



Grow Your Own? Rice Self-sufficiency in Timor-Leste

By mid-2011, the Democratic Republic of Timor-Leste had been an independent nation for a scant nine years. In that time, the tiny Southeast Asian island country had achieved considerable political and economic success. It had undergone a process of post-conflict truth and reconciliation, built democratic institutions and laid the foundations for social and economic development. However, while resource-rich, it remained underdeveloped. In particular, local food production was insufficient to meet domestic consumption needs.

At the heart of this dilemma was rice, a staple commodity in the diet of most Timorese citizens and generally preferred over maize and cassava. The country needed a reliable, affordable and high-quality supply of rice; to date, the government had ensured this through an aggressive import policy coupled with a consumer subsidy. But this expensive policy was becoming even costlier and, in light of projected additional hikes in the global rice price, likely untenable.¹ Besides, the country itself had rice-growing potential, and the import subsidy placed domestic rice producers at a competitive disadvantage. For years, the government had struggled with the question of whether to continue importing rice or invest in domestic production. Imports would prevent hunger and maintain political peace; a domestic production emphasis would support rural livelihoods and develop the non-oil economy.

In early 2011, Prime Minister Kay Rala Xanana Gusmão made the call—Timor-Leste's new, 20-year Strategic Development Plan called for increased domestic rice production, with a goal of self-sufficiency by the year 2020. Parliament endorsed the decision on July 11. But as told the closing session of the Timor-Leste Development Partners Meeting only two days later, setting the goal was only the first step: "The drafting of the Plan is an important step, but it is its implementation that will determine whether the effort was worth it."²

¹ Food and Agriculture Organization (FAO), *The State of Food Insecurity in the World*, 2011. See: <http://www.fao.org/publications/sofi/en/>

² Address by his Excellency the Prime Minister Kay Rala Xanana Gusmão at the closing session of the Timor-Leste and Development Partners Meeting, Dili, July 13, 2011. See: <http://timor-leste.gov.tl/wp-content/uploads/2011/07/Closing-Remarks-TLDPM-13.7.11.pdf>

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Implementation would fall to advisors and civil servants in the prime minister's office, the Ministry of Agriculture and Fisheries (MAF) and the Ministry of Tourism, Commerce and Industry (MTCI). Rice self-sufficiency by 2020 was one of the most politically sensitive and cross-sectoral of the targets in the strategic plan, and it was one whose progress the prime minister would watch with particular interest—with good reason: it went to the core of the country's priorities of food security, self-determination, and peace and stability.

Agriculture policymakers had a variety of tools at their disposal. The government could draw from the national Petroleum Fund of Timor-Leste to provide incentives to boost domestic production, and gradually reduce imports as domestic crops increased. Alternatively, it could reduce imports immediately and redirect the savings to domestic rice growing. Or it could encourage reduced domestic rice consumption by increasing the supply of alternative staples such as maize and tubers. Each of these choices, however, came with a price tag and a political consequence—from inadequate income for domestic rice farmers, to the possibility of hunger and civil unrest. A government team would need to consider a host of technical, political, economic and equity questions—and decide on the best mix of policies.

Timor-Leste: Background

In 2011, the Democratic Republic of Timor-Leste was a lower middle income country, with a GNI per capita of \$2,200 and life expectancy of 62.³ It was Asia's youngest country, gaining independence in 2002 after a tumultuous history involving 400 years of Portuguese colonization and 24 years of Indonesian occupation. At least 150,000 Timorese lives were lost in the struggle for nationhood.⁴

Despite scattered incidents of violence and unrest since independence, the country had made considerable headway in instituting the safeguards and processes of a democratic state. With a population of just over one million and an area of approximately 15,000 square kilometers, it was also one of the smallest countries in the world. More than 80 percent of the economically active population was engaged in agriculture and related activities.⁵

Timor-Leste could also boast of considerable oil and gas reserves. The revenue from these was deposited in a Petroleum Fund, established in 2005 so that the country could avoid the pattern of wasteful spending, inflation and corruption which afflicts many countries with an abundance of natural resources, commonly known as the "resource curse."⁶ The fund in 2011 was valued at over

³ World Bank, *Timor-Leste*. See: <http://data.worldbank.org/country/timor-leste>.

⁴ CAVR Timor-Leste (Commission for Reception, Truth and Reconciliation in East Timor). See: <http://www.cavr-timorleste.org/en/Brief.htm>. Exact casualty figures range from 102,800 to 183,000.

⁵ Government of Timor-Leste and National Commission for Research and Development, September 2008, *Timor-Leste—State of the Nation*.

⁶ For more on the Petroleum Fund, see: <http://www.bancocentral.tl/PF/main.asp>.

\$8.7 billion and supplied the majority of monies for the state budget.⁷ Under the Petroleum Fund Law of 2005, the government's annual withdrawal from the fund was capped at the Estimated Sustainable Income (ESI), originally calculated as 3 percent of "petroleum wealth."⁸ This ensured that the same amount could be withdrawn from the fund every year for the indefinite future, even after Timor-Leste's oil and gas reserves were exhausted.

In recent years, however, the government had been spending above ESI: 3.8 percent in 2009, 4.8 percent in 2010, 4.3 percent in 2011, and it proposed to spend 7.2 percent in 2012. On the one hand, greater budgetary expenditures were necessary to jump-start the country's development, but on the other hand, the government was less than 10 years in the making and remained institutionally weak, giving rise to concerns about its ability to manage the expanding budget. One significant line item in the state budget was rice—its production, import and subsidies.

Rice: staff of life

Rice was an integral part of the Timorese diet, and for many citizens, a meal without rice was not considered a proper meal. Although the Timorese ate cassava, potato, sweet potato, taros and maize, if households could afford rice, that was always their first preference. This was a legacy of the Indonesian occupation, which sought to convert the Timorese to rice-growing by telling them that to eat root crops or tubers was uncivilized.⁹ In 2010, 31 percent of farmers cultivated rice.¹⁰ They did so primarily to meet subsistence needs; in general, rural households produced too little to feed even themselves for about four months each year.¹¹

Timor-Leste had 70,000 hectares of lowland suitable for irrigated rice cultivation, but only 40,000 were farmed as of 2011. Timorese farmers had to work with biophysical constraints—steep terrain, poor soil structure and fertility, and erratic rainfall. However, some lowland regions, like Baucau, Viqueque and Bobonaro, had benefited from the construction of irrigation infrastructure during the Indonesian occupation. These districts had the topography and irrigation infrastructure to become the country's "rice bowls."

⁷ Integrated Regional Information Networks (IRIN), 'Is Timor-Leste's plan for oil fund investments a risk worth taking?' *The Guardian*, October 24, 2011. See: <http://www.guardian.co.uk/global-development/2011/oct/24/timor-leste-sovereign-fund-investment>. The state budget had increased from \$70m in 2004 to \$650m in 2009 to \$1.3bn in 2011.

⁸ Petroleum Wealth was the sum of the monies currently in the Petroleum Fund and the net present value of expected future revenues from the oil and gas still to be extracted.

⁹ Author's interview with Dr. Helen Hill, Melbourne, Australia, on July 12, 2011. Dr. Hill, of Victoria University, was writing a book on Timor-Leste. The information was confirmed in other interviews conducted in Timor-Leste in July 2011.

¹⁰ World Bank (2010), *Raising Agricultural Productivity: Issues and Options*, Report No. 50276-TP, Technical Note No 2: Assessment of Food Self-Sufficiency in Timor-Leste, p. 14.

¹¹ Timor-Leste Standards of Living Survey, 2007.

However, productivity was low, averaging in 2011 three metric tonnes (MT) of paddy (or unhusked rice) per hectare.¹² This represented an increase from previous years, thanks in part to government-funded distribution of improved seed varieties and fertilizer. But it continued to fall short of the sector's productivity potential, estimated by the UN's Food and Agriculture Organization (FAO) at five metric tonnes per hectare. Absent ongoing government intervention, the yield was at risk of dropping once more.

Rice deficit. Since domestic rice farmers produced only 70,000 of the estimated 130,000 metric tons of milled rice citizens consumed annually, the country filled the resulting production-consumption gap by importing from Vietnam and Indonesia (see **Exhibit 1**).¹³ A high population growth rate of 2.4 percent further complicated the situation.¹⁴ If unchecked, Timor-Leste would soon need an even higher level of domestic production and/or imports to feed everyone.

Rice Production Challenges

The Timor-Leste government had long debated whether it made sense to increase domestic rice production, or continue to import the additional rice it needed. This deliberation rose to a high pitch in late 2010 as Prime Minister Gusmão's leadership team worked to pull together the many strands of the Strategic Development Plan that would guide the nation's growth for the next 20 years.

Domestic rice farmers had long faced a host of problems. For one thing, they lacked consistent and affordable access to materials (or "inputs") like fertilizer and improved seed varieties. Many relied on the FAO and other development partners to hand out free inputs like seeds and fertilizer. Timor-Leste's farmers had also failed to benefit noticeably from efforts to encourage agricultural mechanization. In 2008-2009, the Ministry of Agriculture and Fisheries had distributed over 2,000 hand tractors to farmers.¹⁵ But many of the tractors broke down and farmers abandoned them because they had not been trained in tractor operation and maintenance, and had no funds to purchase fuel or spare parts.

Irrigation was another challenge. Timor-Leste, a narrow island with elevations up to 3,000 meters, had extremely steep terrain. Coupled with erratic rainfall, this presented the twin problems

¹² "Paddy" was unhusked rice, whereas 'milled rice' was recovered from paddy, usually at an average recovery rate of 60 percent by weight of paddy rice (55 percent using village milling and 65 percent using commercial milling). International Rice Research Institute (IRRI), *Rice Knowledge Bank* (2009). See: <http://www.knowledgebank.irri.org/rkb/index.php/rice-milling>. Yield figure from in-country meetings with FAO and MTCI, June-August 2011.

¹³ This was approximately 120,000 Mt of paddy, according to estimates by MTCI and MAF, 2010.

¹⁴ National Statistics Directorate, Ministry of Finance, "*Population and Housing Census 2010. Preliminary Results*" (MoF, 2010), Timor-Leste.

¹⁵ IFAD. *Timor-Leste Maize Storage Project: Project Design Report*. See: <http://www.ifad.org/operations/projects/design/104/timorleste.pdf>. 3.

of water scarcity during the dry season and flash flooding during the wet season. This natural climate variability appeared to be becoming even more extreme as a result of recent climate changes. Droughts hit every two to three years thanks to El Nino, causing average crop production to drop by 30 percent, while in 2010, as a result of La Nina, the country had no dry period. What was missing was a master plan for comprehensive water resource management.

Then there was training. In some areas, government-hired extension workers conducted Farmer Field Schools (FFS) to teach farmers about Integrated Crop Management (ICM), specifically line-transplanting instead of broadcasting, appropriate water levels, timing and dosage of fertilizer based on leaf color charts, and harvesting techniques. These techniques, along with System of Rice Intensification (SRI), were being promoted with varying degrees of success; some farmers proved resistant to change and were slow to adopt them.¹⁶

As if these difficulties were not enough, Timor-Leste farmers typically experienced high pre- and post-harvest losses.¹⁷ These were attributable in part to pests and disease, but there were other complicating factors. Persuading farmers to use improved seed varieties, for example, was a particular challenge. Many were reluctant to dispense with traditional seed varieties. As a result, more than 10 varieties were in use, some of them very low-yielding. Moreover, each variety matured at a different rate, with some shedding their grain or subject to bird damage before harvest. Post-harvest too, on-farm storage capacity was limited and outdated rice milling technology produced grain-from-paddy yield of only 50 percent, compared with the 60 percent that improved rice mills could achieve.

These combined challenges meant that Timor-Leste had never produced enough rice to feed its population. Instead, it imported the additional 60,000 MT/year that it needed. In 2011, it paid a price of \$0.57 per kilogram (\$570 per MT) of milled rice—or some \$34 million for a year’s supply (see **Exhibit 1**). But Timorese consumers could not afford so high a price, so the government sold the imported rice to domestic consumers at only \$0.34 per kilogram—meaning a subsidy of \$0.23 per kilogram.¹⁸ There were additional costs to store and distribute imported rice throughout the country.

Local Purchase Program

A retail price of \$0.34 per kilogram of milled rice was too low to incentivize farmers to increase production beyond subsistence to commercial levels. So in 2009, the government had put in place a Local Purchase Program (LPP), administered by the MTCL, to supply rice to the Ministry

¹⁶ The role of ‘extension workers’ was to educate farmers to encourage the use of new scientific research and improved techniques in agricultural practice. ‘Line-transplanting’ referred to moving a seedling into the field, planted in rows and spaced apart, whereas ‘broadcasting’ meant scattering seeds over a large area.

¹⁷ Ten percent pre-harvest, and another 10 percent post-harvest.

¹⁸ This was the maximum retail price mandated by the Timorese government in 2009.

of Education's school feeding program. MTCI purchased rice directly from local producers, offering a price of \$0.45 per kilogram of paddy (equal to \$0.70 per kilogram of milled rice). The LPP purchased locally produced rice at that uniform price regardless of its quality. There were no standards or grades.

The LPP had its own problems, however—payment delays, distribution chain inefficiencies, lack of quality controls, and inadequate marketing of the program to farmers. Some rice producers in the program reportedly were not paid for up to three months. Since MTCI contracted third-party companies to undertake the purchasing, there was also no guarantee of the price actually paid to farmers. Anecdotally, some farmers were opting to sell to firms at a farm-gate price lower than that guaranteed by MTCI for the sake of being paid up front.

Distribution inefficiencies. The payment delays appeared due in part to poor logistics. MTCI hired contractors to collect paddy from the farm gate, transport it to MTCI warehouses for storage and milling in Tibar (near the capital, Dili), and then delivered the milled rice to the Ministry of Education (MoE) for distribution to schools under the MoE's school feeding program. The contractors did not get paid until they delivered the rice to the MTCI warehouse, and some of them reportedly did not pay the farmers until they returned to the farm three months later. What's more, 4,000 MT had reached the schools in 2009, but only 2,000 MT in 2010.

Inadequate marketing. The government recognized that one way to make existing rice supplies go further was to encourage consumption of alternative staples as well as income generation through the sale of various cash crops. So the LPP extended to crops other than rice—including maize, soybean, mungbean, red beans, string beans, turmeric and ginger. But many farmers seemed unaware of the government's support for these other crops. Anecdotally, farmers would opt to grow a second crop of rice within a year—even though second-crop yields typically achieved only 60-70 percent of the first yield—because they knew the government would buy rice. Though unintended, it seemed that LPP was contributing to the entrenchment of a rice monoculture in TL.

Even with these challenges, however, Prime Minister Gusmão and his team of agricultural advisors decided it was crucial to help Timor-Leste graduate from its considerable reliance on the global rice market. For one thing, global rice prices were rising. For another, increased domestic rice production was integral to the broader national goals of self-sufficiency, food security, economic growth, peace and stability. Launched in July 2011, the long-awaited Strategic Development Plan announced a new policy of rice self-sufficiency by 2020. Now the policy team would have to make that possible.

Options and Levers

A possible first step was to reduce or eliminate rice imports. It was costly anyway, given rising world rice prices.¹⁹ Phasing out imports, however, would not be simple. For example, should Timor-Leste begin to lower the volume of imports immediately, or stagger the reductions to take effect only after domestic yields increased? Timing was important: continuing to import and distribute at current levels as yields increased could saturate or flood the rice market, driving domestic rice prices even lower—good for consumers but potentially disastrous for farmers. But reducing imports too soon ran the risk of a rice shortage if yield increases faltered. As an interim measure, the country might try a futures contract—buy a predefined amount of rice at a set price, delivered at a specific date in the future. This was one way to stave off anticipated price hikes and buy the country some time to boost local production. But how reliable were the futures markets?

Another policy option was to remove the consumption subsidy. But this was risky as well. The subsidy provided a safety net to households who otherwise could not afford rice. Agriculture officials would need to balance the needs of rice consumers against the need to give rice producers a sufficiently high farmgate price to make their agribusinesses profitable.

Spend above ESI? The government could choose to invest in domestic production while maintaining the current import-and-subsidy system. That route, however, would require the treasury to spend even more above ESI than it had been doing. The administration had already come under fire from vocal and influential members of Timorese civil society for exceeding the ESI threshold. For instance, a Timor-Leste NGO, L'ao Hamutuk, said that it “believes saving the people's money is better than wasting it, and we do not encourage rapid spending without planning or results.”²⁰

Other models? Another choice was to maintain subsidies, but transfer those subsidies to producers for the purchase of inputs rather than consumers for the purchase of the end product. One subsidy program, piloted in Malawi, might be a model for Timor-Leste. It provided farmers with vouchers to purchase inputs at a fraction of the market price.²¹ As with any input subsidy program, however, there was a risk of cross-border leakages and the emergence of secondary (or “black”) markets.²² So another option was simply to give farmers cash and let them choose what to do with the money. A revolving seed system, such as the one used by the not-for-profit Mercy Corps in Timor-Leste, offered yet another option. Mercy Corps gave a group of farmers seeds on the

¹⁹ FAO Rice Market Monitor. November 2011, Volume XV-Issue No. 4. See: <http://www.fao.org/docrep/014/am945e/am945e00.pdf>.

²⁰ L'ao Hamutuk, *RDTL Budget for 2011*. See: <http://www.laohamutuk.org/econ/OGE11/100JE2011.htm>.

²¹ Glenn Denning et al. “Input Subsidies to Improve Smallholder Maize Productivity in Malawi: Toward an African Green Revolution.” *PLOS Biology*, 2009: 1, e1000023.

²² Secondary markets exist when recipients of subsidized inputs sell those inputs to others, usually at a discounted price (that is, at less than the price of unsubsidized inputs).

condition that they return to Mercy Corps the same amount of seed after harvest; the new seed in turn was given to another group of farmers for the next planting season. Perhaps this could be replicated at a national level.

Budgetary constraints. Whether the money came from the Petroleum Fund or elsewhere, however, the government's development plan required a significant increase in agricultural investment. The Ministry of Finance would have to steeply increase the budget allocation to agriculture (see Exhibit 2). In recent years the Ministry of Agriculture and Fisheries, responsible for domestic production support, had been given a limited budget of only 1.2 percent of the national budget—far short of the 10 percent that many Asian countries had allocated during Asia's Green Revolution that saw cereal production double between 1970 and 1995.²³

Distribution. Finally, the implementers of the strategic plan would have to improve distribution channels—both to get supplies to farmers and to get rice to market. At the moment, there was no market for seed and other farming needs. The country also lacked a robust system to collect, process and distribute rice to retailers and ultimately consumers. Neither appropriate infrastructure nor incentives for each actor along the production and distribution chain were in place.

Government officials would need to facilitate the creation of linkages between producers, collectors and rural transportation services, traders, millers, wholesalers and retailers. Lack of information and information sharing among these actors had left a supply-demand mismatch (where a need and the service-provider able to meet that need do not find each other), and the necessary economies of scale for each stage to be profitable would not be achieved for some time. In the meantime, the government would have to intervene by providing these services itself or organizing, training and providing incentives to private contractors.

Moreover, roads in Timor-Leste were in very poor condition and required urgent improvement. Transferring rice from the farmgate to the growing urban market in Dili, or to a non-rice-growing district, was likely to be as costly and logistically difficult as the distribution of imported rice had been to date, if not more so. Though the country was small in size, it could take upwards of five hours to drive 80 kilometers. This constituted an implicit “infrastructure tax” and potentially could increase the price consumers paid for rice. Even if rice imports continued, domestic supply networks would need to be strengthened and expanded, because demand was growing and imported rice entered Timor-Leste only through the port in Dili.²⁴

²³ The Green Revolution, which took place from the 1940s to 1960s and was led by Nobel Laureate Dr. Norman Borlaug, transformed agricultural practices following investments in research and development and the transfer of new technologies such as high-yielding seed varieties. It led to significant improvements in agricultural productivity in Asia.

²⁴ World Bank (2010), *Expanding Timor-Leste's Near-Term Non-Oil Exports: Diagnostic Trade Integration Study (DTIS)*, p.9.

Finding the Right Balance

Planners had to factor in population growth as well. A projected growth rate of 2.4 percent, increasing urbanization and rising incomes would put ever greater strain on rice supplies. The World Bank had estimated that to achieve rice self-sufficiency by 2035, rice production would have to grow aggressively. By its calculations, production would need to increase 5 percent per year compounded, while the area irrigated would need to increase by 5 percent per year compounded up to 2020 to achieve self-sufficiency by 2035.²⁵ To reach self-sufficiency by 2020 would require even more dramatic production gains. Even then, if the population continued to grow at current rates, imports would need to resume in 2040. This was ambitious. Even at the peak of the Asian Green Revolution, rice yield growth rates did not exceed 3.5 percent.²⁶

Agriculture policymakers would also need to factor in maternal and child nutrition. The latest Demographic and Health Survey had revealed a startling 58 percent of children under five were stunted.²⁷ Rice was low in protein and micronutrients, and the habit of eating a big helping of rice with very little vegetables, egg or meat had become entrenched. Planners might want to introduce a vitamin-fortified strain such as golden rice, with beta-carotene (for combatting vitamin A deficiency).²⁸

The ultimate goal was to offer both farmers a sufficiently high farmgate price for paddy and consumers an affordable price per sack of rice. Other countries had used a variety of mechanisms to achieve this. They included transfer of a consumer subsidy from imported to locally produced rice; a registered voucher system for rice consumers; cash transfers made conditional on quality and minimal leakage; or co-payments to millers and rural transport services along corridors connecting rice baskets to key urban centers.

Other countries' experience had demonstrated that investing in agricultural productivity has a multiplier effect on other sectors in the economy through consumption and production linkages.²⁹ For example, a rice farmer who earned additional income from selling his surplus rice would spend this income at a local kiosk; or an increase in paddy yield generated more business for a local miller and increased demand for seeds, fertilizer and farm labor.

There was also the broader question of whether it made sense for Timor-Leste to invest primarily in rice production, or instead to support a wide array of crops. Good harvests in one crop could compensate for bad harvests in another. Crop diversification would also help improve food security, and investing in produce with higher protein and vitamin content would improve

²⁵ World Bank (2010), *Raising Agricultural Productivity: Issues and Options*, p.1.

²⁶ Dawes, D. 'Running Out of Steam,' *Rice Today*, July-September 2008, p.41.

²⁷ Timor-Leste Demographic and Health Survey 2009-10, p.150.

²⁸ For more on golden rice, see IRRI, *Golden Rice*. See: <http://irri.org/goldenrice>.

²⁹ World Development Report 2008, p.34.

household diet diversity and nutritional security. Investing in other staple crops could also reduce the rice consumption-production gap by encouraging reduced, or at least stable, levels of domestic rice consumption.

The ministers and advisors in charge of agricultural policy had much to consider. Making Timor-Leste 100 percent sufficient in rice by 2020 was an ambitious goal. Had all the factors been considered when the target was decided? Did the policy hold up under scrutiny? Could the money that it would cost be spent elsewhere more effectively? What was the optimal combination of policies and investments?

Exhibit 1: Cost of Rice Importation, Storage & Distribution

Stage in value chain	Per Unit Cost (USD)	Number of Units Per Year	Total cost	Cumulative costs
Import				
Rice	\$566.66	60,000	\$33,999,600	\$33,999,600
Import duties (5%)	\$28	60,000	\$1,699,980	\$35,699,580
Stevedores	\$17	60,000	\$1,020,000	\$36,719,580
Storage				
Replacing of damaged bags	\$0.80	4,800	\$3,840	\$36,723,420
Warehouse maintenance	\$2,000	2	\$4,000	\$36,727,420
Warehouse hiring	\$42,000	3	\$126,000	\$36,853,420
Warehouse staff (Lvl 1)	\$2,400	1	\$2,400	\$36,855,820
Warehouse staff (Lvl 2)	\$1,980	8	\$15,840	\$36,871,660
Warehouse staff (Lvl 3)	\$1,740	23	\$40,020	\$36,911,680
Fumigation (every 3 months)	\$2	240,000	\$480,000	\$37,391,680
Distribution				
Loading onto trucks	\$0.10	2,400,000	\$240,000	\$37,631,680

Truck driver + Telly	\$160	52	\$8,320	\$37,640,000
Petrol	\$200	52	\$10,400	\$37,650,400
Unloading	\$0.10	2,400,000	\$240,000	\$37,890,400
Replacement of loss				
Loss due to damage	1.50%	(1.5% of \$37,890,400)	\$568,356	\$38,458,756
TOTAL				\$38,458,756

Exhibit 2: Costs of Rice Production

* All costs are rough estimates only.

Current rice fields: 40,000 ha

Population: 1 million

Rice fields potential: 70,000 ha

Percent agrarian: 80

Yield potential: 5 Mt/ha (paddy)

Percent of farmers producing rice: 30

Input	Quantity	Capital cost	Recurring costs	Comments
Seed	<i>Per hectare</i>		<i>Per hectare</i>	
IR-64	30kg		\$60	1kg of seed can produce 100kg of milled rice
Fertilizer	<i>Per hectare</i>		<i>Per hectare</i>	
Urea (46% nitrogen)	100kg		\$60	Urea increases production by 30%.
Phosphorus	50kg		\$40	Nitrogen + phosphorus used together increases production by 40%.
Land preparation		<i>Per unit</i>	<i>Per hectare</i>	
Motorized tractor	See Note A	\$15,000	\$80 (incl. petrol)	
Hand tractor	See Notes B, C	\$2500-\$3000	\$60 (incl. petrol)	

Water buffalo		\$700		
Irrigation	<i>Per scheme</i>			
Irrigation scheme	See Note D			
Farmer Training	<i>Per Year</i>			
Farmer Field Schools (FFS)	4 per farmer		\$400 per FFS	Each FFS comprises 8 sessions delivered over a 3-month period
Staff salaries	2 per FFS		\$1992 per extension worker	
Logistics	1 per FFS		\$500 per FFS	

Notes

A: 1 motorized tractor can till 5-8 ha a day.

B: 1 hand tractor can till 2-3 ha a day.

C: MAF's Mechanization Policy involved the distribution of 2000 hand tractors, which exceeded what was required nationally given the limited area of irrigated rice cultivated (even if every rice farmer used a hand tractor for land preparation).

D: The GoTL had identified 9 priority irrigation schemes. If properly functioning, they would service 10,000 ha. These 9 schemes were estimated to cost a total of \$100 million.