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Seasonality, Labor Scheduling, and Agricultural Intensification in the Nigerian Savanna

Human labor is the primary factor of production in indigenous agricultural systems, yet the organization and scheduling of labor, and effect of agricultural intensification on these processes, remain poorly understood. While most theoretical and empirical studies have emphasized overall labor input and efficiency, this study of the Kofyar of Nigeria analyzes the scheduling and mobilization of labor in ecological context. Detailed labor diaries for a sample of households over an entire agricultural cycle reveal intricate schedules that balance the labor demands of a variable crop complex with a set of complementary mechanisms for mobilizing labor. With rising population density and market impetus, the Kofyar have increased gross labor inputs, adjusted crop mixes to reduce weekly fluctuations in labor, and extended the agricultural season. Labor demands are met by three social mechanisms of labor mobilization, which offer varying sizes of labor pool, degree of flexibility, and type of compensation.

THE INTERNATIONAL ATTENTION DEVOTED TO FAMINE AND FOOD SHORTAGES in Africa usually brings with it a call for agricultural change involving Green Revolution plant varieties, chemical fertilizer, irrigation, mechanized equipment, and fossil fuel energy. It is seldom remarked that agrarian intensification, the process of increasing output per unit of land area and time (Boserup 1965, 1981; Turner and Doolittle 1978), can be achieved using indigenous ecological knowledge, local crops, and traditional or innovative low-energy methods of turning the soil, weeding, manuring, crop rotation, soil conservation, livestock husbandry, and arboriculture (Netting, Cleveland, and Stier 1980:187; Richards 1985). Instead of importing energy for farming at high cost and with low caloric efficiency (Pimentel and Pimentel 1979; Bayliss-Smith 1982), this type of intensification relies primarily on human work effort and the social mobilization and management of labor. In the classic Boserup model of intensification, more hours per day and days per year of work by more members of the rural society raise production to meet the demand of a growing population, or as Turner and Brush (1987:31–35) add, to fulfill the demand of an expanding market economy. Labor becomes a substitute for increasingly scarce land, but it can also be used when capital limitations make technological change too expensive.

But labor power is not just a standard measure of energy expended. It is applied within specific environmental constraints of season, rainfall, soils, and differing crop requirements. It is differentiated by age and gender. It is performed by single individuals, by households, by exchange groups, and by hired hands whose motivations and effectiveness

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may vary with the task. To analyze labor, we must see it as an element of central importance in a complex agro-ecosystem, and a social factor that can be variably applied to increase farm production.

The Kofyar, a small population in Nigeria's Plateau State, have in the last 35 years colonized the Benue Valley savanna and begun to market sizable quantities of yams, millet, and rice (Netting 1968; Stone, Johnson-Stone, and Netting 1984). Decisions on settlement and land use were made by individual Kofyar without external direction or control. As swidden cultivators on a frontier with abundant land and, more recently, intensifying farmers maintaining and increasing crop output from permanent plots, the Kofyar have relied on their own labor as the primary factor of production.

Because time is a common resource of all groups, and it is always in some sense scarce (Carlstein 1982), time allocation studies of agricultural labor provide a comparative economic measure for societies with differing farming systems or changing market involvement (Cleave 1974). Fine-grained case studies of time allocation have the potential of demonstrating optimizing behavior in a specific economic, historic, and ecological context (Gross 1984). Since data should cover a wide variety of tasks over an entire agricultural year by different individuals and groups, sustained field observations and record keeping can be cumbersome and expensive. For the Kofyar, long-term direct observation by the investigators was not practical, and the more efficient use of randomly sampled time frames for sample households (Johnson 1975) could not effectively monitor activities conducted infrequently or during a limited part of the year in widely scattered neighborhoods (Tripp 1982). Gathering representative information from a sample of several hundred individuals using three- or four-day recall would have required a full-time staff of trained interviewers (Norman 1969). We opted instead for a labor diary method in which resident family members recorded the daily work time, task, and labor group for each adult member of their own and a neighboring household.

In 15 sample households in three rural neighborhoods near the town of Namu (Figure 1), seven local enumerators recorded on a standard form the crop, task, estimated hours, and type of labor mobilization for 26 males and 36 females over age 15. The survey covered a total of 50 weeks in 1984 and 1985.[1] Every evening, the enumerator would record the activities of the members of the two households based on brief interviews. The enumerators were young Kofyar men with at least a primary education. The daily returns were painstakingly checked weekly or biweekly.[2] Our graphs chart mean hours per day per person for the sample population in specific seven-day weeks.

Kofyar Agricultural Change

When studied by Netting in the 1960s, the Kofyar resided in the hills of the southern Jos Plateau near the geographical center of Nigeria (Figure 1). They practiced a type of subsistence agriculture which, unlike the large majority of African farming groups, was intensive, with terracing, manuring from stall-fed goats and compost, tie ridging, intercropping, and arboriculture. Their one- to two-acre homestead farms immediately surrounding each residential compound were kept in annual production of millet, sorghum, cowpeas, and various tuber crops (Netting 1968). Around 1953, they had begun to migrate to a largely vacant, forested area some 40 km south (see Figure 1), where more extensive swidden methods could be used for cash-cropping yams and grains (see Netting 1968:193–224).

By 1984, when we conducted fieldwork, seasonal settlements of dispersed farmsteads on the frontier had become permanent, and over 20,000 Kofyar had moved down from the homeland. In recent years, some migrants to the frontier have received fragmented farms in long-settled areas, while others have pioneered virgin territory to the east, west, and south (G. D. Stone 1986, 1988; Netting, Stone, and Stone 1989).

Spurred by a declining per capita land base and the desire to produce a marketable surplus, Kofyar frontier agriculture has intensified markedly. The large, low-input, high-

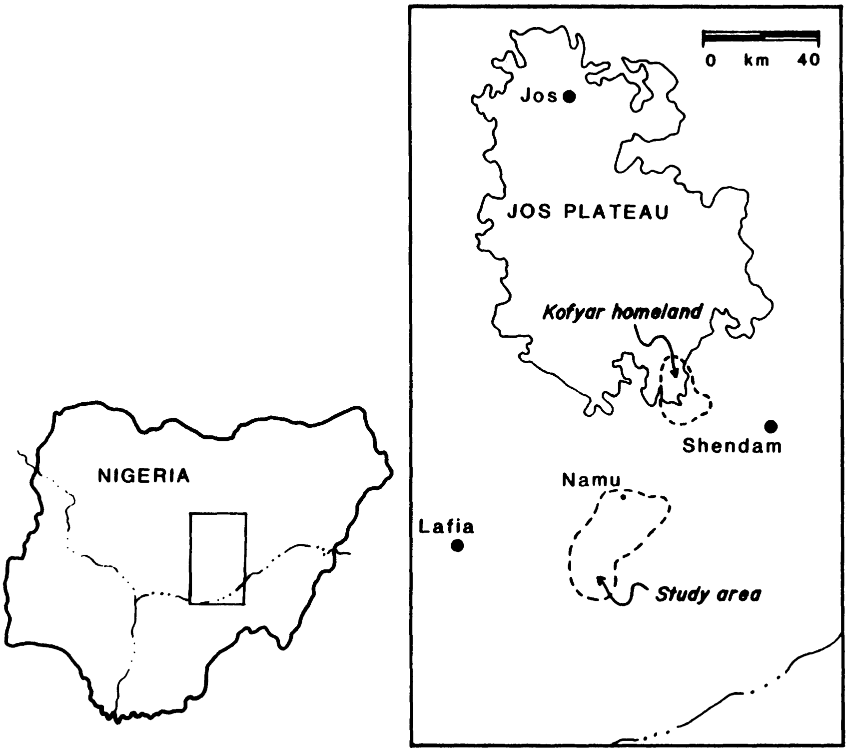

Figure 1
Map of central Nigeria and the study area.

yielding, swidden farms of the early colonists (Netting 1968, 1969) have been replaced, in many areas, by smaller farms with up to 80% of the land in permanent cultivation. Farmers now experiment with chemical fertilizers or apply animal dung to fields, and the forest vegetation has been mostly replaced by a scatter of economic trees on open fields (see Mortimore 1967). Most important, Kofyar farmers have come to follow intricate schedules that balance the labor demands of a variable crop complex with a set of complementary mechanisms for mobilizing labor.

It is worth noting that while intensification may be forced by reduced land availability, it can also occur when more extensive methods are still possible. This ecological interaction of environment, technology, and labor organization is neither automatic nor deterministic, and other culturally distinct ethnic groups in similar environments, such as the Tiv, maintain more extensive agricultural labor regimes. The systematic ways in which the Kofyar allocate time and effort reflect both the habits and strategies of traditional intensive subsistence cultivators from what was originally a land-scarce hill environment and the motivations of an expanding population bent on producing a surplus for the market economy.

Intensifying Labor

Agricultural labor demands are conditioned in part by the local environment. The northern Benue Valley receives 1,200 mm of mean annual rainfall. An almost totally dry period alternates with a rainy season of 200–210 days, usually beginning in mid-April and finishing in late October (Hill 1979:10–11). Precipitation peaks in early June and again in September, the intervening period being decidedly drier (Kowal and Kassam 1978; Oguntoyinbo 1982).

This constitutes the growing period for most Kofyar crops, and their yields may be severely affected by a delay or interruption of the coming of the rains or an early cessation of precipitation. Kofyar farmers must mobilize themselves to meet peak labor requirements for planting certain crops as soon as possible after a soaking rainstorm, and for performing successive tasks at optimum times of the crops' cycles. Labor shortages in seasonal peak periods can be a major limiting factor in tropical agriculture (Ruthenberg 1976).

The Middle Belt climatic zone allows cultivation of the northern Nigerian crops of millet, sorghum, and groundnuts; the tuber crops of the south, including yams, cassava, and cocoyams; and rice. The Kofyar have adopted yams and rice as cash crops, and have increased production for sale of their traditional crops, such as millet and groundnuts. Sorghum continues to be grown as the dietary staple. From their homeland fields of less than 1 ha, they have expanded to frontier farms averaging around 4 ha in 1966 and 3.6 ha in 1984 (Netting 1988).

As the Kofyar have enthusiastically increased their participation in the cash economy to the point where median household income from agriculture is ₦808, they have consistently limited monetary expenditures. Food remains largely home grown, and there has been minimal investment in new technology. Plows and tractors have not replaced hoes. A few farm workers may be hired from among high-plateau seasonal migrants, but the bulk of farm labor continues to come from household members supplemented by exchanges among individuals and by large work groups of neighbors, who are given millet beer by the host household whose field they cultivate. The millet comes from household stores, or is purchased, and women in adjoining households cooperate in the brewing. The Kofyar claim these means of mobilizing unpaid labor are cheaper, more reliable, and provide higher quality work than hiring strangers (Netting, Stone, and Stone 1989).

With little directly labor-saving technology, larger household farms, seasonal crop labor bottlenecks, land use requiring shortened fallows and other intensive practices, and minimal wage labor, the Kofyar have responded to their need to produce a marketable surplus in addition to subsistence through a fuller exploitation of their own labor. We have identified four components of this process: (1) a total labor input comparatively high by African standards; (2) relatively equivalent mobilization of males and females in variously organized labor groups; (3) filling in of slack periods; and (4) extension of the agricultural season.

Working More

The Kofyar sample population was putting in an estimated 1,599 hours a year per adult worker on all phases of field and crop processing labor. The recorded mean total for 50 weeks was 1,549 hours, an average of 4.4 hours per day in a full seven-day week.[3] Average labor inputs vary from a daily high of 7.4 hours during millet planting to a low of 2.8 hours in the dry season (Figure 2). The 21 weeks of peak demands for cereal farming average 5.0 hours, followed by seven weeks of heavy yam labor in which daily work averages 4.8 hours.

Though a workday of less than the familiar Western eight hours (annual 2,000 hours) does not sound onerous, it is well above average standards for rural Africa. Other measurements of labor inputs have tended to place shifting cultivators in the 500–1,000 hours/year range, with more intensive systems exceeding 1,000. The surveys reviewed by Cleave show with remarkable consistency that adult members of African farm families work in the fields for only 120–160 days in the year with four- to six-hour working days, giving totals of 480 to 960 hours annually (Cleave 1974:189). Much higher inputs have been documented elsewhere in the world, such as the Japanese figures of 1,832 hours for men and 1,490 for women in wet rice agriculture (Clark and Haswell 1967:138).

The nearest geographical comparison would be with Niger Valley Nupe male farmers who put in 728 hours per year (an average of 4.6 hours on the 158 days worked), while

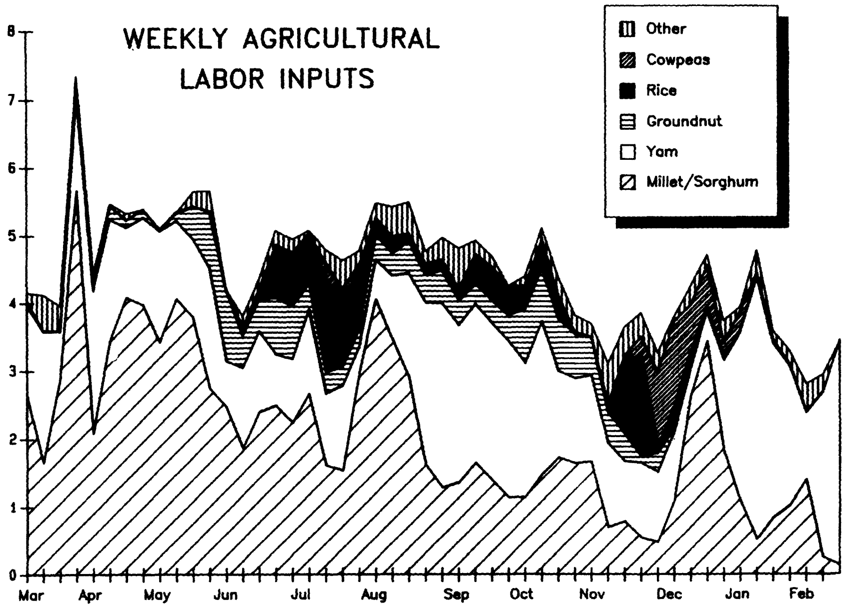

Figure 2
Mean daily labor inputs per individual (scale in hours) for each week in the agricultural calendar, broken down by crop. Data were not collected for the two weeks in the dry season (Feb. 18–Mar. 3).

females contributed no farm labor (Baldwin 1957). Moslem Hausa cultivators in three Zaria villages worked 556 to 684 hours per year and from 4.2 to 4.8 hours per working day. The Hausa peak labor of 4.9 hours daily during June and July (Cleave 1974:35) accords well with Kofyar early wet-season records.

Labor Mobilization

A characteristic feature of the Kofyar division of labor is ready interchangeability of male and female labor (Netting 1968:125–127; M. P. Stone 1988). Particular farming tasks or crops are not rigidly assigned to a single sex (cf. Haswell 1953:25, 37–38; Guyer 1984; Linares 1985). Adjusting for the male:female ratio in our sample, men do 50% of the weeding and transplanting labor and 52% of harvesting, storage, and processing. Women do 42% of the heavy ridging and mounding, or 35% on a per capita basis.[4] In terms of total work hours in all agricultural activities, women's contribution is 53%, and their per capita labor input is 46%. Care for domestic animals is again almost evenly split, but the addition of brewing, cooking, and other domestic labor raises the total female per capita contribution to approximately 54%.

Because of the balanced and flexible labor contributions of Kofyar men and women, they can effectively increase production without creating disproportionate burdens. This full involvement of Kofyar women in every phase of field labor makes a substantial difference in the total number of person-hours available for agricultural work, especially in contrast to neighboring Moslem groups, such as the Hausa, whose women are largely secluded. It might also be pointed out that Kofyar men do not, like the Tiv, do an initial clearing and hoeing of the yam fields and then leave all the remaining jobs to women (Burfisher and Horenstein 1983). The fact that Kofyar men and women work side by side in most field tasks means that they could rapidly increase cash-crop labor, and they credit their comparative economic success in part to the major contribution of women.

A variety of social labor arrangements have developed to meet agricultural labor demands. This analysis focuses on the three principal labor mobilization strategies which account for over 98% of all farm work.[5]

Household labor, in which family households work on their own fields, accounts for the bulk of Kofyar agricultural hours. Household fields include both those plots controlled by the household head and those held in usufruct by individuals in the household. Seventy-three percent of adult women tend their own fields (M. P. Stone 1988), controlling the proceeds from sales. Household labor is applied by individuals or groups usually numbering five or less. It is represented by solid shading in Figures 3–8.

Mar muos (farming for beer) are large neighborhood work groups, also known as festive labor parties (Erasmus 1956; Şaul 1983). These gatherings typically involve 30–60 workers but may exceed 100. They are characterized by a spirit of friendly competition, and all present are served millet beer after the work. They are well adapted to agricultural tasks in which several activities such as ridging and weeding are conducted concurrently (*simultaneous labor*[6]). *Mar muos* also allow "banking" of labor, since the means of underwriting the group labor (beer) is produced by work distributed across the previous farming season (millet cultivation) and across the five days preceding the labor party (brewing). This labor banking does entail obligatory participation in neighbors' *mar muos,* but there is a net gain in the farmer's flexibility in mobilizing labor. This type of labor is represented by hatched areas in Figures 3–8.

Wuk exchange labor groups, typically ranging from 5 to 20 in size, are between the more formal *mar muos* and small-scale, flexible household labor. *Wuk* are membership groups or voluntary associations whose participants take turns working on each other's fields. The workers are repaid with reciprocal labor (which is carefully noted) at later meetings of the group. Most households belong to a *wuk* with their neighbors, sending various household members to each labor event. Individuals also form *wuk* groups, usually along age and sex lines, which meet to work on individual plots. *Wuk* is represented by white areas in Figures 3–8.

The organization of labor by gender and type of work group is closely adapted to the seasonal calendar of rainfall, specific crop requirements, and the available technology. Scheduling tasks and coping with labor bottlenecks caused by high and often conflicting labor demands are problems that each farm household must address. Early planting after the first rains is importantly related to cereal yields, and the highest Kofyar labor expenditure is when millet is planted after the onset of the rains (Figures 2, 3a). Millet that should be ready for harvest in 120 days needs the precipitation of the early rains and the somewhat drier period of late July and early August for harvest before the return of heavy rains in September.

Pennisetum millet is a day-neutral crop that comes into ear after a fixed number of leaves have been formed, maturing in the minimum possible time after sowing. Ecologically it is a desert ephemeral that escapes drought by completing its life cycle rapidly (Kowal and Kassam 1978:239). Though the Kofyar area does not have the constraint of a short wet season, the early millet provides the first grain food that can, if necessary, serve as a hunger breaker. It also occupies the same field as the later-maturing sorghum, so the sooner the millet is harvested, the sooner the interplanted sorghum can be exposed to maximum sunlight.

Conflicting with the need to plant millet as early as possible is the need to make parallel ridges in which the millet and sorghum can grow. Ridging exacts a high cost in time, but it serves to turn and aerate topsoil around the developing root systems, create drainage furrows, and provide support for the fast-growing millet stalks. The Kofyar have devised two solutions. The first is to delay the ridging until after planting. Following a rainstorm, small mounds called *koo* are made in rows by a one-hand hoe and seeds are inserted; after the grains have sprouted, the ridges are completed by hoeing dirt in between the small heaps, in an operation called *ya ogot* ("closing"). This has the added advantage of weed-

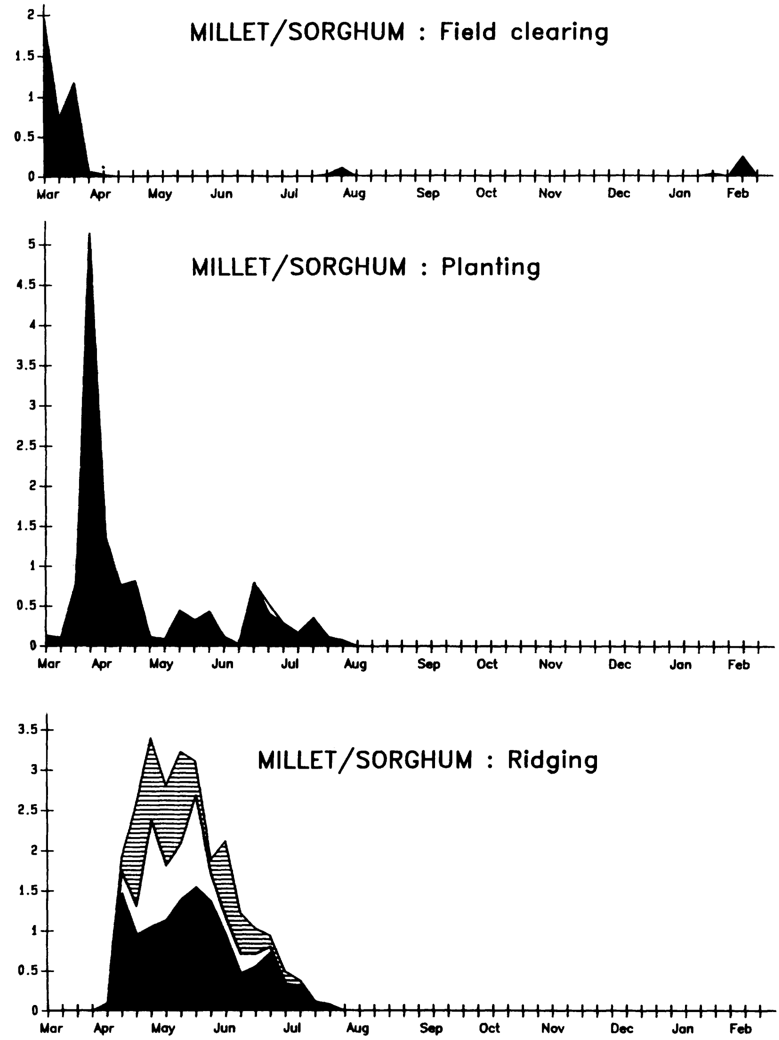

Figure 3a
Mean daily labor inputs per individual (scale in hours) into intercropped millet and sorghum. Black areas represent household labor; white areas represent *wuk;* hatched areas represent *mar muos.*

ing the field. The *koo*-planting operation is done quickly, using household labor, but the more arduous *ya ogot* is often done by *mar muos* (Figure 3a).

Alternatively, complete ridges *(pian)* can be made in a single operation. Since this demands a large labor input, and must be completed in short order after the onset of rains, it is often done by *mar muos* or hired workers. While the end result is the same with the two methods, they differ in the scheduling of labor. The April–May bottleneck is diminished by some farms doing *pian* and others *koo-ya ogot* each year. Ridging is the dominant task in the first half of the season, peaking in late April when it absorbs over 69% of all farm labor (Figure 3a).

Sorghum may be planted as early as the millet or as late as July. The sorghums, unlike millet, are photoperiodic, flowering more or less independently of the time they are sown

(Kowal and Kassam 1978:239). Although yields undoubtedly decline with later planting dates (see Kassam and Andrews 1975), delayed planting provides important flexibility in adjusting the crop mix as the season unfolds. Ridging for late sorghum is done mostly by household labor.

The next labor peak after the ridging operation is the August millet harvest. Total labor expenditure rises to the third-highest point in the year (Figure 2), as up to 64% of work time goes into uprooting stalks and transporting the seed heads to the compound (Figure 3b). These activities are conducted sequentially (*linear* labor demands [Wilk and Netting 1984]) by household labor. The week following the harvest is dominated by the millet storing, the best example of *simultaneous* labor demands. Grasses are gathered for ropes and thatching; ropes are braided to tie bundles of seed heads while thatch mats are woven; workers throw the bundles up to a high wooden rack, where others arrange them in a conical heap, around which the thatching mat is wrapped. *Mar muos* are particularly adapted to this task, and account for over 72% of the work (Figure 3b). Millet storage

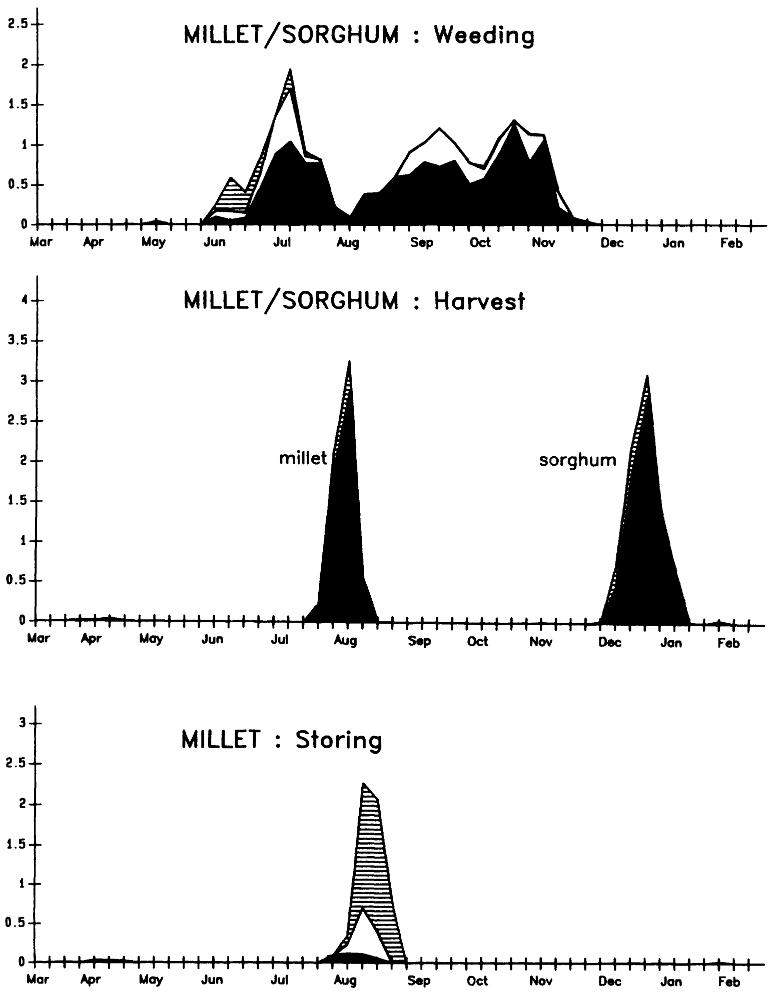

Figure 3b
Mean daily labor inputs into intercropped millet and sorghum. Shadings are as in Figure 3a.

parties can put away millet for several households in one day, often beginning early in the morning and working into the late afternoon.

Although this operation takes place during the midsummer trough of twin peak rainfall, there is need for hurry in completing the harvest, drying the millet, and storing it under cover and over a low fire to protect the grain from moisture and mold. Further impetus to complete this task is provided by the appearance of the weed *Striga hermontheca* at this time, parasitizing the growing sorghum plants and killing them if not stopped by a mid-season weeding.

This early August bottleneck is the main limit on agricultural production because of the interplay among labor demands of millet, sorghum, and yams. The scale of millet production and the need for cooperative labor in storing it place major time demands on each farmer. The millet storing coincides with the striga parasitization of sorghum fields. The labor demands of the two grains limit production of yams by causing a major interruption of mid-season weeding. A scheduling miscalculation or the loss of labor to sickness may prevent a farmer from catching up with the weeding before the yam heaping season begins; if he does not have a heaping party (described below) which uproots the striga, his sorghum crop may suffer.

These labor bottlenecks appear when crops grown by all farmers present demands that must be met within a narrow temporal window. The graphs show how during bottlenecks a single task dominates the collective agenda, demanding substantial participation in group labor (especially during the millet storage). Since farmers also strive to maintain flexibility by cultivating minor crops, these periods of relatively uniform work are bracketed by periods of greater diversity in agricultural tasks. Thus, midway between the peak of the grain ridging (early May, when this task absorbs over 65% of all labor) and the millet storage bottleneck (late July, when this task absorbs almost 65% of all labor) is the period when work is evenly distributed among several crops. These periods allow those farmers who did not have *mar muos* for major tasks to mobilize household or *wuk* labor to complete them, and to adjust their crop mix by allocating labor to minor crops which vary among households. These strategies for "picking up the slack" in the agricultural schedule are an important aspect of Kofyar labor intensification and agrarian change.

Picking up the Slack

While labor peaks largely reflect local rainfall patterns and growth cycles of staple grains, the filling in of periods between the peaks represents the adoption of crops and management strategies that profitably absorb labor when it would otherwise be underemployed. A pivotal aspect of this strategy involves the link between intercropping (and multicropping) and temporal distribution of farm tasks.

Part of the sequencing of operations and the meshing of crops with different planting, weeding, and harvesting dates was present in the traditional Kofyar farming system. The homestead farm grains, early millet and long-season sorghum, were seeded alternately on the same ridges. Intercropping, as opposed to monocrop cultivation of separate plots in pure stands, furthers intensification by increasing total yield per unit area, reducing risk of crop failure, minimizing the attacks of plant-specific pests, and using a single farming practice (ridging, weeding) to foster several crops at the same time. Intercropping or mixed cropping with two or more cultigens grown on a given piece of land at the same time is widespread in West Africa and may indeed be the primary means of agricultural intensification where seasonal rainfall and absence of irrigation militate against multicropping (Richards 1985). The advantages of complementary biotic relationships among crops with differing growth cycles and of management efficiencies with labor benefiting several crops simultaneously at peak seasons are apparent in production.

Kofyar millet reaches maturity in only four months, while sorghum has its major growth phase in the latter half of its seven- to eight-month cycle. With such a partly overlapping relay crop system, the soil surface shielded by foliage for a longer part of the year may also be less subject to erosion.

The Kofyar companion crop of cowpeas is further staggered, with planting in July, just before the millet harvest, and picking in November and December just before the sorghum harvest (Figure 4). Cowpea cultivation is one of the optional activities that may be initiated with household labor between the grain ridging and millet storage bottlenecks (Figure 4). This nitrogen-fixing legume may also contribute to maintaining the soil fertility for succeeding crops, and interplanting reduces the insect damage to which sole-cropped cowpeas are vulnerable (Norman, Simmons, and Hays 1982:48).

Intercropping spreads labor use, rather than increasing seasonal bottlenecks. Investigations among Hausa farmers in Zaria (Norman, Simmons, and Hays 1982:53–55) showed that mixed crops required 62% more work per hectare than sole crops, but in the peak season of June and July, labor went up only 29%. Returns to land increased over 60% per hectare under crop mixtures, and returns per person-hour for the periods of labor shortage were 20% higher than those achieved in monocropped fields. By increasing the average production and labor per unit of land, intercropping probably reduces or eliminates the decline in marginal productivity that often accompanies permanent land use (Boserup 1965). Tasks "present themselves in a steady and readily manageable way over the duration of the farming season," thus smoothing the labor input profile (Richards 1985:67).

The intercropped staples of millet and sorghum, with their stringent labor scheduling demands, must be complemented with more temporally flexible crops. Relatively short-season crops may be planted over long periods, when time allows, and harvested piecemeal. Goundnut is a short-season crop offering considerable scheduling flexibility, and is favored by women both for subsistence and sale. The crop is planted either on plots allocated yearly to women or intercropped with the household millet and sorghum (circumventing a separate field preparation). Planting dates range from the first rains in March to the end of July (Figure 5). Women often take advantage of the comparatively slack periods to brew beer for their own *mar muos* for field preparation and planting. The weeding, harvesting, and processing of groundnuts can be timed so as not to interfere with labor bottlenecks, such as the major crop harvests (Figure 5; see M. P. Stone 1988).

Work on a variety of other vegetable and tuber crops such as cucurbits, sesame, peppers, okra, and cocoyam is similarly low and intermittent, with concentrations in the slack periods of June to early July and November (Figure 6). Collectively these crops are an indispensable component of intensification, as they allow filling in of gaps in the major crop work schedule. Labor for these crops must be highly flexible and is mobilized almost exclusively within the household, often by individuals working alone.

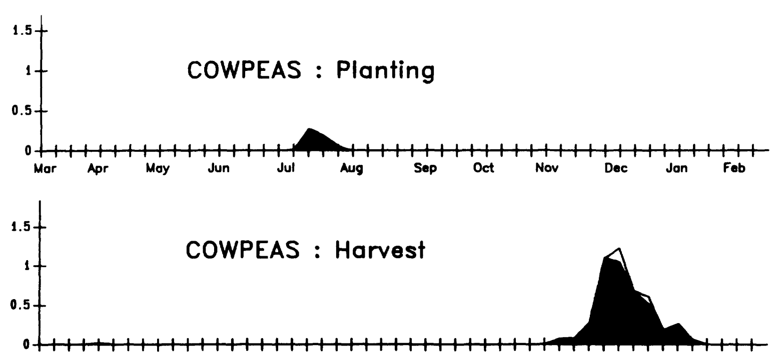

Figure 4
Mean daily labor inputs into cowpeas. Shadings are as in Figure 3a.

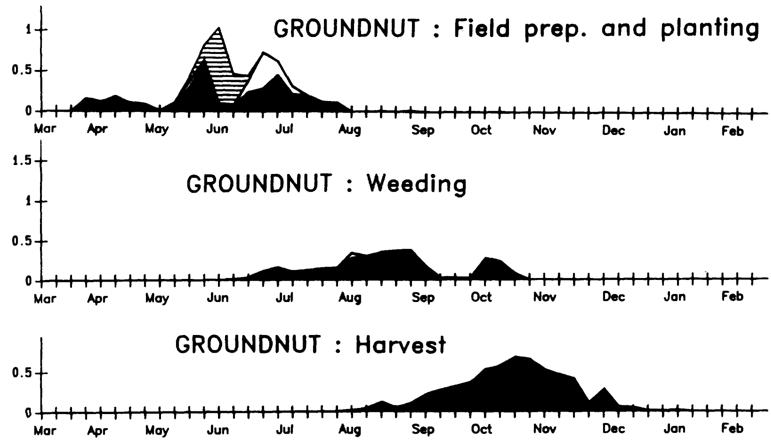

Figure 5
Mean daily labor inputs into groundnuts (peanuts). Shadings are as in Figure 3a.

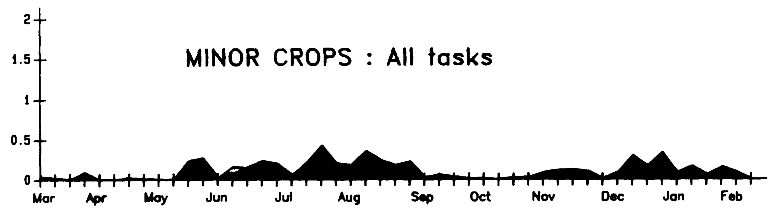

Figure 6
Mean daily labor inputs into minor crops. Shadings are as in Figure 3a.

But the most economically important strategy for both increasing total labor and using slack times productively has been the adoption of yams and rice, crops that were not a part of the traditional farming system. Yams flourish in the Benue Valley, and are in demand in the urban markets. Making the knee-high heaps in which yams are grown is a skilled and demanding procedure. A man or a strong woman considers 100 heaps a good day's work. Although yams occupied 9%–25% of the cultivated area in a sample of 12 mapped farms, 36% of all agricultural labor time goes into this crop. Because it is unlikely that work on cereals and other subsistence crops has diminished in absolute terms, much of the yam labor would be in addition to previous household time expenditures.

Kofyar sell not only yams and rice but also significant amounts of millet and minor quantities of groundnuts, sorghum, Bambara nuts *(Voandzeia subterranea),* and sesame. With yams and rice alone absorbing some 40% of labor time, it appears that farmers devote roughly half their work hours to marketed output. This suggests a sharp increase in household productive labor over that of the earlier subsistence economy, although data are not available for before 1984.

The preferred time to make yam heaps is between the August millet storage and the end of rains in October, when the ground hardens (Figure 7). The heaps are commonly made in the field where the millet was grown and where the sorghum is in its major phase of growth. This leaves the following April and May free for grain ridging, but it offers other key advantages as well. It prepares the field for next year's major cash crop, while weeding the current year's major subsistence crop just as the fields are threatened by

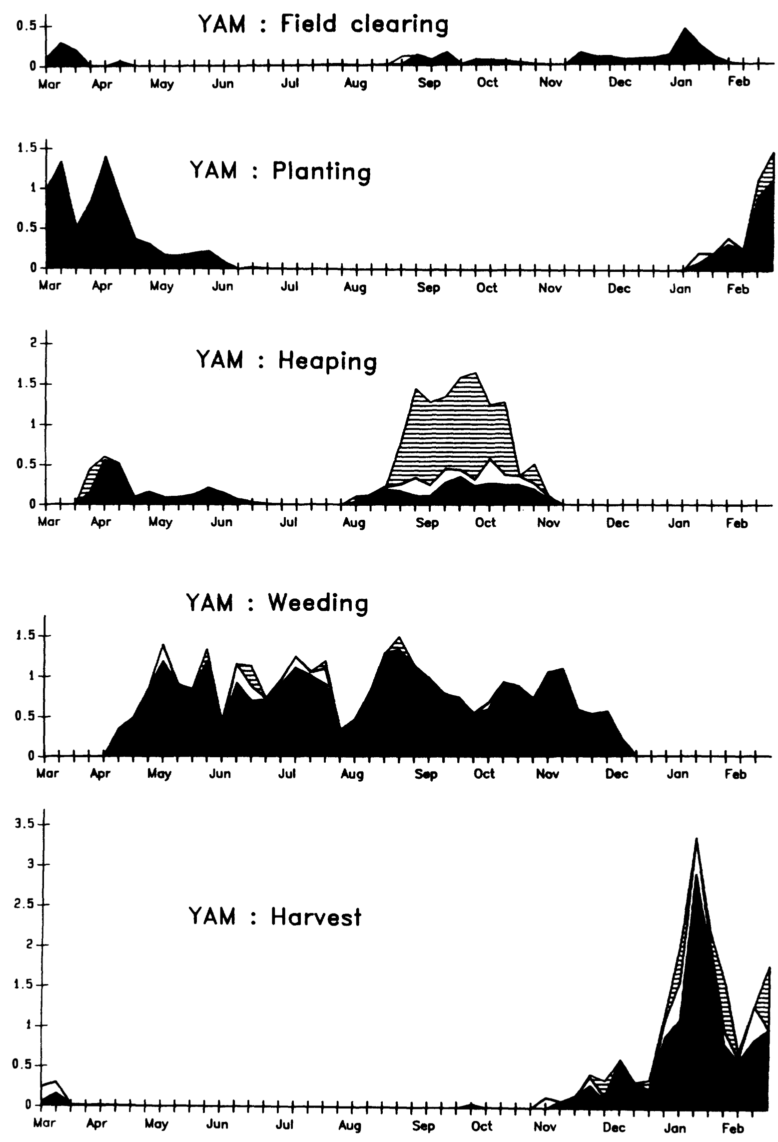

Figure 7
Mean daily labor inputs into yams. Shadings are as in Figure 3a.

striga. It also buttresses the sorghum against wind damage, which can occur once the millet has been removed. Though technically yams and cereals are not intercropped (the yams are not planted until after the sorghum harvest), the work that allows crop rotation to take place overlaps the successive growing cycles, and the Kofyar continue to invest labor in the late wet season when normal farm tasks would otherwise have declined (see Figure 2).

To maximize the labor mobilized for the late rainy season yam heaping, farmers sponsor especially large *mar muos* (Figure 7), preparing generous portions of beer and sometimes having drummers to enliven the work. *Mar muos* for yam heaping average 57 persons, as compared to an average of 48 overall. The advantages of heaping during the late rains are sufficiently great that many farms hire wage laborers in years that they fail to schedule a *mar muos;* migrants from the high plateau appear every September for this work. Much of the heaping that is postponed until April is for individuals' private yam plots, which is why it is done by household or individual labor.

Since women specialize in beer brewing and men are able to do the arduous work of yam mounding more quickly, a sexual division of labor develops during this period, with the women's stepped-up beer production sponsoring the heaping, of which 72% is done by men.

At the same time that heaps are being made, the job of weeding yams that began in April must continue (Figure 7). Weeding yams is a more sustained task than weeding of millet and sorghum (Figure 3b); it absorbs small-scale but continuous labor, mostly from household or *wuk* groups, until just before the harvest.

Rice is also produced as a cash crop, in or near streambeds. The short six-month season of rice and its reliance on the late rains allow work to be interdigitated with that of other crops. Rice planting begins in June but must be completed by the beginning of millet storage. Removal of the thick grasses, turning the soil, and broadcasting the rice are often done at the same time, and, as is common with simultaneous labor, much of the work is accomplished by *mar muos* (Figure 8). The November reaping of rice starts the sequence of cowpea, sorghum, and yam harvests (Figures 4, 3b, and 7, respectively). Rice remains a relatively minor crop, but it can produce significant income in wet years, using short segments of time and swampy portions of the local environment that might otherwise be uncultivated.

Extending the Season

A wet-dry savanna climate concentrates 50% to 70% of the agricultural labor into four months (Delgado and Ranade 1987), while leaving considerable periods with few on-farm occupations. The Hausa may use the dry season for migratory wage work, trade, or crafts, unless they have access to irrigated *fadama* land for cash-crop production (Goddard, Mortimore, and Norman 1975). The Kofyar solution to this environmental dilemma has been to extend their agricultural year by doing harvesting, processing, field clearing, and some planting in the dry season (Figures 3a, 5, 6, 7, 8).

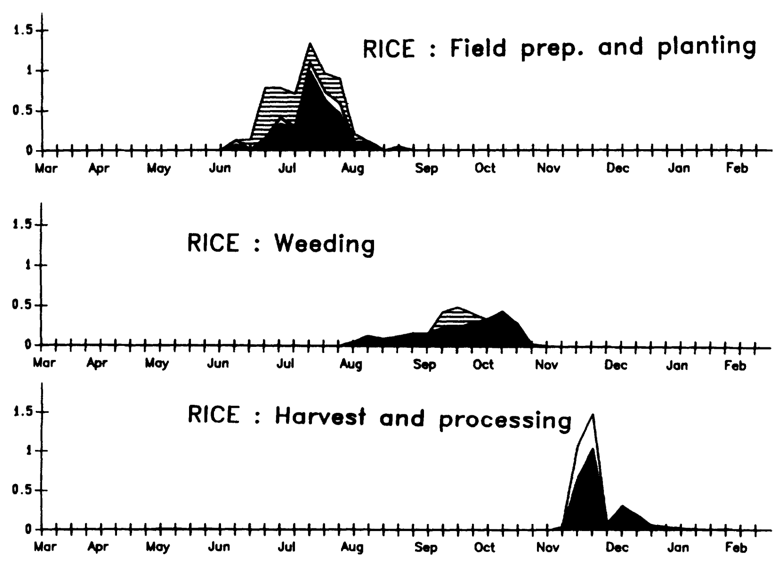

Figure 8
Mean daily labor inputs into rice. Shadings are as in Figure 3a.

The sorghum variety that Kofyar grow on the frontier has a longer season than that characteristic of their home area. The earlier ripening of red as opposed to white varieties allows the harvest to be spread over four weeks. The danger of rain damage is past at this point, and the gathering and storage of sorghum is less time-dependent. Scheduling constraints come principally from the successive demands for other harvests—rice in November, cowpeas in early December, and the peak in yams in January and February. Like other crops, the sorghum harvest is accomplished almost entirely by household labor.

The yam harvest goes on over some four months (Figure 7) and is preceded by clearing away of yam vines in November and December. It peaks after the sorghum harvest in January. Salable tubers are piled near the road, from where they are sold to traders that arrive in January. The threshing, winnowing, and bagging of millet (and in good years, sorghum) for market takes place in the early part of the dry season.

Before the planting season begins, fields are cleared of stalks and crop debris. Sorghum stalks may be saved for cooking fuel and roof construction, and grass and brush are cut on fallow fields that will return to cultivation (Figures 3a, 7). Seed yams can be planted during the dry season; the heaps are capped with pieces of millet stalks left from the previous year's harvest, and weighted with earth for protection from the sun. Planting date (Figure 7) has a strong effect on yam yield because it influences size of vine and length of the period in which the tuber develops (Kowal and Kassam 1978:278). If the yam sets are in the ground, they can take full advantage of the first rains.

There are suggestions that crop labor can be extended even further into the dry season. Cassava, planted before the end of the rains, grows during the winter months, but it must be fenced for protection from free-ranging pigs and goats. The cultivation of cassava is spreading outward from the less fertile fields near Namu town. Some individuals have experimented successfully with growing bananas in stream valleys where earthen dikes and ditches allow dry-season irrigation and drainage during the rains.

Shifting some of the harvesting, processing, storage, clearing, and planting into the dry months has smoothed the seasonal variation in labor input. Indeed, average adult daily labor between January 7 and March 24 was only 12% below the period from mid-August to early January, and only 25% below the peak demands of the millet planting to harvest period (see Figure 2). There is no parallel among the Kofyar to the precipitous dry-season drop in agricultural work (from 5.06 to 0.24 hours for males and from 3.71 to 0.16 hours for females) in the Nankane area of Northern Ghana (Tripp 1982). Though labor shows an expectable decline from its high in the early rains, the peaks and valleys have been flattened and the working year extended significantly into the dry season.

Concluding Comments

The Kofyar have continued habits of hard, steady work and a balanced male/female division of labor from their system of intensive subsistence agriculture on the Jos Plateau homestead farms. The opening of frontier lands in the Benue Valley has made possible cash-cropping without a major change in technology. The key measure for the extension of hoe cultivation and the production of marketable food surplus has been labor. By selecting new commercial crops such as yams and rice and creatively integrating them into the traditional cropping cycle, the Kofyar have been able to meet the peak demands of the wet-season growing period while efficiently using slack time to care for intercropped and sequenced cultigens. A new rotation with yam mounds made after the millet harvest amid growing sorghum is an example of this effective scheduling of labor. The diversification of Kofyar crops and the interdigitated series of tasks reveal both the complexity and the efficiency that may characterize indigenously designed, low-technology systems of intensive agriculture.

The Kofyar have achieved a high total labor input and smoothed the seasonal application of farm work as their primary means of increasing crop production and developing a sustained intensive agricultural regime. The average of around 1,600 hours per adult puts them well above the levels of most African cultivators and shows the potential for labor-powered gains in marketable surplus. The agricultural intensification that is generating high yields from an increasingly restricted land base has been achieved in large measure by heavy, voluntary labor investments in a manner congruent with the Boserup model, and without dependence on imported technology or fossil fuels.

With the changing work schedule has evolved a distinctive set of institutions for labor mobilization, including household, exchange labor, beer party, and hired work forces that perform a wide variety of operations with very modest cash expenditures. It is apparent that the Kofyar have coped with environmental, technological, and capital constraints in developing a coherent, integrated agricultural calendar of tasks and effectively mobilizing their own labor to get the job done.

Notes

Acknowledgments. We are grateful to Steve Ferzacca, Emmanuel Datson, and Godfrey Daboer for help in collecting and coding data for this analysis. We thank Dan Gross and the anonymous referees for comments on the paper, but we take full responsibility for the final product. The Kofyar Research Project was sponsored by National Science Foundation grants to Netting (BNS-8318569) and to G. D. Stone and M. P. Stone (BNS-8308323); Wenner-Gren Foundation grants to G. D. Stone and M. P. Stone; a University of Arizona Social and Behavioral Sciences Summer Research Grant to Netting; and a University of Arizona Educational Fund for Archaeology grant to G. D. Stone. Further support was provided to G. D. Stone by a Weatherhead Fellowship at the School of American Research, Santa Fe.

[1]Since the enumerators had to be knowledgeable, resident observers, it was impossible to use a probabilistic sample of households. However, the sample households are representative in size, averaging 4.13 adult workers (ages 15–65) as compared to a mean of 4.20 for the frontier households in our larger census ($n = 865$).

Enumerators made daily entries for each adult in their own and a selected neighboring household, relying on individual reports for tasks not personally observed. Time spent on each activity was rounded to the nearest hour and activities less than ca. 45 minutes in duration were omitted. This procedure produced an underreporting of domestic tasks, but almost all agricultural work is at least 45 minutes in duration. Also omitted were the significant contributions of children. Despite the imprecision in the enumerators' records, the data present a reasonable, systematic representation of the changing seasonal mix of agricultural tasks, their relative time expenditure, the general profile of weekly labor inputs, and the division of labor by gender.

Slight weekly variations in sample size resulted from enumerators being hired and released at different times, or being sick or absent. For each activity and each week, the reported sample was adjusted for absences.

The enumerators recorded activities between May 21, 1984, and June 2, 1985, with a two-week break at the height of the dry season (February 18–March 3). Data from late May 1985 were more reliable than those from the same time in 1984, when recording conventions were still being worked out. We have used data from the week of June 4–10, 1984, because that week was not duplicated in 1985, although enumerators were incompletely trained and apparently underreported some tasks.

[2]For analysis at the University of Arizona, the sample of 50,000 labor bouts was managed on a microcomputer in a relational data base written by G. D. Stone. Analysis was conducted with mainframe statistical packages and a microcomputer spreadsheet. For further details, see G. D. Stone (1988) and Netting (1988).

[3]The yearly input rises to 1,661 if beer brewing for work parties (described below) is included. Crop processing time was counted as agricultural work, with the exception of sorghum processing, which was classified as a cooking activity. In adjusting the 50-week figure of 1,549 for a 52-week year we must remember that in the two unrecorded weeks, agricultural inputs were at a yearly low. Assuming that the workload in this period was 80% of the yearly average gives a total of 1,599.

During the agricultural season Kofyar usually work on their farms every day, although labor inputs are reduced on Sundays and on the day of the weekly market in the nearest market town.

[4]In our time-allocation study sample, there was an adult male/female ratio of 1:1.38, while the ratio in our household census population of 4,621 individuals 16 and older was 1:1.36.

[5]Wage workers were hired by 36.2% of frontier households in 1983. The average number of paid person-days was 12.0 ($s = 30.4$, $n = 851$), which is around 1% of the total 1984 labor input. Data

on wage work were collected as part of an agricultural census and the precise timing of the wage work is not available.

[6]*Simultaneous* labor sequencing is characterized by the application of many hands at the same time; in *linear* labor a smaller group performs each operation in sequence (Wilk and Netting 1984:7).

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