A Theory of Communal Land Tenure: The Optimality of Fragmented and Temporary Usufruct Allocation Under Equity Constraint

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Section I. Introduction and Motivation

In this paper we attempt to provide a fuller understanding of communal land systems. In particular, we focus on land usufruct system, one of typical communal land management regimes under which each commoner is granted the right to individually and exclusively use a specific part of communal land (sometimes during a specific period). Although prevailing, this regime has been unduly understated and understudied. A careful inquiry into the economic nature of this system would provide the basis for deep understanding of communal land systems, as well as of the property right regime thereon. In this section, we briefly explain this motivation.

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Individual and exclusive land use system is particularly prevailing in densely populated agrarian societies. This suggests that it has strong advantage compared to other communal land management regimes under the scarcity of land relative to population. It is thus maintained by property right school, originating from Demsetz (1967), Alchian and Demsetz (1973), and North and Thomas (1977), that the outstanding desirability of usufruct system lies in its characteristic that it could remedy the discrepancy between private and communal economic calculations. Such discrepancy could entail excessive negative externality under intense population pressure. Thus, as is familiar, intensifying population pressure makes usufruct system more and more advantageous compared to other regimes under which land use is either non-individual or non-exclusive.

However, in this commonplace discussion is missed an important factor, the negative aspect of usufruct system. Under this system, commoners have to specify who uses which plot of land. That is to say, insofar as usufruct is an individual and exclusive right over a specific plot, it must be assigned to a specific cultivator (during a specific period). Then, a difficulty arises from the crucial contradiction that commoners claim *equal* assignment of land, whereas the land is quite *diverse*. Who could be assigned the good land, while others are not? What allocative method could be recognized as just so that it is unanimously agreed upon? Note that, contrary to orthodox economists' concern for ex post equity (see Weitzman, 1974), due to the nature of communal property, equity is required ex ante: *Commoners must be treated equally in any management regime*. Note also that such equity consideration must always exist but would not be problematic unless the land use is made as specific as in usufruct system. Thus we can say that this is the problem inherent in usufruct system.

In this paper, we investigate this problem and find out a striking result that, to solve this problem, commoners have to accept some degrees of fragmentation and temporariness of usufruct. This is because, for the sake of equal treatment of all, no one could be so favored, at the expense of others, that s/he permanently monopolizes the good land. Therefore the good land must be fragmented so that everyone could use it simultaneously, or alternatively, be used alternately by allowing each commoner to use it only temporarily. Which of these two methods, or more accurately, what combination of the two is adopted depends on exogenous conditions. Anyway, under land usufruct system, equity cannot be maintained easily, but requires such a bothersome task. The central aim of this paper is to clarify this logic.

Besides the inquiry into the logic of usufruct assignment, this viewpoint has implication to two other phases of land institution. First, due to the difficulty involved in

usufruct system, it could be the case that non-usufructuary system, namely, non-individual or non-exclusive use regime over communal land is preferred, in spite of the externality problems inherent therein.

Second point is regarding property right regime. Freehold private property right is none other than a bundle of rights, of which *permanent* usufruct is the most basic component. That is to say, private property could evolve only from long-term usufruct. However, since commoners have to accept either fragmentation or temporariness for the sake of equity, long-term (i.e. non-temporary) usufruct tends to involve intensive fragmentation. This implies that under such technological or ecological conditions that the cost of fragmentation is prohibitive, and hence the optimal usufruct system would be temporary and consolidated rather than long-term and fragmented, private property is not likely to evolve therefrom.

The remainder of this paper is organized as follows. In the next section, we revisit the problem of communal land systems and see why and how equity restricts the institutional choice ex ante. We offer an interpretation of ex ante equity requirement from methodological individualism perspective. Based on this consideration, in Section III, we cite some of relevant findings from the literature and attempt to derive the inter-linkage between fragmentation and temporariness of usufruct holding. In particular, it is suggested that these features are endogenously and simultaneously determined as a consequence of commoners' striving for the most economical way of maintaining equity.

To provide an economic explanation to the finding from literature survey, in Sections IV and V, we formulate the problem as the choice of lottery, and obtain the trilemma of usufruct allocation, that is, to the extent that commoners adhere to usufruct system rather than non-individual or non-exclusive regime, they have to accept either one among following three unfavorableness: Fragmentation, temporariness, or allocative riskiness. This interpretation suggests that commoners would choose moderately fragmented and temporary usufruct allocation, thanks to which the allocation would be not very risky, though it may not free from riskiness. Thus, in Section VI, we demonstrate the mechanism by which commoners choose the optimal degrees of fragmentation and temporariness of usufruct allocation. In doing so, special attention is paid to such exogenous factors as population density and types of technique.

As mentioned above, this study is partly motivated by the inadequacy of property right theory. It is clear as this theory is applied to predict the effect of population pressure on the temporariness of usufruct system. Indeed, economists relying solely upon the property right theory tend to naïvely but assertively predict that usufruct will become permanent, but it is

consistent with the evidences only partly. From our viewpoint that focuses on the trade off between temporariness and fragmentation, the change in temporariness may well be ambiguous. In Section VI, in this regard, we reexamine the controversy as to the land question in post-reform Chinese villages. Section VII concludes the paper with some suggestions for possible applications and extensions of our framework.

Section II. Communal Land Management and Equity as Required Ex Ante

With regard to communal land property, economists are almost exclusively concerned with the externality problems arising from the discrepancy between private and communal calculation of cost and benefit. In order to illustrate what the usufruct system is for in this respect, let us briefly examine two basic regimes of communal land management, each of which typifies the discrepancy as such.

Two typical regimes are: 1) *joint farming with equal output sharing*, often practiced in socialist brigade system or tribal society; 2) *shared access* with/without regulation. By regulation is meant such communal rules as the allowance during some specific period, or technical restraint imposed on the equipment like fishing net. Within of the regulation, if any, the access is non-exclusive for each other: It is free from other commoners' interference, insofar as the rule is observed. As for the former, since the output is shared ex ante irrespective of how much each have contributed, shirking or under-provision problem would be entailed. With regard to the latter, even under regulation, a cost entailed by some commoner's activity is shared by all, hence over-exploitation.

At the stage where land resource is abundant, however, there is little motivation for labor- and capital-intensive and exploitative land use. Thus, these problems would not arise. There would be neither room for shirking nor fear of resource degradation as long as its exploitation is above the renewable level. However, as is famous as Boserup model, this changes as the population grows: Intensifying population pressure inevitably makes the resource relatively scarce and thus necessitates greater amount of intensive labor input into the crop and the land.

At this stage, the respective disadvantages of these regimes become crucial. Note that under joint farming the exploitation of land is non-individual, and under shared access, it is non-exclusive. These salient features must respectively make them undesirable because of those sources of externality inherent therein. Usufruct system, under which each commoner's land

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exploitation is communally warranted as individual and exclusive, is hence apparently preferable in this regard. This is the central logic of private property school, that is, in short, intensifying population pressure makes the resource scarce and necessitates intensive farming, and thereby induces the institutional change toward individual and exclusive system from other regimes.

Property right school asserts that an institutions change along Pareto-improvement as the potential benefit from the change excess the involved cost. In this regard, it is largely due to the cost involved in, or we might say, the obstruction to, the shift toward superior institutions that any inferior institutions could persist. The prevalence of *shared access* or *joint farming* is explained as such.

But is it straightforward that the individual and exclusive use regime (and its more complete form private property right) is *always* potentially desirable? Does not this regime have any disadvantage? Could such communal land regimes that grant only non-individual or non-exclusive use rights prevail only because it is costly to depart therefrom? We would like to shed a new light on this point in this paper. As a preliminary step, let us see two lines of argument, each of which suggests the disadvantage of individualized and exclusive land use regimes and its extension, private property. These are found out to provide introductions for our thesis.

The first point is recently made by Lesorogol (2003; 2005) and Mwangi (2004; 2006), both of whom analyze the experience of rangeland individualization in Kenya. Mwangi argues that even though individualization could potentially benefit all the commoners as economic theory tells, in practice, this transformation procedure is by its nature quite subject to an unfair implementation, particularly when done solely by local elites in a self-interested and inconsiderate way. This is what Bardhan (2005: 37) dubs 'elite capture.'

Actually Bardhan argues in more general context that an institutional change, no matter how Pareto-improving it is, can face critical obstruction when there are winners and losers, and ex post compensation is not credible. In such a case, the potential loser would strongly resist, and hence "[t]he costs of collective action of such change may be too high." (Bardhan, 2005: 31)

While Bardhan clearly considers those situations where local vested interests resist the redistributional change, the same logic applies to Mwangi's discussion: Even though the individualization of rangeland is such a change that every commoner could be benefited from it, it may tend to concentrate in the hands of a few elites. Mwangi suggests "an allocative method

that can promise for constraining self-interest and minimizing personal bias and prejudices. The *lottery* system is one avenue." (2006: 33, emphasis added)

Whereas this discussion enriches the above-mentioned notion of obstruction to the change in communal land management, Field (1989) cast more direct doubt to the common sense that individual and exclusive communal land use regime is superior to other regimes. Field's study is motivated by an important ambiguity in historical evidences:

"[W]e have two opposite changes being attributed to the same causal factor; how could population growth in one period have produced a shift from individualistic to more common tenures; while at another time produced a shift from common to individual property?" (320)

Field (1989) offers an exclusion- versus enforcement-cost explanation. The more individual is the use of common land, the longer is the boundary to be protected, and hence the more is the cost of enforcement: "it is at a minimum when there is a single [undivided] commons, at a maximum with individual property (327)". Taking into account the exclusion cost entailed by not drawing the boundaries, Field concludes that the optimal degree of division of communal land lies somewhere between two extremes:

"The model presented above depicts changes in the size of the optimal commons as resulting from differential changes in transactions costs, the costs of making and enforcing agreements among commoners, and exclusion costs, the costs of excluding non-commoners from a resource. When the former increase faster than the latter, a move toward individual property is efficient; when the relative movement of these factors is reversed, *efficiency calls for a move toward common property*." (341, emphasis added)

Thus above, we have referred to two lines of argument, each of which may partly explain the prevalence of non-individual or non-exclusive regimes of communal land use. These points are, in fact, closely related to our focus in this paper. Let us clarify our point of view.

First, Mwangi (2004; 2006) is quite right in suggesting that equity matters ex ante in any institutional choice on communal property land. It suggests that otherwise it would face trouble. Second, Field (1989) is also right in pointing out that it could be costly to make specify who cultivates which land. However, consider a case where neither such selfish ruler who takes advantages of the process of individualization, nor such hostile atmosphere that necessitates costly fencing. This setting seems to us more realistic. We would like to maintain that, under such circumstances, there is nevertheless a difficult problem inherent in individualization and exclusion.

The problem is that, under the individual and exclusive use regime, equal treatment of every commoner is not easy. To see this, note first that once communal land use becomes individual and exclusive, the commoners have to specify who uses which plot of land, or we could say *the communal land must be divided and allocated*. Second, this problem is made difficult by the very fact that the communal land is heterogeneous in quality and type. How could *diverse* land be allotted *equally*? Munoz-Pina (2003) explains this point with regard to the case of dividing communal land in *ejido*, Mexico:

"The division process entails difficulties in determining the quality of the land each particular *ejidatarios* will receive. When opting for individual titling, the *ejido* must solve the problem of land allocation among its members, which is especially difficult when land quality is heterogeneous and difficult to predict." (138)

Before elaborating on this point, it may worthwhile to consider on what theoretical ground can we assume that equity matters? To see this, recall that, by the nature of communal property, each commoner is equally entitled to it. Also recall that the commoners' desire for usufruct system has been understood along Popkin's line of argument: If commoners were altruistic or communalistic, joint farming would not entail shirking problem, or shared access would not lead to resource degradation. It must be because commoners are basically self-seeking that individualized and exclusive use regime is desired.

Now it is clear that since each commoner is equally entitled to the communal resource and not self-sacrificing enough to agree on an arrangement regime under which s/he would be treated worse than others. Therefore, any management regime over communal property should be carefully arranged so that it would treat every commoner equally. Otherwise, the community cannot reach an agreement.

In this regard, a notable advantage of those management regimes other than usufruct is the simplicity of equality among commoners. This point is largely neglected in the analyses of communal land system, only implicitly suggested by Field (1989), Lesorogol (2003; 2005) and Mwangi (2004; 2006) as quoted above.

To elucidate this point, in the next section, we cite some of relevant empirical findings to illustrate why and how equity requirement could lead to difficulty when commoners think of usufruct system. In particular, we focus on land fragmentation problem that arises as an inevitable side effect of commoner's pursuit of long-term usufruct.

Section III. Land Fragmentation Stemming from Equity Requirement and its Mitigations

Let us first refer to Vinogradoff's classical explanation as to why commoners in villages of medieval England had to accept fragmentation of land use or landholding:

[T]he assignment of scattered strips to every holding depended on the wish to equalise the shares of the tenants. ...[T]he territory of the township is not like a homogeneous sheet of paper out of which you may cut lots of every desirable shape and size: the tilth will present all kinds of accidental features, according to the elevation of the ground , the direction of the water-courses and ways, the quality of the soil, the situation of dwellings, the disposition of wood and pasture-ground, etc. The whole must needs be dismembered into component parts, into smaller areas or furlongs, each stretching over land of one and the same condition, and separated from land of different quality and situation. ...[I]f you want the holding to lie in one compact patch you will have to make a vary complicated reckoning of all the many circumstances which influence husbandry, will have to find so me numerical expression for fertility, accessibility, and the like; or else you may simply give every householder a share in every one of the component areas, and subject him in this way to all the advantages and drawbacks which bear upon his neighbours. ...There can be no question that the second way of escaping from the difficulty is much the easier one, and very suitable to the practice of communities in an early stage of development. *This second way leads necessarily to a scattering and an intermixture of strips*." (1892: 235-6, emphasis added)

Here, Vinogradoff clearly explains the practice that, given the equity requirement and the diversity of the communal land, commoners have to implement an allocative method which we call ***assortative subdivision***: 1) To assort the whole land by quality and type so that in each group the land is homogeneous like a 'sheet of paper'; 2) To subdivide each group of land into equal parcels of the number of commoners; and 3) To allocate to each commoner one parcel from each class of land. As Vinogradoff points out, this allocative method necessarily leads to ***fragmentation***: each commoner's allocation is fragmented, scattered, and intermixed.[2]

There are two typical cases where fragmentation of landholding is likely to occur: When communal property land is divided among commoners, and when a private property land is inherited jointly by co-heirs (Bentley, 1987).[3] Note that their respective explanations as to the

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[2] Note that implicitly assumed in this mechanism is the absence or imperfectness of land rental market, which would enable inter-plot cardinal comparisons of value and thus relieve the commoners from having to hold every class of land.

[3] There is another famous explanation that fragmentation is a device for risk spreading. However, *under*

cause fragmentation are logically equivalent: When a number of persons (families) consider to equally divide their common land, given the diversity of the land and the requirement that everyone be treated equally, they would decide to subdivide all types of land.

Importantly, the scarcer is the land relative to the population, the more intensive would be the fragmentation, as far as this principle is complied with. And population tends to increase, imposing a severe pressure on the limited land. How, then, would rational commoners cope with it? The aim of this section is to exemplify that commoners would consider an alternative device by which they could mitigate fragmentation while treating everyone equally: *rotation*.

Before explaining this point, as a preliminary step, it would be worthwhile to some evidences that suggest that *joint-ownership could mitigate fragmentation*. King and Burton (1982) succinctly put it:

"Another mechanism to combat fragmentation [than to adjust labor intensity given the geographical dispersion of plots] is joint ownership in individual fractional shares. *This allows the subdivision of title demanded by equity and inheritance customs but without the physical subdivision of the land*, since the coowners agree to farm it as one unit. Joint ownership is more flexible than individually fragmented ownership since it allows farmers to rearrange ownership units into more suitable operational units thereby avoiding the deleterious effects of minute fragmentation." (484, emphasis added)

Also, based on an intensive case study of a family's land tenure arrangement in Taiwan, Vander Meer (1975) states:

"Given the capacity to minutely subdivide already small cadastral plots it takes little imagination to project the eventual effects that joint ownership might have on the number and dispersal of the plots making up a single farm (275)." "Joint ownership can be a powerful instrument for curbing the effects and reversing the process of farm fragmentation. …[It] facilitates precise and minute subdivision of land property without impairing agricultural efficiency (282)," and in effect it "is used to consolidate farm holdings both for operation and for ownership (275)."

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land scarcity, principal cause of fragmentation must be understood as Vinogradoff did. Risk spreading, if any, is a positive side effect that may cause it to persist. Note that equality explanation has never been refuted but rather simply ignored, perhaps due to the confusion of equity as a constraint and egalitarian sentiment, the latter being out of scope of traditional economics. The only evidence ever offered to refute equality explanation is that actually communal land allocation was actually unequal (McCloskey, 1972). However, underlying such phenomenon was the fact that commoners' *entitlement* was not equal (Blum, 1971). Therefore this fact does not contradict with equality explanation that equally entitled commoners must be treated equally and hence fragmentation.

As suggested here, it could be quite possibly the case, especially under severe land scarcity, that commoners (co-heirs) would give up the completely privatized division of common land, when it would lead to awfully fragmented landholding due to equity constraint. Put differently, we could understand this as a choice of the lesser of two evils: Commoners accept the cost involved in joint-ownership rather than that in excessively minute holding.

This can be the case usually when the cost of fragmentation is prohibitive. However, a similar case can be observed when fragmentation is legally prohibited. This case is found in Bulgaria, where commoners also face the problem of how to allocate the land formerly managed by the brigade, and the government has prohibited implementation of subdivision too thoroughly:

"To prevent excessive fragmentation of land, a law was introduced which states that a plot cannot get a separate ownership title if it is smaller than 0.3 ha. …Hence, a parcel cannot be divided among heirs if the size of the newly created plots falls below these levels, a situation referred to with the term "forced" co-ownership. According to our survey, more that 40% of the parcels owned by rural households are in co-ownership and can not be divided among the owners by law." (Vranken *et al.*, 2004: 399)

Thus far, we have observed that joint-ownership could mitigate fragmentation that is caused by equity requirement. Nevertheless, even under joint ownership or communal property, the contradiction between equal treatment of all and diversity of land is no less problematic, as far as usufruct system is considered. That is to say, unless commoners decide to farm the land jointly, or grant each other only a non-exclusive access, they have to specify *who uses which land*. This is the problem inherent in allocating usufructuary rights over communal land, and has common feature with the division of communal land. It is clear by a straightforward extension of the above discussion that if commoners rely solely on assortative subdivision, the resultant usufruct allocation must involve fragmentation. Further, it would be aggravated by population pressure. How could commoners cope with it?

Now let us introduce a new usufruct allocation principle, *rotation*, which could substitute for assortative subdivision. The basic idea is that in order to equally divide the usufruct over diverse land, commoners have to accept either *spatial* or *temporal* discontinuity. Put more roughly, for the sake of equal treatment of each other, commoners have either to fragment both good and poor land (subdivision) so that everyone can use them simultaneously, or use them alternately without fragmenting each group (rotation). Otherwise only a few of

commoners would permanently monopolize the good land forever, which is not acceptable from equality's point of view.

Importantly, these basic principles, subdivision and rotation, could be combined so that the total cost of both spatial and temporal discontinuity would be minimized. For example, when the former entails excessive cost, commoners would partially incorporate rotation so that they could mitigate fragmentation without impairing equality. However, rotation entails its respective cost: temporariness of land use. Here is a trade off. Before elaborating on this point, let us see one notable example of rotation.

Heston and Kumar (1983) cites an interesting case in Sri Lanka, where villagers equally share scarce land without excessively subdividing it, by implementing extremely sophisticated rotation system:

"About 6% of the paddy land in Sri Lanka is farmed in Tattumaru and/or Kattimaru systems of rotation, like vesh system in Pakistan. In these systems each landholder has a right a plot in rotation. In principle, if say, two or more original families held distinguished qualities of paddy land, their descendants would allow (1) all of the land to be farmed by one family in a year (Tattumaru), or (2) all land to be rotated over a multi-year cycle so that each descent group farmed each piece of land once (Kattimaru). Combined Tattumaru-Kattimaru tenure is possible." (208)

Clearly, rotation is necessitated simply because the common land (whether it is communal or consanguineous) is heterogeneous. Rotation is such a device that could enable the *equal treatment of all without fragmenting the land excessively*.

Note, however, that rotational allocation, no matter how effective it may be in pursuit of equality, could be a choice only in such small scale as family or extended family. In the communal scale, it would be difficult to be implemented. Nevertheless, the fundamental role of rotation to mitigate spatial discontinuity at the expense of temporal continuity takes its characteristic form in communal scale management: *periodic repartition*.

Periodic repartition is a typical one of communal land management, which is as widespread and ancient as assortative subdivision. Commoners are granted the right of individual and exclusive use over a specific plot of land, on a *temporary* basis. Periodically, say every 10 years, the community reallocates the land, usually by lottery. It is noteworthy that *any* repartition is accompanied by a certain extent of assortative subdivision (Blum, 1971; Sanderson, 1932). This fact suggests that this practice has a function similar to rotation: It partially substitutes for too costly assortative subdivision in pursuit of equality; Or equivalently,

it mitigates spatial discontinuity at the cost of temporal continuity.

This relationship being striking, we need to offer some evidences. In his survey of rural history of Europe, Blum (1971) writes:

"In at least two recorded instances communities returned to periodic redistribution after abandoning it. The Rhineland village of Losheim gave up the practice in 1655. Sixty-nine fears later, in 1724, under the pressure of the excessive parceling of holding *that resulted from individual permanent occupancy*, the villagers decided to restore the old custom." (173, emphasis added)

More from history. In medieval rural Russia, there prevailed quite characteristic village communism, *mir*, which Bates and Curry (1992) justly dubbed 'a repartitional commune (457).' Sanderson (1932), in the comprehensive rural history, interprets the custom of repartition in a way consistent with Blum's statement:

"One of the claims made for the advantages of the Russian *mir* system is that it obviates this excessive division and maintains a division of the land more equitable and efficient for the village community as a whole, and upon the emancipation of the serfs the government recognized the mir as a public organization which would prevent excessive subdivision." (247-8)

These historical statements clearly explain the salient aspects of repartition that it could mitigate excess land fragmentation, while maintaining equality among commoners. As is observed in the above-cited literature, repartition can partly substitute subdivision so as to *more economically maintain equality*.

Another important evidence is found in post-reform China. As is well known, at the drastic rural reform in 1978, each household was allocated usufruct right over communal land that had formerly been collectively managed by production brigade. As for the allocation, it has been widely observed that each community practice repartition for equality's sake. In fear of under-investment or exploitative land use due to short contract, the government has been attempted to prevent this practice. Time after time, it has issued regulations aimed at longer-termed contract. However, Cheng and Tsang (1995-6) observe:

"Contrary to the policy intensions, when it was announced that contracts were to be lengthened, most production teams turned to a more equitable way of distributing land to the households. …[T]he long-term nature of the land contract, instead of inducing the farmers to invest more in the preservation of land fertility, aroused concern about equitable land distribution. … The survey results also showed that *the fragmentation further intensified*.' (49-50, emphasis added)

Also, Tan *et al.* (2005) report the communities' interesting responses to recently issued 30-year contract law, which prohibits the repartition for 30 years once the allocation is

settled after it is implemented:

      'Land was again redistributed within a few years of the laws' implementation, with the goal of being more considerate and equitable than ever. To achieve this, the land was divided into several plot classes in terms of soil type, water access, drainage condition, road access, and any other conditions the farmers consider to affect agricultural yield and land management (209)," and "Zhu argues that the duration of the contract matters in determining the number of land classes (210)." "As a result, China's land became even more fragmented after the implementation of the 30-year contracts (209)."

      These observations convincingly support the above-mentioned hypothesis that *periodic repartition could partly substitute the assortative subdivision*: Indeed, if repartition is legally prohibited, commoners have to rely solely on subdivision in their pursuit of equality, and as a result fragmentation is aggravated than it is when endogenously determined.

Let us summarize the findings that have been obtained in this section. 1) For equality's sake, the establishment of private ownership over a diverse communal land tends to involve fragmentation of holdings, which could impair the desirability of private property. When fragmentation is prohibitively costly (or legally prohibited), joint ownership or some sophisticated tenurial arrangement would effectively be incorporated, which could mitigate fragmentation while maintaining equality among commoners. 2) Even within joint or communal ownership regime, the same logic applies to the choice of usufruct allocation over communal land: First, the allocation of long-term (or let alone permanent) usufruct must involve intense fragmentation; Second, periodizing the usufruct could mitigate the fragmentation while maintaining equality. 3) It is suggested that commoners adopt such combination of assortative subdivision and periodic repartition that would allow commoners to farm economically while maintaining equality among them.

      While the above discussion would seem straightforward, for a fuller understanding of communal land system, it would be helpful to provide a formulation with this. In the next two sections, we offer a theoretical illustration of the mechanism by which commoners implement both subdivision and periodization for economically seeking equality.

Section IV. Seeking Equality by Subdivision and Repartition (I): An Intuitive Exposition

In this section, we confine ourselves to the investigation of how class-subdivision and periodic repartition could be effectively combined in pursuit of equality in allocation. In particular, we

focus on the role of lottery for *equally* allocating *diverse* land and how class-subdivision and periodic repartition jointly determine the economic nature of this allocative lottery. We leave to Section VI the consideration of the disadvantages entailed respectively by these devices.

To begin with, let us briefly restate our problem. Our starting point is the following contradiction: Commoners are *equally* entitled to the communal land so that any management regime on it requires *equal* treatment of every commoner; Nevertheless communal land is *diverse* in quality and type. As mentioned above, this contradiction would not be acute unless commoners desire individual and exclusive use of communal land. It is from this claim that a serious difficulty arises as to how to who uses which land. How could it be possible for the commoners to *equally* allocate *diverse* land? This is the inherent problem in usufruct allocation.

As succinctly explained by Vinogradoff (1892) in the above quotation, the simplest answer to this problem would be *assortative subdivision*. But it inevitably entails fragmentation of land use. It is clear that the more thoroughly is this method implemented, or equivalently, the more accurately is the communal land assorted for subdivision, the more equal is the allocation, involving the more intensive fragmentation. But why do they have to adhere to perfect equality at such an excessive cost? If it is rational for commoners to maintain equality at the cost of economical farming, why, then, would not they pursue the latter at the expense of the former? The purpose of this and the next sections is to provide a theoretical basis for understanding this point.

Let us clarify the notion of equity requirement that every commoner be treated equally with regard to communal property. Note first that the *resultant* inequality in usufruct allocation does *not* necessarily imply that such an allocative method treats commoners unequally. In the extreme case, for example, even such an allocative method by which only one of commoners are selected so that s/he could use whole land permanently meets the equity requirement, to the extent that s/he is selected randomly. However, although it may be equitable in its stochastic sense, it is *not* in its everyday sense. Indeed, it would hardly be recognized as an equitable way of sharing scarce resource. Why? To answer this question, we have to inquire more deeply into the sense of equity.

We decompose the sense of equity into two claims: First, exactly equal chances must be given to all so that everyone is treated equally; Second, on condition that the first claim is satisfied, more equal resultant allocation is preferred. Note that the first rule is a *requirement*, whereas the second one is merely a *preference*. That is to say, the first rule is what commoners have to take for granted, or we can say that it is a *constraint* imposed on the institutional choice.

On the other hand, the second claim could be traded off with others. In the present context, it can be traded off with some diseconomy involved in pursuit of equality in the second sense.

But on what theoretical ground do commoners prefer equal resultant allocation? We offer an interpretation that it is their aversion to allocative riskiness. That is, if the allocative lottery includes large variance, due to equal treatment requirement, the resultant allocation must also be quite variable. *The more equally is a lottery constructed, the less risky is the allocation by that lottery*.

Now we can restate the problem: The more thoroughly do commoners assort the land for subdivision, the less risky is the allocative lottery, but at the expense that the more intensive fragmentation is involved. Conversely, if they loosely assort the land, it would enable each commoner an economical farming, but the allocation becomes risky in that only a few lucky commoners could use the good land, at the expense of others having to put up with poor land. Thus commoners face the problem as to *how to compromise between the aversion to allocative riskiness and mitigation of fragmentation*.

This interpretation enables us to understand why commoners do not necessarily accept the excessive cost of fragmentation, but rather loosen the criterion of assorting for subdivision, also why they do not adopt such all-or-nothing allocative gamble as mentioned above. The rational commoners would conduct moderate assortative subdivision so as to avoid both excessive fragmentation and intolerable riskiness.

We can now fully understand the striking finding derived in the previous section: *By periodizing usufruct, commoners could mitigate fragmentation while maintaining equality*. Let us reinterpret this claim in the present context. As preliminary step, consider a simple game where the player's monthly salary is determined by a coin flip.

Suppose that the player, say a laborer, faces two alternative lotteries for salary determination. By lottery A, the laborer flips a coin every month and if s/he gets a head his/her salary is $5,000 for that month, and otherwise $1,000. By lottery B, s/he flips only once at the beginning of each year, and if s/he gets a head the salary is $5,000 every month and otherwise $1,000 every month. If the laborer is a risk averter, s/he must prefer A to B. That is to say, if his/her certainty-equivalent monthly salary for lottery A is, say, $2,500, that for lottery B would be less than this, say $1,500.[4]

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[4] Note that in a time-separable expected utility function, these two lotteries are equivalent. To see this, it

This numerical example suggests that even if the construction of a payoff lottery is exactly the same, *its riskiness depends on how frequently one draws from it*. A risk averter would prefer to draw frequently. This is perfectly analogous to our present question as to how temporariness of usufruct could enhance equality.

Now it is clear that the more thoroughly is the usufruct periodized, or equivalently, the more frequently do commoners conduct periodic repartition, the less risky is the allocation, given the degree of assorting accuracy in subdivision. Put differently, if the commoners desire to loosen the accuracy of assorting but hesitate to make the allocation more risky, they can make it by repartitioning more frequently. Also the contrary holds: By assorting the land more accurately, commoners could make the usufruct duration longer while keeping the allocative riskiness at the same level. Thus, we have obtained the substitutive relationship between the accuracy of assortative subdivision and the frequency of periodic repartition, given the level of allocative riskiness. In the next section, we develop a model to formally demonstrate it.

Section V. Seeking Equality by Subdivision and Repartition (II): The Model

We have so far studied an institutional choice problem without making explicit *who* optimizes the institution. Before developing the formal model, we need to offer here a clarification of this point.

Owing to the equity constraint, an allocative lottery must give everyone a same chance, irrespective of how risky it is. Assuming homogeneous preferences among commoners, this allows us to considerably simplify the problem: It reduces to an *individual* choice as to how to arrange the lottery. Insofar as one considers within equity constraint, any alternative is feasible. For example, suppose that one of the commoners think that it is most desirable for him/her, under equity constraint, to draw from lottery C. Since this lottery must be such that it treats everyone equally, given the homogeneity of preference, every commoner surely considers it best. In this setting, therefore, there does not exist such complicating factor as bargaining. Of course, heterogeneity could be non-negligible, especially when studying the dynamic aspect of communal land system. However, when incorporating heterogeneity, we nevertheless have to pay attention to equity constraint.

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suffices to observe that, in both cases, for every month his/her salary is either $5,000 or $1,000 assigned fifty-percent probability to each. Thus time-separable expected utility function does not reflect the correlation between lotteries in distinct times. See the modeling below how we treat such correlations.

Now let the *fertility* of communal land uniformly diversified as the figure below: The fertility of the most fertile plot among less fertile x acres is, $h(x) = \alpha x + \beta$. The *product* on some plot is the value of fertility function integrated thereon. Total land is A acres.

$$h(x) = \alpha x + \beta$$

Fertility
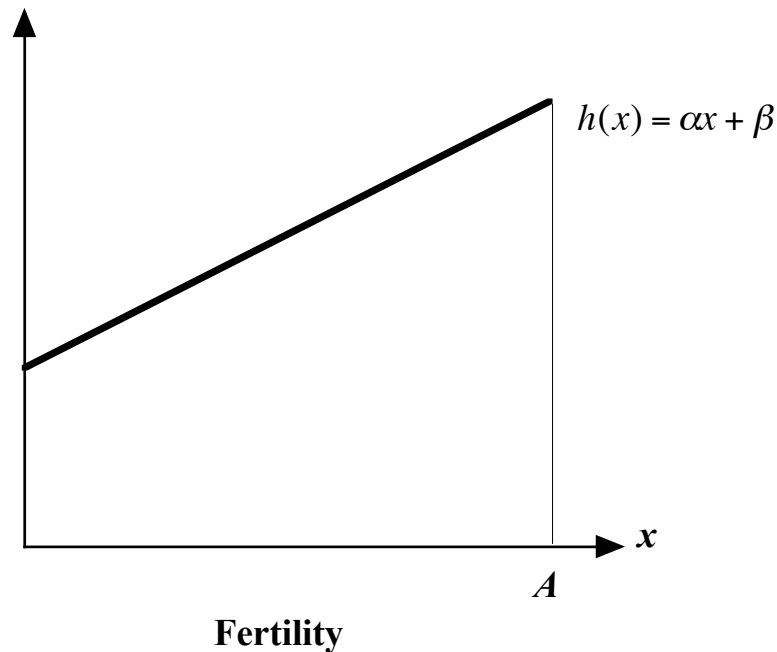
The community consists of N equally entitled commoners. The problem is how to allot the usufructuary rights of A-acre communal land. By allotment is meant both instantaneous and intertemporal ones. It is assumed here that only feasible allocation method is the combination of following two:

Subdivision **with M classes**: To equally divide the whole land by the quality into M classes, each class being A/M acres; then randomly allot to each villager a plot of A/MN acres from each classes. M lotteries are *independently* drawn. Thus, each villager is allotted M pieces in sum. ($M = 1, 2, ...$)

Repartition **in every S years**: To entirely reallot the plots in every S years, with M being constant. ($S = 1, 2, ...$)

Thus the choice variable is (M, S). Obviously, unless the villagers make any effort to reduce allocative riskiness, (M, S) = (1, ∞). This is the benchmark of our analysis and is called *CP*: *consolidated and permanent usufruct regime*.

Now, let us calculate the riskiness of allocative method (M, S). The riskiness is represented by the standard deviation of a villager's basic product on his allotted land.

The riskiness of allocation (M, S) is derived as follows: first, the *instantaneous* riskiness, that is, the riskiness per each year, which turns out to be the diminishing function of M, is computed; then, *net* riskiness, that is, the discounted aggregate of riskiness perceived by each commoner, which turns out to be the function of instantaneous riskiness, time discount rate, and S, is calculated. In sum, net riskiness is the function of M, S, and the discount rate.

Let q_j denote the instantaneous product from a commoner's allotment in j'th class, where $j = 1, 2, ..., M$. Most importantly, q_j is the function of k_j, which is a random draw from the set of positive integers, $\{1, 2, ..., N\}$, where 1 is the worst draw and N is the best.

a villager's allotment

$h(x) = \alpha x + \beta$

A

x

<class 1>   <class M>
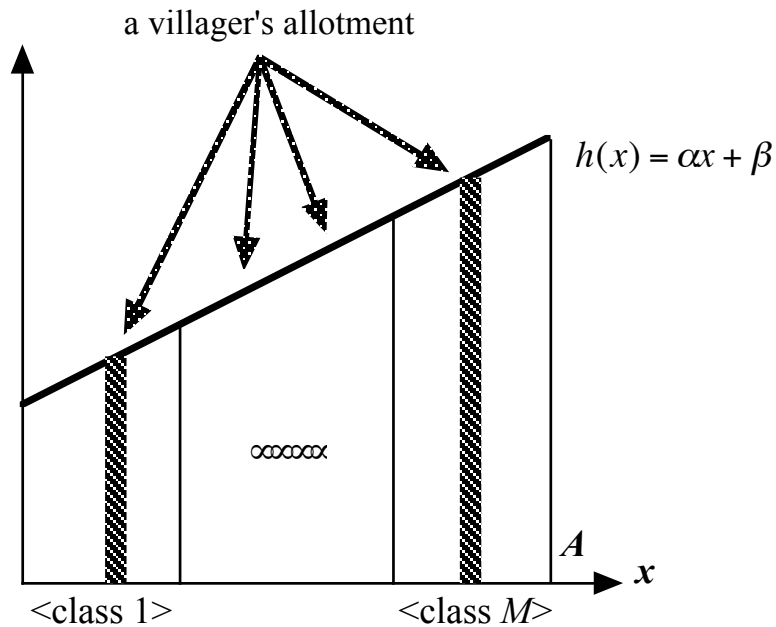
Thus,

$$q_j(k_j) = \int_{(j-1)A/M+(k_j-1)A/MN}^{(j-1)A/M+k_jA/MN} h(x)dx$$

$$= \alpha\left(\frac{A}{MN}\right)^2\left(k_j - \frac{1}{2}\right) + \frac{A}{M^2N}\{(j-1)\alpha A + M\beta\}.$$

Since $Var(k_j) = \left(N^2 - 1\right)/12$ by elementary statistics, the variance of q_j is

$$Var(q_j) = \alpha^2 \left(A/MN\right)^4 \cdot Var(k_j)$$
$$= \alpha^2 \left(A/MN\right)^4 \cdot \left(N^2 - 1\right)/12 \approx \alpha^2 \left(A/MN\right)^4 \cdot N^2/12,$$

assuming N is sufficiently large. Thus the variance of q_j is independent of j. Obviously, the assumption of uniform diversity leads this convenient result. Further, since the draws from each of M classes are independent, the variance of a villager's instantaneous basic product, $Q_I = \sum_{j=1}^{M} q_j$, is simply M times $Var(q_j)$. Hence, the variance and standard deviation are:

$$\sigma_I^2 = Var(Q_I) = \sum_{j=1}^{M} Var(q_j) = \alpha^2 A^4/12M^3N^2,$$

$$\sigma_I = \left(\frac{\alpha A^2}{2\sqrt{3} \cdot N}\right) \cdot M^{-3/2} = \sqrt{3} \cdot r_{SD} \cdot \rho \cdot \mu,$$

where $\begin{cases} r_{SD} = M^{-3/2}, \\ \mu = E\left(\sum_{j=1}^{M} q_j\right) = \left(\frac{\alpha}{2} \cdot A^2 + \beta A\right)\Big/N, \end{cases}$

thus μ being the mean of instantaneous product per commoner, and ρ the Gini coefficient of fertility: $\rho = \alpha A/3(\alpha A + 2\beta)$. Let us call $r_{SD} = M^{-3/2}$ the *rate of riskiness reduction by means of subdivision*. Note that this rate exclusively depends on M. If M is set to unity, $r_{SD} = 1$, implying no effect of riskiness reduction.

Next, based on the instantaneous riskiness derived above, let us calculate net riskiness. Beforehand, an intuitive explanation would be helpful. Just like instantaneous one, net riskiness is represented by the variation or standard deviation of a villager's net allotment, that is, the discounted aggregate of basic product.

By periodically reallocating every S years, the allotments in each set of years {1, 2, ..., S}, {$S+1$, $S+2$, ..., $2S$}, ..., {$(p-1)S+1$, $(p-1)S+2$, ..., pS}, ..., for $p = 1, 2, 3, ...$, are completely correlated, and contrarily, every pair of allotments that are included in different sets are independent of each other. As mentioned above, in time-separable expected utility function, such correlations can not taken into account. We will thus consider the discounted sum of the product, and calculate its variance. Put differently, we focus simply on the variance of product rather than of utility. By doing so, we could capture the importance of *correlation between lotteries*. Note that underlying this

is an assumption that the products in next period is equivalent to that of today times some discount factor. Note also that in a subsistence autarky economy this discount rate reflects the storage technology rather than return to investment.

Let $\sigma_N^2 = \sigma_N^2(M,S)$ denote the variance of a commoner's discounted aggregate of the product, and denote by δ and Q_t time discount rate and the product the villager obtains at the year t, respectively. Then,

$$\sigma_N^2 \equiv Var\left(\sum_{t=0}^{\infty} \delta^t q_t\right)$$

$$= \sum_{j=1}^{\infty} Var\left(\sum_{t=(j-1)S}^{jS-1} \delta^t q_t\right)$$

$$= \sum_{j=1}^{\infty} Var\left\{\left(\sum_{t=0}^{S-1} \delta^t\right) \cdot \delta^{(j-1)S} \cdot q^j\right\}$$

$$= \left(\sum_{t=0}^{S-1} \delta^t\right)^2 \cdot \left(\sum_{j=1}^{\infty} \delta^{2(j-1)S}\right) \cdot \sigma_I^2$$

$$= \left(\frac{1-\delta^S}{1-\delta}\right)^2 \cdot \frac{1}{1-\delta^{2S}} \cdot \sigma_I^2$$

$$= \frac{1-\delta^S}{1+\delta^S} \cdot \frac{\sigma_I^2}{(1-\delta)^2}.$$

Now let $r_{RP} = \left\{\left(1-\delta^S\right)/\left(1+\delta^S\right)\right\}^{\frac{1}{2}}$. Then

$$\sigma_N(M,S) = r_{SD} \cdot r_{RP} \cdot \left(\frac{\sqrt{3}\rho\mu}{1-\delta}\right).$$

Clearly, if $(M, S) = (1, \infty)$, then $r_{SD} = r_{RP} = 1$. Hence, the net riskiness in consolidated and permanent usufruct allocation is
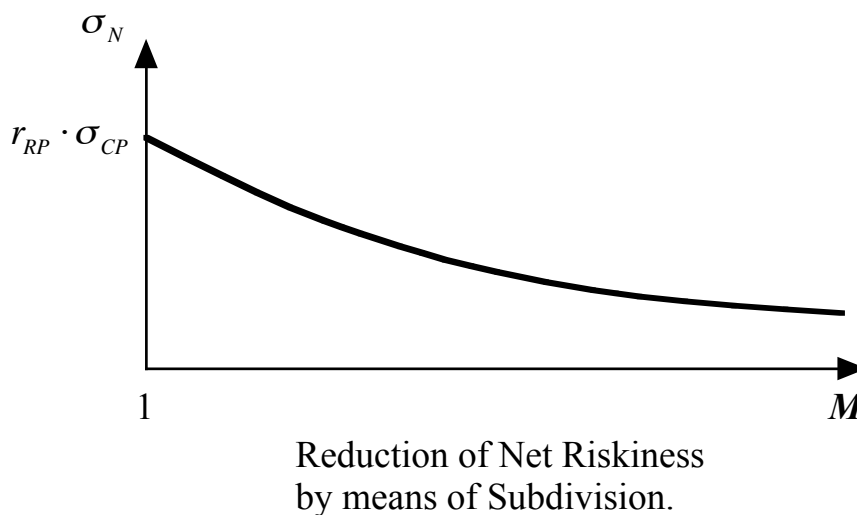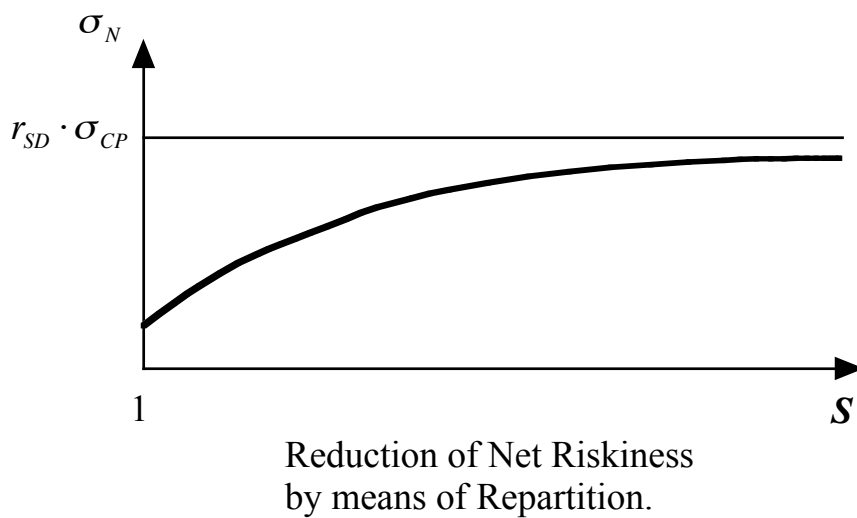
$$\sigma_{CP} = \sigma_N(0,\infty) = \left(\frac{\sqrt{3}\rho\mu}{1-\delta}\right),$$

and we obtain the following useful exposition of net riskiness reduction:

$$\sigma_N(M,S;\delta) = r_{SD}(M) \cdot r_{RP}(S;\delta) \cdot \sigma_{CP}.$$

In this model, it is illustrated in a simple manner that an increase in *M* and a shortening of *S* are independently effective for the reduction of net allocative riskiness (see the figures below). Thus it demonstrates that: 1) the accuracy of assortative subdivision and the frequency (captured as the inverse of *S*) of periodic repartition jointly positively effective for the reduction of allocative riskiness; 2) the accuracy and the frequency are substitutive for each ether.

Based on the findings obtained in the previous and this sections, in the next section, we discuss the optimal degrees of fragmentation and temporariness.

σ_N

$r_{SD} \cdot \sigma_{CP}$

1

S

Reduction of Net Riskiness
by means of Repartition.

σ_N

$r_{RP} \cdot \sigma_{CP}$

1

M

Reduction of Net Riskiness
by means of Subdivision.

Section VI. The Optimality of Fragmented and Temporary Usufruct Allocation

Let us first reformulate the problem of communal usufruct allocation. Under equity constraint, commoners consider how to arrange the lottery: How accurately to assort the land for subdivision; How frequent to repartition. The more accurate do they assort the land, and the more frequent do they repartition, the less risky is the usufruct allocation, but at the expense that the resultant usufruct being fragmented or temporary.

Thus we can interpret the problem faced by the commoners as a *trilemma*: They have to accept at least one of the following: fragmentation; temporariness; or allocative riskiness. In the previous section we have obtained substitutive relationship between subdivision and repartition, which constructs the feasible set of fragmentation and temporariness, given the level of allocative riskiness. Given the risk averting nature of the commoners at a subsistent society, they would accept considerable degrees of fragmentation and temporariness. The balance between the two would be determined by the type of biochemical and mechanic technology, geographical condition, or population density.

However, one of the most important implications of this model is the ambiguous effect of population pressure on the choice variables. Its effect is ambiguous even on commoners' acceptance of allocative riskiness. That is because, the scarcer is the total communal land, the severer is the allocative riskiness, but at the same time, the more burdensome is the costs entailed by fragmentation and temporariness.

Suppose that population pressure is so fierce that the amount of land per commoner is near the limit of subsistence. In such case, fragmentation is serious in that each parcel of land is all the more minute. But at the same time, commoners would desire longer-term usufruct because they have to raise the yield per acre given the limit in area. As far as these factors are considered, it seems that total cost entailed by fragmentation and temporariness is more seriously conceived under land scarcity. But at the same time, their aversion to the allocative riskiness is stronger. Thus, we could not tell unambiguously how population pressure affects the commoners' balancing on this trilemma. However, by this model, we could specify what particular causalities would jointly determine the comparative static properties of population growth as well as the technological change, which has not been possible due to the lack of economic theory to demonstrate the logic of usufruct system.

An important implication could be derived from our discussion: as to the effect of population

pressure on the repartition. In post-reform Chinese rural villages, as mentioned above, how to understand the village community's repartitional behavior is the hottest land issue. On this, Tan et al. (2005) summarizes:

"With respect to the frequency of reallocation, Yao… sees an inverse U-shape relationship between land endowment and land adjustment frequency. Kung, in contrast, has found that… land endowment has a negative impact on both the frequency and the magnitude of land reallocation." (207-208)

Let us add to these the third hypothesis: 'a naïve application of property right theory.' On the same land question, Liu et al. (1998) state:

"[Hypothesis] Other things equal, property rights will be most deeply privatized in land-scarce areas." (1794)

Here, the term 'being deeply privatized' is meant that the communal control over land arrangement is weak, so that the repartition in pursuit of equality is less frequently and, if any, is practiced in less magnitude. This prediction is clearly based on property right theory in that it solely focuses on the positive side of privatization, and neglects the endogenous logic of usufruct system.
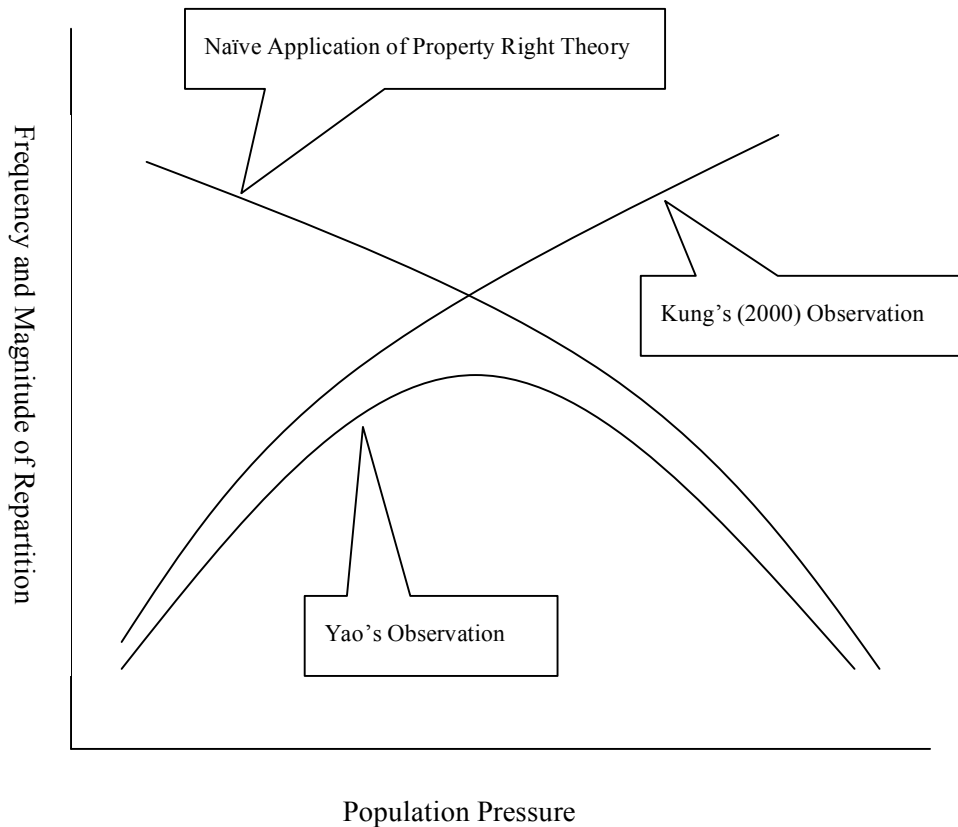
As clearly depicted in the above figure, this is an acute controversy. However, there has not been useful framework by which we could investigate this question. The present paper has of immediate relevance to this one of the most important transitional agrarian problem.

Moreover, our viewpoint casts strong doubt on the economists' dominant conception of temporary usufruct: It is usually recognized as 'tenure insecurity.' Of course it may partly true that 'insecurity' is caused by some non-economic factors as elite capture. Nevertheless, it must still be worthwhile to carefully examine if our interpretation of temporary usufruct as demonstrated above is of relevance or not. If it is, it implies that more *temporary* usufruct regime could be *securer* in the sense that none of the commoners have to put up with permanent disadvantage.

Section VII. Concluding Remarks

As mentioned in the introduction, the motivation of this paper was the inadequacy of currently predominant economic view with regard to communal land property. It is recognized as source of diseconomy and to be fated to break down as population pressure is imposed in it. But it is none other than population pressure that necessitates sophisticated, complicated, and often burdensome arrangement of individual's land use. Thus a careful investigation of this mechanism is indispensable for fully understanding the process of, say, privatization.

Also, one of the novelties of our approach is treating equity as a requirement imposed on any institution regarding communal property. This perspective would be helpful for constructing a relevant and tractable theory of village community.

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