FAO'S METHODOLOGY FOR DAMAGE & LOSS ASSESSMENT IN AGRICULTURE
&
SENDAI INDICATOR C2

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D&L METHODOLOGY
background · motivation

FAO is working towards:

- Rolling out the **FAO D&L Assessment Methodology** as an innovative system to monitor the AG-sector on a regular basis

- Institutionalizing a **D&L information system** to collect, process, assess and report data on damage and loss from disasters on agriculture

- Developing national capacities to monitor **Sendai Framework Indicator C2 & SDG Indicator 1.5.2**

- Providing **technical support & capacity building** to countries in the implementation of the D&L methodology and information systems

- Generating greater **evidence for policy making** in DRR and DRM in agriculture
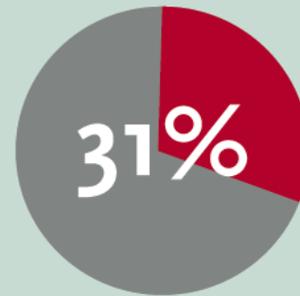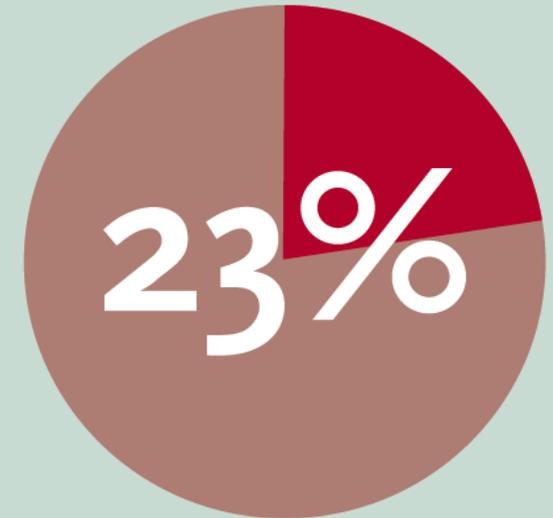
Figure 1. Damage and loss in agriculture as share of total damage and loss in all sectors (2006-2016)
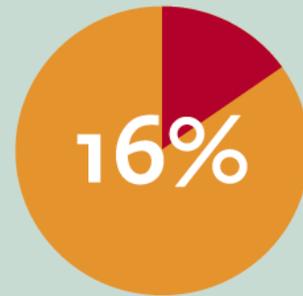
16%
Disaster **damage** in agriculture, share of total

31%
Disaster **loss** in agriculture, share of total

23%
Disaster **damage and loss** in agriculture, share of total

Download at:

http://www.fao.org/emergencies/resources/documents/resources-detail/en/c/1106859/

- **Lack of agriculture-specific methodology**: Detailed assessments of economic loss and damage are regularly carried out <u>using different methodologies</u>; when applied to agriculture, these often fail to capture the specificities of the sector & result in imprecise or under-estimated evaluations**; need for a precise methodology to consider all agricultural subsectors and their specificities**.

- **Need for universality and comparability**: Given the lack of a universal assessment methodology, disaster impact tends to be estimated based on variations of PDNA or ECLAC methodologies, making it impossible to compare results across countries or disasters (it is difficult to determine which methodology, criteria and parameters have been used and which elements of agricultural damage and loss have been considered)

- **Gap / Need for a standardised and holistic methodology** to suit different disaster events and in different country/regional contexts and to address the prevailing knowledge gap on disaster impact on the sector and provide a useful tool for assembling and interpreting existing information about both past and future events

- **Sendai Framework and SDG Monitoring**: Need for an adequate methodology to capture all impacts of disasters in the sector, in the context of global resilience frameworks and targets
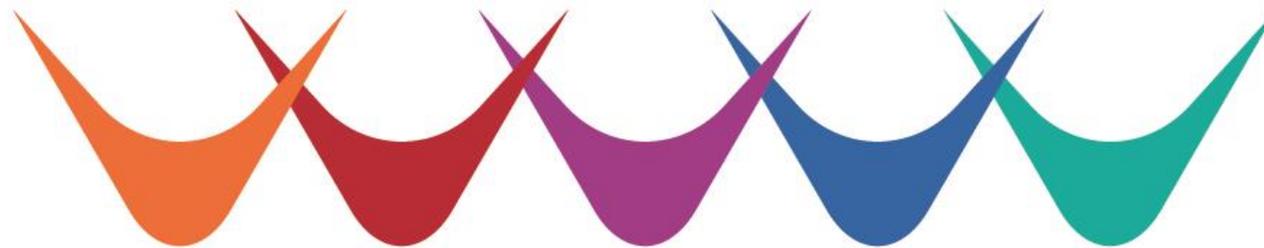
D&L METHODOLOGY FOR C2
background · definitions · components

Damage VS Loss

Damage is defined as the replacement/repair cost of totally or partially destroyed physical assets and stocks in the disaster-affected area

Loss refers to changes in economic flows arising from the disaster (i.e. declines in output in crops, livestock, fisheries, aquaculture and forestry)

Production VS Assets

Each sub-sector is divided into two main components, namely **production** and **assets**. The production component measures both damage and loss from disaster on production inputs and outputs, while the assets component measures damage on facilities, machinery, tools, and key infrastructure related to agricultural production

		Damage	**Loss**
Crops **Livestock**	Production	Pre-disaster value of **destroyed stored production and inputs**	**Difference between expected and actual value** of crop production Short-run post-disaster maintenance costs
Fisheries **Forestry**	Assets	Replacement or repair value of **destroyed assets** – machinery, equipment, tools	

C2-C (Crop) = *Crop production damage* + *Crop production loss* + *Crop assets damage*

C2-FO (Forestry) = *Forest production damage* + *Forest production loss* + *Forest asset damage*

C2-L (Livestock) = *Livestock production damage* + *LS production loss* + *LS asset damage*

C2-AQ (Aquaculture) = *AQ production damage* + *AQ production loss* + *AQ asset damage*

C2-FI (Fisheries) = *Fishery production damage* + *Fishery production loss* + *Fishery asset damage*

- The methodology for Sendai Indicator C2 (developed by FAO) measures the value of **direct production damage and loss** from disasters in the ag-sectors, together with the **value of damaged agricultural assets**.

- Also measures SDG indicator 1.5.2

- Holistic representation of the agricultral sector:
  - covers all subsectors
  - covers all components of the FAO methodology: production loss + production damage + asset damage

Indicator C-2 Direct agricultural loss from disasters

$$C_2 = C_{2C} + C_{2L} + C_{2FO} + C_{2A} + C_{2FI} + C_{2La} + C_{2Lb}$$

C-2C: Direct crop loss
C-2L: Direct livestock loss
C-2FO: Direct forestry loss
C-2A: Direct aquaculture loss
C-2FI: Direct fisheries loss
C-2La: Direct damage to agricultural assets
C-2Lb: Direct damage to stored inputs and outputs

The computation method proposed for indicator C-2 is used to assess the direct loss which occurs in the agricultural sector as a result of disasters and takes into consideration the specificities of each sub-sector, i.e. crops, livestock, forestry, aquaculture and fisheries.

This indicator aims to measure the direct effects of a broad range of disasters of different types, duration and severity. Moreover, it applies to disasters of various scales – from large-scale shocks to small and medium-scale events with a cumulative impact.

This indicator is calculated based on five sub-indicators:

- C-2C: Direct crop loss
- C-2L: Direct livestock loss [12]
- C-2FO: Direct forestry loss
- C-2A: Direct aquaculture loss
- C-2FI: Direct fisheries loss

Impact to Agriculture: $C2 = C2C + C2L + C2FO + C2A + C2FI$

Sub-indicator components:

- **Production**

- **Productive assets**

Each sub-sector is sub-divided into two main sub-components, namely **production** and **assets**. The production sub-component measures loss from disaster on both production inputs and outputs, while the assets sub-component measures loss of facilities, machinery, tools, and key infrastructure related to agricultural production.

In order to capture the direct impact of disasters on agriculture, it is important to take into account both:

- Losses, that is, changes in economic flows arising directly from the disaster (i.e. reduction in output in crops, livestock, fisheries, aquaculture and forestry); and

- The replacement and/or recovery costs of totally or partially destroyed physical assets and stocks (stored inputs and production) in the disaster-affected area.

The table below describes the key elements of the methodology, including an indication of the items that should be considered in the assessment of each sub-sector, as well as the proposed calculation methods for assigning a monetary value to each component. For a detailed presentation of computation methods and subsector-relevant formulas, please refer to Annex 1.

DISASTER IMPACT ON PRODUCTION

Items	Measurement
Stocks: **Stored inputs** (Seeds, fertiliser, feed, fodder, etc.) **Stored production** (Crops, livestock produce, fishes, logs, etc.) **Perennial trees**	1. Pre-disaster replacement value of destroyed stored production and inputs
Production **Value of lost crops, livestock, forestry, aquaculture production and fisheries capture production** (excluding stored outputs, already stated above)	2. Difference between expected and actual value of production (crops, livestock, forestry, aquaculture production and fisheries capture) in disaster year <u>For perennial crops and forestry</u>: 2. Pre-disaster value of fully destroyed standing crops and trees and Discounted expected value of crop production in fully affected harvested area until full recovery <u>For livestock and aquaculture</u>: 2. Discounted foregone value of livestock products from dead livestock until full recovery 3. Temporary costs incurred towards the maintaining of post-disaster agricultural and farming/fishing activities

DISASTER IMPACT ON ASSETS

Items	Measurement
Machinery, equipment and tools [13] used in crop and livestock farming, forestry, fisheries, aquaculture, apiculture	<u>Total destruction</u>: replacement cost of fully destroyed assets at pre-disaster price <u>Partial destruction</u>: repair/rehabilitation cost of partially destroyed assets at pre-disaster price

1. C-2C - Direct Crop loss

$C-2C$ = *Loss in annual crop stocks + Loss in perennial crop stocks + Annual crop production loss + Perennial crop production loss + Crop assets loss (complete and partial)*

- *Loss of annual crop stocks* – 1) Pre-disaster value of destroyed stored annual crops and 2) Pre-disaster value of destroyed stored inputs

- *Loss of perennial crop stocks* – 1) Pre-disaster value of destroyed stored perennial crops; 2) Pre-disaster value of destroyed stored inputs; and 3) Replacement value of fully damaged perennial trees;

Production Damage

xxx tons of inputs (fertilizer, feed, forage, seeds, etc.)

$$$ per unit of stored input

xxx tonnes of stored production

$$$ per ton of stored production
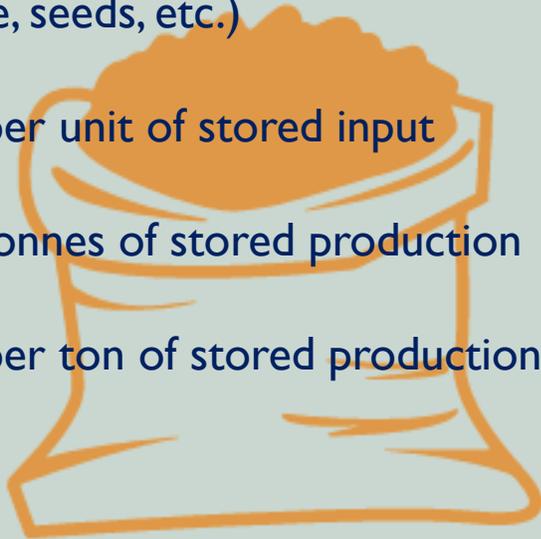
Production Loss

xxx tons/ha of commodity – expected yield

xxx tons/ha of commodity – actual yield

$$$ per ton of commodity

Short-run post-disaster maintenance costs

Asset Damage

xxx of asset (tractors, fishing gear, feeders, boats, cages, fish pens)

$$$ per asset

Sample Data Requirements for calculating D&L in Crops: Best Case Scenario

Production Damage

Production Loss

Asset Damage
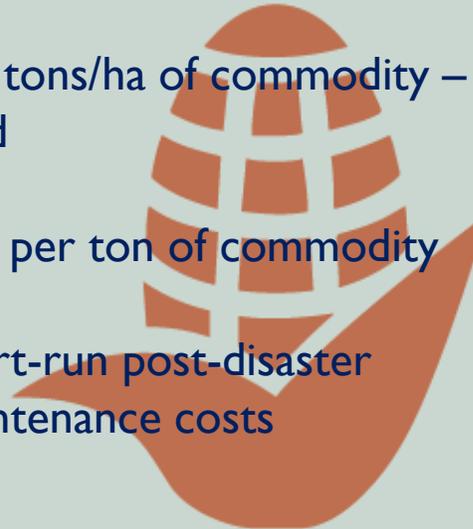
xxx tons/ha of commodity – expected yield

xxx tons/ha of commodity – actual yield

$$$ per ton of commodity

Short-run post-disaster maintenance costs

Sample Data Requirements for calculating D&L in Crops: Minimum Data Scenario

Disaggregation by crop / livestock type is key

D&L METHODOLOGY
formulas · calculation · SFM

C2-C (**Crop sector impact**) = *Crop production damage + Crop production loss + Crop assets loss (complete and partial)*

- ***Production damage - annual crops***

  ➤ 1) Pre-disaster value of destroyed stored annual crops and inputs

  PD (Crops) = ΔQ inputs, stored . P t-1   + ΔQ outputs, stored · P t-1

- ***Production loss - annual crops***

  ➤ 1) Difference between expected and actual value of crop production in **non-fully damaged harvested area** 2) Pre-disaster value of destroyed crops **in fully-damaged areas (non-harvested)**; 3) Short-run post-disaster maintenance costs

  PL (Crops) =   P t-1 · ΔY · HA   +   P t-1 · Y · ΔHA +   P short-run

- ***Asset damage***

  ➤ 1) Pre-disaster value of partially or fully destroyed assets

  AD (Crops) =   Pt-1 ·ΔQ (asset)

C2 in the SFM

GLOBAL TARGETS: Reporting

Metadata

A Mortality

B People affected

C Economic loss

D Critical infrastructure & services

E Disaster risk reduction strategies

F International cooperation

G Early warning and risk information

Target C STATUS: Not started

Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.

C-1 Direct economic loss attributed to disasters i domestic product

2016	2017	BAS

CALCULATE COMPOUND INDICATOR C-1

+ **C-2** Direct agricultural loss attributed to disa

+ **C-3** Direct economic loss to all other damag destroyed productive assets attributed

+ **C-4** Direct economic loss in the housing sec attributed to disasters

GLOBAL TARGETS ▾

OVERVIEW

SET UP

GLOBAL REPORTING

CUST
TAR

CALCULATE COMPOUND INDICATOR C-1

− **C-2** Direct agricultural loss attributed to disasters

Not started

SUBMIT INDICATOR C-2

Data entry options

○ Enter monetary value & hectares manually

● Enter hectares manually & monetary value to be calculated

○ Both values to be imported from National Disaster Loss Database

Agricultural loss

YEAR	MONETARY VALUE (LCU)	SOURCE
2017		
2016		

C2 in the SFM

C2-C (Crop sector) =

Crop production damage +

Crop production loss +

Crop assets loss

C-2C Loss of crops damaged or destroyed attributed to disasters

ℹ

Loss of crops

YEAR	MONETARY VALUE (LCU)	HECTARES			SOURCE
		TOTAL	DAMAGED	DESTROYED	
2017					
2016					

Disaggregation (optional)

+ **Agricultural Crops**

+ **Hazards**

+ **Geography**

C2 in the SFM

C2-C (Crop sector) =

Crop production damage +

Crop production loss +

Crop assets loss

…with Disaggregation

C-2C Loss of crops damaged or destroyed attributed to disasters   i

Loss of crops

YEAR	MONETARY VALUE (LCU)	HECTARES			SOURCE
		TOTAL	DAMAGED	DESTROYED	
2017					
2016					

Disaggregation (optional)

−   **Agricultural Crops**

#	AGRICULTURAL CROPS	YEAR	MONETARY VALUE (LCU)	HECTARES			UNIT PRICE
				TOTAL	DAMAGED	DESTROYED	
1	Maize	2017		60	40	20	
		2016					
2	Soybeans	2017					
		2016					
3	Rice, paddy	2017					

C2-L (Livestock impact) = *Livestock production damage + production loss + asset loss (complete and partial)*

- *Production damage*

  Any obtained revenue from dead livestock sold should be subtracted

  ➢ 1) Pre-disaster value of stored inputs (feeds, fodder and forage) and stored livestock products destroyed by the disaster; 2) Pre-disaster net value of dead livestock (fish) (minus any obtained revenue from dead livestock sold)

  $$PD = \Delta Q_{inputs,\,stored} \cdot P_{t-1} + \Delta Q_{outputs,\,stored} \cdot P_{t-1} + (\Delta Q \cdot W)(P - \alpha \cdot P)$$

- **Production loss**

  ➢ 1) Difference between expected and actual value of production (of livestock and fish products) in disaster year; 2) Discounted present value of lost future production (until full recovery); 3) Short-run post-disaster maintenance costs

  $$PL = Q \cdot P_{t-1} \cdot \Delta Y + P_{t-1} \cdot Y_{future}/(1+i)^n + P_{short-run\,(lump-sum)}$$

- *Asset damage*

  ➢ 1) Pre-disaster value of partially or fully destroyed assets

  $$AD = P_{t-1} \cdot \Delta Q_{(asset)}$$

C2 in the SFM

C2-C (Livestock impact) =

Livestock production damage +

Livestock production loss +

Livestock assets loss

C-2L Loss of livestock lost attributed to disasters

Loss of livestock

YEAR	MONETARY VALUE (LCU)	ANIMALS AFFECTED			SOURCE
		TOTAL	AFFECTED	LOST	
2017					
2016					

Disaggregation (optional)

− Livestock

#	LIVESTOCK	YEAR	MONETARY VALUE (LCU)	ANIMALS AFFECTED			UNIT PRICE
				TOTAL	DAMAGED	DESTROYED	
1	Cattle	2017					
		2016					
2	Buffaloes	2017					
		2016					
		2017					

C2-FO (Forestry impact) = *Forestry production damage + production loss + asset loss (complete and partial)*

- **Production damage**
  - ➢ 1) Pre-disaster value of destroyed stored outputs and inputs; 2) Replacement value of fully damaged trees

  $$PD = \underline{\Delta Q \text{ inputs, stored} \cdot P_{t-1}} + \underline{\Delta Q \text{ outputs, stored} \cdot P_{t-1}} + \underline{\Delta HA \cdot H_{(tree)} \cdot P_{t-1}}$$

- **Production loss**
  - ➢ 1) Difference between expected and actual value of production in non-fully damaged harvested area; 2) Pre-disaster value of fully destroyed forest products; 3) Discounted present value of lost future production (until full recovery)

  $$PL = \underline{P_{t-1} \cdot \Delta Y \cdot HA} + \underline{P_{t-1} \cdot Y \cdot \Delta HA} + \underline{P_{t-1} \cdot Y_{future} / (1+i)^n}$$

- **Asset damage**
  - ➢ 1) Pre-disaster value of partially or fully destroyed assets

  $$AD = \underline{P_{t-1} \cdot \Delta Q_{(asset)}}$$

C2 in the SFM

C2-C (Forestry impact) =

Forest production damage +

Forest production loss +

Forest assets loss

C-2Fo Loss of forests affected/destroyed by disasters ℹ️

Loss of forests

YEAR	MONETARY VALUE (LCU)	HECTARES			SOURCE
		TOTAL	DAMAGED	DESTROYED	
2017					
2016					

Disaggregation (optional)

+ **Forestry**

+ **Hazards**

+ **Geography**

C2-AQ (Aquaculture impact) = *Aquaculture production damage + production loss + asset loss (complete and partial)*

- *Production damage*

  ➢ 1) Pre-disaster value of stored inputs and stored aquaculture products destroyed by the disaster

  PD = $\Delta Q_{\text{inputs, stored}} \cdot P_{t-1}$ + $\Delta Q_{\text{outputs, stored}} \cdot P_{t-1}$

- **Production loss**

  ➢ 1) Difference between expected and actual value of aquaculture production in non-fully damaged aquaculture areas; 2) Pre-disaster value of aquaculture production lost in fully-damaged aquaculture areas; 3) Discounted present value of lost future production (until full recovery); 4) Short-run post-disaster maintenance costs

  PD = $\text{AREA} \cdot P_{t-1} \cdot \Delta Y$ + $\Delta\text{AREA} \cdot P_{t-1} \cdot Y$ + $P_{\text{short-run}}$

- *Asset damage*

  ➢ 1) Pre-disaster value of partially or fully destroyed assets (cages, cold stores, feeders)

  AD = $P_{t-1} \cdot \Delta Q_{(\text{asset})}$

C2 in the SFM

C2-C (Livestock impact) =

Livestock production damage +

Livestock production loss +

Livestock assets loss

C-2a Loss of aquaculture production area affected

Loss of aquaculture

YEAR	MONETARY VALUE (LCU)	HECTARES			SOURCE
		TOTAL	DAMAGED	DESTROYED	
2017					
2016					

Disaggregation (optional)

+ **Aquaculture**

+ **Hazards**

+ **Geography**

C2-FI (Fisheries impact) = *Fisheries production damage + production loss + asset loss (complete and partial)*

- *Production damage*
  - ➤ Pre-disaster value of stored inputs and stored capture destroyed by the disaster

  $$PD = \Delta Q_{\text{inputs, stored}} \cdot P_{t-1} + \Delta Q_{\text{outputs, stored}} \cdot P_{t-1}$$

- **Production loss**
  - ➤ Difference between expected and actual value of fisheries capture in disaster year

  $$PD = AREA \cdot P_{t-1} \cdot \Delta Y$$

- *Asset damage*
  - ➤ Pre-disaster value of assets used for fisheries partially or fully destroyed by disaster (vessels, fishing boats, tools, equipment, cold storage, etc.)

  $$AD = P_{t-1} \cdot \Delta Q_{(\text{asset})}$$

C2 in the SFM

C2-C (Livestock impact) =

Livestock production damage +

Livestock production loss +

Livestock assets loss

C-2FI Loss of fisheries production area affected   ℹ

Loss of fisheries

YEAR	MONETARY VALUE (LCU)	VESSELS/ASSETS			SOURCE
		TOTAL	DAMAGED	DESTROYED	
2017					
2016					

Disaggregation (optional)

+   Fisheries

+   Hazards

+   Geography

C2 in the SFM

C2 (all sectors) =

Crop / Livestock / Forest / Aquaculture / Fishery PRODUCTION DAMAGE +

Production loss +

Assets loss

C-2LB Loss of agricultural stock affected

ℹ️

Loss of agricultural stock

YEAR	MONETARY VALUE (LCU)	HECTARES			SOURCE
		TOTAL	DAMAGED	DESTROYED	
2017					
2016					

Disaggregation (optional)

+ Agricultural Stock

+ Hazards

+ Geography

C2 in the SFM

C2 (all sectors) =

Production damage +

Production loss +

Crop / Livestock / Forest / Aquaculture / Fishery ASSET DAMAGE

C-2LA Loss of agricultural assets area affected

Loss of agricultural assets

YEAR	MONETARY VALUE (LCU)	ASSETS			SOURCE
		TOTAL	DAMAGED	DESTROYED	
2017					
2016					

Disaggregation (optional)

+ **Agricultural Assets**

+ **Hazards**

+ **Geography**

C2 DISAGGREGATION in the SFM

GLOBAL TARGETS ▼   CUST TARG

- OVERVIEW
- SET UP
- GLOBAL REPORTING

RESPONSIBLE INSTITUTIONS
DISAGGREGATION

Hazards	⊘
Geography	
Agricultural Crops (C-2C)	⊘
Livestock (C-2L)	⊘
Forestry (C-2FO)	
Fisheries (C-2FI)	
Aquaculture (C-2A)	
Agricultural Assets (C-2LA)	
Agricultural Stock (C-2LB)	
Productive Assets (C-3)	
Housing Sector (C-4)	
Other Critical Infrastructure	

Disaggregation metadata: Livestock

The information only needs to be entered once and is used to calculate the loss of live (Target C-2L).

LIVESTOCK *	AVERAGE SIZE *	ELEMENT UNIT *	UNITS *	NO. WORKERS *	METHODOLOGY	
Buffaloes	1	Animal ▾	Units ▾	0.05	FAO Method ▾	✖
Cattle	1	Animal ▾	Units ▾	0.05	FAO Method ▾	✖
Chickens	1	Animal ▾	Units ▾	0.02	FAO Method ▾	✖
Horses	1	Animal ▾	Units ▾	0.05	FAO Method ▾	✖
Pigs	1	Animal ▾	Units ▾	0.05	FAO Method ▾	✖

+ ADD MORE

SELECT LIVESTOCK   **DONE**

D&L METHODOLOGY
application • trainings

Assessment methodology developed by ECLAC in 1970s

Adapted for use by WB as DaLA

PDNA - common integrated approach that combines context, effects, impacts and recovery strategy (2008)

FAO's deepening of sectoral perspective - providing a compatible and complementary base for PDNA in agriculture
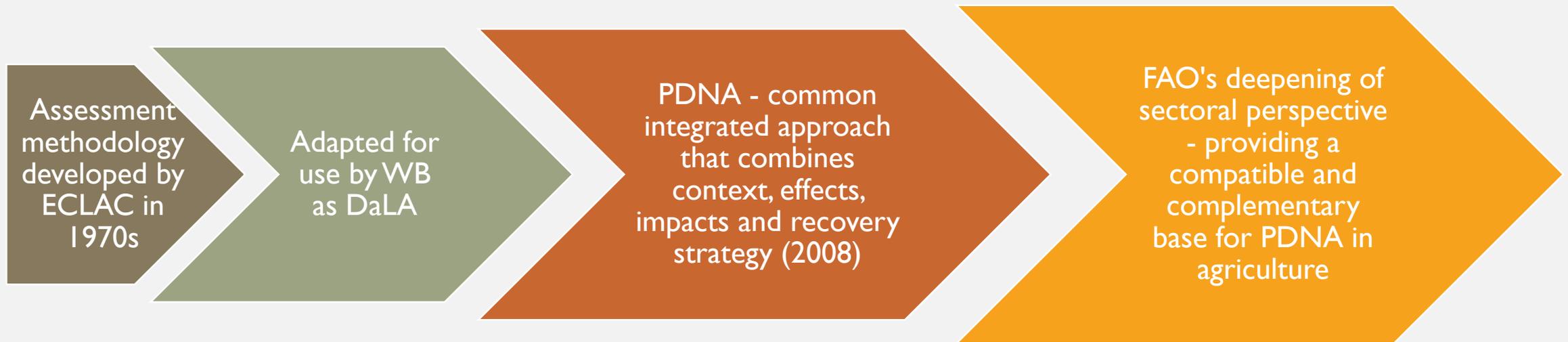
Context Analysis
- Pre-Disaster context-baseline of social, economic, cultural, financial, political status

Disaster Effect
- Infrastructure and assets
- Production of goods and services
- Governance processes
- Increased risks

Disaster Impact
- Economic
- Human/social

Recovery Needs
- Includes BBB
- Includes DRR

Recovery Strategy

FAO D&L Methodology

PDNA

Focus on emergency response

- Provides quantification of impacts and effects after big disasters
- Focus both direct and indirect impacts
- Defines recovery and reconstruction needs of different sectors and population groups
- Identify the financial requirements for recovery and reconstruction
- Establish mechanisms of recovery planning
- Focus on recovery + DRR through Building Back Better (BBB)
- Mobilize the relevant financial, technical and human resources for recovery different sectors

PDNA
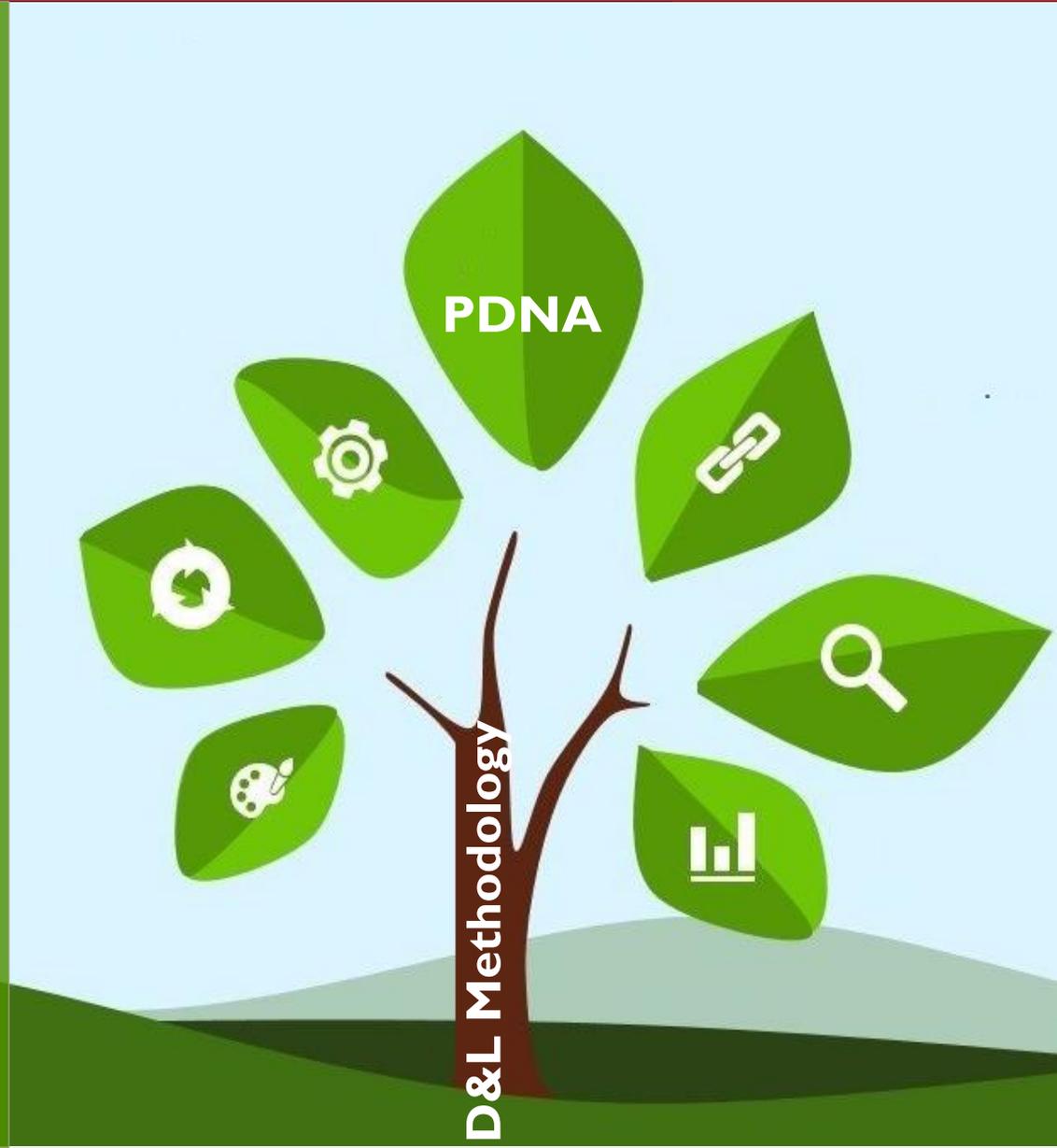
D&L Methodology

FAO's D&L Methodology
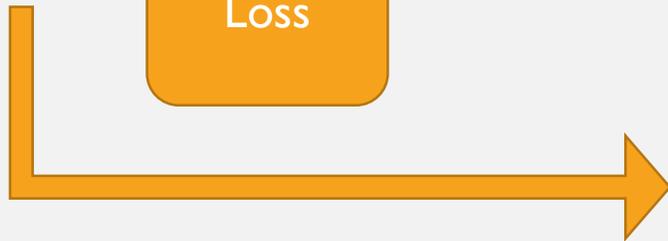
Focus on ag sector development and resilience

- Provides regular monitoring of agricultural sector damage and loss
- Targets ALL events that affect the agricultural sector, including silent and localized "disasters"
- Focus on direct impacts
- Provides a structure for a national information system on D&L (regular data collection, database upkeep, analysis and reporting)
- Provides baseline data
- Serves as evidence base for policy
- Serves to generate investment resources in ag resilience

Normal Condition:
D&L Methodology / regular data collection / database & D&L information systems
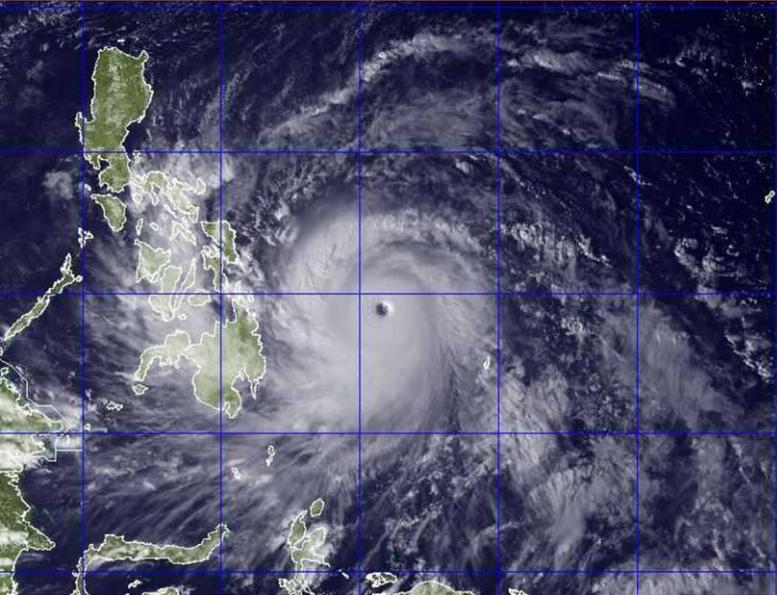
DISASTER

Damage

Loss

Effect on governance and social processes

Effect on availability and access to goods and service

Effect on Livelihood

FAO's D&L METHODOLOGY

Case Study Trials – Philippines and Ethiopia

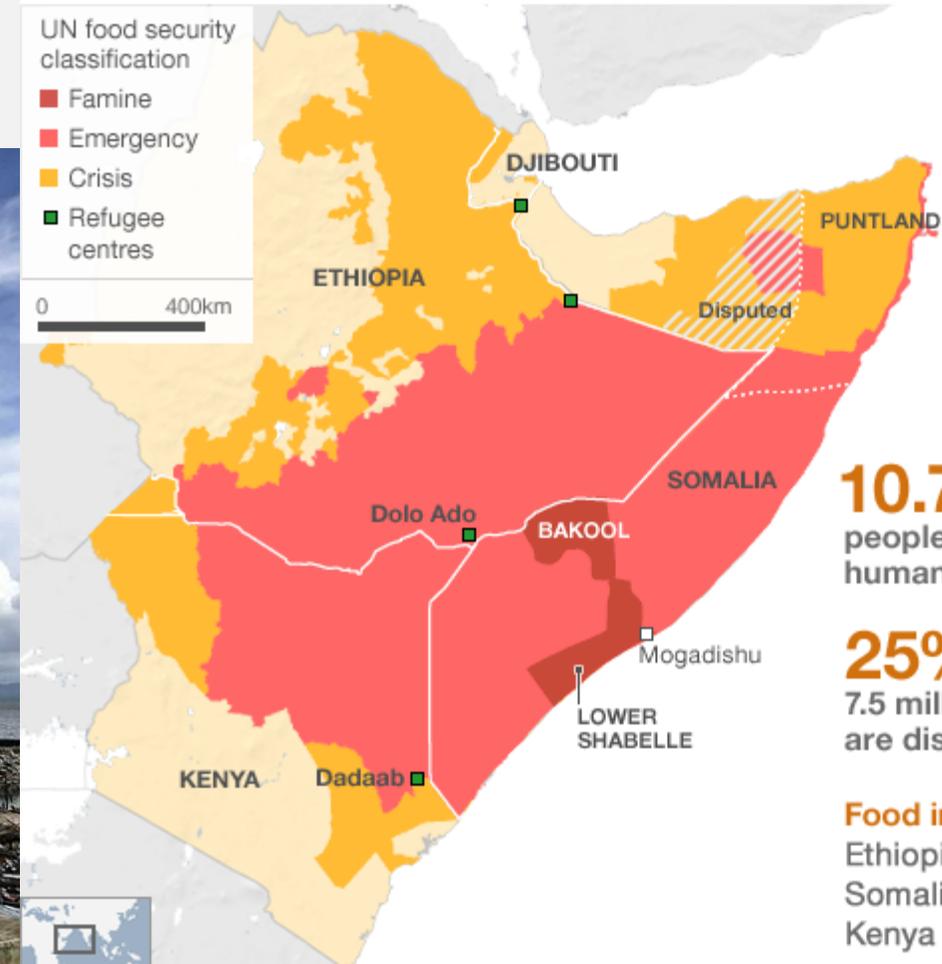Areas of food shortages

UN food security classification
- Famine
- Emergency
- Crisis
- Refugee centres

0   400km

DJIBOUTI
PUNTLAND
ETHIOPIA
Disputed
SOMALIA
Dolo Ado   BAKOOL
Mogadishu
LOWER SHABELLE
KENYA   Dadaab

10.7 million people in need of humanitarian assistance

25% of Somalia's 7.5 million people are displaced

Food insecure populations
Ethiopia 4.56 million
Somalia 3.7 million
Kenya 2.4 million

Source: UNHCR/USAID

Source: OCHA, Fews Net

Chile:
Following a D&L Assessment Training in 2017, the Ministry of Agriculture is currently piloting the D&L information system in the country
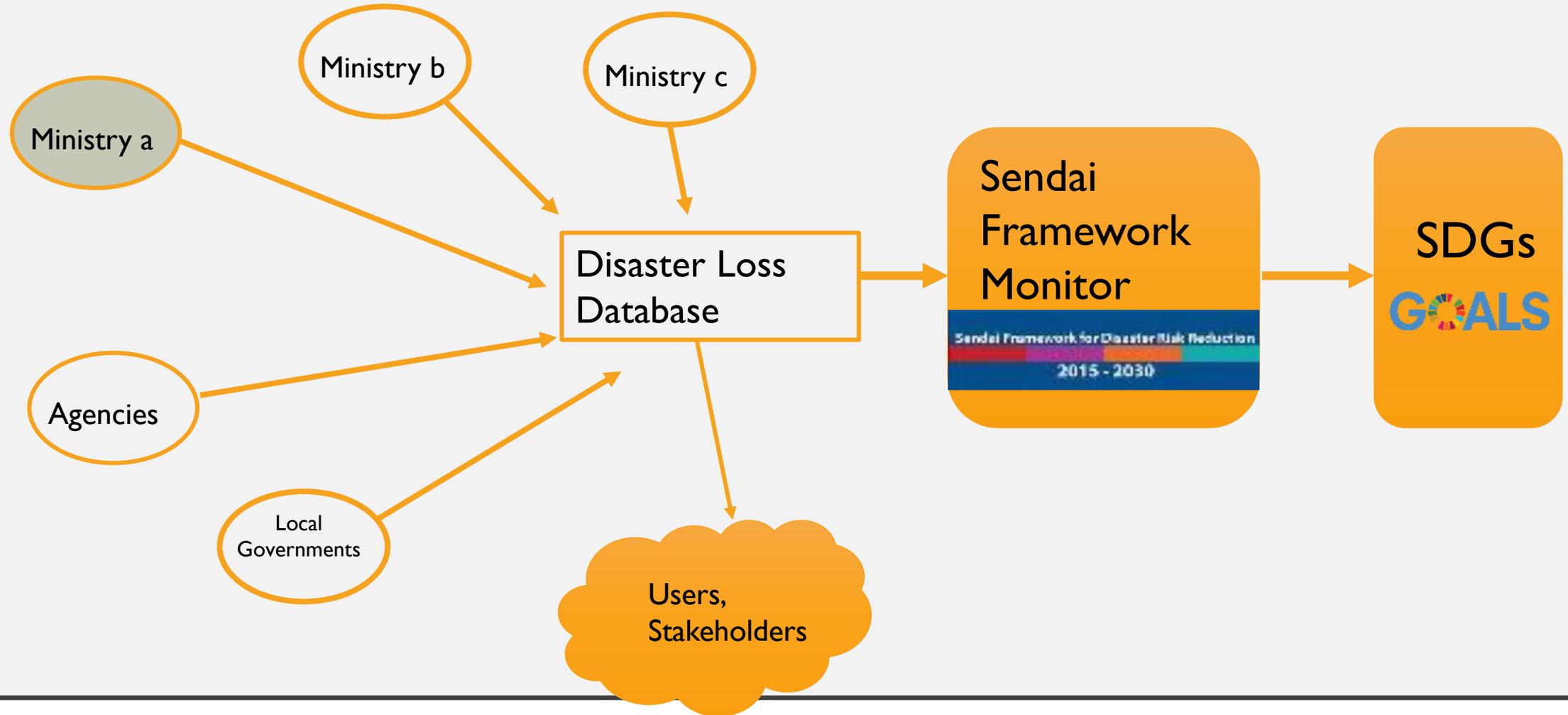
Dominica:
Following Hurricane Maria, a combined training on PDNA + FAO D&L Methodology was conducted and a diagnostic report was produced on the insitutionalisation of a D&L information system

Colombia & Peru:

A training was conducted on the institutional aspects of D&L assessment;
a roadmap was produced by Government stakeholders and a pilot will be trialled in selected regions in both countries

THANK YOU