REVIEW OF COMPOSITE FLOUR TECHNOLOGY IN THE CONTEXT OF TANZANIA

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ABSTRACT

This paper reviews the work carried out in recent years on composite flour, particularly for bread, with special emphasis on sorghum and the millets in Tanzania.
The reasons for the high bread consumption in Africa are discussed. Composite flour technology is reviewed and it is noted that technologies are now available both for composite and, to a less extent, for wheatless products. Sorghum is well suited to this use and up to 30% could be used, with an optimum at 20%. Previous composite flour projects are examined and reasons for failure suggested, notably lack of enthusiasm by participants at Government and industry level.

Criteria for successful implementation are outlined. The pros and cons of composite flour use in Tanzania are then discussed, quoting the 1988 report on the subject and updating the costs to 1993, with a worked example. Savings of $40 in foreign exchange per tonne of the mixed grain for milling (grist) are possible with a 20% dilution. A key issue is the external cost of transport. Other products are also suggested and would provide valuable and new outlets for sorghum. These include biscuits, snack foods, pasta, malted products, instantized uji meals and pearled sorghum: the emphasis must be on convenience and modernity.

INTRODUCTION: Definitions

Composite flours may be considered firstly as blends of wheat and other flours for the production of 1) leavened breads, 2) unleavened baked products, 3) porridges, 4) pastas and 5) snack foods; or, secondly, wholly non-wheat blends of flours or meals, for the same purposes. Sometimes, only one flour is used as a replacement - for example, tortillas and wheatless bread from sorghum, pasta from sorghum or maize, lager beer from sorghum.

In the case of composite flours for staple foods such as bread, it should be noted that there are two reasons for mixing the wheat with other flours: economic and nutritional. The latter, using, for example, soya flour to increase the protein content of the bread, or adding vitamins, is of marginal economic relevance and of debatable use in a health context. Using blends, now called composite flours (CF), of wheat and other flours for breadmaking has always occurred in times of scarcity of wheat, from whatever cause, climatic or economic.

INTRODUCTION: History and justification

Why is bread so popular throughout the world? Four reasons come to mind: globally, it is convenient, nourishing and versatile - reasons taken for granted in wheat growing countries; and, in the context of Africa, it is the food of modern people. Dendy and Trotter (1988) have described how the bread habit was acquired in developing countries unable to grow wheat, and examined the possibilities for reducing or eliminating wheat imports in the SADC countries. It is a fact that the bread habit has had a profound effect on the economies of all the countries unable to grow any or sufficient wheat to satisfy the demand for bread.

The subject of composite flours (CF) has been reviewed several times (for example Dendy 1988, Fellers 1987, Dendy, Clarke and James 1970), and bibliographies were published in what might be called the heyday of the subject (Dendy and Kasasian, 1975, 1977, 1979). The total number of publications related to the subject has reached well over 1200, with at least 500 directly relevant (Table 1), though with few studies of either economics or implementation: there must be few practical technologies that have been so thoroughly researched and so little applied.

One reason for the apparent lack of enthusiasm, I suggest, is that those working on CF at that time - the late 1960s - had a top-down approach, and assumed, with little justification, that CF would benefit the developing countries and that their governments would at once become enthusiastic. Reality was otherwise, and it was usually lack of total government support that led to failures at the implementation stage. Money for the R & D was usually available externally. Among key problems were the provision of suitable raw materials at suitable prices and the stimulation of local organizations. A further consideration was the simplistic assumption that use of CF would automatically save foreign exchange and stimulate local agriculture and agribusiness. Later, in some worked examples, I shall show that this is possible, though neither always nor everywhere.

COMPOSITE FLOUR: THE STATE OF THE ART

An examination of the literature shows the order of publications on composite flour as being: cassava, maize, rice, sorghum, the millets, potato, barley, sweet potato and yams (Table 1).

In selecting raw materials for use as alternatives one must consider the following criteria: a) compatibility - that is to say, suitability for end use and b) availability and cost at point of use. This last is the most important and, until recently, the most overlooked.

Table 1

Papers published on composite flour (CF),
excluding protein enrichment, milk substitutes, weaning foods, etc

	NRI composite flour bibliographies			NRI database	Grand Total	as %
	G89 (1975)	G111 (1977)	G124 (1979)	CFBIB 1979–1991		
Sorghum	26	10	7	23	66	13%
Millets	18	8	8	12	46	9%
Maize	54	19	15	17	105	21%
Chenopods	6	1	1	1	9	2%
Barley & oats	15	4	3	6	26	5%
Rice	37	13	7	18	75	15%
Total cereals	156	55	41	77	329	65%
Cassava	57	11	22	20	110	22%
Potato	11	7	9	0	27	5%
Sweet potato & aroids	12	1	4	1	18	4%
Yams (true)	7	3	7	2	19	4%
Total roots	87	22	42	23	174	35%
TOTAL	243	77	83	83	503	100%

from "Perspectives in Composite and Alternative Flour Products"
(Dendy, 1992)

Table 2

Suggested levels for non-wheat moieties in composite flour bread (as % of total flour) *

commodity	protein content	maximum used experimentally	realistic maximum	key disadvantage
maize	8-10	30	20	flavour, volume
sorghum	8-10	50	30	(colour)
millets	8-10	30	20	flavour
barley	8-10	30	20	colour
rice	8-10	25	25	
cassava flour	1-2	30	15	volume, pale crust, coarse texture.
cassava starch	0	50	40	blandness, pale crust
yam	2-4	30	20	colour, volume
potato	2-4	30	30	stickiness
sweet potato	2-4	30	20	colour, flavour

NB Wheat flours were of various strengths
Information on preparation of flours rarely given

* from numerous sources on NRI databases and in NRI bibliographies, updated to 1993

Compatability has been the concern of many of the 500-plus papers referred to in Table 1: just how much non-wheat material can be included in a composite to make a product reasonably similar, though probably not identical, to that which it attempts to simulate?

Table 2 summarizes work carried out on composite flour bread in the past 25 years in many institutes worldwide. Leavened bread of the conventional Western type is, for reasons discussed elsewhere (Dendy, 1988; Dendy et al., 1970; Fellers, 1987), more difficult to make from composites or non-wheat materials than are other products. It would seem that for most commodities, however well prepared for incorporation, there is a limit of 30%. Beyond that the product ceases to resemble bread, though it may have selling characteristics of its own - a point that deserves more emphasis.
There have been three principal scientific advances in the past thirty years which have improved the quality of composite flour products.

The first was in the late 1960s, when it was found that no-time doughs, whether chemically activated or mechanically developed, were able to tolerate weaker wheats and hence larger proportions of non-wheat material in a composite.

The second was the discovery by de Jongh and others that certain emulsifying agents were able to support the formation of a dough structure with starch alone. This work was coupled with the use of the no-time doughs with emulsifying agents such as the expensive lactylic acid derivatives or cheaper and more accessible glyceryl monostearate and led to the use of up to 30% non-wheat material.

More recently there has been a realisation that as a substitute for the gluten in the wheat one can use pre-gelatinised starch and this has been used to make bread-like materials containing no wheat at all.

Certain cereals such as maize appeared to interact with wheat gluten during dough development and give a poor loaf volume: others such as sorghum did not. Indeed, sorghum does appear to be one of the better cereals for use in composites.

The Basic Criteria for the quality of raw materials are:

1) wheat flour of reasonable strength,
2) clean, fine flour from the non-wheat source:
   the colour should be as white as possible and free from any taint or strong odour.
3) consistency, so as to give a predictable performance.

Root crops are probably not suitable as they contain 80 per cent moisture and therefore store and transport with some difficulty and high cost relative to cereals in terms of actual food value. Root crops should, therefore, be processed into a flour or starch near to the source before transport and incorporation.

Concerning milling technology one should also bear in mind that a mill consists basically of break and reduction rollers and sieving systems. Most wheat flour mills are very complex but in fact one can make good flours from sorghum, maize and pearl millet using simple mills. The important part of the process is the de-branning operation and we have found that we can successfully de-bran and mill sorghum using just two pairs of break rollers, one coarse and one fine, and making a meal very similar to posho and then grinding that to fine flour. For incorporation into composite flour the particle size must be reasonably fine otherwise the bread will have a granular texture which is not appealing.

EXPERIENCE ELSEWHERE

When FAO surveyed composite flour programmes in 1980 there were 72 programmes on bread, 36 on biscuits, and 21 on pasta, with nothing reported on other foods (FAO, 1980, quoted by Faure, 1988). In that it is more difficult to make bread than other foods from CF, I shall now look at a few examples of CF programmes where bread was the intended product.

Experience in Nigeria

The experience of Nigeria is now well known and has been publicised by Olatunji (1992).

Bread is a convenience baked food conventionally made from wheat flour. Wheat, however, is not native to Nigeria and has to be imported. This exercise resulted in a large foreign exchange cost, with, in 1984, some 15.2% of Nigeria's food calories being imported. This would not have mattered if there had been exports to pay for it. Finally, in January 1987, the Federal Government banned the importation of wheat. Since then bread has gradually moved out of the reach of the average Nigerian because of its high price.

Though wheat is now being grown under irrigation in certain states in Northern Nigeria, the production is very small compared to the total annual requirement of Nigeria. The fact that wheat was banned, however, should not have, and indeed, did not, stop bread consumption. Since 1972, FIIRO has directed attention towards identification and screening of local crops that could be suitable for making CF and non-wheat bread. No action was taken until 1988 because Nigeria had sufficient foreign exchange to pay for wheat, especially during the oil boom. Whether such wealth should have been used for this purpose rather than infrastructural development has been the subject of debate. Composite flour was certainly used, though the non-wheat part was more usually maize, not sorghum. The reasons for this are obvious: sorghum is grown in the North, maize in the South and the main population centres are in the South. Transport costs for Nigeria are not available to the writer, but it is probable that wheat at the coastal ports is much cheaper in forex terms than are grains from the hinterland.

Work at NRI and at the IAR Samaru confirms that it is with small goods that we can incorporate the greatest proportion of sorghum.

I am assured that the CF programme in Nigeria is succeeding.

Sri Lanka

Composite flour was experimented with in 1971 using cassava and also sorghum. The pilot stages of the project were successful, but lack of co-operation between ministries, coupled with a drought, led to insufficient non-wheat material being available for further work. The project was abandoned when a large flour mill was constructed in the mid-1970s.

Senegal

The choice was pearl millet and we are told that the project did not succeed because the composite flour bread was being sold below the price of ordinary bread - that was in the 1970s. When the project was revived recently the bread was given great publicity as being a healthy food - not *pain de mil* but *pain nourissant*; the middle classes therefore purchased it and it is now an established product. I have referred elsewhere to the importance of psychology in using alternative flours (Dendy, 1992a).

Zambia

Work started in the 1970s with NRI co-operation, has been renewed with ICRISAT stimulation and has also reached the pilot scale. Cassava, maize and sorghum have all been tried experimentally. As with many SADC countries, wheat is grown to some extent: the external cost of production in 1988 was 73%.

Zimbabwe

Maize and sorghum have been used as diluents during recent shortages.

COMMENTS ON PREVIOUS EXPERIENCES

Some composite flour programmes failed because of lack of a regular supply of raw materials. Provided that forex is available and there are no political constraints, a flour mill has no difficulty in obtaining regular supplies of wheat, especially if the mill is at a port. However, to arrange for thousands of tonnes a year of any agricultural product to be bought and brought, either processed or not, from perhaps many small farms to a central point, requires an very high level of planning, a good transport infrastructure, suitable storage, plus the technological capability to ensure high and consistent quality.

Cost considerations will also limit availability of raw materials. Production costs can sometimes be made up of a high percentage of external currency - for example, in Zambia in 1988, 73% of local wheat production costs, using modern farming technology, were in foreign exchange, so that the savings made by local production compared to importation were really quite low. For small-scale production by traditional agriculture, even if there is a surplus it will be small and scattered, with ensuing problems of collection and with increased cost of transport and of quality control. Proper supervision to ensure clean and uniform material is labour- and technology-intensive.

A NEW APPRAISAL: Can CF succeed in Tanzania and what are the criteria for success?

In 1988 Dendy and Trotter surveyed four SADCC countries and concluded that composite flour could well succeed. They noted that composite flour was already in use to some extent in Zimbabwe with at that time some minor constraints to its use. Zambia and Tanzania were considered to have very good prospects but in Botswana, with a weak agricultural sector and a strong foreign exchange position, the prospects for composite flours were poor.

At an international workshop in 1988 (ICRISAT, 1992) it was noted that in CF there was mature technology awaiting adoption, and that "in wheat importing countries and countries with some but insufficient local wheat, composite products should be given high priority". The knowledge is available from at least eight regional or international technological institutes. Breeders at the CGIAR institutes are now aware of the criteria needed for new varieties even better suited to use in composites than those currently available. Problems of adoption are mainly economic and political.

In revisiting the Dendy-Trotter report we must remember that five years is a very long time in the history of grain prices, foreign exchange positions, government policies and drought.

In 1988 we said that "the prospects for composite flour are good. However, transport costs are so high from the sorghum-growing areas to the principal bread eating regions that unless the Government charges the milling corporation the true value of imported wheat, composite flour technology cannot have a sound economic base in the coastal regions."
The transport infrastructure of the country is very poor and, because of this, areas of food imbalance are not necessarily corrected.

TABLE 3

FOOD STAPLE CALORIFIC INTAKE AND MARKETABLE SURPLUS
(1976/78 Household Budget Survey
1987/88 Annual Review, MDB)

	Rural (%)	Urban (%)	% Crop Marketed Official	Parallel	Total
Maize	62	53	9	16	25
Cassava	13	11	1	14	15
Sorghum/Millet	8	6	2	13	15
Paddy	8	24	3	47	50
Wheat	0	2	67	33	100

Seenappa, M (1987)
Household Food Security in Tanzania Data Report on the Food and Nutrition Situation in Tanzania 1974/75, 1979/80.

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TABLE 4

TANZANIA: CROP PRODUCTION, 1987, TOP 5 PROVINCES (kt)

Province	Maize	Province	Sorghum	Province	Wheat
Iringa	388	Dodoma	247	Arusha	42
Ruvuma	296	Singida	177	Iringa	23
Mbeya	266	S'Yanga	105		
Arusha	265	Mwanza	78		
Tabora	232	Tabora	72		
Other	912	Other	275	Other	7
Total	2,359		954		72

ex Dendy and Trotter 1988.

TABLE 5b:

DOMESTIC MILL PURCHASES AND IMPORTATION OF WHEAT 1980–1990

(NB not the same as production)

Year	Production (from above)	Purchase (tonnes)	Import (tonnes)	% Purchased (%)	% imported
1979/80		26530	32500	45	55
1980/81	90000	27912	48539	37	63
1981/82	95000	23080	70836	25	75
1982/83	58000	31175	2000	94	6
1983/84	74000	28256	42481	40	60
1984/85	83000	33185	28198	54	46
1985/86	72000	50289	8505	86	14
1986/87	72000	23688	24965	49	51
1987/88		48223	8505	85	15
1988/89		43460	27565	61	39
1989/90		47056	3000	94	6

Source: Tables G14 and G15 in: Bureau of Statistics (1992) Statistical Abstract 1990 and President's Office Planning Commission, Dar es Salaam, February 1992.

TABLE 5a

WHEAT PRODUCTION AND IMPORTS, 1980–87
(Source: MDB; Int. Fin. Statistics, IMF) (ex Dendy/Trotter)

year	production	IMPORTS commercial (kt)	IMPORTS aid (kt)	value US$/t	exchange rate/$	Gov't revenue million Tshs
1980/81	90	-	48.7	226.11	8.241	90.7
1981/82	95	-	83.1	209.99	8.784	153.3
1982/83	58	9.4	20.0	190.73	10.213	38.9
1983/84	74	-	46.3	187.54	13.218	114.8
1984/85	83	11.5	21.8	183.56	16.382	65.5
1985/86	72	5.5	16.3	162.07	25.085	66.3
1986/87	72	-	53.5	-	48.479	-
		av.	44.5			

Assumed: aid imports are sold by Government at landed cost and at official exchange rates to NMC.

As has been noted, "One consequence of this (imbalance) is that estimates of food import requirements are not always a function of production shortfalls, but are rather a reflection of National Milling Corporation's inability to secure adequate supplies from domestic sources to meet the needs of major urban centres, particularly Dar es Salaam" (Anon, 1986)

Constraints and positive aspects of CF in Tanzania

1. Loss of Budget Revenue from Import Reduction

Concessional and donated wheat aid is sold ultimately to the consumer and generates revenue for the Government of Tanzania. Table 5a attempts to quantify that for the years 1980-86. The amounts are not large enough to suggest budgetary dependence, and conditions are different in 1993.

2. Wheat

90% of wheat production is in Arusha and Iringa districts, on large scale farms controlled by the Government. This of course leads to a high market share to the National Milling Corporation relative to other crops (see Table 3). Official prices were then well below parallel ones: some 3 to 4 times lower in 1987. Table 5a gives wheat production and imports and Table 5b mill purchases and imports. Discrepancies between the figures reflect the different sources.

3. Low Foreign Exchange Savings

Although there are wheat imports for which local sorghum could substitute, in many years these were exclusively Food Aid, not commercial imports (see Table 5). Accordingly a reduction in wheat imports does not necessarily result in a saving of foreign exchange. Not all aid is wholly donated, as some is sold on concessional credit terms.

4. Transport Costs

The regions of production are given in Table 4 (1988 figures). It will be noted that grain is grown at considerable distances from Dar, so that transport is a major cost. In 1988 the cost of transport to Dar in external currency was over Tsh 5000/t or roughly USD 53/t. This was nearly half the purchase price of imported wheat ex USA (Table 7A). When one considers the high foreign exchange component of domestic wheat production (estimated by the Market Development Bureau to be greater than the cost of imported wheat) and of domestic transport, local production of wheat is a large loser of foreign exchange if it is to be used in Dar (Table7B).

Transport is a major cost for all commodities. The cost of transporting sorghum to Dar for blending into wheat flour is high in both local and foreign currency terms (Table 7C).

Table 6

Food Commodity Prices 1993

	Maize	Rice	Wheat	Sorghum	Millet	Potato (Irish)	Beans
Dar	7.00	20.0	18.0	8.00	7.00	9.5	12.3
Dodoma	7.20	20.0	14.0	6.80	8.65	8.6	14.3
Iringa	5.40	18.0	11.0	n.a.	11.0	n.a.	15.0
Mbeya	4.50	24.0	8.95	n.a.	8.75	3.0	12.0
Mwanza	10.1	17.5	n.a.	13.0	13.0	7.0	8.0
Arusha	5.80	17.8	8.0	n.a.	12.0	6.5	11.5
Singida	7.10	14.5	7.25	7.75	8.25	8.00	11.0
Morogoro	6.75	18.3	n.a.	7.75	11.5	8.50	14.8
Swanga	6.00	18.0	12.0	n.a.	7.20	5.00	20.0
Musoma	13.0	23.0	n.a.	8.50	17.5	8.50	15.5
Tanga	8.0	20.5	12.0	8.00	12.0	8.00	13.5

This is a summary of average food commodities in the cost index earning on 5/2/93 based on reports from the urban markets. The prices are based on 100 kilogram bags unless otherwise stated. (Prices are in 000TShs)

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5. Availability of Suitable Sorghum

Though sorghum can be grown successfully in other dry regions, over two-thirds of the total crop is grown in Dodoma, Singida, S'yanga and Tabora (Table 4). These are mainly local varieties or the Serere introductions. Serena is not really suitable for CF. It is important to grow the correct varieties, and this is where our colleagues from ICRISAT can advise. It is also important for the farmer to get a good return for the crop.

Positive Aspects of Composite Flour in Tanzania: Government Involvement

The President had asked the National Milling Corporation to look into the possibility of incorporating diluents in wheat flour. Clearly the National Milling Corporation has a mandate to consider or adopt CF. Composite flour of a type, namely from sorghum dilution of maize flour, was planned to start with the completion of the new mill for sorghum in Dodoma. This mill could be the source of diluent for wheat as well.

In 1984 and 1985 the subsidies on maize grain and meal were effectively removed, which put sorghum on a much more equitable level with maize.

As mentioned above the Tanzanian situation lends itself to the adoption of composite flour via the adoption of new milling technologies that can produce better quality sorghum flours than before.

Commodity prices for 1993 in Dar es Salaam and other parts of Tanzania are given in Table 6. There is no significant change for the regions in the past four years. But, with the drought threat, sorghum is spreading.

There has been a major structural re-adjustment to the Tanzanian economy, with liberalisation of the grain trade, so that "Everybody can purchase, as opposed to the previous situations whereby NMC and Co-operative Unions were the principal traders of grains." (Laswai, personal communication) Subsidies have been removed, which has elevated the economic importance of sorghum.

Table 5b shows the domestic purchases and imports of wheat, up to the year 1990.

Table 7A
TRANSPORT COSTS, WHEAT COSTS, EXCHANGE RATES AND COMPOSITE FLOUR

1. EXCHANGE RATES

Year	1988	1990	1992	1993
Official Exchange rate	103	195	308	340
ratio parallel/official*	1.9	1.8	1.4	1.3

2. TRANSPORT COSTS

a) TRANSPORT COST per tonne in Dar area

		1988	1993
Tshs/t km		10.42	40.0
X 80% (external)	Tshs	8.33	32.0
	US cents	8.09	9.44
X 50km	USD	4.045	4.72

b) TRANSPORT COST per tonne Morogoro/Dar (193 km)

Tshs		7720
X 80% Tshs		6176
(ie, external cost)	USD	18.16

c) TRANSPORT COST per tonne Dodoma/Dar (480 km)

Tshs		5000	19200
X 80% Tshs		4000	15360
(ie, external cost)	USD	38.8	45.2
as cost of imported wheat		27.9%	18.4%

d) TRANSPORT COST per tonne Arusha/Dar (650km)

Tshs		6773	26000
X 80% Tshs		5418	20800
(ie, external cost)	USD	52.6	61.2

* Calculated from the official and parallel rates of exchange given in Africa Analysis. See also Dendy and Trotter (1988) for a discussion of the importance of this.

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Table 7B
TRANSPORT COSTS, WHEAT COSTS, EXCHANGE RATES AND COMPOSITE FLOUR

VALUE/COSTS of Commodities in Dar

a) VALUE/COST of Wheat in Dar

Year		1988	1992	1993
i)	imported**			
	Cost ex USA No 2 HRW USD	110		195
	Shipping cost	29.1		50
	hence, cif Dar	139.1		245
	ditto X ratio ex Table 7A	264.3		318.5
	(ie true value)			

Year		1988	1992	1993
ii)	home produced			
	cost in Arusha Tshs	9000	38400	80000
	cost in Arusha USD	87.4	184.6	235.0
	X 70% = external cost	61.2	129.2	164.5
	transport to Dar USD	65.8	75	76.5
	X 80% = external cost	52.6	est 60	61.2
	total cost in Dar USD	153.2	259.6	311.5
	hence, external cost	113.8	189.2	225.7
	ditto as % total	74.2%	72.9%	72.4%

b) VALUE/COST of Sorghum in Dar ex Morogoro

cost	Tshs	77500
cost	USD	227.94
X 10% = external cost		22.79
transport to Dar	USD	22.71
X 80% = external cost		18.16
total cost in Dar	USD	250.65
hence, external cost		40.95
ditto as % total		16.3%

** I shall not distinguish between aid wheat and that purchased commercially from outside Tanzania, we must remember here that aid funds may well have better uses than providing wheat for emergency use.

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Table 7C
TRANSPORT COSTS, WHEAT COSTS, EXCHANGE RATES AND COMPOSITE FLOUR

a) COMPARISON OF RAW MATERIAL COSTS

all in USD	local	external	total
Arusha wheat in Dar	85.8	225.7	311.5
Imported wheat in Dar	0	245	245
Morogoro sorghum in Dar	209.7	40.95	250.95

b) COMPOSITE FLOUR in Dar

For simplicity, it is assumed that milling costs are the same for wheat and sorghum and that both yield flour at the same extraction rate (75%) and that by-products have the same value.

all in USD		local	external	total
800kg	Imported wheat	0	196	196
200kg	Morogoro sorghum	41.9	8.19	50.19
hence 1 tonne CF		41.9	204.19	246.19

Saving in foreign exchange USD 245 - 204.19 = 40.81/tonne.
On 1 tonne flour: 54.41.
Per loaf of 500g: US cents 1.55 (say, 5.5 Tzshs)

Use of flour in Dar area, about 20,000 tonnes
Therefore hypothetical savings in foreign exchange: USD 816,200
on an outlay of approximately USD 4.9 million: 16.7%.

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In 1988 it was noted that the foreign exchange part of wheat production can be 70% of the ex-farm cost: it is not only the fertiliser and fuel but the cost direct and indirect of levelling the land, purchasing and using modern farm machinery and, one might even add, the cost of the education of the agriculturalist managing the project. For sorghum and other grains the proportion will be less, depending upon the method of production. At the simplest, subsistence, level the foreign exchange cost will tend to zero.

Against this one must offset the overall cost of 'assembly'. Even assuming that an organised infrastructure exists, the cost of buying and bringing together thousands of tonnes of peasant grown grain to a central processing point is high, probably higher than the simple transport system required to bring the yield of a large farm to the central point, though in foreign exchange terms small-scale transport could be cheaper.

One of the principal points made five years ago (Dendy and Trotter, 1988) was that transport costs were very high and made up largely of a foreign exchange component. Furthermore, the currency at that time was over valued so that imported grains appeared artificially cheap and they already carried high subsidy. Table 7 outlines the figures, then and now. As was noted in 1988, the landed price reflects the heavy subsidies on grain produced in North America and Europe. Table 7 calculates prices in Dar for Arusha wheat and Morogoro sorghum and then considers the foreign exchange savings which might be possible by using a composite flour.

For convenience the table is divided into three parts:

a) exchange rates and transport costs
b) commodity costs in Dar es Salaam
c) the composite flour calculations

The final calculation - and it is the method that is important - shows that by using a composite of 80% imported wheat and 20% sorghum from the Morogoro area (193 km from Dar) there is a saving in foreign exchange of USD 40.81 per tonne of grist - probably similar for the flour. For the Dar area this could mean a saving of USD 816,200 per annum. As this is quite a modest sum considering the problems of implementing a CF programme, it is suggested that, in addition, other uses should be found for local cereals such as sorghum which can be or are grown relatively near to the centres of population and incur low external costs of production.

Other Uses: the concept of convenience.

Bread is not the only modern and convenient food, and, in trying to find new markets for traditional local grains, one must consider other alternatives from both a technical and an economic point of view. The staples used should be obtained from near the centres of population where they will be processed and used. Table 8 shows the position with regard to Tanzania: mostly the technology is already well developed.

Wheatless bread

Wheatless bread is even older in concept than composite bread, but until recently attracted little attention from scientists. Leavened foods are attractive and easier to digest than unleavened, so that it has always been thought desirable to try to leaven either by fermentation or by the use of a generator of carbon dioxide such as baking powder. However, efforts to make a material which is truly like bread have not yet succeeded, due to technological difficulties in producing a stable structure without the inclusion of wheat or its extracted gluten. Whether or not it is legitimate to describe such foods as 'bread' is debatable.

Recent work carried out at NRI for FAO has confirmed the possibilities of using pregelatinized starchy materials to provide structure to a leavened bread. Though not quite like wheaten bread, the products are attractive, and the concept is deserving of further research and, later, good promotion. Work at NRI on rolls from 100% sorghum flour confirms that it is with small goods that we can incorporate the greatest proportion of sorghum.

The technology is not yet 'on the shelf' for wheatless bread as it is for composite flour bread. Alongside improvements to the wheatless bread technology must be appropriate publicity: these are to be thought of as new foods, not poor substitutes, and a new name must be found!

Biscuits and cookies

Biscuits and cookies can be made successfully from composites and, less easily, from wheatless flours. For biscuits containing high levels of sugar and fat, and using, conventionally, wheat flour of low gluten content there is less need for gluten.

Pasta Foods

These manufactured foods are becoming increasingly popular and can be made with almost any raw material. Though the tonnages consumed are low in Africa, the subject of pasta from composite flour has been researched quite thoroughly. An important point to remember is that there are very few pasta factories in Africa: thus, if the products are found to be acceptable to the consumers, and at a reasonable price, the market can expand as a new product rather than an inferior substitute as might be the case with composite bread. With few suppliers, the industry might, it has been suggested, be easy to organize (Faure, 1988).

Snack Foods

In the modern world snack foods are becoming increasingly important as sources of nourishment as well as being hedonic foods. The usual substrate is maize, but at NRI we have made extruded snacks with both red and white sorghum and pearl millet, flavoured with cheese ØØ autolysed meat and spices.

Table 8

Other possible uses for sorghum in Tanzania

	Technical know-how (sorghum)	Current use of product	Likely tonnages (tentative estimate)
Wheatless bread	novel	none	unknown
Biscuits	available	limited	hundreds
Pasta	available	low	unknown: could be hundreds
Snack Foods	available	low	tens
Malted products:	already used		hundreds
Weaning Foods	available	informal	hundreds
Lager beer	available	widespread	hundreds
Chibuku beer	already used	mainly informal	hundreds
Instantized drinks	available	low	hundreds
Supa mtama	available	none	hundreds

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To promote the use of local crops to townspeople, much depends on the image as being not coarse or old-fashioned, but modern and 'up-market'. Snack-foods have a modern and very up-market image, so that the use of local materials will enhance the image of the local grains.

Malted Products

Chibuku, lager beer, malted drinks and weaning foods are uses for sorghum that have become well known recently. The technologies have been developed in Nigeria and in Tanzania. With lager beer and with malted drinks there is a large and untried market: what has succeeded in Nigeria can, surely, succeed in Tanzania.

New Foods

In addition to malted drinks sorghum can be used aa raw material for flavoured instant uji meals. Pearled sorghum - that is, dehulled and polished - can be used in the same way as rice. The *supamtama* project in Kenya seems to show promise, with a new factory going into production at Kisumu.

Conclusions

In different regions of this large country there may be cases for using sorghum or other materials in composite flour bread: there will everywhere be a strong case for using locally produced staple foods rather than staples imported from outside the area or outside the country. Tanzania's foreign exchange position is certainly not yet strong enough for the country to be able to rely, other than for occasional emergency use, on imported staple foods.

Locally produced staples will in the future have two principal commercial uses, the first is the obvious one of providing the current staple commodity: the second is the making of new foods from local raw materials. Nigeria has very much led the way in this: lager beer from sorghum; Guinness from sorghum and sorghum malt; Bournevita, a very popular drink, from sorghum: as a result of using local cereals the production of grain has increased from 8 to 12 million tonnes a year since the 1987 Babangida decrees. These decrees may have seemed dramatic at the time but Nigeria is becoming far more self-sufficient in its food supply and local industry has been stimulated.

With all these foods which I have described, we can say that the technologies are available now for composite and alternative products. What is needed is encouragement to entrepreneurs to invest.

References

ANON (1986)
(Tanzania) National Drought Cereals Strategy, Vol 1.

CECIL, J.E. (1986). Roller milling sorghum and millet grain using a semi-wet process. NRI Report L74.

DENDY, D.A.V. (1992a), Perspectives in Composite and Alternative Flour Products, in Proceedings of the ICC 9th Cereal and Bread Congress, Paris.

DENDY, D A V (1992b)
Composite flour, past, present and future: a review of the place of composite flour in the semi-arid zones. in Utilization of Sorghum and Millets (Gomez, House, Rooney and Dendy, eds), Patancheru, AP 502 324, India: ICRISAT.

DENDY, D A V and KASASIAN, R (1975, 1977, 1979)
Composite flour technology bibliographies, Reports G89, 111, 124. London: Natural Resources Institute, at Central Avenue, Chatham Maritime, ME4 4TB, whence copies can be obtained.

DENDY, D A V and TROTTER, B (1988a) A Study of the Constraints to the Adoption of Composite Flour Technology in Tanzania, Zimbabwe, Zambia and Botswana. Report for SADCC.

DENDY, D.A.V. and TROTTER, B.W. (1988b). Wheatless and composite breads - technologies awaiting adoption. Entwicklung und Ländlicher Raum, 6/88.

DENDY, D.A.V., JAMES, A.W. and OLUGBEMI, O. (1991).
The Use of Sorghum in Composite and Blended Products
Paper prepared for the ICRISAT.

FAURE, J (1992) Sorghum and Maize pasta. in Utilization of Sorghum and Millets (Gomez, House, Rooney and Dendy, eds), Patancheru, AP 502 324, India: ICRISAT.

ICRISAT (1992) International Workshop on Policy, Practice and Potential Relating to the Uses of Sorghum and Millets, 1988. in Utilization of Sorghum and Millets (Gomez, House, Rooney and Dendy, eds), Patancheru, AP 502 324, India: ICRISAT.

OLATUNJI, O. et al (1992) Improvement in the quality of non-wheat composite bread presented to the 9th International Congress of the International Association for Cereal Science and Technology, Paris, 1992.

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