Food and Agriculture Organization of the United Nations

Benefits of farm level disaster risk reduction practices in agriculture

Preliminary findings

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Food and Agriculture Organization of the United Nations
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multi-stress tolerant Green
Super Rice (GSR) varieties

Investing in disaster risk reduction (DRR) technologies at farm level is an important way to reduce risk exposure and enhance the resilience of farming families to natural hazards a wide range of farm level DRR good practice technologies exists to significantly reduce natural hazard-induced damages and losses to agricultural* families and communities

*the agriculture sector is understood to include crops, livestock, fisheries, aquaculture and forestry

Reducing the impact of disasters through DRR good practices

Over the past decade, the number of disasters caused by natural hazards has increased sharply, together with the number of people affected and the amount of economic loss. Between 2006 and 2016, the agriculture sector absorbed approximately 23 percent of the damage and losses caused by natural hazard-induced disasters in developing countries (FAO, 2017). Worldwide, 2.5 billion people depend on agriculture for their livelihoods[1]. Investing in DRR technologies at farm level is a way to easily reduce risk exposure and enhance the resilience of farming families to natural hazards.

The Food and Agriculture Organization of the United Nations (FAO) is conducting a comprehensive study across regions to assess the benefit from applying DRR good practices[2] in agriculture. The study identifies practices that help to reduce the vulnerability of households and communities to natural hazards. The study is based on data collected from ongoing projects at the farm level that promote good practices for DRR and climate change adaptation[3]. It uses a systematic approach to quantify, on a case-by-case basis, how much damage and loss can be reduced in the agriculture sector through the implementation of DRR good practices at farm level, compared with usual practices[4]. The approach compares the performance under hazard and non-hazard conditions, including various types of hazards and agro-ecological zones.

This document summarizes the preliminary findings from the study's pilot phase, and it highlights challenges and opportunities for realizing the benefits of DRR good practices at a larger scale. The aim is to support policy-makers and DRR practitioners in making evidence-based decisions towards reducing risk exposure of agricultural producers.

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1 Increasing the Resilience of Agricultural Livelihoods, FAO 2016, www.fao.org/3/a-i5615e.pdf

2 A DRR good practice in the context of this study was defined as a successful experience that has been tested and validated, has led to positive results in several contexts and can be recommended as a model for wider replication

3 A special thanks to the project coordinators and staff, agricultural extension workers, associations of agricultural workers and other key partners and stakeholders who supported all stages of the study, from data collection to data analysis and validation of results

4 For the purpose of this document, "usual practices" are those practices commonly adopted in the analysed areas before new DRR practices were introduced

DRR good practices bring a number of environmental co-benefits thanks to a more sustainable use of inputs and natural resource management

indoor mushroom production for livelihood diversification

mushroom farmer Gorreti Asiimwe working inside her mushroom farm

Monitoring the performance of DRR good practices

a systematic approach

25 different practices were monitored between 2015 and 2016 in Bolivia, Cambodia, Lao People's Democratic Republic (PDR), the Philippines and Uganda. The performance of the DRR practices was compared with that of previously used practices in areas exposed to hazards, including drought, dry spells, floods, frost, hailstorms, strong winds, pests and diseases.

The selected practices were already recognized by national or international research institutes or promoted by national extension services as agricultural good practices. Therefore, this study does not aim to validate DRR practices, but rather to identify those practices that perform best when exposed to natural hazards, while performing no less better than previously adopted practices when no hazards occur (Figure 1).

Relevant data were gathered and analysed through a participatory monitoring and evaluation process (Figure 2).

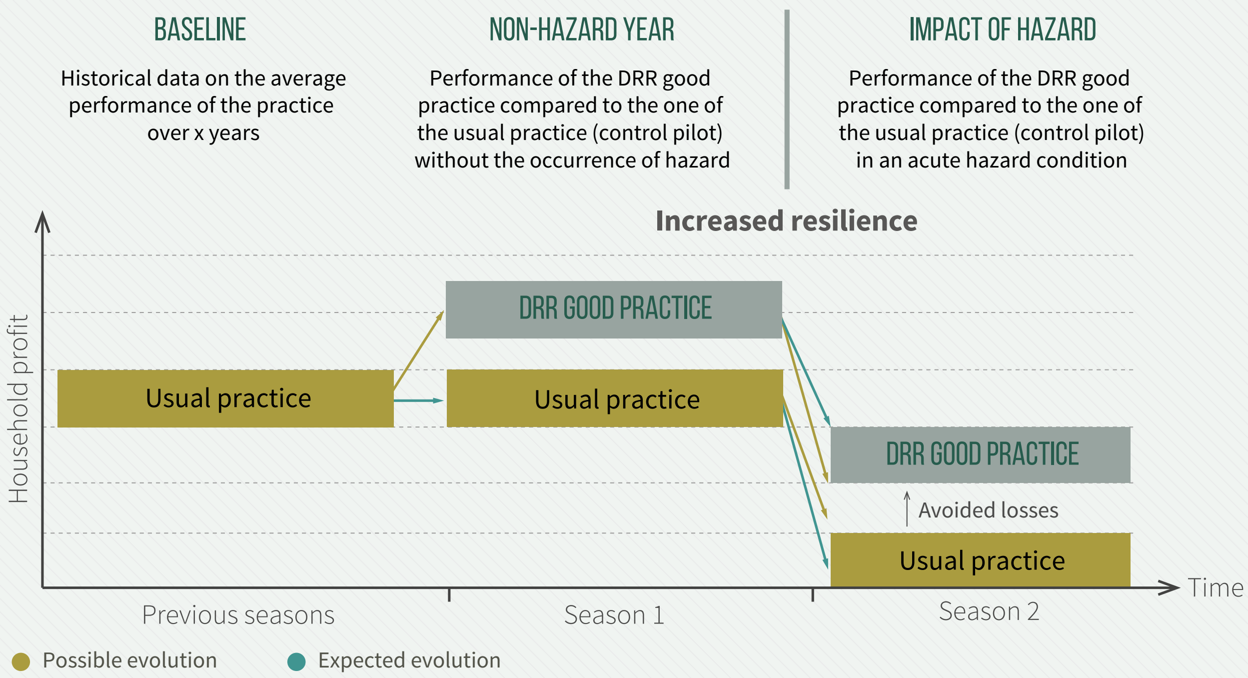
Data collection: A group of farmers and agricultural extension staff collected key field data on the performance of good practices. In addition, quantitative and qualitative interviews were conducted with agricultural household members. In order to apply the methodology, it was necessary to define a "good practice plot" and a "control plot". Technical experts with good knowledge of the practices and agro-ecological zones supported the data collection process.

Data analysis: A cost-benefit analysis was undertaken in order to measure the performance, compared with usual practices, under hazard and non-hazard conditions, when applicable. The appraisal period for all cost-benefit analyses was 11 years, with a 10 percent discount rate. Qualitative evaluations were also carried out based on the interviews. The results were analysed according to four main criteria:

1. agro-ecological suitability: the good practice is suitable under existing and near future climatic, edaphic and topographic conditions and/or the same agro-ecological zones
2. socio-economic feasibility: the good practice is economically and socially beneficial and contributes to improved livelihoods, even in the absence of hazards
3. increased hazard-specific resilience: the good practice increases the resilience of agricultural livelihoods against the impacts of hazards
4. environmental co-benefits: the good practice brings environmental co-benefits and contributes to sustainable agricultural development

Upscaling analysis: Customized models were used to simulate the potential impacts of scaling up the good practices. These simulations were based on the results obtained from field level appraisals and from considering context-specific potential barriers (e.g. agro-ecological, socio-economic and cultural). Eventually, the results were consolidated into an integrated assessment of economic, social and environmental impacts of each DRR good practice.

Figure 1. Monitoring the performance of DRR good practices: the analytical framework



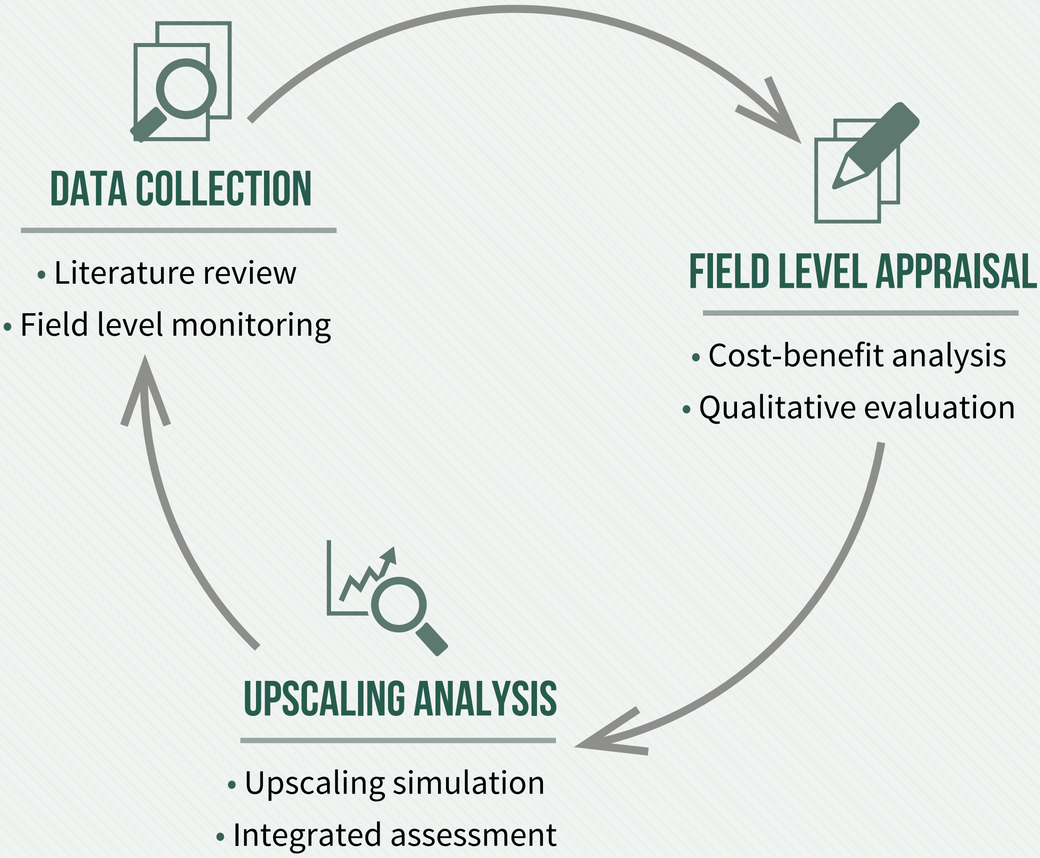
Aggregated analysis: To facilitate aggregated analysis, the practices were categorized into four groups based on specific criteria:

1. agronomic practices and livelihood diversification
2. agriculture-related infrastructure and equipment
3. improved drought- and flood-tolerant varieties and species
4. combined application of several mutually reinforcing good practices (crops and livestock good practice packages)

Two indicators were used to communicate the results of the financial appraisal:

1. increase in net benefits – that is, the percentage difference between the net present value of benefits of the good practice and the usual practice
2. benefit cost ratio measuring the extent to which benefits outweigh costs.

Figure 2. Measuring the returns from DRR good practices: the methodological process



indoor mushroom production for livelihood diversification

mushroom farmer Gorreti Asiimwe displaying her finished product after harvest, packaged and ready to sell at the market

Although aggregated results were presented according to the type of good practice, results are also available for each individual practice. Detailed information on each good practice including implementation guidelines is available on FAO's web platform on Technologies and Practices for Small Agricultural Producers (TECA): http://teca.fao.org/

It is important to note that only 7 percent of all the hazards that affected the farms during the monitoring period (2015–2016) were of severe or medium intensity, while the remaining 93 percent were moderate hazards. The intensity of hazards was determined based on expert judgment combined with feedback from farmers, livestock raisers and fishers during the evaluation interviews.

on average, the net economic benefits from improved farm level DRR good practices are about 2.5 times higher than the usual practices adopted by farmers, livestock raisers and fishers

preliminary study results show that the combined application of several mutually reinforcing **good practice technologies in the crop sector** leads to **economic benefits that are more than four times higher** than the previously used practices in hazard-prone areas. These include the combination of agronomic practices for soil and water management, infrastructure improvements and equipment for DRR and stress-tolerant crop varieties

early maturing rice varieties to reduce production losses due to dry spells and floods

Benefits from farm level DRR good practices: pilot trials in five countries

Agronomic practices and livelihood diversification

For the purpose of this study, the group of agronomic practices included tested practices that relate to soil and water management, such as mulching and trenching; sustainable use of inputs (e.g. organic fertilizers and pesticides); agroforestry activities, such as planting shade trees; intercropping; and livelihood diversification in hazard-prone areas. The good practices described below were monitored on 72 small-scale farms between 2015 and 2016.

GOOD PRACTICE DESCRIPTION	COUNTRY	MAIN HAZARD(S) ADDRESSED
home gardening with botanical pesticides and liquid compost	**Cambodia**	pest outbreaks
application of guano fertilizer to keep moisture and improve soil fertility in paddy fields in drought-affected areas	**Lao People's Democratic Republic**	dry spell
indoor mushroom production for livelihood diversification in dry areas	**Lao People's Democratic Republic and Uganda**	dry spell
cattle raising in silvopastoral systems to reduce the impact of drought on pasture	**Bolivia**	dry spell

Benefits of DRR agronomic practices and livelihood diversification

NON-HAZARD		HAZARD	
percentage increase in net economic benefits under non-hazard conditions, compared with usual practices	173%	**percentage increase in net economic benefits under hazard conditions, compared with usual practices**	158%
benefit-cost ratio under non-hazard conditions	3.2	**benefit-cost ratio under hazard conditions**	2.8
more production (% of respondents)	88%	resilience score rated by adopters (1 to 5)	4.6
more income (% of respondents)	58%	safer livelihood practice (% of respondents)	69%
lower cost of inputs (% of respondents)	39%	more resistance to climate constraints (% of respondents)	68%
less labour (% of respondents)	0%		
better and more diverse food (% of respondents)	52%		

home gardening with botanical pesticides and liquid compost

Agriculture-related infrastructure and equipment

Investing in small-scale DRR agricultural infrastructure is key for improving the resilience of smallholders in risk-prone areas. The good practices analysed under this category included those requiring an upfront capital investment for the purchase and installation of DRR technologies. The good practices were monitored in 47 small-scale farming and fishing communities in Uganda and the Philippines.

GOOD PRACTICE DESCRIPTION	COUNTRY	MAIN HAZARD(S) ADDRESSED
rooftop water harvesting and water storage tanks for vegetable production in drought-affected areas (tomato, cabbage, *ntula*)	**Uganda**	dry spell
fish pots as passive fishing gear to prevent fish losses in the event of storms	**Philippines**	strong winds, typhoons

rooftop water harvesting and water storage tanks for vegetable production in drought-affected areas

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Benefits of agriculture-related infrastructure and equipment for improved resilience

NON-HAZARD

percentage increase in net economic benefits under non-hazard conditions, compared with usual practices 98%

benefit-cost ratio under non-hazard conditions 4.3

more production (% of respondents) 25%

more income (% of respondents) 100%

lower cost of inputs (% of respondents) 100%

less labour (% of respondents) 100%

better and more diverse food (% of respondents) 17%

HAZARD

percentage increase in net economic benefits under hazard conditions, compared with usual practices 147%

benefit-cost ratio under hazard conditions 3.7

resilience score rated by adopters (1 to 5) 4.3

safer livelihood practice (% of respondents) 25%

more resistance to climate constraints (% of respondents) 100%

Improved drought- and flood-tolerant varieties and species

This category refers to good practices that introduced improved, stress-tolerant varieties and species. As part of this study, FAO monitored improved crop varieties for rice, beans, maize and cassava. FAO also monitored the performance of stress tolerant fish species for aquaculture. The seven good practices listed below were monitored on 456 small-scale farms and fishing communities between 2015 and 2016.

GOOD PRACTICE DESCRIPTION	COUNTRY	MAIN HAZARD(S) ADDRESSED
multi-stress tolerant Green Super Rice (GSR) varieties	**Philippines**	dry spells, diseases
early maturing rice varieties to reduce production losses due to dry spells and floods	**Lao People's Democratic Republic**	dry spells, floods
flood-tolerant rice varieties	**Lao People's Democratic Republic**	floods
multi-stress tolerant bean varieties	**Uganda**	dry spells, diseases
improved maize varieties for increased production in hazard-prone areas	**Uganda**	dry spells, diseases
early maturing cassava to reduce production losses due to floods	**Bolivia**	floods
drought-tolerant aquaculture species	**Lao People's Democratic Republic**	dry spells

Benefits of improved drought- and flood-tolerant varieties and species

NON-HAZARD

percentage increase in net economic benefits under non-hazard conditions, compared with usual practices **71%**

benefit-cost ratio under non-hazard conditions **6.6**

more production (% of respondents) 73%

more income (% of respondents) 41%

lower cost of inputs (% of respondents) 13%

less labour (% of respondents) 6%

better and more diverse food (% of respondents) 22%

HAZARD

percentage increase in net economic benefits under hazard conditions, compared with usual practices **88%**

benefit-cost ratio under hazard conditions **5.1**

resilience score rated by adopters (1 to 5) 4.8

safer livelihood practice (% of respondents) 50%

more resistance to climate constraints (% of respondents) 38%

early maturing rice varieties to reduce production losses due to dry spells and floods

Case study

potential benefits of upscaling Green Super Rice varieties in the Bicol region of the **Philippines**

This case study analyses the potential added benefits and avoided losses from upscaling a multi-stress tolerant rice variety called Green Super Rice (GSR) in the hazard-prone region of Bicol in the Philippines, where 40 percent of the population relies on agriculture for their livelihoods and rice fields represent almost half of the harvested crop area. GSR lines are multi-stress tolerant, inbred, non-genetically modified rice lines developed by Chinese researchers in 2011. The different types of stresses GSR lines are tolerant to include abiotic stresses (e.g. drought, salinity, alkalinity, iron toxicity), diseases (e.g. blast, bacterial leaf blight, sheath blight, bacterial leaf streak, false smut) and insects (e.g. brown planthopper, green leafhopper, stem borer).

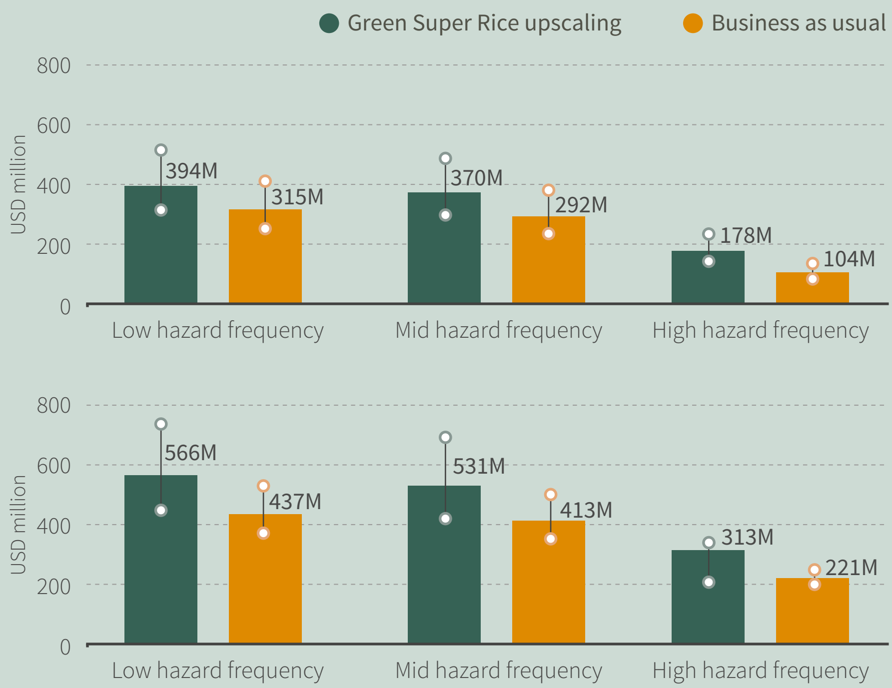
The performance of GSR lines 1, 5a, 8, 11, 12a (tolerant to drought, flood and saline conditions) was monitored on 256 farms over three consecutive seasons (2015 dry and wet seasons, and 2016 dry season) in the provinces of Camarines Norte, Camarines Sur, Catanduanes, Masbate and Sorsogon. About half of the farms were affected by dry spells during that period. Most farmers noted that the dry spells were of moderate intensity, mainly consisting in delays in the rainy season and dry periods of short duration.

The upscaling simulation assumes the adoption of GSR lines in 50 percent of the total rice land in Bicol region. Results show that GSR upscaling would bring an increase in the annual average net economic benefits from overall rice production in Bicol region in both the dry and rainy seasons. The largest difference between GSR upscaling and business as usual is observed when hazards are more frequent, suggesting that GSR lines are particularly effective under hazard conditions. In particular, GSR helps prevent a significant share of losses during the dry season, when farms are affected by dry spells. Overall, the amount of potentially avoided losses through GSR upscaling ranges between USD 33 and USD 129 million per season, on average.

Table 1. Percentage difference in net benefits from rice production, GSR upscaling vs. business as usual

	LOW HAZARD frequency	MID HAZARD frequency	HIGH HAZARD frequency
DRY SEASON	+25.1%	+26.7%	+71.2%
RAINY SEASON	+29.5%	+28.6%	+41.6%

Figure 3. Average annual net benefits from rice production in dry season (above) and rainy season (below), 2016–2026*



* The appraisal period is 2016-2026. A 10 percent discount rate is used. Sensitivity analysis uses 15 percent and 5 percent discount rates.

In representative qualitative assessments, three-quarters of the interviewed farmers who participated in the testing firmly stated that they would like to continue planting GSR in their farms, even without any external support for buying improved seeds or other inputs. More than 60 percent of the farmers suggested introducing GSR to other farms, provided that adequate training is carried out when inputs are distributed. Interviews with farmers emphasized that GSR brings environmental co-benefits. With the adoption of GSR and after appropriate training, farmers use a much larger share of organic inputs than before. Lower use of chemical inputs would have a positive impact on soil quality and ecosystems.

Crops good practice packages

Interventions that combined multiple complementary good practices to maximize benefits and DRR potential were defined in this study as "good practice packages". In the crop sector, the analysis focused on three packages that aimed to increase soil moisture and water retention for crop production during dry seasons or dry spells. The performance of the three packages described below was monitored on 54 small-scale farms.

GOOD PRACTICE DESCRIPTION	COUNTRY	MAIN HAZARD(S) ADDRESSED
coffee cultivation with mulching, digging of trenches for water retention, organic composting and planting of shade trees to keep soil moisture and reduce production losses due to dry spells, pests and diseases	**Uganda**	dry spells, pests, diseases
banana cultivation with mulching, digging of trenches for water retention, organic composting and improved varieties to keep soil moisture, increase productivity and reduce production losses in drought-prone areas	**Uganda**	dry spells
home vegetable gardening with rooftop water collection, drip irrigation and plastic mulching to keep soil moisture and reduce production losses in drought-prone areas	**Cambodia**	dry spells

banana cultivation with mulching, digging of trenches for water retention, organic composting and improved varieties to keep soil moisture, increase productivity and reduce production losses in drought-prone areas

Benefits of DRR good practice packages (crops)

NON-HAZARD

percentage increase in net economic benefits under non-hazard conditions, compared with usual practices — 317%

benefit-cost ratio under non-hazard conditions — 2.8

more production (% of respondents) — 77%

more income (% of respondents) — 84%

lower cost of inputs (% of respondents) — 79%

less labour (% of respondents) — 89%

better and more diverse food (% of respondents) — 47%

HAZARD

percentage increase in net economic benefits under hazard conditions, compared with usual practices — 341%

benefit-cost ratio under hazard conditions — 2.3

resilience score rated by adopters (1 to 5) — 4.7

safer livelihood practice (% of respondents) — 12%

more resistance to climate constraints (% of respondents) — 89%

Livestock good practice packages

In the livestock sector, the analysed good practice 'packages' involved three main elements, namely: infrastructure; improved management practices or improved breeds; and animal health. The performance of the six good practice packages described below was monitored on 151 small-scale farms.

GOOD PRACTICE DESCRIPTION	COUNTRY	MAIN HAZARD(S) ADDRESSED
cattle raising with zero grazing, improved cattle breeds and drought-tolerant fodder to enhance drought resilience of livestock raisers	**Uganda**	dry spells, diseases
chicken raising in chicken houses and improved chicken breeds to increase production and reduce production losses in drought-prone areas	**Uganda**	dry spells, diseases
chicken raising with improved chicken breeds and vaccination to increase production and reduce production losses in drought-prone areas	**Lao People's Democratic Republic**	dry spells, diseases
goat raising in controlled areas and vaccination to reduce production losses due to the spread of animal diseases	**Lao People's Democratic Republic**	diseases
camelid raising with livestock shelters (*corralones*) and veterinary pharmacies to reduce animal mortality due to heavy rains and diseases	**Bolivia**	heavy rains, diseases
cattle raising with livestock refuge mounds, deworming and preventive vitaminization to reduce animal mortality due to floods and diseases	**Bolivia**	floods, diseases

Benefits of DRR good practice packages (livestock)

NON-HAZARD

percentage increase in net economic benefits under non-hazard conditions, compared with usual practices 99%

benefit-cost ratio under non-hazard conditions 4.6

more production (% of respondents) 91%

more income (% of respondents) 55%

lower cost of inputs (% of respondents) 42%

less labour (% of respondents) 43%

better and more diverse food (% of respondents) 32%

HAZARD

percentage increase in net economic benefits under hazard conditions, compared with usual practices 103%

benefit-cost ratio under hazard conditions 4

resilience score rated by adopters (1 to 5) 4.9

safer livelihood practice (% of respondents) 56%

more resistance to climate constraints (% of respondents) 69%

chicken raising in chicken houses and improved chicken breeds to increase production and reduce production losses in drought-prone areas

Environmental co-benefits of DRR good practices

In addition to socio-economic and resilience benefits, the analysed DRR good practices bring a number of environmental co-benefits, thereby contributing to sustainable agricultural development.

Many of the analysed technologies contribute to easing pressure over water resources in drought-prone areas. For instance, rainwater harvesting in Uganda and Cambodia improved access to water for domestic use and reduced pressure on groundwater resources. In Cambodia, water use declined by four times after the introduction of drip irrigation systems, while the amount of fertilizers washed away decreased.

Soil quality benefitted from the introduction of DRR good practices in the crop and livestock sectors. The adoption of zero grazing in Uganda, for instance, helped reduce overgrazing and preserve soil fertility for crop production. Also, the adoption of organic pesticides and fertilizers reduced the use of chemical inputs in Cambodia, Lao People's Democratic Republic and Uganda, which in turn improved soil quality.

Early maturing crop varieties and fast-growing improved breeds helped cut down the amount of inputs required for agricultural production, thus reducing the environmental footprint of productive activities. For instance, fewer inputs (e.g., feed, water) were required to raise improved chicken breeds in Uganda and Lao People's Democratic Republic, as they grow faster than native chickens.

Finally, some good practices brought environmental co-benefits in terms of reduced pollution, carbon sequestration and lower emissions. For instance, the planting of shade trees in coffee plantations in Uganda and in silvopastoral systems in Bolivia contributed to increased carbon sequestration, while also preventing the deterioration of the nearby pasture and forest. Also, the use of fish pots in the Philippines reduced the number of boat trips required to harvest the fish, helping to cut down on diesel fuel and related pollution and increase emission reduction benefits.

Further analysis is required in order to assess the economic value of these environmental co-benefits.

rainwater harvesting improves access to water for domestic use and reduces pressure on groundwater resources. In Cambodia, water use declined by four times after the introduction of drip irrigation systems, while the amount of fertilizers washed away decreased

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Challenges and opportunities for upscaling DRR good practices

DRR agricultural good practices have the potential to significantly reduce damage and losses caused by natural hazards. To ensure that the largest number of small producers can strengthen their resilience and preserve their livelihoods, the most effective DRR good practices that have scope for wider replication should be identified and promoted. This requires an estimation of the potential added benefits, avoided losses and co-benefits coming from scaling up locally tested and validated practices at national or sub-national level.

As part of the study's pilot phase, good practice field plots and control plots were monitored during 2015 and 2016. The results are preliminary. In order to draw overarching conclusions on the scaling up potential of a good practice, additional data need to be collected from several consecutive seasons, and upscaling analyses and integrated assessments need to be conducted. This critical issue of "walking the next mile" is introduced in the preliminary case study on improved rice varieties in the Bicol region of the Philippines.

In addition, a sustainable and effective process for scaling up the most successful DRR good practices requires a combination of community-led initiatives and relevant institutional and policy processes that create the enabling conditions for wider dissemination and uptake.

the added value of DRR good practices is highly location and context specific; replication and upscaling should focus on the most effective DRR good practices that can be widely replicated and have the potential to significantly reduce damages and losses

the main challenges in scaling up and replicating DRR good practices include access to credit, markets, services and inputs by communities dependent on crops, livestock rearing, fisheries and aquaculture

Lessons learned and policy recommendations

Findings from the preliminary study show that the DRR good practices implemented in the five countries in three regions helped increase the resilience of small-scale agricultural livelihoods to various natural hazards in the following ways:

- Most of the analysed DRR good practices bring significant socioeconomic benefits compared to the usual practices according to the cost-benefit analyses based on the data collected from monitored agricultural households and in-depth interviews with farmers, livestock raisers and fishers.
- All of the farm level practices analysed are no-regret measures as they help increase agricultural productivity regardless of the occurrence of hazards.
- Most of the farm level DRR good practices bring environmental co-benefits, such as soil and water conservation, prevention of deforestation and reduction in greenhouse gas emissions. The environmental co-benefits should be fully considered in decision-making.
- On average, the analysed DRR good practices bring benefits 2.5 times higher than previously used practices in hazard conditions. The percentage increase in benefits varies significantly from practice to practice, ranging between 2% and 886%.
- What can be considered as DRR good practice in agriculture is highly specific to context and location. Not all practices have the potential for wider upscaling. The upscaling potential has to be assessed in a separate step.
- In order to replicate and scale up the DRR good practices and to realize the benefits at a larger scale, some challenges related to access of small scale producers to inputs and markets need to be addressed through relevant policies and adequate investments.

- Capacity development initiatives oriented towards the communities to sustain the established support services and prioritized technologies need to be strengthened. This should include adapting the technologies according to the different agro-ecological, geographical and socioeconomic contexts and cultural preferences; improve market regulations and access to credit to level the playing field for small producers; and provide continuous training on topics such as soil and water management, cultivation techniques, pest control, self-production of inputs and marketing.
- The regular monitoring and evaluation of DRR agricultural good practices at national level, and the systematic assessment and reporting on damages and losses caused by extreme events to the agricultural sectors, are essential to guide decision-makers in prioritizing investments that maximize the benefits of DRR good practices under both hazard and non-hazard conditions.
- Additional data collected over a longer period are needed to reinforce these findings.

cost-benefit analyses based on the quantitative data collected from monitored agricultural households and in-depth interviews with farmers, livestock raisers and fishers show that many of the analysed DRR practices bring significant economic benefits compared with the usual practices

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Annex 1. Overview of DRR good practices analysed as part of this study

Detailed information on each good practice including implementation guidelines is available on FAO's web platform on Technologies and Practices for Small Agricultural Producers (TECA): http://teca.fao.org/

Category	Country	Sector	DRR good practice	Usual practice	Season	Main hazard(s) addressed
Agriculture-related infrastructure and equipment for improved resilience	Philippines	Fisheries/ aquaculture	Fish pots as passive fishing gear to prevent fish losses in case of extreme events **http://teca.fao.org/read/8939**	Bottom set longlines	Dry and wet seasons	strong winds
	Uganda	Crops	Rooftop water harvesting and water storage tanks for tomato production **http://teca.fao.org/read/8922**	Tomato growing without rainwater harvesting and water storage tanks	Dry season	dry spells
	Uganda	Crops	Rooftop water harvesting and water storage tanks for cabbage production **http://teca.fao.org/read/8932**	Cabbage growing without rainwater harvesting and water storage tanks	Dry season	dry spells
	Uganda	Crops	Rooftop water harvesting and water storage tanks for Ntula production **http://teca.fao.org/read/8924**	Ntula growing without rainwater harvesting and water storage tanks	Dry season	dry spells
Agronomic practices and livelihood diversification	Cambodia	Crops	Home gardening with botanical pesticide and liquid compost **http://teca.fao.org/read/8925**	Home gardening	Wet season	pests, dry spells
	Lao PDR*	Crops	Indoor mushroom production for livelihood diversification **http://teca.fao.org/read/8945**	n/a (opportunity cost of labour)	Dry season	dry spells
	Lao PDR*	Crops	Application of guano fertilizer to keep moisture and improve soil fertility in paddy fields **http://teca.fao.org/read/8946**	Local rice varieties	Wet and dry seasons	dry spells
	Uganda	Crops	Indoor mushroom production for livelihood diversification **http://teca.fao.org/read/8933**	n/a (opportunity cost of labour)	Dry season	dry spells
	Bolivia	Livestock	Cattle raising in silvopastoral systems **http://teca.fao.org/read/8954**	Cattle raising with no silvopastoral systems	Dry season	drought
Improved drought- and/ or flood-tolerant varieties and species	Philippines	Crops	Multi-stress tolerant Green Super Rice varieties **http://teca.fao.org/read/8935**	Local rice varieties	Dry and wet seasons	dry spells
	Lao PDR*	Crops	Early maturing rice varieties **http://teca.fao.org/read/8943**	Local rice varieties	Wet and dry seasons	dry spells
	Lao PDR*	Crops	Flood-tolerant rice **http://teca.fao.org/read/8944**	Local rice varieties	Wet season	floods
	Lao PDR*	Fisheries/ aquaculture	Drought-tolerant aquaculture species **http://teca.fao.org/read/8940**	Usual aquaculture species	Wet and dry seasons	dry spells

Improved drought- and/ or flood-tolerant varieties and species	Uganda	Crops	Multi-stress tolerant bean varieties **http://teca.fao.org/read/8919**	Local bean varieties	Dry season	dry spells
	Uganda	Crops	Improved maize varieties **http://teca.fao.org/read/8920**	Local maize varieties	Dry season	dry spells
	Bolivia	Crops	Early maturing cassava variety **http://teca.fao.org/read/8952**	Local cassava variety	Dry season	floods
Crops DRR good practice packages	Cambodia	Crops	Home vegetable gardening with rooftop water collection, drip irrigation and plastic mulching **http://teca.fao.org/read/8934**	Home gardening with no rooftop water collection, no drip irrigation and no plastic mulching.	Wet season	dry spells
	Uganda	Crops	Coffee cultivation with mulching, digging of trenches for water retention, organic composting and planting of shade trees **http://teca.fao.org/read/8928**	Coffee cultivation with no mulching, no trenches, no organic composting and no shade trees	Dry season	dry spells
	Uganda	Crops	Banana cultivation with mulching, digging of trenches for water retention, organic composting and improved varieties **http://teca.fao.org/read/8947**	Local banana varieties, no mulching, no trenches, no organic composting	Dry season	dry spells
Livestock DRR good practice packages	Lao PDR*	Livestock	Chicken raising with improved chicken breeds and vaccination **http://teca.fao.org/read/8941**	Chicken raising local breeds	Wet and dry seasons	diseases
	Lao PDR*	Livestock	Goat raising in controlled areas, and vaccination **http://teca.fao.org/read/8937**	Free roaming goats	Wet and dry seasons	diseases
	Uganda	Livestock	Cattle raising with zero grazing, improved cattle breeds and drought-tolerant fodder **http://teca.fao.org/read/8926**	Free ranging cattle, local breeds	Dry season	dry spells and diseases
	Uganda	Livestock	Chicken raising in chicken houses and improved chicken breeds **http://teca.fao.org/read/8938**	Free ranging chicken, local breeds	Dry season	dry spells and diseases
	Bolivia	Livestock	Camelid raising with livestock shelters (corralones) and veterinary pharmacies **http://teca.fao.org/read/8931**	Camelid raising without shelters nor veterinary pharmacies	Dry season	frost and snow
	Bolivia	Livestock	Cattle raising with livestock refuge mounds, deworming and preventive vitaminization **http://teca.fao.org/read/8951**	Cattle raising without refuge mounds, deworming or vitaminization	Dry season	floods

* Lao People's Democratic Republic

www.fao.org/resilience

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