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POLICY AND INSTITUTIONAL LANDSCAPE FOR GROUNDWATER MANAGEMENT

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ABSTRACT

This paper examines the policies governing groundwater management in the Philippines. It identifies the institutions and their programs to address groundwater utilization. The paper also presents a conceptual framework for sustainable groundwater management and relates this to the country's present situation. Groundwater is a reliable water source for irrigation is the last to be depleted during periods of drought. But compared to surface water, groundwater is like an invisible resource. Limited information on the characteristics of aquifers and use patterns; and weak institutional capacity may pose challenges to sustainable groundwater management.

The comprehensive development, utilization, conservation and protection of groundwater resources, is embodied in the Philippines' national policies. However, there is a lot to be desired in the control and management of groundwater for irrigation. An integrated groundwater management and effective coordination among agencies has yet to be institutionalized. Monitoring and tracking mechanisms on groundwater use also have to be established; and sustainability issues such as groundwater protection, should be appropriately addressed.

Keyword: national policies, groundwater management, groundwater resources, groundwater protection

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POLICY AND INSTITUTIONAL LANDSCAPE FOR GROUNDWATER MANAGEMENT

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I. Rationale for policy study on groundwater

The Organisation for Economic Cooperation and Development (OECD, 2016) affirmed the growing importance of groundwater for agriculture. Groundwater is used for over 40% of global irrigation on almost 40% of irrigated land. It accounts for half of South Asia's irrigation with China, India, and Pakistan as the leading groundwater irrigating OECD countries over the past 25 years (OECD, 2016). Groundwater is a reliable water source for irrigation. Among the water supply sources for irrigation, groundwater from aquifers is the last to be depleted during periods of drought.

Groundwater is an invisible resource as its state is unseen, unlike surface water. Particularly in rural areas of developing economies, there is no clear formal practice governing access to and use of groundwater. Practices are usually based on users' perception of their rights, instead of or in parallel with formal rules and regulations. Limited information on the characteristics of aquifers and use patterns and weak institutional capacity challenges management processes. Over the last decade, increasing pollution of aquifers and collective impacts of groundwater abstraction has posed the need for groundwater governance (Mechlem 2012).

This paper, thus, aims to review current policies and programs related to groundwater; and identify possible policy reforms for sustainable groundwater management. The discussion forms part of the project on 'Policy Study towards Effective Groundwater Management for Sustainable Agriculture' (Luyun Jr. et al. 2017).

II. State of groundwater resource in the Philippines

There is an approximately 50,000 square km of groundwater reservoir (EMB, 2007) contributing about 14% of the total water resource potential of the country (WB, 2003). Regions I and VII have the highest potential while Region X has the lowest.

As of 2005, the National Water Resources Board (NWRB) has granted 9,711 abstraction permits; 91% was for agricultural purposes (irrigation and fisheries), 4% was for domestic use, and the remaining 4% was divided among industrial, commercial, and recreational uses. In contrast, the biggest consumer of groundwater was the domestic sector at 49% followed by the agriculture sector (39%). The industrial and other sectors accounted for 10% and 4%, respectively.

The NAP also cites that Regions IV and III had the highest abstraction rate with 21% and 16%, respectively. However, unregulated abstraction, which account for about 60% and indiscriminate withdrawal resulted to groundwater level decline (i.e., Cebu) and in some areas, seawater intrusion in coastal aquifers (WB, 2003). The NAP also reported that saltwater intrusion was evident in nearly 28% of coastal municipalities in Luzon, 20% in the Visayas, and 29% in Mindanao.

Aside from over exploitation, pollution and contamination due to improper disposal of household, industrial and agricultural wastes further threaten the country's groundwater resource. For instance, about 50% of the wells monitored by the Environmental Management Bureau (EMB, 2007) in 2005 were found contaminated with fecal coliform. Regions II and Region VI (seasonally-arid and drought-prone areas) have the most number of contaminated sites. Protecting the groundwater resource is critical to ensure sustained supply of freshwater, especially during drought periods. This will require a policy and institutional strategy.

III. Conceptual framework for groundwater management

The analysis is based on the groundwater management framework that incorporates the following key components (Foster 2008; Mechlem 2012): 1) Groundwater resources assessment; 2) Groundwater strategic planning; 3) Groundwater abstraction and use regulation; 4) Groundwater quality assessment and protection; and 5) Monitoring and evaluation and groundwater data basing. Improved groundwater governance would require policy instruments that will support these components.

Groundwater resources evaluation includes hydroecological survey and groundwater monitoring. An adequate level of resource characterization and quantification is needed to provide the scientific foundation for efficient and sustainable groundwater resource management. Assessment of shallow aquifer recharge mechanisms and rates, together with evaluation of shallow-deep aquifer interactions is related to the field assessment of hydro-geological sustainability and socioeconomic benefits of existing informal conjunctive use of groundwater for supplementary agricultural irrigation (Foster 2008).

Groundwater strategic planning includes preparation of groundwater management master plan (such as the mandated groundwater management plan in Australia); aquifer storage and recovery program; utilization and valuation. Plans may have a legally binding nature where there sustainable diversion limits and management arrangements as practiced in Australia. It also deals with how stakeholders can be involved in the plan preparation and revision/updating, stewardship schemes, decision making and management processes (Mechlem 2012).

Regulation on groundwater abstraction and use are imposed constraints such as licensing of abstraction, entitlement allocation such as water use rights (permit). There

are guidelines on who can access groundwater, where, for what purpose and under what conditions. These includes regulations on wells such as approval of new wells, groundwater withdrawal restrictions, mandated metering or monitoring system for groundwater for agriculture and other uses as practiced in Australia and Japan)

Groundwater quality assessment and protection addresses the question how aquifers are protected. This includes groundwater hazard/vulnerability assessment, water quality monitoring, and review of impact of human activity.

Groundwater data basing and information provision includes updating and linkaging of groundwater database, national groundwater data center. Water legislation must contain obligations to monitor groundwater use and status. Monitoring should include changes in flow, storage, water quality, inventory of wells, registers of abstraction, and wastewater discharge permits

There should be a much clearer distinction between the groundwater regulator and the groundwater users. The primary tasks for the government are improving groundwater management while retaining limited groundwater exploration and drilling capacity and to continuously search for minor aquifers in the more remote regions of the country.

With the very large number of individual abstractors often involved, 'groundwater resources management is as much about managing people as it is about managing water'. It is therefore important to mobilize water-user (and broader stakeholder) participation in the definition and implementation of local groundwater management strategies and into bringing all volumetrically-significant groundwater abstraction (including shallow irrigation wells) inside the regulatory process. These two critical steps involved a large amount of primarily administrative action, and careful technical and political promotion at regional and provincial level.

IV. Polices and institutions governing groundwater

Water resources management in the Philippines, including the comprehensive development, utilization, conservation and protection of groundwater resources, is embodied in formal policies.

The Philippine Development Plan 2011-2016 pushes for a competitive, sustainable, and technology-based agriculture and fishery sector. Irrigation programs are usually integrated as a component of major agricultural flagship program of the national government. The PDP identifies the inadequacy of water supply as one of the challenges to irrigation development.

Based on the key components of groundwater management governance, policy provisions are anchored mainly on the Philippine Water Code of 1976 (P.D. No. 1067). It states that the utilization, exploitation, development, conservation and protection of water

resources shall be subject to the control and regulation of the government through the National Water Resources Council (Article 3). NWRC is later renamed as the National Water Resources Council (NWRB).

Other agencies are also mandated specific functions (Table 1). The Mines and Geosciences Bureau (MGB) performs groundwater resource assessment and provides publish a national groundwater vulnerability map.

Table 1. Major policy provisions on groundwater management by key component.

Component	**Policy**	**Institutions involved**	**Provisions**
1) Groundwater resources assessment	The Philippine Mining Act of 1995 (RA No. 7942)	Mines and Geosciences Bureau **(**Geosciences Division)	Mandates MGB to undertake land and marine geoscientific surveys including groundwater resource exploration and vulnerability assessment
	SSIP Master Plan 2014-2022	Department of Agriculture - Bureau of Soils and Water Management (DA-BSWM)	BSWM will conduct Resource Mapping to identify spatial extent of SSIP infrastructure development
2) Groundwater strategic planning	AFMA (1997)	Department of Agriculture	*Irrigation* The Department (DA) shall formulate and develop a plan for the promotion of a private sector-led development of minor irrigation systems, such as Shallow Tube Wells (Chapter 4, Sec. 32).
	Executive Order No. 116 of 1987	BSWM, Local government units (LGUs), DA – Regionl Field Offices	BSWM shall undertake the design, preparation and implementation of Small Scale Irrigation Projects with the Local Government Units and Regional Field Units of the Department of Agriculture; and formulate measures and guidelines for effective soil, land and water resources utilization
	R.A. No. 3601 (1963)	National Irrigation Administration (NIA)	NIA shall investigate, study, improve, construct and administer all international irrigation systems in the Philippines; and investigate all available and possible water resources for irrigation, and to plan, design and construct the necessary projects (Sec 2)
3) Groundwater abstraction and use regulation	Water Code of 1976	National Water Resources Council/Board (NWRB)	*Ownership of water resources* - Subterranean or ground waters including those found on private lands belong to the State (Articles5 and 6)

	Water Code of 1976	NWRB	*Rights over the use of waters or the taking or diverting of waters* – appropriation of water through water permits which shall specify the maximum amount of water which may be diverted or withdrawn, the maximum rate of diversion or withdrawal, the time or times during the year when water may be diverted or withdrawn, the point or points of diversion or location of wells, the place of use, the purposes for which water may be used and such other requirements (Articles 9, 18).
	Water Code of 1976	NWRB	*Coordinated use of ground and surface water* - The utilization of subterranean or ground water shall be coordinated with that of surface waters such as rivers, streams, springs and lakes, so that a superior right in one is not adversely affected by an inferior right in the other. Sec. 26 of IRR, appropriation of surface water has preference over groundwater; permit for groundwater is valid only to the extent that it does not prejudice surface water supply
	Water Code of 1976	NWRB	*Drilling requirements* – Except for domestic use, permit to drill a well for extraction of groundwater or any alteration to an existing well must be secured (Water Code IRR Section 42). Well drillers must be registered with the Council (now NWRB) (Water Code IRR Section 41). Regular permit to drill shall be issued after the rate of withdrawal has been determined (Water Code IRR Section 10)
	P.D. No. 198 - "The Provincial Water Utilities Act of 1973	Water districts	Water districts are authorized to adopt rules and regulations governing the drilling, maintenance and operation of wells within its boundaries for purposes other than single family domestic use on overlying land (Sec. 32)
	National Building Code		It requires that the design, construction and operation of deep wells for the abstraction of groundwater shall be subject to the provisions of the Water Code of the Philippines (Section 902).
	Agricultural and Biosystems Engineering Act of 2016	Department of Public Works and Highways (DPWH), LGU	Article IV stipulates the coordination among a duly registered agricultural and biosystems engineer, local building official and DPWH in the issuance of building permits; and with other national agencies and LGUs in regulatory and auditing

			functions pertaining to irrigation, soil and water conservation structures
4) Groundwater quality assessment and protection	Water Code	NWRB	Report on drilling operations (within 6 months prior to issuance of regular permit) includes effects on environment, danger of contamination of aquifers, deterioration of water quality or salt water intrusion (sec 12).
	P.D. No. 198 - The Provincial Water Utilities Act of 1973	Water district	Water districts may intervene to prevent interference with or deterioration of water quality or the natural flow of any surface, stream or ground water supply
	National Building Code	Local Government Units (LGUs)	Rain water drainage shall not discharge to the sanitary sewer system. (b) Adequate provisions shall be made to drain low areas in buildings and their premises (Section 904). The applicant must also conform with approved standard requirements on zonings and land use, sanitary and sewerage, environmental health, among others (Section 303).
5) Monitoring and evaluation and groundwater data basing	Water Code	NWRB	Measure and control on use of water – Except for domestic use, every appropriator of water shall maintain water control and measuring devices, and keep records of water withdrawal (Articles 21 and 28).
	SSIP Master Plan 2014-2022		DA (CAFED/FOS and Planning Group in coordination with BSWM to conduct field monitoring and evaluation of the SSIS implementation
	The Clean Water Act (2004)	MGB	Mandates MGB (in coordination with the NWRB) to prepare and publish a national groundwater vulnerability map incorporating the prevailing standards and methodologies

V. Government programs on groundwater

Mines and Geosciences Bureau - The Groundwater Resource Assessment Program

In the 1960s, the Hydrogeology Section of the Geological Survey Division of MGB implemented the program to determine the availability and quality of groundwater in the various rock units in the entire country. Activities include systematic collection of geologic, hydrologic and meteorological information; and field surveys covering provinces, regions and river basins. Program implementation starting in the late 1980s was scaled-down due to insufficient funding and shifts in the priority projects of MGB. Most of field surveys undertaken were for technical assistance to LGUs to locate

groundwater sources for deepwells. Hydrogeologic and Groundwater Availability Reports and Maps at 1:250,000 and 1:50,000 scales cover most of the county (Source: MGB Groundwater Resource and Vulnerability Assessment Program (2015-2020), powerpoint presentation).

The first edition of the Groundwater Availability Map of the Philippines was published by the Mines and Geosciences Bureau in 1982 (GOP v.2). An updated map was published in 1997(MGB-DENR).

To date more than 70% of the country had been covered by reconnaissance or semi-detailed field surveys. Assessments made on the rest of the country were made based on available geologic and hydrologic data.

MGB is currently implementing the Groundwater Resource and Vulnerability Assessment Program for 2015- 2020. The revised 1995 Standard Legend will be used for the preparation of Hydrogeologic (Groundwater Availability) Maps and Reports. With an annual budget of PhP18M, the program targets 81 provinces but priority will be given to provinces experiencing water supply shortages due to effects of climate change and increase water demand from rapid population & economic growth.

National Water Resources Board - The Groundwater Management Plan

Together with CEST, Incorporated as the consulting agency, NWRB will undertake the development of groundwater management plan (GMP) for highly urbanized water constraint cities with Iloilo City and surrounding areas, portions of Pampanga, and Metro Manila as pilot areas. Its overall goal is to effectively and equitably manage the groundwater resources of Iloilo City through the development of systematic and science-based management strategies that consider current situation as well as future impact of climate change to ensure sustainability of the resources.

The expected outputs include GMP for Iloilo City and surrounding areas; GIS maps generated using groundwater modeling software procured by the consultant; design of Groundwater Monitoring Network; operation manual on the use of the groundwater model; and report of stakeholder consultations and trainings conducted.

Department of Agriculture - Strategies and Policies on Groundwater Use

Under the Department of Agriculture (DA), the Bureau of Soils and Water Management (BSWM) formulates and implements policies and programs for the protection of existing and potential sources of soil and water for agricultural development. The National Irrigation Administration (NIA), now under the Office of the President, also undertakes water resource projects for agricultural irrigation and other purposes, such as flood control and drainage, hydropower development, etc. Both the BSWM and NIA previously implemented groundwater utilization projects, specifically STW irrigation programs, although NIA also manages deep wells for irrigation. NIA ‘s

groundwater irrigation projects face the problems of economic viability due to high cost of energy and agricultural inputs and low price of agricultural products (Tolentino 1996).

Also under DA is the Philippine Council for Agriculture and Food (PCAF), a body consolidating the National Agriculture and Food Council (NAFC) and the Livestock Development Council (LDC) by virtue of EO No. 336 of 2013. It aims to pursue a functional and holistic approach in dealing with agricultural and fisheries issues and concerns.

The Guidelines in Implementing SSIPs delegates BSWM to coordinate and monitor planning and implementation of SSIP, technical assistance including capacity building to DA-RFUs and other organizations. The DA-Regional Field Units implement SSIPs, monitor O&M of SSIPs and report to BSWM (Table 2).

Table 2. Responsibilities of the Department of Agriculture on Small Scale Irrigation System Project

Office	**Responsibilities**
Office of Undersecretary for Operations	Overall supervision
Bureau of Soils and Water Management	BSWM shall take the lead as national SSIP Coordinating Office to provide management guidance to the overall implementation
Central Agriculture and Fisheries Engineering Division /Field Operation Service	□ Conducts field monitoring and evaluation of the SSIS implementation. □ Assists BSWM in the review of Major Final Outputs 3 plans prepared by the Banner programs. □ Ensure that plans/proposals conforms to PAES standards
Planning Group (Monitoring and Evaluation Division, Policy Research Service, Project Development Service, PPD, PIPD,	□ Assists in the formulation and periodic review of the medium-term or strategic plan of SSIS. □ Assists BSWM in the formulation of resource allocation scheme that will determine prioritization of the various programs/projects/activities identified in the strategic plan. □ Conducts strategic monitoring and evaluation of SSIS (quarterly, semestral, annual reports) in coordination with BSWM
Regional Field Offices	□ Takes the lead in the implementation of SSIS. □ Coordinates with the LGUs on SSIS implementation □ Prepares and submit regular report. □ (Thru RAED prepares the necessary designs/POW
	□ Recommend measures on issues and concerns that cuts across various agencies concerning SSIS implementation.

Regional Irrigation Coordinating Committee	□ Provides harmonized data relative to irrigation

Source: DA-BSWM National Master Plan for SSIP 2014-2022

VI. Emerging issues

Ideally, a single institution handles all water (surface and groundwater) management issues. But in practice, an interagency mechanism such as council, committee coordinates these different agencies. There is an increasing trend to complement this institution with institutions at the river basin/watershed level. Aquifer boundaries however do not follow the river basin boundaries and UN ECE Groundwater Management Charter states that groundwater management should not be limited to catchment areas and should cover its entirety (Mechlem 2012). This may call for inter-state institutional mechanisms such as that in Australia.

Groundwater resource assessment

- The status of development of a given aquifer is not clearly determined.
- MGB is conducting resource assessment on a project basis (As an R&D activity). NWRB is also doing it in major cities, and BSWM is doing it for SSP development. There is no consolidation of information or database, information sharing or exchange for integrated planning.

Groundwater strategic planning

- There is lack of information dissemination on available aquifer maps, as well as implementing rules and regulations on the appropriation of groundwater resources at the regional level. The lack of data on aquifer properties is the primary reason for inadequate planning and under-utilization of groundwater resources (David, 2003).
- DA-BSWM has SSIP Plan and DRRM Plan is still in progress
- There is no national and regional groundwater management plan

Groundwater abstraction and use regulation

- The Water Code has policies on water permit, drilling and data reporting but compliance is reportedly not high. One constraint to the application for water permit of STW users from NWRB is that the permit is only for a specific location (with coordinates). STW has to be centroid (confined in an area) but it is often moved by farmers from one spot to another, where groundwater is available.
- There is no clear mechanism of regulating and guiding groundwater development for agricultural irrigation

- Shallow wells (even when used for agricultural irrigation) do not tap licensed drillers; and do not obtain water permits (including those constructed by government agencies). This has to be addressed in view of the large numbers and/or large pumping rates involved, groundwater sat water intrusion, aquifer level getting deeper.
- Low compliance with regulations on drilling due to lack of public appreciation on the need to regulate abstractions, lack of awareness of the impact of uncontrolled overdrawing of the aquifer, and the importance of seeking experts' advice (Tolentino 1996). NWRB have limited manpower for monitoring compliance with regulations and the penalties are very old
- 'No water, no pay' was the policy for drilling needs to be evaluated.

Groundwater quality assessment and protection

- More detailed work on major groundwater basins threatened by overexploitation and establishment of an extensive groundwater monitoring network should be made over the next decade years to insure proper utilization and management of the country's groundwater resource.
- There is a need to promote groundwater quality protection, both at source and resource levels.
- The responsibility for groundwater resource quality protection can only be carried out effectively in close collaboration with other government agencies, which have responsibility for controlling specific sources of potential pollution.

Monitoring and evaluation and groundwater data basing

- There is a need to continuously update and monitor groundwater conditions (quantity and quality) in the entire country.
- The lack of data on aquifer lithologic, hydraulic, and hydrologic properties is the primary reason for the under-utilization of groundwater resources (David 2004). The available information on important aquifer properties is inadequate for planning.
- There is also a need to strengthen the technical capability of MGB in groundwater research/study in terms of manpower development and acquisition of office, laboratory and field equipment**.** Lack of software/hardware for data analyses, uncertainty in annual budget allocation, difficulty in acquiring data from other agencies (public/private) are also concerns of MGB.
- Each agency concerned with groundwater use compiled its own records of development and performance
- No single national agency responsible for coordinating groundwater resources but there is coordination among agencies, and with NWRB.
- Monitoring reports usually show number of STWs distributes, number of beneficiaries and farm area covered. There is no monitoring and evaluation of impacts of the program, e.g., of STW and other water management technologies

or programs implemented. Such data should also be used for decision making in SSIS expansion.

- Establishment of an extensive groundwater monitoring network should be made to ensure proper utilization and management of the country's groundwater resource.

VII. Summary and Recommendations

While the Philippines has enough rules in the management of the national irrigation systems using surface water the rules for extraction, control and management of groundwater for irrigation should be widely understood. In summary, the following issues emerge:

a) Absence of integrated groundwater management (from assessment to monitoring and evaluation to guide planning);
b) Lack of effective coordination among agencies and inadequate monitoring and tracking mechanisms on groundwater use; and
c) Absence of clear mechanisms to address sustainability issues e.g., groundwater protection.

The five principal components of groundwater management should be enhanced. The following are recommended:

- Databasing – A national groundwater data center (e.g., within BSWM) and regional groundwater offices (e.g., within DA-RFUs) should be established; requirements for drillers to provide well construction data for all wells drilled should be enforced.

- Resource characterization/assessment should be enhanced to provide the scientific foundation for efficient and sustainable groundwater resource management BSWM, MGB, NWRB should share information e.g., characteristics of aquifers which can be used in groundwater plan.

- Groundwater management plans should be developed based on a sound understanding of the resource. This should involve community consultation and the development of strategies to regulate use based on sustainable levels

- Monitoring and evaluation mechanism should be established. A monitoring unit (e.g., within BSWM) should be identified.

- As per the Local Government Code, the multi partite monitoring team (MMT) composed of Regional DENR, LGU and the NGO representative monitors water quality in environmentally fragile areas. This team can widen their monitoring function to also include the water quantity and other water related features as one expands SSIS.

- Close collaboration with other government agencies on concerns about the vulnerability of groundwater (e.g., pollution). Restricted groundwater zones should be established in sensitive areas/locations, especially where there are rapidly declining aquifers, increasing chemical contaminants and instances of rapid and serious land subsidence

  Research and development must be continuing to improve the knowledge base on groundwater.

- Review of proposed policies such as the following should be undertaken:

  - House Bill No. 04527 by Cong. DVB Savellano – An Act requiring all deep well owners and operators, including applicants for water extraction permits to incorporate, construct, and install artificial recharge wells so that the water they extract form aquifers will be replenished
  - House Bill No. 4528 by Cong. DVB Savellano – An Act crating the National Rainwater Harvesting Board under the Office of the President for the purpose of promotion, development and utilization of rainwater harvesting technology
  - Senate Bill No. 422 by Sen. Legarda – An Act promoting Soil and Water Conservation Technologies and Approaches for Sustainable Land Management

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