 1 with the minimum being 0. For all the indicators, the hypothesis is that countries with affirmative responses had stronger synergy potential than those responding otherwise.

3. Results

3.1. *Analysis of the enabling conditions for synergies between M + A*

On a scale of 0–1 (i.e. after adjusting for the number of indicators), the order of value of the enabling conditions was institutional setups (0.66) > implementations schemes (programs and projects) (0.45) > financial mechanisms (0.36) > policies and strategies (0.26). Developing countries may be performing well on institutional setups due to the relative ease of setting up committees and teams/units in the ministries. Several of these were constituted to write National Communications, NAMAs and NAPAs many of which had no further engagement past the document creation. The high value also implies that there are already handfuls of institutions that could help the implementation of synergies

between M + A measures and hence there is no serious limitation in developing countries in this regard. As this study put more emphasis on the presence or absence of institutions rather than their actual capacity, it is advisable to consider and analyze further the capacity of the institutions to accommodate various sizes of programs or projects.

3.2. *Analyzing the synergy scores of countries*

About 51% of the countries (27 out of 53) had a synergy score above or equal to 4 based on the eight indicators (Fig. 2) hence demonstrating the promising move toward synergy despite the concept being relatively new in climate change dialogs and

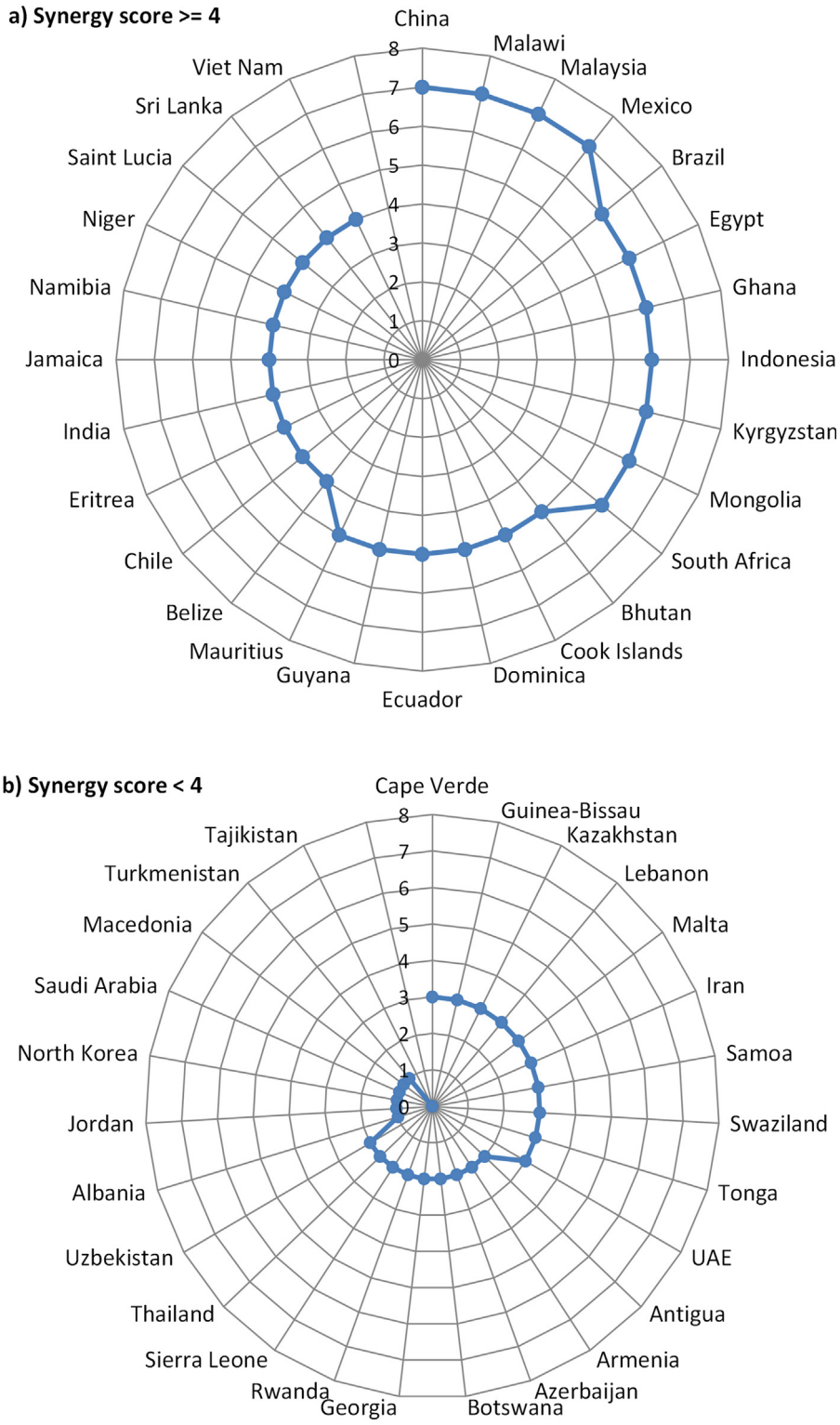

Fig. 2 – Synergy scores of countries on a scale of 0–8. UAE stands for United Arab Emirates.

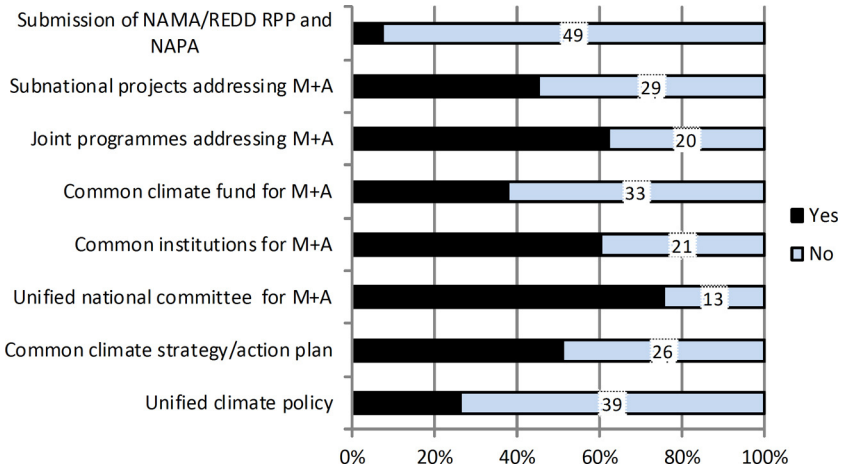

Fig. 3 – The presence–absence distribution of the synergy potential indicators in the study countries. Numbers on the bars for the 'No' response indicate number of countries (out of the 53) that do not possess the specified indicator.

actions. The score presented here is only indicative of the potentials for synergy and does not show the extent to which M + A are being effectively addressed within the climate policy of a given country. Therefore for countries to realize this potential, proper implementation and follow-ups are required to sufficiently address climate change problems in integrated manner.

Some typical features characterize the 27 countries with high potential for synergies. For example, 85% of these countries had a considerable length of their national borders exposed to major water bodies like oceans and seas. The prevalence of disaster events and risks along coastal areas, e.g. sea level rise and tropical cyclones, which are directly or indirectly associated with climate change may have caused them to adopt a holistic approach to climate change – boosting the adaptive capacity while managing their international emission reductions commitments. The other 15% of the countries (Namibia, Niger, Malawi and Kyrgyzstan) were among the frequently drought and/or flood affected countries. Countries with greater synergy potential also had a relatively higher average forest cover (36.25 ± 25.59%) compared to those with synergy score below 4 (22.07 ± 20.79%) in the time frame 2000–2007.

3.3. *Difference in prevalence among the indicators for synergy enabling conditions*

The four widely present indicators in their decreasing order were: common national level committees, joint programs, common implementing bodies and common climate change strategy/action plans (Fig. 3). Common climate funds (40%), unified climate policies (28%) and submission of both NAMA/REDD+ R-PP and NAPA (19%) were the rarest synergy potential indicators (Fig. 3). The rarity of common climate funds for integrated M + A may be due to limitations in financial resources given other competing development programs and projects that are often prioritized over M + A measures. The limited number of climate policies may be attributed to the relatively slow pace in addressing climate change particularly among developing nations. Thus, most of the approaches to address climate change are in their initial phases (e.g. needs assessments and data collection) and most countries are yet to determine how to appropriately implement climate change measures in a way that fits their development goals. About half of the study countries had a specific NAMA submission to the UNFCCC while only 17% of them had submitted a NAPA. The low submission of both documents may be because most countries were engaged in climate change mitigation (perhaps aligning themselves with international conventions) thus only emphasizing REDD+ and/or NAMAs.

3.3.1. *Common climate policies, strategies and institutions addressing M + A*

Almost 75% of countries did not have a unified climate policy at the time of the study. However, 52% of the study countries had a strategy that captured both M + A measures. Among these countries, 69% of them had a strategy that was specific to climate change while the rest had a strategy that combined climate change with other sectoral goals. Around 85% of survey respondents also indicated that their countries had some national climate change policy or strategy. It is also interesting to note that 40% of countries with climate change strategies bore the phrase ''climate change'' in their title.

In 72% of the countries ministries were the dominant responsible bodies[1] for climate change issues. Among the prominent ones were ministries of agriculture, environment, natural resources, and rural development. Climate change was strongly associated with ministries in charge of environment and natural resources in nearly 85% of the countries. There were, however, countries that already had an independent or adjunct ministry of climate change, e.g. Jamaica and Tonga. Indonesia also has an independent body named the

[1] *Responsible body* refers to higher level (e.g. national) institutions that engage in negotiations with either national governments or international bodies.

Office of Climate Change under the supervision of the country's President.

In 70% of the countries a national committee/team addressing both M + A existed. The implementation of activities to address M + A was however only evident in 59% of the countries which had a specific implementing body[2] (institution, agency, council or department). Among these, around 30% of them had implementing agencies with the title bearing the phrase 'climate change' and 25% of them had climate change issues implemented by institutions responsible for environmental issues.

3.3.2. *Programs and subnational projects jointly addressing M + A measures*

Around two-thirds of the countries had at least one program addressing both M + A measures. Fifteen of the 53 countries (28%) had at least two programs that captured both M + A. This suggested that there was considerable experience at program level in addressing M + A simultaneously. The sectoral classification of the programs shows that most of them emphasized climate change (42%), forestry (33%), and capacity building (21%) while a significant number of the programs emphasize agriculture (including food security and land management) (21%) and low carbon growth (12%).

More than half of the countries (24 of 53) possessed subnational projects addressing M + A together. This should, however, be regarded as a conservative figure as only projects highlighted in the NCs were considered and countries may have had projects not listed in the reviewed documents. Most of these projects (75%) were confined to forestry, agriculture and climate change. Other projects were mostly multi-sectoral in nature.

The analysis of the open survey data also supported the presence of a significant number of programs and projects with 80% of survey respondents mentioning their knowledge of national initiatives that address both M + A. According to the survey, such initiatives included REDD+ projects, climate smart agriculture, geothermal generation projects, water sector strategies, national policies on climate change and national conservation plans.

3.3.3. *Financing schemes for addressing both M + A measures*

Most implementations of M + A measures were financed by bilateral and multilateral funds and grants. The most important international sources of funds were the Global Environmental Facility (GEF), the World Bank and the United Nation Development Program (UNDP). Fifteen of the 53 developing countries had domestic funding sources that addressed both M + A measures. Table A2 (Supplementary materials) shows list of in-country trust funds and other domestic financial measures to address climate change related issues in some selected countries. In two countries (Malaysia and Malta) private sector financing had also commenced especially in the energy sector. Though most of these funds were directed toward mitigation measures, they also contributed to the economic efficiency of households that aided to increase households' resilience to climate change-related impacts.

3.4. *The synergy score and its association with selected vulnerability and income related national indices*

As the long-term climate risk index score (CRI) increased, the synergy score declined. The negative correlation between long-term CRI and the synergy score implies that countries that are more affected by climate change had a stronger synergy score. This may be a reflection of the efforts being made to address climate change M + A simultaneously using the available resources. Another factor that was significantly related to the synergy score is the trend of CO_2 emission per unit GDP (Fig. 4d). On the other hand, the synergy score increased as the 2012 Environmental Performance Index (EPI) (Emerson et al., 2012) and 2005 Environmental Sustainability Index (ESI) increased (Fig. 4c). The observed significant positive correlations between synergy score and EPI and ESI indicates how environmental issues play a key role in the efforts to address climate change measures in a synergistic manner.

The correlation test between the synergy score and the recent GDP per capita and HDI of countries showed non-significant negative relationships in the context of developing countries. This might be associated with the poor consideration of environmental issues by such indices during the computation. The association between the synergy score and ecological footprint revealed that with the increasing demand for resources the move toward synergy decreases though not significantly. The relationship between the synergy score and biocapacity was a strongly significant positive correlation indicating that countries with more available productive area show better readiness in addressing adaptation and mitigation in a holistic manner. We also observed significant correlation between the ecological reserve/deficit (difference between biocapacity and ecological footprint) and synergy potential ($r = 0.286$, $P < 0.05$).

4. Discussion

4.1. *Understanding the motivations for the pursuit of synergy*

More than half of the countries had a synergy score above or equal to 4. For all four enabling conditions, countries belonging to the middle income category surpassed the rest (Fig. 2) and no considerable difference was observed between the low and high income developing countries. The majority of the countries with strong synergy potentials belonged to the middle-income group (Fig. 5). Countries like China, Malaysia, Mexico, Brazil, South Africa and Indonesia which are in this category are experiencing rapid development and economic growth which is often associated with increasing emissions. This is corroborated by the trend of CO_2 emissions that had a strong positive correlation with the synergy potentials of countries (Fig. 4d). Indeed, Raupach et al. (2007) found that 73% of the global emissions growth in 2004 originated from developing and least developed economies and observed the

[2] *Implementing body* refers to those institutions or offices which directly are engaged in the operationalization of the activities.

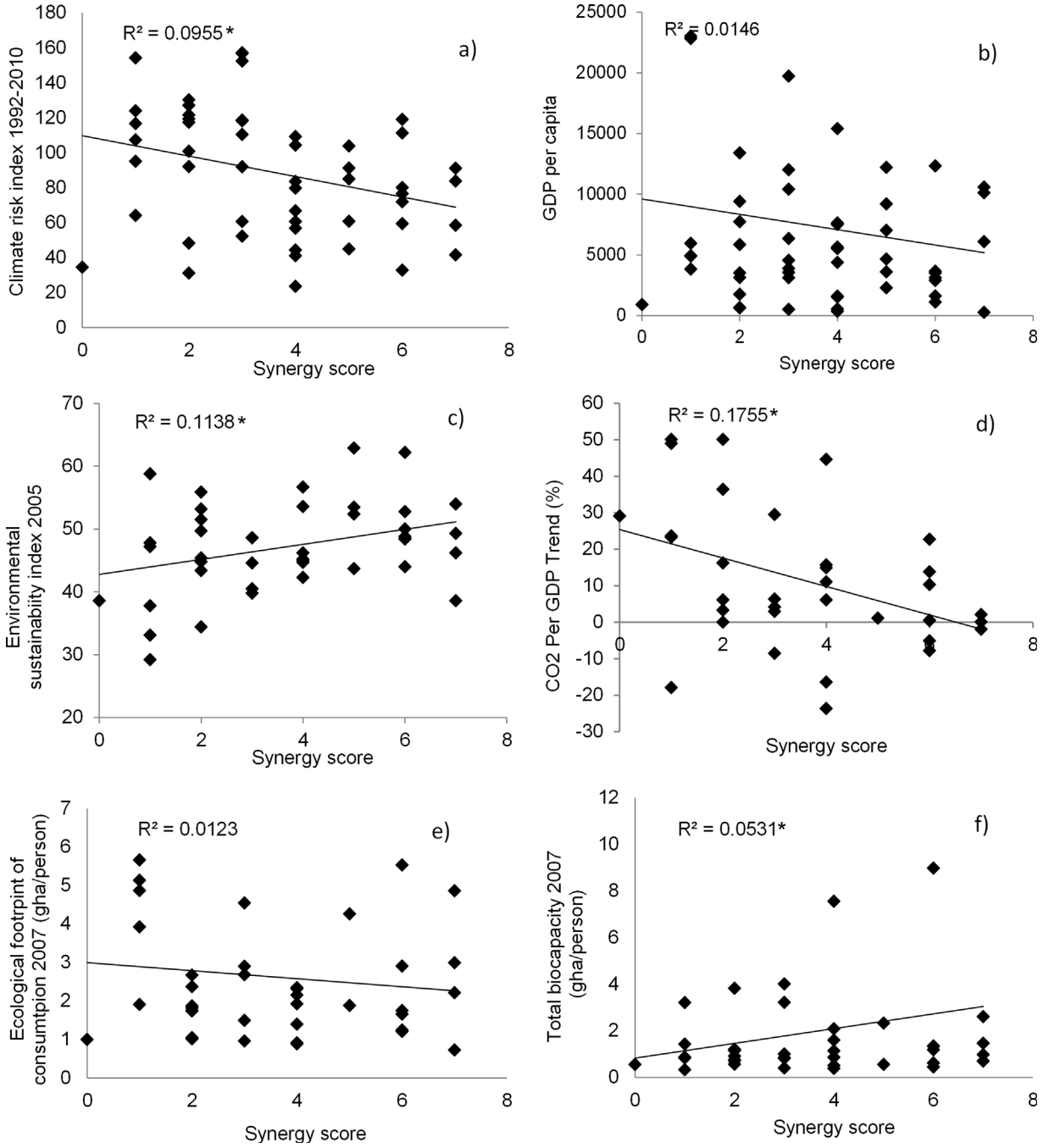

Fig. 4 – (a–f) The association of the synergy score of countries with selected national indices. *Note*: R^2 values followed by asterisks are the ones whose correlations are significant at 5% probability.

emission growth rate was highest among the fast growing economies.

The prominence of the fast growing countries among those with strong synergy potentials could therefore be motivated by the need to mend their international image. For example, a recent study by van Noordwijk et al. (2013), showed that one motivation behind the strong move toward REDD+ in Indonesia was mending their international image due to the high rate of deforestation (thus high CO_2 emissions) that the country was experiencing as oil palm and other industrial plantation expanded at the expense of forest and peat lands. Such moves by the BRICS excluding Russia, i.e. Brazil, India, China, and South Africa and other middle income countries could also be because they desire to be seen as ''responsible global citizens'', also argued by van Noordwijk et al. (2013) in the case of Indonesia. Another reason could be intentions to gain and win the support and attention of higher climate change bodies like the UNFCCC and FCPF (Forest Carbon Partnership Facility) to finance climate change related projects. The emerging economies also have numerous CDM projects particularly in China, Brazil and Malaysia (Bayer et al., 2013). The linkages between the CDM dominance and the

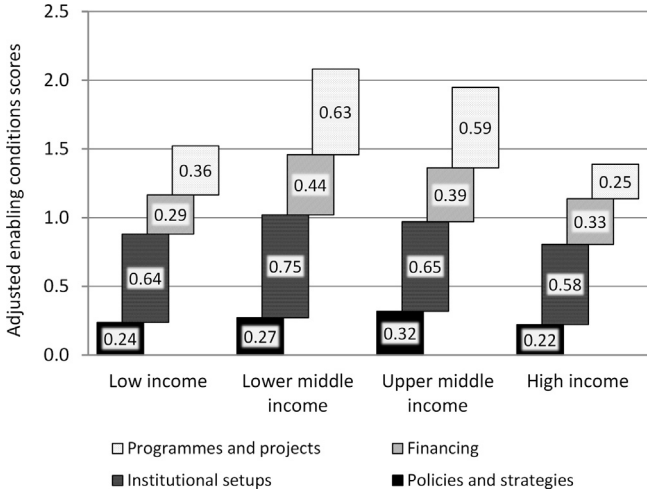

Fig. 5 – Analysis of enabling conditions among the four income categories based on the World Bank Atlas 2013.

strong synergy potentials may be due to the initially set objectives of the mechanism to embrace both emission reduction and complement sustainable development (Torvanger et al., 2013) which is the back bone of adaptive capacity in the developing world.

Most of the least developed countries had a synergy score below the threshold, i.e. <4. This result went against our initial assumption that low-income countries would have made noteworthy strides in pursuing integrated approaches to climate change measures given their resource limitations and high vulnerability. This finding was supported by the non-significant correlation results observed between synergy score and HDI (UNDP, 2013) and GDP per capita. Considering their national mitigation-related commitments and need for adaptation, one might expect these countries to have had better synergy potential especially as they (developing countries) actively lobby for the inclusion of adaptation at global climate dialogs. The low scores may be because LDCs are limited in their options for large-scale programs that help them implement climate change measures. For example, compared to the island states, climate change-related investments in the LDCs are limited to REDD+ or negligible in general. It is hoped that current efforts to make REDD+ more livelihood-sensitive will help the move toward embracing adaptation thereby promoting their synergy potentials. Malawi and Ghana were strong exceptions within the LDCs as they exhibited strong synergy potential. Both countries have taken significant steps in integrating climate change into their development objectives. Malawi, for example, prioritized climate change in its Growth and Development Strategy while Ghana has strong initiatives incorporating the environment, natural resources, climate change and livelihoods such as its Natural Resources and Environmental Governance Program financed by the World Bank. Both countries also had strong environmental sustainability indices (Esty et al., 2005). These indicate a strong commitment to ensure sustainable development and poverty reduction through good environmental and natural resources management (Bass et al., 2011).

Small island states and countries composed of many islands also stand out within the promising synergy potential class. This group makes up one-third of the countries that obtained above the minimum threshold synergy score of 4. Their high vulnerability as indicated by their low scores on the long-term Climate Risk Index (CRI (Harmeling and Eckstein, 2012)) means they have high adaptation needs. This, coupled with their mitigation commitments, may motivate them to adopt more holistic approaches to climate change. Their policies and strategies, financial mechanisms and institutions may have therefore shifted to harbor mitigation within their adaptation frameworks. These countries also had large-scale regional programs, e.g. The Pacific Adaptation to Climate Change and the Caribbean Climate Change Center, which provided financial and technical support for the island states. Some of these countries were also beneficiaries of the REDD+ programs as far as they had forests that qualify. Such strong and diverse programs might have boosted their strong potential for synergies as well.

4.2. *The state of the synergy enabling conditions*

Major limitations were observed in policies and strategies and financing mechanisms for synergies. Financing mechanisms and polices and strategies are the two enabling conditions with the lowest values in all the countries (Fig. 2). Two possible reasons could be offered for this: (1) the synergy approach by itself is an emerging issue even at the UNFCCC and other globally responsible institutions and has not transcended into national policies and strategies; (2) which as a result has not led to any defined financing mechanisms for the activities promoting synergies. Furthermore, considering the slow move in addressing climate change issues in many countries, it is expected that the policy formulation (and the finances accompanying it) could be a slow process. Hence efforts to implement and promote synergy should first emphasize building the capacity of developing countries to enhance their unified policy formulation process and the financial support required to implement the policy.

Often policy precedes strategy as the first serves as the blueprint for the latter. Rumelt (2011) even emphasizes that a good policy is like a kernel to have a good strategy in place. The fact that more countries had climate change strategies than climate policies may be due to the 'sudden' realization of the effects of climate change both at national and global level forcing countries to have some guiding documents in place prior to formulating a policy. The crosscutting nature of climate change issues may also have forced it to be embedded in other sectoral policies. Sector-based ministries were not initially instituted to address climate change issues but now have to, as the awareness about climate change related problems is juvenile particularly in developing countries. The dominance of ministries responsible for environment and natural resources in climate change issues may be due to: (1) the perception of climate change problems as being caused by environmental degradation and/or natural resources' depletion. The problem might thus be best addressed through environmental management and proper natural resource conservation, management and utilization; (2) the perception of climate change as an environmental problem in general; (3) the impact of climate change on fragile natural resources on

which the majority of populations in developing countries depend on for their livelihoods (Kumssa and Jones, 2010). Some institutions, however, have high political visibility, e.g. are placed under the President's supervision. Such strong positions in the country's political and administrative hierarchy could facilitate the policy development processes if coupled with appropriate resource allocation (financing and infrastructure), skilled manpower to implement the policies and proper institutional arrangements for operationalization. The presence of national committees/teams addressing both M + A measures might render an opportunity to facilitate the decision-making and implementation processes of climate change measures in a holistic manner.

Programs and projects addressing climate change holistically were prevalent. However, an in-depth analysis of the programs is necessary to identify at what stage of synergy they are at – early stage of synergy (co-benefit context), which is characterized by complementarity or a fully developed synergistic approach. Though the uptake of adaptation in global climate dialogs is relatively recent, the existence of such considerable number of programs addressing both M + A measures in developing countries implies that it is already well placed in ongoing measures to address climate change. The identified projects to some extent implicate that even mitigation was done with some adaptation benefits strongly linked to community livelihoods.

Although domestic financing for climate change remains low, the existence of diverse funding sources in developing countries as illustrated challenges the general notion that climate change activities often rely on bilateral and multilateral supports through international financing mechanisms. Such evidence also clearly backs the presence of a strong need to address climate change issues by mobilizing domestic resources. The fact that most of the identified domestic and trust funds were already institutionalized was also a strong advantage for the promotion and implementation of the synergized approach to climate change measures.

5. Summary

This study aimed at exploring enabling conditions for synergies between climate change M + A so as to shape the future direction of climate policy in developing countries which strongly need both M + A measures.

The findings indicate that a significant number of developing countries (51%) exhibit positive actions toward synergy despite the limited familiarity of the approach to the wider climate change communities (i.e. policy makers, scientists and negotiators). Among developing countries, middle income countries had strong synergy potentials compared to low and high income countries. They outperformed all other groups of countries particularly with regards to enabling conditions like institutional setups, financial mechanisms and program and projects implementation that address M + A simultaneously. National committees and bodies addressing climate change, and joint programs at the national and sub-national levels were prevalent indicators while unified climate policies and submission of both NAMA/REDD R-PP and NAPA were the least prevalent in developing countries.

With increasing climate-related risks, countries were found to push more toward a synergized approach to climate change. This is evident from the observation that nearly one-third of the countries with promising synergy potentials are island states (either small island states or countries composed of many islands, e.g. Indonesia) that are often affected by climate related hazards. Countries with better environmental governance and environmental sustainability measures possess stronger synergy potential as compared to the rest. Generally, with increasing trends of CO_2 emissions per unit of GDP, the synergy potentials of countries declined. However, this has had two (rather opposite) explanations when considered from specific countries context: (1) increasing CO_2 emissions may imply intensive growth and with increasing global concerns of GHG emissions countries may prioritize the emission reductions rather than moving forward to the synergized approaches; (2) countries like China, Brazil, Mexico and Indonesia which had increasing CO_2 per GDP trends are already taking measures to tackle the problem using integrated approaches and hence had stronger synergy potentials.

Efforts to strengthen the potentials of developing countries to address climate change measures in an integrated manner should emphasize the reinforcement of appropriate unified policies and strategies, institutional arrangements, and ensure proper and sustainable financial mechanisms to promote the synergy approach. Unless such enabling conditions are prioritized, the accompanying inefficiency in addressing climate change issues will remain a challenge.

The framework presented in this paper (the synergy score analysis) is a first attempt at identifying, analyzing and comparing enabling conditions for synergies among countries and could be a promising tool for policy makers and climate negotiators to know where various countries stand relative to one another. The tests of the association of the synergy score with other nation attributes confirm the credibility of the method applied with most of the observed patterns following the general expectations. The findings from this study could help in formulating appropriate actions to address climate change measures from a holistic perspective. However, the findings reflected emphasized the enabling conditions and do not explore how balanced M + A measures are in practice within the countries. Therefore, the adaptation–mitigation balance in integrative policies and strategies of countries with good enabling conditions is an issue demanding further scrutiny.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.envsci.2014.06.003.

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