-PHILIPPINE COUNTRY REPORT
INTEGRATED NUTRIENT MANAGEMENT AND SOIL FERTILITY: CHALLENGES FOR SUSTAINABLE AGRICULTURE IN THE PHILIPPINES[1]

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INTRODUCTION

The agricultural sector in the Philippine economy. Agriculture is one of the important sectors of the Philippine economy. Agriculture grew by 4.68 percent in 2007 compared to previous year. The fisheries subsector leads, the crops subsector, contributing 47.5 percent in the total agricultural output, also performed well. Livestock and poultry production surpassed the 2006 production levels. The gross value of agricultural production amounted to PhP971.8 billion and posted a 9.37 percent increase over the previous year. (BAS website)

The concept of integrated nutrient management. Agriculture is a soil-based industry that extracts nutrients from the soil. Effective and efficient approaches to slowing that removal and returning nutrients to the soil will be required to maintain and increase crop productivity and thereby sustain agriculture in the long term (Gruhn, et.al., 2000).

The overall strategy for increasing crop yields and sustaining them at a high level must include an integrated approach to the management of soil nutrients, along with other complementary measures. An integrated approach recognizes that soils are the storehouse of most of the plant nutrients essential for plant growth and that the way in which nutrients are managed will have a major impact on plant growth, soil fertility, and agricultural sustainability.

Fertilizer usage, the Philippine scenario. Historically, in the years prior to 1973, the fertilizer industry in the Philippines was marked by a policy of laissez faire – the importation, distribution, marketing, and other aspects – free from government control. Fertilizer demand was low and agriculture was accorded low priority. This suddenly changed in February, 1973 when Presidential Decree 135 was promulgated creating the Fertilizer Industry Authority (FIA), eventually replaced in 1977 by the Fertilizer and Pesticide Authority (FPA). With the liberalization policy in 1986, there was lesser intervention (such as scrapping of price-setting function) and FPA focused more on quality assurance and strict monitoring system.

[1] Philippine Country Report for the Workshop on Integrated Nutrient Management, 27-30 May 2008, held in China.

The several fertilizer grades available in the world market are also obtainable in the Philippines. The six major types of fertilizers used in the country are (1) urea, (2) ammonium phosphate, (3) diammonium phosphate, (4) muriate of potash, (5) ammonium sulphate, and (6) complete or the triple-14. Of the straight N fertilizers, urea and ammonium sulphate dominated the market; potassium was derived mainly from the muriate of potash. There are other specialty formulations but mainly used by the cutflower-ornamental industry.

The inorganic fertilizer supply and demand scenario can be gleaned by the following 2005-2006 (partial) data obtained from the FPA website (volume in metric tons):

Year	*Grade*	*Production*	*Import*	*Sales*	*Export*
2005	Urea	-	788,201	275,532	31,712
	21-0-0	170,516	377,136	204,532	122,063
	16-20-0	178,928	90,060	188,251	21,096
	18-46-0	91,919	92,998	10,594	101,475
	14-14-14	192,930	76,842	362,154	500
	0-0-60	-	129,819	47,414	-
2006 (Preliminary data)	Urea	-	534,492	242,494	-
	21-0-0	4,043	351,415	90,352	-
	16-20-0	72,709	93,165	86,177	-
	18-46-0	-	105,310	4,185	-
	14-14-14	182,590	18,704	198,012	-
	0-0-60	-	146,962	50,639	-

The long-term and continued use of urea alone resulted in serious nutrient imbalances and contributed to the actual silent soil degradation known as “soil mining”. The general trend based from the soil analyses conducted by the Bureau of Soils and Water Management from 1970 to 1990 indicated very active soil mining such that generally, Philippine soils only required nitrogen fertilizers in the early 1960’s, nitrogen plus phosphorus are required by the 1970’s, nitrogen, phosphorus, potassium, plus zinc are required for rice and plus magnesium for corn by the time of the 1980’s. (BSWM, 2004)

It is only recently that the organic fertilizers and organic agriculture makes a big stride as prices of inorganic fertilizers skyrocket, compounded by the higher export taxes imposed by fertilizer-exporting countries. The government recognizes that it would not find respite from the increasing cost of fertilizer inputs. As a consequence, most farmers reduced their fertilizer usage by half of the recommended or the ideal amount. Among the rice farmers, the reported decline in fertilizer usage is about 30-percent. This imperils national rice production target. Fortunately, the Philippines is not listed by the Food and Agriculture Organization (FAO) among the 36 countries that require external assistance as “food insecure”. The Department of Agriculture (DA) has undertaken several measures to ensure adequate food supply at a time of global scarcity. Even the Philippine president made a strong pitch for organic fertilizers to enable farmers cope with increasing production input costs.

The promotion of organic agriculture receives an impetus with Executive Order 481 issued by President Arroyo in 2005. This relates not only to pesticide-free agricultural enterprise, but also to the popularization of organic fertilizers. The government finds itself streamlining indigenous and organic practices alongside with its scientifically-based production technologies for state support.

The 2006 organic fertilizer supply and demand (preliminary data, not yet final) as reported by the Organic Fertilizer Manufacturers of the Philippines (volume in metric tons) can be gleaned from the FPA website:

Month	*Production*	*Sales*	*Imports*	*Exports*
January	315	237	129	
February	531	605	239	
March	539	417	110	160
April	711	909	-	
May	553	323	147	20
June	416	528	154	
July	631	782	-	
August	527	552	129	
September	589	506	41	
October	447	382	235	20
November	529	560	-	
December	484	509	220	
Total	6,271	6,309	1,404	200

Objective of this report. This report focuses on the rice sector and the concerted efforts of the various national and international (notably the International Rice Research Institute, IRRI) agencies to address the skyrocketing costs of inorganic fertilizer inputs to avert negative impacts on the country's food supply. The objective is to elucidate on the national government program on integrated nutrient management and to share the experiences with other Asian countries.

THEORETICAL FRAMEWORK

In program design of the integrated nutrient management, there are basically three major elements that must be considered – (1) the soil, (2) the crops, and (3) the nutrients recycled in the soil and needed for uptake by the crop.

Soil quality. Since agriculture is nutrient mining by the crop, declining soil fertility is the major issue that must be addressed. The physiographic location as well as the physical properties of the soil affect its chemical properties. The human or anthropogenic factor need also to be considered. The way soils are managed can improve or degrade the natural quality of soils. Organic matter is important for proper management of soil fertility.

Crop nutrient requirements. Crops need a given quantity and mix of nutrients to flourish and provide the desired yield levels. A shortage of one or more of the nutrients can inhibit or stunt plant growth; excess levels can be wasteful and harmful to the environment. To achieve healthy crop growth and optimal yield levels, nutrients must be available not only in the correct quantity and proportion, but in a usable form and at the right time.

Nutrient cycle. Soil nutrient availability changes over time. At any one time, a certain amount of organic and inorganic N, P, and K is present in the soil in stable or labile plant-available forms (Roy, et.al. 2003). Nutrient cycling involves complex biological and chemical interactions. Important input sources are inorganic fertilizers; organic fertilizers such as manure, plant residues, green manuring; and cover crops; nitrogen generated by leguminous plants; and atmospheric nitrogen deposition. Nutrients are removed from the field through harvested crops and crop residues, as well as through leaching, atmospheric volatilization, and erosion. It is important that policy makers are aware of any gaps in nutrient balance (what the soil can supply as against what the crop needs) so that they can make and implement proper and appropriate policy directions.

The major issues and challenges to address. While our major concern in integrated nutrient management is addressing any gaps in nutrient balance, we should realize that there are other interrelating issues that complicate any policy decisions at national level. We can cite two examples –

(1) The plateau in yield growth. Despite continued development of new and improved modern varieties and greater use of chemical fertilizers, there is a global slowdown in yield growth. From 1961 to 1990, yield increased from about 1.87 tons per hectare to 3.61 tons per hectare owing to wide adoption of high yielding varieties, availability of irrigation water, and intensive use of agro-chemicals. By 1997, rice production has tripled compared to the 1961 levels. However, it is recognized that the yield potentials of high yielding rice varieties have reached a plateau, which conventional breeding has not been able to surpass.

In the Philippines, the national cumulative average yield for rice is about 3.8 metric tons per hectare (4.21 tons per hectare for irrigated rice and 2.5 tons per hectare for rainfed areas). The national average of course varies from year to year and from cropping season to cropping season. The Department of Agriculture launched the Ginintuang Masaganang Ani (GMA) banner programs to cover rice, corn, fisheries, livestock, and high value commercial crops to increase agricultural productivity. GMA banner programs target to cover significant percentage of the agricultural areas for introduction of production technologies, infrastructure, credit, and market support. About 300,000 to 500,000 hectares of a million hectares of rice lands are targeted for inclusion in the GMA Rice Program. The program objective is to increase rice production from 16.24 million metric tons in 2007 to 17.3 million metric tons in 2008. A glimpse of 2007 rice production in the Philippines covers 1,042,340 hectares; for the 2008 dry cropping season, the area coverage is 1,040,003. (BAS, 2008).

Corn is the second most important crop in the Philippines. The areas devoted to corn has been declining because of poor farm profitability owing to confluence of several factors like low adoption of production technologies, high post harvest losses, and high transport and marketing costs. The GMA Corn Program was launched to increase productivity and production quality of corn for human consumption, feeds, and industrial uses. The GMA Corn Program targets corn cluster areas in 27 major corn producing provinces covering some 100,000 hectares of agricultural areas with potential for growing of corn. As for corn production statistics, the 2007 total area for both white and yellow corn is 2,046,000 hectares with total yield of 5,291,000 metric tons or a yield average of 2.59 metric tons per hectare. The 2008 dry season figures are 2,154,000 hectares with production of 5,807,000 metric tons or yield average of 2.70 metric tons per hectare. (BAS, 2008)

At farm level, any targeted improvements from previous yield level would have corresponding nutrient inputs. And this is in addition to other production inputs such as use of improved variety, and other infrastructural support like provisions for irrigation facilities in irrigable areas. When this target yield increase is translated to national policy, the added production costs could be interpreted as production subsidy to marginal farmers.

(2) Rising costs of fertilizers. For January 2007, at national level, the prices of three grades of fertilizers increased relative to previous year's records – urea by 1.37-percent (PhP900.21 per sack), ammonium sulphate by 0.31-percent (PhP471.75 per sack), and ammonium phosphate by 0.15-percent (PhP724.50). The price of complete fertilizer slightly decreased by 0.10-percent (PhP757.02 per sack). By May 2008, at the national level, prices of all grades of fertilizers were increasing faster compared to the rate of price increases of the previous year with increases ranging from 46.51-percent to 119.85-percent. Just to compare with the cited 2007 prices of fertilizers, urea cost by end of May 2008 PhP1,437.04 per sack, ammonium sulphate is PhP883.61 per sack, ammonium phosphate is PhP1,629.78 per sack, while the complete fertilizer is PhP1,627.66 per sack. The cost of fertilizer inputs are getting beyond the reach of ordinary farmers. Any production subsidy to marginal farmers could mean either higher budgetary support (and the country's resources are limited) or lesser farmer beneficiaries for its GMA banner programs (the most likely option). Thus, attaining food production targets to feed the country's increasing population is being put in jeopardy.

THE INTEGRATED NUTRIENT MANAGEMENT (INM) PROGRAM: THE SAMPLE CASE FOR RICE

The goal of the program. Hossner and Juo (1999) stated that in integrated nutrient management, the goal is to combine old and new methods of nutrient management into ecologically sound and economically viable farming systems that utilize available organic and inorganic sources of

nutrients in a judicious and efficient way. It attempts to achieve tight nutrient cycling with synchrony between nutrient demand by the crop and nutrient release in the soil, while minimizing losses through leaching, runoff, volatilization, and immobilization.

The agencies involved. The Department of Agriculture's GMA Rice Program is the lead agency in the rice self-sufficiency program at the national level and coordinates the implementation of all projects and activities relating to production, credit, and marketing. The development of an integrated nutrient management program for rice is coordinated by the GMA Rice Program.

The Philippine Rice Research Institute (PhilRice) undertakes, coordinates, and funds the national R & D program for rice and rice-based farming systems. They are also involved in rice technology promotion and policy advocacies to be able to serve as vital force in attaining and sustaining rice sufficiency.

The Bureau of Soils and Water Management (BSWM) is the focal point in the implementation of the National Organic Agriculture Program. Executive Order 481 (Promotion and Development of Organic Agriculture in the Philippines) was signed by President Gloria Macapagal Arroyo in 27 December 2005 to focus on regulations and guidelines; certification and accreditation; market promotion and networking; organic information for producers, handlers, and processors; research, development, and extension. BSWM undertakes the Agri-Kalikasan Program that promotes the organic-inorganic fertilizer mix and the use of biofertilizers.

Based in the Philippines, the International Rice Research Institute (IRRI) works closely with rice-producing and –consuming countries for partnership in research, training, and dissemination of sustainable technologies. For the rice INM program, the Crop and Environmental Sciences Division develops the Nutrient Manager, a computer-assisted decision tool in the development of fertilizer recommendations.

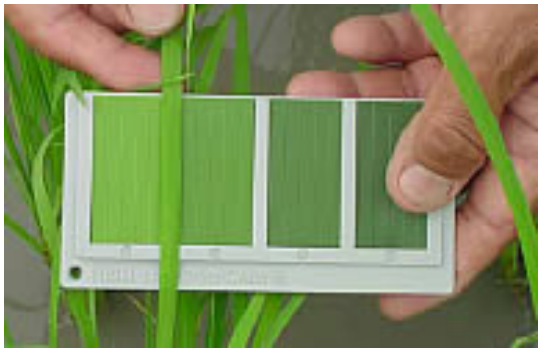
There are other relevant government agencies and non-government organizations (NGOs), although not directly involved in INM program, but part of the Organic Agriculture Program and plays major role in the organic fertilizer industry: The Fertilizer and Pesticide Authority (FPA) – which handles not only fertilizer supply and demand but also the regulatory aspects; the Bureau of Agriculture and Fisheries Product Standards (BAFPS) for setting of organic fertilizer standards; the University of the Philippines at Los Baños – National Institute of Molecular Biology and Biotechnology (BIOTECH) for the development and commercialization of biofertilizers; the Organic Producers and Traders Association (OPTA) which is a national network of organic farmers and traders established to police among themselves the organic integrity of products. The Department of Science and Technology (DOST) through its Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD) complements efforts of the Department of Agriculture in the development of INM and the Organic Agriculture Programs.

The Integrated Nutrient Management Program. Historically, as early as 1989, it was the rice farm sector that was first to introduce INM through the use of compost fungus activator (Ponce, 2004). Its initiator, Dr. Virginia Cuevas, received the 1989 DOST Pantas Award for her pioneering studies on the utilization of *Trichoderma harzianum* to hasten decomposition of rice straw and other farm wastes as substitute for chemical fertilizers in crop production by small farmers (Cuevas, 1989). Her study recommended a combined use of one-half organic and one-half dose of inorganic fertilizer, improving yield by as much as 20-percent. The labor input cost in compost preparation and field application was expected to be offset by the yield increase. However, later studies show that this is only true if the wages in the community are low and non-farm incomes are not available (Rola, et.al., 1996).

In 1998, BSWM launched the Balanced Fertilization Strategy (BFS) that promotes the optimum use of organic and inorganic fertilizers with the proper grades and amounts that supply the correct ratio of plant nutrients to ensure soil productivity. The country was divided into seven fertilizer groups for the purpose of developing the site specific organic-inorganic fertilizer recommendations for rice and corn. BFS requires prior information on the base nutrient content of the soil plus the amounts of fertilizers applied during the previous cropping season. Thereafter, adjustments are made in the organic-inorganic fertilizer mix for the succeeding cropping seasons.

As a consequence, the use of soil field tests or qualitative soil tests, specifically the **Soil Test Kit** for NPK fertilizer rate computation can be considered as an integral sub-component of the INM program. BSWM further developed the **Rapid Soil Test Kit** (RST) for quick field analyses of lime requirement, zinc, calcium, magnesium, sulphur, ammonium, and nitrate.

Furthermore, PhilRice developed the leaf color chart which is being used as a qualitative crop diagnostic tool in timing and amount of nitrogen fertilization.



Taking off from the BFS, BSWM launched in 2006 the Tipid Abono Project (literally translated as "judicious use of fertilizers") and the Modified Rapid Composting (MRC) Project under the Agri-Kalikasan (literally translated as "natural agriculture") Program.

The Tipid Abono Program introduces the use of biological fertilizers or soil inoculants in addition to organic fertilizers. Furthermore, the farming community is encouraged to produce its own organic fertilizers instead of just relying on commercially available ones by providing farmer cooperatives with shredders and making available composting technologies such as vermiculture, and use of compost enhancers such as fungal and enzyme activators.

In MRC, we discourage the burning of rice straw in accordance with Republic Act 8749 or the Clean Air Act of 1999. The project concept takes cognizance of the extra effort needed to compost rice straw, and promotes its decomposition in-situ, or right there in the field. The promotion and use of compost activators is part of the program

Current thrusts and challenges. There are currently two biological fertilizers or soil inoculants being promoted by BSWM – (1) the commercial use of nitrogen-fixing bacteria, *Azospirillum* sp. and commercially available as Bio-N, it is applied in the GMA-Rice as well as in the GMA Corn Programs; and (2) the fungal-based soil inoculants consisting of three strains of *Trichoderma* sp and commercially available as Bio-Con, and it is used in the BSWM Agri-Kalikasan Program for enhanced nutrient uptake. The two biofertilizers are registered with FPA for commercial distribution and given to farmers as part of the production kit. The promotion of soil inoculants is seen as complementary efforts to organic fertilization and thereby reduce inorganic fertilizer levels. BSWM is also in the forefront on the continuing promotion of *Rhizobia sp.* for leguminous crops and *Trichoderma harzianum* as compost fungus activator.

As other decomposition enzymes and compost activators become commercially available in the Philippines for conversion of solid urban wastes and farm wastes to organic fertilizers, BSWM will be in the forefront for its promotion. Corollary to this, the promotion of composting equipment, primarily shredders, will remain a priority equipment grant for the farming communities.

Thirdly, to mainstream the organic-inorganic fertilizer-inoculant recommendation currently promoted in Agri-Kalikasan with that of fertilizer recommendation for GMA Rice, the promotion and use of Nutrient Manager developed by IRRI as a computer-assisted decision tool for computing inorganic fertilizer rates would be considered as an important INM component. The IRRI-developed decision tool can deduct organic fertilizer inputs, soil inherent fertility including natural renewal such as those brought about by siltation due to flooding, and those NPK brought about by the microflora and microfauna in the rice ecosystem. BSWM is in the process of reviewing its organic-inorganic fertilizer recommendation rates using Nutrient Manager.

SUMMARY AND CONCLUSION

The Philippine INM program for rice consists of several inter-related components:

1. Organic fertilizer use – focused on management and utilization of farm wastes
   a. The promotion of commercially available organic fertilizers;
   b. The promotion of community-produced organic fertilizers through technical assistance on availability of shredders and compost activators;
   c. The promotion of in-situ composting under the Modified Rapid Composting Project
   d. The promotion of commercially available biological fertilizers, soil inoculants, and compost activators.
2. Inorganic fertilizer use – focused more on efficiency and timing
   a. The promotion on the use of qualitative field tests such as Soil Test Kit (for NPK) and Rapid Soil Test Kit (for micronutrients);
   b. The promotion on the use of leaf color chart;
   c. The promotion of Nutrient Manager developed by IRRI as a computer-automated decision tool in computing site-specific fertilizer rates.

It will be basically the same INM program for corn, except that in the absence of Nutrient Manager for corn, site-specific fertilizer rates for purely inorganic, and organic-inorganic mix are continually being developed as part of the corn fertilization R & D. A network on site-specific nutrient management for corn has been established among the various government and international institutions with the Bureau of Agricultural Research as lead among the Department of Agriculture agencies and affiliates and with the UPLB in the forefront for the academe. The GMA Corn Program coordinates all corn-related activities in the Department of Agriculture including the research component. It is the International Plant Nutrition Institute that assists the Philippines in the development of site specific nutrient management recommendation for corn.

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