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What Makes Agricultural Intensification Profitable for Mozambican Smallholders? An Appraisal of the Inputs Subsector and the 1996/97 DNER/SG 2000 Program

Volume 1: Summary

By

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1. BACKGROUND

Mozambique, at peace since 1992 after three decades of civil strife, must increase agricultural production in order to feed its rapidly growing population. Intensification (increasing yields on land already under cultivation through the use of inputs such as chemical fertilizer, improved varieties of seed, and pesticides) is an important part of this strategy. The country's prime agricultural lands are already densely populated, and the presence of tsetse fly in the productive northern areas makes area expansion through the use of animal traction difficult.

Current yields of major food and export crops in Mozambique are low in comparison with other African countries[1], and the use of improved inputs is extremely limited. During 1991-95, Mozambique used 1.84 kg of NPK per hectare of arable land annually, compared to 16.55 kg/ha in Southern Africa,[2] 8.89 kg/ha in sub-Saharan African overall, 54 kg/ha in Latin America, and 80.3 kg/ha in Southern Asia (Naseem and Kelly 1998). Although many smallholders received improved varieties of seed through emergency programs during the late 1980s and early 1990s, the programs have now ended and farmers are recycling instead of purchasing new seed.

2. OBJECTIVES AND METHODS

This report summarizes an appraisal of input utilization and marketing in Mozambique, focusing on the following research questions: (1) what are current smallholder yields for major commodities, and what is the potential for increasing yields through the use of improved technologies? (2) to what extent are improved technologies already being used by smallholders, and is the use of improved technologies profitable? (3) how are improved seeds, fertilizer and pesticides currently produced and distributed? and (4) what are the key constraints and opportunities for increasing the use of improved technologies by smallholders?

A two-part approach was used to gather data. First, key informants and reports from government agencies, NGOs, donors and international organizations were consulted to obtain information on yields, levels of technology adoption, and production and distribution channels for seed, fertilizer and pesticides. Second, an in-depth analysis of one of the country's leading efforts to promote intensification was carried out. A survey of 223 smallholders participating in the *Direcção Nacional de Extensão Rural*/Sasakawa-Global 2000 program (DNER/SG) was undertaken to evaluate the financial and economic profitability of the improved maize technology package as applied by farmers in Manica and Nampula Provinces during 1996/97.

3. KEY FINDINGS ABOUT THE INPUTS SUBSECTOR

Use of improved inputs by smallholders is limited almost exclusively to cotton and tobacco contract growing schemes and greenbelt vegetable production. During the early 1980s Mozambique used between 40,000-80,000 tons of fertilizer and 2-3 million liters or

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[1]For example, smallholder maize yields range from 0.3-1.3 tons/ha: the average in Zimbabwe is 1.4 tons/ha and for sub-Saharan Africa (SSA) is 1.2 tons/ha.

[2]Includes Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, and Zimbabwe.

kilograms of pesticide per year, reflecting large investments in the state farm sector made by the Mozambican government and donors. Agrochemical use fell dramatically through the mid-1980s due to the war and collapse of the state farm sector. Current fertilizer and pesticide consumption is less than 10,000 tons and 400,000 lt/kg respectively.

Most agrochemicals currently imported are channeled by the three large joint venture companies (JVCs) and other smaller cotton and tobacco companies to their smallholder outgrowers. State sugar and citrus enterprises and large private producers of maize, rice, processing tomatoes, and other vegetables, tea and tobacco consume smaller amounts. Only an estimated 7% of smallholders use purchased inputs.

Large commercial farmers producing maize and vegetables and some smallholder producers of vegetables purchase improved varieties of seed annually through formal channels such as the Mozambican seed company SEMOC. Substantial quantities of improved seed for staple food crops were provided to Mozambican smallholders through emergency distribution programs during the late 1980s and early 1990s. These distributions met over half of the estimated annual seed demand for principal food crops. Most of these programs have now ended and up to 80% of the seed used by smallholders is saved from year to year (Domínguez and Chidiamassamba 1997).

Substantial yield gains are possible through the use of improved inputs, but fine-tuning recommendations to agroecological conditions is very important. A summary of available evidence indicates that the use of improved seed and fertilizer technologies could increase the yields of major crops by 67-576%. Current average and potential yields (in parentheses) are: maize 0.4-1.3 tons/ha (5-6.5); sorghum 0.3-0.6 tons/ha (0.8-2); rice 0.5-1.8 tons/ha (2.5-6); beans 0.3-0.6 tons/ha (0.5-2.5); cassava 4-5 tons/ha (5-10); cotton 0.3-0.6 tons/ha (1.2) (MAP 1997, World Bank 1996).

The response to fertilizer and improved varieties varies widely, depending on agroecological zone and soil type. This implies that recommendations should be fine-tuned to soil type and agroecological zone if farmers are to maximize financial benefits. For the soil types found in the DNER/SG study areas, N and P recommendations for maize ranged from 30-100 kg/ha and 0 to 60 kg/ha, respectively (Guerts 1997). The actual amounts of N and P applied on DNER/SG plots were 58 and 24 kg/ha in all cases, usually a much lower rate than recommended. An additional 12 kg/ha of potassium was applied on the DNER/SG plots, although this was not recommended for any of the crop/soil/agroecological zone combinations.

Outside of contract growing schemes, smallholder access to improved inputs is extremely limited following the closure of parastatal retail outlets. Through the 1980s the parastatal Interquimica imported all agrochemicals and Boror Commercial, another parastatal, distributed them through a network of retail outlets. Both of these firms have subsequently been privatized and companies are now free to import agrochemicals. The closure of Boror Commercial retail outlets and the scarcity of private retail outlets for agrochemicals outside of Maputo have severely restricted small and medium-scale farmers' access to inputs. Large agricultural enterprises which are the major users of fertilizer and pesticides now obtain inputs in one of several ways: by ordering through private companies representing multinational firms such as BASF or Ciba-Geigy, ordering inputs directly, or obtaining inputs through donor aid programs (Pantazis 1997).

The KRII aid program has been ineffective in assuring a reliable supply of high quality inputs to smallholder and larger growers. The program has been operating since 1986 and supplies an estimated 1/3 of national pesticide demand and virtually all fertilizer used in Mozambique. These in-kind grants are worth approximately $9 million per year. KRII is intended to support smallholder food production, but in practice most of the inputs are routed to large companies for use (often by smallholder contract growers) on cash crops such as cotton and tobacco[3]. Recipients of KRII agrochemicals are supposed to pay a countervalue of 2/3 FOB for pesticides and 2/3-100% CIF for fertilizers and equipment into an agricultural development fund, but in practice a large part of the countervalue goes uncollected (World Bank 1996).

Companies can access KRII agrochemicals in two different ways. First, they can directly request specific products and quantities through the KRII program. Doing so is cheaper than ordering through agrochemical representatives or directly from the international market, but companies may be responsible for paying the countervalue, there is considerable uncertainty about when the inputs will arrive (it may take up to 18 months between order and delivery) and companies may also have to pay large storage fees if the inputs sit at the docks for a long period. In practice, a large part of KRII program imports go unclaimed and are auctioned off after one or two years. This provides a second, even cheaper way to get agrochemicals, if users can find what they need.

Creating a demand for purchased seed among smallholders has been difficult after many years of free seed distribution. Development of the seed subsector since the 1970s has concentrated on the establishment of a formal seed industry similar to those in more developed countries. Formal seed production (non-cotton) by SEMOC (a former parastatal now being privatized) increased rapidly from 2000 tons in 1988 and peaked at almost 9000 tons in 1994, but the rapid expansion was due almost entirely to the demand for seeds by government and NGOs for distribution through emergency programs[4]. In the early 1990s, SEMOC's seed sales for emergency programs represented over 90% of its total business (Strachan 1994).

When the emergency programs began to wind down in the mid-1990s, demand for formal sector seed fell sharply. National production fell to just over 5000 tons in 1995, far below the installed processing capacity of 18,000 tons/year. Because the distribution of emergency seeds was carried out through the Provincial Directorates of Agriculture or directly by NGOs, the commercial infrastructure for the distribution of seeds was almost non-existent by the mid-1990s.

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[3]Research suggests that cotton production, especially when intensified, has positive spillover effects on food crop production among participating farmers. See Strasberg (1997) for more details.

[4] During this period an estimated 1.2 million families received seeds and tools programs annually (World Bank 1996).

4. KEY FINDINGS FROM THE DNER/SG PROGRAM

The DNER/SG program began operating during the 1995/96 cropping season with selected farmers in high-potential areas of Manica and Nampula Provinces. The DNER/SG program operates in four different agroecological regions (Regions 4, 7, 8, and 10), which are described in Table 1. Results are reported by region in Table 2. Farmers participating in the DNER/SG program received a package of maize inputs on credit for use on a half hectare of their land. The 1996/97 package (the season in which the assessment was carried out) consisted of 15 kg of Manica SR improved open-pollinated maize and 50 kg each of 12-24-12 NPK and 46% urea fertilizers.

Table 1: Characteristics of Agroecological Regions Included in 1996/97 DNER/SG Survey

	Region 4	Region 7	Region 8	Region 10
Location	central and eastern parts of Sussundenga, Manica and Barue Districts, Manica Province	Ribaué District, Nampula Province	Monapo and Meconta Districts, Nampula Province	western Manica Province; Malema District, Nampula Province
Altitude	200-1000 meters	200-1,000 meters	coastal	> 1,000 meters
Avg. rainfall	1,000-1,200 mm	1,000-1,4000 mm	800-1,200 mm	> 1,200 mm
Avg. temperature during cropping season	17.5-22.5°C	20-25°C	>25°C	15-22.5°C
Soils	Light, some areas of heavy soil	Sandy to heavier clay	Sandy, heavier soils in low-lying areas	Heavy

Source: MAP 1996

DNER/SG maize yields in 1996/97 far exceeded the provincial means for smallholders using no purchased inputs, but were lower than average yields reported on DNER/SG plots in 1995/96. Yields from a sub-sample of the DNER/SG plots were estimated from crop cuts taken from 2 randomly selected 7 x 7 meter areas in each field. DNER/SG yields in 1996/97 were highly variable, ranging from .5 - 4.9 tons/ha (Table 2). The mean yield for the sample was 2.3 tons/ha, compared to provincial means of .4 - 1.3 tons/ha and DNER/SG yields in the previous season of 4.6 tons/ha. Regression analysis indicates that plant density, number of days of labor input and weather conditions were all important determinants of maize yield. Many farmers also reported abnormally late and intensive rains during 1996/97 that flooded fields, delaying operations and causing cobs to rot in the field. In Regions 4 (East/Central Manica Province) and 7 (Ribaué District, Nampula Province) the late delivery of

DNER/SG inputs further delayed planting. Mean plant density (35,659) was much lower than the rate recommended by DNER (50,000 plants/ha).

Financial analysis: due to the high cost of inputs and low prices for maize, many DNER/SG farmers lost money instead of profiting from the investment in maize technology. Farmer decisions about whether to adopt a technology package will depend not only on the yield increases achieved, but on the profitability of the package. Financial analysis shows the profitability of the DNER/SG package to farmers in 1996/97, using output and input prices actually faced by the farmer during that season. Net income per hectare was calculated for farmers selling maize in June, December, and midway between July and December (Table 2). **During 1996/97, storing maize for several months instead of selling immediately after harvest dramatically increased farmer gains**, although this might not hold true every year. When farmers sold in June, only 36% made a profit. At the December price, 80% profited; of those selling midway between July and December, 62% profited. The proportion of gainers and losers varied considerably by region and period. All of the Region 7 (Ribaué District, Nampula Province) farmers selling in June lost money; 25% turned a profit if they waited until December to sell. In Region 4 (East/Central Manica Province), 27% of farmers made a profit at June prices, while 89% took a profit at December prices.

Net income per hectare per day of family/mutual labor can be compared to the prevailing wage rate in the study areas to assess the relative attractiveness of the technology under varying yield and price levels (Table 2). Estimated wage rates vary from 6000 meticais/day in Region 10 (Malema District, Nampula Province) to 20,000 meticais (mt)/day in Region 4 (East/Central Manica Province). When maize is sold at June prices, net income per labor day is lower than the prevailing wage rate in all regions except the top terciles of Region 8 (Monapo/Meconta Districts, Nampula Province) (17,100 meticais/day) and Region 10 (Malema District, Nampula Province) (19,200 meticais/day).

At average July-December prices, returns per family/mutual labor day remain lower than the prevailing wage rate everywhere except the top terciles of Region 4 (East/Central Manica) (25,000 meticais/day), Region 8 (Monapo/Meconta, Nampula Province), and the top two terciles in Region 10-Manica (Western Manica Province) (12,000 - 22,000 meticais/day) and Region 10-Nampula (Malema District) (7000 - 24,000 meticais/day). When farmers sell in December, returns per labor day are still negative for the bottom two terciles of Region 7 (Ribaué District, Nampula Province) (-9600-to -7200 meticais/day) and the lowest terciles in Region 4 (East/Central Manica) and Region 8 (Monapo/Meconta, Nampula Province), but

Table 2. Summary of Results -- Financial and Economic Analyses of 1996-97 DNER/SG Maize Technology Package, by Region and Yield Tercile

Budget Item	Reg.ion 4 (East/Central Manica Province) 1	2	3	Region 7 (Ribaue, Nampula Province) 1	2	3	Region 8 (Monapo/Meconta, Nampula Prov.) 1	2	3	Region 10 (Western Manica Province) 1	2	3	Region 10 (Malema, Nampula Province) 1	2	3
YIELD (t/ha) 1/	0.9	2.1	3.4	0.5	0.7	1.4	1.2	2.5	3.8	1.2	2.6	3.8	1.3	2.9	4.9
TOTAL FAMILY/MUTUAL LABOR DAYS															
(adult equiv. days/ha)	77	124	102	80	73	105	81	47	73	97	109	132	67	110	88
N used in calculations	14	15	15	5	6	5	8	8	8	12	13	13	7	7	7
FINANCIAL ANALYSIS															
a. Net Income 2/ ('0000 meticais/ha)															
June 97 Price 4/	(137.7)	(34.5)	37.5	(90.7)	(77.9)	(44.1)	(44.8)	31.7	124.6	(118.7)	(39.0)	42.2	(40.3)	54.8	169.4
Dec 97 Price 4/	(22.6)	272.9	545.5	(77.1)	(52.9)	21.0	(24.1)	86.7	215.8	51.0	341.1	609.3	16.5	204.8	430.7
Jul-Dec 97 Price 4/	(90.4)	98.1	259.1	(94.6)	(79.7)	(38.7)	(50.8)	28.4	124.2	(47.3)	125.8	289.9	(36.4)	75.4	210.1
b. Net Income per Family and Mutual Labor Day ('0000 meticais/ha) 3/															
June 97 Price 4/	(1.8)	(0.3)	0.4	(1.1)	(1.1)	(0.4)	(0.6)	0.7	1.7	(1.2)	(0.4)	0.3	(0.6)	0.5	1.9
Dec 97 Price 4/	(0.3)	2.2	5.4	(1.0)	(0.7)	0.2	(0.3)	1.9	3.0	0.5	3.1	4.6	0.3	1.9	4.9
Jul-Dec 97 Price 4/	(1.2)	0.8	2.5	(1.2)	(1.1)	(0.4)	(0.6)	0.6	1.7	(0.5)	1.2	2.2	(0.5)	0.7	2.4
Median wage rate per 8 hour day															
('0000 meticais)	2.0	2.0	2.0	1.0	1.0	1.0	1.6	1.6	1.6	1.2	1.2	1.2	0.6	0.6	0.6
ECONOMIC ANALYSIS															
a. Maize Deficit in Southern Africa															
NET INCOME ('0000 meticais/ha)															
HTC 5/	(121.5)	12.0	186.8	(157.8)	(146.7)	(148.1)	(158.8)	(91.5)	(57.7)	(64.6)	92.7	236.1	(106.2)	(67.6)	0.4
LTC 6/	(95.5)	68.6	275.3	(115.2)	(91.4)	(48.3)	(68.6)	77.2	193.6	(29.9)	160.8	333.9	(15.7)	126.8	318.6
Export to Malawi	(not a viable option at this time)			(87.1)	(51.2)	34.2	4.7	225.1	419.8	(not a viable option at this time)			58.0	299.1	608.3
b. Maize Surplus in Southern Africa															
NET INCOME ('0000 meticais/ha)															
HTC	(161.9)	(87.2)	26.1	(180.3)	(178.8)	(214.0)	(217.3)	(209.5)	(238.2)	(121.7)	(28.8)	57.4	(165.1)	(205.1)	(230.8)
LTC	(135.9)	(30.7)	114.6	(137.7)	(123.5)	(114.2)	(127.1)	(40.8)	13.1	(87.0)	39.3	155.2	(74.5)	(10.7)	87.4
Export to Int'l Mkt	(not a viable option at this time)			(128.7)	(110.7)	(87.9)	(103.8)	62.8	85.1	(not a viable option at this time)			(51.0)	44.2	179. 65

Study Zone; Maize Yield Tercile

Source: Field data from 1996/97 MAP/MSU FSP/DNER/SG2000 Smallholder Survey

Notes to Table 2

1/ Estimated from crop cuts. Assumes storage losses of 1% per month.
2/ Gross revenue - (cash costs + interest + purchased labor).
3/ Net income/adult equivalent family + mutual labor days.
4/ Prices (mts/kg) were: **June**: 653 Region 4, 666 R7, 694 R8, 658 R10; **Dec**: 2419 R4, 1394 R7, 1123 R8, 2045 R10; **July-Dec**: 1426 R4, 838 R7, 787 R8, 1211 R10.
5/ Long distance road haulage cost is estimated at USD 0.05/ton/km (Coulter 1995)
6/ Long distance road haulage cost is estimated at USD 0.03/ton/km (Coulter 1995)

exceed the wage rate elsewhere. These returns/day range from 20,000 meticais/day in Region 7 (Ribaué, Nampula Province) to 46,000 and 49,000 meticais/day for the top yield terciles in Region 10-Manica and Region 10-Nampula, respectively.

Economic analysis: farmers in Nampula Province may be better off if they can export maize to Malawi, Tanzania, Kenya or elsewhere. An estimate of the value of maize production to the Mozambican economy was obtained by valuing maize, fertilizer, and seed at world market parity prices, and economic profitability was estimated for the contrasting scenarios of maize deficit and surplus in the southern Africa region. Results are summarized in Table 2.

Maize deficit in southern Africa. When southern Africa has a maize deficit, Mozambican farmers compete with U.S. or other world maize producers to supply the large Maputo consumer market and other consumers in the region. Three cases were considered: (a) high transport costs; (b) low transport costs; and (c) low transport costs, and Nampula Province farmers export maize to Malawi rather than Maputo.

Even under the assumption of high transport costs, conditions are relatively favorable for DNER/SG participants in Manica Province (Regions 4, 10-Manica), where intensified maize production is profitable for two-thirds of farmers. For farmers in Nampula (Regions 7, 8, 10-Nampula) who are far from the Maputo market, intensified maize is barely profitable for the top tercile in Region 10 and unprofitable for all the rest. With lower transport costs, profits increase for Manica Province farmers, but the package is still unprofitable for the lower tercile of farmers. Reduced transport costs do not help farmers in Region 7 (Ribaué, Nampula Province), where intensified maize is still unprofitable for all terciles, but seed and fertilizer use becomes profitable for the top two terciles in the rest of Nampula Province (Regions 8-Malema, 10-Nampula). Nampula Province farmers are best off when they can export maize to Malawi rather than transporting it the much greater distance to Maputo .

Maize surplus in southern Africa. When the southern Africa region has a maize surplus, Mozambican producers compete with South Africa to supply Maputo. As a result, farm-level prices are much lower across the board than in the maize deficit scenario. Nampula Province farmers (Regions 7, 8, 10-Nampula) are affected much more severely than their counterparts in Manica Province (Regions 4, 10-Manica). In surplus years, Manica Province prices fall by one-third from deficit price levels, but in Nampula Province prices fall by an estimated 50-85%. When there is a maize surplus in southern Africa, farmers in northern Mozambique may be better off exporting their maize to countries in other regions of Africa. Weather patterns in Tanzania and Kenya are different from southern Africa's and may provide a market for surplus Mozambican maize (Koester 1986). Maize production in neighboring Malawi has been declining for some years, and this country may also be a market for Mozambican maize even when the region as a whole is in surplus. If export to international markets is possible, the analysis indicates that maize intensification will be profitable for the top two yield terciles in Regions 8 (Monapo/Meconta) and 10 (Nampula), although it will still be unprofitable for farmers in Region 7 (Ribaué). Export to Malawi would likely be more profitable than to the international market.

Credit repayment: DNER/SG is setting a dangerous precedent by not enforcing repayment of input loans made to farmers during 1996/97. DNER/SG has not started to collect loan repayments for the 1996/97 season, and farmers may not be expected to pay back these loans at all. As of December 1997, less than 20% of farmers had made any payments on loans from the previous season. Thus, farmers may now regard the DNER/SG program as a grant rather than a loan program, a potentially dangerous precedent that can undermine the development of private sector input supply channels in these areas.

5. CONCLUSIONS AND POLICY IMPLICATIONS

Our analysis of the DNER/SG program suggests that there is substantial scope for increasing farmer yields and agricultural production in Mozambique through the use of inputs such as improved seed varieties, fertilizer and pesticides. Sustained adoption of these inputs by farmers will depend on the successful implementation of policies and programs that increase the profitability of input use by (1) improving smallholder awareness of the benefits and correct use of inputs; (2) reducing the cost of inputs and ensuring their timely availability; and (3) reducing the cost of marketing commodity outputs and developing new markets for smallholder commodities.

Improving smallholder awareness of the benefits and correct use of inputs. Most sample farmers were convinced that the use of Manica seed and chemical fertilizer improved maize yields. The successful DNER/SG experience in Mozambique (and the DNER/SG experience in other countries) suggests that it would be useful to replicate this model elsewhere in the country with maize and other crops.

Since SG resources are limited, other NGOs, JVCs or private sector firms (including agrochemical and seed firms) could provide support to expanded DNER efforts in this area. Several modifications in the way the program is implemented would increase its effectiveness. First, the process of identifying candidate crops and areas for intensification should include a feasibility study to determine (a) the potential yield gains from use of improved technology and (b) estimates of the farm-level profitability of the input package.

Second, the database of information from the Instituto Nacional de Investigaçao Agronómica (INIA) and non-governmental organization (NGO) trials on yield response to fertilizer and improved seed varieties should be more effectively utilized: fine-tuning seed and fertilizer recommendations to match the diversity of agroclimatic conditions found in the country can increase yields and reduce costs of improved technology. The addition of complementary technologies, e.g., storage pesticides and herbicides, may increase the farm-level profitability of the package. Storage pesticide would be especially important, allowing farmers to take advantage of potential seasonal price rises without the risk of losing a large proportion of their stored grain to insect pests. Herbicide would help address the weeding labor constraint, which becomes even more binding when fertilizer is used. Third, greater attention should be given to training extension agents and ensuring that they are providing adequate technical support on appropriate planting and fertilizer methods and weeding times.

Investments to reduce costs and ensure timely availability of inputs. In Mozambique the cost of inputs is very high compared to the output prices currently faced by farmers. Using June prices, the ratio of the cost of the total input package to the price of one kilogram of maize ranges from 1,504 in Region 8 (Monapo/Meconta, Nampula Province) to 2,074 in Regions 4 and 10 in Manica Province. This means that farmers must produce between 1,504 and 2,074 kilograms of maize to pay for the package of inputs used on one hectare. Using prices from our economic analysis, we calculate ratios in Nampula that range from 717[5] to 3,165[6]. In Manica, the economic ratios range from a low of 700 to a high of only 873. These economic ratios are similar to the financial ratios faced by Ethiopian farmers in 1996/97, who only needed to produce 748 kilograms of maize to pay for a comparable package of inputs (using comparable prices immediately after harvest). Not coincidentally, the SG2000 package was highly profitable for nearly all Ethiopian SG2000 participants.

This analysis suggests that if the export market is developed, especially to Malawi, Nampula farmers can expect to face ratios of around 1,000 or lower. This means that they will begin to make money with yields of 1 ton per hectare. With yields of 3 tons and more attainable on smallholder fields with this technology, the potential profits to farmers become extremely attractive.

Per-ton seed prices are comparable or lower than those in neighboring countries, but seed is expensive for Mozambican farmers relative to the output prices they receive. The average ratio of open-pollinated seed to grain price is 4.5 in sub-Saharan Africa and 5.4 in southern Africa, compared to 7.1 in Mozambique (CIMMYT 1994). Late delivery of inputs was a problem for many of the DNER/SG participants and is also a concern of smallholder contract farmers working with JVCs and other large cotton firms. Major factors affecting input costs and delivery are the poor state of transportation infrastructure,[7] the lack of wholesale and retail outlets for inputs in the rural areas, and weak demand for fertilizer and seed by smallholders. Input dealers cannot deal in large enough quantities to realize significant economies of scale.

A four-part approach is recommended to reduce the cost of getting inputs to smallholders: (1) improving the transportation infrastructure; (2) reorienting the KRII program to give greater flexibility and control to private participants; (3) broadening the role of farmer associations in input distribution and encouraging private agribusinesses to expand the wholesale and retail network for inputs; and (4) promoting the diversification of the seed sub-sector, especially more informal seed replication and distribution.

Improving transport infrastructure. The Mozambican government and donors are well aware of the need to improve transport infrastructure: the Roads and Coastal Shipping Project II (ROCs II) represents an important step in improving conditions. Roughly half of Mozambique's estimated 43,000 kms of paved, earth/gravel, and feeder roads are scheduled

[5]Using the maize price when exporting to Malawi and assuming low transport costs.
[6]Using the lowest maize price - selling in Maputo in a surplus year - and the highest input cost.
[7]Transport and handling costs between the port and farmgate add between 31-64% to the import parity price of fertilizer for farmers in Nampula and Manica Provinces.

for rehabilitation by the year 2000. Additional investments will be required to upgrade the remaining portions of the network and maintain improved road surfaces.

Reorienting the Japanese KRII program. The KRII program provides an important source of credit, but the current system of centralized ordering and distribution of KRII inputs is retarding the development of the private input procurement and distribution system in Mozambique. We propose that the centralized ordering and distribution system for KRII inputs be abandoned, and that the KRII program become purely a financing mechanism to enable private firms and farmer associations to order the quantities and types of agrochemicals they need, and pay back the amount over time. Using the KRII funds as a source of credit, but leaving the process of aggregating orders, tendering for bids, and arranging for importation in the hands of the Mozambican private sector would reduce costs through economies of scale and the long time lag between order and receipt of KRII goods. If it is not possible to reconfigure KRII in this way, the program should be eliminated.

Broadening the role of farmer associations in input distribution and facilitating the development of private input marketing channels.
Strengthen farmer associations. Building smallholder demand for improved inputs while simultaneously creating a network of wholesale and retail input suppliers will be a long-term process. Government and donor funds could be used to strengthen the capacity of smallholder associations to reduce the cost of input procurement and delivery by aggregating input orders, guaranteeing payment, and repackaging bulk orders for delivery to individual customers. One innovative experiment with farmer associations has had good results and should be studied more closely to determine how the model could be expanded to other areas in a cost-effective way. In 1996/97 the Cooperative League of the USA (CLUSA) began working with groups of farmers producing cotton for 3 JVCs operating in northern Mozambique. The farmers had been unhappy with the late delivery and quality of inputs delivered by the company. Under new agreements negotiated by 18 associations supported by CLUSA, companies agreed to channel their input supply and extension services, which had traditionally been supplied to individuals, through associations instead. This strategy reduced the cost to JVCs of service provision and improved the timeliness of input delivery.

If supplier credit is made available through a redesigned KRII and other donor programs, Mozambican agrochemical firms might similarly work through farmer associations to aggregate orders and make inputs available locally on a cash basis. In the future, the DNER/SG program could work with CLUSA and farmer associations as well as individual stockists to organize input procurement, delivery and guarantee payment of credit.

Reduce barriers to market entry. Policy changes have made it easier to import and sell inputs, but several administrative barriers to market entry remain. Retail licenses must be approved by provincial governors and are difficult and time-consuming to obtain, for example. Lack of credit is widely perceived to be a major constraint to the development of input markets. However, the severity of the problem is not well understood, and the discouraging experience with scaled-up credit programs in many SSA countries calls for careful examination of alternative approaches to increasing credit availability.

Discontinue direct distribution of inputs by government and NGOs. The Mozambican government and NGOs can encourage the development of input markets by discontinuing the direct distribution of relief or otherwise subsidized fertilizer and seed for commodities that are available commercially. The government/NGOs can instead provide farmers with vouchers to purchase inputs from local sources.

Provide technical training for stockists. Another important constraint is the lack of trained personnel in rural areas who are capable of handling products safely, giving competent advice about their utilization, and bookkeeping. Innovative NGO programs such as Citizens Network are helping to train shopkeepers in Manica Province in collaboration with SG. In Zimbabwe, CARE's AGENT program also provides credit guarantees until the stockists graduate to regular supplier lines of credit, in addition to training in input use, storage and bookkeeping.

Diversification of the seed sector. Mozambican farmers in some agroecological areas are becoming aware of the value of hybrid maize seed, and this market may expand over the coming years. For the foreseeable future, however, the bulk of demand will be for open-pollinated seed that can be replanted for several seasons, not renewed every year. This suggests that the development path for SEMOC will differ from counterpart formal seed organizations in neighboring countries that have relied heavily on centrally grown, centrally processed hybrid maize as a flagship product.

Because of its research and varietal testing capability for a wide range of crops and links with external public and private seed organizations, SEMOC (together with INIA, DNER and the public seed organizations) can play a unique role in the development of a multi-tiered seed sector in Mozambique that can better serve the needs of smallholders. While some activities of the seed system can be supported by commercial firms, others will require support from the government and/or donors. Examples follow.

Decentralize Seed Production and Marketing. First, SEMOC and other potential entrants to the seed market can reduce their costs by decentralizing seed production and marketing. This will require joint efforts by companies, public agencies and NGOs to (a) provide links to NARS, international research centers and the private sector to get information and seed of appropriate varieties; (b) train extension agents to choose appropriate varieties for different agroecological zones and types of clients; (c) train and supervise farmers in seed production, selection, storage and marketing; and (d) provide technical training to rural stockists.

Review Seed System Regulations and Functions. Seed subsector regulations need to be rationalized to encourage the development of the informal seed sector. We recommend a two-tier seed multiplication and distribution system rather than a compulsory certification system for all crops. At the first level, foundation seed would be multiplied to certified seed under the stringent and highly controlled conditions currently required by seed authorities and made available for direct sale. In the second stage, seed from the first level would be bulked by individual farmers and farmer groups in local villages under inspection by extension workers and marketed as standard seed. Removing compulsory seed certification and restrictive trade licensing requirements will permit formal production of quality open-pollinated maize and other crops by smallholders and sale among neighboring farmers. In addition, seed companies will be able to involve smallholders in contract seed production more easily.

Reducing the cost of marketing commodity outputs and developing new markets for smallholder commodities. Increasing the demand for improved inputs by smallholders ultimately depends on expanding the post-harvest market for commodities produced by smallholders. It will be especially important to develop foreign markets for Mozambican commodities. Any strategy to develop regional export potential in food and other crops in northern Mozambique must be active on many fronts. Needs include the continued improvement of port management and roads, especially secondary and tertiary routes; simplification of licensing and other bureaucratic procedures related to trade; improved access to credit for agricultural trade; and continued development of farmer associations. In addition, the government can facilitate regional trade in three ways.

Making a clear policy statement that the government will not prohibit maize exports even during drought years. If traders expect the government to close off profit opportunities during years of regional deficit, they will not invest in their capacity to efficiently and regularly assemble and export large quantities of grain. The result will be continued small-scale operations, high costs, low prices to farmers, and high prices for consumers.

Collaborating with the private sector to create a regional trade information network. An effort is currently underway in MICTUR and should be strengthened. It will be especially important to coordinate this effort with the existing market information system (SIMA) in the Ministry of Agriculture and Fisheries. If successful, such a network could eventually provide the basis for an agricultural commodity exchange in the area.

Removing bureaucratic barriers to the formalization of farmer associations so that they can continue to expand their marketing activities. Stronger farmer associations can play a key role in reducing the costs of marketing commodity outputs both domestically and internationally. During the 1995/96 season, CLUSA helped associations in JVC cotton areas set up management systems enabling them to weigh, record and deliver the cotton to the gins themselves for a higher price. Farmer groups are also beginning to coordinate exports. In the same year, nine CLUSA-assisted associations involving about 3000 farmers in the Ribaué area coordinated to sell 1200 tons of maize to a South African company The buyer paid the associations 1000 meticais/kg compared to the market price of 750 meticais/kg, with part of the proceeds invested in the association's development fund. JVCs and other large commercial farms can also play a role in seeking out new markets and contracting smallholders for the production of these commodities. For example, several cotton firms interested in encouraging a cotton-maize or cotton-maize-legume rotation are actively exploring alternative markets for maize and legumes such as pigeon pea and groundnuts.

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