INDIGENOUS SEED, KNOWLEDGE AND RICE PRODUCTION PRACTICES OF THE MARANAOS IN MAPANTAO, LUMBA-BAYABAO, LANAO DEL SUR

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A community’s seeds and seed system are keys to cultural knowledge and may open avenues to sustainable agriculture and development. A study was conducted in the Maranao area of Mapantao, Lumba Bayabao, Lanao del Sur to evaluate rice agronomic practices in the context of the area’s bio-physical and socio-cultural characteristics, including rituals and associated beliefs. Storability and other seed characteristics, as well as crop field performance were assessed using four local farmer-developed varieties (traditional or introduced). Seeds collected from farmers were stored up to six months under ambient conditions in both Mapantao and UPLB, and in a 13°C chamber at UPLB. Field performances were assessed in Mapantao under three production practices: use of synthetic fertilizer (244-44-44, modified Mapantao practice (112 kg N/ha manure from carabao and cow) and control or no fertilizer. Mapantao is on a valley near Lanao Lake, with rainfall that is favorable for lowland rice and a yearly average temperature of 23°C. The soil has high organic matter (4%). Rice farmers are mostly tenants, resource-poor, and they do two plantings using formal varieties and chemical production system. The younger farmers have stronger inclination towards modern agricultural practices than older farmers who, on the other hand, still know (but mostly no longer practice or use) traditional systems. Seed quality from farmers was high. Seed dormancies were generally short or non-existent. After six months of storage, germination levels from all storage treatments were still high (75-90%). Germination under ambient UPLB (28°C) was the lowest. Mapantao gave generally 10% higher seed germinability than cold storage. Overall, the two traditional varieties ‘Lantik’ and ‘Kotong,’ were poorer storers than ‘AG5’ and ‘M12-22B5.’ Seed (grain) yields from all production practices were relatively high compared to the national rice yield average. ‘Lantik’ (glutinous white) and ‘Kotong’ (glutinous black), produced the highest (6.6 t/ha) and lowest (3.9 t/ha) yields. Modified Mapantao gave the lowest yields (4.5 t/ha). The yield from control or no fertilizer application (5.1 t/ha) was not significantly different from synthetic fertilizer treatment (5.6 t/ha). Among the yield determinants taken, only filled grain percentage and spikelet number were positively, but only moderately, associated with yield.

dormancy, farmer-bred varieties, indigenous knowledge, Maranao agriculture, modern agriculture, quantum mechanics, rice seed system, seed storability, sustainable agriculture, traditional practices, traditional varieties

INTRODUCTION

Seeds and associated management practices mirror the culture and environment of a community and have been critical in the survival of local or indigenous communities (Pareño-De Guzman & Fernandez 2001). Local seed management is highly integrated with a people’s way of life and practices including belief system and actual crop production. A change in the seed inevitably leads to change in culture, while culture spells the survival of a community (Tauli-Corpuz 1998, Fernandez 1994 & Boef et al. 1993). The agricultural intensification in the 1960’s and 70’s, through the Green Revolution, came in through the seed, specifically IR8, or Miracle Rice. Communities and countries have changed because of the Green Revolution. That movement has superimposed modern agriculture on diverse indigenous agriculture, water and forest management systems (Tauli-Corpuz 1998). Meanwhile some efforts are being done to reverse local damage, including documentation and promotion of indigenous knowledge systems, which encompass seed and related agricultural practices (Fernandez 1994). Seed practices and seed systems involve a wide range of activities and
decisions such that analysis of these activities and the farmers' indigenous knowledge can reveal where and how quality of local seeds may be promoted or improved by the local people for a more sustainable agriculture or sustainable development effort.

It is globally acknowledged that the process and results of farmer experimentation and crop improvement have been important in promoting diversity and the conservation of species and varieties (Boef et al. 1993, Ashby et al. 1989). Moreover, landraces, products of farmers' breeding, have made vital contributions to crop science. Unfortunately, the roles that farmers play in seed development have been largely unacknowledged or unrecognized by the formal sector (Fernandez 1992). Local or farmers' seed production systems have greatly allowed diversity of practices, varieties and crops species (Almekinders & Louwaars 1999). Local species are highly adapted and suit local needs and preferences.

A holistic study of farmers' ways will reveal not only the actual practices and approaches, but also their greater context and overall culture. Various studies have shown that indigenous seed systems and practices, highly accompanied by rituals, snugly fit into the framework and dimensions of sustainable agriculture (Fernandez 1994). The Philippines has significant populations of indigenous peoples. Among these, of great interest and challenge, especially to an outsider, is documenting the agricultural seed system of the Maranao in Southern Philippines. This is because the area is highly politically insulated and the Maranaos are among those who successfully resisted Christianization of the country. The first author belongs to that group and thus had a freer access to the area. The study site, Barangay Mapantao, is one of the 38 villages of Lumbar Bayabao, which has the biggest rice land area in Lanao del Sur (Figure 1).

The study aimed to analyze the Maranao seed practices in the context of the area's biophysical features, agronomic practices and culture, including rituals and belief system of the local people. Seed practices cover the whole rice system, seed sourcing, field production, harvesting, storage, maintenance, conservation, and product utilization. The documentation and appreciation of the Maranao system may help clarify misconceptions and explain local systems, and help promote their strengthening, especially in the light of their being actually backed by holistic scientific principles.

The validity of indigenous practices is now bolstered with the emergence of a new science (i.e., quantum mechanics) (Perlas 1993) and the recognition of the limitation of material science to explain certain phenomena or processes. The movement to recognize indigenous practices and systems is spreading (Gupta et al. 1990) and now manifests in newer approaches, such as biodynamic farming, that ride into the realm of subtle energies (Steiner 2003 & 2005, Diver 2000). Biodynamics has been recommended by the Indian Council of Agricultural Research as a form of sustainable agriculture (Sud 2003); more than that, it has revolutionized the growing of banana in the Dominican Republic (Boshart 2004).

**MATERIALS AND METHODS**

The research had three components, namely (1) documentation of biophysical, socio-cultural characteristics, including people's rituals and beliefs associated with rice seed and production practices, (2) study on rice seed quality characteristics and storability using four local or farmer-bred varieties, and (3) comparison of the field performance of selected varieties when grown under three production practices (conventional or with chemical fertilizer, modified Maranao with animal manure, and no fertilizer treatment). The four varieties used were the two traditional or landraces 'Lantik' and 'Kotong,' and the two farmer-bred 'AG5' and 'M-12-22-B5' which had been introduced from Nueva Ecija (Northern Philippines) and are now locally adapted.

**Biophysical, Socio-cultural and Agronomic Aspects of Mapantao**

Individual and group interviews of key informants were conducted from October 2002 to April 2003. The study was focused on rice seed systems, while other crops or systems were also noted. Key respondents were Mapantao farmers. The ages of the farmers who were interviewed were grouped into three – the younger (19-38 years old or those born between 1965 and 1984), the middle-aged (45-53 years old or those born between 1950 and 1958), and the older ones (58-86 years old or born between 1917 and 1945). Out of the 22 respondents, only two were female.

**Seed Quality Traits and Storability**

Seed physical and quality traits, including storability under Mapantao and UPLB conditions of four varieties (naturally dormant or with dormancy broken) were assessed. Seeds were two months old. Seed germination
ability, field emergence as an expression of seed vigor, and moisture content were determined at UPLB. For seed health determination, sample seedlots from each of the varieties collected from the farmers and from the subsequent field experiment were submitted to the Bureau of Plant Industry (BPI), Quezon City for testing. In general, the seed testing methodology adapted the ISTA rules (ISTA 1985). Replications and amounts of seeds used for the initial assessment of germinability, field emergence and moisture content were modified according to seed availability, thus the values 3x50, 3x50 and 2x5g, respectively. Purity or heterogeneity of seedlot was evaluated; the values were all above 90% (high purity). Before storage, the dormancy of seed varieties for the no-dormancy treatment was artificially broken according to ISTA procedure, which is heat treatment (50°C) for 3 days. The seed physical dimensions were measured, endosperm starch type verified, and grain shape and hull color noted. The factors (and factor levels) for the storage experiment were varieties (the same four used to determine physical characteristics), storage condition (ambient-Mapantaos, ambient-UPLB and cold temperature (13°C cold chamber at UPLB), and storage duration (2, 4, and 6 months). Initial seed moisture content was 12%. Seeds were kept in net bags. Statistical analyses of dormant and non-dormant seedlots were done separately. Dormant seeds were represented only by the first three varieties (‘Lantik,’ ‘Kotong’ and ‘AG5’) while non-dormant seed was represented by four varieties, with naturally dormant ones having their dormancy artificially broken. Germination percentage (top of paper), field emergence, and moisture content of seeds from the different storage set-ups were determined according to ISTA rules. Germination data only represented actual germination. The remaining firm seeds when present were not further tested for germination. Given high seed germinability and vigor and the known longevity of seeds, which is more than a year, it was considered that non-germinated firm seeds in the dormant seed set-up were dormant. Field emergence as a test of seed vigor was carried out by planting seeds in a soil medium in the screen house of the Department of Agronomy, UPLB. Seed moisture content was assessed following ISTA rules.

**Agronomic Performance of Four Varieties Given Three Different Rice Production Practices**

The field study was conducted in Mapantaos from February to July 2003. The study area as far as residents could remember had been exclusively under a rice-fallow system for many years. For land preparation, natural vegetation was cut manually and mixed with animal manure, which came from grazing animals (cows, carabao and goats) during fallow, and plowed into the soil. Flooding (from a nearby irrigation water source) was done two days after land preparation. Plowing was done twice. Harrowing was done the day before seedling transplanting, which in turn was conducted 25 days after the initial land preparation. Handweeding was done in all plots throughout the growth period until maturity. Instead of the common wetted practice of seedling preparation, the “dapog” method was used for all seedling treatments. No pesticide was applied in any of the treatments.

The factors (and factor levels) for the field experiment were variety (the same set of varieties as in the storage experiment) and rice production practices (synthetic fertilizer), modified Mapantaos fertilization using carabao and cow manure from local farmers based on a 112 kg N/ha rate and the control (no application of fertilizer). Synthetic fertilizer treatments used were 14-14-14 (at 44-44-44 rate) and urea (at 200-0-0 rate) which was applied in split. Seeds of all treatments were 8-10 months old at the time of planting. The experimental design used was split-plot in Randomized Complete Block Design (RCBD) with four replications. Production practice served as main plot and variety as sub-plot. Data was analyzed using the ANOVA procedure and means were compared using Least Significant Difference (LSD) and Duncan’s Multiple Range Test (DMRT).

Other information and practices incorporated in the different treatments were as follows: a) Modified Mapantaos practice – animal manure was applied 15 d before transplanting; planting distance was approximately 21x21 cm (or 227,000 hills/ha), which is the local spacing used; b) Conventional practice – basal application of 14-14-14 and half of urea 15 days before transplanting; top dressing of urea was done 55 days after transplanting; planting distance was 20x20 cm (250,000 hills/ha); and c) Control – plots were not given any fertilizer or pesticide; with 20x20 cm (250,000 hills/ha) planting distance. The amounts of organic and inorganic fertilizers applied were calculated based on the soil analysis and the recommendation of the Bureau of Soils and Water Management, Department of Agriculture.

The parameters taken for the field experiment were (1) plant height noted from five randomly selected plants (done 10 days before harvesting), (2) number of tillers
from the same randomly selected and tagged plants for plant height, taken at 50-55 days after sowing, (3) grain yield obtained from harvested mature tillers from the inner one m² of each plot, and (4) yield components or determinants, including number of panicles per hill, panicle length, percentage of filled grains per panicle, total number of spikelets per panicle, and 1000-seed weight, which were all collected from the same plants used for grain yield determination. Yield was taken from seeds with 12.6% moisture content.

RESULTS AND DISCUSSION

The Mapantao farmers’ agricultural knowledge shared in the interview was from their elders, personal experience as well as government technicians. Modified rice farming is now the norm, which is adapted from both traditional and modern practices. Farmers rely mostly on local inputs while some do not apply fertilizer at all. Yet in general they claim they are able to produce adequate harvest to feed the family and pay debts. Economically, they still are marginalized. Most of the farmers do not own a farm animal, such as carabaos, so they still rent it for essential farm activities such as land preparation. Most Mapantao farmers are tenants.

Government assistance through agricultural technicians had not been sustained. An irrigation system was provided in 1972, which allowed farmers to have two cropping(s) yearly. Seed chemical fertilizers and other inputs are a challenge to source out, while seminars are few. There are neither existing cooperatives nor organized groups that could have helped keep farmers abreast of development from outside.

**Biophysical and Socio-cultural Profile of Mapantao**

**The Environment.** The farmers who were interviewed were articulate and highly willing to impart knowledge on their local practices. Farming is the main source of livelihood in the province. Rainfall is ample (200.3 cm yearly average) and average yearly day-night temperature is 19–25°C; the soil is also fertile and considered suitable for rice and corn production (Provincial Profile 2001). The area has a sandy loam soil type with 4% organic matter based on the soil sample analyzed at UPLB. The soil is an alluvium deposited by the Salicata River, which is the main source of irrigation water for the Mapantao farmers, and is connected to Lanao Lake, which in turn is the water source for the whole province (Figure 1). Two lowland rice croppings per year is already feasible with the use of short duration varieties and irrigation. The longer duration traditional rice varieties, which were grown before the Green Revolution, only allowed one cropping.

**Biodiversity.** A farm practice that is gradually being lost among the new generations is backyard gardening. Maranaos are eaters of chili or hot pepper. Thus this species still exists in abundance. Commonly raised animals include goats, ducks and native chickens. The carabaos are mostly rented from other farmers. Horses are less common in Mapantao but are used for transporting goods from the valley up to the mountain areas. They are also raised in Barangay Gambio, south of Mapantao.

**Socio-cultural Profile.** The respondents came from a lineage of farmers. Polygamy is common practice, the area being a Muslim community. Early marriages constrained farmers to finish schooling. The highest educational attainment was 2nd year college, but this by only one respondent out of 22. Almost a third of the respondents have undergone Arabic education, which integrates and teaches the Islamic faith. Because Maranao families are patriarchal in nature, the male Maranaos handle the tedious work in farming while the women or the wives help in the lighter farm work. Women are in charge of seed and grain safekeeping.

Very few women in the past were professionals since Maranao parents keep their female children at home to learn Arabic and do household chores. Mat weaving has already become rare since most Maranao women prefer professional careers. Men and women with college degrees are pursuing careers in teaching or office job, if not the chance to have overseas contract work. The prevalent aim of parents is to send children to school so they don’t become like them, poor and “just farmers.” The older farmers related that rice production used to be primarily for the family and secondly for the market. Today, focus has shifted to the market. Thus there has been a shift in values along with a growing family, and greater external influence.

**Maranao Rice Production and Related Beliefs, Rituals and Other Cultural Practices**

Many superstitious beliefs and rituals of the Maranaos relate to agriculture, particularly to rice cultivation. Respondents cited a number of beliefs and rituals (also called ‘kakup-kupet ko elaw’ or ‘arate’) associated with seeds and rice cultivation (Box 1).
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<thead>
<tr>
<th>ASSOCIATED WITH</th>
<th>BELIEF / RITUAL</th>
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<tbody>
<tr>
<td>Stars at night</td>
<td>1. Appearance of certain stars at night and their position in the sky indicate rain, thus favoring planting of rainfed crops. Respondents no longer check the sky out for their planting.</td>
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<td>Astrology</td>
<td>2. 'Kapaminion' or Maranao astrology describes the periodic movement of the constellations across the heavens. This is used as guide for their agricultural practices. Some rituals and practices that may help indicate the best planting and harvesting time need a consultation with a Maranao astrologer to interpret the constellation movements. Respondents don’t consult astrologers anymore.</td>
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<tr>
<td>Pregnant woman</td>
<td>3. Seeds for the next cropping season and which are in the house where there is a pregnant woman or a dead person should be separated or transferred to another house to prevent rat infestation of the field when the seeds are planted. Respondents are still practicing this.</td>
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<td>Epic heroes</td>
<td>4. 'Kashawing' is a rice ritual, which considers the supremacy of the Maranao’s epic heroes. This is no longer incorporated in the current agricultural practices.</td>
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<tr>
<td>Silent prayer</td>
<td>5. For a bountiful harvest, older Maranao farmers utter a silent prayer before or while planting. The prayer goes this way: ‘Assalamualaikom embutad akun na pur ko di leyawaw a buta, lupa, buta so taman ko amo, reya, na di neyan dun kanonowan na di dun kumaran’. In English it means ‘Allah be with the seeds while we sow them into the soil and keep them away from rat damage;’ some ask older farmers to do the prayer; others do this while facing ‘kaaba’ (west) or direction of sunset; ‘pamalotan’ or the practice of placing cut turfs or bamboo sticks tied around the growing rice plants in the middle part of the field is being done for the same purpose. Respondents no longer practice these.</td>
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<tr>
<td>Flowering of Mango</td>
<td>6. Traditional rice seed varieties are planted when mango trees start to flower. Respondents no longer practice this.</td>
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<td>Sunday</td>
<td>7. Sunday is believed to be a good day for pre-germination as it is also believed to bring good harvest even before the 1960s and 70s, as reported by the older and middle-aged respondent groups. Other crops may have similar rituals or beliefs as that of rice; but days of planting differ: root crops produce better when planted on Saturdays or Sundays; red beans will give good produce when planted during Sundays; leafy vegetables on Tuesdays, trees on Wednesdays, and Thursdays for sugarcane. Respondents no longer practice this. Friday is a holiday for Muslims for this is the time they do the ‘jam’at prayer. They are still practicing this.</td>
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<tr>
<td>Offering for good harvest</td>
<td>8. ‘Kabto’ is the hanging of few rice panicles at the ceiling of the house as offering to spirits or a prayer for good harvest. Panicles are cut a few days before harvesting. Cut panicles are brought in to the house and exposed to smoke then hung on the ceiling. This is done with a ‘hat’ or intention for good harvest. One respondent still practices this.</td>
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<tr>
<td>Verse reading from Quran</td>
<td>9. ‘Pulembonan,’ the act of reading a verse from the Quran on each side of the field asking Allah to safeguard the rice crop from pests and other elements that may cause low yield, is done late afternoon for seven days until harvest. Late afternoon is the time of praying called ‘ashar’, where most wishes asked from Allah are granted. Very few among the respondents still practice this.</td>
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<td>Tithe</td>
<td>10. After threshing, 10 'jantias' (25 kg) of the harvest are taken and the tenth portion of this is given to a high priest or religious person as a form of ‘zakat’ or tithe. This practice is believed to bring more blessings and to keep away the negative forces. ‘Zakat’, or the giving of alms to the poor, is considered a must for every Muslim, it being part of the five pillars of Islam and is being practiced by all respondents.</td>
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<td>Prayer against rats</td>
<td>11. To drive rats away, a practice is to walk around the rice field and utter a prayer: ‘Assalamualaikom ko elawe, leyawaw ko di manin, bentok ko halungan, patre ko badan humbang ko neyawa’ (May Allah be with the seeds and may there be good harvest as rice putting the grains into the sack and while washing the rice to be cooked. This practice is still going to be a part of our body and soul). This could also be done when weighing and done by older farmer. However, younger farmers occasionally request an older farmer who is knowledgeable about this practice to do this for them. Only the older respondents do this.</td>
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<td>Slaughtering a chicken</td>
<td>12. ‘Pukasangay’ is a practice of slaughtering a chicken to drive away negative forces that may bring negative incidents while working in the field. It is believed that such practice would prevent rat infestation on the crops. Respondents no longer practice this.</td>
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<td>Sneezing</td>
<td>13. Sneezing before leaving the house is believed to be a bad omen for the traditional Maranaos. If sneezing happens on the way to the field, a farmer needs to rush to the field so he will arrive ahead of the unseen negative forces. Respondents are no longer mindful of this.</td>
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These beliefs and practices are often labeled superstitious but are highly related to astronomy and quantum mechanics or metaphysics, not only faith and spirituality (Fernandez 1994, Fernandez et al. 2002, Diver 2000). A time-tested model of agriculture, biodynamic farming (ATTRA 2004, Podolinsky 2004, Steiner 2005, Perlis 1993), offers insights. Biodynamic farming has grown in popularity since 1922 (Saunders 2007). Biodynamics relates to cosmic energies, astronomy and metaphysics. Biodynamic agriculture is compatible with social, economic, cultural and environmental development goals (Perlasis 2000).

Some of these ritual- and belief-based practices are still being practiced but mostly, if not only, by the older respondents. An indigenous knowledge system is derived from living in close contact with the earth (Parreño-De Guzman & Fernandez 2001). The current agricultural production practices (both the “peripheral” and actual management system) among the Maranaos are deeply rooted in Islam and are still basically traditional.

_Crop Production and Seed Practices_

_**Land Preparation.**_ Farmers are highly dependent on animals for cultivation. Carabao-drawn farm implements such as moldboard plow, harrow are common. The oil-driven small-farm rototiller is also used.

_**Cropping Practice.**_ Most farmers do not practice crop rotation, while root crops, local vegetables and other fruit-bearing trees are grown in the farm or backyards.

_**Soil Management.**_ The older farmers believe that the soil is alive and has life and life forms. All of the farmers are generally aware that their soil is good, based on good harvests. But they still apply synthetic fertilizers even for traditional varieties. Younger farmers tend to use more fertilizers which are being promoted by government extension agents, although the amounts applied are lower than formal recommendation. Rates may also be based on what farmers hear from other farmers.

Indicators of good soil to the farmers are dark color, earthworms, and good water-holding capacity. A poor soil to them is where there is no vegetation that grows, or which produces low yields. Rice farmers leave rice straw in the field to decompose, but burning is also done when there are large amounts of biomass that have accumulated and farmers are already ready to plant. Farm animals comprise of carabao, cows and goats and these are tied in the field during fallow period, thus contributing to soil fertilization.

_**Weed Management.**_ Manual weeding is common but sometimes herbicides such as 2,4-D are used especially when cash becomes available. Usually non-crop biomass or weeds, which also grow luxuriantly especially before cropping, are gathered and left to decompose in one spot of the field. These serve to fertilize the soil. Fields are also flooded occasionally (most commonly two days after clearing and two weeks after transplanting) to suppress weed growth. In general, the respondents consider wild plants growing as weeds (pests) while the rice is growing, but some also considered them as nutrients for the next crop.

_**Pest Management.**_ Synthetic pesticides, which are already available in the area, are applied by a few farmers for pest control, one or more times on problematic spots or as the need arises, as determined by the farmers themselves. Biological measures are also being practiced by approximately a third of the respondents, especially, the older ones. For example, rice bugs ("tanangaw" or *Leptocorisa oratorius*) are fed with water hyacinth (*Eichornia crassipes*), which is locally called ‘linamon.’ The plant, which can be collected from Lanao Lake, is tied at the center of the rice field where the bugs would gather. The rice-bug filled ‘linamon’ is then removed and burned. The bird maya (*Oreicus orca*) is reported as a major problem during the ripening stage. Most respondents would connect bamboo pegs in the corners of the farm using plastic ropes and create a sound that frightens the birds. This practice is locally called ‘pamarayongan.’ Snails are mostly manually removed from the paddies. For rats, most respondents use available chemical rodenticides mixed with a painful of rice grains. These baits are left at the corners of the field.

Some respondents, especially the older ones, recalled that pests became prevalent when rice varieties were introduced and farmers started using agrochemicals. They noted that synthetic fertilizers make the stems more succulent and susceptible to insects, a phenomenon associated with chemical farming and had been given scientific explanation (e.g., Lampkin 1995, Chaboussou 2004). Farmers observed that pesticides had a temporary effect, and subsequent attacks of pests was worse. They stated that too much spraying with pesticides could burn the leaves and eventually injure the whole plant. However, this knowledge did not translate to action. For the modern varieties, pesticides are used especially by younger farmers.

_**Harvesting and handling of produce.**_ The farmers harvest when 75-80% of the lower portion of the panicle has turned yellow or golden brown. Farmers use sickle to
cut the straw, leaving the harvest in the field to dry for at least two days. The cut panicles are bundled then piled in the field to as high as 6 m, a system called ‘kapagenmong’ by the Maranaos. Thereafter, panicles are manually threshed and winnowed and the grain sun-dried on cemented areas. Most of the respondents sell their unmilled rice to the miller or buyer, sometimes before the grains are fully dry. Grain moisture content is judged mainly from the hull color, by listening to the sound created when the grains are rubbed together by the palms, or by biting the seed.

**Seedling Preparation.** Seedling preparation of Mapantao farmers is commonly by wetted method. Rice seeds in sack are soaked in the irrigation canal of the rice field for 24 hr. Incubation is done for another 24 hr by wrapping the sack of pre-germinated seeds in a thicker sack. Seeds are sown in a wetted of 300 to 350 m². At 40-45 days after germination, seedlings are pulled and transplanted. The planting distance is arbitrarily measured by the span of the thumb against the index finger (‘dangaw’), which is approximately 8-10 inches, which results in a population of about 22,000 hills to a hectare.

**Seed Improvement.** Only very few of the respondents practice seed improvement. Criteria of good seeds vary and include preferred color of grains, good crop stand, high yield, drought resistance, pest resistance, good cooking quality and being aromatic, grain that is dense and full, high marketability, homogenous stand or low proportion of off-types, adaptability to the area, early maturity, sturdy stems, long or short panicles depending on need, greater number of spikelets, and erect leaf orientation. On the other hand, roguing, or the removal of diseased and off-type plants from the main variety, is an old practice for variety maintenance, and practiced by all respondents. Most get their seeds through seed exchange. Seed exchange is done usually among family members and relatives, co-farmers within the area, or from other towns. Very few of the respondents buy seeds from neighboring towns or from other local farmers and stores. Respondents remember that government technicians in the 1970’s brought in some new rice seed varieties.

Approximately half of respondents, especially the old ones, express appreciation of the value of off-types. Those who do usually produced their own seeds and select from the off-types or from the rice plants with good stand. Seeds for the next cropping season are meticulously segregated from the other seedlots at harvest, dried, cleaned and stored.

Respondents cite a special variety called Alimona from Barangay Taloan, which is a few km away from Mapantao. This variety has been selected from off-types and propagated as cultivar, and is now being mass-produced and named after the farmer. Alimona is now popular in the area. It is white, non-glutinous, and soft when cooked. A parallel effort in improvement may be found in many different places (Ashley et al. 1989). In Bohol province, there are farmers who consciously select from off-types of white-grained modern varieties to compose red rice seed population, which commands a high price in the market (Bertuso 2002).

**Dormancy.** Older respondents remember more than the younger ones that the traditional lowland varieties had dormancy, but not as long as that of upland varieties. To them, dormancy is favorable to those who intend to keep seeds for a longer period, especially two years or more. Moreover, seed protection then was through selecting mature seedlots and proper drying to avoid fungi. Further selection for seed health and quality is based on seed germination.

**Seed Storage.** Mapantao’s relatively low average ambient temperature (23°C) favors ambient rice seed storage. Most respondents report that it is a practice to keep seeds in nylon woven plastic bags in a cool dry area of the house, most commonly under the house (‘atag-a-walay’ in Maranao). Farmers who save their seeds would separate enough seeds from the harvested grains to be used for the next cropping. Grains and seeds are stored in a clean part of the house. Seed storage duration is from 3 to 12 months depending on the variety and time of the next cropping. With recent varieties, two croppings are possible.

The respondents believe that traditional rice seed varieties can keep for 2 years as long as they are dried properly. The study of De Guzman & Fernandez (2004) revealed a similar trend in storability of local varieties among the Bagobos of Davao, which is also in Southern Philippines. Most respondents recall that in earlier years, seeds or grains were stored in ‘busuk’ (round woven basket made of rattan and bamboo), ‘busaka’ (big sack made of abaca), ‘kaban’ (traditional rectangular container made of wood), ‘labit’ (round woven basket made of abaca, which can store a minimum of 40 kg rice) and ‘maan’ (woven basket made of bamboo, which can store up to 2 sacks rice). These storage containers are no longer used today, except for ‘busaka,’ which is now made of plastic. Big tin cans with air-tight cover, in
addition to plastic-woven sacks, have replaced traditional containers and materials.

**Rice Genetic Conservation.** Local rice varieties are still present in the area (Table 1). All respondents recall a few of the traditional varieties planted by their elders/parents. The older farmers still plant some of these varieties; these farmers have difficulty describing most of those they can only recall. Respondents describe the traditional rice varieties as having good eating quality, being soft when cooked, late maturing and having tall sturdy stems. Seeds are either with or without awns. From the list enumerated by the respondents, only two remain popularly used by the farmers. This is an indication of serious disappearance of rice genetic diversity. This genetic erosion is necessarily paralleled by loss of knowledge on seed and crop management.

Maranaos are mostly rice eaters and most of the delicacies prepared for special occasions are from rice. Glutinous rice commands a higher price than the non-glutinous. Only two of 10 varieties listed are glutinous. For ‘dodol’ food preparation (pudding-like consistency), black or violet grain glutinous rice is preferred. For ‘amek’ and ‘puto’ (both are a variation of rice pudding) and other delicacies, white grain glutinous rice is used. Of the non-glutinous rice, the Maranaos prefer soft or aromatic types, which have high market demands. These are for the staple carbohydrate served at meals.

A variety trait noted to change over time is crop duration or maturity. Most traditional varieties have long maturity. For example, Kalana matures in 8-9 months, but the ones used in this study mature only in 5 months, and thus offer the possibility of two rice crossings a year, just like the modern varieties. Some modern varieties are even much more early maturing and allow a maximum of three crossings a year.

**RICE SEED CHARACTERISTICS AND STORABILITY WITH DORMANCY**

**Seed Characteristics**

The four varieties studied are all awned and differ in size, hull and grain color. ‘Lantik’ has reddish brown hull and glutinous black grain. ‘Kotong,’ on the other hand, has light brown hull and glutinous white grains. Varieties ‘AGS’ and ‘M-12-22B5,’ on the other hand, have both yellowish hulls and non-glutinous white grains.

Purity or heterogeneity analysis of seedlot by the Bureau of Plant Industry (BPI) shows that values are all above 90% for all treatments. This means that each seedlot has been well processed and is homogenous.

The seed health test report listed the presence of several field and storage fungi on two seedlots, that which are from farmers and from the field experiment. All the seedlots have organisms that can be pathogenic such as *Alternaria*, *Fusarium*, *Cladosporium*, *Helminthosporium*, *Aspergillus* and *Penicillium*. Despite the considerable presence of what are usually considered pathogenic organisms, no disease outbreak has been reported in the area in the most recent or in previous crossings. This indicates that the agroecosystem is stable and/or crops are resistant to these pathogenic organisms.

**Seed Storability under Different Storage and Dormancy Conditions**

Seeds collected and used for the study were 1 to 2 months old and had viability levels above 90%; but those dormant had germination levels that ranged only from 9 to 41% at the start of storage. Variety ‘AGS’ had highest level of dormancy (only 9% germination) while ‘Lantik’ and ‘Kotong’ had approximately 40% germination around two months after harvest. Variety ‘AGS’ had highest germination relative to ‘Lantik’ and ‘Kotong’ over storage time, while ‘Lantik’ dormancy tended to persist the longest. Variety ‘M-12-22B5’ is rated to have no dormancy and had an initial germination of 94%. After applying dormancy-breaking (heat) treatment, varieties had at least double the germination and field emergence than their dormant origin. Variety ‘AGS’ is considered to be weakly dormant, as it easily responded to the heat treatment and readily increased germination level to above 90%. Dormancy of the three originally dormant varieties used was easily broken (although not completely) after 2 to 4 months of storage.

Although the amounts of seeds were not sufficient for some varieties to allow complete treatment trials, some generalized means may still be used for rough comparison. Some dormant seedlot germination levels ranged from 70% to 95% across the different storage time and storage conditions. These are still relatively high values and indicate that dormant seeds may have lower deterioration rate, hence can be stored for up to the next planting season (if planting is around 6 to 7 months after harvest) without any dormancy treatment.

Non-dormant seedlots generally behaved the same way regardless of storage condition. ‘Lantik’ and ‘Kotong’ non-dormant seedlots had lower germination level than ‘AGS’ and M12-22B5. Under UPLB ambient conditions, 6 months of storage gave lower germination.
levels in all treatments. The germination level of the dormancy-broken seeds was lower than dormant ones on the sixth month of storage. By the sixth month, ambient Mapantao storage gave the best seed performance and this was most evident with the two traditional varieties. Cold storage might afford some storage advantage as well, but it was costly and not necessarily better than ambient Mapantao. This is of interest given that it has become an axiom in seed storage that, within specified range of moisture and temperature, the lower the temperature the better it is for seed longevity (Copeland & McDonald 1995). It is of interest to note that moisture content of non-dormant seedlots was lower (10%) as a result of heat treatment than the dormant ones (12.5%), yet seed germination levels of non-dormant seeds were lower around the 4th and 6th month of storage.

**YIELD AND YIELD COMPONENTS**

*Grain yield*

There were significant differences in grain yield among rice production practices and among varieties, and these differences were consistent across treatments (Table 2). Overall the conventional practice gave the highest grain yield. The traditional variety ‘Lantik’ had the highest average grain yield of 6.6 tons/ha (Table 3). This is a difference of 2.7 tons/ha or more than 70% of the other traditional variety ‘Kotong,’ which only yielded 3.9 tons/ha. ‘Lantik’ also produced higher average grain yield of about 18% than ‘AG5’ and 60% than ‘M-12-22B5.’ These results indicate that ‘Lantik’ is the most adapted variety in the site. It also has been selected by farmers for stability and higher yields. The high grain yield can be attributed to ‘Lantik’ having the highest percentage of filled grains (Table 3).

*Filled grain percentage okay*

Significant differences were found among varieties but not among seed production practices in terms of filled grain percentage (Table 3). Varietal differences were consistent across rice production practices. ‘Lantik’ and ‘AG5’ had the highest filled grain percentages, followed by ‘M-12-22B5,’ then ‘Kotong’ (Table 3, Figure 2). Ranking of these four varieties for filled grain percentage was the same as that for grain yield. ‘Lantik’ and ‘AG5,’ which topped in filled grain percentage, had surprisingly shorter grain filling duration than the other two varieties. Days to maturity and grain filling duration, if shorter, would expectedly result in lower filled grains but this was not the case for ‘Lantik’ and ‘AG5,’ which had shorter growth duration than the other two varieties.

**Number of panicles**

The number of panicles per hill was affected by variety and seed production practice but differences were not consistent across treatments. Variety ‘M-12-22B5’ in general gave the highest number of panicles (21 per hill), while ‘Kotong’ had the lowest with only, 16 per hill. Lowest values were under conventional practice. The advantage in this yield component however, was not entirely reflected in the grain yield because ‘M-12-22B5’ may have had the highest number of panicles yet it is ‘Lantik’ that had the highest grain yield. On the other hand ‘Kotong,’ which had the lowest number of panicles and percent filled grain, also had lowest grain yield.

*Panicle length*

For panicle length, there were significant differences due to variety but none due to production practice. Such varietal differences were consistent across rice production practices. Variety ‘AG5’ had the shortest panicle among the varieties but ranked second highest in yield (Table 3). The other three varieties produced panicles of about the same length.

**Number of spikelets okay**

The number of spikelets differed with varieties (Table 3), but not with production practices. Interaction effect between the two factors is significant only at 10% α level. Varieties ‘M-12-22B5’ and ‘Kotong’ had more spikelets than ‘Lantik’ and ‘AG5,’ but the last two were better yielders than the first two. Among the production practices, control gave the lowest number of spikelets (Figure 3). The greater number of spikelets of ‘Lantik’ and ‘AG5’ ‘Kotong’M-12-22B5’ may be attributed to their earlier days to heading, days to maturity and grain-filling duration.

**Thousand-seed weight**

For seed density expressed as 1000-seed weight, only the varieties and not production practices differed from each other (Table 3). The differences were consistent across production practices. Variety ‘Lantik’ had the highest seed density followed by ‘Kotong,’ while ‘M-12-22B5’ had the least. This followed more closely the trend in grain yield, indicating that 1000-seed weight of varieties studied affected the grain yield more than the other yield components, indicating that it is a major

*IB Dimaporo & PG Fernandez*
determinant of grain yield. Since rice production practice had no effect on seed density, this suggests that seed density is more of a varietal characteristic than management-determined.

GENERAL DISCUSSION

The current rice production system of the Mapantao farmers is a combination of traditional and chemical agriculture practices. Despite the strong cultural, social and political identity that is characteristic of the area, changes have occurred that reflect the acquired character of the rest of the country, including having been heavily influenced by the Green Revolution. The original traditional varieties like 'Lantik' and 'Kotong' performed well with or without fertilizer application as well as in the modified Maranao rice production practice. Relatively high yields were obtained even without fertilizer application. 'Lantik' had the highest yield among the varieties studied but 'Kotong,' although a low yielder, commands a higher market price because of its black grain. The performance of 'Kotong' is commonly expected, i.e., to have low yield, because of its glutinous nature. But the high yield of 'Lantik,' which is also glutinous, defies the common conception. The average yield of modern varieties, according to the Philippine Rice Research Institute (PhilRice) (cited source), is 4 to 5 t/ha, and this is for newer glutinous varieties because older glutinous varieties only yield an average of 2.1 t/ha or less (irrigated lowland). Adaptation and allocation of assimilates to the grain of the traditional varieties used (especially 'Lantik') is exceptional; it is comparable in performance to non-glutinous modern varieties given chemical fertilizer application.

The other two varieties, 'AG5' and 'M-12-22B5,' are non-glutinous; their yields are comparable to the general yield obtained from modern varieties. These are farmer-bred or farmer-maintained, with pure or half traditional parents. Although not native to Mapantao, these varieties, especially 'AG5,' have adapted well and are now widely planted in the area. Fertilizer application is not needed for the varieties under Mapantao growing conditions. For as long as fallowing the land is practiced and integrated with animal manure and plant biomass, and the forest is maintained in the mountainous landscapes of Mapantao Valley, fertilizer application may not be necessary.

The outstanding performance of the varieties, traditional or otherwise, emphasizes the fact that farmers themselves do a form of breeding. Hence, the potential for varietal improvement for the farmers to meet their needs and that of the area is high.

Soundness of traditional farmers' practice also was shown in seed quality. Seed germination was maintained at high levels over time especially under local ambient conditions (average of 23°C). A reduction of 5°C in temperature could have led to doubling of life span according to the rule of thumb in seed storage (Copeland & McDonald 1995), but a colder temperature at UPLB (13°C) did not prove better. Ambient temperature at UPLB was 28°C but seeds had generally lower germination in this setup. Dormancy, which is characteristic of the three of the varieties studied, seemed to have kept seeds alive for a longer period.

In the study of De Guzman (2004), Manobo rice seed dormancy was found broken just in time for the next cropping. Dormancy is being considered as an ally in local production systems. In the present study, artificial breaking of dormancy led to a slight increase in the rate of deterioration. Field emergence (a measure of vigor), as a measure of seed quality, may be a more useful and realistic comparison of seedlot quality relative to laboratory germination (especially since seed viability or the germination capacity was not assessed; firm seeds from the different storage treatments were not verified if truly dormant). Overall, varieties did not meaningfully differ in emergence.

While agronomic practices of the Mapantao farmers are valid and working well, associated rituals and beliefs are already considered inappropriate and remembered only by older farmers. Some are attached to the Islamic faith while others have pre-Islamic origins. Their direct effects on production have yet to be established, but their existence is being threatened by the changing values of the people and the people's bias toward materialist science. The science behind these more indirect farming practices is now being uncovered, but only a few have knowledge of such concepts. One need only to follow discussions and understand discourses related to biodynamic agriculture (e.g., Koepf. et al. 1990, Diver 2000, Steiner 2005), whose principles are now used for some of the criteria for organic farming as established by the International Federation of Organic Agriculture Movements (IFOAM) (Fernandez 2001). One also needs to understand that the new science is beyond the material, and resides in subtle energies, in quantum mechanics and beyond. To recognize quantum science but not utilize such body of knowledge and regard them
even as unscientific practices, is a manifestation that the limit to progress reside more in the mind and human being's difficulty to unlearn and get away from the materialist reductionist mindset, where the parts are more important than the whole.

**SUMMARY AND CONCLUSIONS**

The study was conducted in the Maranao area of Mapantao, a barangay of Lumba Bayabao, Lanao del Sur with the overall objective of evaluating rice agronomic practices in the context of the area's bio-physical and socio-cultural characteristics, including rituals and other associated beliefs. Storability and other rice seed characteristics, and crop field performance were also assessed using four local farmer-developed varieties (traditional or introduced). Seeds collected from farmers were stored up to six months under ambient conditions in both Mapantao and UPLB, and in a 13°C chamber at UPLB. Field performances of the varieties were assessed in Mapantao under three production practices: use of synthetic fertilizer (244-44-44), modified Mapantao practice (112 kg N/ha manure from carabao and cow) and control or no fertilizer.

Mapantao is on a valley near Lanao Lake, with rainfall that is favorable for lowland rice and a yearly average temperature of 23°C. The soil has high organic matter (4%). Rice farmers are mostly tenants; and they do two croppings using formal varieties and chemical production system. The younger farmers have stronger inclination towards modern agricultural practices than older farmers who, on the other hand, still know (but mostly no longer practice or use) traditional systems.

Seed quality of varieties collected from farmers, and which were used in the study, was high. Several seed pathogens were present but these did not lead to crop or seed disease problems. Seed dormancies of varieties were generally short or non-existent. After six months of storage, germination levels from all storage treatments were still high (75-90%). Germination of seeds stored under ambient UPLB (28°C) was the lowest. Mapantao gave generally 10% higher seed germinability than cold storage. Overall, the two traditional varieties, ‘Lantik’ and ‘Kotong,’ were poorer storers than the recently introduced but already adapted varieties ‘AGS’ and M12-22B5. Seed (grain) yields from all production practices were relatively high compared to the national rice yield average. ‘Lantik’ (glutinous white) and ‘Kotong’ (glutinous black), produced the highest (6.6 t/ha) and lowest (3.9 t/ha) yields, respectively. Modified Mapantao gave the lowest yields (4.5 t/ha). The yield from control or no fertilizer application (5.1 t/ha) was not significantly different from synthetic fertilizer treatment (5.6 t/ha). Among the yield determinants taken, only filled grain percentage and spikelet number were positively, but only moderately, associated with yield.

A study in rice production practices and seed systems of the Mapantao farmers revealed some rituals and beliefs that are related to Islamic faith. However, much of the indigenous practices especially those predating Islam have been lost along with traditional rice varieties, since the Green Revolution did not favor their existence and practice.

The soil and climate are favorable for ‘no fertilizer’ rice production. The fallow period combined with livestock raising and grazing contribute to the maintenance of fertility.

Changes or evolution of the Mapantao farmers’ practices are evident mostly in their values, aspirations and knowledge of traditional practices, use of seed and other farm inputs. Most farmers already have the mindset of modern or chemical agriculture where synthetic fertilizer and pesticides are the norm. However, they use only levels lower than that prescribed by the formal sector. Only a minority still uses traditional varieties and associated practices.

The different rice varieties yielded well under no fertilizer or control treatment while the modified Maranao practice, which used organic fertilizer, did not show better results than control. The conventional production practice gave slightly higher yields. In general, the yields in the area were comparable or even higher than the national average, despite the two traditional varieties used being glutinous.

The highest and lowest yielders were ‘Lantik’ (6.7 t/ha) and ‘Kotong’ (3.9 t/ha). The high yield was associated primarily with high percentage of filled grain and number of spikelets.

Seed quality tests showed relatively high purity of seeds despite the accessions not being under the National Seed Industry Council (NSIC) registry. Pathogens that were found in the seed health test did not relate to crop performance, grain yield and seed storability.

Varieties differed in degree of dormancy, but after six months the advantage of dormant seeds in storability was not that great relative to non-dormant ones. All seeds had germinability above 60% after six months. Non-dormant seeds aged slightly faster than dormant ones.
Only one of four varieties, 'M-12-22B5,' was identified as non-dormant. The three dormant seed varieties had less than 50% germinability but had higher field emergence (vigor) than the non-dormant 'M-12-22B5.'

The two farmer-bred varieties not native to Mapantao have become locally adapted in the area. This proves that traditional varieties bred by farmers elsewhere may perform well when adapted into an area. Their yields are also higher than formal varieties even without fertilizer application. This emphasizes the value of farmer involvement in seed practices even in seed breeding.

This study hopefully serves as part of a template to do documentation of indigenous knowledge systems in the Philippines where technical and non-technical aspects are looked at together, for a more holistic approach in agricultural development. The results are best utilized if relayed and fed back to the community under study.

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Table 1. Traditional rice varieties with good eating quality being planted during the 1960’s and 1970’s and their characteristics, as described by farmer respondents in Mapantao, Lumba Bayabao, Lanao del Sur.

<table>
<thead>
<tr>
<th>Traditional Varieties</th>
<th>Maturity (months)</th>
<th>Crop Height</th>
<th>Grain Characteristics</th>
<th>Presence Of Awns</th>
<th>Texture When Cooked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalana</td>
<td>8-9</td>
<td>More than 1 meter, red hay, long tillers</td>
<td>Non-glutinous, long, red</td>
<td>No recall</td>
<td>Soft</td>
</tr>
<tr>
<td>Tagutus</td>
<td>7</td>
<td>No recall</td>
<td>Non-glutinous, red</td>
<td>Awnless</td>
<td>Hard</td>
</tr>
<tr>
<td>Iloilo</td>
<td>5+</td>
<td>More than 1.7 meter, resistant to diseases</td>
<td>Non-glutinous white</td>
<td>No recall</td>
<td>No recall</td>
</tr>
<tr>
<td>Papakan</td>
<td>5+</td>
<td>No recall</td>
<td>Non-glutinous white</td>
<td>No recall</td>
<td>No recall</td>
</tr>
<tr>
<td>Dagudub</td>
<td>5+</td>
<td>No recall</td>
<td>Non-glutinous, red</td>
<td>Awnless</td>
<td>Hard</td>
</tr>
<tr>
<td>Karone</td>
<td>5+</td>
<td>No recall</td>
<td>Non-glutinous white</td>
<td>Awnless</td>
<td>Soft</td>
</tr>
<tr>
<td>Lilingayen</td>
<td>5+</td>
<td>No recall</td>
<td>Non-glutinous white</td>
<td>Awnless</td>
<td>Soft</td>
</tr>
<tr>
<td>Mangkasar</td>
<td>5+</td>
<td>No recall</td>
<td>Non-glutinous white</td>
<td>With awns</td>
<td>No recall</td>
</tr>
<tr>
<td>Lantik*</td>
<td>5+</td>
<td>At least 1 meter</td>
<td>Glutinous black</td>
<td>Slightly awned</td>
<td>Soft</td>
</tr>
<tr>
<td>Kotong*</td>
<td>5+</td>
<td>At least 1 meter</td>
<td>Glutinous white</td>
<td>Slightly awned</td>
<td>Soft</td>
</tr>
</tbody>
</table>

*Still being used by Mapantao farmers. Both have good eating quality.*
### Table 2.
**Summary of ANOVA results in terms of Pr>F for the agronomic characteristics of different rice varieties under three different rice production practices at Mapantao, Lumba Bayabao, Lanao del Sur.**

<table>
<thead>
<tr>
<th>AGRONOMIC CHARACTERISTICS</th>
<th>RICE PRODUCTION SYSTEMS (A)</th>
<th>VARIETY (B)</th>
<th>A X B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Plant Height (cm)</td>
<td>0.0921 ns</td>
<td>0.0001**</td>
<td>0.0134*</td>
</tr>
<tr>
<td>2. No. of Tillers</td>
<td>0.0001**</td>
<td>0.2545 ns</td>
<td>0.7521 ns</td>
</tr>
<tr>
<td>3. Grain Yield (kg ha⁻¹)</td>
<td>0.0128*</td>
<td>0.0001**</td>
<td>0.561 ns</td>
</tr>
<tr>
<td>4. No. of Panicles</td>
<td>0.0020**</td>
<td>0.0001**</td>
<td>0.0001**</td>
</tr>
<tr>
<td>5. Panicle Length (cm)</td>
<td>0.1287 ns</td>
<td>0.0001**</td>
<td>0.9477 ns</td>
</tr>
<tr>
<td>6. Filled Grains (%)</td>
<td>0.2315 ns</td>
<td>0.0001**</td>
<td>0.9506 ns</td>
</tr>
<tr>
<td>7. No. of Spikelets</td>
<td>0.9250 ns</td>
<td>0.0001**</td>
<td>0.0912 ns</td>
</tr>
<tr>
<td>8. 1000-Seed Weight</td>
<td>0.3919 ns</td>
<td>0.0001**</td>
<td>0.8613 ns</td>
</tr>
</tbody>
</table>

ns, *, ** - not significant, significant and highly significant at 5% and 1% α, respectively.

### Table 3.
**Comparison of means of the agronomic characteristics of different varieties (averaged over rice production practices) grown in Mapantao, Lumba Bayabao, Lanao del Sur.**

<table>
<thead>
<tr>
<th>AGRONOMIC CHARACTERISTICS</th>
<th>VARIETIES</th>
<th>LANTIK</th>
<th>KOTONG</th>
<th>AG5</th>
<th>M-12-22B5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Plant Height (cm)</td>
<td></td>
<td>93.4 b</td>
<td>94.1 b</td>
<td>87.0 c</td>
<td>120.8 a</td>
</tr>
<tr>
<td>2. No. of Tillers</td>
<td></td>
<td>18.0 a</td>
<td>19.5 a</td>
<td>20.5 a</td>
<td>21.4 a</td>
</tr>
<tr>
<td>3. Grain Yield (kg ha⁻¹)</td>
<td></td>
<td>6647.9 a</td>
<td>3872 c</td>
<td>5622.9 b</td>
<td>4140.7 c</td>
</tr>
<tr>
<td>4. No. of Panicles</td>
<td></td>
<td>17.5 c</td>
<td>15.6 d</td>
<td>19.4 c</td>
<td>20.8 a</td>
</tr>
<tr>
<td>5. Panicle Length (cm)</td>
<td></td>
<td>21.8 a</td>
<td>21.8 a</td>
<td>20.1 b</td>
<td>22.2 a</td>
</tr>
<tr>
<td>6. Filled Grains (%)</td>
<td></td>
<td>80.8 a</td>
<td>34.2 c</td>
<td>76.1 a</td>
<td>56.3 b</td>
</tr>
<tr>
<td>7. No. of Spikelets</td>
<td></td>
<td>93.5 c</td>
<td>107.0 b</td>
<td>86.9 c</td>
<td>129.8 a</td>
</tr>
<tr>
<td>8. 1000-Seed Weight</td>
<td></td>
<td>29.4 a</td>
<td>25.6 b</td>
<td>24.6 c</td>
<td>18.7 d</td>
</tr>
</tbody>
</table>

Means in a row followed by a common letter is not significant at 5% α using DMRT.
Figure 1. Provincial map of Lanao del Sur. Barangay Mapantao is in Lumba Bayabao, which is indicated by an arrow (Provincial Profile, 2001).
Figure 2. Filled grain percentage of different varieties grown under different rice production practices in Mapantao, Lumba Bayabao, Lanao del Sur.

Figure 3. Number of spikelets of different varieties grown under different rice production practices in Mapantao, Lumba Bayabao, Lanao del Sur.