Nutrient management in rainfed lowland rice farming systems of Myanmar

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Declaration

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis and all sources used have been acknowledged in this thesis.

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Abstract

This research was undertaken to determine the key factors affecting grain yields and profitability of rainfed (monsoon) lowland rice in a township area of the Ayeyarwady delta in the north of the Yangon Division, Myanmar. The production of monsoon rice provides the farming family's basic food supply as well as cash income. Higher domestic production of rice in conjunction with increased rice exports could also stimulate economic growth and poverty reduction at the national scale. In addition to quantifying the bio-physical aspects of the monsoon rice production systems in the study area, particularly the key issue of soil fertility management, this research also sought to document and analyse the perceptions of farmers about their farming and the socio-economic pressures they face. Such knowledge may help with the planning of agricultural and regional development programs by government, international aid donors, civil society and businesses.

The first part of the study involved a survey of 100 rice-farming households during the 2010 monsoon season across five village tracts – Auto, Hlaing, Joephyu, Kyiksagaing and Targwa – in Taikkyi township, Myanmar (17°10'–17°40' N, 95°40'–96°0' E). The questions were designed to provide key demographic information (e.g. farmer gender, age education, household size), farm information (e.g. farm size, soil type, monsoon rice yields, crops grown, machinery and livestock assets), socio-economic information (e.g. income and costs, other sources of income, credit systems) and knowledge and perceptions of nutrient management and rice farming.

The interviewed rice farmers were very experienced (average of 29 years of farming), but they had generally low levels of education with just 24% going beyond middle school. Soil type (e.g. sandy or alluvial) and water availability were key determinants for decisions about cropping patterns, intensity of production and monsoon rice yields. There was a widespread lack of mechanisation, with all farms using manual labour for transplanting and harvesting, as well as other farm management tasks. The interviewed farmers also reported a lack of access to affordable credit and that effective training and extension services were limited or non-existent.

The primary drivers of monsoon rice productivity were the use of legume rotations in the farming system, the application of locally available organic-based manure and compost

fertilisers and the inherent quality of the soil on their farms. Average yields for the village tracts were 3.0 t/ha (Kyiksagaing), 2.8 t/ha (Auto), 2.7 t/ha (Hlaing), 2.2 t/ha (Joephyu) and 2.0 t/ha (Targwa). The low average yield of 2.2 t/ha at Joephyu was in part due to the large percentage (32%) of land that was sandy and very low in nutrients (compared to average of 8% sandy land for the other village tracts).

Legumes were widely used by farmers in my study (average of 80% farmers grew mung bean at Auto, Hlaing, Joephyu and Kyiksagaing), the exception being the Targwa village tract (25% farmers growing mung bean). Interestingly, Targwa was one of the two low-yielding village tracts. The correlation of rice yield and land planted to legumes indicated that, for every 10% increase in land sown to legumes there was a 90 kg/ha increase in rice yield. Across the 100 farms, 45% of nitrogen (N) inputs were from urea and 26% from legume residues. For phosphorus (P), 74% was from manure and 10% from compost and for potassium (K) the major sources were also manure (76%) and compost (18%).

The application rates of mineral fertilisers were very low, especially for P (average of 5 kg/ha) and K (average of 1 kg/ha). Farmers demonstrated some awareness of good fertilisation practices, e.g. through the use of split applications for urea. Risk factors such as climate variability, high fertiliser costs, concerns about fertiliser quality and fluctuating rice prices discouraged farmers from greater use of mineral fertilisers.

The average gross margin for monsoon rice was USD242/ha. Most household income was from monsoon rice and other crops, i.e. on-farm. However, income from rice alone was not enough to support the family in many cases. A large majority of farmers (85%) used at least half of their harvested rice for earning cash income rather than non-market uses such as home consumption and saving for seed, indicating that few farmers were completely disengaged from the market. The profitability drivers were closely aligned with the productivity drivers. Almost all demographic and household variables were not correlated with monsoon rice profitability, with the exception of a positive correlation with education level. In terms of agronomic practices, fertiliser usage and favourable soil types improved profitability. Fertiliser costs were positively correlated with income, suggesting that the investment in fertiliser was beneficial, although increasing mineral fertiliser use is potentially risky given the high proportional cost (80% of all fertiliser costs).

Several constraints pose serious limitations to improving rice yields and income in the short to medium term. Credit and labour were the primary concerns for the farmers in Taikkyi. Most of the farmers used credit providers, with higher interest rates but more lenient lending practices, to get capital to purchase agricultural inputs, e.g. fertilisers. Accessing labour at critical times, i.e. land preparation, transplanting and harvesting, was problematic as well as being expensive.

The second part of the study involved soil and crop sampling of 50 individual monsoon rice fields from Taikkyi township, a subset from the original 100 farms, during the 2010 monsoon to determine soil fertility status, rice yields and partial budgets for the major nutrients, N, P and K. The nutrient budgets were calculated using farmer statements of inputs and laboratory analyses of sampled soils and harvested grain. Although a large number of demographic, socio-economic, farm management and soil test values were recorded for the farmers, their rice fields and their farms, I found very few significant correlations between N, P and K balances and other survey variables. The average organic + mineral inputs were 33 kg N/ha, 8 kg P/ha and 6 kg K/ha at the field scale. Average nutrient (input – output) balances were -17 kg /ha for N, -1.2 kg/ha for P and -29 kg/ha for K. The low inputs of fertilisers, particularly mineral fertilisers, meant that farmers were producing relatively low yields (average of the 50 fields was 2.7 t/ha) and not maintaining soil fertility. Potassium was especially concerning due to the large removal of that element in rice straw.

Many of the farmers were capable of evaluating soil fertility and had a practical understanding of key soil chemical and physical characteristics such as pH, colour and texture. Farmers were mostly aware of the value of different fertiliser types, especially the greater productivity capacity of mineral fertilisers and the greater soil-building characteristics of organic fertilisers. But increased adoption of high analysis inorganic fertilisers is limited due to financial constraints and a lack of training to maximise the return on investment for fertilisers. Legumes were widely used by farmers with a direct benefit of improving rice yields, but explicit recognition or perhaps acknowledgement of the nutritional benefits from legumes was not widespread. The participating farmers were modest about their own farming skills, but they expressed good knowledge of the main agronomic factors that contributed to their monsoon rice yields.

Several socio-economic factors profoundly constrained production and hence income. Financial limitations, mostly related to low and volatile prices and the low ceiling on

affordable credit that forces farmers onto high-interest loans from money-lenders, were the major concern for farmers. Hence, a higher ceiling on the low-interest government loans would make a strong contribution to development of Agriculture especially for monsoon rice production in Myanmar. Labour shortages, especially at peak times like transplanting and harvesting, is an already a serious issue that is very likely to increase. Farmers also reported the lack of useful agricultural information, insufficient extension services, and the lack of policy and supporting mechanisms for promoting agricultural productivity and profitability. Bio-physical issues raised by farmers were largely related to crop agronomic factors, such as fertilisers, crop protection, water management and coping with climatic variations. With decreasing farm labour, there is greater pressure for farmers to mechanise where possible. However, the lack of machinery and other agricultural technology was also mentioned by farmers, not just due to financial constraints, but also due to the lack availability, training and maintenance. Inadequate infrastructure such as roads remains an on-going challenge for farmers, traders and others in the supply chain.

Tackling the constraints of monsoon rice production in Myanmar will require a combination of approaches from 'bottom-up' community-driven activities to 'top-down' national policies and programs over a long period of time, with input and involvement from farmers, government, civil society and business. However there are strong incentives in place and that is the ever-increasing demand for food at the local, national and international scales. If supply does not meet demand, there is a likelihood that prices will rise and benefits will flow on to the farmers. The risks are that skills and commitments to farming that currently exist in communities like the Taikkyi township of Yangon Division, Myanmar, will be lost as a younger generation leave the home villages to seek work elsewhere.

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