Department of Environment and Natural Resources, Republic of the Philippines

Design of an Adaptation Oriented NAMA Option for the Rice Sector in the Philippines
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Table of Contents

LOGO

LOGO

List of Tables

List of Figures

LOGO

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List of Acronyms

ACPC	Agricultural Policy Council
AWD	Alternate Wetting and Drying
BAS	Bureau of Agricultural Statistics
BSWM	Bureau of Soils and Water Management
CALF	Comprehensive Agricultural Loan Fund
CARP	Comprehensive Agrarian Reform Program
CCC	Climate Change Commission
CDA	Cooperative Development Authority
CDM	Clean Development Mechanism
CIS	Communal Irrigation System
COP	Conference of Parties (to the United Nations Framework Convention on Climate Change)
DA	Department of Agriculture
DNA	Designated National Authority (for the CDM)
DS	Dry Season
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IA	Irrigators' Association
IRRI	International Rice Research Institute
ISF	Irrigation Service Fee
MRV	Measurement, Reporting and Verification
NAI	Nationally Appropriate Improvements
NAMA	Nationally Appropriate Mitigation Actions
NCCAP	National Climate Change Action Plan
NFSCC	National Framework Strategy on Climate Change
NIA	National Irrigation Administration
NIS	National Irrigation System
PCIC	Philippine Crop Insurance Corporation
PHP	Philippine Peso
PVC	Polyvinyl chloride
PhilRIce	Philippine Rice Research Institute
SD	Sustainable Development
SEC	Securities Exchange Commission
SWOT	Strengths, Weaknesses, Opportunities and Threats
USD	United States Dollar
VND	Vietnamese Dong
WS	Wet Season
WST	Water Saving Technology

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Introduction

Negotiations pursuant to the Bali Action Plan at COP 18 in Doha (2012) confirmed that developing country Parties will take **Nationally Appropriate Mitigation Actions (NAMAs)** in the context of sustainable development, supported and enabled by technology, financing and capacity-building, aimed at achieving a deviation in GHG emissions relative to 'business as usual' emissions in 2020.

NAMAs are diverse and range from project based mitigation actions to economy-wide emission reduction objectives. Compared to the Clean Development Mechanism, which depends heavily on the international demand of carbon credits and the emission reductions achieved by individual projects, NAMAs do not follow strictly defined rules and aim at reflecting the national circumstances in each country, thus offering more flexibility in mobilizing resources, especially in sectors that have remained underrepresented within the Kyoto Protocol framework.

An open invitation for countries to communicate NAMAs aimed at achieving deviation from business as usual emissions is included in decision 16/CP.1, paragraph 50. So far, fifty-seven countries as well as the African Group have done so. As part of the agreed outcome, the COP also decided to establish a registry to record information on NAMAs and support and to facilitate matching of NAMAs with support available[1].

This study will address the development of a NAMA option[2] in a sector that is normally associated with adaptation and food security - rice cultivation. The idea for this study originated in 2013, as part of the development of a standardized baseline for the rice sector in the Philippines, building on the existing CDM methodology AMS-III.AU. “Methane emission reduction by adjusted water management practice in rice cultivation”[3]. Although the methodology has been in place since 2011 and its latest version 3 even provided some global default emission reduction factors, interviews with various stakeholders and practitioners pointed out to the conclusion that it is extremely difficult to develop adjusted water management projects under the CDM framework. On one hand, the sector is heavily dominated by individual land owners that manage small plots of land and follow a deeply entrenched cultivation practice – continuous flooding of rice fields up to harvest. On the other hand, the CDM does not offer sufficient revenues and there are no policies or economic incentives for farmers in the Philippines to implement new or modified water management. Thus, a consensus started emerging that methane emissions in the rice sector can be tackled only under a holistic approach, such as NAMA, that introduces overall transformational changes and addresses a wide array of issues in the sector beyond GHG emission reductions.

This study aims to become the basis for the development of a fully-fledged NAMA Option to be developed and incorporated in the existing agricultural sector policies in the Philippines. The first chapter provides a brief country background of the Philippines, followed by an overview of the rice sector in Chapter 2. Chapter 3 provides a summary of possible interventions in the rice sector that can lead to methane emission reductions. Chapter 4 presents the NAMA Option proposal, while Chapter 5 describes the MRV framework addressing GHG emissions and sustainable development co-benefits. Finally, Chapter 6 analyzes the financing needs of the NAMA Option.

[1] http://www4.unfccc.int/sites/nama/SitePages/Home.aspx

[2] The term “NAMA option” will be used throughout this report, as in the Philippines a mitigation option can become NAMA only upon approval by the Climate Change Commission (CCC) of the Philippines.

[3] http://cdm.unfccc.int/methodologies/DB/D6MRRHNNU5RUHJXWKHN87IUXW5F5N0

Chapter 1: Country Background

1.1 Geography

The Republic of the Philippines is an island nation in Southeast Asia located in the western Pacific Ocean with a total land area of approximately 300,000 km^2. It is an archipelago of more than 7,100 islands, categorized into three main geographical regions, namely Luzon, Visayas and Mindanao. It is bounded by the South China Sea in the west, Philippine Sea and Pacific Ocean in the east, Sulu and Celebes Seas in the south, and Bashi Channel in the north. The Philippines is approximately 800 km away from the Asian mainland. Its northernmost islands are about 240 km south of Taiwan and the southernmost islands are about 24 km from the coast of the Island of Borneo (Kalimantan). 11 of its largest islands, namely Luzon, Mindanao, Negros, Samar, Palawan, Panay, Mindoro, Leyte, Cebu, Bohol and Masbate, contain 94 % of the total land area, and are characterized by large mountainous terrain, interior valleys and plains.

(Source: www.google.com/maps)

Figure 1: Map of the Philippines

1.2 Climate

The Philippine climate is tropical and maritime with average annual temperature of 26.6 ^{o}C, high humidity and abundant rainfall. Based on the amount of rainfall, there are two major seasons, the **rainy or wet**

season (WS) lasting from June to November and the **dry season (DS)** - from December to May. The dry season is further subdivided into the cool dry season from December to February, and the hot dry season from March to May. The coolest month fall in January with a mean temperature of 25.5 ^{o}C, while the warmest month is in May with a mean temperature of 28.3 ^{o}C.

The average annual rainfall of the Philippines is in the range of 965 mm to 4,064 mm and varies regionally depending upon the direction of the moisture-bearing winds and the location of the mountain systems. A great portion of the rainfall is also influenced by typhoons. Due to the Philippines' geographical setting, typhoon occurrences are high compared to other countries with annual average occurrence of 20 and the highest recorded number of 32 typhoons in year 1993.

1.3 Effects of Climate Change

The increasing mean temperatures and changes in the amount and intensity of rainfall, as well as the number of tropical cyclones indicate that the Philippines has already been affected by climate change. The figure below shows a raising temperature pattern in the Philippines through observed mean temperature anomalies (or departure from 1971-2000 normal values) during the period 1951-2010, indicating an increase of 0.648 ^{o}C or an average of 0.011 ^{o}C annually.

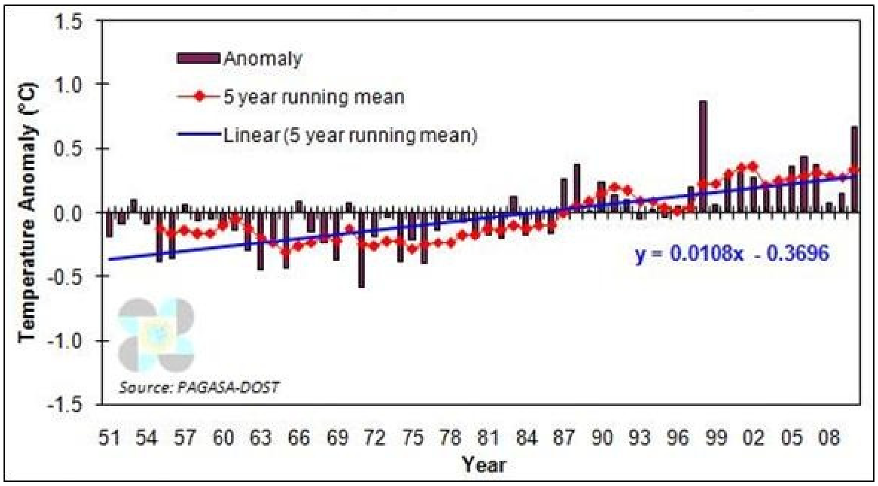

Figure 2: Observed annual mean temperature anomalies (1951-2010) in the Philippines

Agriculture is one of the sectors most affected by climate change. For example, increased temperatures result in decreased yield in crops due to spikelet sterility (no grain within the glumes). Additionally, increased frequency and strength of tropical cyclones can influence strongly agricultural production levels.

Climate change has been recognized as an issue of national importance in the Philippines. In response to the urgency for action, Republic Act 9729[4], also known as the Climate Change Act of 2009, was passed. The Act mandates the mainstreaming of climate change in policy formulation, so that policies and measures that address climate change are integrated in the development planning and sectoral decision-making. In

[4] http://www.lawphil.net/statutes/repacts/ra2009/ra_9729_2009.html

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April 2010, the National Framework Strategy on Climate Change[5] (NFSCC) was adopted and, based on its guiding principles, the National Climate Change Action Plan[6] (NCCAP) was formulated outlining the country's agenda for adaptation and mitigation for the period 2011-2028. Priorities and expected outcomes for the NCCAP are listed below.

Box 1: Priorities and Expected Outcomes of the NCCAP

- **Food Security** - The objective of the national strategic priority on food security is to ensure availability, stability, accessibility, and affordability of safe and healthy food amidst climate change.
- **Water Sufficiency** - In light of climate change, however, a comprehensive review and subsequent restructuring of the entire water sector governance is required. It is important as well to assess the resilience of major water resources and infrastructures, manage supply and demand, manage water quality, and promote conservation.
- **Ecological and Environmental Stability** - Ecosystem resilience and environmental stability during the plan period is focused on achieving one immediate outcome: the protection and rehabilitation of critical ecosystems, and the restoration of ecological services.
- **Human Security** - The objective of the human security agenda is to reduce the risks of women and men to climate change and disasters.
- **Climate-Friendly Industries and Services** - NCCAP prioritizes the creation of green and eco-jobs and sustainable consumption and production. It also focuses on the development of sustainable cities and municipalities.
- **Sustainable Energy** - NCCAP prioritizes the promotion and expansion of energy efficiency and conservation; the development of sustainable and renewable energy; environmentally sustainable transport; and climate-proofing and rehabilitation of energy systems infrastructures.
- Knowledge and Capacity Development - The priorities of the NCCAP on knowledge and capacity development are:
  - Enhanced knowledge on the science of climate change;
  - Enhanced capacity for climate change adaptation, mitigation and disaster risk reduction at the local and community level; and
  - Established gendered climate change knowledge management accessible to all sectors

1.4 Agriculture and Rice: A Macroeconomic View

[5] http://www.neda.gov.ph/wp-content/uploads/2013/10/nfscc_sgd.pdf
[6] http://adaptationmarketplace.org/data/library-documents/NCCAP_TechDoc.pdf

Although the Philippine economy has been transitioning to services and manufacturing due to accelerated industrialization, agriculture still plays a significant role. The Philippines employs about 12 million people in the agricultural sector out of its total labor force of approximately 40 million people. In 2012, the country's Gross Domestic Product (GDP) grew by 6.81 % and the agricultural sector accounted for 11 % of the GDP. The figure below shows the composition of the GDP as of 2012.

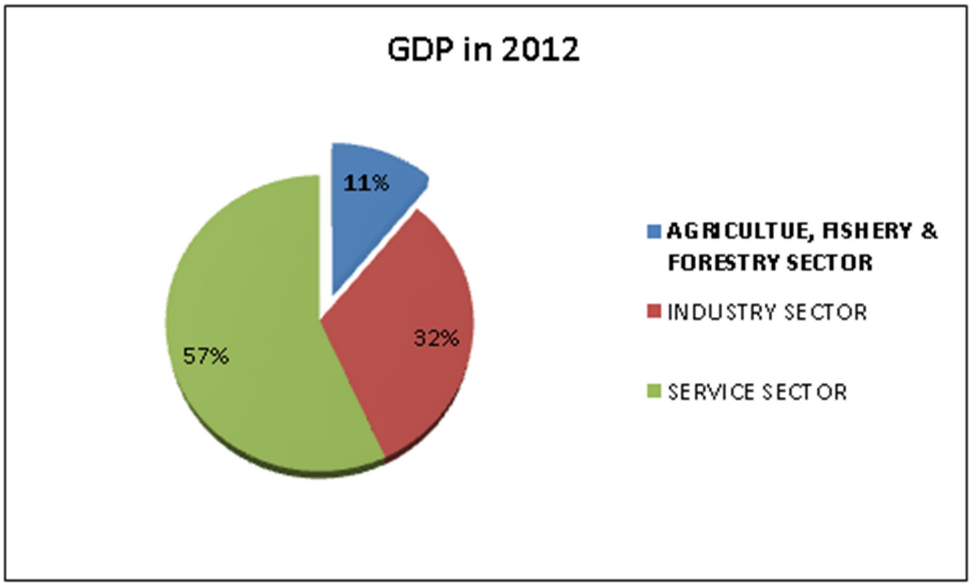

Figure 3: Philippine GDP in the Year 2012

Rice is considered the most important agricultural product in the country and is a staple food. The Philippines was the 8th largest rice producer in the world in 2012 with about 18 million tons of rice produced, as shown in the table below.

Table 1: Rice Production by Country in 2012

Country	Rice Production (mill. tons)
China	206.0
India	153.0
Indonesia	69.0
Viet Nam	43.7
Thailand	37.8
Bangladesh	33.9
Myanmar	33.0
Philippines	**18.0**
Brazil	11.5
Japan	10.7

However, in terms of food security, Philippines still remains extremely vulnerable. With a population of over 92 million as of 2010, rising at an average rate of more than 2 % per year, the amount of rice produced relative to domestic consumption remains insufficient. The Philippines need to compensate for that through imports. In 2010 it ranked top in the world among rice importers and the fourth largest in 2012 (See the table below). Therefore, any future policies in the sector need to aim at increased and sustainable domestic production, while taking into consideration the possible adverse effects of climate change.

Table 2: Rice Import by Country in 2012

Country	Rice Import (mill. tons)
Nigeria	2.7
China	2.4
Iran	1.7
Philippines	**1.5**
Iraq	1.5
Saudi Arabia	1.2
Ivory Coast	1.1
Malaysia	1.1
Senegal	1.0
South Africa	1.0

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Chapter 2: Rice Sector in the Philippines

2.1 Organizational Structure of the Rice Sector

Rice cultivation in the Philippines is governed by the **Department of Agriculture (DA)**[7], an executive department of the Government of the Philippines responsible for the promotion of agricultural and fisheries development and growth. Programs in rice production have been implemented by DA to increase yield and to attain rice self-sufficiency. However, the latter goal has not been reached so far due to the decreasing area planted with rice brought by urbanization and land conversions, as well as limited availability of irrigation water during the dry season.

Most of the rice production land in the Philippines is owned by individual farmers, who gained ownership a result of the **Comprehensive Agrarian Reform Program (CARP)** adopted by the Government of the Philippines in 1988. Under this program, tracks of land or *haciendas* were distributed to farmers. The program limits land ownership to a maximum of 3 ha for irrigated and 7 ha for rain-fed farms per individual. Currently, the average land holding stays at about 1.2 ha per farmer in irrigated ecosystems.

Under previous land reform programs from the 1970's, farmers were organized into **"agricultural cooperatives"**. These cooperatives were registered with the **Cooperative Development Authority (CDA)**[8]**.** Cooperatives were given capacity building interventions and trainings to operate as small farming enterprises and also to master new rice and other crop production technologies. The cooperatives were provided with agricultural production loans by government-owned banks at minimal interest rates. However, most of these cooperatives defaulted in the repayments of their loans and, at present, there are very few remaining in the country.

As an alternative to the cooperatives, farmers in the irrigated ecosystems, **national irrigation systems (NIS)** and **communal irrigations systems (CIS)**, are currently organized into water users' associations or **Irrigators' Associations (IAs)**. To date, there are about 5,320 IAs in the country, representing farmers from the irrigated ecosystem both from the national (2,460) and communal (2,860) irrigation systems.

Such organizational structure was originally envisioned to empower farmers and transform the IAs into independent bodies, so that in the future, they could manage a portion of the irrigation system and perform the delivery and allocation of the irrigation water within the boundaries of laterals or sub-laterals. The IAs are registered with **the Securities and Exchange Commission (SEC)**[9] and enter into maintenance contracts with the **National Irrigation Administration (NIA)**[10], the agency that manages the national irrigation systems.

Most of the data related to agricultural activities in the Philippines is collected by the **Bureau of Agricultural Statistics**[11] (BAS). It is an agency under the DA and a central information source for statistics on agriculture, fishery and related fields. In the rice production sector, several statistical information are publicly available, including rice production, rice harvested area, irrigated area and others.

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[7] http://www.da.gov.ph/

[8] http://www.cda.gov.ph/

[9] http://www.sec.gov.ph/

[10] www.nia.gov.ph

[11] http://www.bas.gov.ph/

Philippines is in the advantageous position to host two major rice research institutes on its territory, the **International Rice Research Institute**[12] **(IRRI)** and the **Philippine Rice Research Institute**[13] **(PhilRice)**. IRRI was established in 1959 and is the global knowledge hub for rice cultivation. The institute has been promoting for many years improved water management as part of adaptation and mitigation strategies in rice cultivation and has been pioneering the research in this area. PhilRice, on the other hand, is a national research and development institute established under the DA in 1986 for the purpose of supporting sustainable rice production in the Philippines. The institute has been partnering with IRRI on the issues related to water management and irrigation and is one of the strongest advocates of the introduction of improved irrigation practices across the Philippines.

2.2 Types of Ecosystems and Cultivation Practice

2.2.1 Types of Ecosystems and Their Share

In the Philippines, there are 3,019,609 ha of irrigable area, out of which only 1,678,595 ha (55.58 %) are irrigated. Of these, 740,214 ha (44.09 %) belong to the NIS, while 576,419 ha (34.33 %) are CIS, and the remaining 361,962 ha (21.56 %) are privately owned irrigation systems. In 2013, the total area harvested during the dry season (DS) was 2,043,746 ha, where 1,526,057 ha (74.66 %) were under the irrigated ecosystems and the remaining 517,689 ha (25.34 %) were under rain-fed ecosystems. In the same year for the wet season (WS) crop, total harvested area was recorded at 2,702,337 ha, where 1,710,280 ha (63.28 %) were irrigated and 992,057 ha (36.72 %) were rain-fed[14]. It is noted that in 2013 the area harvested was approximately 658,591 ha more during the WS or 32.22 % higher compared to the DS of the same year. The lower harvested area during the DS crop can be attributed to the decrease or limited irrigation water in both ecosystems during the first and second quarters of the year.

2.2.2 Cultivation Practice

Rice cultivation in the Philippines follows the practices in irrigated lowland culture. The soil is soaked to make it workable for plowing and subsequently for harrowing. Five to seven days intervals between plowing, first harrowing and second harrowing are observed to allow weeds and rice stubbles to be incorporated into the soil and decompose. Final harrowing and leveling is done one day before transplanting or broadcasting of seeds (for direct seeded rice).

In an attempt to introduce new technologies to the rice sector, the Philippine Rice Research Institute[15] (PhilRice) published in 2007 a handbook entitled “PalayCheck System for Irrigated Lowland Rice” which was patterned with the “RiceCheck” in Australia. The handbook aims at of the dissemination of information on new cultivation practices including water management and was subsequently adopted by the Department of Agriculture (DA) in its national Rice Programs. However, due to the lack of additional incentives and training for farmers, it is still not widely applied, leaving continuous flooding the predominant cultivation practice.

[12] http://irri.org/

[13] http://www.philrice.gov.ph/

[14] 2013 Country Statistics, Philippines

[15] http://www.philrice.gov.ph/

A brief summary of “PalayCheck” is provided in the following box.

Box 2: *PalayCheck* Outline

PalayCheck is a dynamic rice crop management system that presents the best key technology and management practices as Key Checks; compares farmers’ practices with the best practices; and learns through farmers’ discussion group to sustain improvement in productivity, profitability, and environment safety. *PalayCheck* is simply “learning, checking, and sharing for best farming practice”.

PalayCheck is Rice Integrated Crop Management (RICM) System. RICM recognizes that rice growing is a production system consisting of a range of factors that are interdependent and interrelated in their impact on the growth, yield, and rice and rice grain quality and on the sustainability of the environment. It dictates that technology recommendations for yield improvement be developed and transferred to farmers as a holistic and integrated package and not by components such as integrated nutrient management (INM) or integrated pest management (IPM).

PalayCheck covers the principal areas of crop management such as seed quality, land preparation, crop establishment, nutrient management, water management, pest management, and harvest management.

(Source: 2007 PhilRice).

2.3 Irrigation Systems and Water Management

Irrigation plays a central role in rice production and the proper operation of the irrigation systems is the major task of the NIA. The viability of a NIS is dependent on the ability of the NIA to collect **Irrigation Service Fee (ISF)** from the farmers it serves. The current **irrigation service fee (ISF) collected from farmers is levied based on the irrigated area, not on the amount of water used**, and varies depending on the type of irrigation system (e.g. pumps, reservoir, diversion). The ISF ranges from 2 to 22 bags[16] of *palay* (rice) per hectare per cropping season (See Table 3). **Thus, the way the ISF is currently set provides no economic incentives to farmers to introduce water saving technologies.**

[16] At 50 kg per bag and a support price of 17.00 PHP/kg.

Table 3: Irrigation Fees in the Philippines

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IRRIGATION SERVICE FEE FOR DIVERSION, RESERVOIR AND IRRIGATION SYSTEMS

SCHEME/CROP		WET SEASON	DRY SEASON	THIRD CROP
		CAVANS PER HECTARE		
	DIVERSION			
	Rice	2	3	3
	Other Crops	60% of the rate for rice		
	Annual Crops	7.5		
A.	Fishponds	5	5	5
	RESERVOIR/STORAGE			
	MARIIS	3	3	3
	UPRIIS	2.5	3.5	3.5
	Other Crops	60% of the rate for rice		
	Annual Crops	7.5		
B.	Fishponds	6	6	6
	PUMPS			
	Rice	5.0 - 10.0	6.0 - 12.0	6.0 - 12.0
	Other Crops	60% of the rate for rice		
	Annual Crops	7.5		
C.	Fishponds	15	15	15

IRRIGATION SERVICE FEE RATES FORNATIONAL PUMP IRRIGATION SYSTEMS

REGION	PUMP IRRIGATION SYSTEM (PIS)	NATIONAL IRRIGATION SYSTEM (NIS)	ISF RATE	
			WET SEASON	DRY SEASON
			CAVANS PER HECTARE	
1	Bonga Pump No. 1	Ilocos Norte Irrigation System (INIS)	8	12
1	Bonga Pump No. 2	INIS	8	12
1	Bonga Pump No. 3	INIS	8	12
2	Iguig-Alcala-Amulung	Iguig-Alcala-Amulung PIS	4	4
2	Solana	Solana PIS	5	5
2	Magapit	Magapit PIS	3.75	3.75
2	MRIIS Pump No. 1	Magat River Integrated Irrigation Systems	3	3.5
2	MRIIS Pump No. 2 & 3	MRIIS	3	3.5
3	Turbine Pump	AMRIS	P 3,000/ha	P 3,500/ha
3	Bunay	AMRIS	P 1,800/ha	P 5,000/ha
3	Kapatiran	AMRIS	P 1,500/ha	P 3,200/ha
3	Tibagan	AMRIS	2.5	3.5
3	Bustos-Pandi	AMRIS	2.5	2.75
3	Buenavista	AMRIS	2	3
3	Penaranda	Upper Pampanga River Integrated System	7	10
3	Nueva Ecija	Nueva Ecija PIS	22	22
4	Cabuyao East	Laguna Friar Lands Irrigation System	6	8
4	Dambu	Sta. Maria-Mayor River Irrigation System	No pump operation	10
5	Libmanan-Cabusao	Libmanan-Cabusao PIS	3	3
13	Lower Agusan	Lower Agusan River PIS	2.75	2.75

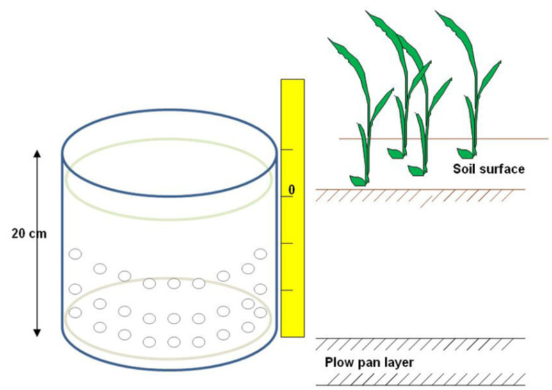
The willingness of farmers to pay their irrigation service fee is largely dependent on how much yield they get from their farm and the degree of satisfaction they receive from the irrigation service provided to them. With inequitable distribution of irrigation water within the system (national and communal) and even within the irrigators associations, getting higher service fee collection rates is still unattainable.

The establishment of irrigators associations was expected to become a solution for even distribution of irrigation water among farmers and provision of better irrigation services. Farmers were thought to be able to agree among themselves as of how to equitably allocate the irrigation water in order to serve every irrigation association member. However, the situation did not improve, i.e. too much water in farms at the upstream and too little or no water at all at the tail-end is still observed, leading to persistent conflicts among farmers.

Several programs have been designed to allow **downstream farmers to be served first**, but this mode proved to be unsustainable since upstream farmers will still tend to draw water at their own convenience.

Another approach implemented on an experimental basis in some pump systems in Cagayan Valley in Luzon and on Bohol Island in Visayas was the **"volumetric" pricing**. Under this scheme, water diverted from the canal is measured and corresponding cost per unit volume was determined. However, implementation of this scheme is inappropriate nationwide since most of the canals in the secondary and tertiary levels are unlined and dilapidated or without control structures.

Alternative schemes emerged from research and development efforts aimed at **"producing more with less water"**. One example of this is **"Alternate Wetting and Drying" (AWD)**, which deviates from the continuously flooding of the field from transplanting up to two weeks before harvest. AWD is a water management technology that uses a simple tool to guide the farmer to determine the right time to irrigate and the right amount of water to apply.



Source: IRRI

Figure 4: Use of PVC Tube for AWD

The simple tool is a perforated 10 cm x 25 cm polyvinyl chloride (PVC) tube that is inserted 15 cm to the ground during the dry season and 20 cm during the wet season. Irrigation water of 5 cm over the soil surface is applied and allowed to recede. Irrigation water is again applied when there is no more water inside the PVC tube. The AWD scheme is implemented at about 20 days after transplanting or sowing for direct seeded rice. However, during fertilizer application and panicle initiation to flowering, sufficient water must be maintained at 3-5 cm. When AWD is observed, the number of irrigation events in a season ranges from 4-6 times only. This scheme achieves water saving up to 30 % and can results in significant adaptation and sustainability improvements resulting from the change in rice cultivation practice, i.e. leading to more efficient use of water resource translating to more irrigated rice fields, and ultimately, better food security from increased rice production.

Box 3: Example of AWD Implementation

In 2001, the International Rice Research Institute (IRRI) together with the National Irrigation Administration (NIA) and the Philippine Rice Research Institute (PhilRice) implemented a project funded by the Asian Development Bank entitled "Technology Transfer on Water Saving". It was implemented in Tarlac, Central Luzon, Philippines in GP 125 pump irrigation system with 32.7 hectares service area. The performance of pump system was recorded as follows: with the same service area and pump discharge, the pumping hours per hectare per season was reduced from 22-28 without AWD to only 13 – 16 with AWD and the irrigation time per hectare also reduced from 6 to 8 hours without AWD to only 3 to 6 hours per hectare with AWD. Statistically, there was no significant difference between the yield of the AWD plots and non AWD plots. At this time the farmers serviced by the pump irrigation system in the province adopted AWD and saved water and directly saved money which was due to reduced use of electricity or diesel fuel that runs the engine.

The biggest challenge with AWD technology is its application to the national irrigation systems which serve the irrigated ecosystems. A demonstration pilot project was carried out in 2007 at the Upper Pampanga River Integrated Irrigation System (UPRIIS) with the Pantabangan Dam and reservoir as main source of irrigation. It has a service area of about 100,000 hectares. The result of the demonstration trial was successful and sufficient to convince the National Rice Program and later the Department of Agriculture to come up with a Technical Working Group to formulate implementing guidelines for adopting water saving technologies for rice in the Philippines.

On September 11, 2009, the Department of Agriculture issued DA Administrative Order 25 "Guidelines on the Adoption of Water Saving Technologies (WST) in Irrigated Rice Production Systems in the Philippines"[17]. This is the only existing policy document as of now to support the implementation of AWD, however, it has not been enforced. Thus, **currently there is no enforced policy at any level that supports the dissemination of AWD in rice production**.

2.4 Funding Sources for Agricultural Activities

Implementation of any policies and measures in the agricultural sector depends also on funding availability. Funding can be broadly divided into governmental funding or subsidies and credit supply for agricultural activities.

[17] http://www.da.gov.ph/images/PDFFiles/LawsIssuances/AO/2009AO/ao25.pdf

2.4.1 Governmental Funding

Currently, the Government of the Philippines generally channels its financial assistance to farmers through the IAs. The major directions of government support in the past ten years are summarized below:

a) Provision or facilitating of access to high quality seeds (certified inbred seeds or hybrid seeds);
b) Subsidy on fertilizer (provision of one bag of urea per hectare);
c) Provision of soft loans on agricultural machineries at hugely subsidized rates (e.g. "Makina-Saka" Program where farmer organizations has to pay only 15 % of the cost of the equipment such as threshers, combine harvesters, tractors, etc.);
d) Rehabilitation and repair of irrigation facilities including provision of shallow tube wells for irrigation; and
e) Access to new technologies on rice production through trainings such as the conduct of Farmers' Field Schools (among others.

However, there is no assistance currently provided for the support of AWD introduction and improved water management.

2.4.2 Agricultural Credit

Agricultural credit has an important role in the development of the agriculture sector. However, agriculture's relative use of formal credit is much lower than that of the non-agricultural sector. The bulk of agricultural loans supplied by the banking systems were absorbed by commercial agriculture. Small scale agriculture sourced their loans mostly from informal lenders. As the Asian Development Bank (1990) reports, the volume of institutional credit to the agriculture sector is considered inadequate and the sector has received a much smaller share of formal credit than the non-agricultural sector. (Llanto 1993).

In the 1970s and 1980s, macro-economic policies tended to promote formal institutions as sources of credit. For instance, the abolition of share tenancy by the land reform of 1970s reduced the role of landlords as the main sources of credit (Land Bank and ACPC, 1997). On the other hand, the expansion of rural banks in the 1980s made formal financial institutions more accessible to rural borrowers. The early 1990s, however, were generally characterized by the return to the popularity of informal lenders, as banks eventually limited their exposure to farms. Thus the current lending system is not fully prepared to supply large and targeted credits for the rice sector transformation.

2.4.2.1 Formal Lenders

The formal lenders are composed of commercial banks, thrift and development banks, the rural banks and the credit guarantee institutions. Commercial agriculture, consisting of both medium and large scale individual and corporate borrowers, is served by all types of lenders in the formal sector.

The government banks involved in agricultural and rural credit are the Land Bank of the Philippines[18] and the Development Bank of the Philippines[19]. The credit supply of the Land Bank of the Philippines in the countryside increased tenfold from PHP 105.06 million in 1987 to PHP 2.8 billion in 1990 (Llanto 1993). The Land Bank achieved its phenomenal growth in agricultural lending (mainly to small agrarian reform

[18] https://www.landbank.com/
[19] https://www.devbnkphl.com/

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beneficiaries) by using cooperatives as loan conduits. The bank worked with private groups to help organize these cooperatives which, according to its latest report, totaled to some 5,000 during that time. The growth in Land Bank's agricultural credit was also due to its mandate to lend to agrarian reform beneficiaries. By the end of 1990, the Land Bank delivered credit to 305,156 farmers through 2,879 cooperatives. However, the number of cooperatives to date has tremendously declined and most became non-operational and with outstanding loans with the Land Bank. At present, IAs are replacing the cooperatives as borrowers from the bank.

A new emerging entity in the formal lending system is the credit guarantee institution (CGI). The following CGIs are currently operating:

1) Philippine Crop Insurance Corporation [20] (PCIC) which is used by the Comprehensive Agricultural Loan Fund (CALF) to guarantee the production credit of small farmers;
2) Quedan Rural Credit and Guarantee Corporation[21] (Quedancor), which provides a guarantee cover to inventory financing and the
3) Small Business Corporation (SBC)[22] which provides a credit guarantee to small and medium-sized firms/enterprises.

The CALF is managed by the Agricultural Policy Council (ACPC) of the DA which oversees the credit guarantee operations of these three institutions and pays the guarantee calls submitted by the banks through the PCIC, Quedancor and SBC. The credit guarantee covers up to 85 % of the total amount of loan (Llanto 1993).

2.4.2.2 Informal Lenders

The second source of agricultural credit is the informal sector. The informal sector is composed of the informal money lenders (such as traders, millers, large farmers, friends, relatives, landowners and recently, overseas contract workers), the credit unions and credit cooperatives, rotating savings and loans associations. The informal lenders usually serve the financing requirements of small scale and subsistence agriculture and the majority of small rural borrowers.

It was reported by Llanto (1990) that despite the recent growth of formal credit to agriculture, the informal sector continues to be a critical feature of rural credit markets. The majority of rural borrowers in the Philippines, as in many developing countries, has always depended on informal lenders. Unfortunately, there are no organized and systematic data on the informal lenders to help us assess their relative importance to the agriculture sector. Anecdotal evidence and several local surveys, however, point to their ability to operate in certain areas and for specific clientele that banks fail to serve.

2.5 SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis

This section provides a summary of the observations in this chapter and summarizes the findings in a simple SWOT diagram.

The rice sector in the Philippines occupies a large share of the national economy and has a well-established organizational structure that can be used for carrying out any potential interventions. It also has

[20] http://pcic.gov.ph/
[21] http://www.quedancor.gov.ph/
[22] http://www.sbgfc.org.ph/

ready access to the established knowledge base within IRRI and PhilRice, which allows it to stay abreast with the most recent scientific advances in rice cultivation.

On the other hand, the sector does not produce sufficient amounts of rice to meet the domestic consumption. This can be further aggravated by the advances of climate change, especially through changing weather patterns and water shortages. Improved irrigation practices can be one potential solution for overcoming the sectors' weaknesses and improving its management. However, the lack of targeted government policies and lack of funding is still an impediment for the fast dissemination of such approaches.

The analysis of the various aspects of rice cultivation in the Philippines is summarized in a SWOT diagram below.

Strengths	Weaknesses
- Share of the sector in the Philippine economy - Strong knowledge base within IRRI and PhilRice - Established organizational structure	- Lack of targeted policy for water management improvement - Lack of targeted funding for water management improvement - Insufficient domestic rice production
Opportunities	**Threats**
- Introduction of new irrigation practices - Overall improvement of the sector management	- Climate change (water shortage, changing weather patterns) - Food security (increasing international food prices)

Figure 5: SWOT Analysis of the Rice Sector in the Philippines

Chapter 3: Mitigation Options for the Rice Sector

3.1 GHG Emissions in Rice Cultivation

Agriculture contributes to more than 30 % of the GHG emissions in the Philippines and is the second largest GHG emission source in the country[23]. Among the agricultural emission sources, rice cultivation occupies the top position. There are two main sources of GHG emissions from rice cultivation:

1) Methane from decomposition of organic material in the soil in flooded rice fields; and
2) Methane emissions from anaerobic decomposition of rice straw and rice husk.

Box 4: Methane Formation in Rice Fields

Paddy fields are considered to be an important anthropogenic source of atmospheric CH4. The main vectors behind methane emissions from paddy rice fields are methanogenic (methane forming) bacteria (Epule, 2011). The bacteria perform well under anaerobic conditions and are responsible for harvesting organic carbon and transforming it into methane through the process of methanogenesis (Bloom & Swisher, 2010). The anaerobic conditions are the biochemical pathways of methane production (Epule, 2011). Methane is vertically transported to the atmosphere through three main pathways. These pathways include a) diffusion of dissolved methane, b) the emergence of bubbles triggered by soil fauna and crop management procedures, and c) finally plant transport by diffusion into the roots and conversion to gaseous methane in the cortex and aerenchyma and subsequent release of methane to the atmosphere through plant micropores (Wassmann et al. 1993).

The emergence of the Clean Development Mechanism (CDM) in the Philippines provided a boost for mitigation activities in the agriculture sector. However, all of the developed projects relating to the agricultural sector involve methane emissions avoidance from anaerobic decomposition of agricultural wastes (rice husk and straw) and their use as an alternative energy source. Methane emissions resulting from the anaerobic decomposition of organic matter in the rice fields due to flooding practices have received little to no attention, despite the existence of an approved methodology, AMS-III.AU., “Methane emission reduction by adjusted water management practice in rice cultivation”[24].

3.2 Mitigation Activities in Rice Cultivation

[23] http://unfccc.int/resource/docs/natc/phinc1.pdf
[24] http://cdm.unfccc.int/methodologies/DB/D6MRRHNNU5RUHJXWKHN87IUXW5F5N0

Several measures are considered effective in reducing methane formation and the amount of methane released into soil and subsequently into the atmosphere, including the following:

a) Modification of water management, allowing for shorter periods of rice field flooding and better soil aeration;
b) Selection of nitrogen fertilizer source, soil amendments, and organic fertilizers, which reduce the formation of methane;
c) Choice of cultivars that result in lower volumes of methane formation;
d) Use of biochar, which, when added to the soil, can improve soil health and be used as carbon storage; and
e) Plant population and density management, as higher plan density tends increase methane flux.

A description of each of the measures is provided in the ensuing sections.

3.2.1 Water Management

Methane emission rates vary markedly with water regimes. A **single midseason drainage** may reduce seasonal emission rates by about 50 % (Sass et.al. 1992; Kimura 1992). Midseason drainage resulted in a decrease of CH_4 flux by 65% without straw (Zou et al 2005). Yang and Chang (2001) also reported that CH_4 emissions were reduced in the intermittent irrigation system compared with the continuously flooded paddies. A net reduction of CH_4 emissions will only be achieved if soils become fully aerated. Increasing percolating rates of water may supply enough oxygen to the soil to raise the Eh, decrease CH_4 production, and increase CH_4 oxidation.

Status of AWD Dissemination

IRRI (2008) reported that AWD as a water management strategy is widely used in China, and is rapidly being adopted in Vietnam, Bangladesh, Myanmar, and Indonesia.

In the **Philippines,** validation and promotion of AWD with the national agricultural research and extension systems and their partners started in 2001 in pump irrigation systems in Tarlac Province. The experience was positive, as the introduction of AWD translated into direct fuel savings from the reduced operation of irrigation pumps.

Since 2005, the technology was attempted to be spread to gravity irrigation systems. Big national irrigation systems such as the Upper Pampanga River Integrated Irrigation System and the Magat River Integrated Irrigation System, both in Luzon, have started piloting AWD as an irrigation management scheme in selected service areas of the system. From the combined 160,000 farmers getting irrigation water from both gravity irrigation systems in these areas, 20 % were reported originally to be using AWD technology.

Experience with such pilot projects conducted in the past demonstrated that farmers are willing to follow water management programs during the duration of the pilot projects and while they receive continuous guidance with their performance being monitored, however, in the absence of incentives to support continuous water management after the end of the pilot projects, they tend to return back to continuous flooding. This should not come as a surprise, as continuous flooding has been the traditional practice and is perceived to be “risk-free” by most farmers. It also represents the most rational economic behavior under the current policy framework, because:

1) There are no particular economic gains associated with water management and switch to AWD, as farmers pay only a fixed irrigation fee depending on the irrigated area, but not on the amount of water used. The only exception is for pumped irrigation systems.
2) Water management and AWD can initially be more labor intensive, as it requires farmers to attend more often to the fields and strictly follow an established irrigation calendar up to harvest.

As of now, despite the few successful examples, only 0.04 % of all irrigated rice fields in the Philippines or 140,000 ha applied AWD in 2013.

In **Vietnam**, the dissemination of AWD started in 2005 in the Mekong Delta in collaboration with Vietnam's Plant Protection Department. AWD was integrated in the successful "Three reductions, three gains" program (Ba Giam, Ba Tang), an integrated crop management approach that became a national policy for Vietnam. Farmers who adopted and tried the technology confirmed that AWD reduced water consumption and pumping cost, with savings of about VND 200,000 (USD 13) per hectare and yields were relatively higher by a few percent compared to the regular practice. AWD was also introduced in other parts of Vietnam where water is scarcer than in the Mekong Delta. The lack of sufficient water resources made it easier for water management measures to spread and currently more than 5,000 farmers are estimated to have adopted the technology in Vietnam. Yet, this still constitutes less than 1 % of all farmers, emphasizing the need for more and targeted dissemination policies.

In other countries, AWD technology is still at the "techno-demo" stage. **Myanmar** and **Indonesia** are at piloting the technology in water scarce areas, which serve as "lighthouse" to disseminate AWD to the wider community.

Under AWD water saving conditions, methane emissions are likely to be reduced by more than 50 % and nitrous oxide (N_2O) emissions can be kept at level similar to that of a continuously flooded paddy system by adjusting the timing of nitrogen fertilizer application and irrigations. Generally, AWD as an effective and efficient technology not only increases rice production and helps conserve a limited resource, water, but also mitigates rice paddies' contribution to global warming. (IRRI 2008)

3.2.2. Other Options

Several other options are currently studied that may lead to reduction of methane emissions in rice cultivation. However, these options are not at a commercialization stage and have not been targeted under the current NAMA design. A brief summary of these options is provided in the next box with the hope that in the future they can find widespread practical application in bringing the agricultural sector to a more sustainable path.

Box 5: Other Mitigation Options in Rice Cultivation

Source of N fertilizer and soil amendments

The type of fertilizer as source of nitrogen affects methane gas emissions in rice paddies. Application of NPK @ 125:50:50 kg/ha with N as urea increased the methane flux while N as ammonium sulphate depressed it beyond 45 DAT (Abrol et.al. 1999). Moreover, combining gypsum with these nitrogenous fertilizers decreased the methane flux in general. Likewise, Corton et al. (2000) reported that using ammonium sulphate as source of nitrogen fertilizer rather than urea resulted in a 25-36% reduction in CH_4 emission. Application of phosphogypsum in combination with urea fertilizer also reduced CH_4 emissions by 72 %.

Choice of Cultivars

Wide variation in cumulative ammonium flux amongst rice cultivars has been reported. Methane emissions from eight rice cultivars grown under similar conditions differ by as much as by one order of magnitude. (Parashar et.al. 1991) Sapathy et.al. (1998) reported that the emissions range from 4.61 gm^2 20.25 $g/m^{2.}$ The cultivars could be classified into three groups on the basis of their methane flux potential. It was recommended that, a careful selection and breeding of cultivar is also an important mitigating factor of CH_4 (Epule, 2011). According to Wassman et al (1993), varieties that do not have well developed aerenchymal systems would also be a mitigation measure to reduce methane emissions to the atmosphere. This is because rice cultivars vary in their exudation of organic carbon and likewise their support of methanogenesis (Wassman et al 2002).

Use of biochar

Judicious biochar management may contribute to reduction of emissions by agricultural and active withdrawal of atmospheric carbon dioxide, as part of a comprehensive carbon management scheme in agricultural and forestry watersheds. Biochar is a carbon-rich organic material generated by heating biomass in the absence, or under limited supply of oxygen. Recently, interest has grown in understanding the potential of this process to improve soil health by adding biochar as an amendment to soil, to manage agricultural and forestry waste, to generate energy and to store carbon (Lehman and Joseph, 2009a).

Plant Population

Plant population and emissions are inter-related. It was observed that increasing plant densities enhanced the methane flux. It is likely that the roots of the plants concentrated over the area in the closer spacing foraged methane on a large scale compared to plants planted with a wider spacing. Flooded rice paddies are considered as one of the culprits in increasing the atmospheric concentration of methane. Submerged conditions which are predominantly anaerobic as encountered throughout the growing period of the rice plant or at some growth stages of the plant promote the production of methane, the end product of anaerobic decomposition of organic matter.

About 60-90% of the methane produced during a cropping season is oxidized when diffusing into the rice rhizosphere or into the aerobic flood water soil interface. Schutz et.al. (1989) as cited by Abrol et.al. observed a seasonal variation in oxidation rates. They found that during the early phase of the vegetation

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3.3 Estimation of Methane Emissions in the Rice Sector in the Philippines

Based this framework for GHG emission estimation described in Chapter 5, this section will provide an overall estimate of the methane emission baseline and methane emission reduction potential in the rice cultivation sector of the Philippines.

Analyzing the data for rice cultivation in 2013 presented in Chapter 2, it can be concluded that for most of the irrigated land in the Philippines double cropping is practiced for rice production. Thus, excluding the areas where AWD is already introduced, or 140,000 ha, it can be assumed that approximately 1,386,057 ha of land are used for double cropping in the wet and dry seasons, and only 184,233 ha are used for single cropping during the wet season. Following the formula described below and default baseline emission factors in Chapter 5, it is estimated that the actual baseline emissions from rice cultivation are approximately 48 million tCO_2e/year.

$$BE_s = \sum_{g=1}^{G} EF_{BL,s,g} * A_{s,g} * 10^{-3} * GWP_{CH4} \quad \textbf{(1)}$$

Where:

BE_s	Baseline emissions from project fields in season *s* (tCO_2e)
$EF_{BL,s,g}$	Baseline emission factor of group *g* in season *s* ($kgCH_4$/ha per season, use default values)
$A_{s,g}$	Area of project fields of group *g* in season *s* (ha)
GWP_{CH4}	Global warming potential of CH_4 (tCO_2e/tCH_4, use value of 25)
g	Group *g*, covers all project fields with the same cultivation pattern (*G* = total number of groups)

The introduction of AWD can significantly reduce these emission levels. If the Philippine rice sector manages to fully adopt AWD as a standard cultivation practice, it is estimated using the same approach as above, that approximately 23,217,300 tCO_2e/year of emission reductions can be achieved, which represents a 52 % reduction from the baseline level.

The ensuing chapters will discuss how the NAMA Option proposes to reach such emission reductions.

Chapter 4. Proposal for an Overall NAMA Option Design

4.1 NAMA Option Objectives and Targets

This NAMA Option targets all farmers in the Philippines cultivating rice at irrigated rice fields. It aims to design policy and economic incentives for farmers to switch to AWD and maintain that practice in the long run. In order for the NAMA to succeed, it will target the existing rice irrigation policy framework, while providing at the same time sufficient capacity building and knowledge dissemination for individual farmers. Carrying out both sets of interventions simultaneously is a prerequisite for the NAMA to bring the necessary sectoral transformations.

The NAMA will target a total of 1.7 mill. ha of irrigated rice fields across the whole country estimated to emit approximately 2,278 $ktCH_4$/yr or 56,967 $ktCO_2e$/yr. The introduction of AWD across continuously flooded irrigated rice fields in the whole of the Philippines has the potential of bringing approximately 27,344 $ktCO_2e$/yr of emission reductions. This will represent a sizable **mitigation effect** decreasing GHG emissions from rice cultivation by more than 50 %.

However, this NAMA will also result into **adaptation and food security benefits**. Although the Philippines is often perceived as a country with abundant water resources, climate change is expected to bring more unexpected weather patterns and droughts. Introducing proper water management will allow saving water and having **more resilient rice production** that is able to withstand these challenges.

In terms of food security, two aspects should be taken into consideration. On one hand, switch to AWD will allow an **increase in the total irrigated areas**, as more water will be available for irrigation. Some research and pilot projects also demonstrated that AWD does not lead to decrease in yield and in some cases can bring up to 5 % of yield increase. Thus the introduction of AWD can be expected to **allow for an increase** in rice production.

Finally, Philippine Rice Research Institute reported, based on pilot projects, that the introduction of AWD lead to decrease of conflicts between farmers. In farming communities, it is often the case that downstream farmers receive less water than upstream farmers, especially during the dry season. The introduction of water management practices allows for more even distribution of irrigated water among farmers, thus leading to **reduction, if not total elimination of conflicts**.

It is worth noticing that the current climate change policy in the Philippines targets agriculture under the country's overall adaptation framework. Some stakeholders voiced concerns as of whether the current activities should have been targeted under the NAMA, a mitigation approach. However, this NAMA can also be viewed as an adaptation activity with strong mitigation benefits, thus its development does not by any means contradict the established climate change policy approach in the Philippines.

The implementation timeline and the exact timing of individual interventions will be the scope of a detailed NAMA Option proposal.

4.2 Baseline Scenario

The baseline scenario will consist of two components, **GHG baseline and Sustainable Development (SD) baseline**. Setting the baseline in this way allows properly assessing the effects of the Nationally Appropriate Improvements (NAI) and quantifying them through the monitoring activities described in the MRV system.

The **GHG baseline** is the continuation of the current rice cultivation practice at irrigated rice fields in the Philippines, i.e. continuous flooding of rice fields up to harvest. The baseline emissions are estimated to be approximately 56,967 ktCO_2e/yr. These cover the emissions from the existing irrigated rice fields during the dry and wet seasons where both single and double cropping is practiced. The details of the GHG baseline estimation are provided in Chapter 5.

The **SD baseline** is the continuation of non-resilient rice production, characterized by unsustainable water and land usage, sub-optimal rice yield and use of rice production technology that does not apply state-of-the-art agricultural techniques. The SD baseline is characterized by various parameters related food security, adaptation benefits, social benefits, knowhow transfer and other nationally appropriate improvements (NAI). The exact baseline values will be established as part of a full NAMA Option development. Wherever possible, the parameters will be quantified, otherwise qualitative description will be provided.

Table 4: Nationally Appropriate Improvements

Co-Benefits	Parameter
Food Security Benefits	Rice production (ton)
	Area of irrigated land (ha)
Adaptation Benefits	Number of farmers having access to reliable irrigation services
	Water usage (m^3)
Social Benefits	New jobs created
Knowhow Transfer	Share of irrigated rice fields that have adopted AWD (%)
Other Benefits	Reported decrease in conflicts (survey based)
	Improved satisfaction with irrigation services (survey based)
	Share of ISF collection

It is important to emphasize that currently there is no concrete action plan with well-defined steps and clear management structure to support the sector transformation at present. Although, there is an overall understanding among policymakers on the benefits of AWD and willingness to promote that, there are is no clear vision as of how to do that. Researchers and participants in past pilot projects generally put emphasis on the capacity development; however, the overall assessment of capacity development projects up to the present shows a strong tendency to revert to continuous flooding after the end of the projects. Finally, no concrete plans also exist as of how to incentivize farmers to switch to AWD, making promotion of AWD extremely difficult without any further policy interventions.

4.3 NAMA Management Structure

The proposed NAMA management structure is presented in the figure below.

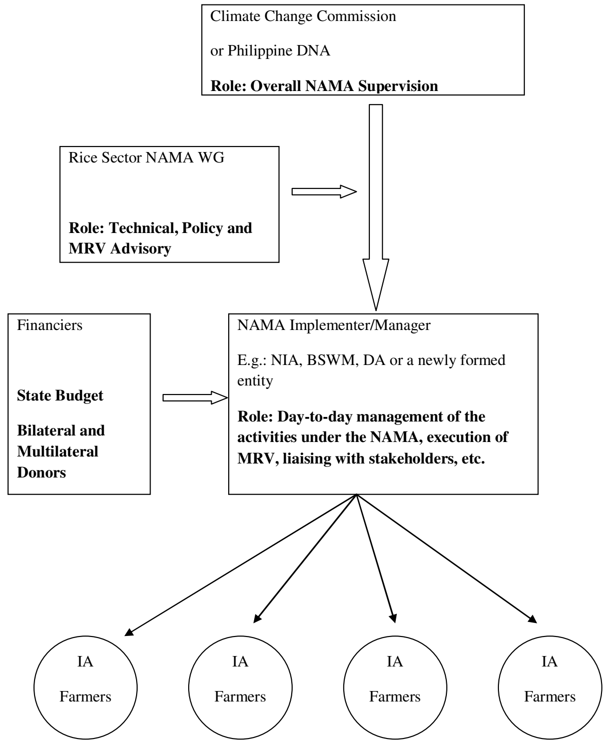

Figure 6: NAMA Management Structure

Under the current institutional structure in the Philippines, NAMA implementation is supervised by the **Climate Change Commission of the Philippines**[25] (CCC) which is also the designated NAMA approver. The CCC will be the focal point for negotiations with potential NAMA investors and will also supervise the congruence between the NAMA implementation and the national sustainable development goals of the Philippines.

Under the CCC, a special advisory group, **Rice Sector NAMA WG**, is proposed to be created to provide technical, policy and MRV advisory to the CCC and the NAMA implementer. The advisory group will consists of members from relevant government agencies, research institutes and other stakeholders.

The actual implementation of the NAMA will be carried out by a **NAMA Implementer** or **NAMA Manager**. Several options are discussed below, but the exact selection of the NAMA implementer and the development of its management structure will be part of a detailed NAMA Option development.

The first option is to create a **new separate entity** that will be in charge of the NAMA management. This can be a special agency that will take over the entire NAMA operation. Under this model, the new entity should recruit, among others, rice cultivation and irrigation specialists, staff with extensive business

[25] http://climate.gov.ph

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experience, as well as capacity building specialist that have previously worked with farmers and irrigators associations.

The other option is to entrust the **National Irrigation Administration (NIA)** with the NAMA management. As NIA is the authority managing the NIS and controlling the collection of ISF, it will be natural for them to become an implementer of the NAMA. At the same time, however, the NAMA implementation would require more business-oriented skills, therefore, NIA might need to strengthen its capacity in this area.

A third option is to locate the NAMA implementer in the **Bureau of Soils and Water Management[26] (BSWM)**. BSWM has already implemented several AWD projects in the Philippines and has gained the necessary project management and implementation experience.

Whoever the NAMA implementer is, they have to be in charge of the day-to-day NAMA management, execution of the MRV and liaising with stakeholders, among others. Therefore, it should develop the necessary human resource and managerial capacity and maintain sufficient knowledge base.

The actual activities under the NAMA will be implemented by individual farmers and the irrigators associations. They will receive from the NAMA Implementer the necessary guidance and training, as well as assistance for the implementation of the MRV system.

4.4 NAMA Interventions

The NAMA interventions can be classified into two packages - **basic package** and **additional package**. The basic package will require creation of policy incentives and investments in trainings and education of farmers. The additional package will also include investments in rebuilding and upgrading of irrigation systems to allow for a more efficient implementation of the AWD.

4.4.1 Basic Package

The basic NAMA package will consists of two major components: national level incentive scheme and farmers/IA capacity building.

An efficient intervention is the one that offers a win-win solution for the stakeholders involved, in the case of this NAMA Option – government agencies and farmers. The introduction of AWD is a means to provide farmers with improved and reliable irrigation services. Additionally, AWD is expected to bring increased yield and, possibly, increase in the cultivated area available due to the larger availability of water.

On government agencies side, the stakeholder that will directly benefit from the introduction of AWD is NIA. For NIA, stable ISF collection is the main incentive for the introduction of any new measure and change. AWD introduction has the potential to increase the ISF collection rate as more farmers will get access to irrigation water and improved irrigation services, which is expected to increase their willingness to pay. Moreover, if AWD leads to an increase of the area cultivated, it translates into increased revenue for NIA, which is an additional incentive.

In view of the above, the first step in the NAMA implementation is proposed to be a complete overhaul of the ISF system, so that farmers adopting AWD can benefit from reduced ISF. The decrease in the ISF is expected to be offset by increased ISF collection rate and increased payments from the additional harvested

[26] http://bswm.da.gov.ph/

land, which can guarantee that NIAs revenue does not decrease. More detailed calculations should be carried as part of a detailed NAMA Option.

The second component of the basic NAMA package will require that the NAMA implementer reaches each and every farmer. The NAMA implementer should play a pivotal role in delivering information dissemination campaigns and introducing AWD as the “new” and “appropriate” way of irrigating the rice crop or managing irrigation water at the farmers’ field. The NAMA implementer should organize trainings and lead the development of pilot projects. The implementer should also develop a “hot line” service and provide to farmers constant support in correctly implementing the AWD. IRRI and PhilRice can provide the technical feedback and also dispatch trainers for dissemination of the knowledge already gained from previous pilot projects that it has conducted. Extensive support at the initial stage is vital for establishing successful examples on a large scale that will allow the further dissemination of the practice among farmers. Monitoring of farmers who do not practice AWD can be done hand in hand with the IAs officers.

The exact scope of the interventions, as well as their timing will be designed in detailed a part of a full NAMA Option development.

4.4.2 Additional Package

The additional package will target areas were the reconstruction of the irrigation system is considered to deliver better results combined with the implementation of AWD. Priority should be put to systems that are not equipped with controlled irrigation and drainage facilities. The selection of these areas should be a subject of careful economic analysis and is beyond the scope of the present work.

Chapter 5: Measuring, Reporting and Verification

5.1 Overview

A credible and transparent MRV framework is essential for effectively assessing the impact of this NAMA on the nationally appropriate improvements (NAI), greenhouse gas emissions and SD co-benefits. It would provide the country with accurate and credible information framework that can serve as a basis for understanding the impact of such holistic mitigation actions and identifying areas that would need more targeted effort. On the international level, a strong MRV framework would assist the country in getting the legitimate recognition for its contributions to GHG emission reduction and transformation to low-emission sustainable agriculture, while also increasing the likelihood of accessing international financial support.

5.2 MRV System for GHG Emissions

The MRV system for this NAMA is designed based on a Standardized Baseline (SB) proposal for the Rice Sector in the Philippines. The SB was developed by the Philippine Designated National Authority for CDM (DNA) in cooperation with the United Nations Development Programme (UNDP) and Mitsubishi UFJ Morgan Stanley Securities Co., Ltd. (MUMSS). The proposal has been finalized and validated by designated organizational entity (DOE), SGS International, Inc. In June 2014, the SB proposal was submitted to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat for review and approval.

The SB developed Philippines-specific seasonal default values derived from the results of a Global Environment Facility (GEF) funded research on greenhouse gas emissions from rice cultivation executed by the International Rice Research Institute (IRRI) and Philippine Rice Research Institute (PhilRice) in the period 1994 – 1999. The default emission factors provide the value of emissions per area per season (kgCH_4/ha/season) allowing emission reductions to be estimated only from the area of the rice fields over which AWD practice is adopted.

5.2.1 Baseline Emissions

Baseline emissions are calculated on a seasonal basis using the following formula:

$$BE_y = \sum_s BE_s \quad \textbf{(2)}$$

$$BE_s = \sum_{g=1}^{G} EF_{BL,s,g} * A_{s,g} * 10^{-3} * GWP_{CH4} \quad \textbf{(3)}$$

Where:

BE_y	Baseline emissions in year *y* (tCO_2e)
BE_s	Baseline emissions from project fields in season *s* (tCO_2e)
$EF_{BL,s,g}$	Baseline emission factor of group *g* in season *s* ($kgCH_4$/ha per season, use default values)
$A_{s,g}$	Area of project fields of group *g* in season *s* (ha)
GWP_{CH4}	Global warming potential of CH_4 (tCO_2e/tCH_4, use value of 25)
g	Group *g*, covers all project fields with the same cultivation pattern (*G* = total number of groups)

The baseline emission factors are calculated using the following formula adapted from IPCC 2006:

$$EF_{BLs,g} = EF_c \times SF_p \times SF_w \times SF_o \quad \textbf{(3)}$$

Where:

$EF_{BL,s,g}$	Baseline Emission Factor
EF_c	Baseline emission factor for continuously flooded fields without organic amendments in the Philippines
SF_p	Scaling factor to account for the differences in water regime in the pre-season before the cultivation period
SF_w	Scaling factor to account for the differences in the water regime during the cultivation period
SF_o	Scaling factor to account for the organic amendments

The baseline emission factors for continuously flooded rice fields for the dry and wet seasons are determined as follows:

Table 5: GHG Baseline Emission Factors (kgCH$_4$/ha/season)

Dry Season

	EFc	Baseline			
		SFw	*SFp*	*SFo*	*Emission Factor*
For double cropping	171.40	1.00	1.00	2.88	**493.63**
For single cropping	171.40	1.00	0.68	1.70	**198.14**

Wet Season

	EFc	Baseline			
		SFw	*SFp*	*SFo*	*Emission Factor*
For double cropping	297.42	1.00	1.00	2.88	**856.56**
For single cropping	297.42	1.00	0.68	1.70	**343.81**

5.2.2 Project Emission Factors and Emission Reduction Factors

Using the same approach as the calculation of baseline emissions and determination of baseline emission factors, the project emission factors and emission reduction factors are determined as shown in the following table:

Table 6: Emission Reduction Factors (kgCH$_4$/ha/season)

Dry Season

	EFc	Baseline				Project Scenarios	Project				Emission Reduction Factor
		SFw	SFp	SFo	Emission Factor		SFw	SFp	SFo	Emission Factor	
For double cropping	171.40	1.00	1.00	2.88	493.63	Scenario 1: Change the water regime from continuously to intermittent flooded conditions (single aeration)	0.60	1.00	2.88	296.18	197.45
						Scenario 2: Change the water regime from continuously to intermittent flooded conditions (multiple aeration)	0.52	1.00	2.88	256.69	236.94
For single cropping	171.40	1.00	0.68	1.70	198.14	Scenario 1: Change the water regime from continuously to intermittent flooded conditions (single aeration)	0.60	0.68	1.70	118.88	79.26
						Scenario 2: Change the water regime from continuously to intermittent flooded conditions (multiple aeration)	0.52	0.68	1.70	103.03	95.11

Wet Season

	EFc	Baseline				Project Scenarios	Project				Emission Reduction Factor
		SFw	SFp	SFo	Emission Factor		SFw	SFp	SFo	Emission Factor	
For double cropping	297.42	1.00	1.00	2.88	856.56	Scenario 1: Change the water regime from continuously to intermittent flooded conditions (single aeration)	0.60	1.00	2.88	513.94	342.62
						Scenario 2: Change the water regime from continuously to intermittent flooded conditions (multiple aeration)	0.52	1.00	2.88	445.41	411.15
For single cropping	297.42	1.00	0.68	1.70	343.81	Scenario 1: Change the water regime from continuously to intermittent flooded conditions (single aeration)	0.60	0.68	1.70	206.29	137.53
						Scenario 2: Change the water regime from continuously to intermittent flooded conditions (multiple aeration)	0.52	0.68	1.70	178.78	165.03

5.2.3 GHG Monitoring Parameters

Based on the above described approach, the required monitoring parameters for the calculation of actual GHG emission reductions are reduced only to one – area where AWD is applied. A Summary of the monitoring parameters is provided in the table below.

Table 7: Monitoring Parameters

Parameter	Description	Unit	Measuring methods and procedures

$EF_{BL, s, g}$	Baseline Emission Factor	$kgCH_4$/ha per season	As per Standardized Baseline emission factors
$EF_{P, s, g}$	Project Emission Factor	$kgCH_4$/ha per season	As per Standardized Baseline emission factors
$A_{s. g}$	Aggregated project area in a given season. Only compliant farms are considered.	ha	To be determined by collecting the project field sizes in a project database. The size of project fields shall be determined by GPS or satellite data. Should such technologies not be available, established field size measurement approaches shall be used provided that uncertainties are taken into account in a conservative manner.

5.2.4 Monitoring of Farmers' Compliance with AWD Practice

In order to determine whether the participating rice fields are correctly applying the AWD and can participate in the emission reduction calculations, the following protocol is proposed:

- Cultivation logbook shall be used and maintained, and at least the following shall be documented:
  - Sowing (date);
  - Fertilizer, organic amendments, and crop protection application (date and amount);
  - Water regime on the field ((e.g. "dry/moist/flooded") and dates where the water regime is changed from one status to another;
  - Yield.
- Statement from farmers that they have followed fertilization recommendations provided.
- Assure that only those farms that actually comply with the project cultivation practice are considered.
- Database should be set up which holds data and information that allow an unambiguous identification of participating rice farms, including name and address of the rice farmer, size of the field and, if applicable, additional farm specific information.

The database and the compliance system will be set up by the NAMA implementer. Irrigators Associations will collect the data for their members and forward it to the NAMA implementer. Government entities, such as DA and BAS will reflect the compliance data in the national statistics and provide additional support for this component of the MRV, if needed. This system will be further detailed as part of the NAMA Option.

5.3 Monitoring of Sustainable Development Benefits

In addition to GHG emissions, the MRV system of this NAMA option covers sustainable development benefits improvement. The monitoring parameters and the monitoring procedure are summarized in the table below.

Table 8: Monitoring of Nationally Appropriate Improvements

Co-Benefits	Parameter	Data Source
Food Security Benefits	Rice production (ton)	Using data from the BAS database
	Area of irrigated land (ha)	Using data from the BAS database
Adaptation Benefits	Number of farmers having access to reliable irrigation services	Data provided to NIA and IAs
	Water usage (m^3)	Data provided by NIA and IAs
Social Benefits	New jobs created	Data based on labor statistics
Knowhow Transfer	Share of irrigated rice fields that have adopted AWD (%)	Using data from the BAS database
Other Benefits	Reported decrease in conflicts (survey based)	Survey
	Improved satisfaction with irrigation services (survey based)	Survey
	Share of ISF collection	Using data of NIA

5.4 Monitoring and Reporting Structure

The proposed monitoring and reporting structure for the NAMA Option is presented below:

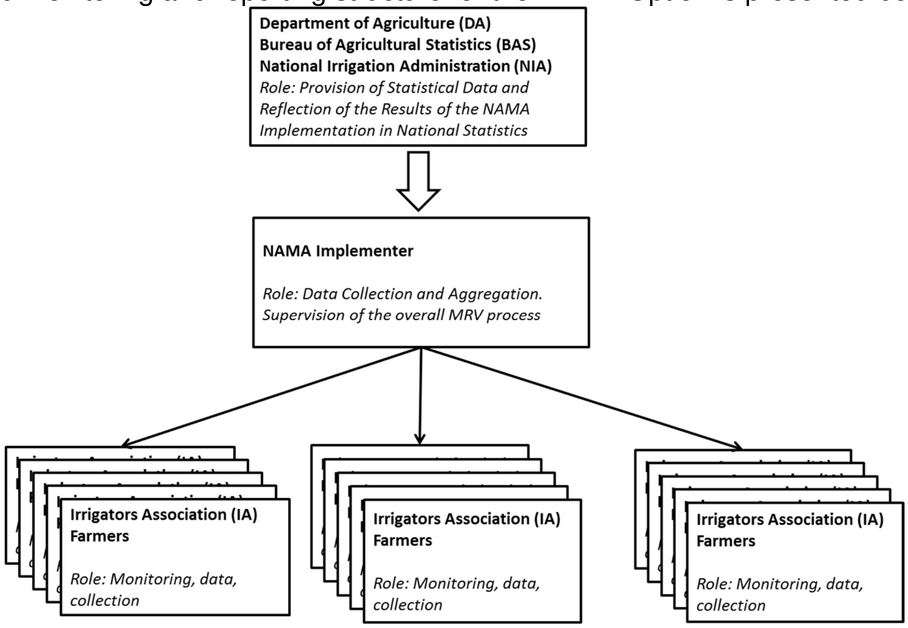

Figure 7: Monitoring and Reporting Structure

GHG monitoring data, i.e. area adopting AWD, is collected by the Irrigators Association (IA). This information is forwarded to the NAMA Implementer for data processing, aggregation and archiving. It is also possible to consider the integration and addition of monitoring parameters to the existing database system of the government, for example, the BAS database.

For SD parameters all other data can be accessed through national statistic databases managed by the BAS and NIA. Therefore, the existing data collection system of the government may continue to be used as data source in the MRV framework of the NAMA Option. If the particular monitoring of some parameters requires additional information, new entries can be added to the existing statistical and data-collection forms.

5.5 Verification

Verification rules for NAMAs are usually based on the requirements of the NAMA funding agencies, as well as the host country requirements. Prior to developing domestic capacity for verification, it is recommended to use some of the existing CDM auditors with experience in the agricultural sector and good understanding of the Philippine local conditions, but NAMA-specific verification rules shall be developed in the future.

Chapter 6: Cost of the NAMA Development

This Chapter will be prepared as part of the final draft of this NAMA Study and will include several examples of AWD implementation in the Philippines in pump and gravity irrigation systems. The detailed financial planning and budgeting will be developed as part of a detailed NAMA Option.

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