NUTRITION, EMPLOYMENT, AND EFFICIENCY: ACTIVITY PATTERNS AMONG RICE FARMERS IN LAGUNA PROVINCE, THE PHILIPPINES

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The life of the tropical farmer is both mundane and mysterious. While many consider his days monotonous, few agree on how he spends them. Some suggest long hard hours; others see leisurely afternoons. Disagreement can be partly attributed to cultural differences. There is, after all, no reason to assume that tropical farmers are more homogenious than those in the temperate zone. But the fact remains that there is little empirical evidence to back either view.

The question is of more than academic interest. Indeed it has a bearing on two of the most basic problems confronting low-income countries: food and employment. For years these countries have relied on FAO's scale of calorie requirements to estimate food shortages and plan future needs (1, pp. 9-46). These standards provide useful caloric adjustments for differences in weight, age, sex, and environment. But they helplessly ignore the impact of alternate levels of physical activity--clearly the most crucial caloric variable.

In recent years, however, unemployment has replaced hunger as the chief concern of politicians and planners. The welldocumented farm-to-city migration continues to gain momentum at a time when industry is increasingly capital intensive. If political turmoil is to be averted, new sources of employment must be found. This had led to a consideration of labor requirements under alternate strategies of development.

Data on human energy output would seem useful in dealing with both problems, particularly in the context of rapid technical change. In rural areas, logic suggests that the energy requirement rises with the introduction of irrigation and the adoption of improved practices. It presumably falls if and when mechanization is introduced. The quantification of this hypothesis would surely aid in the development of national food projections. Such data might also help determine the optimum population density in settlement schemes, and the desirability of various systems of crop production.

Up to now, efforts to measure human energy expenditure have been hampered by the bulkiness of the monitoring equipment and by the need to watch subjects throughout the day in order to chart accurate activity patterns. Both have generated unnatural reactions. However, these problems seem to have been largely overcome by recent improvements in technology. A small, lightweight instrument (SAMI) has been developed which can be inconspicuously carried about while it records the heart beat in pre-set ranges. Fortunately there exists a linear relationship between heart rate and oxygen intake for each individual, thus permitting daily caloric energy expenditure to be measured more quickly, more accurately and less expensively than ever before.

Since its development, the SAMI has been used only in urban, temperate environments. It now seems appropriate to test the feasibility of this new technique under tropical field conditions. This paper outlines a study to be implemented in rural Laguna, the Philippines, from September to December 1971.

Review of Literature

Less than a handful of studies have dealt with energy output among tropical farmers. In 1949, Fox set out to measure the ". . . energy expended on cultivating food crops by hand labour during one year in a primitive African community" (2, p. 1). The Fox study--and one by Phillips a few years later--determined that many agricultural operations involve moderate to heavy exertion (2, pp. 86-88; 3, pp. 12-20).

Two other studies have attempted to relate activity and calorie requirements to FAO standards. Burgess and Laidin found that per capita daily consumption of Malay smallholders and fishermen were respectively 14 and 22 percent short of requirements computed according to the first FAO report (4). Nichol, however, provides evidence that not all peasants have a level of caloric intake well below FAO standards.

Among seven communities in Nigeria, Nichol found mean body weight lowest in two groups of hard-working farmers and herdsmen. Yet their diets supplied up to 120 percent of their estimated requirements. Another group of energetic farmers lost weight over the year presumably because their food intake had been restricted by a poor crop and amounted to only 94 percent of requirements. The men of a third group, who cultivated yams but did not have to travel far to their fields, maintained a higher body weight throughout the survey year on an estimated intake of 94 percent of requirements. Nichol concluded that the intake of calories approximates the computed FAO requirements where men and women are not unduly energetic (5, pp. 293-306).

Unfortunately, hardly any new data has been added to this conflicting picture in 15 years. Thus, McArthur suggests there is simply insufficient evidence on activity patterns in both agricultural and non-agricultural sectors to ". . . allow us to decide whether . . . (the FAO calorie scale) gives a per capita requirement figure which is too high, too low, or about right. Hence, we cannot assess accurately . . . the magnitude of any existing deficiency in order to make allowance for it in estimating future food needs." (6, p. 406).

Getting data on energy expenditure has never been easy. For years it could only be guessed at through detailed consumption surveys such as those developed by Burgess and Laidin. There are, however, serious problems with this approach. Every morsel of food has to be weighed and analyzed. This is not only time consuming, but may unknowingly distort the normal diet. More important, unless the survey is taken over an extended time period, there is no way of knowing if food intake is being balanced with energy expenditure. For example, if the study is conducted immediately following the harvest, the subjects may be in the process of gaining weight. On the other hand, in the months preceding the harvest they may eat less than the amount necessary to meet energy output, living partly off accumulated fat.

The development of indirect calorimetry was a major breakthrough in the technique of energy measurement. This approach rests on the relationship between energy and oxygen. It is well known that energy is provided by food and must be liberated before it can be used by the body for physical and chemical work. As energy can only be liberated from food through oxidation, the measurement of oxygen consumption by the body is, indirectly, a measurement of energy expenditure (7, I-VIII).

The application of this principle was first undertaken in industrial countries about 1930. A respirometer measured the energy costs of specific tasks, and these were then multiplied by appropriate time spans. But this method quickly revealed its drawbacks, particularly for tropical conditions. The respirometer is only worn for a few minutes, and is so bulky and uncomfortable that its presence is hardly conducive to normal behavior. Fox, who used this method in his West African study, acknowledged that his most likely source of error was in assigning energy expenditure values to the individual activities (2, p. 28). In addition, time-span recording must be meticulously accurate in order to be useful. "And to obtain meticulously accurate time-span data under primitive conditions is probably asking too much of both subjects and enumerators (8, p. 12).

Fortunately, another relationship has recently been discovered which extends the scope of indirect calorimetry. It has now been established that there is a linear relationship[1/] between heart rate and oxygen intake for each individual (9). Thus, energy expenditure can now be measured by recording heart beats in the small, light-weight instruments (SAMI) previously mentioned (10, pp. 1-5).

Nature of the Study

One area in which SAMI technology would appear to be of value is in determining labor and energy requirements for various systems of rice cultivation. In the Philippines, irrigated acreage is expected to increase from 825,000 in 1966 to 2,375,000 by 1974 (11, p. 14). Hence, the energy requirement of lowland irrigated vs. lowland rainfed production may be of great significance.

Before considering the implementation of such a study, a sketch of both systems seems appropriate. Since research will probably be confined to Laguna, data and descriptive accounts from that region will be used whenever available.

There are 24,426 farms in Laguna of which 3,756 (15%) are fully irrigated; an additional 5,252 farms are partly served

1/ This relationship does not hold for very strenuous activities or when the level of activity is extremely low.

(12, p. 27). The bulk of these farms are able to produce at least two crops of palay[2/] per year. Some also have corn and vegetable acreage (13, pp. 29-37).

Preparation of the seedbed begins at the onset of the monsoon, generally in June or July. It is not uncommon, however, for preparation and planting to extend into August and September. Depending on the variety, the crop is harvested from $3\frac{1}{2}$ to 6 months later. During the interim, irrigation, transplanting, and hand-weeding take place, perhaps supplemented by improved practices such as fertilization and pest control.

Although most of the irrigated acreage is resown by January, the cropping season is quickly over for the 15,418 rainfed farms. Dry-season palay cannot follow the wet-season crop unless there is sufficient water during the early growth of the second crop. Not only is this uncommon, but the data suggest that there is seldom a crop of any kind from harvest to the next monsoon (13, p. 119).

It should be apparent, however, that labor and energy requirements are not solely a function of water availability or the length of the cropping season. The alternative methods of carrying out field operations can also have a significant impact.

The first operation in the paddy cycle is land preparation. This usually involves both plowing and harrowing, and may be done by any of three alternative methods: carabao (water buffalo), hand tractor, or four-wheel tractor. This is followed

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2/ Unprocessed rice.

by nursery operations which may be carried out in the traditional "wet bed" fashion or by the newer "dapog" method. The "dapog" involves germination on moist banana leaves or other surfaces so that the seedlings can be gathered and carried to the planting field with little root damage.

There are at least seven possible ways to plant. The rice may be transplanted from either wet bed or dapog, and in straight rows or randomly. Planting may also be done directly by a row seeder or by hand. Broadcasting is another possibility.

Weeding and threshing are two other major operations. Weeding may be done mechanically, by hand, or with a herbicide. Three options are available for threshing: hand, peddle thresher, or more modern machines (14, p. 2).

Implementation of the Study

It has already been pointed out that both rainfed and irrigated rice are being grown in Laguna. With one or two exceptions, the various operational techniques are also being practiced. It is now necessary to develop a procedure such that with SAMIs we may:

1) determine labor and energy requirements for two systems of lowland rice production; and

2) determine labor and energy requirements for alternative methods of performing the same task.

Thirteen SAMIs will be available, of which ten can be allocated to the macro-study of rainfed vs. irrigated production. Hopefully, seven barrios--each with both types of production--

will be selected. As the study is restricted to four months, selection will aim to include barrios at various stages of the production cycle in order to reflect as much of the crop year as possible (18, pp. 1-21).

In each of the seven barrios, ten individuals--five from each production system--will be selected. Here again, several considerations seem to rule out a random selection. First, it will be necessary to enlist people willing to cooperate with the study. Second, with only 35 people involved from each system, it seems necessary to stratify so that possible extremes in social and material status (with obvious activity overtones) do not distort the results. Hence, SAMIs will be used only on peasants working holdings of five to eight acres--the median in Laguna Province (12, p. 4)

Each barrio will be visited once per week on a randomly selected day. This is done to scatter feast days, market days, and other special days equally among the data. The ten individuals in the selected barrio will be fitted with SAMIs early in the morning. The SAMIs will be removed in the late evening and the readings recorded. It is anticipated that during the first few weeks, the curiosity of co-workers may interfere with normal activity patterns. Hence, the first two weeks of readings will be discarded, postponing actual data collection to the third week in September. The rather uncomfortable process of calibration (to determine each individual's heart beat to oxygen ratio) will begin in October after farmers have become familiar with the monitoring equipment and research personnel.

Consumption data for the 70 participating farmers will also be gathered during the four-month study to supplement and cross-check SAMI readings. The consumption survey will be carried out largely by staffers from the Food and Nutrition Research Center, and will probably involve the weighing of one day's ingestion per week plus recall of the other six.

Farmers involved in the macro-study will also be given a questionnaire. Besides general biographical data and a farm resource inventory, they will be asked to recall, as nearly as possible, their crop and activity pattern over the entire year.

At the same time the major production systems are being studied, a number of trials involving alternative methods of cultivation will be carried out. Three SAMIs should be available for this purpose. It would seem desirable to run at least 20 trials on each operation and/or technique.

All field work will be carried out with the cooperation and guidance of the International Rice Research Institute, in particular, Dr. Randolph Barker and Dr. Bart Duff, and in association with the Food and Nutrition Research Center, particularly Dr. Carmen Intengan (Deputy Director), and Mrs. de Guzman.

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