

The measurement of labour productivity; a case study

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Summary

In recent statements on economic development of the heavily populated, less developed countries much stress has been laid on the use of rural labour and its possible contribution towards increasing productivity. In this paper it is indicated that a clear answer to the problem of labour productivity can only be given by carefully assembling the data.

1. Introduction

In recent literature on the use and productivity of agricultural labour in the less developed countries much stress has been laid on the development of theoretical models (LEWIS, 1954; RANIS and FEI, 1960; NICHOLLS, 1963). In these models it is assumed that the supply of agricultural labour is unlimited, the marginal productivity of labour is zero or practically zero and withdrawal of a part of the labour force would have no significant effect on total agricultural output. This situation of abundant labour supply appears to occur in some heavily populated areas such as parts of South-East Asia, the Middle East and Southern Europe.

However, not much factual information has been provided on this subject. MELLOR (1963) concludes :

the empirical record regarding the marginal productivity of labor appears to be mixed.

The present article presents some additional information on this subject. Data are taken from an agro-economic survey conducted in a densely populated area of Northern Nigeria.

2. Definition

Labour productivity is defined as the ratio of total output to input of labour. Unfortunately, all factor inputs entering the production have an effect on labour productivity. In order to make the latter a measurable quantity we should confine ourselves to a micro situation in which the associated factors remain constant. This has been attempted below.

3. Environment

It is often stated that Africa is a thinly populated continent. Although this is generally true, there are pockets of high population density; several of those can be encountered in Nigeria.

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The area studied is situated in the North-Western Sokoto Province, Northern Nigeria. One village, Tulluwa, was selected for investigation in 1962. The area has a population density of 500—600 persons per square mile. Density of population is a rather deceptive term as long as nothing is stated about the carrying capacity of the land, the proportion of families engaged in crop production, the length of the farming season, etc.

Soils are of the upland type, very coarse sandy and practically devoid of organic matter. The rainy season lasts 3—4 months, and the average precipitation is 25 inches. Rainfall starts at the end of May, rises to a peak in August and ends by the middle of September. Crops are rainfed. The cropping pattern is quite uniform, viz. millet (*Pennisetum typhoideum*) interplanted with cow-peas (*Vigna sinensis*), a few stands of guinea corn (*Sorghum* spp.) and some groundnuts (*Arachis hypogea*). The ecological and soil conditions are such that guinea corn and groundnuts are risky crops in this area.

Farming is traditional hoe farming, no plough and draught animals being used. Soils around the village are of uniform quality. Due to lack of fodder and grazing facilities, animals are few. Droppings are collected and applied to the fields. There is no fallow land, all farm land being permanently cultivated each farming season.

The water table in the area is remarkably high. At the bottom of the slightly sloping sandhills there are small perennial streams bordered by a limited amount of heavier soils where dry-season farming is carried out on very small plots.

All adults in the sample group have farming as their main or subsidiary occupation. Rain distribution and subsequent crop production were average in the 1962 season.

4. Survey

Data of 30 families were collected through interviews. Random selection took place according to the recommendations of the Nigerian Federal Department of Statistics. In each family the head of the household (informant) was interviewed four successive times during the agricultural year. In addition, a study was made of five families. The latter were interviewed about their labour activities daily from 1st May until 1st December 1962, a period covering the complete agricultural year as far as upland crops are concerned.

5. The labour pattern

In this particular area farm work is done by men, the women taking no part; their tasks are confined to the household, and sometimes they are engaged in such minor activities as spinning and preparing food for sale. It is customary for boys, from the age of 14—15 years onwards, to work with their fathers in the field. Previously they are given such tasks as taking care of the animals and light farm work.

Case studies of farm labour in Nigeria have revealed that, on the average, an adult male in an area such as Tulluwa can satisfactorily cope with 4—5 acres of farm land in order to make full use of his labour.

In this sample group of 30 families who cultivated a total area of 61.6 acres the theoretical labour force available was 40½ working units¹, or only 1.5 acre per

¹ An adult male (between 15—55 years of age) is considered as 1 working unit; a boy (below 15 years) working on farms as ½ unit.

worker. It is evident that in such a situation serious unemployment and underemployment¹ occur even in the farming season (mid-May to mid-November), not to mention the other six months of the year.

There are, however, subsidiary ways of earning income in and around the village. Information obtained from respondents about these occupations during the farming season is presented in TABLE 1. This table is self-explanatory. It shows that labour is quite mobile in procuring additional employment.

TABLE 1. Primary and subsidiary occupations amongst total labour force in farming season

| Nature of primary occupation | Distribution of workers | Nature of subsidiary occupations | Distribution of workers |
|------------------------------|-------------------------|----------------------------------|-------------------------|
| Farming | 34 | Farm labour | 22 |
| Farm labour | 3 | Farming | 6 |
| Weaving | 1 | Crafts | 8 |
| Petty trading | 1 | Trade | 5 |
| Collecting fodder | 1 | Instruction in the Koran ... | 1 |
| Total | 40 | Total | 42 |

N.B.

All 40 workers had a primary occupation; 6 out of this number had no subsidiary occupation. 26 out of the rest had a primary and secondary occupation, while the remaining 8 had also a third occupation during the rainy season.

6. Labour input

As stated before, apart from labour we have kept the other factors of production constant. This seems a reasonable assumption in a small village with homogeneous soils closely surrounding it, a traditional outlook and an agricultural economy that hardly uses any capital at all. Moreover we have confined ourselves to a particular group of family holdings², *i.e.* those of a size of 3 acres or less. This group consisted of 28 holdings. In each case informants were asked to estimate the time devoted to farming and to other sidelines during the six months of the farming season, breaking down the total time into halves and quarters. This breakdown is given in TABLE 2.

TABLE 2. Estimated occupational distribution during farming season

| Theoretical number of work-units | Actual units engaged in farming | Deductions due to | | |
|----------------------------------|---------------------------------|-------------------------------|-------------------------------|-------------------------------|
| | | illness | paid labour (farm) | other occupations |
| 35 ¹ / ₂ | 17 ¹ / ₄ | 1 ¹ / ₂ | 7 ¹ / ₂ | 8 ³ / ₄ |

In this group of holdings there is only 1,4 acre theoretically available per worker and, assuming that half the time is devoted to farming only, this figure becomes 2,8 acres, which is still far below the average acreage per worker in other similar but less heavily populated areas of Northern Nigeria.

¹ Underemployment is defined here as the situation in which the value of the marginal product of labour (with standard technology) is less than the rate of wages paid.

² A family holding is defined as the aggregate number of parcels of land actually cultivated by a particular family.

In TABLE 3, the informants are grouped according to the estimated days worked on their fields after deductions have been made as indicated in TABLE 2.

TABLE 3. Estimated labour input, net return per acre, average and marginal returns (in shillings)

| Estimated number of days p. acre on holdings less than 3 acres | Number of cases | Return per acre | | |
|--|--------------------|---|---------|----------|
| | | net | average | marginal |
| less than 40 days/acre . . . | 4 | 114 — 53,5 — 41,5 — 43 | 63,0 | } 21,5 |
| 40—50 days/acre | 8 | 70 — 106 — 94 — 80,5 76,5 — 74 — 62 — 113 | 84,5 | |
| over 50 days/acre | 16 | 138,5 — 110 — 69 — 93,5 72,5 — 43 — 42 — 100,5 125 — 70 — 77,5 — 60,5 135,5 — 95 — 70 — 44 | 84,2 | } — 0,3 |

Net returns have been calculated after deducting actual expenses incurred from gross returns. These items were seed, depreciation on farm tools, cost of hired labour and rents paid to landowners. The value of the manure applied has been considered as an infra-farm affair and is therefore excluded here. Total expenditure amounts to approximately 12 % of the gross return. The farming period covered about 180 days. Conclusions derived from TABLE 3 are questionable, as the sample group is small and variations within each class are wide. It would appear that marginal productivity is around zero beyond a certain labour input, as calculated according to TABLE 2.

The question is whether this is a reality. We will therefore turn to the analysis of the labour records of the five farmers who were interviewed daily. All working hours were recorded. One working day is assumed to equal eight working hours. The data show this to be the average length of a working day during the farming season.

Although the holdings of these farmers differed extensively in size, the number of man-days spent per acre on crop production was remarkably uniform, viz. 16,4; 18,5; 18,8; 20,4 and 20,7 man-days. The average comes to 19 man-days per acre with a small variation. These workers also had subsidiary occupations during the farming period. Although the sample group is small, figures indicate that there is a limit to the amount of labour input per acre. This is also brought out by personal observation while living in the village of Tulluwa.

Furthermore, in a labour survey conducted in two villages of the Katsina Province, Northern Nigeria, which have similar ecological characteristics, the author found a consistently uniform figure of 20 man-days per acre, more or less irrespective of the size of the holdings (LUNING, 1963).

Against the background of this information the figures in TABLE 3, column 1, seem very high. We may conclude that the method of estimating the breakdown of the labour period, as attempted in TABLE 3, has led to erroneous results. Farmers who spread their farm work over a long period, interrupted by other occupations and pursuits, seem unable to make any correct assessment of time spent on actual crop production.

In Northern Nigeria, the crucial farming period coincides especially with the period of first and second weedings. In areas south of Tulluwa, where rainfall is higher, vegetation more vigorous, soils more fertile and heavier and the variety of crops

greater, there is a close relationship between yields and intensity of weeding on peasant farms. Due to the rather primitive means at their disposal, many farmers have difficulties in keeping up with weeding, especially in years when the rains of the planting season are late and more work has to be done in a short time. A labour survey in villages of these areas showed that an average of 30—40 man-days were devoted per acre to crop production.

In Tulluwa and other villages in this ecological zone there are no such difficulties. Farmers plant on level ground and do not have to maintain ridges under these sandy conditions. Weeding is light and the clean-weeded fields show that the farmer has no difficulty in keeping ahead of weed growth. As the soils around Tulluwa are of uniform quality, which is by no means a common situation, it seems fair to say that there is a limit to further labour inputs. This seems to be realized by the farmer who shifts to other occupations. Detailed labour requirements are given in the next section.

7. Distribution of labour

The FIGURE shows the combined labour activities of the five families mentioned in par. 4. Total time has been broken down into the following categories:

1. Farm occupations

- a. *major farm operations*: all farm work connected with the cultivation of the main upland crops;
- b. *minor farm work*: work connected with the livestock industry (collecting fodder, grazing of animals) and work on dry-season gardens. This sector of the occupational pattern could not be analyzed as the survey only followed the major cropping pattern.

2. Non-farm occupations

All other work covering household work, paid labour, crafts and trades, social obligations.

The line of major farm operations shows a pronounced peak in June when labour congestion is heaviest, afterwards sloping down gradually barring a small rise in September due to the millet harvest.

Minor farm work does not show much variation over the seven-month period. The line of non-agricultural occupations has its lowest level in June, when the bulk of the work is concentrated on weeding and replanting the land. In July farmers gradually shift to other occupations, especially paid labour which is carried out partly in the vicinity, although in many instances farmers or farmer's sons leave the area for several weeks on a paid-labour expedition, finding farm work as far as 60 miles away. In July and the beginning of August, before the millet is harvested and home food supplies are at their lowest ebb, there is an incentive to earn additional income. TABLE 4 illustrates the extent of these short labour migrations amongst the 30 farmers. 18 out of 40 workers took part in such a short-term migration, mostly in July, August and September.

TABLE 5 shows the total work actually done by the labour force within these five families after deducting the share of paid labour employed by them.

These families comprise 8 workers and it is clear that no time was taken off in June and July. Even if they had some leisure, it would have to be made up by

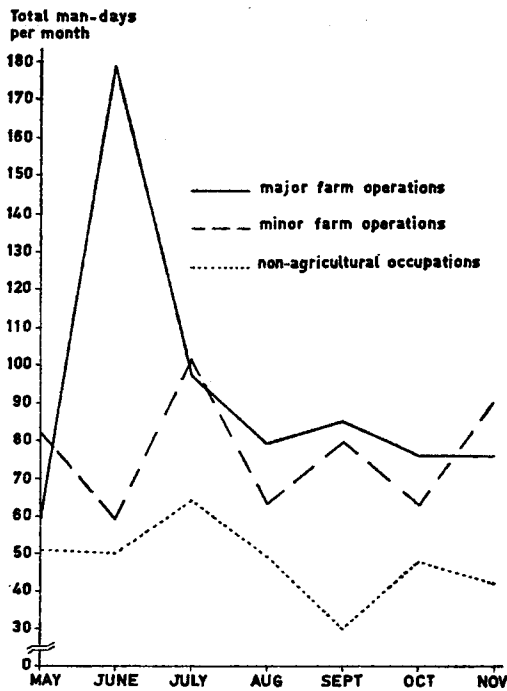


FIGURE
Combined labour activities of the five families

TABLE 4. Wet-season labour migration

| Length of period | Number of workers |
|--------------------|-------------------|
| 1—2 weeks | 13 |
| 2—4 " | 4 |
| over 4 weeks | 1 |
| Total | 18 |

TABLE 5. Total work, total work carried out by family labour and theoretically possible number of working days (in man-days per month)

| | May | June | July | August | Sept. | Oct. | Nov. | Total |
|----------------------------------|--------------------|--------------------|------|--------------------|--------------------|--------------------|--------------------|---------------------|
| Total work (3 categories) | 192 ^{1/2} | 286 ^{1/2} | 262 | 191 ^{1/2} | 194 ^{1/2} | 186 ^{3/4} | 208 ^{3/4} | 1522 |
| Minus paid labour | 11 | 40 | 34 | 8 ^{3/4} | 20 ^{3/4} | 1 ^{1/2} | 3 ^{1/2} | 119 ^{1/4} |
| Is actual family work ... | 181 ^{1/2} | 246 ^{1/2} | 228 | 182 ^{3/4} | 174 | 185 ^{1/4} | 205 ^{1/4} | 1402 ^{3/4} |
| Theoretical number of days | 232 | 225 | 232 | 232 | 225 | 232 | 225 | 1603 |
| Leisure | 50 ^{3/4} | — | 4 | 49 ^{3/4} | 51 | 46 ^{3/4} | 19 ^{3/4} | 221 ^{1/4} |

longer working hours. This was the case in June. One family reported a considerable amount of illness in November which has been included under non-agricultural occu-

pations, as were also rainy days when farm and other work was impossible¹.

It is evident that workers had an average of 4 days of leisure per month, which is not an unduly high figure, especially in view of the fact that most of this spare time was not full days but parts of days (the difference between an 8-hour day and the actual labour done).

On a close examination of the situation there is no trace of unemployment at all, although there may be forms of "disguised" unemployment in certain activities such as the livestock industry where the marginal productivity of an hour of work may be very low. We have not been able to scrutinize these other enterprises due to lack of sufficient data and the fact that the survey could not cover a complete calendar year.

8. Labour productivity and the wage level

We have found that the average acreage available was only 1,4 acres per worker. This figure becomes 2,8 acres in case the estimated *actual* labour input is taken. This is still considered to be a small acreage. It is therefore surprising to find that amongst the 28 informants in the size-group lower than 3,0 acres/family, there were 10 who even employed paid labour. Six out of these ten employed farm labour and also worked as paid labourers themselves in the farming sector.

This feature needs further investigation. The 10 informants cultivated an average of 1,8 acres per worker which is higher than the average in this size-group (1,4 acres). In order to understand this inconsistency of labour employment and hiring out of labour to other smallholdings, we should take a closer view of the labour requirements for major farm operations.

Turning once again to the analysis of the five labour records, it appears that two out of these five farmers employed farm labour and also worked for others.

It was found that in 1962 labour could be divided in the following periods:

Prior to 20th May: carrying manure to the farm;

20th May; first planting-season rains and planting started immediately thereafter;

From 20th May to mid-June: planting and replanting of millet, sorghum and ground-nuts during the time of successive showers. Very often owing to poor germination and drought, replanting is required;

From mid-June to approximately 10th July: first weeding of crops, planting of cow-peas and replantings;

Thereafter, until three weeks later, there is no urgent farm work;

First two weeks in August: second weeding;

Thereafter another quiet period until the millet harvest in the last few days of August.

It is clear from the records that during the busiest part of the farming season there are periods of seasonal unemployment, when workers can offer their services as labourers elsewhere in the neighbourhood or to take up other occupations at home. Nevertheless, in periods of intensive farm work (first and second weeding) they may hire paid labour on their own farms for a number of days.

¹ These items are of an enforced kind, with the exception of leisure proper.

It is not clear why farmers do not extend the weeding period a few days by using family labour only, since even when the total output added by the hired labour is equal to the cost of this labour, there is little farmwork to be done after this period.

What might be the reason farmers employ these labourers? In some cases it is illness at a crucial time and in other cases it may be the weather that compels farmers to complete certain jobs within a given time. CUMPER (1963) has tried to reconcile the existence of unemployment on one hand and wages on the other by introducing the concept of "the propensity to share", *viz.* "a transfer of part of the income of those who are in work". HUIZENGA (1959) points out that in the peasant economy of Java income disparities are reduced by the use of the "ani-ani" knife in the rice harvest. When this knife is used labour requirements are 600 hrs/ha, but a simple sickle would reduce work to 50—60 hrs/ha. However, the harvesting with the ani-ani leads to a more equal distribution of income as mutual services increase under this system.

Is the wage level merely fixed by custom requiring a fair subsistence level for the labourer, or does productivity play a rôle? We will attempt to answer the last question. Hiring of labour is very casual, *viz.* a contract for a day or a number of hours. Thus, the links between subsistence level and wage rate are not necessarily strong.

It should be noted that there is a correlation between hours of work and total wage received. For instance in Tulluwa, the average rate was 2 shs. from 07.30 to 13.30 and 2,5 shs. plus food worth 0,5 shs. (altogether 3 shs.), when work was done from morning to 16.00 approximately. Again, remuneration was higher during first weeding compared with rates at harvest. Whether this was due to a greater demand for labour or to the more strenuous work is not known. Sometimes labour was paid in kind, especially during the harvest. Some farmers paid slightly different rates compared with others, or different rates even in the same week. Whether this is connected with the exact number of hours worked, the relation between labourer and employer, or with the age and estimated output of the labourer, or with the type of task to be performed, is equally unknown.

Finally, we have calculated the net return per day in case of family labour for the five farmers. The figures are 2,5; 3,1; 3,5; 3,7 and 4,0 shs.¹ per man-day respectively. This is the average return per day. In all cases they are equivalent to or higher than the wage rate, which can be put at 2,5 shs. per eight-hour day. In only one case did we obtain information on other occupations, *viz.* net earnings from collecting firewood for sale were 2,25 to 2,5 shs. per day during weeding time.

However, the most interesting information is lacking. We were unable to calculate the marginal productivity of labour. TABLE 3 would suggest that it is at a very low level, but the method of calculation was too rough. The fact that 20 man-days per acre are spent in this and ecologically similar (but less heavily populated) areas would suggest that marginal productivity is reaching a limit. Whether this limit is equal to the wage rate or to a zero level is not clear. The indications are that the former conclusion has some validity, why otherwise would farmers who have sufficient time make use of labour to finish the relatively short jobs? There are cases in which farmers worked as labourer on one day, and employed others on their own farms on the next.

This is apparently contradicted by the following information. Among the 28 informants, six cases were recorded of share cropping on a total of seven fields (on the average there were three fields per holding). These fields comprised an area of 6 %

¹ Parts of shs. are expressed in decimals, not in pence.

of the total acreage cultivated. The owners did not supply any seed, *etc.* and were entitled to half the produce. Total gross return on these 3,5 acres was 44,8 shs. per acre. After deducting the share and farming expenses, there remains only 20 shs. per acre for family labour. If 20 man-days per acre were spent, the return per man-day would be only 1 sh. Even if half the time had been worked, labour returns would still have been lower than the wage level. On the other hand, a return of 44,8 shs. per acre was very low. On the average, gross return on all farms together was 87 shs. per acre in Tulluwa. If we take the latter figure, labour returns after deducting the share and other expenses would have been at the wage level when 16 man-days/acre were spent. Owing to adverse conditions, yields may not have come up to expectations, resulting in a reduced labour return, or some farmers may have mentioned only the share which they received.

The information collected suggests that the marginal productivity of labour on the farm is *not zero* and not even *near to zero*; the great mobility of labour points to this.

We may conclude that farmers spend time on their farming operations up to a point where they consider they can earn more by shifting to another activity. During these periods of farm work they may employ extra labour in anticipation of equally remunerative jobs which become available as soon as the crops have been sufficiently taken care of. As pointed out by BAUER and YAMEY (1957) :

The fluidity of labour between certain occupations arises largely from the fact that only a low level of skill and capital is required in these occupations in underdeveloped countries. People can generally move with little sacrifice or difficulty within a wide range of occupations, in accordance with changes in prospective net advantages.

The area studied is heavily populated, but due to the fact that it is only a small area (approximately a twenty-mile radius around the town of Sokoto), unemployment can be prevented by short movements. In the long dry season, from December to May, a large part of the male population of this area which is not engaged in dry-season farming, can be found all over West Africa working on the cocoa farms in Western Nigeria and Ghana, at Ibadan as porters or in the tin mines on the Jos Plateau (MANSELL PROTHERO, 1958).

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