PN-ACS-941

MALR
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Ministry of Agriculture & Land Reclamation
US Agency For Intl. Development
Agriculture Policy Reform Program
Reform Design and Implementation

وزارة الزراعة واستصلاح الأراضي
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RDI REPORTS

Ministry of Agriculture and Land Reclamation

AGRICULTURE POLICY REFORM PROGRAM

Reform Design and Implementation Unit (RDI)

USAID CONTRACT NO. 263-C-00-97-00005-00

Report No. 100

SOME ECONOMIC ASPECTS OF THE MIXED-FLOUR BALADI BREAD PROGRAM

APRP

Reform Design and Implementation Unit

Development Alternatives Inc. Group: Office for Studies & Finance, National Consulting Firm Development Associates, Cargill Technical Services, The Services Group, Training Resources Group, Purdue Universities, University of Maryland

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March 2000

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Acknowledgements

The authors wish to acknowledge the assistance of Dr. Aly Abd El-Rahman Aly, Advisor to the Minister of Supply and Home Trade during the course of this study.

Richard Prior and Dr. Hamza A.Hamza of the U.S. Wheat Associates shared with us their knowledge of the flour industry.

Eng. Ali El Kholie, former First UnderSecretary for the MTS and consultant on the wheat-maize flour mixing project for the MTS shared with us his valuable experience with the mixed-grain baladi bread project.

Dr. Nabih A. Ibrahim, Director, and Dr. Ibrahim Youssef, Agric. Economist of the Food Technology Research Institute of ARC provided information on the nutritional value of maize flour blended with wheat flour and characteristics of the mixed flour bread and observations on sorghum flour.

Reda Nigm, Inspector in the MSHT arranged field trips to visit two stone mills now milling maize and answered numerous questions for us.

Dr. Hassan N. Ibrahim and Dr. Ragab M.A. Zein of the University of Menofiya assisted in data gathering and interpretation.

Mr. Urs Hanselmann, milling engineer for Buhler, provided an understanding of some of the engineering problems and costs in the milling industry.

We also appreciate the time and efforts of those millers and bakery operators whom we interviewed who willing provided information on the industry.

Executive Summary

- The major determinate of subsidy costs of the baladi bread program is the price of imported wheat.

- The major determinate of the costs of the mixed-grain flour program is the relationship between the price of domestic maize and imported wheat. Use of domestic maize will reduce treasury costs when the CIF Alexandria price of imported wheat exceeds US $157/MT with domestic maize at the current price level and the elimination in leakage due to mixing of the flour at the mills.

- The savings in foreign exchange from the mixed-grain flour program are currently about US $61 M. per year and will increase in direct relationship with any increases in the price of wheat or any decline in the value of Egyptian currency vis-a-vis the US Dollar.

- With international wheat prices at the recent 13-year average of US $ 161/MT (CIF Alex.) the mixed-grain flour program would save the national treasury LE 228 million/annum about 10 percent.

- Under the mixed-grain flour program milling fees paid by the MSHT will increase from about LE 47.5/MT of all-wheat flour to about LE 50.4/MT of mixed-grain flour, or about 6 percent/MT.

- The conversion of flourmills from wheat to maize will decrease the milling capacities by about 23 percent due to the greater difficulty of milling maize. Some of the excess milling capacity currently existing in the 72 percent flour market could be shifted to the 82 percent flour market if the proper pricing incentives are found.

- Leakage of 82 percent flour at bakeries to the fino flour market will likely <u>continue with no reduction</u> with the milling and delivery of two types of flour, unless the flour is mixed at the mill.

- Mixing flour at the mill is expected to reduce leakage to near zero levels. Mixing flour to eliminate leakage would save an estimated LE 3/MT of flour over and above the mixing costs if the mixing were accompanied by a reduction in quotas by the same 11.5 percent reduction in leakage.

- Elimination of leakage and reduction of flour quotas to bakeries would result in a saving of foreign exchange to the program of US$ 110 million under the current prices and maize purchase programs.

- Use of mixed-grain flour in baladi bread <u>will not</u> likely result in any self-targeting, i.e. reduction in its use by higher income groups.

- Users of this model must be cautioned to remember that results of the spreadsheet model represent savings or costs <u>only to the baladi bread program</u>. Substitution effects within the economy that are outside the baladi bread program may offset the benefits or saving estimated by the model for the program

Recommendations

- Continue the mixed-flour baladi bread program. Under current world wheat price conditions there are no savings to the national treasury but in the long run, with higher wheat prices there will be substantial savings to the program and in foreign exchange outlays from the program.

- Add flour-mixing equipment at the wheat mills where maize flour is milled and collected for forwarding to the bakeries and flour stores. Pay millers a fee, equal to costs, for mixing maize and wheat flours. All flour delivered to bakeries or flour stores should be mixed-grain flour only.

- From the standpoint of costs of converting the mills from wheat milling to maize milling, continue to convert stone mills to maize with the addition of hammer mills as a first pass. The wheat needed for the mixed-grain flour should be milled in the cylinder mills.

- The MSHT should conduct studies to determine if any flour leakage occurs with mixed-grain flour and to determine if there is any improved targeting of this mixed-grain baladi bread to the needy people.

Introduction and Background

The purpose of this study was to examine some of the major economic aspects of the mixed-flour baladi flour and bread programs in Egypt and to develop a model, which can be used to assist decision-makers in the administration of this program. The model is to be designed to examine varying price, cost and demand conditions. This program is administered by the Ministry of Supply and Home Trade (MSHT), formerly the Ministry of Trade and Supply (MTS).

The baladi bread and flour subsidy programs

The Egyptian food subsidy program currently includes four commodities: baladi bread[1], baladi wheat flour, sugar and cooking oil. The total GOE national treasury cost in 1996-97 for the food subsidy system was LE 3.74 billion. The total cost of the baladi bread program was LE 2.30 B. This included the purchase cost of both domestic and imported wheat, duties, transport, milling, storage, and interest costs less receipts for wheat bran and flour sold to bakeries. The baladi flour program costs totaled LE 0.56 B. for a grand total of LE 2.86 B. in 1996-97.

In 1996-97 the two baladi flour programs required the purchase of 1.2 million metric ton (MMT) of domestic wheat and 4.8 MMT of imported wheat (Total = 6.0 MMT). Hence; 80 percent of the wheat was imported (see Table 1 in Annex I).

Subsidized baladi bread is available without limit at a price of LE 0.05/ piece. In 1997 the MTS supplied about 3.4 MMT of 82 % wheat flour to 10,700 bakeries, most of which are privately owned and most of which are located in urban areas (Figure 1). The bakeries pay LE 292/metric ton (MT) of flour from which they are required to produce 10 pieces of baladi bread per KG of flour. Each piece must weigh 130 grams. MTS officials monitor activities at the private bakeries.

The remaining 1.3 MMT of 82 % flour is distributed to 21,000 flour warehouses or stores, which are mainly located in rural areas. The flour-store owners pay LE 500/MT for this flour. The price to the consumer is fixed at LE 0.60/KG.

The data (Table 2) show that the baladi bread program serves primarily the urban population while the flour program is focused on the rural population. Fino flour (72 % extraction rate) currently has a value of about LE 800/MT but was LE 1,000/MT a few years ago when international wheat prices were higher.

This differential in the prices of these two closely related commodities results in some 'leakage'. Leakage being the difference between the amount of baladi bread that should be produced and sold by the bakers and the amount that they actually do bake and sell. Some bakers, and flour store operators, are tempted to sift some of the bran from the 82 % flour and sell as 72 % flour at much higher prices. The technical difficulty involved in sifting this flour is minor.

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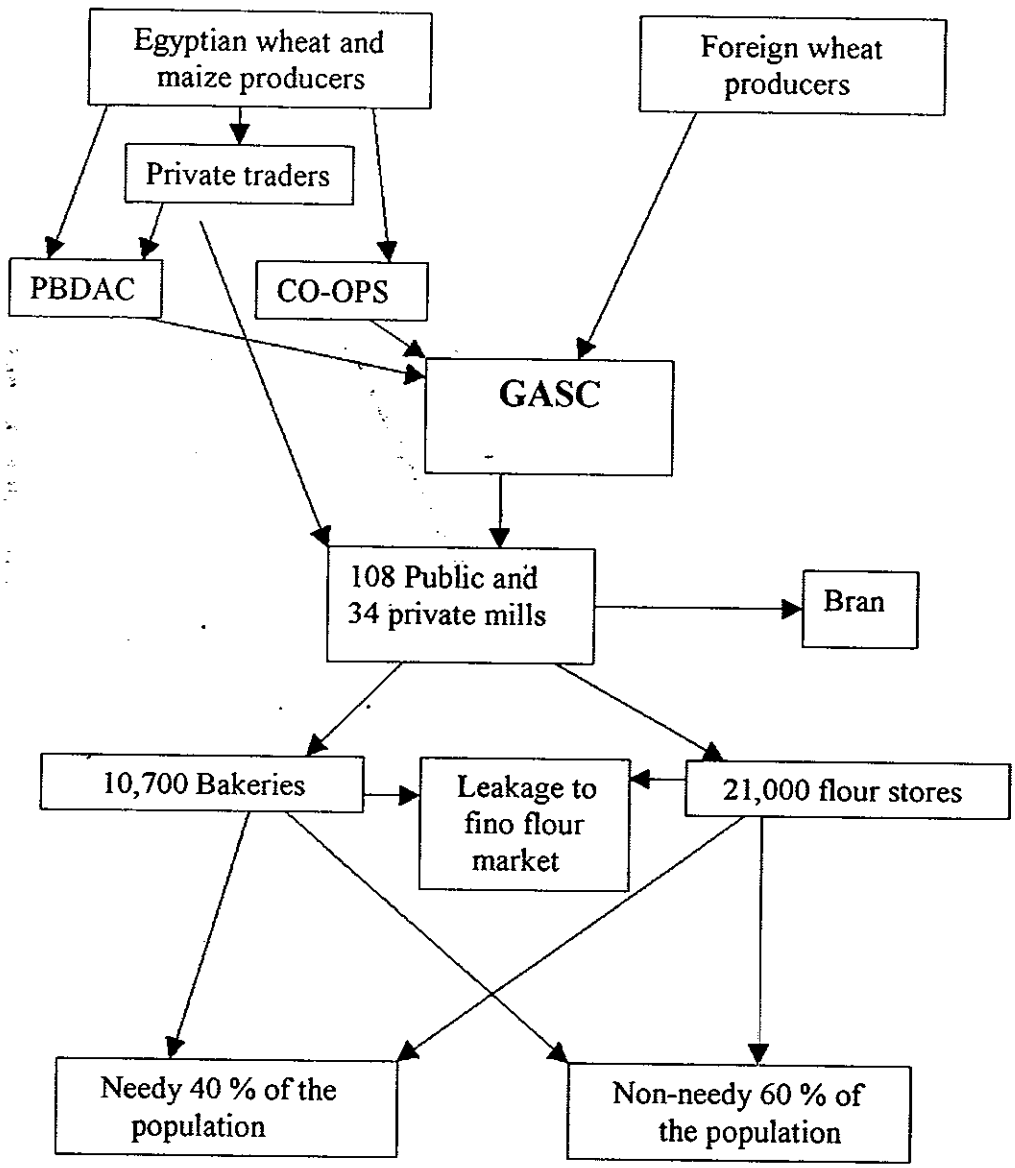
[1] Baladi flour is 82 % extraction rate flour; i.e. 82 KG of flour is obtained from milling 100 KG of wheat.

Figure 1: Structure of the Baladi Bread program



The mixed-flour program

Human consumption of maize flour is an old practice in Egypt. Rural people have produced many types of maize and mixed a variety of wheat-maize breads (6, page 33). Maize has also been mixed with wheat to provide food during war emergency periods. In 1995, several ministries within the government of Egypt (GOE) conducted a joint study of mixing wheat and maize flour for baladi bread. Both the nutritional and economic aspects of the practice were examined.

The mixed-flour project was initiated for several reasons, namely; a) to reduce wheat importation expenditures, b) to reduce leakage, and c) for the improvement of diets. For nutritional reasons, it was decided that the maize germ should be included in the maize flour. This method of milling produces an extraction rate of 97 % on maize and produces maize flour with 3-4 % lipids, which may improve the taste, but also reduces the shelf life of the bread.

Under the all-wheat flour program approximately 6 MMT of wheat were being used to produce 4.92 MMT of all wheat flour. To produce the same amount of mixed flour at a ratio of 4:1 would require 984,000 MT of maize flour, from 1,014,000 MT of maize and 3,936,000 of wheat flour from 4.8 MMT of wheat. The total tonnage of grain required for the baladi bread program would be reduced with the mixed-flour program because of the 97 % extraction rate with maize compared to 82 % for wheat.

The current situation

The GOE, through GASC[2], purchased 18,000 MT of maize in 1996-97. Maize purchases were expanded to 180,000 MT in 1997-98 and to 368,000 MT in 1998-99. This maize has been milled and bagged and sent to bakeries for mixing with the 82 % wheat flour. The target for purchases in 1999-2000 is 450,000 MT.

The GOE has converted 4 roller mills and 20 stone mills from wheat mills to maize mills. These mills produce all-maize flour, which is sold separately in bags to the bakers who are instructed to mix it with the wheat flour in a ratio of four KG of wheat flour to one KG of maize flour. (To facilitate the mixing at the bakeries the wheat flour is put into 50 KG sacks and the maize flour into 25 KG sacks so that the baker mixes one sack of maize flour with 2 sacks of wheat flour to get the proper ratio.) The milling capacity of these mills, in total, is 1,950 MT/day or 585,000 MT per year (See Table 3).

There is currently only one mill, a privately owned stone mill, which began in October 1999 to produce mixed wheat-maize flour. This mill grinds wheat and maize grain separately, mixes the flours, bags it and sends it to the bakers. This mill has a capacity to mill about 150 MT/day but is currently receiving only 100 MT of wheat and 20 MT of maize from GASC per day to produce about 100 MT of mixed flour/day.

At the end of November 1999 a public sector cylinder mill in Zagazig, with a capacity of 500 MT of wheat/day, will begin to mill both grains and blend and bag the flour. This is a wheat mill to which a maize mill of about 100 MT/day capacity is being added. A flour blender is also being added. This mill will soon be producing about 500 MT of mixed flour/day. In February of 2000 a disk mill for milling maize will be added to a cylindrical wheat mill in Helwan and it will begin to produce 450 MT/day of mixed flour. Thus, by February the maize milling capacity will be approximately 2,175 MT/day or 650,000 MT/year. This would be sufficient maize flour to produce about 3.1 MMT of mixed-grain flour /year.

[2] The General Authority for Supply Commodities (GASC) is the agency within MTHS that purchases the grain for the food subsidy program.

Economic Aspects

The national treasury costs and foreign exchange requirements of the mixed-grain flour mixing program depends on the following major variables:

1. The relationship between the price of wheat and the price of maize,
2. The increase in milling costs resulting from the conversion to milling maize,
3. The effect of mixing flour at the mills on the leakage and targeting of the food subsidy program.

Commodity prices

The prices of wheat and maize are the major determinants of the economic costs of the baladi bread subsidy program. The relationship between the price of maize and the price domestic and imported wheat will be the main determinant of the cost of the mixed flour bread versus all wheat flour bread.[3]

Since a major purpose of mixing maize with wheat flour was to reduce import costs, only domestic maize is utilized for baladi bread. Also, domestic maize is white maize, which is not readily available to import. The domestic maize price is currently determined by the GOE. Maize is traded in local markets but the price level is based on the GOE price. In 1999 the GOE base price set for maize was LE 90/ardeb, which results in an average current cost to GASC of LE 731/MT.[4] The domestic maize price has risen slightly in recent years but the GOE appears to be the price setter since it is far above international prices (see Table 4).

The current prices of wheat in the international markets are at cyclical lows. Soft red winter wheat (the type grown in Egypt) is currently available for $100/MT at Gulf ports in the USA. Adding $14/MT for sea shipment gives a CIF Alexandria price of $114/MT or LE 388/MT. During the period 1986-1998 the annual average prices of #2 soft red winter wheat in Chicago ranged from $2.73 to 4.82/bushel but the current price is about $2.22/bushel (Figure 2, and Table 5).[5] The equivalent CIF Alexandria price of that wheat is US $132-209/MT or LE 449-711/MT. The average CIF Alexandria price for that period was US$161/MT or LE 547/MT.[6]

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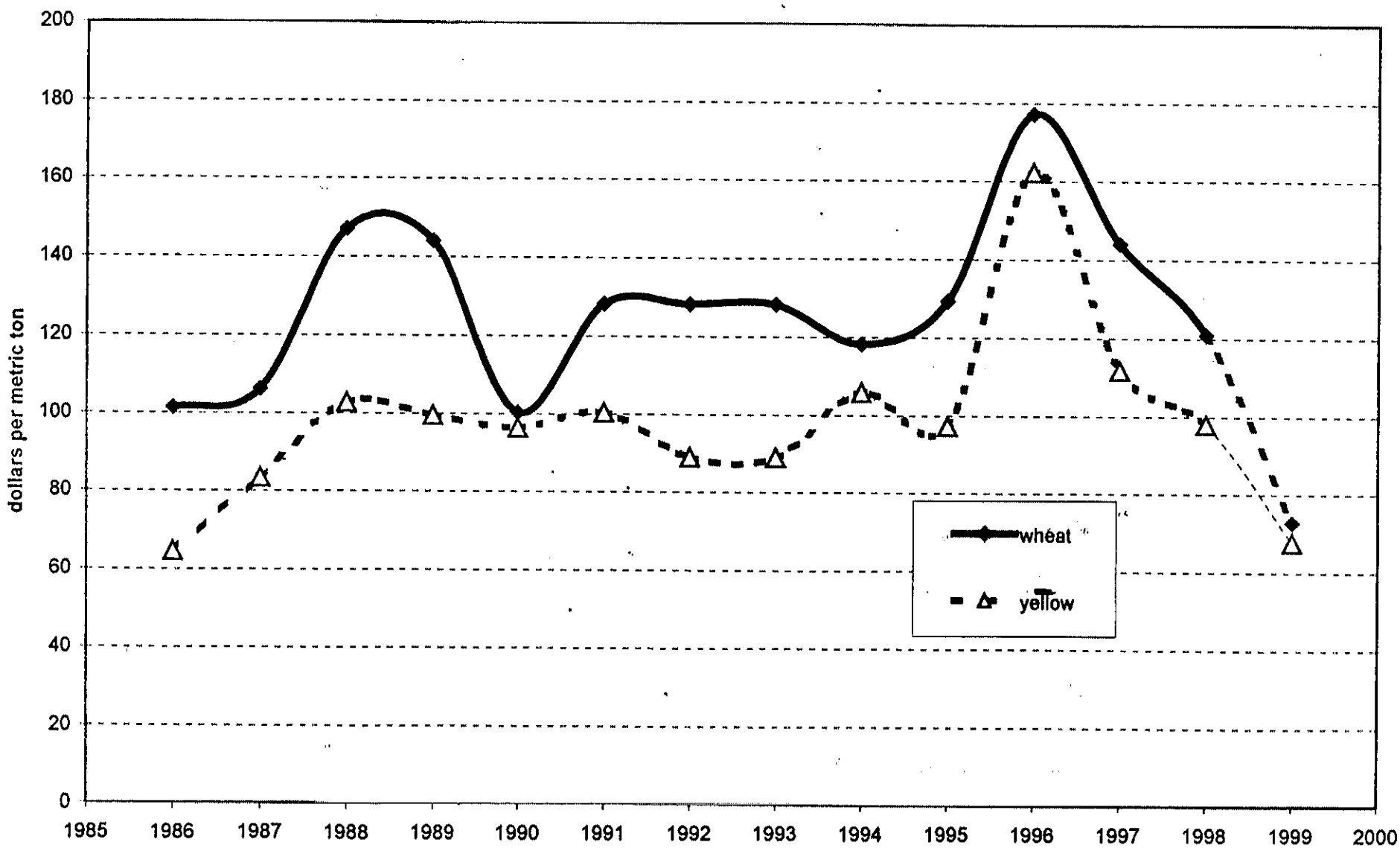
[3] Approximately 20 percent of the wheat used in this program is obtained domestically but at the margin the domestic maize is being used as a substitute for imported wheat.

[4] The base price of domestic maize in 1999 was LE 90/ ardeb (140 KG) for a purity of 22.5 kerat (24 kerat is pure) and a base moisture of 14 %. LE 4 was paid for each additional kerat and an additional LE 1 for each point reduction in moisture. The average price paid to farmers was LE 96 in Lower Egypt and LE 97 in Upper Egypt. Transport costs averaged LE 1/ardeb within governorates and LE 3/ardeb. to move grain between governorates. The buying commission paid to PBDAC or the co-ops for handling the grain is LE 32/ MT. Thus, the average procurement cost to GASC in 1999 is LE 731/MT.

[5] This period was chosen because these data were available on the Internet.

[6] The domestic wheat price is much higher currently than the import price. The base price of wheat is LE 95/ardeb (150 KG) and with premiums for purity the average price paid to farmers is LE 100/ardeb and with commissions and transportation costs the average cost to GASC is LE 702/MT. However, at the margin, GASC must compare the price for domestic maize with the price for imported wheat.

Figure 2. Prices of Wheat and Maize in the United States, 1986 to 1998



A spread sheet model was developed to determine subsidy costs under a variety of price and cost assumptions (See Annex 2). This model is essentially an accounting model that calculates costs of producing all-wheat flour or mixed-grain flour under various price and cost assumptions. The user should be cautioned that this model does not contain supply or demand equations and hence does not estimate the effects of these program changes on any other portion of the Egyptian economy.

Figure 3 depicts the relative cost of the baladi bread program with the domestic maize price held constant at its current level and at various prices of imported wheat. The subsidy costs of the two programs (100 % wheat flour versus mixed-grain flour) are about equal at a CIF Alexandria wheat price of US $157/MT. At lower wheat prices the 100 % wheat flour program would give lower total costs and with a wheat price above this level the mixed-grain program gives the lower costs. At the current CIF Alexandria price of US $114/MT the least-cost program would be to use only wheat and no maize. The cost of one MT of all wheat flour increases by about LE 122 for each LE 100 increase in the price of wheat (the inverse of the extraction rate). However, the cost of one MT of the mixed-grain flour increases by only LE 103 for each LE 100 increase in the price of one MT of wheat.[7]

A major cost factor in the mixed-grain flour program is the high price paid for maize in Egypt. Figure 4 illustrates how flour costs are related to the price of maize in Egypt. Of course the cost of all-wheat flour is not affected by the price of maize but the cost of the mixed flour increases by about LE 20.62 for each LE 100/MT increase in the cost of maize to GASC.

The spread sheet model contains a provision for different exchange rates. The current rate of LE 3.40 to US 1$ is used but this rate can easily be modified. Hence, a decline in the relative value of the Egyptian pound would automatically produce a higher domestic price for imported wheat in the model.

[7] One MT of mixed-grain flour requires 0.2 MT of maize flour (.206 MT of maize X .97 %) and 0.8 MT of wheat flour (0.976 MT of wheat X 82 %). Milling cost is 6 % greater for mixed flour.

Figure 3: Relative Cost of Baladi Bread Program as the World Price of Wheat Changes

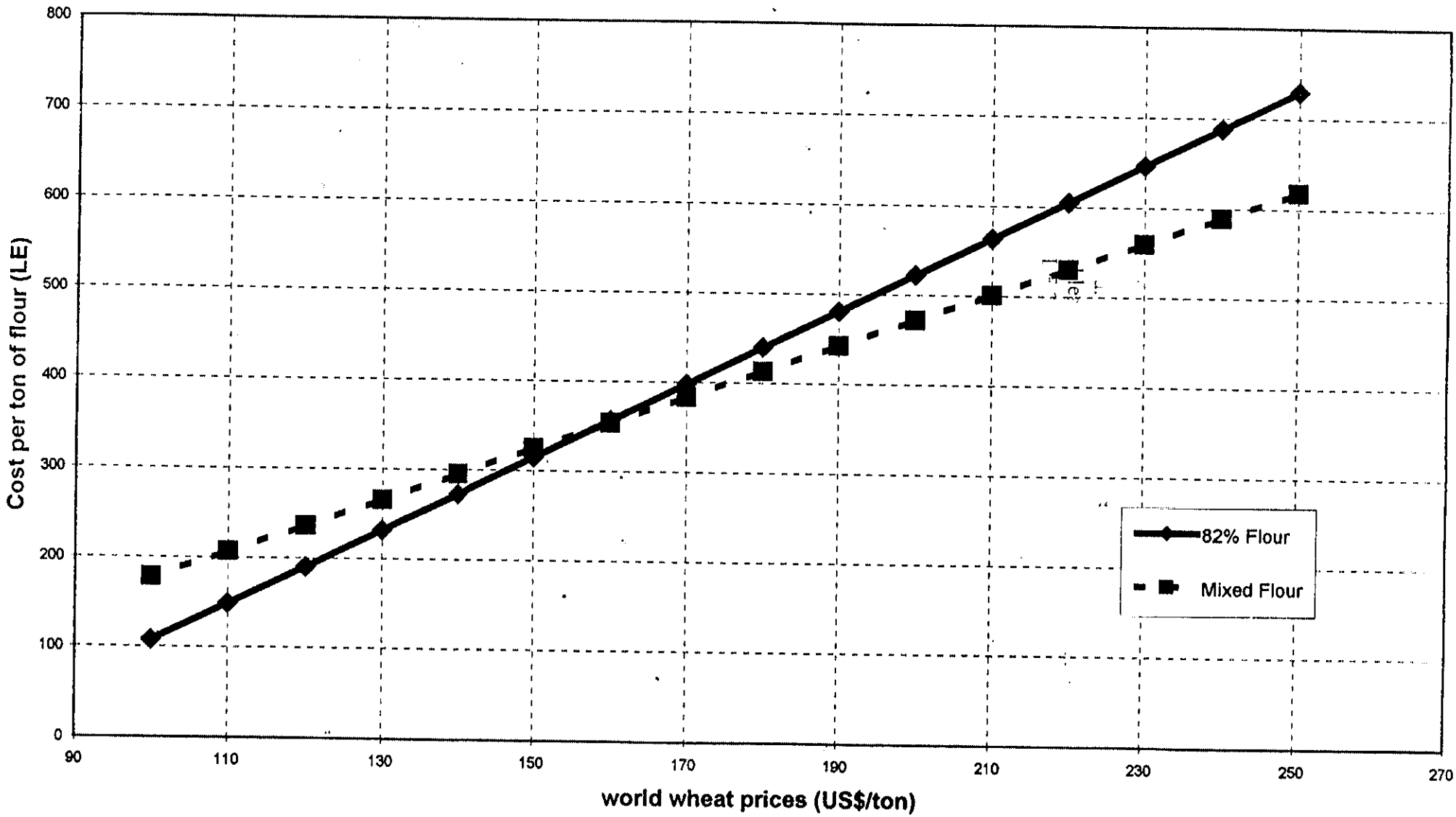
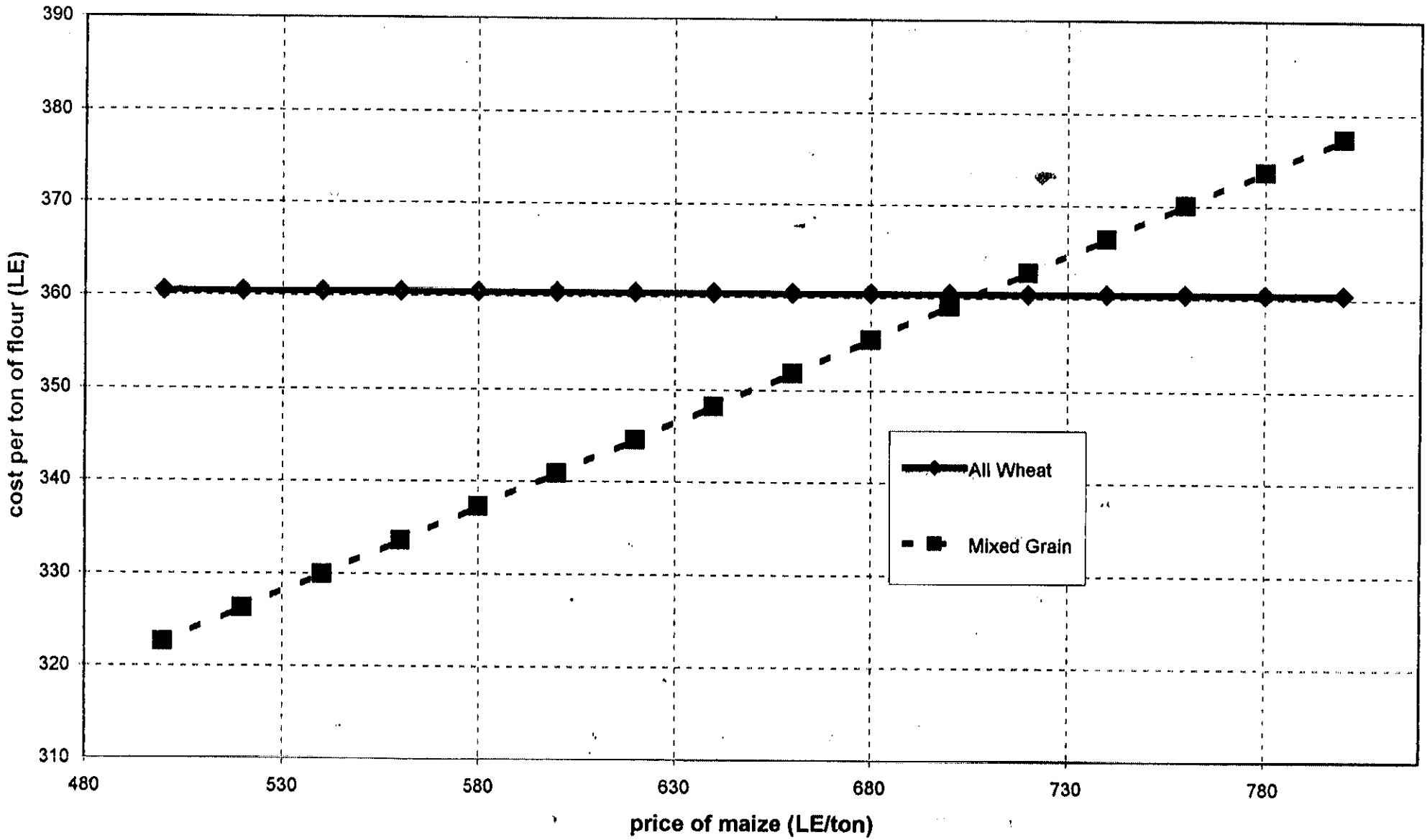


Figure 4. Comparative Costs of Baladi Bread Program as the Price of Domestic Maize Changes



Milling fees

The public mills used for producing baladi bread flour are described in Tables 6 and 7. The public mills are under the Ministry of Public Enterprise (MPE). Those mills that are used for milling 82 % flour have only one client, the MSHT. A milling fee of LE 34/MT is paid by the MSHT for milling wheat in all stone mills, public or private. The fee for the older roller mills is LE 48/MT and LE 56/MT for the newer roller mills. The average fee paid to public mills is LE 40/MT. There are 45 public roller mills and 63 stone mills used for milling baladi flour.[8] The 63 stone mills have an average daily capacity of 140 MT/day (of wheat) and the roller mills have a capacity of 155 MT/day (of wheat). The average fee paid to all mills for milling baladi bread is LE 39/MT of wheat.

The privately owned and operated stone mills have a daily capacity per mill of about 83 MT with a total annual milling capacity of about 850,000 MT for the entire 34 mills. These mills are under contract to produce exclusively for the MSHT. The flour is provided to these mills on a daily quota basis along with instructions as to what bakeries and flour stores can receive flour from their mill.

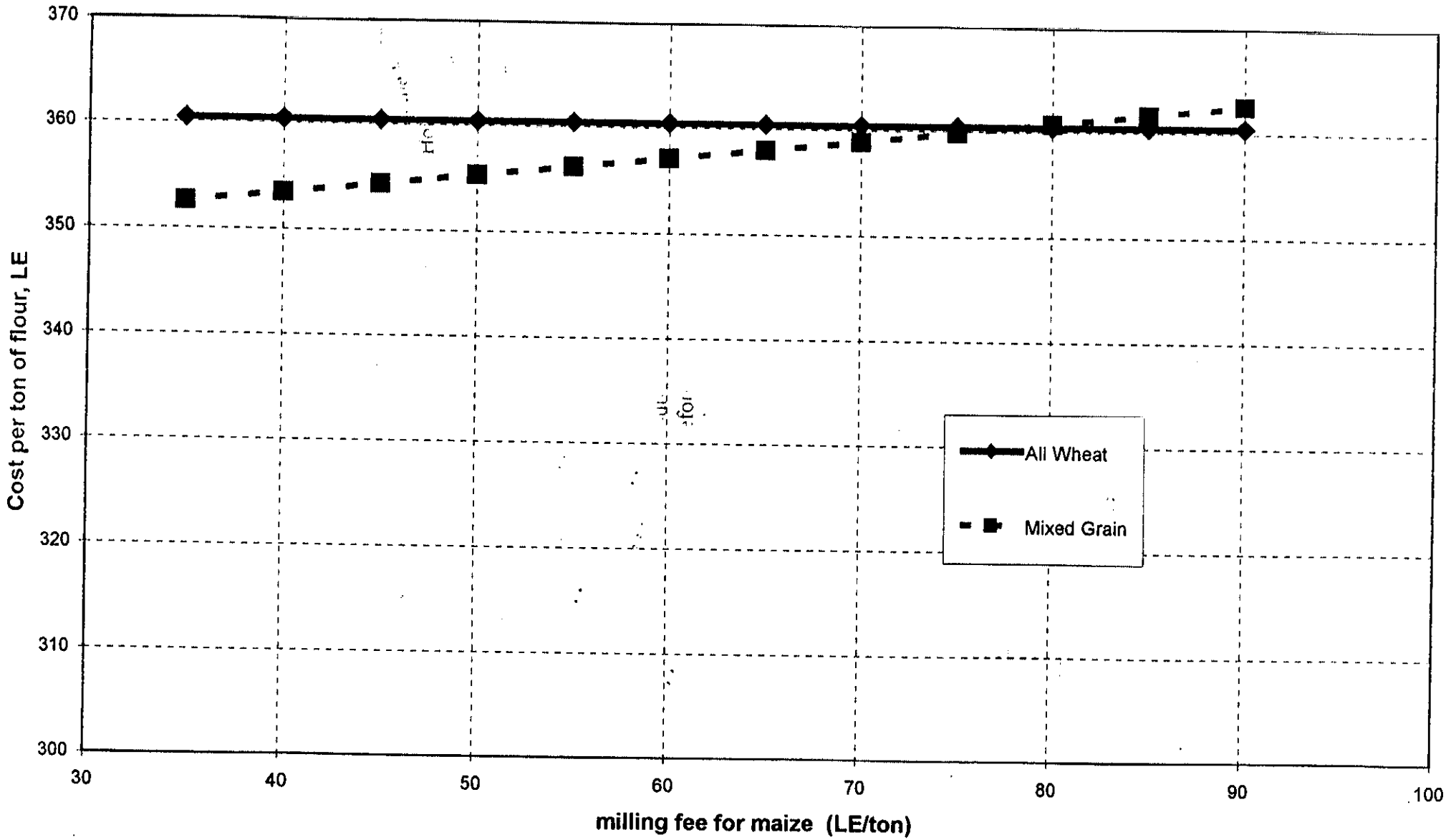
Currently the MSHT is paying a fee for milling maize of LE 60/MT for all mills, regardless of type or ownership. These two fees, LE 39 and LE 60 were used as the default values in the spreadsheet model. Figure 5 illustrates the relationship between the milling fee for maize and the relative costs of the baladi bread program. As Figure 5 illustrates, the milling fee is not a relatively large item in the cost structure.

The milling cost of wheat flour is LE 39 for 820 KG of flour or LE 47.56/MT. The milling cost of maize flour will be LE 60 for 970 KG of flour or LE 61.86/MT. When these two flours are mixed in the ratio of 4:1 we have a final cost per MT of mixed grain flour of LE 50.42, or an increase in milling fees of 6 percent.

The milling fee may or may not accurately represent total milling costs of the MPE or of the private mills. The limited scope of this study prohibited analysis of milling costs. IFPRI recently conducted a study of Egypt's milling industry with some emphasis on milling costs and returns (3). Again, the assumptions regarding the milling fees in the spread sheet model can easily be updated.

[8] Some public mills have been closed since 1996-97. The terms, roller mill and cylindrical mill are used interchangeable since they are the same technology.

Figure 5. Relative Costs of Baladi Bread Program as Milling Fee for Maize Changes



Leakage to the fino flour market and mixing flour

As described above, leakage in the baladi bread program is defined as the difference between the amount of baladi bread that should be produced and sold by the bakers and the amount that they actually do bake and sell. This results from the illegal sifting and selling of the 82 % flour in the 72 % flour market. An IFPRI study estimated the average leakage at the bakery stage at 11.5 percent and leakage of wheat flour at the flour stores at 29.6 percent (2, pages 89 & 90). These results differ from what one might expect since the potential for gain is much greater for the bakeries who pay only LE 292/MT for this flour compared with the price of LE 500/MT paid by the flour stores.

However, the general consensus of consumers, bakery operators and millers interviewed in the course of this study is that the leakage at the bakeries and the flour warehouses is less than 20 percent. These people also felt that leakage was much greater at the bakeries than at the flour stores. They argue that leakage varies seasonally and increases at the time of the feasts. Many also believe that leakage is greater at the public owned bakeries than at the private bakeries. They also indicted that the consumers are a more effective control of leakage than were the MTHS inspectors. Hence, we use the IFPRI estimate of 11.5 percent leakage at the bakeries as a default value in the spreadsheet model.

The almost unanimous consensus of these respondents is that leakage will be reduced to practically zero with mixing of the maize and wheat flour at the mills. The resulting blended flour can be sifted to remove bran but sifting cannot remove the maize, including its flavor and poor bread-making qualities for 72 % flour products.

These sources also estimate that the leakage remains the same whether the all wheat flour is delivered to the bakeries and stores or grain in separate sacks. The wheat flour could still be sifted and there is a market for maize flour as poultry feed. Thus, it is estimated that milling and delivery to the bakeries of the two separate types of flour will not reduce leakage. Blending or ***mixing*** of the two flours ***at the mill*** is necessary to reduce leakage.

Production of blended or mixed grain flour will require the installation of equipment to mix and bag the flour. The location of these mixer-baggers depends upon the method of conversion of the mills, which is discussed below. Currently the MTHS does not pay millers a fee for mixing.[9] A payment for mixing will be needed to offset additional investment and operating costs.[10]

The spread sheet model was used to determine the possible savings from a reduction in leakage. The model is configured to compare the cost of mixing the two flours versus the savings in reduction in leakage. With the long run average wheat price of US $

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[9] Actually there is currently only one mill, a private stone mill, that produces mixed flour.

[10] A few estimates were obtained on the investment costs of flour mixers. These estimates ranged from LE 70,000 -100,000 for batch mixers with capacity of 90-150 MT/day, to a continuous flow mixer with a capacity of 30 MT/hr at US $80,000. These convert into investments of LE 400-700 per Mt of capacity/day. Total ownership and operating costs of flour mixers-baggers are estimated to be LE 5-10/MT.

161/MT the model estimates that GASC could pay as much as LE 13/MT of flour if leakage is cut from 11.5 percent to zero. Thus, if the mixing fee is LE 5/MT of flour the cost saving from mixing would be LE 5/MT of flour.

Figure 6 illustrates the cost savings from the mixed-grain flour program at various original leakage rates. This figure is based on the assumption that the mixed-grain flour program reduces leakage to zero and that the flour quotas of the bakeries and flour stores are then reduced the same amounts so that all saving goes back to the program. This figure indicates that if there was zero leakage originally the costs of switching to the mixed-flour program increased from LE 360/MT to LE 400. A reduction in leakage from 10 percent to zero would offset the costs of switching to the mixed-grain flour program. And if the original leakage rate had been 30 percent, eliminating this leakage would cut costs to about LE 280/MT.

This savings from reduced leakage is based on the assumption that the quotas for flour delivered to the bakeries and flour stores would be reduced to offset the reduction in leakage. Thus, if leakage is cut by 11.5 percent than the delivery quotas could all be cut by 11.5 percent, thus causing a reduction of 11.5 percent in the total quantity of grain purchased and milled. Those bakers and flour stores who had not formerly participated in cheating may consider such reductions in quotas unfair. Also the people served by those who had not cheated would now have less bread than formerly.

Figure 7 illustrates break-even prices for the mixed-grain versus all wheat flour programs with three different assumptions about the reduction in quotas. The three assumptions were that; a) delivery quotas cannot be reduced at all, b) delivery quotas can be reduced by 50 % of the reduction in leakage, and c) that delivery quotas will be reduced 100 % of the reduction in leakage.

If, for any reason, flour quotas cannot be reduced when the leakage has been reduced, then the baladi flour program receives none of the benefits from the control of leakage. The line in Figure 7 that is labeled "no reduction in quotas" represents this situation.

But if flour quotas can be reduced as much as the leakage is reduced than the program receives maximum benefits from the control of leakage. The line labeled "full reduction in quotas" in Figure 7 represents this situation.

Targeting of the food subsidy program

One important advantage of the general food subsidy program in Egypt is that the program is operated without a large bureaucracy to identify eligible persons. All who ask to buy bread or flour are permitted to do so without limit. However, the drawback of this type of program is that the government must absorb the costs of providing bread and flour to all customers, not just the needy people. Hence, one can ask, "What share of the baladi bread and flour actually goes to the needy people?" IFPRI has conducted several recent studies on this topic (1, 2). They define the needy people as those who are in the lower 40 percent of the population when classified on the basis of expenditures.

Figure 6. Comparative costs of baladi bread program with various original rates of leakage

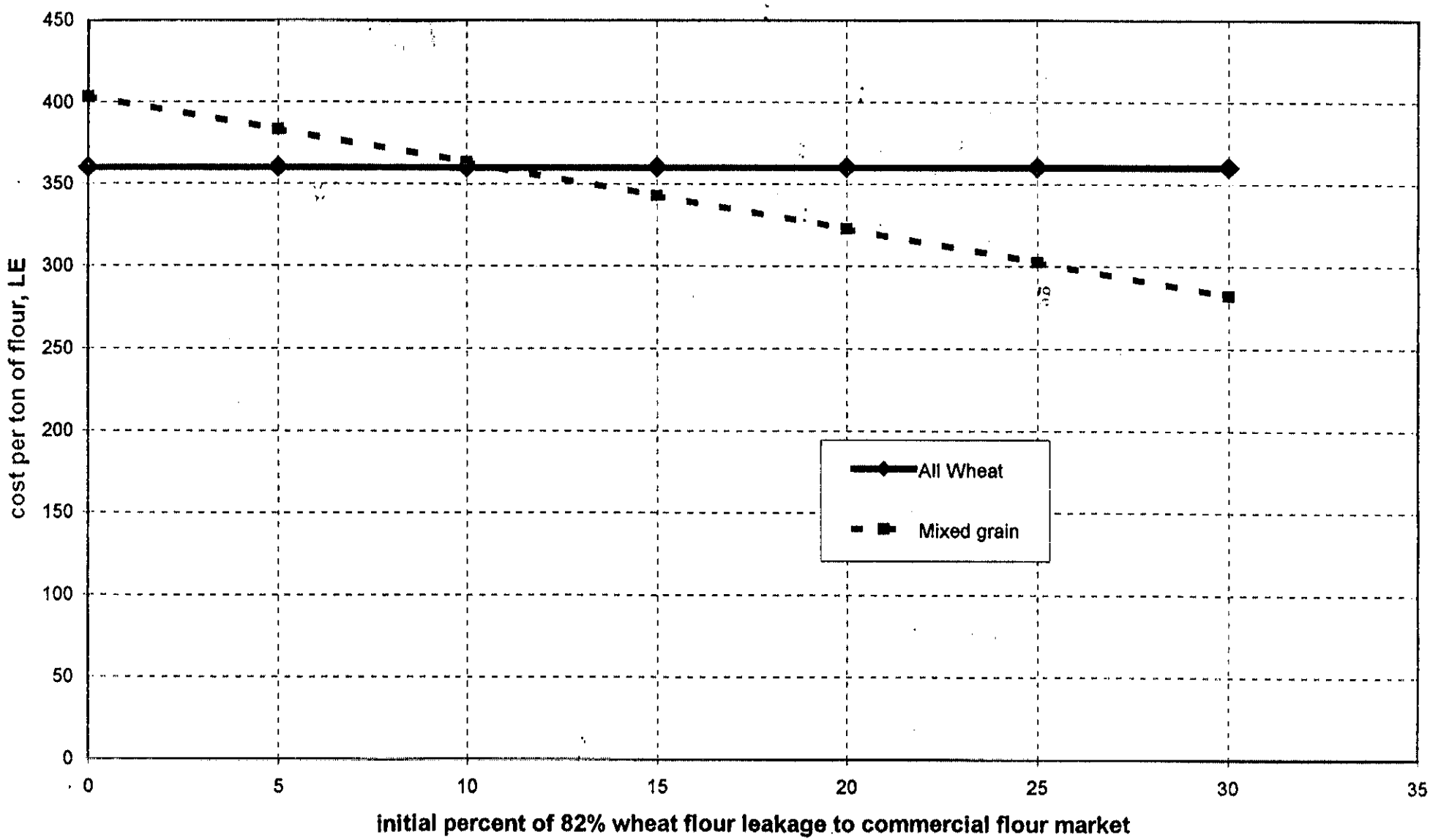
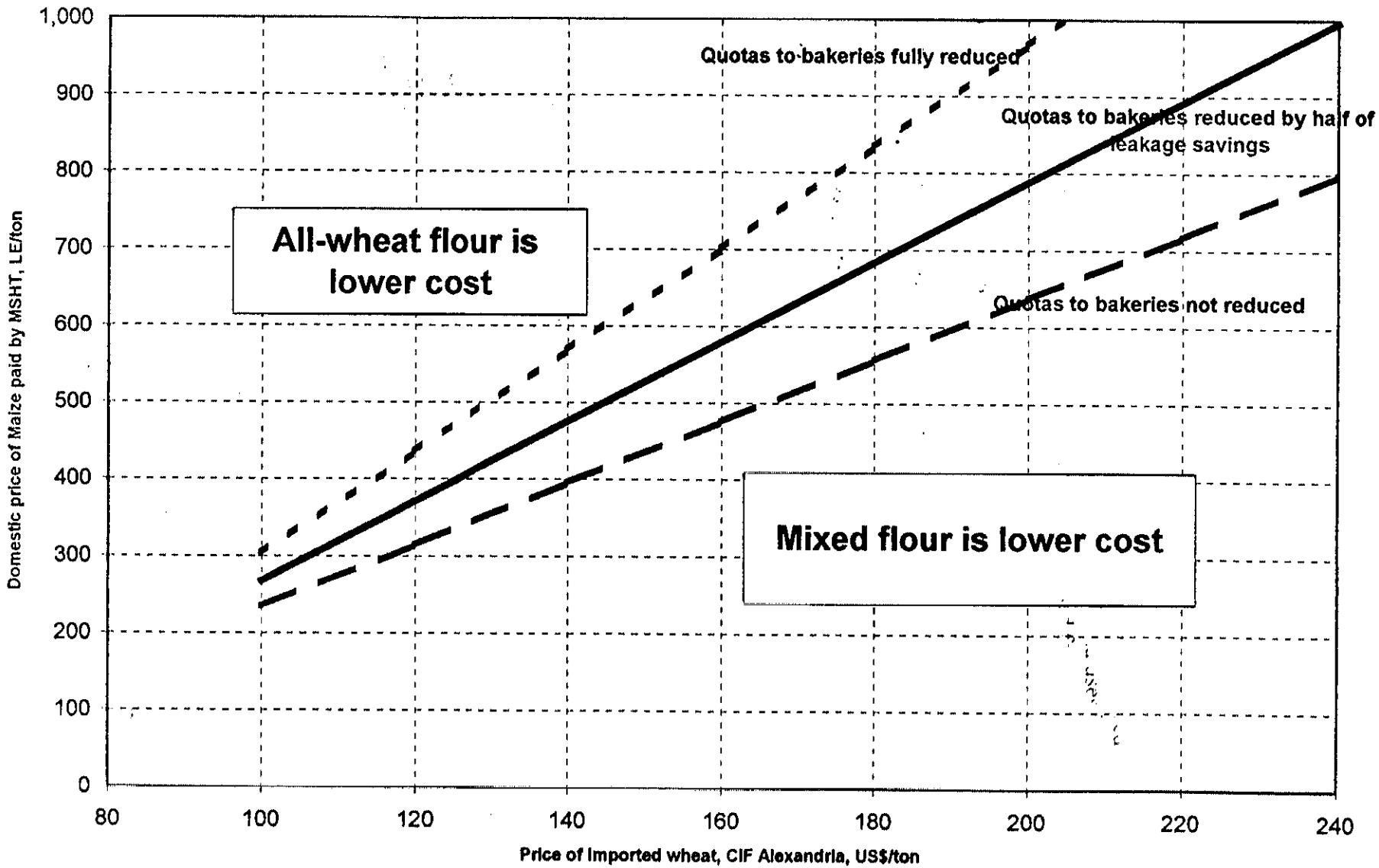


Figure 7. Break-Even Prices for Wheat and Maize used in Baladi Bread Flour



Research conducted by IFPRI indicates that baladi bread is consumed by all income classes with only the highest expenditure category showing any significantly lower consumption of baladi bread or flour. Thus, the needy 40 percent of the people are receiving only 41.3 percent of the baladi bread and 42.6 percent of the baladi flour (2, Tables 29 and 30). This represents very poor targeting of benefits. One can thus conclude that the food subsidy program is very inefficient in providing benefits to the needy people. Out of the LE 2.86 billion treasury costs of the baladi flour and bread program the needy received only LE 1.19 B. in benefits or an efficiency of only 41.6 percent.

IFPRI suggests (2. Page 62) that mixed-flour baladi bread may be self-targeting, i.e., that only the needy people would purchase the mixed-flour or mixed-flour bread due to the change in the taste or texture of the bread. Under this assumption the higher income groups would automatically shift to fino-flour products. However, the general consensus of consumers, bakery operators and millers interviewed in the course of this study is that the quality of the mixed-flour baladi is such that no change in consumption patterns can be noted in any income group. Some consumers have indicated that they prefer the mixed-flour bread because they like the flavor or because they know it is more nutritious. But consumers have also noted that the mixed-flour bread becomes stale quicker.

Controlled surveys or studies have not been conducted in this study. However, for the past three years the maize supplies purchased by GASC for the baladi bread program have been exhausted each season before the new maize crop is available. Hence, bakeries have been required to switch back and forth between selling mixed-flour bread part of the year and all-wheat flour the remainder of the year. Under these conditions, no decrease in demand was noted when the mixed-flour was being used. Daily sales continue at the same level although fino flour products were always available as a substitute.

The spread sheet model includes provision for inclusion of alternative targeting assumptions; but there currently is no evidence that mixed-flour (wheat-maize) bread is self-targeting.

Conversion of the mills

Mills from two MPE holding companies and 34 private[11] companies are currently being used at nearly full capacity to mill the wheat and maize needed for the bread and flour subsidy programs (Tables 6 & 7). The stone mills have a combined total annual capacity of about 3.9 MMT of wheat, or about 65 percent of the total capacity now being used for the baladi bread program.

The stone mills can be converted to milling maize with less difficulty than the conversion of the cylindrical mills. The maize kernel is harder than the wheat kernel and hence to mill maize with either a cylindrical or stone mill the maize must first be put through a crusher or hammer mill. The increase in difficulty in maize milling results in a reduction in capacity of mills when they are converted from wheat to maize.

[11] The two holding companies are the Holding Company for Rice and Wheat Mills (HCRWM) and the Food Industries Holding Company (FIHC)

Based on the experience of the public mills already converted to maize (Table 3), the milling capacity is reduced by approximately 23 percent.

As stated earlier, 20 stone mills have been converted to milling maize but no provisions have been made for blending of the maize and wheat flour at these mills. The flour is sent to the bakeries in separate sacks for their mixing in the bread making process. However, it appears that sacks of maize flour are currently being transported to the wheat mills and then combined with the sacks of wheat flour to make deliveries to the bakeries of both types of flour at the same time.

Several different strategies can be followed in the conversion of the mills to obtain the configuration of mills needed for the baladi mixed-grain flour. The assumption here is that the 4-1 flour ratio will be continued. Three strategies are briefly discussed below. Costs of these conversions have not been estimated but the first two strategies definitely appear to have lower investment costs.

Conversion of portions of the stone mills.

The study team visited a private stone mill to which the owner had added a small stone mill to mill maize in his old stone wheat mill. He had added a maize roller-crusher, six stones for the maize milling, sieves for maize, a flour mixer, and all necessary conveyor equipment. This mill began milling maize in October 1999. His design permitted use of the entire mill for milling wheat or maize or milling of maize with the smaller line and wheat with the larger line. This concept gives the miller maximum flexibility to adjust to changing supplies of grain or changing market demands.

Subdivision of some existing stone mills into two separate lines (one for maize and one for wheat) may prove difficult, depending upon the lay-out of the mill and the amount of space available in the mill. It would seem to be possible in many cases. The capacity to mill both wheat and maize flour would seem to be a wise strategy, for all millers but especially for the private sector miller. In the case of rice milling many small private entrepreneurs with new mills have taken business away from the old stone village mills because the newer mills gave higher milling percentages and a better quality milled rice. The same could happen with wheat milling. The private millers could mill for both the public and for MSHT.

Milling both grains on the same site has a definite advantage in the production of mixed-grain flour because it eliminates the need to transport maize flour to the wheat mill before bagging.

Conversion of some stone wheat mills to maize and transport of the flour to the wheat mills for mixing.

The 20 stone mills converted by the GOE from wheat to maize mills have followed the first step in this conversion process. Stone mills are easier to convert to maize mills than are the roller mills. Generally a hammer mill is needed for the first pass to break up the hard maize kernels before proceeding with the stone milling. The 20 stone mills thus far converted have capacity needed for milling about 1,517 MT/day or 450,000 MT/year, which is about 45 % of the maize needed for the mixed-grain flour program.

Up to the present time these 20 mills have operated only about half of the year milling maize and are then reverting back to wheat milling for the rest of the year when maize is not available. The public and private sectors together have more than adequate numbers of stone mills to mill all of the maize needed to provide mixed-grain flour for the entire country. Conversion of perhaps only 20 more stone mills would be needed to mill maize.

The next step needed to be taken by the GOE would be to transport the maize flour produced at these converted mills to the site of large wheat mills, mix the two types of flour, and then bag and deliver to the bakeries or flour stores. Bulk methods should be considered for moving the maize flour to the wheat mill. The volume of flour is sufficient to require the investment in a line of trucks with covered, bulk containers to facilitate pneumatic handling at both ends. Flour mixers require a small amount of space in a building and the equipment can all be constructed locally with low total investment costs. Baggers can easily be designed to permit bagging of wheat, maize, or mixed flour for maximum flexibility.

Addition of maize mills to existing wheat mills

A more costly conversion method would be the construction of small maize mills beside large existing wheat mills and then mixing-bagging the two types of flour. The typical large public roller wheat mill has a daily capacity of 500 MT. Hence a 100 MT/day maize mill would be needed. The design could be as simple as only hammer mills with associated sieves, conveyors, storage tanks, and a flour mixer. Or additional rollers could be added. Such a system has been priced at US $600,000.[12]

Minimizing costs

Given the current daily flour quotas of the bakeries and flour stores, one task of the GOE, either the MSHT or MPE, is to choose those mills at which to mill maize and where to mix the maize and wheat flour in such a manner as to minimize transport costs. A linear programming transportation model would be useful for that task.

Storage

GASC currently has some difficulty in finding adequate storage space for maize that it purchases for the mixed-grain flour program. Domestic maize is purchased from producers during and shortly after the maize harvest. It is purchased by PBDAC, by co-operatives, and by the flourmills and is generally stored in sacks at the PBDAC shonas (open yards). Because the maize that is delivered by farmers generally contains higher levels of moisture than wheat, and higher than the safe storage level (14%), it cannot be staked as high and stacks must be further apart to permit air circulation and drying. As a result, the quantity of maize that can be stored in a given space is much less than the amount of wheat that can be stored in the same area. The reported cost of storage paid by CASC to PBDAC for maize storage is LE 32/ MT for the entire season. Also, storage space is limited near some maize flourmills and storage costs are higher for maize. The storage charges in the spread sheet model were set at LE 5/MT of imported wheat and LE 10/MT or domestic wheat or maize. Imported wheat is received periodically throughout the year and does not require storage for long periods.

[12] Private communication with milling engineers from Buhler.

Domestic wheat and maize are purchased only during harvest season so must be stored longer than imported wheat, but the entire crop does not have to be stored the entire season. These storage charges can easily be corrected in the model when better estimates are available.

In a recent study of maize utilization, maize producers reported that 25 percent of the maize that they sold was not sold until at least April-May following harvest (6, page 36). Hence it is suggested that GASC could perhaps modify its maize purchasing practice to reduce purchases immediately after maize harvest and purchase some maize later. Such a practice would reduce financing and storage costs and reduce the storage bottleneck.

Milling maize with removal of the germ

Maize can be milled into flour or meal containing the germ or after removal of the germ. The germ, which represents 8-10 percent of the white maize kernel, contains lipids and proteins. In many parts of Africa where maize is milled to be made into meal the entire maize grain is milled to include the germ. In Egypt, the GOE officials chose to mill the entire kernel, including the germ with the removal of only the coarsest bran to give an extraction rate of 97 percent. This method of milling produces more nutritious flour than if the germ is removed. However, the presence of the lipids (about 3-4 % of the maize flour) increases the chances of rancidity, especially in hot weather. Shelf life of maize flour is estimated to be 2 weeks to 2 months, depending upon temperatures.

The maize germ is an excellent source of edible vegetable oil, of which Egypt is in extremely short supply. Removal of the maize germ prior to flour milling could thus provide a valuable by-product, which would reduce the flour cost and provide large savings to Egypt's food subsidy program. However, the economies of size are very significant in the oil crushing industry. An economical size oil crushing plant has a capacity of 50 MT/hour, or 1200 MT/day, or 360,000 MT/year.[13] With the current rate of maize usage for flour of about 500,000 MT the production of germ would be only 40-50,000 MT/ year. At full usage of maize flour of 1.0 MMT/year the quantity of germ produced would be only 25-28 percent of that quantity needed to operate a germ crushing plant in an economical manner. Hence, at the present time, conversion to milling maize flour in Egypt excluding the germ does not appear to be economical.

The current maize milling and distribution practices of the MSHT are such that much of the maize flour reaches the bakeries within a few days, often the same day, so that no rancidity has resulted. Also, the MTHS currently purchases maize during the maize harvest (October-November) but has purchased only sufficient quantities for 6 months use so that the maize supplies are exhausted before the hot summer weather arrives.

[13] Private communication with milling engineers from Buhler.

Household waste

Other research by IFPRI (4, page 132) reports; " 21.2 percent of rural households fed baladi bread to their animals, and the average household fed 12.2 loaves per week." Thus they estimated that 7-8 percent of the baladi bread goes to animals. This type of usage of the baladi bread is the result of the low bread price. At LE 0.05 for a 130 gram piece of bread the cost is LE 0.38/ KG. This is an extremely low price in comparison to other foodstuffs, or in comparison to the price of animal feed. Hence, this type of use of baladi bread can be avoided only by raising the price of the baladi bread. This is not an income targeting problem.

However, this use of bread is not a complete waste. Most of this 'waste' is used for chickens, which are also food sources. The main loss from such bread uses is not the loss of nutrients but the loss of the energy and other resources used for milling and baking this bread.

Mixing sorghum flour with wheat flour

The possibility of mixing sorghum flour with wheat flour for use in baking baladi bread is also a definite possibility in Egypt. Sorghum is grown extensively in Middle and Upper Egypt at the expense of maize production due to climatic conditions. People in those areas have also baked traditional breads with sorghum flour. The Food Technology Unit of ARC is currently experimenting with baking bread with mixed sorghum-wheat flour. Sorghum can also be milled with the stone mills used for wheat and maize.

Such a product would likely be acceptable only in Middle and Upper Egypt due to the distinct taste of sorghum flour. Mixing of sorghum with wheat flour may be more self-targeting to low income people than is the wheat-maize flour. If this proves to be true the use of sorghum would prove to reduce subsidy costs of delivering food to the low-income groups.

Other possible strategies

At first hand, importing white maize may appear as a method of reducing national treasury costs of the baladi bread program due to the lower prices of imported maize versus the domestic price. But this practice would not result in much saving in foreign exchange. And, in fact, this may not be a viable option. Sufficient quantities of white maize for importation are very limited throughout the world. The USA produces some white maize but the demand within the USA utilizes almost all of the production. South Africa and Zimbabwe occasionally have supplies available for export but the problem is that their exportable surplus is not consistent. Egypt must have a reliable source for food and reliance on such unpredictable sources may be inadvisable.

World wheat prices fluctuate widely. It would be technically possible for GASC to shift from all wheat for baladi bread during periods when world prices are low to mixed-grain flour when the world wheat prices are high. The spread sheet model results have indicated at what price situations this strategy would reduce costs. Such a strategy would imply varying the domestic purchases of maize. This may or may not be advisable when considering the impact on the local agricultural economy. With the use of the US wheat futures markets as a guide, such decisions could be made prior to

maize planting time in Egypt and thus announcements could be made to farmers at that time to guide their decisions. The size of the shift in maize purchases must be considered. Egyptian farmers now produce about 6 MMT of maize annually. The current purchases of maize by GASC of about 450,000 MT represents only 7.5 % of the crop. However, a recent study of the Egyptian maize market estimated that only 56 percent of the maize is marketed and producers retain the remainder for their own use (6, page 36). Thus, current purchases of 450,000 MT represent 13 percent of the total available on the market. When the mixed-grain program is in full operation GASC will need to purchase 1 MMT of maize/year. This quantity would represent 30 percent of the total offered for sale by producers. Thus, GASC could make only marginal shifts in buying domestic maize, shifting only perhaps 100,000 MT annually instead of complete shifts in and out of maize.

Cautions

Users of this spread sheet model are cautioned to remember that the cost savings and other estimates produced by the model represent savings, etc. **only to the baladi bread program**, not to the Egyptian economy or the agricultural economy. The model is an accounting model only. It contains no supply or demand equations or elasticities and hence does not estimate any substitution effects of consumers or producers or income effects on consumers or producers. The GASC administrators in their management of the baladi bread program must consider such factors just as they have done in the past.

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ANNEX I

DATA TABLES

Table 1: Use of wheat in the Egyptian food subsidy program.

Year	Imported wheat (000 MT)	Domestic wheat (000 MT)	Total wheat (000 MT)	Per capita (KG/year)
1991-92	5,532	614	6,146	110.7
1992-93	4,848	1,042	5,891	103.5
1993-94	4,071	936	5,007	85.9
1994-95	4,936	1,123	6,059	101.7
1995-96	5,542	1,252	6,795	111.6
1996-97	4,768	1,205	5,973	96.3
1997-98	5,210	1,525	6,735	106.3
1998-99				

Source: (2, Appendix Table 2.)

Table 2: Number and distribution of bakeries and flour warehouses, 1997

	Urban	Rural	Total
Number			
Bakeries	7,596	3,097	10,693
Flour warehouses	5,879	15,117	20,996
Flour distributed	(000 MT)	(000 MT)	(000 MT)
Bakeries	2,810.8	613.7	3,424.5
Flour warehouses	358.0	897.2	1,255.2
Total	**3,168.8**	**1,510.9**	**4,779.7**

Source: Unpublished data, Ministry of Trade and Supply.

Table 3. Milling capacities of public mills that have been converted from wheat to maize.

Milling Company and mill	Type of mill	Daily milling capacity(MT)	
		Wheat	Maize*
Upper Egypt			
City Cylinders	Old cylinder	125	110
Naser Qena	Old cylinder	105	80
Ahmos Kous	Old cylinder	209	200
Middle Egypt			
Malawy	Stone	120	90
Samalout	Stone	80	90
El Hamraa Elgedid	Stone	140	100
Beba	Stone	60	55
South Cairo			
Diab Ghanem	Stone	70	50
Abd El Halim	Stone	60	35
Bahbah	Stone	85	30
Ouseem	Old cylinder	115	40
El Souey	Stone	100	90
North Cairo			
Aamer	Stone	210	75
Saleh Brothers	Stone	190	75
El Ahram	Stone	175	75
Kandeel	Stone	190	75
Middle and West Delta			
El Fath	Stone	130	110
Khaled Ebn El Walid	Stone	175	100
Sers El Lian El Kadim	Stone	100	110
Sherbin El Kom	Stone	175	117
East Delta			
Oraby Cylinder	New cylinder	500	**
Ismailia Hegara	Stone	150	100
Alexandria			
Sharaf	Stone	150	80
El Kek	Stone	90	60
Total			1,947

Source: MSHT, unpublished data, 1998 and December 1999

*These reported as milling capacities but more likely are the daily quotas.

** Maize mill added, wheat mill not converted.

Table 4. Farm-gate Prices for Wheat and Maize in Egypt. 1985-1999				
Year	Wheat	Summer Maize	Wheat	Summer Maize
	LE/erdab*	LE/erdab*	LE/ton	LE/ton
1985	25.76	27.21	171.73	194.36
1986	33.74	30.66	224.93	219.00
1987	33.09	35.65	220.60	254.64
1988	35.61	45.40	237.40	324.29
1989	65.47	56.65	436.47	404.64
1990	71.00	59.75	473.33	426.79
1991	74.72	61.67	498.13	440.50
1992	79.02	60.96	526.80	435.43
1993	79.33	64.11	528.87	457.93
1994	80.17	66.70	534.47	476.43
1995	84.40	71.70	562.67	512.14
1996	96.06	75.00	640.40	535.71
1997	100.04	77.02	666.93	550.14
1998	102.00	81.08	680.00	579.14
1999	103.40	84.70	689.33	605.00

Note: * wheat erdab or 150 kg; maize erdab or 140 kg.

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Section.

Table 4. Wheat and maize prices in Egypt, 19??-1999.

Table 5. Wheat and Maize Prices in the United States, 1986 to 1999

	Wheat, No.2, Soft red winter Chicago	White Corn No.2, Kansas City	Yellow Corn, No.2, Kansas City
	dollars per metric ton		
1986	101.43	85.44	64.58
1987	106.21	100.41	83.48
1988	147.00	148.05	102.77
1989	144.06	122.06	99.62
1990	100.33	117.34	96.47
1991	128.26	120.49	100.41
1992	128.26	98.04	88.99
1993	128.26	98.04	88.99
1994	118.34	109.46	105.92
1995	129.36	114.58	97.26
1996	177.14	160.26	162.23
1997	144.06	121.67	111.83
1998	120.91	115.37	98.04
1999	*72.77*	*75.99*	*67.73*
Average	128.74	116.25	100.04

Note: * Prices for October 1999 only

	Wheat, No.2, Soft red winter Chicago	White Corn No.2, Kansas City	Yellow Corn, No.2, Kansas City
	cents per bushel of 60 lbs	cents per bushel of 56 lbs	cents per bushel of 56 lbs
1986	276	217	164
1987	289	255	212
1988	400	376	261
1989	392	310	253
1990	273	298	245
1991	349	306	255
1992	349	249	226
1993	349	249	226
1994	322	278	269
1995	352	291	247
1996	482	407	412
1997	392	309	284
1998	329	293	249
1999*	*198*	*193*	*172*
Average	350.31	295.23	254.08

Note: * Prices for October 1999 only

Table 5. Wheat and maize prices in the United states, 1986-1999.

Table 6: Milling capacity of public mills, 1997/98.
(MT of wheat)

Company	82% Flour		72% Flour		Total	
	No. mills	MT/day	No. mills	MT/day	No. mills	MT/day
Holding Company for Rice & Wheat Mills						
East Delta	17	2325	1	500	18	2825
West & Middle Delta	14	2520	4	1200	18	3720
South Cairo	16	1517	2	750	18	2267
North Alexandria	14	1845	2	750	16	2595
Upper Egypt	21	3066	3	600	24	3666
Total	**82**	**11273**	**12**	**3800**	**94**	**15073**
Food Industries Holding Company						
North Cairo	10	1970	4	1650	14	3620
Middle Egypt	20	2470	3	600	23	3070
Total	**30**	**4440**	**7**	**2250**	**37**	**6690**
Grand Total	**112**	**15713**	**17**	**6050**	**131**	**21763**

Source: Ministry of Trade & Supply, unpublished data, July 1999.

Table 7: Baladi flour production by public mills by mill type, 1997/98.
(Capacity in MT of wheat per year)

Milling Company	Stone Mills		Old Roller Mills		New Roller Mills		Total	
	(000 MT)	%	(000 MT)	%	(000 MT)	%	(000 MT)	%
North Cairo	228.7	7.4	199.3	13.3	160.9	42.6	588.7	11.9
South Cairo & Giza	287.4	9.3	211.3	14.1	-	-	497.7	10.0
Alexandria	215.8	7.0	197.3	13.2	2.9	0.8	416.0	8.4
West & Middle Delta	502.1	16.3	282.0	18.9	-	-	784.1	15.8
East Delta	588.6	19.1	259.7	17.4	52.4	13.9	900.6	18.2
Middle Egypt	556.3	18.0	130.5	8.7	90.1	23.9	776.9	15.7
Upper Egypt	708.9	23.0	214.0	14.3	71.0	18.8	993.9	20.0
Total	**3086.7**	**62.3**	**1494.0**	**30.1**	**377.2**	**7.6**	**4957.9**	**100**

Source: Ministry of Trade & Supply, unpublished data, July 1999.

ANNEX II

SPREADSHEET MODEL

Cost Factor Assumptions	
161	Price of imported wheat, $/ton
116	Price of imported white maize, $/ton
689	Price of domestic white maize, LE/ton
39	Milling fee for wheat, LE/ton
60	Milling fee for maize, LE/ton
10	Mixing fee, LE/ton
100%	Reduction in flour leakage, %
0%	Reduction in consumption by poor, %
0%	Reduction in consumption by non-poor, %
100%	Reduction in quotas to bakeries,% of gap
n	Using imported maize? Y/N
1	tons of 82% wheat changed to mixed flour

Government subsidy cost, per ton of baladi bread flour	
360	Cost per ton of 82% Wheat, LE
357	Cost per ton of mixed flour, LE
(3)	Added cost per ton wheat flour, LE
(1)	Percent increase in cost
0.89	Mixed flour required, tons
0.89	Mixed flour delivered, tons
0.39	Mixed flour reaching poor, tons
57	Forex saved, US$ per ton

Computation of Costs per ton of Baladi Bread Flour

Line	Wheat Only: Domestic Wheat	Wheat Only: Imported Wheat	Cost and Revenue Items	Mixed Flour: Imported Wheat	Mixed Flour: Domestic Maize
1		161.00	Price of imported wheat (US$/ton)		
2		3.40	Exchange rate (LE/US$)		
3	667.00	547.40	Grain Price: Imported or Domestic (LE/ton of grain)	547.40	689.00
4	35.00	0.00	Buying Commision (LE/ton of grain)	0.00	32.00
5	10.00	10.00	transport charges to mills (LE/ton of grain)	10.00	10.00
6	10.00	5.00	storage charges, average (LE/ton of grain)	5.00	10.00
7	12.00	4.00	finance charges, average (LE/ton of grain)	4.00	12.00
8	39.00	39.00	milling fee (LE/ton of grain)	39.00	60.00
9	773.00	605.40	Total cost per ton of grain, LE	605.40	813.00
10					
11	82%	82%	extraction rate	82%	97%
12	820	820	flour yield per ton of grain, kilograms	820	970
13	180	180	bran yield per ton of grain, kilograms	180	30
14	400.00	400.00	sale price of bran (LE/ton of bran)	400.00	400.00
15	290.00	290.00	sale price of flour (LE/ton of flour)	0.00	0.00
16	72.00	72.00	value of bran (LE/ton of grain)	72.00	12.00
17	237.80	237.80	value of flour (LE/ton of grain)	0.00	0.00
18	309.80	309.80	Total revenue, LE per ton of grain	72.00	12.00
19					
20			**Cost per ton of flour**		
21	(463.20)	(295.60)	Subsidy cost per ton of grain, LE	(533.40)	(801.00)
22	(564.88)	(360.49)	Subsidy cost per ton of flour, LE	(650.49)	(825.77)
23					
24			blending ratio	4.00	1.00
25			kilograms per ton of mixed flour	800	200
26			Cost of ingredients in a ton of mixed flour, LE	(520.39)	(165.15)
27					
28			cost of ingredients per ton of baladi flour, LE		(685.54)
29			mixing fee per ton of baladi flour, LE		10.00
30			Total cost per ton of baladi flour, LE		(695.54)
31			Sale price per ton of baladi flour, LE		292.00
32	(564.88)	(360.49)	Subsidy cost per ton of baladi flour, LE		(403.54)

33		
34	**Consumption Changes from Substitution to Mixed Baladi Flour**	
35	**1.00**	Tons shipped out of mill
36	**11.5%**	percent leakage to commercial flour market (72%, ...)
37	0.12	tons diverted to commercial flour market (72%, ...)
38	0.89	tons used by bakers for baladi bread
39	0.39	tons of 82% baladi flour consumed by poorer 40% of consumers
40	0.49	tons of 82% baladi flour consumed by richer 60% of consumers
41		**Introduction of Mixed Flour**
42	**100%**	percent reduction in diversion of mixed flour to commercial flour market
43	**0%**	percent reduction in baladi bread consumption among poorer 40% of consumers
44	**0%**	percent reduction in baladi bread consumption among richer 60% of consumers
45		
46	0.89	tons of mixed flour needed to replace 82% wheat flour
47	0.0%	percent of mixed flour diverted to commercial flour market
48	44.5%	percent of mixed flour consumed by poorer 40% of consumers
49	55.5%	percent of mixed flour consumed by richer 60% of consumers
50		
51	**100%**	Quotas to bakeries reduced by % of difference
52	0.89	tons of mixed flour actually delivered
53	0.00	tons of mixed flour diverted to commercial flour market
54	0.39	tons of mixed flour reaching the 40 % lower-income consumers
55	0.49	tons of mixed flour reaching the 60 % higher-income consumers
56		

57		**Comparative Costs of Using Mixed Baladi Bread Flour**
58		
59		**Cost of Present Baladi Bread System**
60	(360.49)	cost per ton of 82 % wheat baladi bread flour (LE/ton)
61	1.00	tons used in present baladi bread system (tons)
62	(360)	total cost of current 82% wheat baladi bread flour (LE)
63	0.39	tons of 82% flour reaching the 40 % lower-income consumers
64	(914.57)	total cost per ton reaching 40% lower income consumers (LE/ton)
65		
66		**Cost of Mixed-Flour Baladi Bread System**
67	(403.54)	cost per ton of mixed baladi flour (LE/ton)
68	0.89	tons used in mixed-flour baladi bread system
69	(357.14)	cost of mixed-flour baladi bread system (LE)
70	0.39	tons of mixed flour reaching the 40 % lower-income consumers
71	(906.07)	cost per ton of mixed flour reaching 40% lower income consumers (LE/ton)
72		
73		**Cost Reduction from Introduction of Mixed Flour**
74	**3.35**	Reduction in cost to Government from introducing mixed flour (LE per ton of original 82% flour)
75	**0.9%**	Percent reduction in cost of baladi bread subsidy from introduction of mixed flour
76		
77		**Reduction in Foreign Exchange Cost**
78	1.22	tons of Imported wheat required, 82% wheat case
79	0.86	tons of imported wheat required, Mixed flour case
80	0.18	tons of imported maize required, Mixed flour case
81	57.33	Reduction in forex outlays for wheat, US$ per ton of 82%
82	0.00	Reduction in forex outlays for maize, US$ per ton of 82%
83	57.33	Reduction in forex outlays, US$ per ton of 82%
84		