

Productivity and Labor Scheduling Aspects of Titicaca Basin Raised Field Agriculture

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Abstract

Previous interpretations of the significance of raised field agriculture in the Tiwanaku political economy have shared a common assumption, termed here the 'hyperproductivity hypothesis'. This hypothesis is critiqued and an alternative proposal, that raised fields allowed state labor demands to be offset from commoner subsistence activity in the agricultural cycle, is advanced. The significance of this strategy of staggered production cycles is explored as a potential 'instrument of expansion' of the Tiwanaku political economy.

[slide] Raised fields may be loosely defined as any surface artificially elevated for agricultural purposes. Normally, this results in a structure such as that

depicted in the slide: excavated canals alternating with elevated planting platforms. Such agricultural features were a very widespread phenomenon in the prehistoric Americas, and indeed worldwide. They are found throughout Bolivia, Peru, Ecuador, in much of lowland South and Central America, and as far North as Wisconsin. The Titicaca Basin, with more than 800 square kilometers of prehistoric raised fields, is thought to be one of the four largest concentrations in the New World.

Among archaeologists, raised field agriculture is considered to be, in Stanish's words, "one of the primary, if not the most important, economic underpinning of the Tiwanaku state." The importance of raised fields in the Tiwanaku political economy has been demonstrated empirically by Stanish, Janusek, Seddon and others, and is thus relatively uncontroversial.

The *explanation* for the importance of raised fields for the Tiwanaku polity is equally uncontroversial, though, I contend, less deservedly so. Erickson was the first to argue, on the basis of his experimental observations, that periodic cleaning of the canals could enrich the soil of the planting platforms, making possible very high yields with very short fallow periods. This formulation has been adopted by virtually every subsequent researcher in the Basin. Many, most influentially Kolata, have argued that the astronomic yields observed on the experimental plots could be sustained indefinitely with no fallow period whatsoever. Kolata has even gone so far as to suggest that two potato crops annually could be cultivated on raised fields with no loss of productivity. This notion, that raised fields are capable of producing extremely high yields sustainably with no fallow interval, I term the 'hyperproductivity hypothesis'.

Although I have serious doubts about the validity of the 'hyperproductivity hypothesis', it is not my aim in this paper to offer a thorough critique of it. Rather, I intend to present an alternative interpretation of the role of raised field agriculture in the Tiwanaku political economy: to wit, that the large scale use of raised fields for state agricultural production allowed the Tiwanaku state to

minimize the conflict between its own labor demands and the subsistence activity of its subjects, and at the same time to maximize total surplus production. I will refer to this as the 'staggered production cycle hypothesis'. In order to formulate this hypothesis, it is first necessary to consider certain aspects of agriculture in the Andean highlands.

In the highlands environment, and particularly in the Titicaca Basin, the timing of the agricultural cycle is closely constrained by the beginning of the rains, on the one hand, and the onset of killer frosts on the other. Planting cannot begin until the rains have wet the soil, and the harvest must be completed before the crop is destroyed by hard frosts or hail. The result of this set of conditions is an agricultural cycle characterized by 'crunch' periods of high labor requirements, particularly at planting and harvest. This situation drastically constrains the amount of land that may be put into production, and results in large amounts of 'wasted' labor potential that cannot be applied toward agricultural production during the 'down' periods.

[slide] The slide displays the mean monthly values for minimum nighttime temperature, precipitation (percent) and agricultural labor (percent) for the contemporary Titicaca Basin. The onset of the agricultural year is clearly indicated, with field preparation beginning with the first rains in September and October, planting in November and December, and harvest in late April and May, before the mean nighttime minimum temperature dips below freezing in June. Note that the harvest season presents the most significant crunch period in the cycle, with the months of April and May accounting for 47.2% of the total annual agricultural labor. It is obvious that the labor requirements of the harvest are the most significant variable constraining the amount of land that a household or community may plant in a given year.

Since in this symposium we are discussing the Tiwanaku political economy, here is a political economic problem the Tiwanaku polity would have had to face: any attempt on the part of the state to increase absolute agricultural surplus

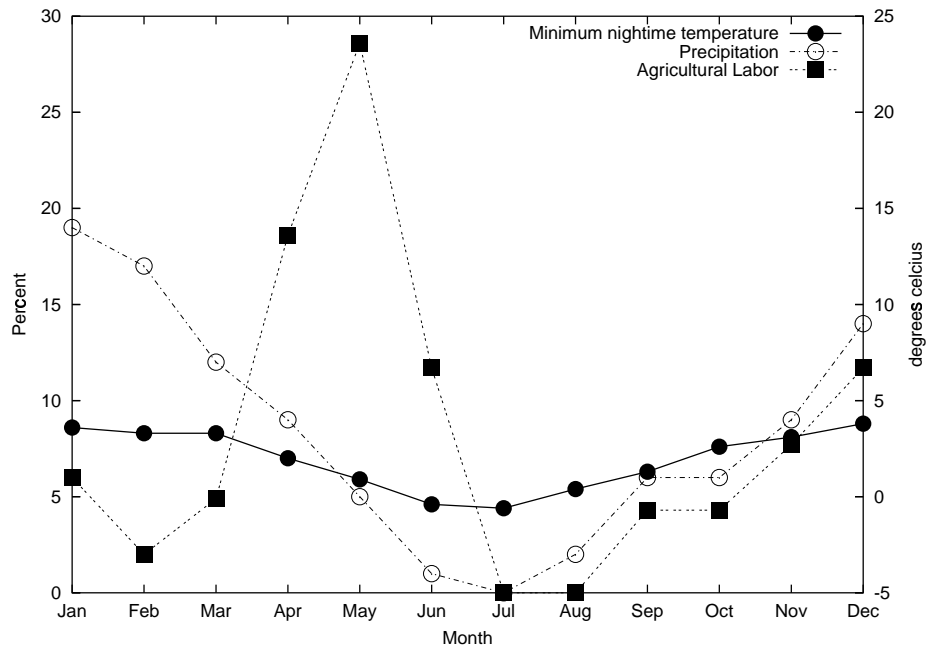


Figure 1: Climatic and economic seasonality in the Titicaca Basin

production would inevitably have demanded labor from its subjects in precisely these 'crunch' times of the agricultural cycle, particularly at the harvest. That is to say that the agricultural labor demands of the state would have directly conflicted with the critical subsistence activities of its subjects, a circumstance which can be expected to have generated considerable discontent or even open rebellion if pushed too far. This circumstance would have put an effective and low cap on the annual amount of agricultural labor extracted from the state's subjects, and therefore on the state's total annual surplus production.

However, there do exist techniques for working around these sorts of constraints. Jurgen Golte calls these 'estrategias policiclicas' - 'polycyclic strategies'. The basic concept of the 'polycyclic strategy' is that a number of different economic cycles may be combined in such a way that their annual crunch periods are offset rather than overlap. That is, the cycles are staggered.

The most fundamental and ancient example of this sort of strategy in the Andes is tuber agropastoralism itself. In this system, the timing of labor investment in the herds is offset from the crunch periods of the agricultural cycle. In this way labor that cannot be invested in agriculture is invested in herding, and vice versa. This results in a more complete and efficient use of labor throughout the year than would be possible in either a purely agricultural economy or in a purely pastoral one.

A second example: Hastorf has observed a similar strategy in the Mantaro Valley of Peru. She describes a practice of using irrigation canals to plant certain fields 1-2 months in advance of the onset of the rains and the main planting. These fields are then safe from possible early frosts and hailstorms, since their harvest is completed well before temperatures begin to drop appreciably, and are harvested before the harvest of the main body of fields is begun.

Another class of related examples are the agricultural systems of the highland valleys, with which Golte is primarily concerned. In these environments, producers practice a form of 'microverticality', exploiting the agricultural properties of land at varying elevations. In these different elevations, different crops may be planted, with differing growing seasons and labor requirements. In this way a whole series of staggered agricultural cycles are exploited, together with pastoralism in the puna grasslands, to spread productive labor more evenly throughout the year. This is a technique for maximizing labor efficiency on the household level.

In this connection, it is interesting to note that Golte singles out the Titicaca Basin as one of two areas in the Andes the other being the Upper Mantaro Valley in which the possibilities for polycyclic labor maximization are most limited. This is because these areas lack dramatic vertical relief and so are unable to employ a 'microverticality' strategy in agriculture. Herding and fishing and more recently wage labor can make up for this to some extent. But, Golte points out, opportunities for maximizing the use of agricultural labor throughout the year

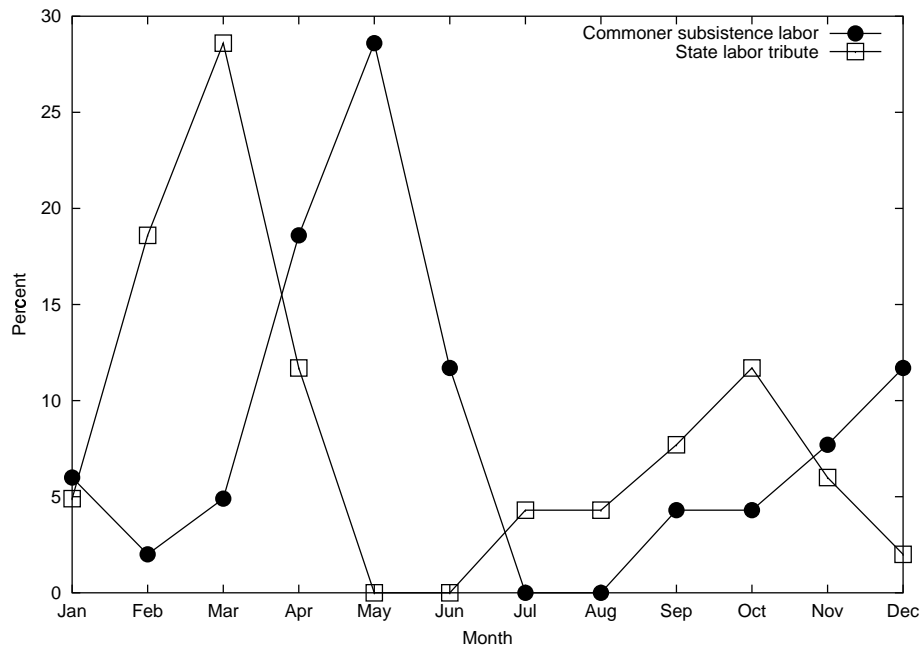


Figure 2: Hypothetical commoner and state labor cycles

remain extremely limited in the Titicaca Basin.

I would like to propose, however, that raised field agriculture represents exactly such a strategy for the staggering of agricultural cycles and the maximization of labor efficiency, and one specific to the Titicaca Basin. The key to this strategy would have been the water in the canals, which, as Erickson has noted, would permit splash irrigation of the fields. This could have allowed planting to take place after the danger of frosts had passed, but still well before the onset of the rainy season.

The implications of this understanding for Tiwanaku labor management are profound. Let us assume that the majority of state agricultural production was in raised fields, and the majority of commoner subsistence production was in dryland fields. Then shifting the agricultural cycle for raised fields forward by two months that is, planting in August and September, rather than in October and

November [slide] would mean that **no labor whatsoever** would be required of tribute payers in the month of May, the crunch period of the dryland harvest, since the raised field harvest would already have been completed in March and April. This means that state labor demands would have conflicted **not at all** with the subsistence activities of its subjects. The slide depicts these offset cycles of state agricultural demands and commoner subsistence labor in this scenario, assuming and this is admittedly a stretch that all state agriculture took place in raised fields and all commoner agriculture in dryland systems.

When viewed in this light, the unique advantage of raised fields for the Tiwanaku state lay not in their hyperproductivity but rather in the fact that they presented the opportunity to exact agricultural labor from its subjects while minimizing its interference with their own subsistence activities. And at the same time putting into action a vast labor potential that could not otherwise have been applied to agricultural production. This would have simultaneously 1) reduced conflicts between state labor demands and the subsistence interests of the populace and 2) permitted a significantly higher rate of annual agricultural labor extraction and therefore of annual surplus production.

I propose as a hypothesis which will hopefully stimulate empirical research that this strategy of staggered production cycles was a crucial factor in the Tiwanaku polity's initial formation and in its subsequent expansion, perhaps even the core component of Tiwanaku statecraft.

The explanatory potential of this idea is considerable. If the strategy of staggered production cycles was indeed a central component of the Tiwanaku political economy, we may begin to understand the structural conditions underlying the state's rather limited and sporadic expansion beyond the confines of the Titicaca Basin. Unlike the Wari state, whose political economy seems to have been 'portable' (at least within a highland context) the Tiwanaku political economy was 'tethered' to areas that were 1) suitable for largescale raised field agriculture (large flat areas with an ample perennial water source) and 2)

characterized by a sharply constrained dryland agricultural cycle. That is, it was tethered to the circumlacustrine areas of the Titicaca Basin itself. Thus Tiwanaku expansion beyond the Basin took the form of trade relationships as in San Pedro de Atacama or of small, intrusive colonies/labor camps as in Moquegua rather than of conquest and administration of local populations. Indeed, it seems likely that the Tiwanaku state never did expand beyond the Basin in a true territorial or administrative sense. Rather, it emitted specifically targeted tentacles to absorb desired resources.

It should also be noted that the strategy of staggered production cycles is in no way a strategy available only to state level societies. It could have been employed at any level of social organization, from the individual family through the ayllu through the Formative Period chiefdoms and 'protostates'; indeed in any situation in which the production of a considerable agricultural surplus was desired. Stanish's data suggest that the Late Formative Sillumocco polity may have employed a similar strategy.

I should point out that the 'staggered production cycle hypothesis' does not in fact contradict the 'hyperproductivity hypothesis'. The strategy of staggered production cycles could have been employed irrespective of the hyperproductivity of raised fields. The viability of the strategy, however, is not dependent upon raised field hyperproductivity. If the 'hyperproductivity hypothesis' turns out to be unrealistic as I believe it will the ideas presented here will in no way be affected.

Finally, raised field agriculture itself is not necessary in order to employ a strategy of staggered production cycles. The extensive irrigated terrace developments of the Inka state, for example, could have been utilized in an analogous manner, irrigated fields being planted before the onset of the rains and harvested before the beginning of the dryland harvest. Indeed, there are some intriguing hints that this was the case. Cobo (Book 12, Chapter 28) says that subjects of the Inka state were charged "with the responsibility of cultivating [the

fields of the Inka] *first and at the proper season*". And Garcilaso (Book 5, Chapter 2) states that the lands of the state, of the local leaders and of the local populace were cultivated in a determinate order, indirectly suggesting that state labor demands were offset from local subsistence production.

Clearly, the limits and implications of the strategy of staggered production cycles have yet to be explored in any truly rigorous fashion. However, I believe that this idea will prove to be of considerable utility in our ongoing attempts to understand not just the Tiwanaku political economy, but Titicaca Basin and highland Andean prehistory generally.