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Food Grain Marketing in Northern Nigeria: Spatial and Temporal Performance

*by H. M. Hays and J. H. McCoy**

This paper examines spatial and temporal aspects of marketing efficiency for the traditional marketing system for millet and sorghum in part of northern Nigeria. Analysis of these price relationships in many cases indicate excessive intermarket and seasonal price increases. Some reasons are given for these excessive intermarket and seasonal price increases. The evidence suggests these cases of excessive increases are not a result of planned manipulation under monopolistic or monopsonistic conditions, but result from imperfections inherent in the system: Some suggestions are made for improving marketing performance.

As in many other less developed countries, rapid population growth and urban expansion in Nigeria are increasing demands for food crops. This has prompted concern about the efficiency of the country's agricultural product markets; a concern resulting in certain reform proposals [*NADC, 1971: 10; Second National Development Plan, 1970 108*]. This paper examines the temporal and spatial aspects of marketing efficiency for millet and sorghum,[1] the two most important food grains in northern Nigeria. The marketing system contains two principal types of grain movements: (1) to urban centres from surrounding rural areas (i.e., rural-urban flow); and (2) between urban centres. Analysis in this paper of marketing between urban centres and the pricing efficiency of the marketing system was accomplished by examining movement between, and prices at, fifteen selected locations in Nigeria's four northern states (during 1969 through 1971), using data from official Nigerian Crop and Weather Reports.[2] First, spatial price relationships were analysed by examining intermarket price differentials in relation to transport and other transfer costs. Secondly, temporal price relationships were analysed by examining the significance of storage costs as a factor in explaining seasonal price rises. Results of this analysis on the marketing systems ability to allocate grain supplies over space and time are the basis for the concluding suggestions of how agricultural marketing performance in Nigeria could be improved.

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SPATIAL PRICE RELATIONSHIPS

The Model

In microeconomic theory, one of the assumptions necessary for perfect competition is perfect information. Under these assumptions, traders in each market would know perfectly the situation in all markets, so that intermarket price differentials would reflect only transport and handling costs of spatial transfer. A comparison of monthly price differentials between Zaria (a major crossroads and consuming centre) and each of fourteen other markets indicated that in some markets transfer costs to Zaria were greater than the price differences, thus precluding significant movement of grain between those markets. Six of the fourteen markets (Sokoto, Gusau, Katsina, Kafinsoli, Daudawa, and Kano) supplied grain to Zaria. Twenty per cent of the millet and forty per cent of the sorghum came from more than 100 miles, a distance which includes five of the six markets [*Hays, 1973: 136*].

A comparative analysis (referred to here as price spread) was made of differences between the cost of transferring grain and observed market price differences for the six markets and Zaria. A so-called parity price was calculated at Zaria. This was accomplished by deducting from the Zaria price transfer costs from each of the six markets. To find the price spread, the actual price in each respective supplying market was subtracted from parity price [*Lele, 1965: 77*]. Specifically, the price spread was computed as follows:

$$PP_{ij} = P_i - (Hc_{ji} + Tc_{ji} + As_{ji}) \qquad (1)$$

where

PP_{ij} = the calculated parity price of one ton of grain in the ith market (Zaria) in relation to the jth market, (1 . . . . . 6, i.e., Sokoto, Gusau, Katsina, Kafinsoli, Daudawa and Kano).

P_i = the actual retail price of one ton of grain at the ith market.

Hc_{ji} = handling costs involved in moving one ton of grain from the jth to the ith market.

Tc_{ji} = lorry transport cost for moving one ton of grain from the jth to the ith market.

As_{ij} = the charge for the assembler's service in moving one ton of grain from the jth to the ith market.[3]

The actual price spread between any two markets would be:

$$PS_{ij} = PP_{ij} - P_j \qquad (2)$$

where

PS_{ij} = the price spread for one ton of grain between the ith and the jth market.

P_j = the actual retail price of one ton of grain in the jth market.

In a perfectly competitive market, where grain was moving from the jth to the ith market, PP_{ij} would always be equal to P_j and, therefore, the actual price spread would be zero. A positive price spread would provide a potential opportunity for traders to make more than normal profits.[4]

Results

Figures 1 and 2 present the results of the calculations of retail prices and parity prices for the six markets for both millet and sorghum. In these figures, parity prices below retail prices indicate a negative price spread; i.e., a difference less than transfer costs, and vice versa for parity prices above retail prices. Except for Katsina, price spreads for millet were negative or equal to zero most of the time; spreads that were positive lasted only a short time. Sorghum had considerably more price spreads that were positive than did millet. The range in price spread for millet, considering all six markets, was from a low of a minus N19.02[5] in Sokoto to a high of a positive N1.42 in Katsina. For sorghum, comparable figures ranged from a low of minus N17·02 in Sokoto to a high of N5·02 in Daudawa. The predominance of negative price spreads indicates the complexity of conducting profitable trade between Zaria and outlying markets; especially when there is a dearth of public information on prices in those markets. Inadequate price information greatly increased risks associated with intermarket trade.

The average of the positive spreads considered separately ranged from N2·96 in Sokoto to N9·12 in Kafinsoli for millet. For sorghum the range was from N5·38 in Gusau to N18·50 in Katsina. However when taking the average of the positive and negative spreads there are only three cases where there are positive spreads which are Katsina for millet and Katsina and Daudawa for sorghum. This tends to indicate that on the average intermarket price differentials are closely related to transfer costs. Those positive spreads imply imperfections in the market and a departure from competitive conditions. Two factors on the nature of those average positive price spreads help explain their apparent magnitude: (1) positive spreads commonly occurred during peak harvest when prices in the supplying markets were declining and the corresponding adjustment in Zaria lagged behind this decline—resulting in a seasonal positive spread that tended to exaggerate the average price spread for the year; (2) positive price spreads occurred occasionally and erratically during the year making it difficult for traders to keep abreast of changes and, therefore, a part of the positive spread must be considered a premium for that extra risk inherent in the system. These factors, which help explain the positive price spreads, indicate that they may not have resulted from exploitative practices of traders but more likely resulted because of the nature of production and defects in the marketing system itself.

Consider first the nature of millet and sorghum production. A lack of specialisation in production leads to a lack of concentration in supply; only small surpluses, located in many different markets, are available for intermarket trade. Because much of the grain is stored on the farm, the marketing patterns and storage practices of producers are important in determining the supply available at any one time and location. Although farmers store grain to take advantage of seasonal price rises, probably a more important reason—and an important determinant of timing of disposal is the need for cash to meet expenditures throughout the year [*Hays, 1973: 73*]. That introduces considerable unpredictability into farm marketings; this is compounded by some marketing-system defects related to lack of adequate information on crop prospects and surplus areas and

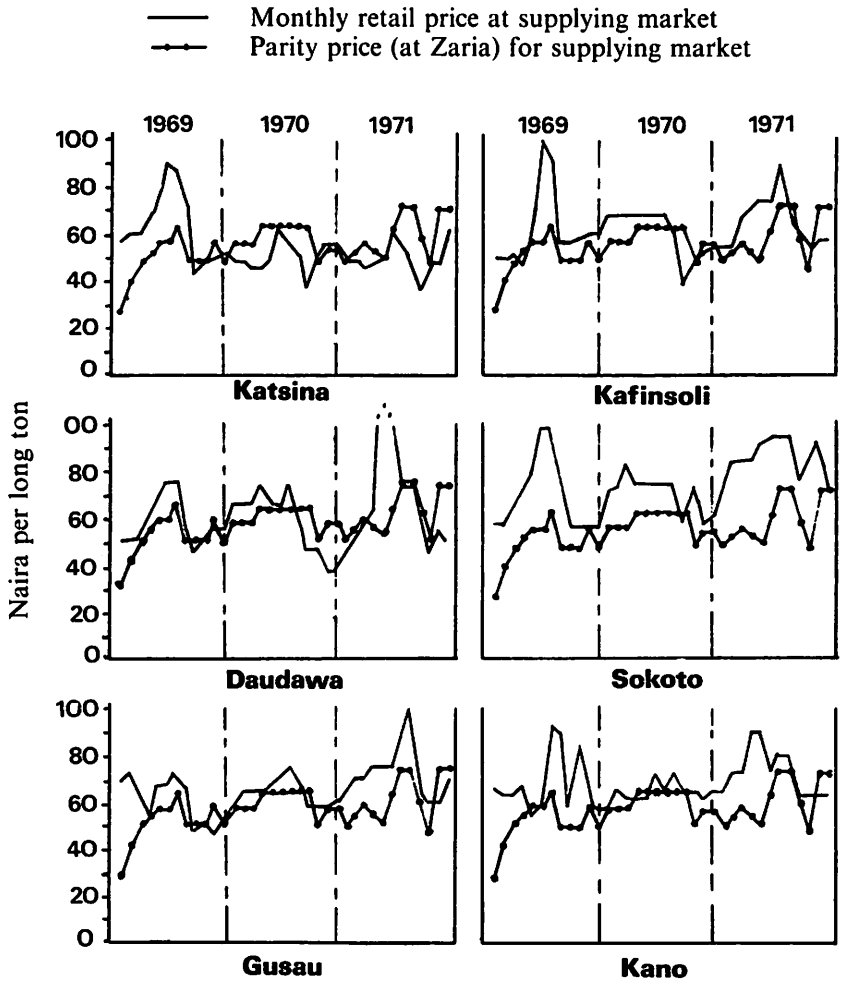

FIGURE 1

Price spread between each of six supplying markets and Zaria for millet, by month, 1969–71.

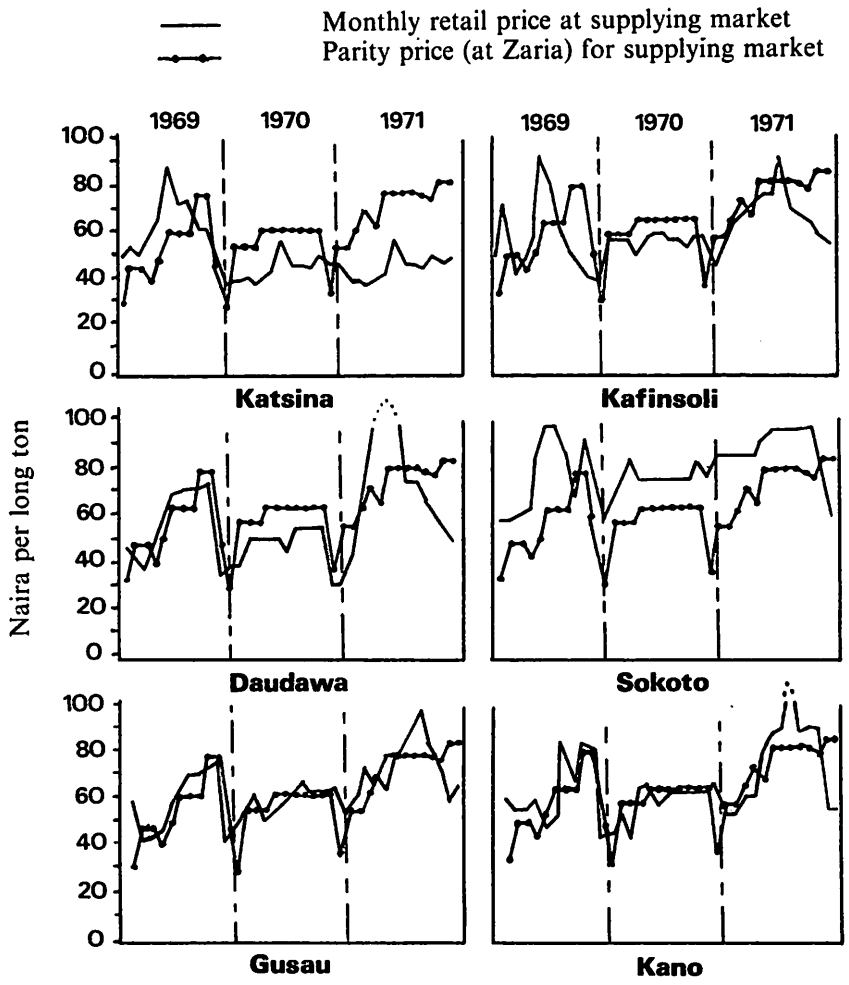

FIGURE 2

Price spread between each of six supplying markets and Zaria for sorghum, by month, 1969–71.

prices, as well to a lack of trade specialisation by traders taking part in arbitrage between markets. All information must be obtained and disseminated through private contacts, because no public information is available at any time.

Lack of market information, considered along with the nature of production and farmers–marketing patterns, introduces uncertainty in supplies and increases the risk of intermarket trade in distant markets where lack of information is likely to be greatest. Traders develop personal contacts in certain areas for market information and engage in trade in these areas with little knowledge of market conditions outside of their own area. This results in competitive situations in areas surrounding urban centres but a lack of integration of the total market network. In summary, the evidence strongly suggests that positive price spreads among markets resulted from: (1) an erratic nature of supply, which tends to increase risks in intermarket arbitrage; (2) an inadequate dissemination of information on prices and supply in the various markets; (3) a lack of specialisation in trade by traders taking part in arbitrage between those markets rather than planned manipulation under monopolisitc conditions.

TEMPORAL PRICE RELATIONSHIPS

The Model

In a perfectly competitive market, economic theory suggests the post-harvest price rise will equal the cost of storing grain. A price rise greater than costs of storing grain provides the opportunity for traders to make more than normal profits. The expected seasonal price increase consistent with a perfect market may be calculated as:

$$E(P_{t_i}) = P_{t_o} + t(R + I + L + D) \tag{3}$$

$E(P_{t_i})$ = expected price per ton of stored grain in i^{th} month.
t = time in months; i = 0 . . . . . 11 months.
P_{t_o} = price of one ton of grain stored at harvest, i.e., t = 0.
R = rent per month per ton of grain stored: calculated to be N0·35 [*Hays, 1973: 157*].
I = interest on capital needed for one ton of grain; estimated at one per cent per month [*Hays, 1973: 157*].
L = amount of grain losses over time; estimated to be five per cent per year [*Giles, 1965; Hays, 1973: 157*].
D = depreciation on sacks used in storing one ton of grain; estimated to be N0·15 per month [*Hays, 1973: 158*].

The net seasonal rise in price (the rise above that considered consistent with storage costs) for any period would be: [*Farruk, 1972: 80*].

$$NSRP_{t_i} = P_{t_i} - E(P_{t_i}) \tag{4}$$

Assuming perfectly competitive conditions, the net seasonal increase in prices will equal zero, which means seasonal price rises equal the computed storage cost.

TABLE 1

NET SEASONAL RISE IN MILLET PRICE EXPRESSED AS A PERCENTAGE GREATER (OR LESS THAN) THAN EXPECTED PRICE, 1960–70 AND 1970–71.[a]

Market	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Ave.*
					1969–70							*year*	
Katsina	—	11	13	15	3	2	−4	−5	−3	20	−4	−11	4·1
Kafin-soli	—	2	2	0	10	8	6	4	2	0	−2	−15	1·5
Daudawa	—	10	16	13	30	28	25	37	20	14	29	−5	19·7
Sokoto	—	−2	−4	−6	14	18	32	14	12	9	7	5	9·0
Gusau	—	—	−5	7	15	26	23	20	18	24	29	16	17·3
Kano	—	50	−4	−6	−5	4	−4	−6	−7	8	−7	0	2·1
Gumel	—	—	19	8	5	36	104	86	25	3	42	38	36·6
Dambarta	—	86	80	61	56	58	54	87	70	83	73	114	74·7
Birnin Kudu	—	−3	−26	1	3	36	2	−20	−3	25	5	17	3·4
Azare	—	6	21	17	15	12	17	14	19	24	28	18	17·4
Potiskum	—	14	12	10	7	19	16	14	12	7	30	22	14·8
Maiduguri	—	5	−10	−17	−50	−21	−30	0	−2	−7	−5	−11	−13·4
Daura	—	17	9	20	31	19	−5	1	7	5	11	0	10·5
Birnin Kebbi	—	−2	13	9	8	2	38	35	33	51	100	37	29·5
Zaria	—	−2	8	−6	4	2	0	7	5	3	1	−1	1·9
					1970–71								
Katsina	—	40	47	43	20	18	9	9	11	37	19	2	23·2
Kafin-soli	—	30	37	43	40	36	55	62	68	64	95	44	52·2
Daudawa	—	−2	−21	−23	−9	0	10	18	161	88	32	30	25·8
Sokoto	—	29	−4	0	21	34	32	29	39	39	36	34	26·3
Gusau	—	0	−3	−2	6	10	8	13	11	9	24	40	10·5
Kano	—	−2	−9	−8	−10	−1	−3	19	17	−8	0	−1	− ·5
Gumel	—	−3	5	2	33	30	27	24	21	48	45	38	24·5
Dambarta	—	—	−3	19	39	72	41	85	85	127	102	97	66·4
Birnin Kudu	—	30	44	49	46	47	9	6	0	−13	3	1	20·2
Azare	—	−2	−5	0	−2	−5	−4	−3	−1	1	3	1	−1·5
Potiskum	—	—	−4	0	−6	−8	−4	−8	1	−1	0	7	−2·3
Maiduguri	—	−2	−11	−19	−60	−25	−37	−58	−34	−28	−23	−13	−28·2
Daura	—	—	13	22	14	12	14	9	17	42	43	25	21·1
Birnin Kebbi	—	−2	1	7	−8	−10	−11	11	14	7	2	−1	·9
Zaria	—	—	8	5	−6	−2	2	−6	−11	5	16	14	2·5

[a]Crop year begins with September.

Results

Tables 1 and 2 show the net seasonal rise in sorghum and millet prices expressed as a percentage greater than (or less than) expected price, $E(P_{t_i})$ for crop years 1969-70 and 1970-71 for the fifteen selected markets. For example, at Katsina the average net increase in millet price for 1969-70 was 4·1 per cent greater than the expected price increase (consistent with storage costs). The highest per-unit profits from buying at harvest would have been obtained by selling in June (Table 1). Seasonal-price increases vary considerably among markets and between months within a given year. Millet is usually harvested in August-September and seasonal price movements show that high and low points are consistent with the harvest period. However, in all but five instances for the fifteen markets during the two years studied, the yearly average seasonal increase in millet prices exceeded the calculated expected increase (Table 1).

Sorghum is usually harvested in November-December, which corresponded with its seasonal low price. The seasonal prices generally are highest several months before sorghum harvest and a little after millet harvest not only because some millet is substituted for sorghum in people's diets but also because by millet harvest time, farmers can estimate sorghum crop prospects and if they are good, market their surplus sorghum. For sorghum, in all but four instances for the fifteen markets during the two years studied, the yearly average seasonal increase in prices exceeded the calculated expected increase (Table 2).

The net seasonal price increases can be used to make hypothetical estimates of traders per-unit profits, depending on assumptions about the timing of storage decisions. When net seasonal rise in prices exceeds the expected price rise, traders can make more than a normal profit, depending on their purchasing skill and on length of storage decisions. Purchasing at harvest and storing until the off-season high price would not necessarily result in the highest per-unit profits. Marketings must vary considerably to achieve the highest per-unit profits; thus, risk in storage operations are considerable.

Do intertemporal price increases result because traders have enough monopolistic power to influence prices through their storage operations (and thus earn abnormal profits)? Though possible profits from storage operations indicates potential trader profits, other findings in this study strongly suggest traders do not have such power. For example, it was found that little storage takes place by traders in the urban markets; in urban markets a trader's monthly purchases about equal monthly sales [*Hays, 1973: 104*]; grain flows continuously to urban markets from the rural areas; and a large amount of grain is stored by farmers allowing them to benefit from the seasonal price rises [*Hays, 1973: 55*]. These findings along with the fact that marketings arise from a large number of farmers in many locations is a situation not conducive to monopoly control of storage stocks.

TABLE 2

NET SEASONAL RISE IN SORGHUM PRICE EXPRESSED AS A PERCENTAGE GREATER THAN (OR LESS THAN) EXPECTED PRICE, 1969–70 AND 1970–71.[a]

Market	*Dec.*	*Jan.*	*Feb.*	*Mar*	*April*	*May*	*June*	*July*	*Aug.*	*Sept*	*Oct.*	*Nov.*	*Ave.*
							1969–70					*year*	
Katsina	–	5	5	−5	0	5	31	−3	2	−3	7	−3	3·7
Kafin-soli	—	43	40	36	14	30	31	24	21	10	16	13	25·3
Daudawa	—	2	23	20	17	14	−1	18	15	13	10	−38	8·5
Sokoto	—	15	26	40	21	18	16	14	12	9	22	5	18·0
Gusau	—	0	13	−3	−3	1	5	9	0	−2	−6	−6	·2
Kano	—	20	−15	31	36	13	23	4	17	15	12	14	15·5
Gumel	—	21	38	90	91	42	6	39	35	7	4	9	34·7
Dambarta	—	4	8	11	31	35	37	34	19	9	−5	−7	16·0
Birnin Kudu	—	—	12	−2	−20	−8	−10	−13	4	1	0	4	−3·2
Azare	—	—	6	11	8	13	18	29	12	3	1	−1	10·0
Potiskum	—	−2	12	10	8	5	13	18	14	1	0	−8	6·5
Maiduguri	—	—	30	18	55	51	48	45	42	33	30	26	37·7
Daura	—	7	1	−9	−9	−16	−18	−20	−21	−24	−27	−9	−14·7
Birnin Kebbi	—	−1	−6	27	24	22	39	84	20	18	16	−6	21·5
Zaria	—	66	61	57	67	63	59	56	52	49	46	−11	51·4
								1970–71					
Katsina	—	—	0	−10	−5	1	25	−1	−3	−7	−1	7	·5
Kafin-soli	—	15	30	39	44	49	46	74	28	22	16	−1	32·9
Daudawa	—	27	89	146	201	291	192	96	93	67	44	32	116·2
Sokoto	—	−2	−4	−6	−7	−1	0	−2	−4	−5	−7	−27	−5·9
Gusau	—	14	32	16	33	30	35	43	53	26	11	−13	25·5
Kano	—	−2	10	8	37	48	48	75	39	39	37	−21	28·9
Gumel	—	32	28	25	22	19	42	39	57	33	39	−23	27·6
Dambarta	—	5	28	26	40	41	68	48	45	18	7	−10	28·7
Birnin Kudu	—	19	−1	−3	−5	−7	−9	0	−2	−11	−13	−18	−4·5
Azare	—	—	5	5	6	8	10	12	10	−11	−6	−17	2·2
Potiskum	—	—	−2	8	14	21	28	30	8	−34	−6	0	6·7
Maiduguri	—	—	46	28	27	45	65	61	68	65	51	38	49·4
Daura	—	7	2	−4	0	−6	28	30	14	2	−10	−12	4·6
Birnin Kebbi	—	—	−2	−4	24	25	29	15	15	9	11	−18	10·4
Zaria	—	−2	7	17	6	23	21	18	16	13	9	15	13·0

[a]Crop your begins with December.

CONCLUSIONS AND IMPLICATIONS

In the marketing system for millet and sorghum in northern Nigeria, many participants perform marketing services. Rural–urban links result in subsystems, each serving certain urban-consuming centres. An examination of the movement of grain between fifteen of these urban centres as well as price movements over time showed the spatial and temporal aspects of performance to be less than satisfactory.

A lack of market integration among the fifteen urban locations studied resulted in spatial price differentials that in some cases exceeded transfer costs. However, when considering the annual average of the positive and negative price spreads, intermarket price differentials were closely related to transfer costs in all but three cases. The evidence suggested that price differentials exceeding positive price spreads among markets did not result from planned manipulation under monopolistic or monopsonitic conditions but rather from imperfections inherent in the system, which made effective arbitrage in response to spatial price differentials difficult. Intermarket price spreads (both greater than, and less than, transfer costs) exist because erratic supply increases risks in intermarket arbitrage, dissemination of information on prices and supply in the various markets is inadequate, and traders taking part in arbitrage within these markets are non-specialised. Consequently, traders develop contacts in certain areas to keep informed on market conditions and engage in trading in these areas, but they have little knowledge of market conditions outside their usual trading areas. This results in competition in local areas or subsystems but lack of integration in the total network of markets.

Analysis of temporal price relationships indicated that seasonal price increases commonly exceeded cost of storing grain. Though that provided the opportunity for those who stored grain to make more than a normal profit, considerable risk was involved in storage operations to achieve high profits. Other findings in this study suggested that traders do not have the monopolistic power to attain such profits. Evidence supporting this view includes the findings that little storage takes place by traders in the urban market; in urban markets, traders' monthly purchases are about equal to monthly sales; there is a continuous flow of grain to urban markets from the rural area; and a large amount of grain is stored by farmers. Marketing patterns of producers indicated that much of the time the farmer benefits from seasonal prices rises.

This study's implication for government policy is that marketing performance can be improved through improving the efficiency of the price system. Market intelligence is an unsatisfactory aspect of the total marketing system. Currently the government neither collects nor disseminates data on market supplies and prices. Information collected in the form of Crop and Weather Reports (referred to earlier in this study) are kept confidential, with restricted circulation. The only source of information to traders is their own private contacts. Developing a system to collect and disseminate information on crop prospects, market supplies, and prices could greatly improve both spatial and temporal performance of the marketing system. The news media (radio and newspapers) should be encouraged to disseminate market–price information, which could be

provided by state governments. Illiteracy and difficulties in distribution among producers now limit the effectiveness of newspapers, but the radio (transistor radios are increasingly available)—an effective communications medium—could provide price and market supply information that would allow for more effective arbitrage among markets, decrease uncertainties on market supplies in different locations, and decrease the risk associated with intermarket trade. In so doing, it would allow for more specialisation in trading functions related to assembly and arbitrage, a prerequisite to obtaining a better integrated network of markets.

NOTES

1. Guinea corn (Sorghum vulgare) and millet (Pennisetum typhoideum) are Nigeria's two most widely grown grain crops. Together they make up a minimum of 70 per cent of the total calories consumed per capita in the northern part of Nigeria. [*see Nicol, 1959: 297–8*].

2. For a similar investigation of prices and marketing efficiency of the staple food marketing system during 1952–65 see Jones [*1968: 95–123*] and Gilbert [*1969*].

3. The value of the assembler's services was based on the yearly average margin found for rural assemblers in the Zaria area study [*Hays, 1973: 136*]. Data on transport and handling costs were obtained from this same study.

4. It does not follow that traders would make excessive profits, as that would depend on the extent of actual grain movement. Likewise, a negative price spread does not necessarily imply actual negative profits or no shipment of grain between two markets. The data used were monthly averages; possibly, considering price variations within month, some days or periods had normal or positive profits.

5. One naira (N) equals approximately 1·52 United States dollars. There are 100 kobo in one naira (N).

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