

# **Measuring disaster-related economic losses**

**Issue Paper**

DRAFT

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## Acronyms

DMSF	Disaster Management Statistical Framework
DRMA	Disaster Risk Management Agency
DRSF	Disaster Related Statistics Framework
FDES	Framework for the Development of Environment Statistics
GDP	Gross domestic product
NSO	National Statistics Office
NSS	National Statistical System
PDNA	Post-disaster Needs Assessment
SF	Sendai Framework
SF-GD	Sendia Framework

## Summary

The assessment of economic losses from disasters is one of the most important roles for disaster-related statistics. When disasters occur, one of the first questions asked (after assessing loss of life and injuries) by stakeholders of all types is what has been the economic impact of the disaster. Likewise, a question on the mind of all those responsible for disaster-risk reduction is what the economic losses might be if a disaster were to occur. Thus, having a clear framework for disaster economic loss statistics is essential.

This report reviews the treatment of economic losses in major disaster-related statistical frameworks. It finds that current guidance on the measurement of these losses varies significantly across frameworks and that many questions remain unanswered. In particular, there is need for greater clarity and consistency on:

- terminology
- valuation of losses
- treatment of the agriculture sector
- the economic loss assessment period, and
- damage to environmental assets, including loss of ecosystem services.

The main points arising from the review under each of the above are summarized below.

### Issues with terminology

With regard to the terminology used to describe economic losses, the main issues revealed are the following.

1. The terms “direct” and “indirect” are sometimes used in relation to economic losses (e.g., “direct damages” or “indirect losses”) and sometimes not.
2. There is inconsistency as well in the scope of what is measured under the headings “direct” and “indirect”. In some cases, damage/destruction of agricultural land is included and in others it is not. Similarly, consumer durables and environmental assets are inconsistently treated.
3. There is further inconsistency with respect to the measurement of the loss of production, with some calling for measures of gross output to be used and others calling for losses in value added to be used.

A fundamental issue is that the use of the terms “direct” and “indirect” in the disaster assessment literature is inconsistent with the established use of these terms in the practice of economic impact assessment (EIA). When assessing the impact of a change in economic activity due to an external shock that changes spending and production patterns (e.g., introduction of a new policy), EIA practitioners consider *direct* impacts to be those associated with the sectors that produce the goods and services on which spending has changed; for example, the loss in output in a regional fishing industry due to a reduction in spending on fish products related to a policy that increases fish prices. *Indirect* impacts are those associated with sectors that provide goods and services to directly impacted sectors. EIA practitioners also consider *induced* impacts, which are those that occur not because of supply-chain effects but because the workers in directly and indirectly impacted sectors have less income to spend on consumer goods and services, reducing the overall level of economic activity elsewhere in the

economy. The use of the terms direct and indirect in the disaster assessment frameworks bears little relation to this. This raises the question whether the use of the terms “direct” and “indirect” should be re-thought entirely in disaster assessment. For example, should what are now called direct losses simply be referred to as “losses of assets” and what are now called indirect losses simply be called “losses of flows”, with such losses being broken down into direct, indirect and induced in line with accepted EIA methodology?

Another issue with terminological considerations is whether losses should be recorded on a gross or net basis. Some frameworks call for measuring economic losses in net terms, taking into account both the negative impacts (e.g., damage to assets) and any positive impacts (e.g., increased investment to replace damaged assets). Others focus only on gross measurement. Should losses be measured in net or gross terms? If measurement is to be on a net basis, should economic loss statistics refer to “net losses” rather than “losses”, to make clear that both negative and positive impacts are to be considered?

Terminology is also inconsistent around use of the term “damages” versus “losses”. Most frameworks use the term “losses” to refer to both losses of assets and losses of production. Some use “damages” to refer only to losses of assets, while “losses” is used to refer to losses of production. One framework actually uses neither, referring to “effects” rather than “damages” or “losses”. And one uses “damages” to refer to both. Should the terms “damage” and “losses” be used, respectively, to refer to losses of assets and production (whether with or without addition of the modifiers “direct” and “indirect”)? Or should “losses” be used for both? Or should “damages” (or “effects”) be used for both?

## Issues around valuation

The frameworks reviewed are generally consistent in their approach to the valuation of lost production due to disasters. Varying views are presented regarding the basis for valuing damage to assets, with some offering a list of options for statistician to choose from but most prescriptively calling for valuation to always be on the basis of as-built replacement costs. It is worth noting that as-built replacement costs represent may not be the soundest basis for valuation in all cases. If the objective is to provide an estimate of the cost to repair/rebuild what existed prior to the disaster without taking into consideration other factors (like the age and state of the assets that were lost), then as-built replacement costs are appropriate. However, if the objective is to assess the impact of the disaster on the country’s long-term economic potential, then as-built replacement costs likely overstate the case. This raises the question whether valuation of asset losses should be always at as-built replacement cost or whether a menu of valuation options should be available for use.

## Issues relating to agriculture

Most frameworks are clear that losses of farmland should be included among economic losses but not all are in agreement on this. If farmland losses are to be included, what method should be used for valuing the losses, especially in cases where market prices are not available for farmland?

The treatment of lost crop production is particularly unsatisfactory in existing frameworks. In principle, lost crop production should be treated in the same way as lost output from any other industry. Yet several frameworks call losses of crops to be implicitly treated as asset losses and included in direct losses, offering differing justifications for doing so (some of which are inconsistent with established national economic accounting rules). Should agricultural

production losses be considered direct losses and, if so, why? Or should they, like losses of outputs in other sectors, be considered indirect losses?

## Other issues

Several questions arise when it comes to the period over which economic losses are to be assessed. One is simply what to consider the beginning and end of a disaster event. Some events are discrete and clearly bounded in time, such as a period of extreme cold. Others are much harder to define clearly, with uncertain beginnings and long, drawn-out endings, such as a drought. From the point of view of assessing economic losses, the choice of start and end date is important, as it determines what will be assessed as direct losses. Only assets damaged or destroyed “at the time of the disaster” are included in direct losses. Thus, it matters very much, especially in the case of drawn-out disasters, how long the “time of the disaster” is.

An arguably more important issue from the point of view of measuring economic losses is how long after the end of a disaster indirect losses should continue to be counted. Some frameworks call for the assessment period in exceptional cases to be up to five years. Others mention only one to two years and still others specify no period at all. What approach should be taken to defining the end-point of disasters for the purpose of assessing direct losses and the duration of the period after the end of the disaster for the purpose of assessing indirect losses?

It is not entirely clear what the various documents reviewed intend regarding damage to the environment due to disasters. Some discuss this at great length but outside of their discussions of economic losses, implying that environmental losses should not be considered part of the former. Others devote little space to the discussion at all. Still others are ambiguous, never quite calling explicitly for environmental assets to be measured as part of economic losses while at the same time including natural resources (but not ecosystems) among the list of items for which direct impacts are to be measured in monetary terms. Should losses of environmental assets be considered economic losses for the purposes of disaster assessment? If so, should only losses of market assets such as timber stands in forests open for commercial harvest or commercial fish stocks be included? Or should losses of non-market ecosystem assets and the associated non-market goods and services also be included?

## Priority for resolving issues

Resolving the issues in relation to terminology should be given the highest priority, as agreement on basic terms is required before the rest of the framework can be properly set out. The major terminological issues to resolve are, in order of importance:

1. Whether the terms “direct” and “indirect” are to be used to refer to losses and, if so, what losses are considered direct and what are considered indirect.
2. Whether the terms “damage” and “losses” should be used, respectively, to refer to losses of assets and production (whether with or without addition of the modifiers “direct” and “indirect”)? Or whether “losses” or “damages” (or “effects”) should be used for both?
3. Whether the use of the terms “direct” and “indirect” should be re-thought entirely in disaster assessment. For example, should what are now called direct losses simply be referred to as “losses of assets” and what are now called indirect losses simply be called “losses of flows”, with such losses being broken down into direct, indirect and induced in line with accepted EIA methodology?

The remaining issues raised by the review are all considered equal in priority and should be addressed as in parallel once the terminological issues have been resolved.

# 1 Introduction

The need for disaster-related statistics to support the Sendai Framework was recognized at the 49th session of the UN Statistical Commission (UNSC). To support this development, an Inter-Agency and Expert Group (IAEG) on Disaster-related Statistics, involving UNSD, UNESCAP, UNECE, UNECLAC and UNDRR, was established in 2019. Progress on the development of disaster-related statistics has been reported to subsequent meetings of the UNSC.

The [UNECE Task Force on Measuring Hazardous Events and Disasters](#) and the IAEG held an [Expert Forum on disaster-related statistics in June 2021](#). Emerging from this was proposal to establish technical working groups and to produce issue papers on selected topics contained in the research agenda. The three topics selected for the production of issue papers were:

- economic losses attributed to disasters
- disaster Risk Reduction Expenditure (DRRE) satellite accounting, and
- environmental and ecosystem-related disaster losses.

The present report serves as the issue paper for economic losses attributed to disasters. It:

- reviews existing frameworks developed in relation to disaster-related statistics (DRS) and determines how they treat economic losses
- identifies issues related to economic losses that require further attention in the development of DRS.

The documents reviewed:

- 1989 ECLAC review note “Natural Disasters and their Socio-Economic Impacts
- 2003 ECLAC *Handbook for Estimating the Socio-economic and Environmental Effects of Disasters*
- 2014 ECLAC *Handbook for Disaster Assessment*
- 2015 UNISDR *Sendai Framework for Disaster Risk Reduction*
- 2017 UNISDR *Technical Guidance for Monitoring and Reporting on Progress in Achieving the Global Targets of the Sendai Framework for Disaster Risk Reduction*
- 2017 UN *Framework for the Development of Environment Statistics*
- 2018 ESCAP *Disaster Related Statistics Framework*
- 2019 UNECE *Recommendations on the Role of Official Statistics in Measuring Hazardous Events and Disasters*
- 2013 joint European Commission, World Bank, UN Development Group *Post-disaster Needs Assessment Guidelines*



## 2 Economic losses in major disaster-related frameworks

Development of the international methodology for measuring economic losses due to disasters stretches back to at least 1989. In that year, ECLAC published a short study (in Spanish) of the costs of various Latin American disasters ([Jovel, 1989](#)). In it, the economic effects of disasters were defined as follows<sup>1</sup>:

- **direct economic effects:** effects due to the loss of physical assets
- **indirect economic effects:** effects on the output of economic production and provision of services; and
- **secondary economic effects:** effects that may appear sometime after the disaster; such as, reduced economic growth and development; rising inflation; balance of payments problems; increased fiscal expenditures and deficits; decrease in monetary reserves, etc.

### 2.1 ECLAC 2003 handbook for estimating disaster losses

Building on Jovel (1989), ECLAC published a formal handbook for estimating the socio-economic and environmental effects of disasters in 2003 ([ECLAC, 2003](#)). In it, the economic effects of disasters were defined as follows:

- **direct damages:** the effects due to the loss of physical assets
- **indirect losses:** effects on the output of economic production and provision of services, and
- **macroeconomic effects:** effects on the performance of the main economic variables of the affected country (GDP, investment, balance of payments, public finances, prices and employment).

Several changes are notable in this set of definitions in comparison to those in Jovel (1989). First, ECLAC (2003) uses the term “damages” when referring to direct effects, “losses” when referring to indirect effects, but retains the term “effects” when referring to macroeconomic effects. It is not clear why the terms “damages” and “losses” were adopted to refer, respectively, to direct and indirect effects, but the terminology has become widely used in the world of disaster assessment. “Damage and loss assessments” (DALA) is a common term.

Another change from Jovel (1989) was to replace the term “secondary effects” with “macroeconomic effects”. Again, no reason is giving for this change.

Other than these terminology changes, the loss concepts in ECLAC 2003 themselves do not appear to differ from what Jovel (1989) defined. However, ECLAC 2003 spells out the measurement of these losses in considerably greater detail than did Jovel (1989).

According to ECLAC (2003), **direct damages** are inflicted on physical structures and equipment (such as roads, bridges, buildings and other infrastructure; machinery and equipment; vehicles; furnishings; farmland; irrigation works; reservoirs, etc.). Direct damages may also be inflicted on stocks of finished or partially finished goods, raw materials, materials and spare parts (we refer

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<sup>1</sup> Free translation using Google Translate.

to these collectively as “materials” in the remainder of this note). Direct damages are considered to occur at the time of the actual disaster and may refer to the complete or partial destruction of items. In the special case of agriculture, the destruction of crops ready for harvest is also considered direct damage. For the purposes of recording damages, a distinction should be made as to the owner of the asset (government, business or household). The portion of damaged assets that is imported is also to be kept track of.

In the first instance, ECLAC 2003 calls for direct damages are to be tracked in non-monetary terms. For example, direct damages to infrastructure might be measured in terms of the number of bridges and the length of roadways damaged or destroyed, while the loss of farmland might be measured in hectares and crop losses might be measured in bushels or tonnes. The ultimate goal in ECLAC (2003), however, is to measure direct damages in monetary terms. To accomplish this, unit prices must be applied to the physical losses to convert them to monetary values. The handbook offers several choices with regard to the prices used in valuation:

- **depreciated (or “book value”)**: the value of an asset at the time of its damage or destruction taking into account the accumulated depreciation of the asset to that point
- **inflation-adjusted original value**: the original purchase price of an asset adjusted for inflation since the time of purchase
- **“as-built” replacement cost**: the cost to repair or replace an asset such that it is taken back to as close as possible to its original state (considering that technological advancements will mean that older assets can never be rebuilt exactly as they were)
- **“improved” replacement cost**: the cost to repair or replace an asset with a new one that includes specific enhancements to make it less vulnerable to future disasters (the “build back better” cost).

ECLAC 2003 does not recommend one of these approaches over the other, noting that the choice of approach rests on “the needs of the analysis, the characteristics of the asset being valued, the availability of information at the time the valuation is made and, most importantly, the time the sectoral specialist has available to carry it out” (p. 20).

It should be noted that ECLAC (2003) treats agriculture as a special case in which the loss of crops ready for harvest is considered part of direct damages, since such crops are, in an economic sense, assets. This is the only sector for which the value of economic production losses is considered part of direct damages. For all other sectors, production losses are considered indirect losses. It must be noted that only agricultural production losses in the year of the disaster are considered by ECLAC (2003) to be direct damages. Any such losses in future years are to be treated as indirect losses, since they are not assets at the time of the disaster.

As for **indirect losses**, ECLAC (2003) defines these as the value of the flows of goods and services that will not be produced or rendered over a time span beginning with the moment of the disaster and extending to the end of the rehabilitation and reconstruction period. It notes that convention calls for a maximum five-year time-frame for recording indirect losses and that most losses occur during the first two years. Indirect losses result from the direct damages to the economy’s productive capacity and to social and economic infrastructure. They include increases in the cost of providing services as well as diminished income in cases where services cannot be provided at all. Examples include losses of future crop harvests; losses in industrial output; and increased transportation costs.

ECLAC (2003) recommends valuing indirect losses at either producer or consumer prices. In the case of losses to producers (such as farmers or manufacturers), losses should mainly be

valued at producer prices. In the case of interrupted services (such as health care or education), consumer prices should be used.<sup>2</sup>

To estimate indirect losses, it is necessary to compare what outputs would have been obtained if there had been no disaster and what was actually produced in the wake of the disaster. The difference between the two are the indirect losses. Such an estimation process is obviously hypothetical, as it requires modelling of what the economy would have produced had the disaster not occurred. Depending when the estimate of indirect losses is made, further modelling might be required to estimate what production will be in the post-disaster world. For example, if an estimate of indirect losses is required 6 months after a disaster with an assumed two-year impact, it will be necessary to model not just what the economy might have produced during that two-year period in the absence of the disaster, but also what it might produce given the disaster's known (and projected) impacts.

ECLAC (2003) notes that direct damages and indirect losses can be added together to estimate the total amount of damage due to a disaster, provided it is understood that such a summation includes changes to both stocks and flows.

Finally, ECLAC (2003) defines **macroeconomic effects** as the changes in the main economic variables of the affected country wrought by the disaster: GDP, gross investment, international trade, public finances, inflation and employment. It notes that the changes in these macro variables are the result of the direct damages and indirect losses, so they must not be added to those to avoid double counting. Rather, macroeconomic effects provide a complementary view of economic losses, which is usually compiled for the national economy as a whole but that may be compiled for specific sectors or regions as well if data are available. As with indirect losses, estimation of macroeconomic effects requires modelling of how each of the macro variables would have performed had the disaster not occurred.

## 2.2 ECLAC 2014 handbook for estimating disaster losses

In 2014, [ECLAC published an updated version of its 2003 handbook](#) for disaster loss assessment (ECLAC, 2014), further building upon the concepts presented in it and in Jovel (1989). As with ECLAC (2003), the 2014 update of the handbook contains substantial departures from its predecessor. Rather than “direct damages” and “indirect losses”, ECLAC (2014) refers to “damages” (with the qualifier “direct” dropped) and “losses and additional costs” (with the qualifier “indirect” dropped). These are simply terminology changes, however, damages in ECLAC (2014) are conceptually equivalent to “direct damages” in ECLAC (2003) and “losses and additional costs” are conceptually equivalent to “indirect losses”. Like ECLAC (2003), ECLAC (2014) also makes reference to “the effects of losses on macroeconomic variables” but notes that “given the local character of most disasters, these effects could be downplayed”.<sup>3</sup>

In addition to a major revision of the terminology used to describe economic losses, ECLAC (2014) also departs considerably from its predecessor in terms of the valuation of losses. This is especially the case for damages (i.e., losses due to damage or destruction of physical assets and materials). Whereas ECLAC (2003) had presented several possible bases for valuation of these losses and made no recommendation among them, ECLAC (2014) states unequivocally that they should be valued using the cost to replace/repair the assets to their original state. In applying the replacement cost, no allowance should be made for the possibility that assets

<sup>2</sup> It is worth noting that the difference between producer and consumer prices for such services is likely to be small.

<sup>3</sup> In spite of suggesting that the estimation of losses in terms of macroeconomic variables can be downplayed, ECLAC (2014) nonetheless devotes a number of pages to guidance on their measurement.

might be “built back better.” In the case of valuing losses and additional costs, ECLAC 2014 is consistent with its predecessor in stating that most losses should be valued using producer prices. Only losses of services should be valued using consumer prices.

Another important departure of ECLAC (2014) from its predecessor is in the treatment of the agriculture sector. Unlike the 2003 handbook, ECLAC (2014) does not consider losses of crop production as part of “damages” to the sector. Rather, reduction in crop output is included in the sector’s “losses and additional costs”. No reason is given for this important conceptual departure.

## 2.3 Sendai Framework for Disaster Risk Reduction

The [Sendai Framework](#) (SF; UNISDR, 2015) aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries. To do so, the SF’s goal is to prevent new and reduce existing disaster risk. To that end, seven targets have been agreed to assess progress in achieving the framework’s goal and objective. Target C of the framework aims to **reduce direct disaster economic loss** in relation to global gross domestic product (GDP) by 2030. The SF identifies four priority areas for action to reach its targets, each with a corresponding list of key activities. The first of these priorities is to *better understand disaster risk*, which is to be carried out by, among others, activities to *systematically evaluate, record, share and publicly **account for disaster losses and understanding the economic, social, health, education, environmental and cultural heritage impacts.***

## 2.4 Technical guidance for monitoring and reporting on progress in achieving the global targets of the Sendai Framework for Disaster Risk Reduction

The SF itself does not elaborate how economic losses are to be measured. This is done instead in a companion document titled [Technical guidance for monitoring and reporting on progress in achieving the global targets of the Sendai Framework for Disaster Risk Reduction](#). This document is devoted to technical guidance on monitoring and reporting the framework’s seven targets and the [38 related indicators](#) (SF-GD; UNISD, 2017). Target C on reducing economic losses has six indicators:

1. direct economic loss attributed to disasters in relation to global gross domestic product<sup>4</sup>
2. direct agricultural loss attributed to disasters
3. direct economic loss to all other damaged or destroyed productive assets attributed to disasters
4. direct economic loss in the housing sector attributed to disasters
5. direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters, and
6. direct economic loss to cultural heritage damaged or destroyed attributed to disasters.

The first thing to note with regard to these indicators is that they focus exclusively on direct economic losses and that the SF-GD adopts – except, as noted below, in the case of agriculture

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<sup>4</sup> Note that the first indicator is simply a composite of the five following indicators divided by the value of GDP.

– the same definition of direct losses as Jovel (1989) and ECLAC (2003 and 2014): losses of physical assets and materials. It should also be noted that the SF-GD does not adopt ECLAC’s “damage” terminology for these losses, referring to them simply as “losses”.

Direct losses to the agriculture sector, which is defined in the SF-GD to include the crop, livestock, forestry, aquaculture, forestry and fisheries industries, are considered a “special case” in the SF-GD. Here the SF-GD adopts an approach (mostly, see below) consistent with ECLAC (2003) – but not with ECLAC (2014) – in which direct losses to the agriculture sector include not only losses due to damaged or destroyed physical assets and materials but also losses due to reduced agricultural production (e.g., reduced outputs of crops or livestock) in the year of the disaster. Thus, direct agricultural losses in the SF-GD comprise what ECLAC (2014) terms direct *and* indirect losses. None of the other four economic loss indicators (indicators 3-6 above) in the SF-GD does this (they all include only losses to physical assets and materials in direct losses) and it is not clear why the SF-GD chooses to align itself with ECLAC (2003) in this regard. Here is worth emphasizing that the SF-GD considers the value of lost agricultural output as a “production” loss (see the table on p. 43 of the SF-GD) and not part of the losses of agricultural assets, even though direct losses are supposed to be losses of assets. This is inconsistent with ECLAC (2003), where it is explained that the reason for treatment of losses of crops ready for harvest in the year of the disaster as direct losses is, in fact, that such crops are assets from an economic perspective. While ECLAC’s (2003) explanation is at least clear, it does not seem sound. According to standard national accounting principles, the cultivation of one-time crops is not considered the creation of an asset.<sup>5</sup> So, there would seem to be no obvious reason why loss of agricultural production would be included among direct losses and neither the SF-GD nor ECLAC (2003) provides a clear justification.

A major departure of the SF-GD from both ECLAC (2003) and ECLAC (2014) is that losses of agricultural land are not included as part of direct losses. Nor does the SF-GD appear to include losses of agricultural buildings such as barns or silos. Only losses of “machinery, equipment and tools” seem to be recognized among the sector’s direct losses.<sup>6</sup> Thus, the direct agricultural losses measured as per the SF-GD would be considerable smaller than those measured under either of the ECLAC handbooks.

In order to value losses of physical assets and materials, the SF-GD recommends, consistent with ECLAC (2014), the use of replacement costs to repair/rebuild damaged/destroyed assets to their original condition. For the valuation of farm production losses, farmgate (or producer) prices are to be used.

The SF-GD acknowledges the difficulty of placing a value on the losses of cultural heritage, as much of the value associated with buildings, sites or items of cultural or historical value is related to aspects of them that are intangible. Nevertheless, the SF-GD recommends valuing them to the extent possible, focusing on the replacement cost of repairing/rebuilding fixed structures (like monuments) and the market cost of movable items like artworks. Some cultural heritage (like the temples of Chichen Itza or the Mona Lisa) simply cannot be replaced if lost, however, and loss of such heritage should simply be recorded in non-monetary terms.

Though the SF-GD does not address indirect losses, it does provide a definition of them: a decline in economic value added as a consequence of direct economic loss and/or human and

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<sup>5</sup> It is worth noting that cultivation of permanent plants, such as fruit trees or tea plants, that yield crops year after year is considered to create assets. But annual crops are never considered assets (except when they have been harvested and are stored for keeping from one year to the next, such as grains held in storage silos).

<sup>6</sup> It is actually unclear what the SF-GD intends here. The table on p. 43 outlining the assets to be included under direct losses clearly includes only “machinery, equipment and tools.” Yet another table (p. 86) clearly mentions agricultural storage facilities (such as barns and silos) among the sector’s assets.

environmental impacts. This, it is worth noting, is not consistent with the way in which indirect losses are considered in either Jovel (1989) or ECLAC (2003 and 2014). In both of these, indirect losses are defined as the value of lost production and services, which is conceptually quite different from the loss of value added.

## 2.5 United Nations Framework for the Development of Environment Statistics

The [United Nations Framework for the Development of Environment Statistics](#) (FDES; UN, 2017) outlines the basic scope of official environmental statistics and provides a conceptual framework for synthesising and categorising environmental statistics and data from a variety of sources. The FDES structures environmental statistics into six “components”, one of which (Component 4) deals with disasters. This component organizes statistics on, among others, economic losses due to disasters.

The FDES does not offer an explicit definition of economic losses, noting only that statistics should be compiled on, for example, damage to buildings, transportation networks, loss of revenue for businesses and utility disruption and that these statistics should be broken by disaster event, economic sector, region and by “direct and indirect damage”. The FDES refers to ECLAC (2003) as a source of methodological guidance related to the measurement of economic losses associated with disasters, implying that it recommends uses of the concepts and methods outlined there (though it does not say this explicitly).<sup>7</sup> It is worth noting, however, that the terms used in ECLAC 2003 are “direct damage” and “indirect losses”, so FDES’ reference to “direct and indirect damage” would appear to be in error.

## 2.6 UNESCAP Disaster Related Statistics Framework

A major effort to define a statistical framework for measuring disasters and their impacts in line with the SF-GD and its related targets and indicators was made by UNESCAP with the publication of its [Disaster Related Statistics Framework](#) in 2018 (DRSF; UNESCAP, 2018). The focus in the DRSF is to clarify the role of official statistics and how they can be made as accessible for risk assessments. It serves to meet the need to translate the concepts and definitions agreed to in the SF-GD into specific instructions and technical recommendations for production and dissemination of statistics. Chapter 4 of the DRSF deals with impact statistics and it is there where economic losses are covered.

Like the SF-GD, the DRSF refers to all economic losses as “losses”, making no reference to “damages”. The DRSF is also consistent with the SF-GD in that it focuses for practical purposes only on measuring direct losses; that is, losses to physical assets and materials. Although the DRSF acknowledges that indirect losses are important and provides a definition of them consistent that is with the SF, it gives no guidance on the statistical requirements for measuring them. The DRSF is further consistent with the SF-GD in terms of the basis for valuation as the SF; it recommends use of the replacement cost for repair/rebuilding of assets.

Though largely consistent with the SF, the DRSF also differs from it in several important ways. One is the inclusion of consumer durables like private automobiles and valuables (e.g., private art works) in the estimation of direct losses. Another is the inclusion of farmland among direct losses to be valued for the agriculture sector, making the DRSF consistent with the ECLAC

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<sup>7</sup> It is worth noting that the FDES acknowledges that ECLAC (2003) was superseded by ECLAC (2014) though, for some reason, it does not explicitly point to the latter as a source of methodological guidance.

handbooks but not the SF. Finally, the DRSF recommends inclusion of natural resources beyond forestry and fisheries in the estimation of losses; this could include, for example, losses associated with mining activities.

Like the SF-GD and ECLAC (2003), the DRSF views direct losses from the agriculture sector to include both losses to physical assets/materials and losses to agricultural production. Here the DRSF adopts ECLAC's (2003) use of the term "damages" to refer to losses to physical assets/materials and "losses" to refer to losses to agricultural production. This is inconsistent with the remainder of the DRSF handbook, where the term "losses" is used to refer to both "damages" and "losses" in the ECLAC (2003) sense of the terms. This is done, apparently, to be consistent with an FAO methodology related to assessment of disaster-related agricultural losses. The DRSF notes (p. 45) that the FAO "has developed a methodology for damage and loss assessment, which is integrated, through a collaborative process with UNISDR, into the Sendai Framework Monitoring Process... [and which] distinguishes between damage (total or partial destruction of physical assets), and loss (changes in economic flows arising from a disaster)". It is not apparent with the DRSF adopts this damage and loss terminology with respect to agriculture, as it is not used elsewhere in the framework. Nor is it, in fact, used in the SF-GD, which does not employ the damage/loss terminology (referring only to losses).

## 2.7 UNECE Recommendations on the Role of Official Statistics in Measuring Hazardous Events and Disasters

The [UNECE Recommendations on the Role of Official Statistics in Measuring Hazardous Events and Disasters](#) (the UNECE recommendations; UNECE, 2019) aim to clarify the role of national statistical offices (NSOs) in providing information related to disasters. They also aim to identify practical steps needed for these organisations, in coordination with disaster risk management agencies (DRMAs) to better support disaster risk management efforts.

Like the SF, the UNECE Recommendations refer all economic losses (direct and indirect) simply as "losses", without making use of the term "damage". According to the Recommendations, economic losses due to disasters consist of direct losses and indirect losses. Direct economic losses are the monetary value of total or partial destruction of physical assets existing in the affected area. This definition is largely consistent with those in the SF-GD, ECLAC (2003 and 2014) and Jovel (1989), though the UNECE Recommendations make no mention of losses of stocks of materials, which the others do. Examples given of physical assets include homes, schools, hospitals, commercial and governmental buildings, transport, energy, telecommunications infrastructure and other infrastructure; business assets and industrial plants; production such as crops, livestock and production infrastructure. It is not clear from this what is meant by "crops". It could be perennial crops (such as fruit trees) or annual crops ready for harvest or both. The UNECE recommendations also note that environmental assets and cultural heritage may be included among the assets considered for the purpose of assessing direct losses. Precisely what is meant by "environmental assets" and "cultural heritage" is not defined. In particular, it is not clear whether the UNECE Recommendations consider farmland to be an asset to be considered when measuring direct losses.

The UNECE Recommendations also provide a definition of indirect economic losses, which, consistent with the SF-GD, are defined as a decline in economic value added.

The UNECE Recommendations note that NSOs should be involved in evaluating the impacts of disasters, including economic losses and that is important to ensure coherence with the statistics used for this evaluation and other official economic, social, and environmental statistics. This will help improve the quality of official statistics. Baseline data on population,

environment, housing and dwellings, infrastructure, businesses and other assets (such as cultural and natural heritage) are noted to be needed for evaluating losses. Ideally, these data will be available in a geocoded format for areas that can be prone to natural disasters (for example, river basins, coastal areas and areas near volcanoes) as well as those susceptible to industrial disasters (for example, areas near factories handling hazardous substances). Several challenges are noted for producing these statistics, including the difficulty identifying the end of a disaster and the difficulty of establishing clear causal links between disasters and some economic losses.

The UNECE Recommendations note that post-disaster surveys, which are where most impact data are collected, are usually carried out by DRMAs and often without involvement of NSOs. Although these reports provide important information about disaster impacts on the economy, infrastructure and the environment, there are limitations concerning their integration with official statistics. Therefore, NSOs should review post-disaster surveys for alignment with statistical classifications and terminology. Data collected through post-disaster surveys should be disaggregated (for example, by industry) following official classifications. Data relating to businesses (including farms) should also be linked with business and farm registers.

## 2.8 2013 joint European Commission, World Bank, UN Development Group *Post-disaster Needs Assessment Guidelines*

Discussion of the 2013 joint European Commission, World Bank, UN Development Group [\*Post-disaster Needs Assessment Guidelines\*](#) is (the PDNA guidelines; European Commission, World Bank and UNDG, 2013) is left for last because these guidelines are largely inconsistent with the frameworks discussed above.

The PDNA guidelines begin by distinguishing economic losses between what it calls “effects” and “impacts”, a distinction not made in any other framework. No justification is given for the splitting of losses in this way. Disaster “effects” are defined to include “damage to infrastructure and physical assets” plus “disruption of production of and access to goods and services”. Disaster “impacts”, for their part, are defined as “economic impact at macro and micro level”, which measure the “the estimation of the disaster’s likely effects on economic performance and the temporary macro-economic imbalances that may arise from it, as well as its varied impacts on personal/household income and employment in all sectors.”

With regard to measuring disaster “effects” on infrastructure and physical assets, the PDNA guidelines call for measurement of losses to

- social infrastructure such as the number of homes, education and health facilities, government buildings, community infrastructure, cultural and religious centers
- basic infrastructure such as transport and communications (roads, bridges, ports, airports, and train lines, among others), water and sanitation systems, irrigation systems, energy generation, distribution and supply lines, and
- productive sectors such as agricultural infrastructure, industrial and commercial installations, and businesses including tourism and service-based industries.

The guidelines note that assets contained in the above assets (e.g., furnishings in buildings) should also be counted as losses. They go on to note that valuation of losses should be in terms of the replacement costs according to the market price prevailing just before and after the disaster.



With regard to measuring disaster “effects” on the production of and access to good and services, PDNA guidelines mentions the need to evaluate the decline of output of primary industries, manufacturing, commerce and services “associated with damage to infrastructure and asset damages”. It also calls for evaluation of “the effect on *service delivery* across all relevant social sectors and population groups, in particular the availability of basic services and the quality-of-service delivery.” The guidelines notes that “a diversity of methods and techniques may be used by sectoral teams to assess post-disaster conditions with greater depth and detail. For instance, it is noted, household surveys could be used to assess disaster-related changes in food consumption and expenditure as well as the overall levels of food insecurity. Nothing more specific than this general advice is offered.

With regard to measuring disaster “impacts” (that is, the macro-economic losses), these are defined to include estimation of temporary macro-economic imbalances that may arise, as well as the potential temporary decline in employment, income and well-being of affected individuals and households. To accomplish this, the guidelines note that analyses are usually made of the post-disaster performance on gross domestic product (GDP), the balance of payments (BOP) and the fiscal sector. Again, few details are offered as to how this is to be accomplished.

### 3 Issues for discussion

In this section we outline the issues requiring further discussion raised by our review of the various guidance documents and frameworks in the preceding section. We discuss issues related to:

- consistency of terminology
- valuation of losses
- treatment of agriculture
- economic loss assessment period
- damage to environmental assets, including loss of ecosystem services.

Note that because the PDNA guidelines are generally not consistent with the other major frameworks reviewed, they are not considered in the discussion below.

#### 3.1 Terminology

The guidance documents and frameworks reviewed in the preceding section are inconsistent in the terminology used to describe economic losses. Several issues can be identified.

##### 3.1.1 Direct and indirect losses

Most of the documents reviewed use the terms “direct” and “indirect” to describe losses, though not all of them do. Jovel (1989) seems to have introduced the terms (though they may have been in prior use). The first ECLAC handbook (ECLAC, 2003) continued this use but then it was discontinued in the second handbook (ECLAC, 2014), which refers simply to “damages” and “losses” with no use of the modifiers “direct” and “indirect”. The SF-GD brought the modifying terms back and they also appear in the DRSF and UNECE Recommendations. The FDES also uses them, apparently drawing upon ECLAC, 2003.

**Issue:** Should the terms “direct” and “indirect” be used in relation to economic losses? Or should just “damages” and “losses” be referred to?

There is inconsistency as well in the scope of what is measured under the headings “direct” and “indirect”. With respect to direct losses, the SF-GD, for example, does not include damage/destruction of agricultural land in the measurement scope, while the DRSF and ECLAC handbooks do. Similarly, the DRSF includes losses of consumer durables and a broad range of environmental assets in the scope of direct losses, whereas the SF-GD does not. ECLAC (2003) and the SF-GD both include losses of crops ready for harvest as part of direct losses, but ECLAC (2014) does not.

**Issue:** What should be the scope of losses included under the heading “direct”?

There is further inconsistency with respect to what is measured under indirect losses. Jovel (1989) and ECLAC (2003 and 2014) both consider indirect losses to be the value of lost economic output of goods and services. The SF-GD and the DRSF, on other hand, define indirect losses to be reductions in value added rather than output.<sup>8</sup>

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<sup>8</sup> Output is defined as the total value of goods and services produced, not accounting for the intermediate use of goods and services in other goods and services. Value added, on the other hand, is defined as the total unduplicated value of goods and services produced, accounting for intermediate use.

**Issue:** Should indirect losses be considered losses of output or value added?

A more fundamental issue is that the use of the terms “direct” and “indirect” in the disaster assessment literature is inconsistent with the established use of these terms in the practice of economic impact assessment (EIA). When assessing the impact of a change in economic activity due to an external shock that changes spending and production patterns (e.g., introduction of a new policy), EIA practitioners consider *direct* impacts to be those associated with the sectors that produce the goods and services on which spending has changed; for example, the loss in output in a regional fishing industry due to a reduction in spending on fish products related to a policy that increases fish prices. *Indirect* impacts are those associated with sectors that provide goods and services to directly impacted sectors. The loss of a dollar of revenue for commercial fishers, for instance, results in fewer purchases of fuel, fishing gear, labour services, insurance, boat maintenance and so on, meaning less revenue for the sectors that supply these goods and services. Those sectors, in turn, will reduce their spending on other goods and services, with corresponding losses further up the supply chain. EIA practitioners also consider *induced* impacts, which are those that occur not because of supply-chain effects but because the workers in directly and indirectly impacted sectors have less income to spend on consumer goods and services, reducing the overall level of economic activity elsewhere in the economy.<sup>9</sup>

The use of the terms direct and indirect in the disaster assessment literature bears little relation to the above. EIA generally does not consider impacts on assets (only on investment flows), so there is no corresponding concept in it to what is considered direct impacts in disaster assessment. As for indirect losses, the term as used in disaster assessment would seem to relate most closely to what is considered direct impacts in EIA. What are considered indirect and induced impacts in EIA would either not be captured in disaster assessment or be captured in what are called (at least in some of the literature) macroeconomic effects.

**Issue:** Should the use of the terms “direct” and “indirect” be re-thought entirely in disaster assessment? For example, should what are now called direct losses simply be referred to as “losses of assets” and what are now called indirect losses simply be called “losses of flows”, with such losses being broken down into direct, indirect and induced in line with accepted EIA methodology?

### 3.1.2 Net losses

Both ECLAC (2003) and ECLAC (2014) are clear that the goal of measuring economic losses is to assess the net effects of disasters, taking into account both the negative impacts (e.g., damage to assets) and any positive impacts (e.g., increased investment to replace damaged assets). The SF-GD and DRSF do not mention the possibility of positive impacts, which makes sense given their focus on measuring direct losses only (which are, by definition, only negative).

**Issue:** Given that the scope of economic loss measurement should include both direct and indirect losses, should these losses be measured in net or gross terms? Gross measurement would include consideration only of the negative impacts of disasters. Net measurement would include consideration of both negative and positive impacts.

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<sup>9</sup> The example of purchasing a loaf of bread can be used to illustrate the three types of impacts. Purchasing the bread has a *direct* impact on the baking industry. *Indirect* impacts associated with the bread are the wheat, water and electricity required to bake the bread, plus the fertilizer and tractors needed to grow the wheat, the steel needed for the tractor and so on. *Induced* impacts associated with bread arise because the person who bakes the bread earns money doing so and spends that money on other goods and services (including bread – meaning that bread produces bread). EIA practitioners use sophisticated economic models to capture all these impacts.

**Issue:** If measurement is to be on a net basis, should economic loss statistics refer to “net losses” rather than “losses”, to make clear that both negative and positive impacts are to be considered?

### 3.1.3 Damages versus losses versus costs

Another source of inconsistency in the disaster assessment literature is the use of the term “damages” versus “losses”. Most of the documents reviewed (ECLAC 2014, SF-GD, DRSF, UNECE Recommendations) use the term “losses” to refer to both losses of assets and losses of production. ECLAC (2003), however, uses the term “damages” to refer to losses of assets and “losses” to refer to losses of production. The earliest document reviewed (Jovel, 1989) actually used neither, referring to “effects” rather than “damages” or “losses”. The FDES uses “damages” to refer to both.

**Issue:** Should the terms “damage” and “losses” be used, respectively, to refer to losses of assets and production (whether with or without addition of the modifiers “direct” and “indirect”)? Or should “losses” be used for both? Or should “damages” (or “effects”) be used for both?

ECLAC (2014) adds to the confusion in this regard by introducing an alternative term for what is elsewhere mostly referred to as “indirect losses”, which it refers to as “losses and additional costs”.

**Issue:** Should indirect losses be referred to as “losses and additional costs”?

## 3.2 Valuation of losses

The documents reviewed are consistent in their recommended approach to the valuation of lost output due to disasters. This is to be valued mainly using producer prices or, in the case of certain services, like tourism and education, in consumer prices (which are likely in those cases to be close to producer prices).

With respect to the valuation of asset losses, several different proposals are offered in the documents reviewed. ECLAC (2003) outlined four possible bases for valuing asset losses:

- **depreciated (or “book value”):** the value of an asset at the time of its damage or destruction taking into account the accumulated depreciation of the asset to that point
- **inflation-adjusted original value:** the original purchase price of an asset adjusted for inflation since the time of purchase
- **“as-built” replacement cost:** the cost to repair or replace an asset such that it is taken back to as close as possible to its original state (considering that technological advancements will mean that older assets can never be rebuilt exactly as they were)
- **“improved” replacement cost:** the cost to repair or replace an asset with a new one that includes specific enhancements to make it less vulnerable to future disasters (the “build back better” cost).

ECLAC (2014) did away with its predecessor’s valuation choice and recommended that asset losses be valued in all cases using the “as-built” replacement cost. The SF-GD and DRSF followed suit, though it is not clear that as-built replacement costs represent, in all cases, the soundest basis for valuation. The choice of valuation basis really depends on the objective of the valuation. If the objective is to provide an estimate of the cost to repair/rebuild what existed prior to the disaster without taking into consideration other factors (like the age and state of the assets that were lost), then as-built replacement costs are appropriate. Such an estimate might

be sought, for example, by a country that has faced a major disaster and is appealing for international aid to help it rebuild. However, if the objective is to assess the impact of the disaster on the country's economic potential, then as-built replacement costs likely overstate the case. The vast majority of assets damaged in any disaster will not be new and, therefore, their loss from an economic perspective should be valued at something less than the cost to replace them with a new version. In this case, the depreciated value of the assets might be more appropriate as the basis for valuation. At the other end of the spectrum, a country might wish to know what the cost to repair/replace its lost assets is taking into consideration the improvements needed to make them less vulnerable to future disasters. In this case, the improved replacement cost would be appropriate.

**Issue:** Should valuation of asset losses always be at as-built replacement cost? Or should a menu of valuation options be available for use, reflecting the different goals of damage assessment exercises?

### 3.3 Treatment of agriculture

#### 3.3.1 Farmland losses

The SF-GD differs from the other documents reviewed in that it excludes farmland from the list of assets valued in assessing direct agricultural losses. It is not entirely clear why this is the case (one wonders if it was simply an oversight in preparation of the guidance). Whatever the reason, it puts the SF-GD out of alignment with all other guidance, including that of the DRSF.

**Issue:** Should farmland be included among the assets valued in assessing direct losses for the agriculture sector? If so, what method should be used for valuing the losses, especially in cases where market prices are not available for farmland (e.g., in countries where farmland does not change hands frequently)?

#### 3.3.2 Losses of crops

The SF-GD, ECLAC (2003) and DRSF treat losses of crops during the year of the disaster as direct losses, whereas ECLAC 2014 does not. ECLAC's (2003) argument for this treatment is clear: crops that are ready for harvest are assets from an economic perspective and, so, their loss is loss of an asset and rightly considered among direct losses. ECLAC (2003) further clarifies that only crops that are ready for harvest at the time of the disaster should be so treated. Losses of crops not ready for harvest at the time of the disaster are to be treated as indirect losses. The SF-GD does not offer any particular explanation why losses of agricultural output are to be included among direct, rather than indirect, losses. Nor does it make any distinction between losses of crops ready for harvest or crops at some other stage of development. In either case, the treatment seems unsatisfactory. ECLAC's (2003) argument that crops ready for harvest are properly considered assets is inconsistent with standard economic accounting principles, in which such crops are considered products and not assets. The SF-GD's assertion that agricultural production losses should be considered a direct loss is also unsatisfactory and its explanation that this is done to be consistent with FAO guidance does not clarify the issue.<sup>10</sup>

**Issue:** Should agricultural production losses be considered direct losses and, if so, why? Or should they, like losses of outputs in other sectors, be considered indirect losses?

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<sup>10</sup> The DRSF does not provide a reference to the FAO guidance it refers to, simply noting in a footnote to Table 17 on p. 117 that those requiring further information should "contact FAO Statistics, Rome."

### 3.4 Economic loss assessment period

Several questions arise when it comes to the period over which economic losses are to be assessed. One is simply what to consider the beginning and end of a disaster event. Some events are discrete and clearly bounded in time, such as a period of extreme cold. Others are much harder to define clearly, with uncertain beginnings and long, drawn-out endings, such as a drought. From the point of view of assessing economic losses, the choice of start and end date is important, as it determines what will be assessed as direct losses. Only assets damaged or destroyed “at the time of the disaster” are included in direct losses. Thus, it matters very much, especially in the case of drawn-out disasters, how long the “time of the disaster” is.

An arguably more important issue from the point of view of measuring economic losses is how long after the end of a disaster indirect losses should continue to be counted. ECLAC (2003) notes that the normal assessment period is one to two years but that, in exceptional cases, this could be extended to five years. ECLAC (2014) mentions a period of one to two year. Other documents do not specify this period.

**Issue:** What approach should be taken to defining the end-point of disasters for the purpose of assessing direct losses and the duration of the period after the end of the disaster for the purpose of assessing indirect losses?

### 3.5 Damage to environmental assets

It is not entirely clear what the various documents reviewed intend regarding damage to the environment due to disasters. ECLAC (2003 and 2014) discusses these at great length but outside of their discussions of economic losses, implying that environmental losses should not be considered part of the former. This may be because much of what is discussed in ECLAC regarding the environment is losses of non-market ecosystem goods and services and the authors of these reports felt that these were best not thought of as economic losses.

For its part, the SF-GD devotes little space to the discussion of the environment and none of this to the discussion of non-market ecosystem goods and services. The environment comes into the SF-GD only in the discussion of the agricultural sector, where losses of due to damaged trees subject to harvest by the forestry industry are covered.

The DRSF is ambiguous, never quite calling explicitly for environmental assets to be measured as part of economic losses while at the same time including natural resources (but not ecosystems) among the list of items for which direct impacts are to be measured in monetary terms (see Table E in the DRSF annex).

**Issue:** Should losses of environmental assets be considered economic losses for the purposes of disaster assessment? If so, should only losses of market assets such as timber stands in forests open for commercial harvest or commercial fish stocks be included? Or should losses of non-market ecosystem assets and the associated non-market goods and services also be included?

## 4 Conclusion

The assessment of economic losses from disasters is one of the most important roles for disaster-related statistics. When disasters occur, among the first questions asked (after assessing the loss of life and injuries) by stakeholders of all types is what has been the economic impact of the disaster. Likewise, a question on the mind of all those responsible for disaster-risk reduction is what the economic losses might be if a disaster were to occur. Thus, having a clear framework for disaster economic loss statistics is essential.

This report has reviewed the treatment of economic losses in major disaster-related statistical frameworks. It finds that current guidance on the measurement of these losses varies significantly across frameworks and that many questions remain unanswered. In particular, there is need for greater clarity and consistency on:

- terminology
- valuation of losses
- treatment of the agriculture sector
- the economic loss assessment period, and
- damage to environmental assets, including loss of ecosystem services.

Resolving the issues in relation to terminology should be given the highest priority, as agreement on basic terms is required before the rest of the framework can be properly set out. The major terminological issues to resolve are, in order of importance:

4. Whether the terms “direct” and “indirect” are to be used to refer to losses and, if so, what losses are considered direct and what are considered indirect.
5. Whether the terms “damage” and “losses” should be used, respectively, to refer to losses of assets and production (whether with or without addition of the modifiers “direct” and “indirect”)? Or whether “losses” or “damages” (or “effects”) should be used for both?
6. Whether the use of the terms “direct” and “indirect” should be re-thought entirely in disaster assessment. For example, should what are now called direct losses simply be referred to as “losses of assets” and what are now called indirect losses simply be called “losses of flows”, with such losses being broken down into direct, indirect and induced in line with accepted EIA methodology?

The remaining issues raised by the review in this report (see Section 3) are all considered equal in priority and should be addressed as in parallel once the terminological issues have been resolved. To summarise, they are:

- Whether asset losses should be valued always at replacement cost or on whatever basis is most relevant to the purpose of the assessment.
- Whether production losses should be valued based on output or value added.
- Whether losses should be valued on a gross or net basis.
- Whether farmland losses should count as losses of an asset.
- Whether lost agricultural production should be considered an implicit asset loss and valued along with other asset losses or as lost production is valued for any other industry.

- What to consider the beginning and end of a disaster for the purpose of evaluating economic losses.
- Over what period losses should be evaluated.
- Whether losses of environmental assets – especially those with commercial value but also non-market ecosystems – should be counted among economic losses.



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