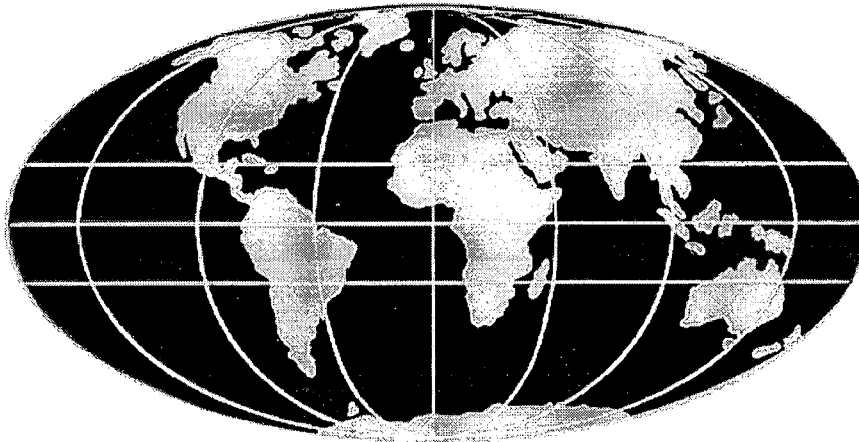


**TITLE: The impact of feeder road
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The impact of feeder road investment on accessibility and agricultural development in Ghana

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In a cross-sectional study of 33 villages in The Ashanti Region of Ghana, little evidence was found to suggest that agriculture was adversely affected by inaccessibility, apart from some difficulty in obtaining loan finance in the more remote areas. The more accessible villages were observed to have a higher proportion of people employed outside agriculture. The improvement of existing road surfaces was estimated to have a negligible impact on prices paid to the farmer. However, connecting a village to a road head by converting a footpath to a vehicle track was calculated to have a gross beneficial effect in the order of a hundred times greater than improving the same distance of earth track to good gravel road.

INTRODUCTION

1. Many case studies carried out in different parts of the world have often pointed to significant development benefits stemming from rural road investment. These studies however, have largely been carried out in untypical isolated locations where the road investment has brought about large changes in transport costs often arising from a change in transport mode from perhaps headloading to vehicle transport. More usually rural road planning is concerned with less dramatic projects to improve existing roads and tracks where no change in transport mode is envisaged.

2. In order to help with road investment planning in a more typical environment a study of the impact of feeder roads was carried out in the Ashanti Region of Ghana by the Building and Road Research Institute (Kumasi) in cooperation with the Transport and Road Research Laboratory. The study was carried out for the Ghana Highway Authority as part of its Second Highway Project and was supported by the World Bank.

3. The purpose of the study was to determine how parameters of rural development (particularly agricultural practises, costs and prices) varied with accessibility within the region. From this it was hoped to infer how rural development would change if access were improved through road investment, and hence lead to better methods of planning rural roads in Ghana and elsewhere.

4. In this paper only a brief resumé of the findings of the survey will be given. More extensive coverage of details will be published by the Transport and Road Research Laboratory and Building and Road Research Institute in due course.

SURVEY BACKGROUND

The region

5. Ashanti Region has an area of 24,000 km². The capital Kumasi has a population of over 400,000 which is many times larger than the combined population of all other urban centres

of the region. Over a million people live in 2,500 small rural towns and villages dispersed widely over the region, except for the uninhabited Afram plains in the north east.

The road network

6. Besides being the major administrative centre Kumasi is also the major market, transport and distribution centre of central southern Ghana and all major roads in the region radiate from there. Excluding Kumasi and the Afram plains, ie in 70 per cent of the region, there are 4,400 km of roads and motorable tracks. Ninety-eight per cent of the rural population lives less than 2 km from a road or motorable track but only 0.3 per cent lives more than 5 km from a road or track. Thirty-one per cent of the land area of the region lies more than 2 km from vehicle access but only 3.3 per cent lies further than 5 km from a road or track.

The rural economy

7. Food crop cultivation and cocoa farming are the major sources of livelihood for most of the population. This is supplemented by the rearing of poultry, sheep or goats. Marketing, the provision of services, rural industry and hand-crafts provide additional sources of income to a small proportion of the rural population.

8. Because land is relatively plentiful, shifting cultivation remains the dominant pattern of food farming. A plot of land is cropped for up to 3 years and then left to bush fallow for up to 10 years to regenerate the fertility of the soil. When the area is to be used again the land is cleared by fire. Large trees and tree stumps are left standing, and the open patches of land are cultivated with hand hoes. Machinery is largely inappropriate to this type of farming; labour (and working capital to hire additional labour) is a more critical factor of production, although modern inputs such as cocoa insecticide and fertilizers are widely used.

SURVEY METHOD

Definitions and sampling frame

9. Throughout this paper the term holder is used to denote an individual who manages a family farm holding. One holding may represent several dispersed fields or farms but in general totaling less than 20 acres (8 hectares). Data was collected on a holding basis.

10. Ministry of Agriculture enumerators collected cross-sectional socio economic data for the study from 491 holders in 33 villages. The sampling frame for the normal Ministry small holders survey was used to keep the data set conformable with other Ghanaian statistics. All but two of the villages in the sample had vehicle access and were between 8 and 102 km by road from Kumasi, lying in the cocoa growing forest zone (except for two villages in the savanna to the north of the region). Figure 1 shows the location of the survey villages.

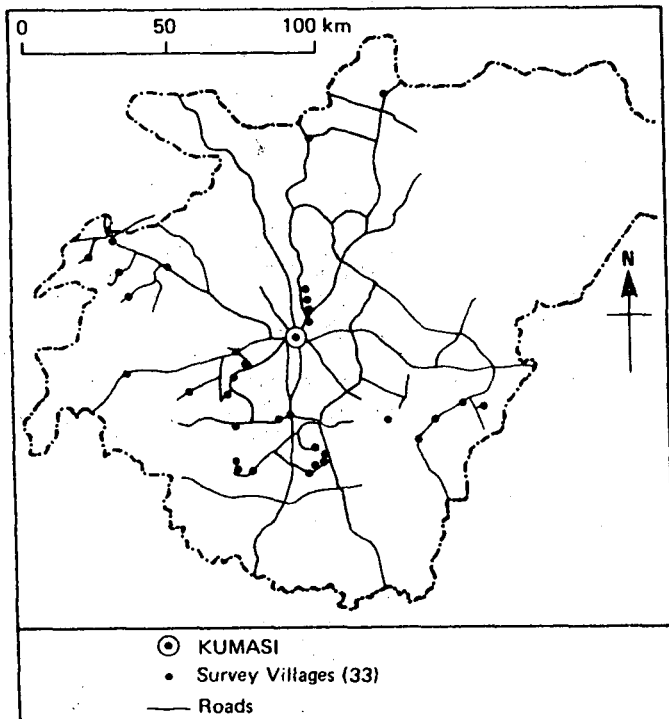


Fig. 1. Ashanti region showing location of survey villages

Parameters of agricultural development

11. A number of parameters such as farm area, cocoa production, cocoa and maize yields, labour input, finance, crop sales and the use of modern inputs were used to indicate agricultural development. Individually none of these parameters would be adequate but considered together they could provide a good overall indication of the pattern and nature of change of agriculture in the region.

12. Additional data on the local population density, soil fertility, crop diseases and rainfall were all collected as parameters of the region and were used to test alternative development hypotheses. The Soil Research Institute (Kwadaso) assisted by analysing soil samples collected from each village. The Ghana

Meteorological Services Department confirmed that rainfall could be excluded as an explanatory variable of agricultural production in Ashanti region in 1979, because rainfall in the main crop season was adequate for all crop requirements.

Parameters of accessibility

13. Two key parameters of accessibility were used in this study. These were:-

- (i) the transport charges of moving a unit of produce equivalent to a headload of produce from each village to Kumasi,
- (ii) the transport charges of moving a unit of produce equivalent to a headload of produce from each village to its district centre.

The transport charges of moving produce from field to Kumasi and from field to district centre were also used as subsidiary parameters of accessibility. The transport charges were found to vary directly with distance travelled.

Data analysis

14. In order to determine whether agricultural development can be explained by accessibility a cross-sectional framework of analysis was used. Survey data from each holder was collected and averaged within each of the 33 villages. Using this data the parameters of accessibility were tested as explanatory variables of the parameters of agricultural development by regression analysis.

SURVEY RESULTS: THE RELATIONSHIP BETWEEN DEVELOPMENT AND ACCESSIBILITY

General characteristics

15. Over half the holders interviewed were female; the proportion of male holders in each village increased the further the village was from Kumasi. Nearly sixty per cent of holders were over 40 years old, this proportion also increasing with distance from Kumasi.

16. The average household size in the survey was found to be 4.66 people, and the average holding size 4.2 acres (1.68 hectares). Total farm area per holder was found to increase with inaccessibility. This applied to both cocoa and non cocoa holdings.

Income

17. 59 per cent of holders reported that their major source of livelihood came from food farming, a further 28 per cent claimed this to be cocoa, and the balance looked to remittances and paid employment. In terms of the geographical distribution of holders between these sources of livelihood food farming was relatively more important in the more accessible villages and cocoa was more important in the more remote villages. Non farming jobs were more commonly reported in the more accessible villages.

18. By way of confirming this last observation household labour input into farming was found to rise with inaccessibility when measured either in terms of days worked per person or in terms of days worked per holding. The labour input per hectare tended to fall with inaccessibility although this probably reflects the smaller labour demands of the cocoa crop.

Modern inputs

19. More holders used fertilizers and other modern inputs in the savanna than in the forest zone villages. One remotely located village in the far north of the region was found to have 32 per cent of the reported extension contact, 65 per cent of the machinery hire and 75 per cent of the fertilizer used in the whole study. Even if the two savanna villages are excluded from the analysis there is still no evidence to show that inaccessibility prevented the use of fertilizer, machinery or insecticide or that it prevented contact with extension workers. Overall it appears that the pattern of extension contact is more dependent on the local management and enthusiasm of individual extension workers than on the problems posed by inaccessibility even though the latter may well hinder directly or indirectly the overall efficiency of each extension organisation.

Finance

20. The proportion of holders in a village that applied for loan finance was found to rise with inaccessibility and age.

21. A different picture emerges with success in obtaining loan finance. Farmers in the more remote locations experienced greater difficulty in securing finance. Loan applications were more successfully made the more accessible the village.

Crop production

22. The survey found that the proportion of holders growing cocoa increased with inaccessibility. Both the average cocoa crop area per holder and the proportion of farmed area covered by cocoa increased with inaccessibility. No significant relationship was found between accessibility and cocoa sales per grower or cocoa sales per hectare. The data does suggest that women holders are more successful in maintaining higher cocoa yields.

23. No evidence was found to suggest that maize yields or food crop husbandry varied with accessibility. However data relating to crop yields are notoriously difficult to interpret where multiple intercropping is practised as widely as in Ashanti.

Animal husbandry

24. Small numbers of poultry were kept by a large proportion of holders in the survey, however data collected on this topic was too unreliable to be analysed in detail. Other sources of information suggest that commercial scale poultry farming is concentrated in and nearby the major towns in the Region. The major towns provide a market and are also major distribution centres of chicken feed concentrate which has been in short supply for some time. In these circumstances a remote location would put the commercial poultry farmer at a distinct disadvantage.

25. Nearly 600 sheep and goats were kept by the 491 holders in the survey. No evidence was found of any significant relationship between accessibility and the ownership of sheep and

goats; although one of the most inaccessible villages accounted for a quarter of all sheep and goats recorded in the survey.

THE RELATIONSHIP BETWEEN ACCESSIBILITY, TRANSPORT AND MARKETINGThe initial movement and location of sale of crops

26. The average distance between field and village was found to be 3.9 km; most of this consisted of footpaths. In over 90 per cent of the households surveyed the principal means of carrying goods from the field was by headload. Tractors were used occasionally in the savanna villages.

27. Fifty-seven per cent of holders sold the dominant proportion of their food produce at their house. A further 24 per cent sold their food principally at the local village market. Cocoa was sold at the village buying posts of the Cocoa Marketing Board at a fixed price set for the whole country. Food is mainly sold to travelling wholesalers at the village who arrange for its transport and onward sale in urban markets. It is expensive for the farmer to arrange to sell his own produce in urban markets because not only must he pay his own return fare but transporters charge two to three times as much for individual loads (such as a bag of maize) than they would charge for movement of goods in wholesale quantities.

Accessibility and food sales

28. Less than 5 per cent of holders identified road conditions which would disrupt the movement of vehicles as a contributory cause of their produce becoming rotten before it could be sold. As farmers were referring to particular instances they remembered over the last few years, only a minute fraction of produce was effectively lost through poor road conditions.

29. Overall it appears that accessibility does not easily explain the proportion of farmers in a village selling food crops. Although the proportion of farmers selling more than 30 per cent of any crop (including cocoa) does apparently increase with inaccessibility this may reflect the indirect influence of other factors such as farm size and the use of labour which probably vary more directly with accessibility. The level of inaccessibility in the more remote areas of the survey was insufficient to hinder food crop sales. Over 55 per cent of all holders surveyed reported selling maize, 36 per cent cocoa, 17 per cent cassava and 13 per cent plantain. No significant relationship was found between the sale of maize and accessibility but cassava was sold relatively more frequently in the more accessible villages. By contrast plantain was sold more frequently in inaccessible locations. This is probably because plantain tends to be grown as a cover crop for cocoa.

Social mobility and migration

30. The level of trip making per holder was found to vary greatly with proximity to urban centres. As might be expected, the most accessible villages demonstrated much higher levels of mobility than the more inaccessible villages. For example one village very close to

Kumasi reported a trip rate to Kumasi of 84 journeys per holder per year. By contrast the most inaccessible villages were found to have trip rates to Kumasi of only one journey per holder per year. The average trip rate of Kumasi for all villages was 19 journeys per holder per year.

31. The percentage of holders having migrated to the region was found to be closely associated with the sex of the holder and accessibility. The least accessible areas in the region are now attracting the most migrants. Male holders are now much more likely to migrate and establish new farms than female holders.

The impact of accessibility on farm gate prices

32. The impact of accessibility on farm gate prices was estimated using Ministry of Agriculture data. Regression analysis confirmed that transport charges were closely related to travel distance. If it is assumed that one third of the Kumasi market price covers wholesale and retail margins and that all producers' prices are set in relation to the Kumasi market price, then it can be calculated that farmers located 100 km from Kumasi would receive 6.7 per cent less for their maize than those selling direct to wholesalers at Kumasi market. The calculated decline in farmers prices was little different for yam (6.5 per cent) or for plantain (5.2 per cent) at the same distance from Kumasi.

ROAD INVESTMENT AND FARMERS' PRICES

Improvement from earth road to good gravel surface

33. In order to assess the relative change in farmers' prices following road investment it is necessary to estimate the proportionate change in transport costs to the transporter following an improvement in the road surface. Unfortunately because of the difficulty in quantifying the engineering standards of motorable tracks and earth roads an exact figure cannot be given and so two separate estimates of the change in vehicle operating costs were used to calculate reduced transport charges following road investment. Scott Wilson and the Economist Intelligence Unit (ref.1) have suggested a 32 per cent reduction in transport costs between an earth and gravel road for a mammy wagon in Ghana. The Transport and Road Research Laboratory (ref.2) have suggested (for somewhat different circumstances) a change of only 6 per cent for a light goods vehicle.

34. By using two alternative methods, which varied in their treatment of standing charges, of calculating the impact on wholesale transport charges, coupled with the two alternative estimates in the reduction in vehicle operating costs, four estimates of the reduced transport charges for each commodity were made for each considered improvement of an earth road to gravel road standard. In this way increases in farm gate prices were predicted for different road lengths and different commodities from these estimated reduced transport charges. Averages of the four different increases in farm gate prices following road improvement are shown in Table 1.

Table 1. Potential improvement in farm gate prices following a road upgrading from earth to gravel surface

Length of improvement	Average percentage increase in farm gate price		
	Maize	Yam	Plantain
5 km	0.08	0.11	0.09
20 km	0.29	0.3	0.24
50 km	0.67	0.5	0.37

35. These figures demonstrate the very small increase in prices that can be expected from a road improvement. All the figures here assumed that the transport cost savings would be fully passed on to the farmer, and that none of the benefits from the road investment would go to the final consumers or to the wholesalers, retailers or transporters.

An improvement from pathway to basic earth road

36. Headloading is many times more expensive than vehicle transport, the survey found that the average charge to a farmer for moving one headload of produce from farm to village was £2.9 for 3.9 km. The impact on farm gate prices of converting a footpath from the village to the road head to the most basic vehicle track can be substantial. Nevertheless though large they might not justify the costs of the construction and maintenance. Although a majority of holders preferred to use domestic labour for this purpose, 40 per cent of the holders did hire labour when necessary.

37. If it is assumed that it costs £0.5 to move a standard 40 kg headload one kilometre then the costs of moving a 100 kg bag of maize would be £1.25 per km. Assuming that the farmer is able to sell his produce to a travelling wholesaler at the village after the construction of vehicle access, the calculated proportionate increase in farmers' maize prices following the conversion of a footpath to an earth road is shown in Table 2.

Table 2. Potential improvement in farm gate maize prices following the conversion of footpath to an earth road

	Length of footpath to be changed to vehicle access		
	2 km	5 km	20 km
Improvement in farm gate maize prices	4.3%	11.4%	70.6%

These estimates suggest that it is in the order of one hundred and forty (140) times more beneficial to the farmer to have vehicle access brought 5 km nearer to his village (where the alternative is headloading) than to improve 5 km of existing earth roads and motorable tracks up to a good gravel standard.

CONCLUSIONS

38. Within the range of accessibility considered in the study little evidence was found to suggest that agriculture was adversely affected by inaccessibility. It appears that the more inaccessible villages concentrate more on agriculture than the more accessible villages. The latter have the advantage of their position to concentrate their efforts on non agricultural sources of income such as marketing, rural industry and the provision of services. Accessibility was also shown to influence strongly the level of passenger trip making.

39. The only important drawback of inaccessibility identified was difficulty in obtaining loan finance. The provision of other modern inputs to agriculture were not observed to be adversely affected by inaccessibility. The pattern of extension contact was more dependent on the local management and enthusiasm of individual extension workers than on the problems posed by inaccessibility, even though the latter may well hinder directly or indirectly the efficiency of each extension organisation.

40. The study found that the improvement of short lengths of roads and tracks would have a negligible effect on the prices paid to the farmer. However replacing a 5 km footpath between a village and the roadhead by a vehicle track may benefit the farmer through increased farm gate prices by over one hundred times more than improving the same length of poor quality road surface to a good quality gravel road. However these benefits would have to be carefully weighed against the cost of construction.

41. Overall the figures indicate the advantages of ensuring that all villages have direct vehicle access. The quality of the road surface is of minor importance. From the points of view of agriculture, investment in bridging, minor drainage work and other small scale remedial work to extend vehicle access and keep routes open to vehicle traffic probably represent the best use of scarce of engineering resources.

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REFERENCES

1. SCOTT WILSON KIRKPATRICK AND PARTNERS, ECONOMIST INTELLIGENCE UNIT, Road vehicle operating cost manual. Ghana Highway Authority, Accra, 1975.
2. ABAYNAYAKA S W, H HIDE, G MOROSIUK and R ROBINSON. Tables for estimating vehicle operating costs on rural roads in developing countries. Department of the Environment, Transport and Road Research Laboratory. Crowthorne, 1976. TRRL Laboratory Report 723.

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