POLICY BRIEF

November 2012
Number 25

Classification of MRV of Greenhouse Gas (GHG) Emissions/Reductions: For the discussions on NAMAs and MRV

Key Messages

- "MRV" is a concept that integrates three independent processes: Measuring or Monitoring (M), Reporting (R) and Verification (V).
- "MRV" has policy implications only when its object, aim, methodology and implementation body are clearly defined. Therefore, when discussing MRV, it is necessary to identify these various elements associated with MRV.
- From this point of view, MRV of Greenhouse Gas (GHG) emissions/reductions can be classified into the following four types.
  - •Type I: MRV of GHG emissions at organisation level
  - •Type II: MRV of GHG reductions at project level for crediting
  - •Type III: MRV of GHG emissions at national level
  - •Type IV: MRV of GHG reductions by policy/action
- There are substantial differences between each type of MRV on their maturity, accumulation level of knowledge and experiences, policy implications and required level of accuracy. Policy debate on MRV without clarification of these differences may lead to a large perception gap.
- "MRV of GHG reductions by implementing NAMAs[1]" is currently considered under UNFCCC (United Nations Framework Convention on Climate Change). This MRV corresponds to Type IV listed above which is still underdeveloped and is neither an internationally recognised guideline nor has a standard available for it.
- Although "MRV of GHG emissions reduction at project level for crediting" like CDM has some similarities with "MRV of NAMAs", there are obvious limitations of its general application for a wide range of policy/action included in NAMAs. It is desirably expected to establish a MRV system of GHG reductions by policy and action.

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[1] "NAMAs" stands for "Nationally Appropriate Mitigation Actions" to which no official definition has been given so far. In this paper, they are defined as the climate change mitigation actions, particularly GHG emissions reduction policy and action, implemented/to be implemented by developing countries under the Cancun Agreement, referring to Fukuda and Tamura (2012).

I Introduction

MRV is a concept that integrates three independent processes: Measuring or Monitoring (M), Reporting (R) and Verification (V). Although each of part of measuring, reporting and verification can be an independent process, MRV in this paper refers to a system where the three processes are systematically integrated. A system with only measurement and reporting, for instance, is not considered as a MRV system here.

The term MRV originally came from the Bali Action Plan, the negotiating text of the UNFCCC (UNFCCC, 2007) in Bali, Indonesia at the end of 2007. The basic understanding of the Bali Action Plan is that climate change mitigation actions – mainly GHG emissions reduction[2] – shall be implemented in a "measurable, reportable and verifiable" manner, and this idea has brought significant implications for international negotiations since then. In parallel, the term of "MRV" has often been used without a common understanding of its definition, objective and content, leading to confusion and misunderstanding.

The aims of this paper are, firstly, to classify the MRV system of GHG emissions/reductions according to its object, aim, methodology and implementation body and, secondly, to demonstrate that there are significant differences between each type of MRV system even though all of them together are usually simply referred as "MRV", suggesting the need to develop of new type of MRV system for quantitative evaluation of NAMAs which can be substantially different from other MRV types.

2 Elements to determine the nature of MRV: object, aim, method, implementation body

MRV is merely a tool. Thus, MRV has clear policy implications only when its object (what do you MRV?), aim (why do you MRV?), method (how do you MRV?) and implementation body (who is doing the MRV?) are clearly defined. In other words, although referred to the same "MRV", there is a possibility that a completely different MRV system is created when these elements are divergent.

2.1 Object of MRV

The object of MRV is the most important element to determine the overall nature of MRV. The object can be broadly divided into two: one is GHG emissions themselves and the other is GHG emissions reduction (hereafter, referred to as GHG reductions). It also can be differentiated by the geographical area (boundary) for which MRV of GHG emissions/reductions is actually being conducted. A difference between objectives changes the nature of MRV. For example, when the object is GHG emissions, MRV can be relatively simple since it is an absolute value of GHG emissions within a geographic boundary. On the other hand, when the object is GHG *reduction*, its MRV is far more technically complex since it is a differenced value between GHG emissions at multiple scenarios with and without project/policy/action taken place in a geographic boundary.

2.2 Aim of MRV

The aim of MRV refers to "why do you MRV?" For example, in the case of the CDM, an issuance of carbon credits is the ultimate aim of MRV, based upon the amount of GHG reductions that has been achieved by implementation of an individual CDM project. Due to a huge responsibility for the creation of financial assets in a tradable form in the carbon market, an extremely high level of accuracy is required for the MRV. On the other hand, in the case of the national GHG inventory under UNFCCC, the aim of the MRV is determination of the total amount of annual GHG emissions at national level, for which very high precision like for CDM is not necessarily required. As such, the aim of the MRV has a significant impact on its required level of accuracy.

[2] Carbon sinks are omitted for simplicity which should also be included here.

2.3 Method and implementation body of MRV

The method and implementation body of MRV are the main parts of the practical procedure of MRV. Although the nature of MRV is predominantly determined by its object and aim, it becomes more clearly apparent in so-called MRV methodology and MRV guidelines where method and role of implementation body are systematically described in a logical manner. Typically, the complexity of MRV becomes evidently visible in a specific form of MRV methodology. MRV methodology and MRV guidelines illustrate procedures and modalities for data monitoring, GHG calculation, reporting, and verification in detail.

2.4 Confusions caused by "too much MRV"

The use of the term MRV alone without clarification of its object, aim, method and implementing body is likely to lead to obscure argument. For example, apart from MRV of GHG emissions/reduction described so far, different types of MRV, such as MRV of the level of supporting capacity building and the amount of financial assistance to developing countries, is also referred as MRV in a completely different context in the negotiations of the UNFCCC (IGES, 2011). It is a situation that may be referred to as "too much MRV". Obviously, the contents of "MRV of funding" and "GHG emissions/reductions" are quite different. Any discussion on MRV without clarification of its object should be avoided. In this paper, MRV refers only "MRV of GHG emissions/reductions" unless otherwise stated[3].

3 Classification of MRV of GHG emissions/reductions

In fact, MRV of GHG emissions/reductions is not a new issue at all. It has been discussed extensively over the past decade as one of the unavoidable issues when one examines the existing schemes mentioned above such as CDM, National GHG Inventory, verified emission reduction (VER) and emissions trading schemes at international level and/or domestic level. In this context, MRV of GHG emissions/reductions is the classic and essential issue associated with GHG related schemes. Nevertheless, MRV was not considered as a system until recently when it was conceptualised under the UNFCCC negotiation in 2007.

Table 1 shows the four types of MRV systems classified according to the differences in their objectives, aims, methodologies and implementation bodies associated with their characteristics, examples of the operated existing schemes and the related international standards and guidelines. There are substantial differences between them in terms of their maturity, policy implications, accumulated knowledge and experiences. At present, these four types of MRV systems are often discussed as the same "MRV" without clear distinctions between them. The following sections examine each type of the MRV in detail.

3.1 Type I: MRV of GHG emissions at organisation level

3.1.1 Widely operated MRV under emissions trading and GHG reporting schemes

Type I is MRV system of GHG emissions at organisation level such as factory, facility, building and company. It has been widely operated under the existing global GHG schemes including EU-ETS[4], Climate Registry (US), California Climate Action Registry (US), Tokyo Metropolitan Government ETS (Japan), JVETS (Japan's Voluntary Emission Trading Scheme) and others[5]. MRV of GHG under emissions trading requires extremely high level of accuracy in monitoring

[3] In reality, in the UNFCCC negotiation documents, the term MRV is often used alone without clarification of its object. For instance, Biennial update reporting guidelines (UNFCC, 2011) describes simply "Information on domestic measurement reporting and verification" without additional explanation. It is unclear what the object of such "domestic measurement reporting and verification" is. It is assumed to mean "domestic measurement reporting and verification of NAMAs implemented by developing countries". Obviously, the description is insufficient as a guideline. Although this may be a result of international negotiation, researcher should make a discussion with clarification of what the object of MRV is.

[4] Strictly speaking, MRV in EU-ETS is conducted at "installation level". However, in this paper, it is included in "organisation level" for simplicity.

[5] There are some schemes, for example "GHG Reporting Programme" in Japan, which include only monitoring (M) and reporting (R), but do not have specific verification process (V). In this paper, such schemes are not considered as the operated examples of MRV.

Table 1 MRV of GHG emissions/reductions

		Type I: MRV of GHG emissions at organisation level	Type II: MRV of GHG reductions at project level for crediting	Type III: MRV of GHG emissions at national level	Type IV: MRV of GHG reductions by policy/action
Object		GHG emissions at organisation level under GHG scheme	GHG reductions realised by individual project	GHG emissions at national/ sub-national level	GHG reductions by policy/ action at national/sub-national level
Aim		Determination of GHG emissions at covered organisation under GHG scheme	Crediting and certification of amount of GHG reductions by individual project under GHG scheme	Determination of GHG emissions at national level and compliance assessment for developed countries under Kyoto Protocol	Quantitative evaluation of policy/action
Methodology	**M·R**	Monitoring and Reporting Guidelines under GHG scheme	Monitoring/ Baseline/Calculation methodologies under GHG scheme	IPCC Guidelines and UNFCCC COP/CMP Decisions	Unavailable
	V	Verification Guideline under GHG scheme	Verification Guideline under GHG scheme	UNFCCC COP/CMP Decisions and Kyoto Protocol Art.8 with related documents for review	Unavailable
Implementation body	**M·R**	Covered organisation under GHG scheme	Project participant of individual project	National government/ sub-national government	Unknown (probably, government that is implementing the policy/action)
	V	Third-party verification body	Third-party verification body	Expert Review Team under UNFCCCC/ Kyoto Protocol Art.8	Unknown
Characteristics		•Very high required level of accuracy •Technically well matured and sophisticated MRV •Sufficient knowledge and experiences accumulated in developed countries •Relatively simple	•Very high required level of accuracy •Technically well matured and sophisticated MRV •Globally operated via CDM all over the world •Technical difficulties inherited in baseline setting, additionality demonstration	•Medium required level of accuracy (not as much as Type I and II) •Technically matured and widely operated in developed countries •Not well established in developing counties •Relatively simple	•Undeveloped MRV •Required level of accuracy unknown, but possibly less than medium •Important MRV regarding effectiveness of international climate regime
Examples operated		•EU-ETS •Climate Registry •California Climate Action Registry (US), •Tokyo Metropolitan Government ETS •JVETS (Japan)	•CDM •VCS •J-VER (Japan) •BOCM (Japan: under developing)	Submission and review of National GHG Inventory	Unavailable
International standards/ Guidelines		•ISO14064-1 •ISO14064-3 •ISO14065 •ISO14066	•ISO14064-2 •ISO14064-3 •ISO14065 •ISO14066	•IPCC Guidelines (M/R) •UNFCCC COP/CMP Decisions (R/V)	Unavailable

and strict data traceability since it directly affects the compliance evaluation of the participants connecting with their monetary interests. For this reason, a series of rigorous and sophisticated guidelines for monitoring, emissions calculation, data reporting and verification are in place for the each scheme[6]. Sufficient experiences and knowledge have been accumulated through the operation of the existing GHG schemes. The degree of completeness and maturity of this type of MRV system counts as top-level, often creating a highly sophisticated level of technical discussions.

ISO14064-1 (ISO, 2006a) for "M" and "R", and ISO14064-3 (ISO, 2006b), ISO14065 (ISO, 2007), ISO14066 (ISO, 2011) for "V" have been established as international standards for this type of MRV system. These ISO standards are "programme neutral" so they only present the minimum required specifications for the MRV, but do not specifically describe detailed methodologies of how to do it, implying that actual MRV cannot be properly conducted only with the ISO standards. Therefore, detailed guidelines for MRV need to be developed individually for each GHG scheme. This is because the ISO standards are not intended to be used for a particular scheme in a restrictive manner, but can be used for various schemes in a flexible manner.

It is possible to conceptualise "MRV of GHG emissions at sectoral level" which may be referred to as "sectoral MRV". MRV under the Sectoral Trading Mechanism (STM) (EU, 2012) is likely to belong here. This type of MRV can be included as an extended version of Type I, since GHG emissions at sectoral level are calculated as a sum of those at organisation level.

3.1.2 Main issue is capacity building for private sector

Since the methodological parts of Type I have been nearly completed, the main issues with this type of MRV are shifting to capacity building of implementation bodies to operate it such as private companies covered by the GHG schemes and verification bodies. When emission trading or/and GHG reporting programme are introduced or plan to be introduced, the covered private companies have to develop their own capacities to conduct Type I MRV if at all possible. However, if this is not the case, private companies are not encouraged to do so. This implies that the capacity of the private sector to conduct MRV really depends upon climate policies as to whether or not GHG schemes are introduced. The same argument can be applied for third-party verification bodies.

3.2 Type II: MRV of GHG reduction at project level

3.2.1 MRV of GHG reduction for crediting

This type of MRV has been well known globally through the implementation of the CDM all over the world. All of the similar verified emission reduction schemes, including VCS (Verified Carbon Standard), J-VER (Japan Verified Emission Reduction) schemes, have this type of MRV. The Bilateral Offset Credit Mechanism (BOCM) proposed by the Japanese Government (Japan, 2012) also has this type of MRV within it. The distinct character of Type II is that, as already mentioned above, its object is "GHG reductions" which can be calculated as a "differenced value" induced by implementation of an individual GHG project, rather than an "absolute value" of GHG emissions.

This creates additional work such as the calculation of counter-factual emissions which are often called "baseline emissions", and demonstration of additionality/eligibility that lead to enormous complexities of this type of MRV. Furthermore, similar to the case of Type I, Type II is also rigorous MRV which requires a very high level of accuracy and strict data traceability since the aim of MRV is crediting of the amount of GHG reductions[7].

[6] However, if the aim of MRV is only for reporting rather than compliance assessment, the required level of accuracy may substantially decrease. Therefore, again, it is important to clarify what the aim of MRV is.

[7] If the aim of MRV is not crediting, but merely quantification of GHG reductions, the required level of MRV may decrease significantly. As repeatedly stated, one should clarify the aim of MRV when discussing the MRV.

Similar to Type I, a series of ISO standards such as ISO14064-2 (ISO, 2006c) for "M" and "R", ISO14064-3 (ISO, 2006b), ISO14065 (ISO, 2007) and ISO14066 (ISO, 2011) for "V" have been established for this type of MRV system. Again, these ISO standards only present the minimum required specifications for MRV and does not describe any particular methodologies on how to do MRV.

3.2.2 Sophisticated MRV methodologies and issues remaining

Like Type I MRV, extensive knowledge and experiences have been accumulated on Type II by the implementations of the CDM and other similar GHG schemes on a global scale. The specific methodologies for monitoring, calculation, reporting format, reporting procedure, validation/verification, and accreditation procedure for validation/verification bodies have reached a highly sophisticated level, indicating Type II system has been nearly completed for the technical aspects. Nevertheless, there are essential difficulties inherent in the setting of a "baseline" and demonstration of additionality/eligibility which still remain for further research.

Applicability of Type II is limited to GHG reductions of "project level" only, rather than all GHG reductions. The limitation comes from the fact that quantification of GHG reductions of this type is based on appropriate baseline-setting which can be properly conducted at "project level" only. In other words, the level of accuracy for MRV is determined by its aim - crediting – which can be met only at project level. This is an important discussion point when considering Type IV MRV (MRV of GHG reductions by policy/action) outlined in the latter part of this paper.

3.3 Type III: MRV of GHG emissions at national level

3.3.1 Well established in developed countries, but not developing countries

Type III is MRV of GHG emissions at the national level where the total amount of aggregated GHG emissions are monitored and reported by the countries themselves. This type of MRV has been well established and satisfactorily implemented at least in developed countries over the past decade. Developed countries are required to monitor and calculate their GHG emissions being annually reported to the UNFCCC secretariat using the common reporting format (CRF) namely the National GHG Inventory Report (NIR) according to a series of IPCC Guidelines (for example, IPCC, 2006) and other related documents. The NIR submitted by each country is thoroughly reviewed and verified by an Expert Review Team (ERT) according to the reviewing guidelines under Kyoto Protocol Art.8.

In this way, the National GHG Inventory has secured its international credibility by establishing Type III MRV for the total amount of GHG emissions at the national level. The methodological parts of Type III are almost complete, often leading to highly sophisticated technical discussion, similar to Type I. Therefore, a major challenge with Type III is capacity building of implementation bodies, rather than the methodological issues. Not only in developed countries, but also in developing countries, it is requested to build the capacity of competent authorities so that they can properly carry out this type of MRV more frequently than the present.

3.3.2 Key feature is MRV at macro level

Data used for Type III are mainly macro data at the national level, which are normally not equal to the sum of GHG emissions at the organisation level in Type I and GHG reductions at project level in Type II. One example is GHG emissions from fossil fuel combustions which occupy a large part of the national GHG emissions in many countries. These are not normally computed based on the aggregated values of the fossil fuel consumption by individual organisations but rather they are based on macro energy statistics at the national level[8]. Therefore, "MRV" in Type III is significantly different from "MRV" in other types in term of

[8] However, a new attempt to employ GHG emissions data at the organisation level using Type I to calculate GHG emissions at the national level by Type III has been started (IPCC, 2011). A complementary relationship can be found between Type I and III since the accuracy of Type III can be improved by Type I as they have common objects which are GHG emissions at absolute level.

its methodologies and implementation bodies.

When the geological scope of Type III is narrowed from country level to local level, the MRV of GHG emissions at local government or municipal level can also be possible. However, none of the internationally recognised guidelines has been established yet for such MRV of GHG emissions at this local level. In contrast to the national level, actual systematic operation of such MRV has rarely been conducted. MRV of GHG emissions at local government/municipality level, as an extended concept of Type III, is still left for further research[9].

3.4 Type IV: MRV of GHG reductions by policy/action

3.4.1 Undeveloped MRV, no international guidelines are available

The aim of Type IV MRV is quantitative evaluation of policy and action including NAMAs. Discussions are often held in which Types I - III and Type IV are confused. It is not appropriate since Type IV is clearly different from the others in a number of aspects. Type I – III are well established with accumulated sufficient knowledge and experiences under a range of GHG schemes over the world, and in contrast, Type IV suffers from a lack of both experiences and knowledge and no international guidelines are available. Type IV is an undeveloped type of MRV.

3.4.2 Cross-sectional and all-inclusive MRV

Type IV is a complex structure such that it can overlap with any of Type I – III, but also can build its own cross-sectional form. For instance, when quantifying GHG reductions by specific types of projects such as renewable energy, energy conservation and energy conversion, project specific data monitoring is needed, allowing Type IV to be close to Type II. In addition, when quantifying GHG reductions using a geographically wider policy so that a particular type of GHG is reduced at the national level, MRV using macro data, like Type III, can be used. Furthermore, in the case of quantification of GHG reductions by particular industrial process such as oil refinery and steel production, MRV at the organisation level may be appropriate when GHG quantification is difficult at the project level.

Therefore, Type IV can cover any of Type I – III comprehensively. Amongst them, Type II has somewhat higher similarity to Type IV since the objects of both of them are GHG reductions.

3.4.3 Difference between Type II and IV

However, it should be noted that the principal aim of Type II, which is crediting of GHG reductions, clearly differs that of Type IV, which is a policy evaluation of mitigation actions i.e. GHG reductions policy and action. This difference has direct influence on the required level of accuracy, baseline/monitoring methodologies and verification process, as already mentioned.

It also needs to be noted that the concept of “baseline” which is commonly used for quantification of GHG reductions by Type II, can be excessively difficult to apply to some cases of policy/action at Type IV.

4 Discussions on NAMAs and MRV

4.1 MRV of NAMAs

The essence of the discussion on MRV under UNFCCC is how to quantitatively evaluate policy and action taken, represented by NAMAs, to reduce GHG emissions in developing countries and GHG emissions reduction commitments by developed countries in a transparent manner. NAMAs can include various types of policies and actions ranging from project level activities like the CDM to macroeconomic approaches. There is a political implication of NAMAs in that they are greatly expected to promote “scaled-up” GHG emissions reduction policies and actions well beyond those at project level (South Pole, 2011).

[9] An international guideline is under development (C40 Cities *et al*. 2012) that has not been completed yet. This draft at currently available version does not include any provisions for verification.

Type IV is exactly suited to this type of MRV, which is different from other types of MRV, and has somewhat higher similarity with Type II with regard to the object of reducing GHG, as already pointed out. However, there is a severe limitation on the applicability of Type II that it cannot be applied beyond project level. No matter how far Type II becomes technically sophisticated, it cannot be properly applicable for MRV of NAMAs including "scaled-up" wide range of policies beyond project level. Of course, Type II can apply NAMAs in cases where they are solely built at project level, but it should be stressed again that Type II cannot be universally applicable to the whole range of NAMAs. Therefore, too much technical elaboration of Type II does not seem to be really appropriate in consideration of MRV of NAMAs.

4.2 NAMA credit

The fact that Type II cannot globally apply to NAMAs indicates that it is difficult to conduct MRV of NAMAs in a higher accuracy level as well as crediting. This may allow the idea that, in order to enabling crediting of GHG reductions, NAMAs should be limited into those of project basis. However, this idea may go against the nature of the NAMAs in that they promote the "scaled-up" wide range of GHG reductions beyond project level. In this regard, an essential contradiction seems to be inherent in the concept of "NAMA credit" which aims to credit GHG reductions generated by NAMAs. If NAMA credit is established as a crediting scheme, it may be strictly limited to only NAMAs on a project basis (Ecofys, 2012). After all, this is entirely Type II MRV for project level.

4.3 Establishment of Type IV

As discussed, the MRV of NAMAs, which is quantitative policy evaluation for GHG reduction policy and action, is expected to have complex and multiple structures relating to Type I, II and III cross-sectionally. The establishment of Type IV is highly intellectual work that needs comprehensive knowledge and experiences related to Type I through III, including consideration of whether such an MRV system can be actually built or not. If Type IV is established, it is likely to have an impact on modalities and procedures for policy evaluation of mitigation actions under the international climate regime in the future.

4.4 Type IV and developed countries

So far, Type IV has been discussed in the context of NAMAs in developing countries in the future international climate regime. This is because mitigation actions taken by developed countries (i.e. GHG emissions reduction commitments at the national level) can be evaluated effectively by using Type III with the national GHG inventory, implying Type IV may be exclusively used for evaluation of the mitigation actions taken by developing countries instead of Type III.

Nevertheless, it is not necessary at all to limit the application of Type IV to developing countries since quantification of GHG reductions policy and action is also required for the evaluation process in developed countries as a domestic climate policy. Only in the context of the international climate regime, developing countries are considered as the main object of Type IV.

In fact, attempts to quantify GHG reductions induced by policy and action have been made in variety of ways in developed countries[10]. However, these past attempts in developed countries mainly focused on calculation methodology of GHG reductions, but did not fully consider MRV as an integrated system including monitoring/reporting methodologies as well as a verification process. It is expected that the accumulated knowledge through past attempts can be effectively utilised as a fundamental point for further research to develop Type IV.

[10] For example, AEA (2007), Japan (2011) and others.

5 Conclusions

This paper has shown that MRV of GHG emissions/reductions can be categorised into four types according to the object, aim, methodology and implementation body, each of which has different characteristics and policy implications.

There is a risk of a large perception gap when conducting political debate on MRV without clarifying the differences between these types of MRV. For example, the major issue emerging for the implementation of Type III is capacity building for developing country governments rather than private businesses. Therefore, it is not the best approach to conduct capacity building for the private sector for Type III. On the other hand, in case of Type IV, there is an urgent need to develop international guidelines that can be applicable and acceptable globally. Moreover, in the case of Type II, the major challenges are the remaining technical issues built upon the highly sophisticated methodologies. Like these, the issues associated with each type of MRV system differ substantially since their maturity, level of knowledge and experience, policy implications are divergent. They are not the same "MRV".

Based on these differences, this paper also discussed the MRV of NAMAs under an international climate regime in the near future. There has been little attempts to capture MRV of GHG emissions/reductions in a systematic manner. MRV of policy/action for quantitative evaluation has just started to develop. Despite the fact that the research scope and approach for such MRV have also not been established yet, related knowledge and experiences have been well accumulated through the implementations of the existing schemes. Further research is expected to be conducted in an integrated way based on such knowledge and experiences over the past decade.

▪ Acknowledgement

I would like to thank to Prof. Hidefumi Imura, Prof. Jusen Asuka and Mr. Kiyoto Tanabe for their very helpful comments on an earlier draft of the paper. The author is, of course, responsible for all errors and omissions.

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