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Chapter 4

The Changing Organization of Uruk Administration on the Susiana Plain

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Introduction

Early state development and organization have again become a topic of intensive discussion as reflected by the recent spate of publications on the subject. (For examples see Cherry 1978; Claessen and Skalník ed. 1978; Cohen and Service ed. 1978; Friedman and Rowlands 1977; Jones and Kautz ed. 1981; Sanders and Webster 1978; Wright 1977; and Yoffee 1979.) This chapter reevaluates the available evidence for Uruk state formation on the Susiana Plain of southwestern Iran (figure 18).

The analysis presented here is based not so much on new data as on a modified framework for ordering the available evidence. This framework includes elements of organization and location theory which, while novel in the present context, have a long history elsewhere. Given the present state of research, one need not detail the extent to which this chapter sketches potential lines of research rather than provides an explanatory synthesis.

Most of the data as well as the interpretive background for this chapter are available in a series of publications including Johnson (1973, 1976); Wright (1977); Wright and Johnson (1975); and Wright et al. (1975). A very brief summary of our previous interpretation of Uruk developments should, therefore, provide sufficient introduction to the reevaluation that follows.

The collapse of the Susa A polity or polities during the Terminal Susa A (Terminal Ubaid) period of the early fourth millennium B.C. on the Susiana Plain was discussed in the previous chapter. It is sufficient to say that this collapse involved a marked decrease in the population of the area. The succeeding Uruk period was one of economic and political reorganization. By Middle Uruk (ca. 3500 B.C.), the Susiana settlement system consisted of a four-tier settlement size hierarchy with direct evidence of resident administrative activity at its top and bottom levels. The presence of administrative function at the intervening levels of hierarchy, and of an overall four-level administrative organization seemed likely. In combination with evidence for the centralization of craft production as part of an administered local exchange system and the presence of an administered labor system, these features suggested the operation of a Middle Uruk state.

Initial state formation during the preceding Early Uruk was supported by the apparent similarities between Early and Middle Uruk institutions. The former appeared to be appropriately less complex and pervasive than the latter. Attempts to account for Early Uruk state formation in terms of the primary importance of processes such as population growth, warfare, expansion of irrigation systems or long-range trade were unsuccessful. We asserted that the immediate processes leading to state formation must have been complex and multiple, and collectively increasing the workload of regulatory institutions to the point where increased vertical complexity of organization was required.

The later Middle Uruk state appears to have been under considerable stress as evidenced by population decline and the fission of the system into two politically autonomous and hostile entities in Late Uruk (ca. 3200 B.C.). The causes of this decline were unknown

but were presumed to involve the inability of Middle Uruk administrative organization to cope with an increasing regulatory workload.

With this interpretive sketch in mind, I will proceed directly with a reevaluation of the evidence. While the general picture of Uruk developments outlined below is consistent with the original interpretation in many respects, it also incorporates a number of significant changes which will be the focus of discussion.

Early Uruk

The Early Uruk settlement pattern is illustrated in figure 19. The almost 95 hectares of settlement are partitioned into a three-level settlement size hierarchy of villages, small centers, and a single large center, Susa (Johnson 1973:79). Designation of settlements as villages, centers, and so forth is based on the discontinuous frequency distribution of site sizes, supplemented by limited excavation data on functional differences between sites of different size classes. I originally suggested (Johnson 1973:101) that the absence of a large center on the eastern portion of the plain probably indicated that this area was something of an administrative vacuum. One way to evaluate the relationship between settlements in the eastern and western portions of the Susiana is to examine the rank-size distribution for the Early Uruk settlement pattern as a whole.

Rank-Size Distributions

A great many ancient and modern settlement systems are characterized by a frequency distribution of settlement population size such that the population of a settlement having rank r in a descending array of settlement sizes approximates $1/r$, the size of the largest settlement in the system. This relationship between settlement rank and size is linear with a slope of -1 in double logarithmic transformation. Analysis of rank-size distributions has long been a popular exercise among geographers and has recently become attractive to archaeologists, due in part to the increasing availability of regional settlement pattern data. (See Adams and Jones 1981; Blanton 1976; Blanton et al. 1982; Crumley 1976; Hodder 1979; Hodder and Orton 1976; Johnson 1977, 1980a, 1980b, 1981; Kowalewski 1982; Paynter 1982, 1983; Pearson 1980; Randsborg 1982; Upham 1982; and Weiss 1977).

This wide archaeological utilization of settlement rank-size distributions should not engender confidence that these distributions are well understood. I think it fair to say that we are presently unable to mathematically account for the linear form of the distribution when it is observed, despite numerous attempts involving: (a) introduction of stochastic variability in a basically Christallerian hierarchy (Beckmann 1958; Beckmann and McPherson 1970); (b) consideration of the linear form as a steady state of a stochastic growth process (Simon 1955); or (c) consideration of the determination of settlement size as a problem in conditional probability (Johnson 1981). It is not even clear that the "ideal" log-linear distribution is the appropriate baseline for comparison (Rapaport 1968; Voorrips 1981).

If our mathematical understanding of rank-size distributions is minimal, there is evidence of progress in stipulation of general nonmathematical conditions associated with the log-linear form and its major classes of deviations. General conditions associated with the presence of near "ideal" rank-size distributions have been reviewed by Richardson (1973) and C. A. Smith (1976) among many others. Posited associations, for example, of the ideal form with urbanization (Crumley 1976) and/or economic development (Berry 1961) have not been empirically convincing (Berry 1961; Richardson 1977:6), and considerable attention has shifted to examination of major classes of deviation from the linear model in the hope that their explication would be informative about processes generating the more frequently observed log-linear form.

Two major classes of deviations from log-linear rank-size distributions have been noted: concave (primate) and convex distributions. Primate distributions are those in which the size of settlements below the largest settlement in the system are markedly smaller than the log-linear model would predict. Primate distributions appear to be characteristic of systems in which economic competition is minimized (Blanton 1976:26; C. A. Smith 1976:32) and/or system boundary maintenance is the primary function of the primate center (Kowalewski 1982). Primacy may also indicate a situation in which the primate center is differentially articulated with a yet larger scale settlement system (Johnson 1977:498; Skinner 1977a:238; Vapnarsky 1969:585).

Convex distributions are those in which settlements below the size of the largest settlement in the system are markedly larger than the log-linear model would predict. Convex distributions are indicative of a relatively low degree of integration (interdependency) among the settlements being examined. This condition may be the product of pooling, the combination of two or more relatively autonomous settlement systems in the same analysis (Johnson 1981; Olsson 1965:21; Skinner 1977a:241), of an inherently open system (Kowalewski 1982:66), or of spatial marginality in a dendritic settlement system (Paynter 1982:152–56). Examples of historical settlement systems with convex rank-size distributions include Colonial America in 1750 (Green and Harrington

1932), China in 1843 (Skinner 1977a), and India in 1850 (Chandler and Fox 1974). All were characterized by low levels of system integration.

Decreasing convexity can, then, be taken as a measure of increasing integration. A numerical index of convexity would facilitate examination of changing patterns of integration. While a number of comparative rank-size measures have been suggested (El-Shakhs 1972; Malecki 1975), I use an index which I find more useful for descriptive purposes. This rank-size index (RSI) can be expressed by the following formula:

$$RSI = \frac{\sum_{1}^{n} (\log P_{obv} - \log P_{rs})}{\sum_{1}^{n} (\log P_{cmax} - \log P_{rs})}$$

where: RSI = rank-size index
n = number of settlements in the analysis
P_{obv} = observed settlement size
P_{rs} = expected settlement size: log-linear model
P_{cmax} = expected settlement size: maximum convex distribution

Here, the sum of deviations of an observed distribution from its associated, "expected" log-linear distribution is divided by the sum of deviations of that log-linear distribution from its associated "maximum convex" distribution. The "expected" distribution is calculated from the size of the largest observed settlement under analysis, and the "maximum convex" distribution is one in which all settlements in the system are the size of that largest observed settlement. As such, a very highly convex observed distribution would have an associated rank-size index value approaching 1.0, a log-linear distribution would have an index value approaching 0.0, and increasing primate distributions would be associated with increasingly negative index values.

Two additional matters require discussion before we can return to Early Uruk. First, the vertical axes of the rank-size graphs used later in this chapter indicate hectares of settlement. They assume that settlement area was directly proportional to settlement population. Further, the absolute values of population estimates will be analytically important. Archaeological population estimation, particularly from survey data, remains a difficult problem that has been reviewed recently by F. Hassan (1978), Kramer (1980), and Sumner (1979). The population estimates used here assume a settlement population density of 200 persons per hectare of settlement area. This figure is derived from data presented by Gremliza (1962) on fifty-three traditional villages on the Susiana. Settlement area and population exhibit a linear correlation of 0.855 (associated probability less than 0.01) with a mean density of 202 persons per hectare. At present, there is no direct way to evaluate the reliability of the use of these data for archaeological estimation. As is the case for many behavioral assumptions in archaeology, their reliability must be evaluated in terms of the degree to which they are consistent with patterning in independent data sets. The high degree of internal consistency among the disparate data sets examined in the following pages suggests that the present population estimates are relatively reliable.

A second issue involves a minor refinement in the calculation of the rank-size index. Most rank-size distributions show rapid falloff at very small settlement sizes. This "lower-limb" relationship (Haggett 1966:106) probably relates to the size below which settlement economic viability decreases rapidly (Johnson 1977:501). Minimum settlement size for inclusion in calculation of an RSI in this study was set at one hectare, the point at which the Susiana survey rank-size curves begin rapid lower limb falloff. This point is indicated on the rank-size graphs as the "RSI cut point."

Definition of Administered Areas

The immediate problem is to evaluate the proposition that Early Uruk settlements on the eastern Susiana were either independent of, or only marginally related to, the administrative system centered on Susa in the western Susiana. If this were the case, the rank-size distribution for the plain should be convex, reflecting the relatively low degree of east/west interaction. Indeed the Early Uruk rank-size distribution (figure 20) was markedly convex and had a rank size index of 0.322.

Extending this line of reasoning, if the western portion of the plain was differentially integrated by an administrative system centered on Susa, the rank-size distribution for this area should be less convex than that for the plain as a whole. Comparative rank-size distributions for the entire plain and for the western area (between the present courses of the Diz and Karkheh rivers) are presented in figure 20. Note that, as predicted, the distribution for the western area alone shows a marked decrease in convexity from that for the plain as a whole. Deletion of the eastern sites reduces the rank-size index from 0.322 to 0.123.

It appears, then, that both the spatial distribution of settlements and spatial variation in rank-size distributions support the proposition that settlements in the western area of the Susiana were differentially integrated in a settlement system to which settlements in the eastern area were only marginally related. Further,

the western system was probably divided into two major administrative areas.

Inspection of the Early Uruk settlement pattern map (figure 19) reveals a relatively regular distribution of sites in the immediate vicinity of the two centers of the western area, Susa and Abu Fanduweh (KS-59). Although villages in the western area seem to have obtained ceramics produced at both of these centers (Johnson 1973:92–94; 1976:210–12), the apparent spatial separation of these two emergent central place systems was probably related to factors of administrative separation. (See C. A. Smith 1976:20–23; Steponaitis 1978:427.)

Susa's relatively greater size doubtless assured its administrative control over the western Susiana in general, although I will suggest later that the degree of control exercised by Susa was relatively low. If the western Susiana, though dominated by Susa, was divided into two lower-level administrative districts, these districts should have been of approximately the same size. (This assumes that the work involved in administration of these districts was proportional to their sizes.) If hectarage of settlement is used as a measure of size, then these proposed districts were approximately equivalent with 22.25 hectares of settlement in the Susa area and 26.78 hectares in the Abu Fanduweh area. Given the fairly regular distribution of villages around centers, settlements north of KS-33 appear to have been associated with Susa, while those to the south (including KS-269) were associated with Abu Fanduweh. Having tentatively established the presence of two administrative districts in the western Susiana, it would be informative to consider their respective spans of control.

Span of Control

Span of control is an attribute of organizational structure that has been very extensively studied in modern cases by sociologists and other organization specialists. The literature on organizations and organization theory is much too large to even characterize here, and I will simply offer a few observations of immediate relevance. These are based on the standard literature as well as on recent applications work on more traditional anthropological and ethnographic cases.

I have suggested elsewhere (Johnson 1982b, 1983) that basic structural characteristics of archaeological, ethnographic, and contemporary organizations are heavily constrained by the information processing capabilities of individuals and groups in decision-making contexts (see also J. Moore 1983). Organizations from hunter-gatherer and egalitarian pastoral nomad camps to modern business firms, employment agencies, university committees, and nations are subject to what I have called "scalar stress," much akin to communications stress as discussed by Meier (1972). Basically, as the number of organizational units—individuals, families, clans, departments, divisions, or whatever—engaged in either consensual decision making or under the supervision of a single, hierarchically differentiated individual or unit increases beyond the organizational size of six, decision performance degrades and the probability of structural alteration of the system concerned increases. This "magic number" of six appears to be related to basic, if poorly understood, characteristics of human neural organization (Johnson 1982b; Mayhew and Levinger 1976:1036; Miller 1956) and appears regularly as a structural transition point in laboratory studies of task-oriented small group dynamics in sociology and social psychology (see, for example, Cummings, Huber, and Arendt 1974).

Our interest here will be in span of control, or the number of individuals or organizational units that are immediately subordinate to a given individual or unit in a hierarchically structured organization.

Span is described as varying from "narrow" when few subordinates are involved to "wide" when many are involved. Urwick (1956:41) suggested some time ago that an optimum span of control in highly integrated organizations is somewhere around the familiar figure of six. This observation has been supported by a very wide variety of subsequent studies. Pugh et al. (1968:104), for example, report an average span for chief executives of fifty-two organizations in the area of Birmingham, England, to be 6.08 (range = 2–24, standard deviation = 3.08). Klatzky (1970:433) reports, in a study of fifty-three state and territorial employment agencies in the United States, that the average number of major subdivisions per agency is 6.6 (range = 2–13, standard deviation = 2.5). In a more anthropological example, Jones (1966:65) provides data on local communities controlled by subchiefs in the state organization of Basutoland in 1938. Subchiefs had an average span of control of 5.13 (n = 18, range = 2–11, standard deviation = 2.75).

Variability in span of control is another problem. While a relatively narrow span has been associated with a relatively wide scope of administrative responsibilities (Blau 1968:543), a narrow span is more often indicative of relatively close administrative supervision and control. Skinner (1977b:305) notes, for example, that span of control for prefectural level units in Late Imperial (Ch'ing) China ranged from 1 to 24 with a mean value of between 5 and 6. Wide spans were characteristic of regional cores where formal administration was concerned almost exclusively with tax collection, and other regulatory functions were exercised through informal political mechanisms (Skinner 1977b:336). Narrow spans were associated

with regional peripheries where a high degree of control was required in areas of potential military disruptions (Skinner 1977b:321).

Elsewhere (Johnson 1983) I have summarized what we appear to know about scalar stress, and I will repeat those observations here.

1. Information processing overload is a mechanism that may constrain the operational size of consensual groups and span of control in hierarchical groups.
2. Information load and scalar stress are an exponential function of organizational size. (See Johnson 1982b for details.)
3. Organizational size is best measured in terms of basal organizational units which may vary in population size both within and between systems.
4. We can specify optimum mean organization size or span of control for decision-making purposes, as well as a rough potential range of variation for size and span.
5. We can predict stress points in organizational growth, beyond which there is an increasing probability of system response. (This is done for Terminal Susa A through Middle Uruk on the Susiana later in this chapter.)
6. We can identify a noninclusive list of types of potential system response to scalar stress that includes expansion of basal unit size, development of (or increase in complexity of) hierarchical organization, and group fission.

Given these considerations, it is clear that estimation of administrative span of control during Early Uruk on the Susiana would provide important information on the operation of the administrative system—most prominently on the relative degree of control exercised by center administrative elites over village populations.

Basal Administered Unit Size

The main problem in attempting to estimate administrative span of control for the Susiana Uruk is that we have no direct evidence of the size of the lowest-level organizational or administrative unit in the system. The best that I can do at this point is to evaluate the implications of a reasonable assumption about unit size. While this is not very satisfactory in an ideal sense, subsequent substantiation of those implications would then support the initial assumption of unit size.

One might well assume that the settlement was likely to have been the basic unit of administrative organization. The range of Uruk settlement sizes (less than 1 to about 25 hectares), however, makes this unlikely. One would expect that in a relatively simple system such as this, basal level administered units would have been of roughly the same size.

An alternative is to take the size of the smallest viable settlement as the basic unit of organization and to consider larger settlements to represent multiples of this basic unit. A larger basal level unit would have necessitated frequent incorporation of spatially separated populations in the same unit and have reduced the potential degree of administrative control. A smaller basal level unit would have required a larger number of such units and have increased administrative workloads (Johnson 1978, 1982b).

The smallest viable settlement size is unlikely to have been the size of the smallest observed settlement in the system. I have suggested elsewhere (Johnson 1977:501) that the point at which a regional rank-size distribution undergoes rapid "lower-limb" falloff (Haggett 1966:106) probably represents the approximate threshold of minimum viable settlement size. This is the point at which the number of increasingly smaller settlements in the system decreases rapidly as seen on a log-normal rank-size plot. A number of variables were likely to have been involved in determination of this size threshold including agricultural productivity, degree of cooperative activity in agricultural production, degree of village articulation within a regional economic system, security, and administrative requirements.

Examination of the Early Uruk rank-size distribution (figure 20) suggests that this threshold value was approximately 1 hectare. This value was maintained in Middle Uruk and was, incidentally, the same as the threshold value for Early Uruk settlements in the Warka area of southern Iraq (Johnson 1980b).

Administrative Organization

While it seems reasonable to take 1 hectare of settlement area as the probable basal level administered unit, calculation of basal level span of control requires an estimate of organizational structure above the level of the basal unit. In the original analysis of the Susiana material, I argued for a three-level administrative hierarchy in Early Uruk on the basis of more detailed data suggesting a direct correspondence between levels of settlement hierarchy and levels of administrative hierarchy in Middle Uruk (Johnson 1973:141). I now suspect that neither of these propositions is correct.

The presence of large Early Uruk buildings on the Acropole of Susa (Wright 1978) can be taken as evidence of administrative activity in this center. The admittedly small excavation samples from two villages (KS-34 and KS-76, Johnson 1976) have not, however, produced similar evidence of resident administrative activity. (They show no evidence of major architecture or artifacts appropriate to resident administration.)

This suggests the possibility that administrative activity was limited to the two centers of Susa and Abu Fanduweh.

Figure 21 presents rank-size distributions for the Susa and Abu Fanduweh administrative districts defined earlier, as well as for the apparently unadministered eastern portion of the Susiana. Note that the distribution for the eastern area is quite convex (RSI = 0.402) as would be expected in an area of very low system integration.

The distribution for the entire western Susiana (figure 20) was relatively linear (RSI = 0.123). Within the western area, the Susa administrative district was highly primate (RSI = −0.547), while the Abu Fanduweh district was more linear (RSI = 0.247) though less so than I would have expected. As reviewed earlier, the primacy of the Susa district suggests that Susa was articulated with a settlement system beyond its immediate area. This local primacy in addition to the distributional linearity produced by combining the Susa and Abu Fanduweh districts and the status of Susa and Abu Fanduweh as large and small centers, respectively, all indicate that regional level administrative functions were located at Susa. If this were the case, one would expect district level administrative functions to have been located at Susa and Abu Fanduweh. Given the lack of evidence for resident administration at settlements smaller than centers, the foregoing analysis would indicate the operation of a two-level administrative hierarchy within a three-level settlement system.

If, as suggested earlier, 1 hectare of settlement represented a basal level administered unit, then the spans of control of district level administration at Susa and Abu Fanduweh would have been approximately equal to the total settlement area in each district of 22.25 (22) and 26.78 (27), respectively. The span of control for the regional administration at Susa would have corresponded to the number of administrative districts in the region, or two. Spans of control of 22 to 27 at the local level are wide and suggest that the degree of control exercised by district administrators on village populations was relatively low. Three classes of information are consistent with this proposition. These include estimates of center requirements for rural agricultural produce, spatial variation in administrative demand for labor, and spatial variation in rural utilization of centrally produced ceramics.

Tests of Organizational Implications

In an earlier analysis of settlement size and location in the immediate vicinities of Susa and Abu Fanduweh (Johnson 1973:94–98), the amount of agricultural land directly available to these centers was estimated. This analysis suggested that the immediate sustaining area available to Susa was 2.12 hectares per person and to Abu Fanduweh was 2.19 hectares per person. Recent rural populations in the area that are involved in near maximum production utilize an average of 1.92 hectares per person, while Oates and Oates (1976b:120) cite Iraq Development Board figures of about 2 hectares per person as the maximum amount of land a family can cultivate with a traditional technology. These figures contrast sharply with those for land required for subsistence production. I estimated a figure of 0.5 hectares per person on the basis of the Early Uruk settlement pattern data (Johnson 1973:-97), a figure that agrees well with estimates based on ethnographic data of 0.3–0.7 hectares per person (Kramer 1980:328) to 1.0 hectares per person (Oates and Oates (1976b:120) for similar agricultural areas.

It appears then that sufficient agricultural land was available in the immediate areas of Susa and Abu Fanduweh to permit maximum potential surplus agricultural production by their respective populations. Surplus is defined here as the agricultural production resulting from cultivation of more than 0.5 hectares of land per capita. If administrative demand for agricultural produce did not exceed the potential surplus productivity of center populations, Susa and Abu Fanduweh could have been largely independent of rural agricultural production. Potential independence would be consistent with the evidence presented earlier suggesting minimal center controls on village populations. The most important assumption here involves the level of administrative demand for surplus produce, a point to which I will return later.

A second line of evidence on administrative demand for surplus (in this case surplus labor) concerns the functional interpretation of a particular Uruk ceramic type, the bevel rim bowl. The bevel rim bowl is a common Uruk vessel which has been interpreted as a ration container for use in an administered labor system (Johnson 1973:129–39; Nissen 1970:137). This proposition along with previous functional interpretations of the type have been reviewed by Beale (1978) and LeBrun (1980). Beale views the type as a "presentation" bowl used in conjunction with religious activity; the very high densities of bevel rim bowls in lowland settlements would then imply a level of religiosity unprecedented among the world's archaic societies.

Wright, Miller, and Redding (1980:272) report bevel rim bowl discard rates at Tepe Sharafabad (KS-36, figure 19) to have been between 11 and 47 times those of other common Uruk ceramic types, with rim sherd densities of 235 to 3,621 per cubic meter in pit fill. As indicated in table 15, bevel rim bowls constitute 39 to 56 percent of the ceramic material in Middle and Late Uruk samples from the Susiana village site, KS-54 (figure 19).

In addition to very high bevel rim bowl densities,

Wright, Miller, and Redding (1980) present evidence for seasonal variability in bowl discard. Two years of winter/summer deposit are represented in the material recovered from a Middle Uruk pit at Tepe Sharafabad, with seasonality established on the basis of tooth eruption data from sheep-goat mandibles. One summer/winter sequence is especially well represented. The summer deposit (representing the agricultural "off-season," but the traditional period of intensive mud-brick construction) has an average bowl density of 2,098 rims per cubic meter. The winter deposit (representing the primary agricultural season) has an average bowl density of 956 rims per cubic meter. Administrative use of labor might be expected to be highest when that labor was not required for agricultural production, particularly if administrative demand for agricultural surplus was high. Further, recent textual evidence attests to the presence of ration issue at Tepe Yahya immediately after the Uruk (Beale 1978:313). Given these various lines of evidence, the ration bowl proposition still seems to account more fully for the available lowland bevel rim bowl data.

Of interest here is the observation (table 15) that Early Uruk bevel rim bowl density was only some 6 to 9 percent of Middle and Late Uruk densities from village deposits. Whatever the absolute level of center demand for Middle and Late Uruk village labor, Early Uruk demand was apparently very much less.

A low level of center demand for rural labor would be consistent with both low-level control of village populations and relative center agricultural autonomy. Center autonomy, however, would presumably have required actual rather than merely potential extraction of surplus production from center agricultural populations in support of other center functions. In this regard, Henry Wright (1979, personal communication) reports that some Early Uruk deposits at Susa contain nearly 700 bevel rim bowl sherds per cubic meter. This figure is roughly equivalent to those for densities in Middle and Late Uruk village deposits, but fully an order of magnitude greater than the available density from an Early Uruk village. This high level of labor demand on center, but not village, populations is consistent with the proposition of relatively low-level center control over villages.

If center administrators could extract little surplus labor from villagers, it seems likely that they could extract little surplus produce as well. This would have made them largely dependent on such surplus as could be generated by the agricultural populations of the centers themselves. On the other hand, if center administrators could extract a relatively large amount of surplus labor from center populations, it is likely that they could extract a relatively large amount of agricultural surplus as well. Given these data and the Early Uruk settlement locations around Susa and Abu Fanduweh indicating that center populations could have been engaged in near maximum surplus production, it would appear that administrative demand for center surplus was high but could be met by center populations.

The bevel rim bowl data are relevant to one additional aspect of the preceding analysis. Recall that the proposition that the eastern portion of the Susiana was only marginally related to a relatively integrated settlement system in the west was derived from spatial variability in rank-size distributions and the absence of a large center in the eastern area. Given the apparent function of bevel rim bowls in an administered labor system centered on Susa and Abu Fanduweh and their presence (in low density) in an associated village, one would expect that bowls should be either absent on eastern sites or exhibit much lower densities than on western sites.

While we do not have density data from the eastern area, bowl data are available from survey collections. Table 16 presents presence-absence data on Early Uruk bevel rim bowls (proto-bowls) from the eastern and western Susiana. While proto–bevel rim bowls are not restricted to the western Susiana, they are differentially associated with the western area. These results provide additional support for the proposition that eastern settlements were only marginally articulated with the west.

To return to the question of relatively low-level center control of Early Uruk villages on the western Susiana, a third source of data on Early Uruk center-village interaction deals with spatial variation in village demand for centrally produced ceramics.

In an earlier discussion of Early Uruk centralization of craft production (Johnson 1973:93–94), I made a case for the identification of workshop variability in neckless ledge rim jars, a common Early Uruk ceramic type. (For illustrations see Boehmer 1972: tables 54: 368–73; Johnson 1973: Plate III-b.) Two varieties were produced, apparently one at Susa and the other at Abu Fanduweh. The relative frequencies of these varieties in survey and excavation samples from six Early Uruk villages were reported earlier (Johnson 1973:183; 1976:212) and may be used to estimate relative interaction between the Early Uruk centers and these villages.

Archaeological interaction studies have increasingly used variants of a basic gravity model to examine the effects of variability in the size and spatial separation of interacting populations (Hallam, Warren, and Renfrew 1976:99–102; Hodder 1978; Johnson 1977:481–87). Wide application of gravity models in locational geography has produced the conclusion that the interaction of two populations is generally directly proportional to some function of the product of their sizes and inversely proportional to some func-

tion of the distance between them. Here, I will initially hold the size variable constant and focus on the distance variable and the expectation that center-village interaction should decline with increasing center-village distance.

In this case we are dealing with the interaction of villages with two centers. In the absence of adequate density data, I will consider the ratios of the two neckless ledge rim varieties present in collections from villages.

Let us begin with the simple proposition that interaction is inversely proportional to distance alone. If, for example, a village were twice as far from center B as from center A, its interaction with center B should be roughly one half of that with center A. If one aspect of this interaction involved acquisition of center products, one might expect products of centers A and B to occur in the village at a ratio of 2:1.

Table 17 presents data on center-to-village distance, as well as observed and expected ceramic frequencies (given sample size) for excavation samples from KS-34 and KS-76, and survey samples from KS-96, KS-108, KS-153, and KS-266. (See figure 19 for site locations.) It is evident that simple center-to-village distance is a reasonable predictor of center-village interaction as measured here. As illustrated in Figure 22, the correlation between the predicted and observed frequencies of the Abu Fanduweh variety at these six sites is 0.986. (Deletion of the comparatively high values for KS-34 reduces the coefficient to 0.980, p less than 0.01.) Not only are the predicted and observed values correlated, but they are identical in four of the six cases examined here.

It would appear then that village acquisition of center products was inversely proportional to center-village distance, or more accurately, center-village travel costs. This would imply both equivalency of "cost" of acquisition of ceramics at either locus of production and the absence of effective administrative constraints on the source from which villagers obtained center products. As such, this pattern of ceramic distribution is consistent with the proposition of relatively low-level administrative control of villages.

There are a number of other interesting aspects of these data. First, the samples under analysis are a mixture of excavation and judgment survey collections. That essentially identical results were obtained with both types of collection emphasizes the utility of survey data.

Second, there is some suggestion that the centers of Susa and Abu Fanduweh may have had a differential effect on villages in their immediate vicinities. Recall from table 17 that while distance-based predictions were accurate for KS-76 and KS-96 near Abu Fanduweh, they were slightly off for KS-34 near Susa where the relative frequency of the Susa-type neckless ledge rim was less than predicted and that of the Abu Fanduweh-type was more than predicted. This may indicate that villages in the administrative district of Susa were either differentially attracted to, or constrained by, Susa in comparison to villages in the Abu Fanduweh district. Given Susa's position as a regional as well as a district center, however, this minor distortion in interactional patterns would not be surprising.

Third, it is interesting that predictions of interaction are reasonably accurate for settlements on the eastern Susiana as well as for those in the west. I suggested earlier that Early Uruk settlements on the eastern Susiana were marginal to the more integrated system centered on Susa and Abu Fanduweh. The differential association of proto-bevel rim bowls with western sites supported this notion. Yet most of the ceramics in eastern survey collections are not obviously different from those in collections from the west. Early Uruk settlements on the eastern Susiana may have been marginal to the system in the west, but were by no means isolated from it. In currently fashionable terms, the distinction between core and periphery on the Early Uruk Susiana was probably clinal and incorporated much more variability than my discussion has suggested. The internal organization of the eastern system(s) and the form of its articulation with the west will be important problems for future work. The question of the impact of administrative relationships between western centers and eastern settlements on administrative workloads in the west will be particularly interesting.

The analysis of the three categories of data just reviewed—potential center requirements for rural agricultural produce, spatial variability in administrative demand for labor, and spatial variability in rural utilization of centrally produced ceramics—supports the proposition, derived from estimation of district level spans of control, that Early Uruk centers exercised relatively little control of rural populations. This low level of control apparently occurred in the context of a three-level settlement hierarchy and a two-level administrative hierarchy. Further, this system appears to have included primarily settlements on the western Susiana, while the eastern area was occupied by an undetermined number of smaller, relatively autonomous polities.

A major problem in this interpretation was originally noted by Sumner (1975:58). Centers are identified as being potentially autonomous, implying the anomalous concept of central places without hinterlands. Center control of rural populations appears to have been low, yet villages obtained at least some craft products from centers and were at least marginally involved in a centrally administered labor system. Further, the relatively regular distribution of villages around Susa and Abu Fanduweh suggests that center-

village interaction had an important effect on village location.

The problem here is largely one of temporal resolution. The Early Uruk appears to have been a relatively long period, as well as one of rapid organizational change. I will suggest in the following section of this chapter that center control of rural populations was high during Middle Uruk. This degree of control is unlikely to have emerged overnight, but must have been achieved incrementally during Early and early Middle Uruk. We are simply unable to measure critical changes within periods in the absence of an improved internal chronology. Not only can we not measure change but the effects of change are likely to be superimposed on one another in a complex palimpsest that presents many analytical and interpretive problems.

Middle Uruk

The Middle Uruk settlement pattern of perhaps 3500 B.C. is illustrated in figure 23. The appearance of a major administrative center, Chogha Mish, on the eastern Susiana constitutes the most obvious change from the Early Uruk system. The population of the Susiana also increased by some 33 percent, and the system expanded from a three- to a four-level settlement hierarchy with the differentiation of a category of large villages (Johnson 1973:79).

I will suggest that Middle Uruk was also a period during which the proportion of the population of the Susiana that was articulated with a centralized administrative system increased markedly. As Blau (1970:-204–13) points out, increasing system size generates structural differentiation in organizations, which in turn enlarges the administrative component of organizations. His observation assumes that the internal administrative span of control remains constant. Structural differentiation and administrative component size would show even more marked increase in a situation in which span of control was being narrowed to increase effective control of the lower-order components of the system. I will attempt to show that the Middle Uruk on the Susiana was an example of just this sort of situation.

Spatial Constraints on Administrative Control

The preceding analysis of the Early Uruk settlement system indicated that center administrative control was, for the most part, spatially limited and only a portion of the settlements on the Susiana were closely articulated with a centralized administrative system. This section will examine the possibility of a similar situation during Middle Uruk.

As indicated above, Chogha Mish was probably founded (or grew very substantially) as an administrative center to control the eastern Susiana, and it is useful to maintain this east/west distinction. If the spatial range of Uruk administrative control from a given center was bounded, one might expect a decrease in settlement density as the bounds of this range were approached. As Adams (1974:11) has pointed out for later periods in Mesopotamia, centralized institutions capable of pooling and subsequent redistribution of subsistence commodities reduce the risk associated with agricultural production in an area of considerable spatial and temporal variability and uncertainty in agricultural yields. Figure 24 plots settlement density in hectares of settlement area per 10 square kilometer unit in 3 kilometer circular zones around Susa and Chogha Mish. The eastern and western portions of the plain are treated separately. Both plots indicate a decline in settlement density between 19 and 23 kilometers from these centers, suggesting the possibility that settlements beyond this approximate range may have been relatively independent of both center services and center controls.

The behavioral implications of distances of this magnitude may be clarified by transforming them to travel times. Movement cost transformations of linear distance have been very useful in locational geography (Olsson: 1965:57ff.), and transport cost or related travel time transformations have begun to appear in the archaeological literature (Hodder and Orton 1976:117; Johnson 1977:485–87). Table 18 presents data on travel times over relatively flat terrain in the Near East. The figures for distance traveled per day refer to linear distances. Briefly, the number of days spent in travel between named locations were extracted from nineteenth- and early-twentieth-century travel accounts. The straight line distances between these points were taken from maps of the relevant areas and divided by the number of days spent in travel between these points. The result is a measure of linear rather than total distance traveled per day. The average distance traveled per day according to these data is 39.44 (40) kilometers. This figure is roughly double that of the range (19 to 23 kilometers) beyond which settlement density falls off with distance from Susa and Chogha Mish.

I suggest that a 20-kilometer radius, or one-day roundtrip distance, may have been the maximum range of direct control from a given Uruk center. Indeed, this range may have been quite common in early systems. Renfrew (1975:14), for example, uses a concept of an "Early State Module" consisting of a central place and associated hinterland. He notes that these modules frequently had an area of about 1,500 square kilometers, with average distances between the central places of adjacent modules of about 40 kilometers. This would have placed the administrative

boundary of adjacent systems at about 20 kilometers from their respective central places.

It is possible then that the Middle Uruk settlements on the Susiana located more than about 20 kilometers from a major administrative center were only marginally articulated with a central Susiana-administered settlement system. This would have placed the boundaries of an integrated settlement system including the major centers of Susa, Abu Fanduweh, and Chogha Mish within the Susiana rather than, as I have often assumed, between the Susiana and adjacent areas.

This proposition may be partially evaluated by examining the Middle Uruk rank-size distributions for the Susiana as a whole, and for the predicted administered portion of the plain. Figure 25 presents a rank-size plot for all Middle Uruk settlements in the survey area. This distribution is highly linear and has an associated rank-size index of 0.084. If, however, marginal settlements were effectively outside an integrated Susiana settlement system, their deletion from the analysis should further decrease the value of the rank-size index. Sites 7, 8, 99, 288, 173, 171, 197, 218, and 220 can be unambiguously deleted from the analysis since they are located more than 20 kilometers from a major center. Site 153 is 19.56 kilometers from Chogha Mish but is located on the opposite side of the Dizful anticline, well beyond a one-day roundtrip distance and can thus be deleted. Site 240 is 16.7 kilometers from Susa but is located on the opposite side of the present course of the Karkheh River and can also be deleted.

Figure 25 also illustrates the result of deletion of these sites. As expected, the rank-size index is reduced, from 0.084 to 0.012. This reduction is consistent with the proposition that the deleted sites were at least marginal to, if not outside, the major Susiana settlement system. These results parallel those discussed earlier for Early Uruk and support the proposition that a one-day roundtrip travel time was a significant factor in local administrative organization.

The implications of this rather restricted range of influence are difficult to evaluate at this time. Cherry (1978:425) attributes size restrictions on Early State Modules to the increasing costs of administration with increasing distance from a central place. I suspect, however, that this one-day roundtrip radius may have been more related to the ability of rural populations to avail themselves of center services than to the ability of center administrators to defray the cost of control of rural populations. It would be useful to examine this possibility more closely.

The relative centralization of Susiana Uruk craft production has been reasonably well demonstrated (Johnson 1973:90ff.; 1976:208–9). Both Henry Wright and I (Johnson 1973:159–60; Wright and Johnson 1975:283) have suggested that this centralization may have been, in part, an efficient system response to increasing seasonal demand by nomad populations. Rueschemeyer (1977) has pointed out that functional theories of differentiation in organizations are based on rather ephemeral efficiency considerations. The question is: efficiency for whom and for what? He suggests that the operational utility of such a functional approach may be enhanced by focusing on the interests or goals of those sectors of the system with access to disproportionate power. It seems reasonable that such disproportionate "power" (what I would call the differential ability to influence the behavior of others [Johnson 1978:100]) as it existed in the Uruk was controlled by center elites. It may be useful then to focus on potential elite goals.

While the importance of nomad demand remains to be ascertained, I now suspect that centralization was above all an explicit strategy of center administrators to more closely articulate rural populations with central economic activities. By subsidizing large-scale craft production, center administrators may well have been able to undercut rural producers and decrease the demand for rural craft products. Decreased demand for rural products would have led to decreased rural production and increased reliance on center workshops. The result of this process would have been an effective decline in the relative economic autonomy of rural villages and the increased articulation of their populations with centers.

It is possible that the circumstances of the Terminal Susa A population decline discussed in the preceding chapter may have favored opportunistic centralization of production in Early Uruk. Fifteen of the eighteen Terminal Susa A settlements in the area continued to be occupied in Early Uruk. Of these, Susa and Abu Fanduweh with estimated sizes of 5.0 and 5.16 hectares, respectively, were the largest settlements of the period, accounting for fully 34 percent of the total Terminal Susa A settlement area. Continued craft production at these two centers with Terminal Susa A abandonment of many villages having resident craftsmen may have markedly increased the proportional contribution of these centers to total craft output and facilitated centralization in Early Uruk.

Availability of craft products was not, of course, the only service attracting villagers to Early Uruk centers. Centers were also the loci of major religious ceremonial and, one supposes, numerous other central place functions.

If attracting rural populations into closer articulation with centers was a major Uruk concern, this would imply a considerable amount of freedom of action on the part of rural populations who, at least in Early Uruk, could largely decide whether or not to avail themselves of center services. Decisions to travel to centers, particularly to take advantage of available

economic services, would have involved an element of cost-benefit calculation. The apparent one-day round-trip radius from major centers that apparently formed the boundary of the administered settlement system suggests that associated travel costs for longer distances were greater than most villagers were willing to assume—at least with any regularity. These costs may have included factors of food, housing, security, and time spent away from work at home.

There is, of course, another side to this story. It is unlikely that center administrators attempted to attract villagers for their decorative value. Increased rural dependence on center services was apparently associated with increased center economic and political control of rural populations, a topic I will address shortly. Recall that if Early Uruk administrators had relatively little control over rural populations, they were apparently able to extract considerable surplus produce and labor from center populations. Much of this surplus was undoubtedly invested in the kind of major construction projects (temples, etc.) which serve to both signal and reinforce elite status positions. Administrative subsidy of centralized craft production may then be viewed as another form in which surplus produce and labor could be invested. The result of this investment appears to have been twofold: some of the ugliest pottery in the Near East and a considerable increase in administrative control of rural populations.

Definition of Administrative Districts and Spans of Control

As was the case in Early Uruk, the Middle Uruk Susiana seems to have been divided into three major areas. The division of the western Susiana into the Susa and Abu Fanduweh areas continued, while the eastern Susiana came to be dominated by Chogha Mish. I noted earlier that at a given level of organizational hierarchy, organizational units can be expected to be of roughly the same size. Again taking settlement area as an indicator of population size and the areas defined above as functional administrative units, the latter should have contained roughly equivalent settlement areas.

If marginal settlements beyond the effective range of center administrative influence are deleted, the total hectarage of settlement for each of these three areas is as follows: Susa area, 33.19 hectares; Abu Fanduweh area, 32.56 hectares; and Chogha Mish area, 40.66 hectares. These figures are sufficiently close to support the proposition that the areas functioned as Middle Uruk administrative districts.

Figure 26 presents rank-size distributions for the three administrative districts discussed. The linearity of the distribution for the Chogha Mish area is particularly interesting. Recall that in Early Uruk, the eastern portion of the Susiana did not contain a major administrative center and had a fairly convex rank-size distribution (RSI = 0.402). The appearance of Chogha Mish and the associated marked decrease in convexity of the rank-size distribution for the eastern area (RSI = 0.090) suggest a considerable increase in the integration of the settlement system in this area and lends further support to its identification as a major administrative district.

An increase in system integration is also indicated in the Abu Fanduweh area where the rank-size index decreased between Early and Middle Uruk from 0.247 to 0.106. The Susa area again shows a highly primate distribution (RSI = −1.264) consistent with the role of Susa in administration beyond its immediate district. Indeed the increase in primacy of the Susa district from an Early Uruk value of −0.547 can be partially related to increased administrative workload occasioned by the Middle Uruk extension of administrative functions to the eastern portion of the Susiana.

Earlier interpretations of Middle Uruk administrative organization appear to require revision. We have direct evidence of resident administrative activity at large centers such as Susa (Wright and Johnson 1975) and at apparently specialized villages such as Tepe Sharafabad, KS-36 (Wright and Johnson 1975; Wright, Miller and Redding 1980). I originally suggested that in view of direct evidence of resident administration at the top and bottom of a four-level Middle Uruk settlement hierarchy, the Middle Uruk administrative hierarchy was also likely to have had at least four levels above the general population (Johnson 1973:141). I am no longer confident that this was the case.

Inspection of the Middle Uruk settlement pattern map (figure 23) reveals that village-size administrative centers (marked by ceramic wall cones from survey and excavation collections) are distributed more or less linearly across the northern portion of the Susiana. Considering the evidence presented earlier for restriction of administrative influence to a 20-kilometer radius, it can be seen that these small administrative centers were located on the effective northern boundary of the administered Uruk settlement system. Indeed, none lie beyond 20 kilometers from either Susa or Chogha Mish, an observation lending further support to the importance of the 20-kilometer administrative radius.

If these small, specialized settlements exclusively represented the lowest level of the Susiana administrative hierarchy, one would expect them to be more uniformly distributed throughout the area rather than being restricted to the northern periphery of the administered settlement system. This northern concentration would have left the central and southern

portions of the plain devoid of lowest-level administrative functions.

Note that with the exception of KS-153 (figure 23), which is located outside the probable area of the central Susiana system, the three remaining Middle Uruk small centers are restricted to the central and southern portions of the area. We have always assumed, although lacking direct evidence other than the presence of wall cones on KS-113, that these small centers were sites of resident administrative activity. If these three small centers were equivalent in administrative level to the smaller known administrative sites like Tepe Sharafabad, the spatial distribution of lowest level administration would appear much more uniform. A situation of settlements of different level in a settlement size hierarchy being of roughly equivalent status in an administrative hierarchy would parallel the China case described by Skinner (1977b:340), and possibly that of medieval Arab settlement systems described by Lapidus (1969:69–70).

Tentative acceptance of this proposition raises a number of problems, including the cause of the formal and spatial differences between small centers and administratively specialized villages. I noted earlier that specialized villages were restricted to the apparent northern boundary of the administered settlement system. As such, they might be expected to have been involved in some kind of boundary maintenance or boundary interaction among other functions. The question is one of interaction with whom—certainly not primarily with the scatter of small Uruk villages to the north. Although there are sedentary Uruk occupations in high valleys of the central Zagros (Wright ed. 1979), the most likely populations to have been important in boundary interaction with a lowland settlement system were the pastoral nomads for whom we have so little evidence. While the northern Susiana provided winter graze for historically known nomad groups (Pierre 1917) and Hole (1974) has excavated portions of a sixth millennium B.C. campsite in this area, we know virtually nothing about nomad populations for the Uruk time range.

The potential equivalency of specialized villages and small centers in administrative level has clear implications for overall administrative organization. It is reasonably clear that Susa dominated the Susiana in Middle Uruk and was the location of the highest level of administration in the area. As argued earlier, the Susiana was divided into three major administrative districts headed respectively by Susa, Abu Fanduweh, and Chogha Mish. The equivalency of specialized villages and small centers in administrative level would imply the operation of a three-level rather than a four-level (Johnson 1973:141) administrative hierarchy in Middle Uruk. As was the case for Early Uruk, the vertical complexity of administrative organization may well have been less complex than I thought earlier.

Estimation of basal level span of control is again difficult. Let us first consider system level rural administration. On the reasonable assumption that rural administrative centers would have had no role in administration of the populations of regional or district centers, Susa, Abu Fanduweh, and Chogha Mish can be temporarily deleted from the analysis. This leaves 61.85 (62) hectares of settlement within the administered area of the Susiana as defined earlier. I assume again that 1 hectare of settlement represented the lowest-level Middle Uruk administered unit. (This is the point at which the Middle Uruk rank-size distribution [figure 25] undergoes rapid lower-limb falloff.) These sixty-two basal level units were distributed among nine rural administrative centers of which six were specialized villages and three were small centers. Average basal level span of control would thus have been about 7 (6.88). This span represented a very marked narrowing of the wide estimated spans of Early Uruk of 22 to 27 and suggests a considerable increase in the degree of administrative control exercised over rural populations.

This picture is somewhat modified if span of control is considered by district rather than on an aggregate level for the entire administered area of the plain. The Susa district had 8.19 hectares of settlement outside Susa and two specialized administrative villages for a basal span of 4 (4.10). This compares favorably with the figures for the Chogha Mish district. With 30.16 hectares of settlement outside Chogha Mish and six rural administrative centers (four specialized villages and two small centers), rural span would have been equal to about 5 (5.03).

The Abu Fanduweh district was apparently quite different. There were 23 hectares of settlement outside Abu Fanduweh with a single rural administrative site (a small center), suggesting a wide span of 23. This would have been comparable to the estimated Early Uruk spans of 22 to 27. The apparently wide basal level span of control in the Abu Fanduweh district might suggest that the district center was differentially involved in direct rural administration, that the number of administered activities was lower in the Abu Fanduweh district than elsewhere or that the degree of control of village populations was simply lower compared with elsewhere.

There is an intriguing parallel here with Skinner's China data. Recall that Skinner found wide spans of control in regional cores where administrators were primarily concerned with tax collection, and narrow spans in peripheral areas where military (boundary maintenance and social control) considerations were

also important. I suggested earlier that the distribution of administratively specialized villages along the northern border of the administered Susiana settlement system might be indicative of their role in system boundary maintenance. Of the three Susiana administrative districts, those of Susa and Chogha Mish shared this northern boundary and had narrow estimated spans of control, while Abu Fanduweh was insulated in the southern portion of the plain and had an estimated wide span of control. This situation would suggest that the number of administered activities in the Abu Fanduweh district was lower than in the Susa and Chogha Mish districts.

These district-to-district variations aside, it seems clear that the overall decrease in basal level span of control between Early and Middle Uruk, along with an increase in the vertical complexity of the administrative hierarchy, would indicate increasing administrative control of rural populations.

Tests of Organizational Implications

The proposition of increasing Middle Uruk administrative control of rural populations may be partially evaluated from a number of different perspectives. Recall that given their respective population sizes, immediate sustaining areas, estimated demand for surplus agricultural produce and labor, and estimated low degree of control over rural populations, the Early Uruk centers of Susa and Abu Fanduweh were probably largely independent of village agricultural production. Given this suggestion of near maximum surplus production by Early Uruk center populations, substantial Middle Uruk increase in center sizes would have necessitated increased acquisition of agricultural produce and probably labor from surrounding villages. It appears that the population of Susa increased by some 2,600 persons and that of Abu Fanduweh by some 500 (528) during Middle Uruk.

It is instructive to examine probable Middle Uruk center requirements for rural agricultural products and potential rural surplus productivity more closely. Recall from the preceding discussion of Early Uruk centers that they had direct access to about 2 hectares of agricultural land per capita, and that this figure approximates both traditional per capita land use in the area today and maximum potential family productivity in Iraq. High administrative demand for labor from center populations plus a variety of other evidence for minimal center control of villages suggested that near maximum surplus production was being extracted from center agricultural populations. Given the figures also cited earlier indicating that approximately 0.5 hectares per capita were required for subsistence production, fallow, etc., maximum potential surplus production would amount to the yield of approximately 1.5 hectares of land per capita. As we are not able to monitor spatial variability in yields for relevant areas of the Susiana, I will assume that yields in these areas were equal.

If we assume that administrative demand for per capita surplus productivity in centers was constant between Early and Middle Uruk, the relationship between center demand and probable surplus production extracted from villages may be estimated. (This is a conservative assumption since it seems unlikely that demand for per capita surplus would decline during a period of increasing administrative complexity.) This estimate requires examination of the distribution of the Middle Uruk population in relation to immediately available agricultural land, or spatial variability in population density.

Figure 27 illustrates the imposition of a 5-kilometer interval grid on the central Susiana settlement pattern. Marginal settlements which appear to have been beyond the range of effective administrative control have been deleted from the analysis. Observed population density per square kilometer is tabulated for each grid square in table 19. Note from figure 27 (grid squares B7, C6, and F5) that agglomeration of the data in this fashion results in pooling the population estimates of two small centers (KS-96 and KS-113) with nearby villages (KS-94 and KS-4,5, respectively). The population of villages KS-54 and KS-98 are also pooled with that of Abu Fanduweh (KS-59). This pooling amounts to the assumption that the populations of these five villages near centers were engaged in maximum potential surplus production.

At maximum surplus production, involving the utilization of 2 hectares of agricultural land per capita, each grid square could have been occupied by about 50 people per square kilometer. It is evident that the populations of squares containing five of the six Middle Uruk large and small centers exceeded the density that could be locally supported at the levels of consumption discussed above. (These density figures are italicized in table 19.) Only the square (F5) containing the small center KS-113 could have been self-sustaining at a population density of 44 persons per square kilometer.

Table 20 contains two kinds of information. First, center surplus requirements in hectares of production beyond what would have been available locally are italicized. Consider the example of Abu Fanduweh (square C6). With a population of 102.72 persons per square kilometer in an area that would support 50 persons per square kilometer at estimated center surplus demand rates, the center population exceeded this maximum by 52.72 persons per square kilometer. This is equivalent to additional demand for 105.44 hectares of production (at 2 hectares per capita) per

square kilometer in a 25 square kilometer unit, or 2,636 hectares of production.

One adjustment has been made to this form of calculation in the case of Susa (grid reference B4). With a unit population density of 200 persons per square kilometer, Susa would have required all of the land in its grid unit simply to support its population at subsistence level (0.5 hectares of production per capita). With estimated center demand of 2 hectares of production per capita, Susa required an additional 7,500 hectares of production from outside its immediate area. It seems probable, however, that Susa was also utilizing land available in adjacent unoccupied grid squares B3 and C4. If these were utilized to their fullest potential, they would have generated surplus of 1,875 hectares of production each or a total of 3,750. This would have reduced the unmet demand at Susa from 7,500 to 3,750 hectares of production (see table 20:B4.) With an estimated population of Susa of 5,000 persons, this model would allocate 3,750 or 75 percent to involvement in agricultural production. The actual size of the labor force would have been smaller than this as these figures were generated on a per capita basis.

This estimated population allocation is at least consistent with what little is known about the internal organization of Susa. The estimated 25 hectares of Middle Uruk occupation on the site was divided between the 9 hectares of the high Acropole and the 16 hectares of the lower Apadana area (Johnson 1973:-69–71). The occupation of the Acropole contained a massive mud-brick platform surmounted by public architecture as well as areas of elite residences or smaller administrative buildings (Wright 1978). The Acropole, which occupies 36 percent of the Middle Uruk site by area, appears then to have been primarily devoted to ceremonial and administrative functions. If the larger Apadana which occupies 64 percent of the site was primarily devoted to lower status occupation, then the internal organization of Susa by area (64 percent "nonelite" and 36 percent "elite") would have approximated the population allocation figures suggested above of 75 percent food producers and 25 percent nonproducers. Interestingly, Oates and Oates (1976b:120) note that agriculturalists represent 75 percent of the population of modern Tell Afar in Iraq and comment that while this is a comparatively high figure, it probably approximates average conditions for later prehistoric towns.

Considering the adjustments of Susa's estimated demand for rural surplus discussed above, total center surplus requirements for the system amount to 8,858 hectares of production against a total potential rural surplus of 11,442 hectares. Estimated demand was thus about 77 percent of potential surplus. (Remember that this potential surplus was calculated on the basis of the number of people estimated to have been living in rural areas, not on some estimate of rural carrying capacity.)

While system level demand may have been at 77 percent of potential surplus, localized demand may have been even higher. If the plain was partitioned into eastern and western sectors along administrative district boundaries, center demand in the western area exceeded potential rural surplus production, while the opposite was the case in the eastern area (see table 21). This suggests that unmet demand in the western area may have been resolved by shipment of significant quantities of produce from the eastern Chogha Mish administrative district to the area of Susa and Abu Fanduweh.

The evidence of administrative technology including both commodity and message sealings (Wright and Johnson 1975:271; Wright, Miller, and Redding 1980) indicates that Middle Uruk administrators were involved in the storage and shipment of goods. This involvement perhaps encouraged the proliferation of Middle Uruk jar types, most of which have everted rims. Such rim forms are highly suitable for anchoring a cord-tied vessel cover, and I suspect that the marked variability in jar rim form during the Uruk represents intensive experimentation with methods of vessel closure associated with an increased volume of commodity storage and shipment.

The demand/potential surplus estimates made here are obviously very crude and probably overestimate both administrative demand and potential rural surplus. Spatial and temporal variability in potential productivity have not even been considered. The figures do, however, suggest a high level of center demand for rural produce and are consistent with the evidence of both administrative and ceramic technology. The figures are also consistent with the proposition of a marked increase in Middle Uruk administrative control of rural populations. Implications of these conclusions for the interpretation of Late Uruk developments on the Susiana will be examined later in this chapter.

Another line of evidence leads to much the same conclusions. Recall that the relatively low administrative demand for village labor in Early Uruk was established by comparing Early Uruk bevel rim bowl density at KS-34 (ca. 37 sherds/cubic meter) with Middle and Late Uruk densities at KS-54 (ca. 430–590 sherds/cubic meter). Of relevance here is the observation that not only were Early Uruk bowl densities low in villages, but Middle Uruk densities were high. This dramatic order-of-magnitude increase in what I would interpret as administrative demand for labor is consistent with both a narrowing of Middle Uruk basal span of control and the high level of center demand for rural surplus production indicated earlier.

Expansion of an administered labor system might well have advantages beyond simple increase in labor and surplus availability. Specifically, the operation of a regularized labor system might well allow administrators to monitor simultaneously changes in population size, composition, and spatial distribution. In other words, operation of such a labor system might allow maintenance of a rough continuing census of the administered population. Continuing census data could have been very important for projecting labor availability for agricultural production, public works construction, and so forth, and in general for increasing the reliability of the administered system.

Whether associated with the maintenance of census data or not, the effective operation of such an administered labor system would probably entail very regularized and frequent utilization of labor to ensure that the system would be operational when required. Considerable labor may then have been used not so much for acquisition of its immediate products, but to ensure its future availability. A portion of the intensive public building activity evidenced on Uruk sites and those of other periods may have been undertaken to absorb temporary labor surpluses which had to be used to maintain the regularity of the system, but were not required for more important economic activities.

More or less "monumental" construction projects had the obvious advantage of both signaling and reinforcing the position of local elites. This kind of labor intensive monumental construction or what might be called "piling behavior" has a very wide distribution in the world in early complex societies (mounds, pyramids, platforms, etc.), and I would simply suggest that the oft-cited advantages of elite aggrandizement may be insufficient in themselves to account for this frequently observed pattern of labor investment.

These admitted speculations aside, not only did Middle Uruk center growth require closer center articulation with villages, but the pattern of center growth within the Susiana system provides additional evidence of expanding center control of village populations. I suggested earlier that centralization of craft production was, in part, a strategy by center elites to increase village dependence on center services. This strategy appears to have been very successful. Table 22 presents grouped data on change in aggregate settlement size by size class and administrative district between Early and Middle Uruk. Large and small villages have been combined for this analysis. These data make it clear that the Middle Uruk increase in hectarage of settlement was restricted almost exclusively to centers despite the foundation, abandonment, and smaller size changes in village sites. Note that in all three Middle Uruk administrative districts, aggregate village area declined slightly, while aggregate center area increased markedly. Only in marginal areas beyond the range of center administration did aggregate village population increase. This rather striking pattern not only supports the proposition of increasing center control of villages but also lends additional credence to the identification of "marginal" settlements as beyond the effective range of regular participation in the central Susiana administered settlement system.

I suspect that during Middle Uruk, many villagers were shifting their residence to centers. It is possible, of course, that population growth was largely restricted to centers, while village populations remained stable. This possibility may be partially evaluated by examination of alternative population growth rates that would have been required to generate the observed pattern of population increase.

While we do not know the length of time over which the Early-Middle Uruk population increase occurred, it is unlikely to have been more than three hundred years. Table 23 presents growth rates that would have been required to account for the estimated Middle Uruk increase in twenty-five year intervals from three hundred to fifty years, under two alternative conditions: a uniform growth rate for the system as a whole with rural emigration to centers, and growth in centers only. The table also distinguishes growth in marginal settlements as they were defined earlier.

Cowgill notes that typical rates of population change prior to A.D. 1750 ranged from negative 7.0 to positive 7.0 persons per thousand per year (1975a:514), with average rates of 1.0 to 3.0 per thousand and surges over two hundred to three hundred years of 3.0 to 7.0 per thousand (1975b:218). Hassan (1975:42) cites figures with more positive variability, with an average "neolithic" growth rate of 1.0 per thousand and highs of 5.0 to 10.0 per thousand. Table 23 incorporates Cowgill's more conservative figures in comparing alternative growth models.

Table 23 contains two points of interest. Accounting for the Middle Uruk population increase solely in terms of population growth in centers would require improbably high rates if that growth occurred in less than 125 years and high rates for periods between 125 and 275 years. Growth in the system as a whole with rural emigration to centers, on the other hand, would require rates exceeding the average range only if that growth occurred in less than fifty years. While center populations may have had somewhat higher growth rates than those in villages, these figures strongly suggest that growth was relatively uniform in the system and that a significant proportion of the marked increase in center populations represented immigration from villages. This is consistent with the overall pattern of increasing center-village articulation suggested earlier.

The second point to note is that rates required to account for growth of settlements marginal to the cen-

tral Susiana system are lower than rates required to account for growth within the system. Given the order-of-magnitude increase in administrative demand for Middle Uruk village labor and the potential importance of demand for labor in accounting for population growth (Blanton 1975:116–26; White 1973), the lower growth rate of marginal settlements was quite expectable. Beyond being expectable, these lower rates are yet another characteristic supporting the original "marginal settlement" classification and the concept of a 20-kilometer radius of effective Middle Uruk administrative influence.

The various classes of data reviewed here were relevant to center demand for surplus rural agricultural production, center demand for rural labor, and rural emigration to centers. All three were consistent with the proposition that the marked decrease in estimated Middle Uruk basal level span of control was associated with an increase in the degree of control exercised over rural populations.

Processes in Uruk State Formation

Table 24 presents a summary of estimated values for several system level variables during Early and Middle Uruk. The development of a three-level administrative hierarchy with substantial administrative influence over village as well as center populations suggests that the end of Early Uruk and the beginning of Middle Uruk was the immediate period of state formation on the Susiana. This operational criterion of vertical complexity of administrative organization has been discussed elsewhere (Claessen 1978:579; Johnson 1973:1–4; Wright 1977:383–58). It seems clear that the vertical specialization resulting in the emergence of a third level of administrative hierarchy in Middle Uruk was a response to an increased administrative workload involved in ensuring the integration of lower-level administered units.

In another discussion (Johnson:1978), I viewed vertical specialization as the addition of a new level to the top of an organization in response to an increasing workload required to provide integrative functions among an expanded series of equivalent highest-order administrative units. This model assumed that the level of integration in the system under analysis was both high and constant. The Susiana Uruk case was more complex than this since it involved change both in administrative organization and in the level of integration of the system.

High-level administration was present during Early Uruk and provided integration between administrative districts with wide spans of control and a relatively low degree of influence over village populations. Simple expansion of the size of the administered system during Middle Uruk with no change in degree of control would probably have resulted simply in a proliferation of district centers—at least up to a point. Uruk administrators, however, were concerned with increasing their level of control over village populations. This increased control required more direct local supervision beyond the capacity of district centers. The response to this problem was the addition of a level of local organization to the bottom rather than the top of the administrative hierarchy.

Lower-level vertical specialization was probably a response to marked increase in the scale of the administered system as well as to increase in the degree of control over village populations. As discussed earlier in this chapter, a large portion of the eastern Susiana was brought under centralized control during the Middle Uruk. This virtually doubled the spatial scale of the system. An additional increase in system population size was generated by population growth, probably in response to increased center demand for rural labor and surplus production. It should be explicitly pointed out, however, that while the population of the Susiana increased by some 33 percent between Early and Middle Uruk, the size of the population actually articulated with a centralized administrative system grew by 118 percent (see table 24).

An increasing number of scholars have stressed the importance of population growth relative to resource availability in the development of complex societies (Athens 1977; Carneiro 1970, 1981; Sanders and Webster 1978; Sanders, Parsons, and Santley 1979; Smith and Young 1972). Most such arguments are phrased in terms of aggregate population densities for relatively large areas. I have suggested here that expansion of the scale of the Early Uruk system was a significant factor in local political development, yet the aggregate population density for Susiana Uruk was comparatively very low. Total (center and rural) population densities, in persons per square kilometer, for the Susiana between Terminal Susa A and Late Uruk are estimated as follows: Terminal Susa A, 2.6; Early Uruk, 8.4; Middle Uruk, 11.2; and Late Uruk, 4.6. Compare these figures with those reported for only *rural* areas of the Near East with traditional agricultural systems: Lower Diyala, 28.9 (Adams 1965:-22); Susiana Diz pilot area, 46.3 (Gremliza 1962:2); Kur River basin Dorudzan project area, 18.9 (Sumner 1972:2,174–75); and the Gorgon region of Iran near Gombab-e Kavus, 28.8 (Daniel G. Bates 1978, personal communication).

There were simply very few people living on the Susiana during the Uruk and in terms of aggregate density, there was no apparent problem of land availability. Yet, I have argued for local resource shortages relative to demand, especially around large centers. The point here is that aggregate population figures often mean very little. The specific distribution of pop-

ulation and differential demand for resources may, however, be of great importance irrespective of aggregate population density.

This is not to imply that growth is not important. The variables of greater interest, however, are probably system organizational scale and the degree to which that system is integrated. In presenting an admittedly tentative model of administrative system response to increase in system scale (Johnson 1978), I predicted that in very highly integrated systems, two levels of administrative hierarchy are likely to be present when about 24 basal organizational units are administered and three levels of hierarchy are likely to be present when about 70 basal units are administered. Although the 1978 model was based on assumptions that were unrealistic in the extreme, by simple accident that model generates organizational transitions when spans of control exceed six—a figure discussed above at some length. The formal characteristics of that model (not its assumptions) are thus in agreement with more recent work (Johnson 1982b, 1983) and may be evaluated with the Susiana data.

During the Terminal Susa A period there were four, largely autonomous enclaves of settlement on the Susiana (Johnson 1973:87–90). The largest of these was centered on Abu Fanduweh and contained about 12 hectares of settlement or, given my assumptions here, about 12 basal administered units. The administered settlement system of the western Susiana in Early Uruk contained about 49 administered units and that of the central Susiana in Middle Uruk about 107 administered units. Table 25 compares these values with those predicted for two- and three-level hierarchy formation. The values predicted for hierarchy transitions fit quite nicely between the estimated values for these three periods and provide additional support for the proposition that about 1 hectare of settlement functioned as the basal administered unit in these systems.

Increase in the scale and degree of integration of the Middle Uruk system also had an impact on the district level. The emergence of Chogha Mish to provide district-level administration in the eastern Susiana beyond the effective administrative ranges of Susa and Abu Fanduweh represented horizontal specialization at the district level of administrative organization.

Both horizontal and vertical specialization of the Middle Uruk administrative system were probably related to the continuing development of Uruk administrative technology. Prior to the appearance of numerical texts in Late Uruk (LeBrun 1971:179), administrative technology seems to have emphasized secure information transfer rather than information storage and as such is likely to have been more involved in maintaining activity coordination between levels of hierarchy than in aiding decision making within a level of hierarchy. (See also Le Brun and Vallat 1978; Schmandt-Besserat 1979, 1980; and Wright, Miller, and Redding 1980.)

Figure 28 presents a partial flow chart of variable relationships for Early and Middle Uruk. It incorporates the variables in table 24 as well as centralization of craft production and other processes discussed here. Early Uruk administrative support functions provide the entry point to this chart. I have suggested elsewhere (Johnson 1978:101–3) that social status differentiation may often be functionally related to administrative organization in structuring or supplementing the differential social influence of administrative personnel that partially ensures general compliance with administrative decisions. (See also Sutherland 1975:290 and Udy 1970:48.) Such differentiation of elite administrators can be expected to be associated with the differentially high elite utilization of resources which serves to signal their status. In the virtual absence of burial data, the best available data on social differentiation come from architecture and its artifact associations. (See Johnson 1976:216–17 and Wright 1981a.) Related administrative support functions, in what was probably a theocratic society, would have involved temple construction and other public works which again serve to both signal and legitimize the position of administrative personnel (Webster 1976).

Administrative requirements for labor and surplus production were high in Early Uruk but could apparently be met largely by center populations. Expansion of the Middle Uruk system and apparently successful attempts to increase center control of village populations both ensured provision of various administrative support functions and ultimately amplified them.

Note that the genesis of Early Uruk administration has not been considered here. We do not yet understand the organization of the Susiana in Susa A or the reasons for its collapse in Terminal Susa A. The Early and Middle Uruk economic strategy to more closely articulate villages with centers may have been associated with a decline in the degree to which kinship relationships were manipulated for political (and economic) ends. This impression is reinforced by aspects of the marked stylistic change in the ceramic assemblage between Susa A and Uruk. Frank Hole (1977b) is engaged in an analysis of painted Susa A ceramics available in both survey collections from around the plain and from excavation samples from Susa, including the Susa A cemetery (Necropole) of perhaps 2,000 burials at Susa itself. He suggests that specific painted types may have been associated with elites at Susa and settlements in its hinterland. If these elaborately decorated types were used to signal affiliation with high status kin groups (see Wobst 1977), then the virtual absence of painted or other elaborate decoration in

Uruk ceramics may also indicate a substantial change in the organization of social relations. A major change in mortuary ritual in the Uruk, reflected by the great rarity of Uruk burials in comparison to earlier and later periods, suggests much the same conclusion.

Whatever the causes of the Susa A collapse, it is probable that Early Uruk integrative mechanisms (at least through most of the period) were significantly different from those operative during Susa A and not yet at the state level of organization of Middle Uruk. This gives Early Uruk a high priority for future research as a critical transitional period in complex society development on the Susiana.

Late Uruk

The Late Uruk Collapse

As outlined elsewhere (Johnson 1973:143–56), settlement on the Susiana declined markedly in Late Uruk to only about 53 hectares of occupied area (see figure 29). This decline was apparently accompanied by the emergence of major hostilities on the plain as suggested by two classes of evidence. First, military scenes appear on seal impressions from both Chogha Mish (Delougaz and Kantor 1969:25) and Susa (Amiet 1961:251, 312). Second, a regular band of area completely devoid of settlement and some 14 to 15 kilometers wide opened between the eastern and western portions of the plain. I suggested that hostilities in the area were generated when Chogha Mish was able to break away from administrative control by Susa and attempt (apparently successfully) to become the center of an independent polity. In 1973, I speculated that Middle Uruk administrative capacity had been exceeded, but was unable to suggest a mechanism that would specifically account for the collapse of the system.

The preceding analysis of probable Middle Uruk administrative demand for rural surplus production indicates that the eastern and western portions of the Susiana were very different in their estimated ratios of demand to supply. While center demand for rural surplus may even have exceeded potential rural production in the west, demand was only about 36 percent of potential production in the Chogha Mish administrative district (table 21). I would like to suggest that elites at Chogha Mish attempted to sever their subordinate political relationship with Susa in order to obtain exclusive control of the eastern Susiana with its relatively high potential for extraction of additional rural surplus. Such separation may have been viewed as especially desirable if the eastern Susiana had been providing a significant level of surplus productivity to the western area of Susa and Abu Fanduweh.

Administrative avarice may, however, not have been the only factor prompting Chogha Mish to try to separate itself from Susa. Shipment of significant quantities of agricultural produce (and perhaps labor) out of the Chogha Mish administrative district to meet administrative demand on the western Susiana might have been a source of considerable rural unrest in the eastern area. Separation from Susa would then serve to both reduce rural dissent and assure provision of labor and produce to Chogha Mish itself.

While this scenario provides a possible reason for Chogha Mish to have attempted to establish itself as the center of an independent polity, it does not account for the inability of Susa to retain control of its subordinate administrative center. Earlier in this chapter, I attempted to demonstrate that the spatial range of direct administrative influence during Middle Uruk was limited to about 20 kilometers, or a one-day roundtrip. It is interesting to note that while Late Uruk Susa retained control of Abu Fanduweh (12.27 kilometers away), it lost control of Chogha Mish which was 28.56 kilometers away. Note that Chogha Mish is 26.55 kilometers from Abu Fanduweh so that neither direct control from Susa nor indirect control through Abu Fanduweh was possible.

If the physical distance in excess of a one-day roundtrip between Chogha Mish and Susa/Abu Fanduweh contributed to the observed breakdown of political integration on the Susiana, there should be cases elsewhere in which regional political integration was maintained and distances between major administrative centers were equal to or less than a one-day roundtrip distance. The contemporary Late Uruk settlement system of the Warka area in southern Iraq provides a contrasting case. In a situation of similar topography, the Warka Late Uruk system appears to have been highly integrated and to have included five major administrative centers. The average first order nearest neighbor distance among these five centers was 18.16 kilometers with a range of 16.99 to 20.29 (Johnson 1975:317). This would appear to have been a nearly optimal spatial pattern for administration in that it would maximize the territory under control of a given center and thus minimize the number of high-order centers required in the system, while maintaining system political integration through linked control from one center to the next.

I would envision a situation in later Middle Uruk in which Susa was losing control of administration at Chogha Mish. As Chogha Mish became increasingly independent, it could be expected to have attempted to assert control over as many settlements within its 20-kilometer maximum administrative range as possible. That Chogha Mish was situated 28.56 kilometers from Susa and 26.55 kilometers from Abu Fanduweh means there would thus have been considerable overlap in the maximum administrative ranges

of these centers. With Chogha Mish attempting to become the head of an independent polity, settlements located in this overlap zone would probably have been subject to conflicting administrative demands from Susa/Abu Fanduweh and Chogha Mish. This conflicting demand would most likely have taken the form of double assessments for agricultural produce and labor. It is not difficult to picture the plight of a villager in this overlap zone who, having discharged his labor (or military) responsibilities to the Susa administration, was confronted with identical demands from Chogha Mish. Recall that the average Middle Uruk center demand for surplus agricultural production was estimated to have been 77 percent of potential rural surplus. Doubling this demand would have created an obviously impossible situation and may account for the abandonment of numbers of villages located between Susa and Chogha Mish. Note that even if my original estimate of average center demand was substantially inflated, doubling that demand would probably have had the same effect as postulated here.

This hypothesis may be partially evaluated with the available settlement pattern data. Figure 30 indicates both the locations of Late Uruk and of abandoned Middle Uruk settlements. An administrative overlap zone has been superimposed on this map by drawing circles with 20-kilometer radii centered on Susa, Abu Fanduweh, and Chogha Mish. This theoretical administrative overlap zone corresponds closely to the observed band of settlement abandonment between the eastern and western portions of the plain. Indeed, of the fourteen Middle Uruk settlements in the overlap zone, eleven were abandoned by Late Uruk. Chogha Mish was apparently able to assert control over the remaining three settlements in this area. Two of these three settlements (KS-36 and KS-113) had been rural administrative centers within the Chogha Mish district in Middle Uruk and may then have been either more loyal to Chogha Mish in Late Uruk or better able to resist administrative demands from Susa.

It seems clear that the substantial conflict on the Susiana in Late Uruk postdates state formation. It is interesting that while this was a case of conflict within a society, it apparently originated within an administrative elite rather than between "classes" of markedly different social and economic characteristics. This view is supported by the rapid depopulation of the Susiana as seen primarily in the abandonment of smaller settlements. The aggregate area of large centers decreased by 22 percent from approximately 43 to 35 hectares. The aggregate area of smaller settlements, however, decreased by 68 percent from approximately 82 to 26 hectares.

The fate of the population represented by this decline is unknown. It is unlikely that a significant proportion of this population met its demise as the result of hostilities in the area. Most of the Late Uruk population decline can probably be attributed to emigration to other areas, despite clear evidence for local military activity. I once suggested that a portion of the Late Uruk population expansion in the Warka area of Iraq (Adams and Nissen 1972:11ff.) may have occurred at the expense of the Susiana (Johnson 1975:-337). A similar suggestion of the impact of possible Susiana emigration has been made by Alden (1979b:79–81) for the Kur River basin of Iran. Whatever the destinations of these people, the differential pattern of depopulation by settlement size on the Susiana suggests that lower-status villagers were moving out of the area, while elites among whom Late Uruk conflict originated tended to remain.

Although these propositions remain to be evaluated, they do focus attention on the role of the relationship between the Susiana and other areas on local Susiana developments. External contacts have not been considered in this chapter despite ample evidence of their existence.

Susiana "Foreign Relations"

Fuller discussion of fourth millennium relations of the Susiana to other areas of greater Mesopotamia would involve an initial exercise in comparative relative chronology that is both a topic of little concensus (few C^{14} determinations are available) and one beyond the scope of this chapter. Therefore, I will sketch my view of sundry issues without recourse to the customary panoply of references to obscure artifact illustrations.

Small excavation samples of Early Uruk material are available from the Eanna deep sounding (von Haller 1932) and the vicinity of the Steingebäude (Boehmer 1972) at Warka in southern Iraq, from Tepe Farukhabad (Wright 1981a) on the Deh Luran Plain, Tall-i-Ghazir (Caldwell 1968) on the Ram Hormuz Plain, and Susa and nearby villages on the Susiana. The remainder of our data are largely from surface survey (Adams 1981; Adams and Nissen 1972; Johnson 1973; Wright 1981b).

Sufficient data are available, however, to note that Early Uruk was a period of increasing interaction of some undetermined sort between the Susiana and southern Sumer. This at least insofar as the conveniently nebulous process of "interaction" may be monitored by the degree of similarity of ceramic assemblages. Whatever the nature of this relation, the pattern of late fifth to early fourth millennium ceramic change on the Susiana virtually precludes Warkan population movement or political control as relevant mechanisms of interaction.

The spatial organization of the Warka area (Johnson 1980b) was quite different from that discussed

earlier on the Susiana. Warka dominated an apparently dendritic settlement system with a four-level settlement hierarchy possibly indicating greater political complexity than is evident on the contemporary Susiana. This picture is complicated by the observation that the Nippur area north of Warka both dominated Warka demographically during Early Uruk and exhibited a distinct spatial structure (Adams 1981), implying a distinct and possibly yet more complex political organization.

Middle Uruk developments outside the Susiana and Deh Luran (Wright 1981a) have unfortunately received less attention, in part due to the difficulty of differentiating Late Uruk settlements from those occupied during Middle and Late Uruk on the basis of survey data. A Late Uruk population decline in the Nippur area (Adams 1981) made Middle Uruk occupations easily detectable in that area, as was the case on the Susiana. Massive Late Uruk expansion in the Warka area (Adams and Nissen 1972; Adams 1981) effectively obscures Middle Uruk developments in that critical area. Middle Uruk interregional data are then very limited, but the overall impression is one of an increasing relationship among a variety of local systems experiencing differential political development.

Late Uruk developments in greater Mesopotamia are better documented if even more poorly understood due to their complexity. Consider even the crude measure of aggregate population as indicated by hectares of occupation. Population of the demographically central Warka area increased by 121 percent (Adams 1981:69), while that of the nearby areas of Nippur (Adams 1981:69) and Ur/Eridu (Wright 1981c:325–27) decreased by 45 percent and 60 percent, respectively. The Late Uruk population on the Susiana declined 58 percent. Further decline in Uruk or Uruk-related settlement has been documented in the Izeh Valley of the Zagros (Wright 1979), on the Ram Hormuz Plain south of the Susiana, and probably in most of Luristan as well (Wright, this volume).

These peripheral population declines were approximately contemporaneous with a pattern of limited and apparently very specialized spatial expansion in a far periphery represented by classical Late Uruk occupations at Samsat, Habuba Kabira, and Jebel Aruda on the northern Euphrates (Alden 1982; Sürenhagen 1974/75; and van Driel and van Driel-Murray 1979), and perhaps slightly later at Godin in the Kangavar Valley of the Zagros (Weiss and Young 1975).

These demographic changes occur in the context of a very high degree of similarity of artifact assemblages, including both ceramics and administrative technology (seals and numerical tablets), that extends to very marked similarities in areas such as technique of building construction. The demographic changes indicated above would thus appear to have occurred during the period of highest interpolity interaction (and interdependence?) of the fourth millennium.

What happened? Fourth millennium specialists have a tendency to hide under their desks if they think that someone might ask them this question. There is some talk of colonies and trade emporia (Alden 1982; Kohl 1978; Lamberg-Karlovsky 1982; Weiss and Young 1975) that sometimes suggests a picture of expanding Warkan hegemony producing a greater Uruk coprosperity sphere. Yet there is little evidence for increasing long-range trade until the post-Uruk, Proto-Elamite period considered in Alden's contribution to this volume.

The interregional picture is thus opaque at best. The fourth millennium appears to have been one of emerging, complex polities, increasingly related to one another in an undetermined number of complex ways. How these large-scale relationships may have affected local developments such as that on the Susiana is an excellent question to which I have no answer. This is partially a problem of inadequate data, but is also one of inadequate theory. We simply have very little idea about what to expect of very large-scale interactions.

Conclusion

The conclusions presented in this chapter on the Susiana Uruk are tentative at best. As Henri Claessen remarked in his review of an earlier version, "It's like juggling with eggs—with all the risks of the game." The discussion has, however, highlighted a few of the problems in the development of this complex society.

The problem of variables involved in administrative control of rural populations is more than a little vexing. While the degree of control in Middle Uruk reflected by basal span of control, estimated administrative demand for labor, and estimated demand for surplus agricultural production was high, it was also spatially bounded. This limitation appears to have been engendered in part by the relative advantages to rural populations of participation in a centralized system rather than by the ability of administrative elites to impose control on those populations. Although many see physical force as central to the operation of early states (see Webb 1975, for example), there is an emerging view that early states functioned through a complex interaction of coercion and consensus (Claessen and Skalník 1978:640; Godelier 1978:767–768; Service 1975:266ff.). The apparent emigration of a significant portion of the rural population out of the Susiana in late Middle and Late Uruk suggests both that the advantages of rural participation in the system were declining rapidly and that administrative elites had access to insufficient force to prevent villagers from "voting with their feet."

The spatial limits on administrative control mentioned above raise another set of problems involving boundary phenomena. There appear to have been boundaries between administered settlement systems and marginal settlements on the Susiana in both Early and Middle Uruk. These boundaries were probably much more clinal than depicted here, being generated by a decline in rural interaction with centers over distance. Some boundaries were more sharply defined. The apparent northern boundary of the administered Middle Uruk settlement system was marked by a series of small, specialized administrative centers which surely must indicate administered boundary maintenance and interaction between the Susiana system and some other population(s), perhaps pastoral nomads. The boundary between the eastern and western Susiana in Late Uruk was the most clearly defined and appears to have been generated by competition and hostility between rival administrative centers. These various boundaries are very poorly understood. Problems of boundary formation, function, and relative permeability would certainly merit further investigation as boundaries may be more sensitive than core areas to processes of system change.

Another problem raised by this analysis involves the determinants of administrative span of control and especially how spatial variability in span may provide information on variability in degree of control and/or range of administered activities. Such questions will probably be most usefully addressed through formal organization theory which has been little used in archaeology.

A further problem is also related to the organization of administration. Throughout this chapter I have used the terms administrators and elites interchangeably although there is little reason to believe that the groups so designated were coterminous. For example, we have a fragment of an unusually heavily constructed building from the Late Uruk occupation of KS-54 near Abu Fanduweh. Copper implements and gold and lapis lazuli beads were found in a nearby pit (Johnson 1976:217). These are unlikely to have been the possessions of simple villagers. Yet (in a small sample) there was no evidence of resident administrative activity on the site. Perhaps this was the rural estate of an elite administrator from Abu Fanduweh, but perhaps not. We can probably expect that this complex society was in fact complex: that it was composed of a variety of noncoterminous groups of administrators of different grades, elites of different status, specialized craftsmen, simple laborers, agriculturalists, and so forth, all pursuing noncoterminous ends. The naiveté of models like that presented in figure 11 becomes ever more obvious.

Although most of the data used here have been available for some time and I thought that they had been wrung for about all they were worth, they have been useful in identifying a number of potentially productive lines of research. If I was wrong, it only illustrates the old point that the results obtained from the analysis of a data set are more than tangentially related to the questions asked.

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Table 15. Bevel Rim Bowl (BRB) Densities in Village Excavation Samples

Site	*Period of Deposit*	*Type of Deposit*	*Vol. (m^3)*	*BRB Sherd Count/m^3*	*Non-BRB Sherd Count/m^3*	*BRB Percent of Total Count*
KS-54	Late	Arch.	17.04	429.87	665.66	39
KS-54	Middle	Pit	9.67	586.05	460.96	56
KS-34	Early	Pit	6.37	37.05	713.18	05

Table 16. Distribution of Proto-Bevel Rim Bowls on Early Uruk Sites (n = 49)

		Western Susiana	*Eastern Susiana*
Proto-Bevel Rim Bowls	*Present*	18	9
	Absent	7	15

Note: $x^2 = 5.87$, df = 1, p less than .02: Data Source—Johnson 1973: 39, 165–167.

Table 17. Distribution of Centrally Produced Early Uruk Neckless Ledge Rim Jars in Villages

Site	*KS-34*	*KS-76*	*KS-96*	*KS-108*	*KS-153*	*KS-266*
Type of Sample	*excavation*	*excavation*	*survey*	*survey*	*survey*	*survey*
Distance to Susa (km.)	5.14	21.49	17.48	25.31	47.96	22.21
Distance to Abu Fanduweh (km.)	7.10	11.20	7.67	22.76	45.68	19.25
Distance Ratio	1.50:1	.52:1	.43:1	.90:1	.95:1	.87:1
Neckless Ledge Rim Sample Size	30	8	8	6	3	4
Predicted Number of Susa Type	18.00	2.74-(3)	2.41-(2)	2.84-(3)	1.46-(1)	1.86-(2)
Observed Number of Susa Type	20	3	2	2	1	2
Predicted Number of Abu Fanduweh Type	12.00	5.26-(5)	5.59-(6)	3.16-(3)	1.54-(2)	2.14-(2)
Observed Number of Abu Fanduweh Type	10	5	6	4	2	2

Table 18. Distances Traveled per Day over Flat Terrain in the Near East

Traveler	*Trip*	*Linear Distance (km.)*	*Days*	*Linear Distance per Day (km.)*
Loftus (1857:306–310)	Shushtar-Dezful	55	2	27.5
Loftus (1857:288–89)	Mohammerah-Ahwaz	115	3	38.3
Loftus (1857:74)	Baghdad-Hilla	100	3	33.3
Heude (1817:215–16)	Erbil-Mosul	85	2	42.5
Heude (1817:220–25)	Mosul-Mardin	245	5	49.0
Soane (1908:109)	Erbil-Kirkuk	90	2	45.0

Table 19. Middle Uruk Population Density per Square Kilometer

	Western Susiana					*Eastern Susiana*			
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*
1†	0.00	*5.44*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	12.08	0.00	8.32	0.00	0.00	0.00	0.00	0.00
3	12.16	0.00	4.80	6.40	3.04	0.00	*80.00*	9.60	0.00
4	0.00	*200.00*	0.00	0.00	12.00	33.92	16.00	0.00	16.00
5	0.00	34.72	18.56	2.88	24.64	44.00	0.00	0.00	0.00
6	0.00	8.96	*102.72*	5.12	6.00	0.00	6.72	0.00	0.00
7	0.00	*60.80*	18.24	18.56	20.96	0.00	*58.64*	0.00	0.00

Notes:
† Refers to grid in fig. 27.
n = densities higher than 50/km².

Table 20. Surplus Requirements and Potential Surplus Production (in Hectares)

	Western Susiana					*Eastern Susiana*			
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*
1†	0	204	0	0	0	0	0	0	0
2	0	453	0	312	0	0	0	0	0
3	456	1875	180	240	114	0	*1500*	360	0
4	0	*3750*	1875	0	450	1272	600	0	600
5	0	1302	696	108	924	0	0	0	0
6	0	336	*2636*	192	*225*	0	252	0	0
7	0	*540*	684	696	786	0	*432*	0	0

Notes:
† Refers to grid in fig. 27.
n = Potential Surplus Production
n = Center Surplus Requirements.

Table 21. Middle Uruk Surplus Requirements and Potential Surplus Production (in Hectares)

	System	*Western Susiana*	*Eastern Susiana*
Center Surplus Requirements	*8858*	*6926*	*1932*
Potential Rural Surplus Production	*11442*	*6093*	*5349*

Table 22. Patterns of Middle Uruk Population Growth: Change in Hectares of Settlement from Early to Middle Uruk

Administrative District	*Large Centers*	*Small Centers*	*All Centers*	*Villages*
Susa	13.00	0	13.00	−1.24
Abu Fanduweh	2.64	4.70	7.34	−1.96
Chogha Mish	10.00	2.30	12.30	−2.01
Marginal Areas	0	0	0	3.96
Totals			32.64	−1.25

Table 23. Alternative Middle Uruk Population Growth Rates

	Required Growth Rates per 1000 per Year		
Years over which Growth Occured	*Marginal Settlements*	*Alternative (1): Administered System*	*Alternative (2): Centers Only*
	Average Rates	*Average Rates*	*Average Rates*
300	0.701	0.989	2.595
275	0.773	1.058	2.831
			high rates
250	0.850	1.164	3.114
225	0.944	1.293	3.461
200	1.063	1.455	3.894
175	1.215	1.663	4.452
150	1.417	1.939	5.196
125	1.700	2.329	6.238
			improbably high rates
100	2.103	2.969	7.083
		high rates	
75	2.838	3.885	10.418
	high rates		
50	4.210	5.947	15.688

Table 24. System Level Changes from Early to Middle Uruk

Variable	*Early Uruk*	*Middle Uruk*	*Change*	*Proportional Change*
Levels of Administrative Hierarchy	2	3	1	.50
Basal Level Span of Control[a]	25	11	−14	−.56
Administered Population	9806	21382	11676	1.18
Proportion of Population in Centers	.39	.56	.17	.44
Population of the Susiana	19036	25338	6302	.33
Demand for Rural Labor(BRB/m³)	37	510	473	12.78
Demand for Rural Surplus (Proportion of Potential Surplus)	.05[b]	.77	.72	14.40

Notes:
[a]These figures are administrative district averages. The Middle Uruk span, without consideration of district variability, is 7.
[b]I do not have a direct estimate of Early Uruk center demand other than it was "low." Assuming a close relationship between demand for produce and demand for labor, the Early Uruk figure of .05 is equal to village bevel rim bowl density as a proportion of center bevel rim bowl density.

Table 25. Observed and Predicted Number of Basal Administered Units in Two- and Three-Level Hierarchies

Period	*Levels of Heirarchy*	*Observed Basal Administered Units*	*Predicted Basal Administered Units Required for Transition*
Terminal Susa A	1	12	
			24
Early Uruk	2	49	
			70
Middle Uruk	3	107	

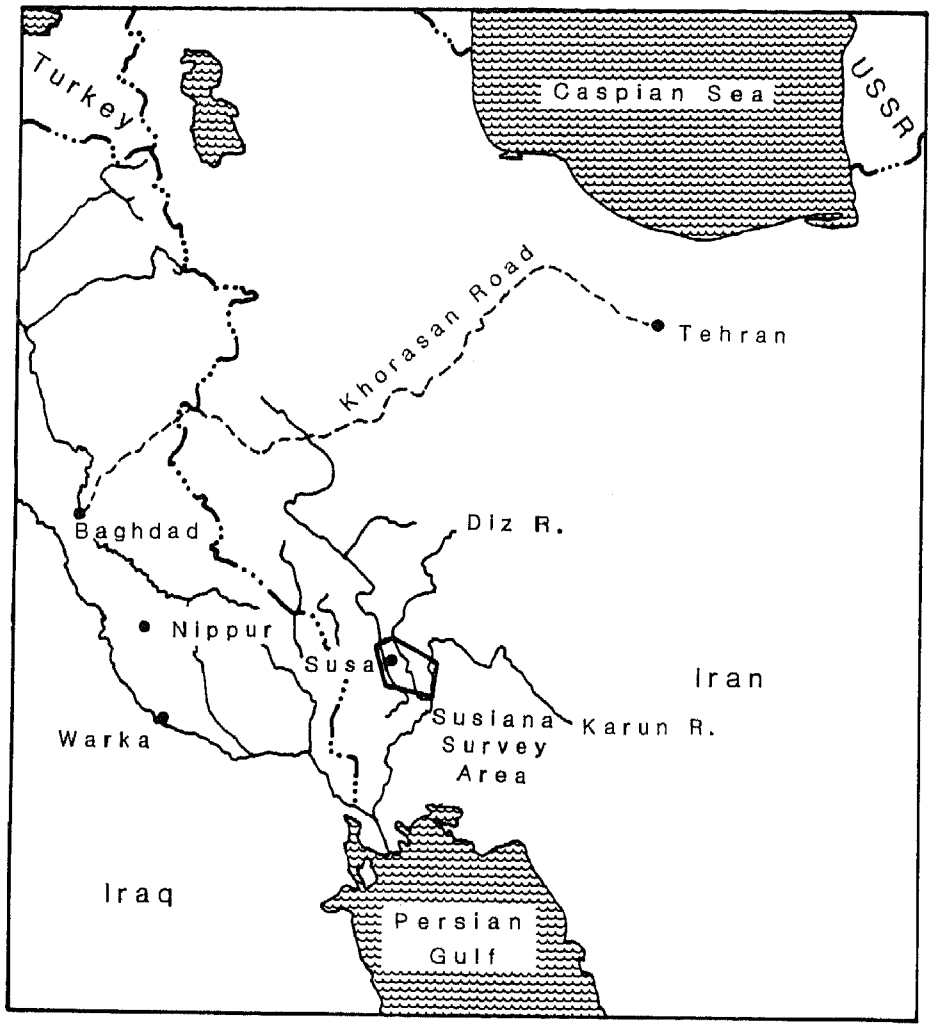

Figure 18. Location of the Susiana survey area.

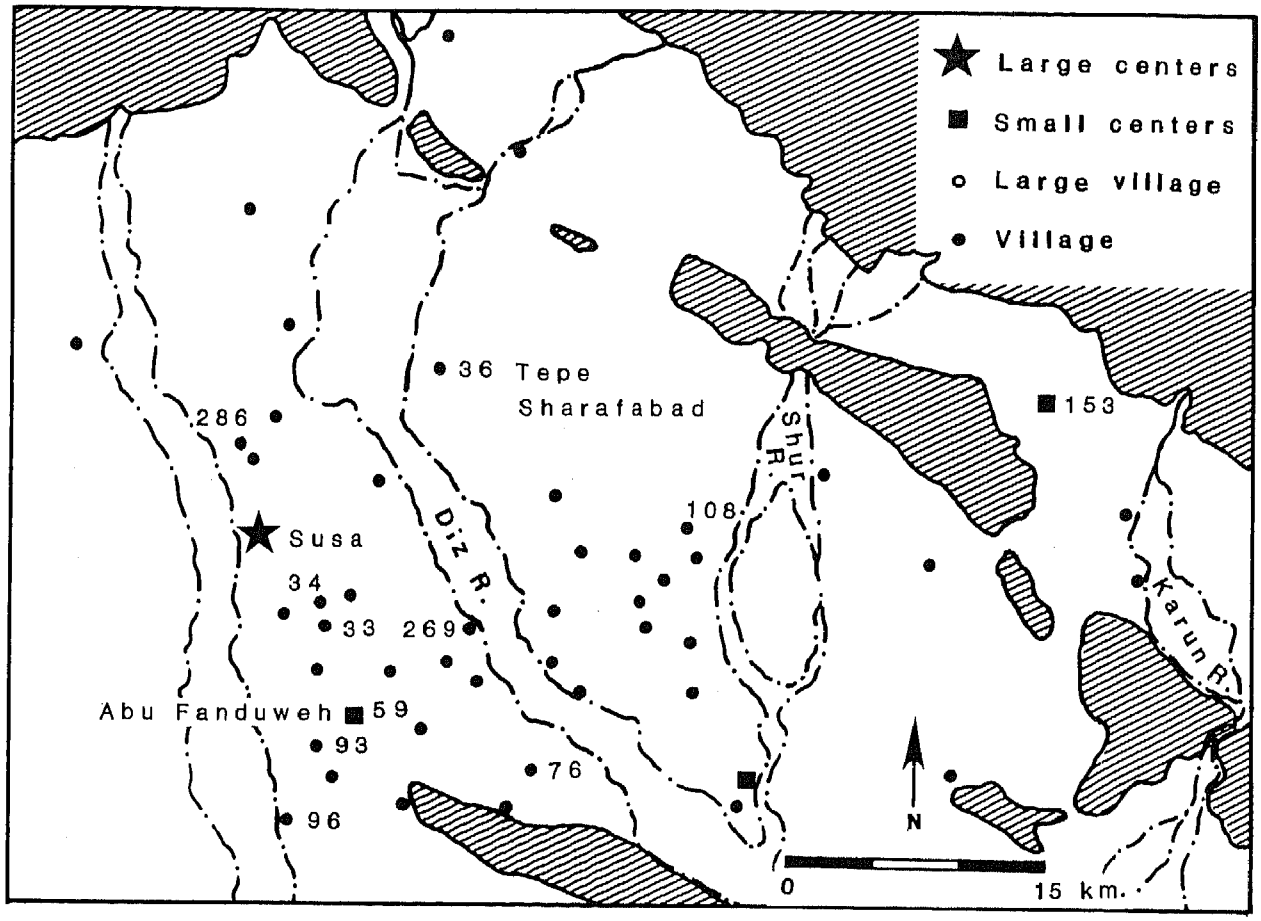

Figure 19. The Early Uruk settlement system.

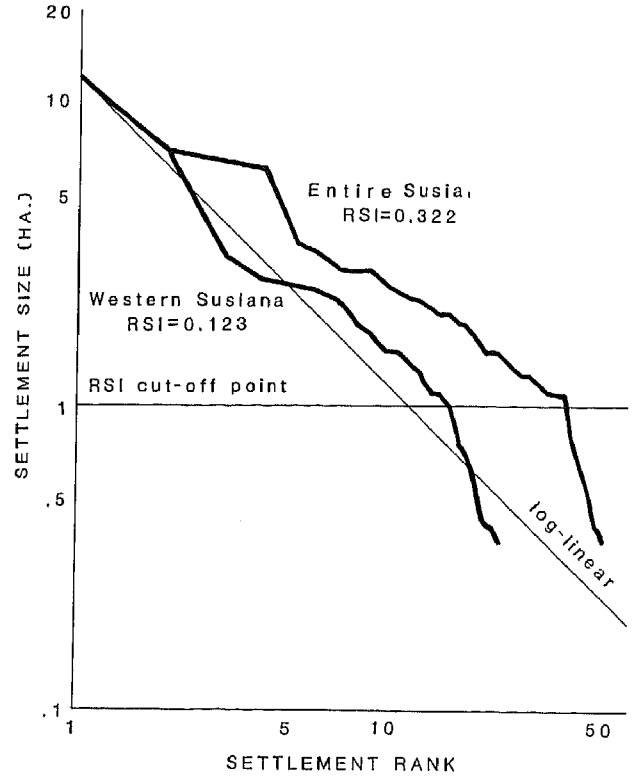

Figure 20. Early Uruk: Definition of the administered settlement system (rank-size distributions).

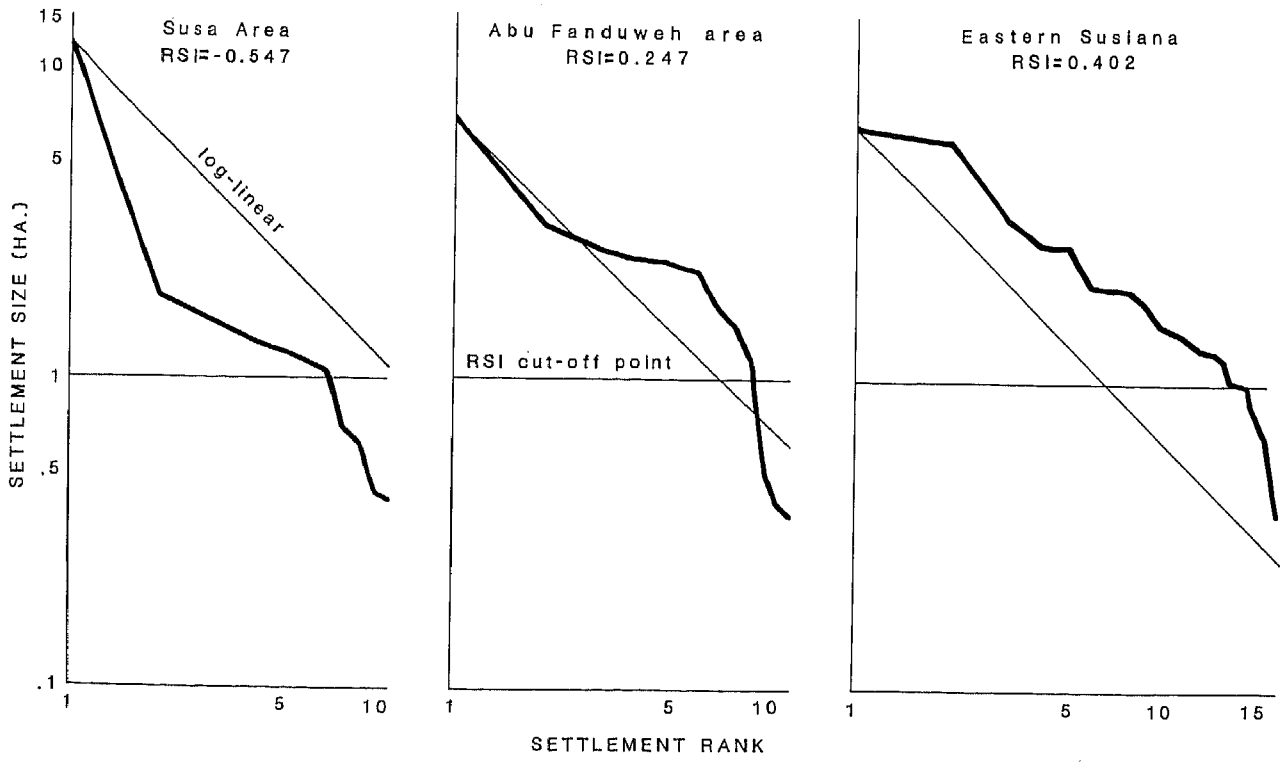

Figure 21. Early Uruk rank-size distributions: Administered districts and marginal area.

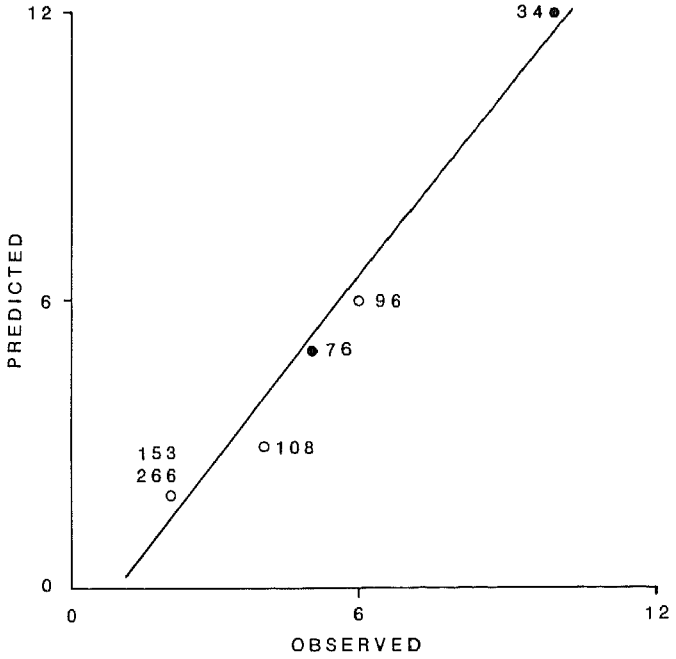

Figure 22. Early Uruk: Observed and predicted frequencies of Abu Fanduweh–type neckless ledge rim jars in villages (open circles = survey collections, filled circles = excavation collections); $r = 0.986$, $df = 4$, $p < 0.01$.

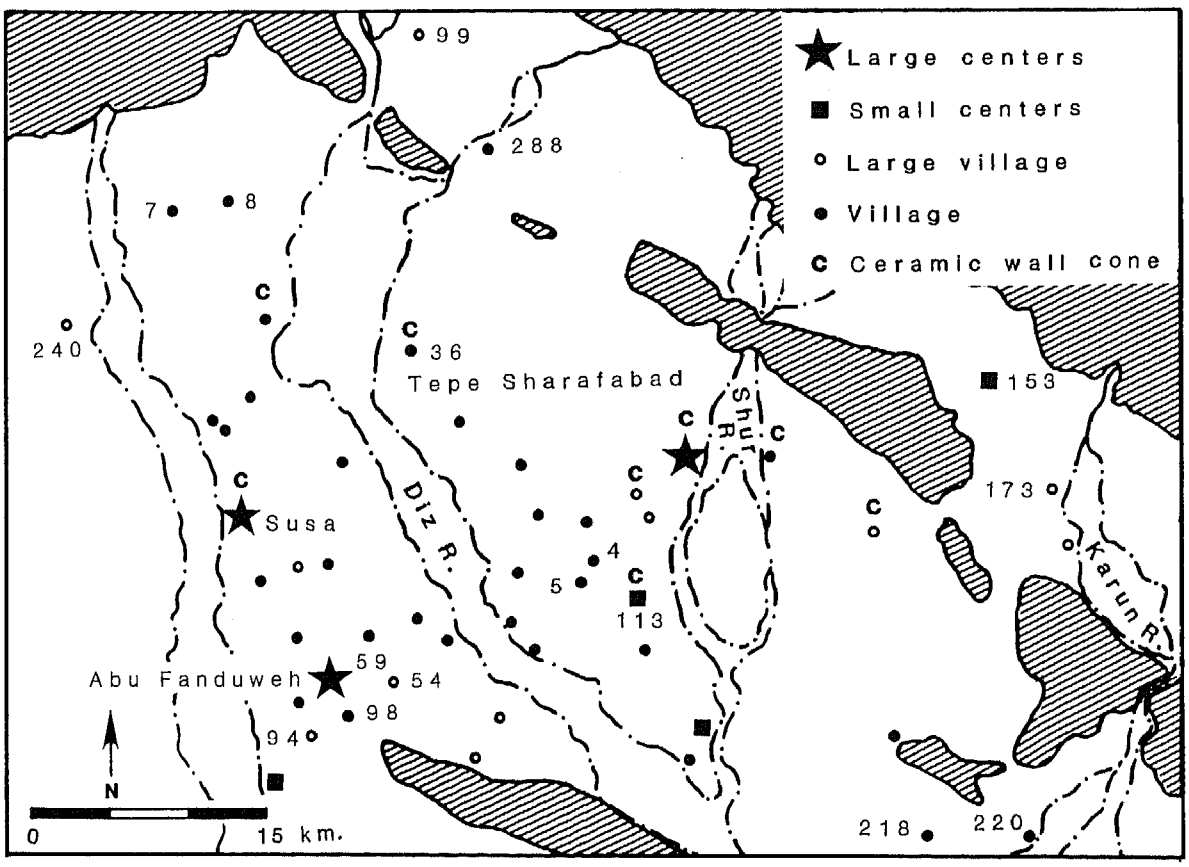

Figure 23. The Middle Uruk settlement system.

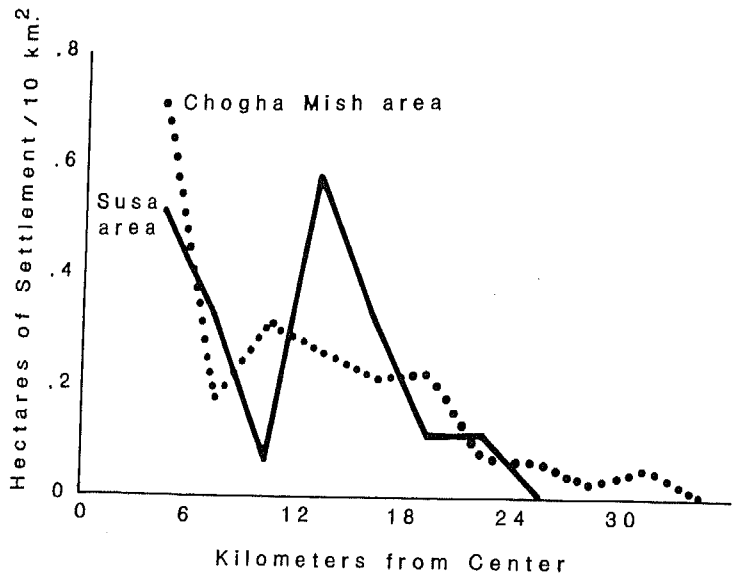

Figure 24. Settlement density in circular zones around Susa and Chogha Mish.

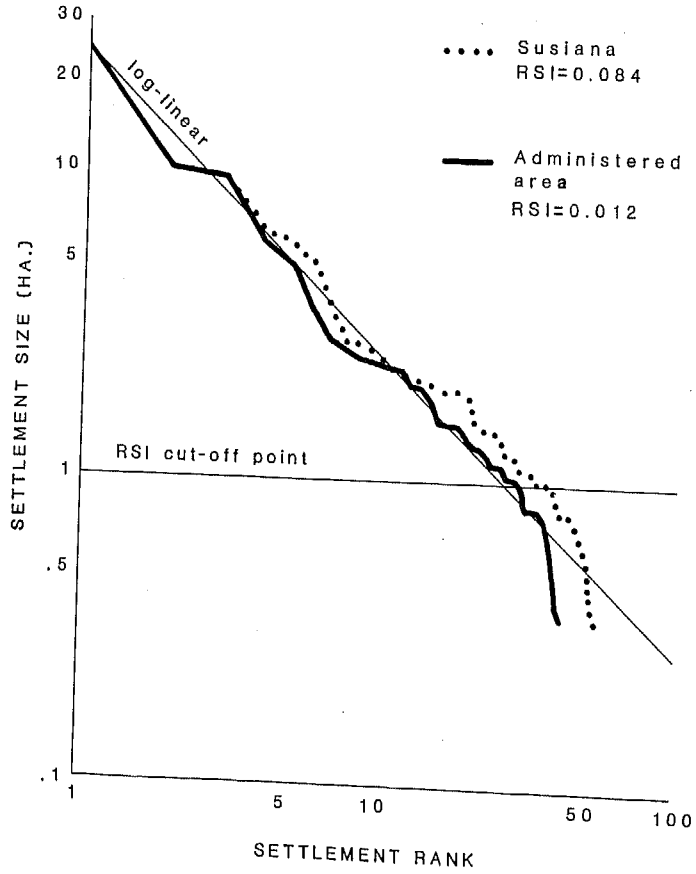

Figure 25. Middle Uruk: Definition of the administered settlement system (rank-size distributions).

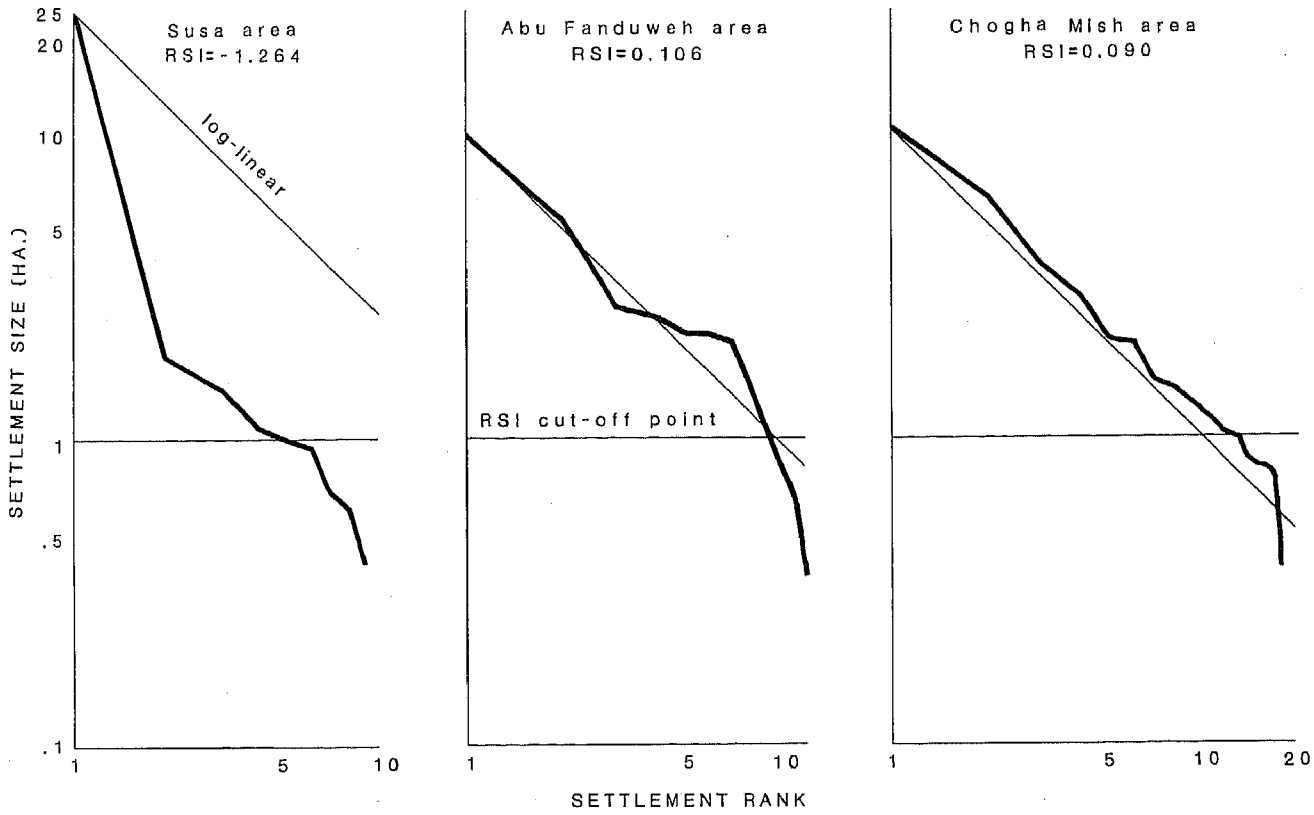

Figure 26. Middle Uruk rank-size distributions: Administrative districts.

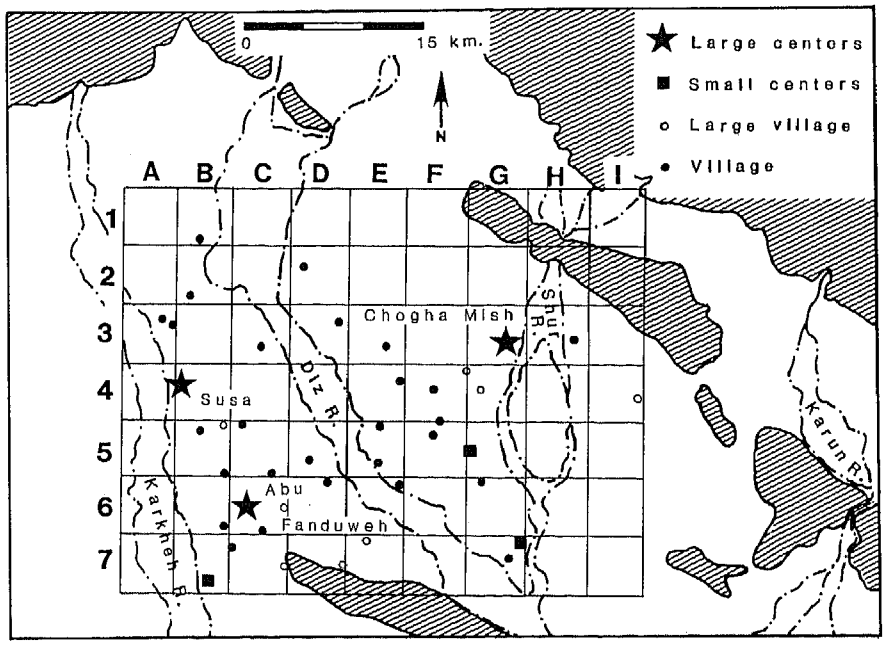

Figure 27. Grid system for analysis of Middle Uruk center demand and potential rural surplus productivity.

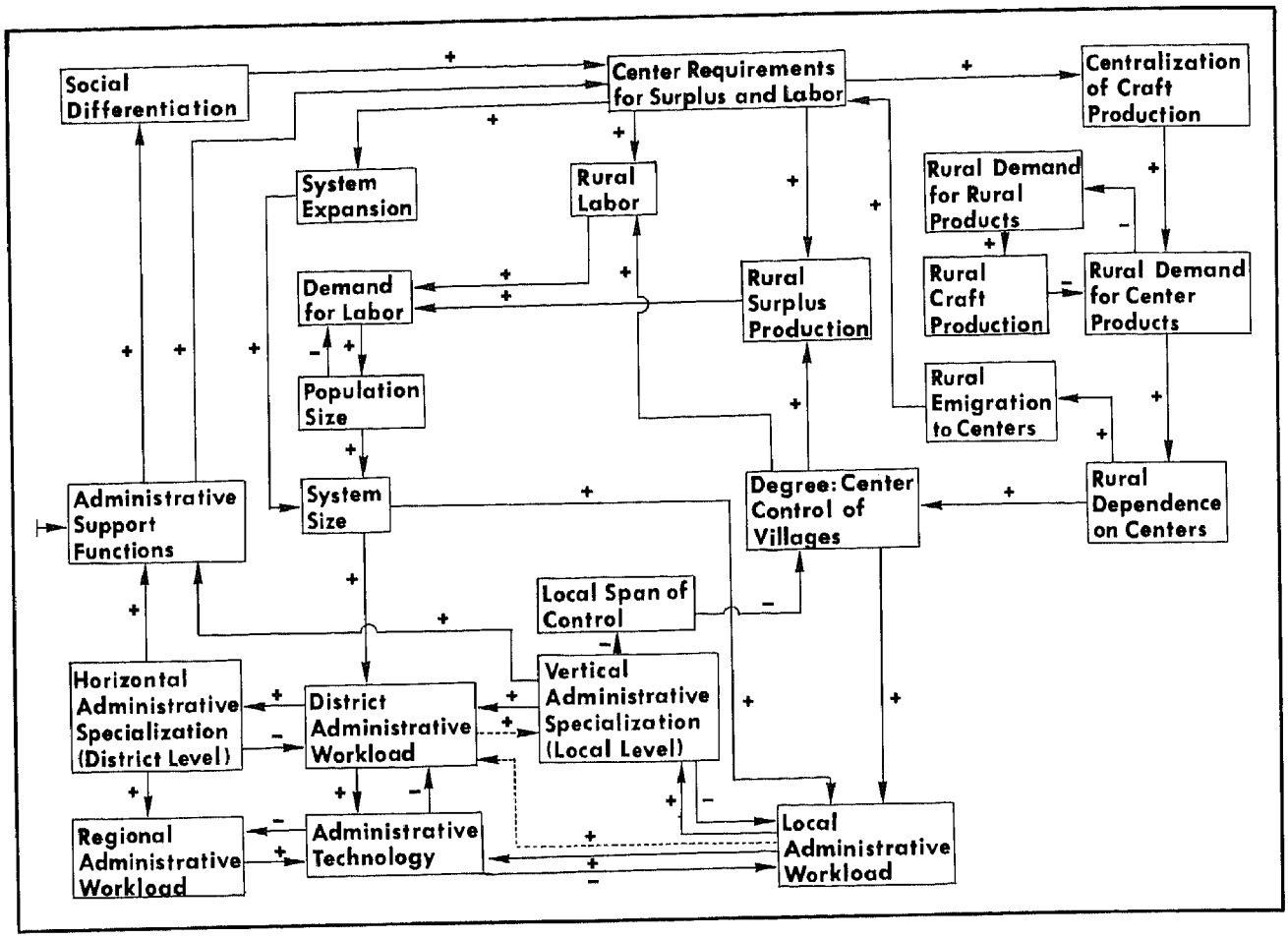

Figure 28. Processes in Uruk state formation (dashed arrows indicate processes operative prior to local-level vertical administrative specialization).

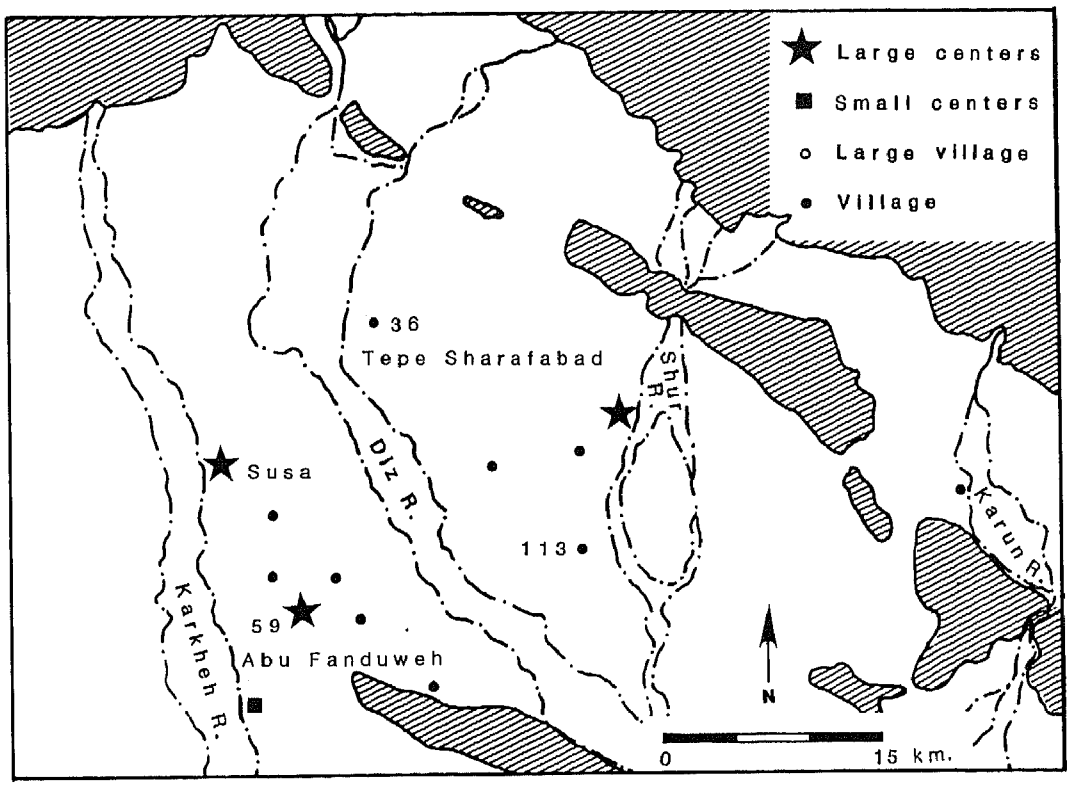

Figure 29. The Late Uruk settlement pattern.

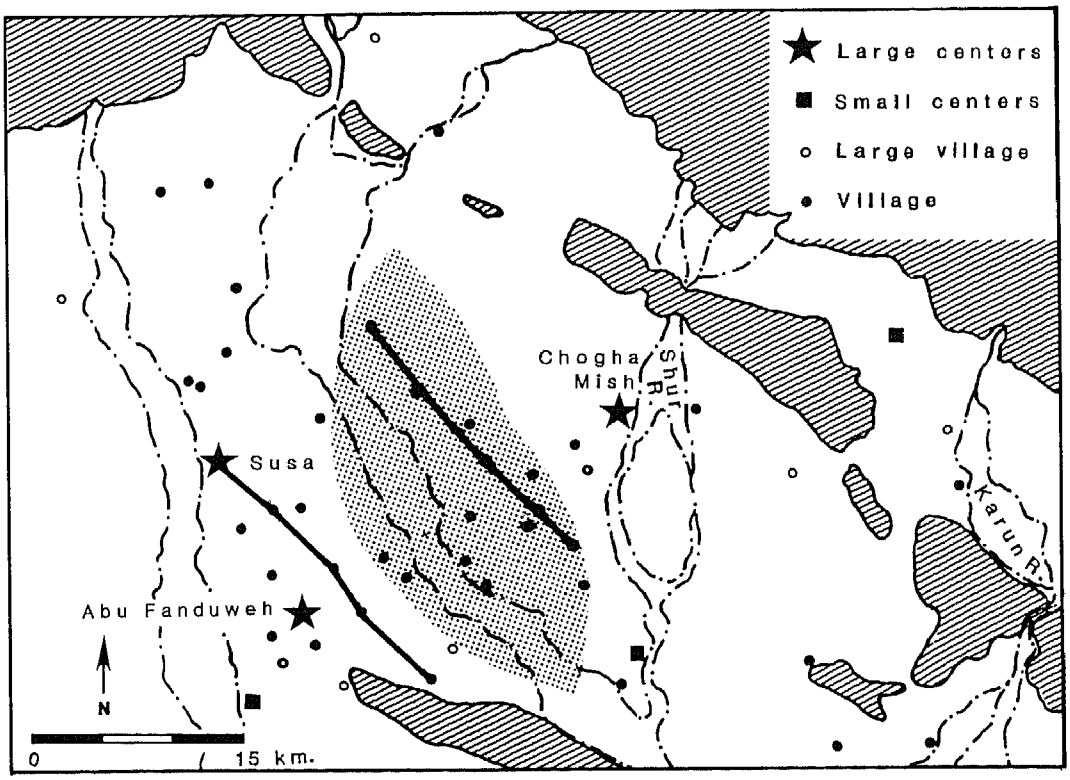

Figure 30. The Late Uruk administrative conflict zone and pattern of settlement abandonment.