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How to Carry Out Land Consolidation  
An International Comparison

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## **How to Carry out Land Consolidation**

### **- An International Comparison**

#### **Abstract**

Based on a mixed economy of private ownership of farmland and public ownership of infrastructure land, dispersed parcels of farms could be consolidated through exchange of private ownership and location into compact land units. In this process, intervention of governments, education of public opinion, active participation of farmers, and combination with overall rural development are necessary, and application of satellite remote sensing and computer technologies is beneficial.<sup>1</sup>

**Key Words:** agricultural holding, parcel, fragmentation, land reform, land consolidation, private ownership of farmland, public ownership of infrastructure land, voluntary, compulsory and partly voluntary consolidation, overall rural development, satellite remote sensing, computer technologies, population growth.

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This article does not discuss the causes, disadvantages and advantages of fragmented farms, nor the desirability, suitability or necessity of land consolidation, which have been the topics of many other papers and books. It only deals with how to carry out land consolidation. Moreover, such a consolidation is based on a mixed economy of private ownership of farmland and public ownership of infrastructure land. That is to say, consolidation under complete public ownership of rural land is not discussed either since it belongs to another land tenure system.

Binns's work on the same topic about half a century ago, although classic, is based on the experiences of a few countries (Binns 1950). Many other authors have produced similar studies, but based on the practices of mainly one country or locality (see the references cited). In contrast, this article makes an international comparison in a much wider scope.

"*Farm*" (or farming unit) means "agricultural holding", which refers to all land that is used wholly or partly for agricultural production and *is operated by one person* - the holder - alone or with the assistance of others, without regard to title, size or location (FAO-PY 1972: 408).

*Fragmentation of an agricultural holding* is generally defined as the state of division of the holding into *many* discrete parcels in a village (Fre-Gov 1950: 56. Binns 1950: 5). But some just define it as the situation in which a household operates *more than one* separate parcel of land (Blarel; Hazell; Place & Quiggin 1992: 233. Vander Meer 1982: 1).

A *parcel* is defined as all land in the holding entirely surrounded by land or water of other holdings or by land or water not forming part of any holding (FAO 1981: 92). It may also be called "noncontiguous piece of land", "plot" or "land unit".

*Fragmentation is measured* by the number of parcels of land in the holding in one village (the case of families holding land in several villages is excluded) (Heston & Kumar 1983: 199).

## **Definition of Land Consolidation under Private Land Ownership**

Land consolidation is an exchange of the private ownership and location of spatially dispersed parcels of farms to form new holdings containing a single (or as few as possible) parcel(s), with the same (or similar) value as the original areas. No land owner should be made a loser through consolidation. (Oldenburg 1990: 183). It is not, however, a measure for social justice. It neither changes the status of the large and small land owners, nor gives farmland to the landless. (Trivedi & Trivedi 1973: 180). Therefore, it could be implemented with no or incomplete land reform [e.g., in India since 1900 (Zaheer 1975: 92-95, 118)<sup>1</sup>], or in conjunction with

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<sup>1</sup> Even in the 1980s, in some areas of India, poor farmers with small parcels of low-value land

land reform, which distributed land of landlords to peasants with equity in consolidated forms [e.g., in Denmark during 1770s-1835 and Ireland during 1870-1940s (Skovgaard 1950: 43, 45. Ire-Gov 1950: 64-76)], or after land reform [e.g., in Switzerland during 1840-1940s, Russia during 1906-17, Japan since 1950, and Taiwan Province of China since 1959, which preserved equity in land ownership (Swi-Gov 1950: 82, 85. OECD 1998: 75. Tsuge 1997. Huang, Chieh 1967: Foreword. Myers 1996: 260)].

## **General Procedure of Land Consolidation**

There has been little difference between developing and developed countries as far as collective action for consolidation is concerned (Sharma 1986: 716). Programs of land consolidation differ in various respects: from voluntary to compulsory; from dealing only with farmland to being linked to overall rural development; from farmers alone bearing the cost to sharing it with the authorities (Oldenburg 1990: 183); and, from using primitive methods to advanced satellite remote sensing and computer technologies. Here is the general procedure.

### **Administrative preparations**

Government guidance committees at national and local levels (province, prefecture, county, municipality, district) should be set up; education of public opinion about the disadvantages of fragmentation and advantages of land consolidation made; laws, statutes and regulations concerning the major aspects of the land consolidation established; and special tribunals at primary and appellate courts formed. Especially, it should be decided whether land consolidation should be started upon the consent of landowners by 100 % (voluntary), or 0 % (compulsory), or between these two extremes (partly voluntary or partly compulsory).

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might only be able to trade them in for an even smaller but better land unit which merely allowed them to grow some vegetables (Oldenburg 1990: 189). The lack of a complete land reform for equity in land ownership may be one reason why rural poverty is still widespread in this country.

Once a village has decided to carry out land consolidation, it should set up an executive committee consisting of representatives of officials, large and small land owners and tenants, and under which a technical group composed of experts on survey, appraisal, land records, computer, rural infrastructure and development, as well as some officials. An expected time limit for implementing the consolidation should be announced.<sup>2</sup> Landholders (owners and tenants) would thereafter be prohibited from taking any action which might lower the value of their land property without the permission of the village executive committee. Infringers of this rule are liable to a fine. (Vanderpol 1956: 552). New construction in the fields and transfer of lands would not be allowed (Elder 1962: 23).

### **Technical preparations**

The technical group should correct the current farmland cadastral records, and produce a provisional consolidation scheme with maps of assessing the value of the current land holdings, setting aside land for communal use, and assigning new holdings to each household (Bonner 1987: 21). It should then present the scheme with the maps to the village executive committee which in turn should inform all households of this for discussion. In case of disagreement, households could appeal for re-arrangement to the village executive committee, the guidance committees of the local governments, the primary court and appellate court whose judgement should be final. (Trivedi & Trivedi 1973: 183. Oldenburg 1990: 185).

### **Implementation**

Once the appeals have been handled, the consolidation scheme could be fixed. After the main (autumn) harvest, it could be implemented. The new land cadastral records should then be established by public notary. The consolidation is thus completed. (Bonner 1987: 22. Vanderpol 1956: 553)

## **Some Major Issues**

### **Consent of peasants**

The process of exchange of private parcels for consolidation would not be easy. There are indefinite individual obstacles to land consolidation. The resulting farms differ considerably in size, type, and topography. Some farmers get better bargains than others - and a still larger number will probably fear that others may do so. Some households may receive poorer land than they had before. It may not be possible to accommodate all the farmers. This would be compounded by the inertia of peasant tradition. For example, one family could claim that its parcels belong to heritage of its ancestors and could not be given away. Another may feel unfamiliar with the new parcels. There also will be financial concerns. For instance,

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<sup>2</sup> For example, it took two-three years in France and three-four years in the Netherlands in the 1940s-50s, and six-nine months in some areas of India in the 1980s (Roche 1956: 543. Van Rossem 1956: 555. Oldenburg 1990: 186, 193).

some farmers may worry that permanent crops, buildings, etc., in the old parcels would not be sufficiently compensated. (Binns 1950: 22-23). Such realities imply that - to fulfil its objectives - consolidation may have to be voluntary, compulsory or partly voluntary.

*Voluntary consolidation* is one when 100 % of landowners of the village (or area concerned) agree to carry it out. It could be through the spontaneous efforts of farmers in the form of cooperatives or personal exchanges, and should be assisted and encouraged by governments. However, for the above reasons, such operations are slow and unsatisfactory. Anything like complete success is unlikely to result from purely private enterprise. (Binns 1950: 24-25. Zaheer 1975: 92-93. Clout 1984: 104)

For example, consolidation was practiced in the village fields of Oster Hjermitslev, Denmark, in 1820 by the freehold farmers (owner-peasants) themselves. Having been unable to agree on a rational consolidation scheme, the farmers' land remained split up in 12 different places all over the village. In 1917, nearly 100 years after, though some amalgamation of the parcels of land had taken place, the situation remained unchanged. The experience in Denmark has been that where the consolidation process has been left entirely to the peasants, it has been ineffectual. (Skovgaard 1950: 45-46, 50-51). Slow progress under voluntary consolidation was also evident in France (1697-1888), Switzerland (1884-1911), India (1900-1951), and the Netherlands (before 1920) (Roche 1956: 539. Swi-Gov 1950: 83. Zaheer 1975: 92-93. Clout 1984: 104. Vanderpol 1956: 549). Therefore, government intervention was called for.

*Compulsory consolidation*, at the other extreme, is imposed by the authorities even if 0 % of landowners of the village (or area concerned) wish to start it. The authorities normally listen to landowners - but not through mass voting - before making decision, and landowners could also appeal although they have to accept the decision of the higher authorities. This approach may result in uncooperation, resentment and resistance of peasants. It might succeed in relatively less democratic times or areas relatively easier for consolidation [e.g., there were positive cases in Denmark during 1770s-1835 and France during 1935-80s (Skovgaard 1950: 43-45. Fre-Gov 1950: 59-60. Roche 1956: 539-543. Clout 1984: 105-110)], but not enjoy much success, if at all, in an increasingly democratic era or regions comparably more difficult for consolidation. For example, in the 1950s, in the village of Manovan, Uttar Pradesh of India, opposition to compulsory consolidation took a political turn when the Jan Sangh Party led a campaign to obstruct consolidation and evicted farmers who took the newly assigned parcels. Police had to arrest seven local leaders before consolidation could proceed. (Elder 1962: 27). In France, such schemes have been criticized as being over costly, bureaucratic and paying too much attention to the interests of land owners, especially in areas where tenancy was important. Fragmentation was still a severe problem in the 1980s, particularly in vine and fruit growing regions. (Harrison

1982: 41-42). In 1996, small farmers in Slovenia resisted the government's decision to proceed with compulsory consolidation (Riddell 1996). Therefore, democracy and sufficient participation by peasants in deciding whether to carry out consolidation are important.

*Partly voluntary consolidation* is one started with the consent of some landowners of the village (or area concerned) and approval of the authorities, while others, although disagreeing, have to follow. On one hand, there is accord by *substantial majority* (two thirds of land owners representing two thirds of land). For example, before 1861, all agricultural land in Russia was owned by the Tsar as state ownership but its use granted to nobles or communities of 'state peasant' households with the duty to serve the state. Serfs providing labor for serf-holders were allowed to use a part of the land held by the serf-holder. The land was used on a communal basis with three-field crop rotations, each peasant household using some strips of land in each field determined jointly by the whole village. Under the *1861 emancipation act* serfs were de jure freed from their serf-holders. The land they used was allocated to them, similar to a land reform. After the 1905 uprisings, the government further encouraged the reorganization of agricultural holdings. By a Law of 9 November 1906 peasants were given the right to change their communal strips of land into fully enclosed farms outside the village or consolidated holdings within it. The village could make this transformation by a two thirds majority vote of the heads of households. (OECD 1998: 75). However, substantial majority is similar to a voluntary scheme and therefore difficult to obtain. In Russia, by the time of the Bolshevik Revolution of November 1917, about 15 % of all the peasant households in the European part had consolidated their land, raising the share of family farms in hereditary tenure to 27 % - 33 % (Figes 1996). However, most individual farms were created in the west, south and south-east. The majority of the peasants in the central part did not change the land layout based on three-field crop rotations. (OECD 1998: 75-6). On the other hand, there is consent by *simple minority* (one third of land owners representing one third of land, or even less) which is close to compulsory action and thus could not always achieve the cooperation of other farmers in a democratic era.

Agreement by *simple majority* (51 %) or half would be more effective. Therefore, on one side, the Netherlands transformed the requirement for agreement ratio from 100 % to 66.7 % in 1920, further to 51 % in 1938 (Vanderpol 1956: 549); on the other, Sweden changed from requiring the agreement of only one land owner in a village in 1757 to that of majority in 1926 (Ytterborn 1956: 560). Taiwan Province of China and Portugal adopted 51 % in 1936 and 1962 respectively, while Greece stipulated 50 % in 1948 [Huang, Chieh 1967: (Appendix) 1, 37-38. Monke; Avillez & Ferro 1992: 69. Keeler & Skuras 1990: 74] [in India, rules vary among states from compulsory, simple minority, to substantial majority (Agarwal 1971: Appendix II)]. In general, once 51 % of landowners representing 51 % of land in the area concerned have agreed, land consolidation



could be started.

Here, governmental intervention to forward consolidation has aimed at encouraging voluntary action and supporting it by financial and other inducements, as well as providing technical assistance. Such activities need to educate public opinion, with very careful and intensive preparation. For instance, in Japan, although the 1949 Land Improvement Law prescribed that agreement by 50 % of landowners of a village (or area concerned) was sufficient for carrying out land consolidation and the 1992 new policies raised it to two thirds majority, in most cases 100 % consent was attained before starting it, but great efforts had to be made by officials to overcome serious difficulties in adjusting interests among peasants (Hyodo 1956: 559. Tsuge 1997. NIRA 1995: 174). Nevertheless, *legal power for compulsory action should be reserved in special cases*. (Binns 1950: 25). For example, the Netherlands empowered the Ministry of Agriculture in 1938 to impose consolidation schemes when they were urgently required in the public interest even if the necessary votes had not been obtained; and Greece prescribed in 1948 that consolidation could be compulsory if it was needed to successfully complete drainage and irrigation projects - both of them have facilitated land consolidation (Vanderpol 1956: 550, 552. Keeler & Skuras 1990: 74-75).

#### **Assessment of the value of current farmland holdings**

The most critical phase of the entire process is the evaluation of the farmlands. Only an impartial and accurate valuation can assure a fair and equitable redistribution. Three major methods for valuing land could be considered. These are valuation by (1) market price; (2) rental value; and (3) land productivity. The main disadvantage of the first method is that the market price of some parcels (e.g., those near the village site) may be very high as reflecting industrial or housing demand for land rather than agricultural profits. The major disadvantage of the second is that rental system varies from fixed rent to proportionate rent in cash or kind, which renders the determination of exact rental value difficult. Therefore, the third method is more suitable. Under this system, the value of a parcel of land is based on an assessment of its agricultural productivity. A variety of natural factors should be considered, including the acreage, fertility, access to water, flatness and distance to the village site, etc. After touring the village lands, the technical group selects some parcels which are, by common agreement, the best in the village in terms of one or some of these factors, thus becoming the standard of others. (Bonner 1987: 22. Roche 1956: 541). Below is an illustration [The principle in the following method has been used in practice (e.g., in India - Oldenburg 1990: 186). But the mathematical generalization is made by the author as not found in the literature reviewed. It could be adapted to local conditions and expanded to more complicated models using econometric tools and computer techniques. The numbers are hypothetical. The sizes of farms in figures are not proportionate to the grades].

Suppose: A village has  $m$  (say, five) household farms -

$F_m$ :  $m = 1, 2, \dots, 5$ ;

Each farm has up to  $n$  (say, 10) parcels located in different places -

$P_n$ :  $n = 1, 2, \dots, 10$ ; also suppose  $F_1$  has 6 parcels,  $F_2$  7 parcels, ...,  $F_5$  10 parcels; (see Figure 3.2)

Each parcel can be assessed on  $i$  factors (say, five: acreage, fertility, access to water, flatness, distance to village site) -  $Q_i$ :  $i = 1, 2, \dots, 5$ ; the best parcel in one factor could be assessed as 1 (e.g., in Figure 3.1,  $P_1$  is valued as 1 in  $Q_2$  - fertility, and  $P_4$  is given 1 in  $Q_5$  - distance to village site), parcels inferior to it could be given numbers smaller than 1.

Each factor could be given different weight -  $W_j$ :  $j = 1, 2, \dots, 5$ ; Total  $W = 1$  (acreage and fertility may receive higher weights, and in general a smaller area of good land could be exchanged with a larger area of poor land; in Figure 3.1, these five factors are given weights of 0.35, 0.35, 0.15, 0.05, 0.1 respectively) (See formulas and illustration in Figure 3.1).

Following the assessment, grade could be given to each farm, say,  $F_1 = 2.48$ ,  $F_2 = 3.26$ ,  $F_3 = 4.37$ ,  $F_4 = 5.93$ ,  $F_5 = 6.12$ .

The fixed capital assets (permanent crops, orchards, vineyards, buildings, wells, etc.) on the parcels are not natural but artificial factors. Those which have to be destroyed should be reimbursed or rebuilt in the new place by the village; those which will be reserved but transferred to another owner should be paid by that owner (offsetting between owners may be arranged), or be valued as extra grade to the parcels.

### **Promotion of rural development**

Among the newly established larger land units, major infrastructure items (main roads among farms and linked to other villages, water conservancy, irrigation and drainage network linking lakes-rivers-canals-ditches-drains, electricity facilities, etc.) should be built, so that each land unit could have easy access to roads, large machinery, irrigation and other facilities. A scientific design for the facilities to process and store agricultural products, schools, hospitals, cultural halls, sport grounds, post and telecommunications office, village administrative offices, housing, land for industrial use, land reserved for future construction, etc., in the village site should be made. Environmental protection (forest, nature reserves, tourist resorts, etc.) should be taken into consideration.

Thus, a number of villages in a district could coordinate their consolidation plans or even create a general one. Migration of some peasants from the congested to less crowded rural districts could be arranged, so that both the remaining and outgoing peasants could acquire larger land units. Apparently, government coordination is necessary.

Each farm should contribute a small percentage (e.g., 3 % - 5 %) of farmland for the communal use. The removal of numerous boundaries would make this possible without (significant) reduction of farm size. (Zaheer 1975: 113). Nominal compensation could be paid to the contributors by the village (Trivedi & Trivedi

1973: 183-184). Exchanges between farmland and non-farmland, and between private and public land could also be organized.

The land accommodating major infrastructure should be publicly owned by governments (central, local) or by the village - hence a mixed economy of private ownership of farmland and public ownership of infrastructure land. The main reasons for this are that private land owners may inhibit others from getting access to the infrastructure (Oldenburg 1990: 188) and also have the right to withdraw their land if they wish, which would exert harmful externalities on other peasants and the whole community. The infrastructure itself could belong to the governments or village and individual investors

*Figure 1 Formulas for Calculating Grades of Farms \**

$$\begin{aligned}
 \text{Grade for } F_1 &= P_1(Q_1W_1 + Q_2W_2 + \dots + Q_5W_5) \\
 &+ P_2(Q_1W_1 + Q_2W_2 + \dots + Q_5W_5) \\
 &+ \dots \\
 &+ P_6(Q_1W_1 + Q_2W_2 + \dots + Q_5W_5) \\
 &= \sum_{n=1}^6 P_n \sum_{i,j=1}^5 Q_iW_j = 2.48, \quad W_j = (0,1), \quad \sum_{j=1}^5 W_j = 1 \\
 \\
 \text{Grade for } F_2 &= \sum_{n=1}^7 P_n \sum_{i,j=1}^5 Q_iW_j = 3.26 \\
 \\
 \text{Grade for } F_3 &= \sum_{n=1}^8 P_n \sum_{i,j=1}^5 Q_iW_j = 4.37 \\
 \\
 \text{Grade for } F_4 &= \sum_{n=1}^9 P_n \sum_{i,j=1}^5 Q_iW_j = 5.93 \\
 \\
 \text{Grade for } F_5 &= \sum_{n=1}^{10} P_n \sum_{i,j=1}^5 Q_iW_j = 6.12
 \end{aligned}$$

\* This figure is the author's own formulation.

Figure 2 Illustration of Assessing Grade for Farm 1 \*

	Q <sub>1</sub>	W <sub>1</sub>	Q <sub>1</sub> W <sub>1</sub>	Q <sub>2</sub>	W <sub>2</sub>	Q <sub>2</sub> W <sub>2</sub>	Q <sub>3</sub>	W <sub>3</sub>	Q <sub>3</sub> W <sub>3</sub>	Q <sub>4</sub>	W <sub>4</sub>	Q <sub>4</sub> W <sub>4</sub>	Q <sub>5</sub>	W <sub>5</sub>	Q <sub>5</sub> W <sub>5</sub>	Sub-grade
P <sub>1</sub>	0.05	0.35	0.0175	1	0.35	0.35	0.9	0.15	0.135	0.8	0.05	0.04	0.5	0.1	0.05	0.5925
P <sub>2</sub>	0.1		0.035	0.8		0.28	0.3		0.045	0.9		0.045	0.3		0.03	0.435
P <sub>3</sub>	0.15		0.0525	0.6		0.21	0.7		0.105	0.7		0.035	0.7		0.07	0.4725
P <sub>4</sub>	0.2		0.07	0.4		0.14	0.5		0.075	0.3		0.015	1		0.1	0.4
P <sub>5</sub>	0.2		0.07	0.3		0.105	0.4		0.06	0.4		0.02	0.6		0.06	0.315
P <sub>6</sub>	0.3		0.105	0.2		0.07	0.3		0.045	0.7		0.035	0.1		0.01	0.265
Q <sub>1</sub> , W <sub>1</sub> : acreage (ha); Q <sub>2</sub> , W <sub>2</sub> : fertility; Q <sub>3</sub> , W <sub>3</sub> : access to water;																2.48
Q <sub>4</sub> , W <sub>4</sub> : flatness; Q <sub>5</sub> , W <sub>5</sub> : distance to village site																Total grade
Sub-grade = Q <sub>1</sub> W <sub>1</sub> + Q <sub>2</sub> W <sub>2</sub> + Q <sub>3</sub> W <sub>3</sub> + Q <sub>4</sub> W <sub>4</sub> + Q <sub>5</sub> W <sub>5</sub>																

\* This figure is the author's own formulation.

*Figure 3 Before Consolidation - Fragmented Farms \**

$F_1P_1$	$F_4P_1$	$F_3P_1$	$F_2P_1$	$F_5P_1$	$F_1P_2$	$F_2P_2$	$F_5P_2$
$F_2P_3$	$F_5P_3$	$F_2P_4$	$F_4P_2$	$F_3P_2$	$F_4P_3$	$F_5P_4$	$F_1P_3$
$F_3P_3$	$F_1P_4$	$F_4P_4$	$F_5P_5$	$F_4P_5$	$F_5P_6$	$F_2P_5$	$F_3P_4$
$F_4P_6$	$F_3P_5$	$F_5P_7$	$F_1P_5$	$F_2P_6$	$F_3P_6$	$F_4P_7$	$F_5P_8$
$F_5P_9$	$F_4P_8$	$F_3P_7$	$F_2P_7$	$F_3P_8$	$F_5P_{10}$	$F_1P_6$	$F_4P_9$

\* This figure is the author's own formulation.

*Figure 4 After Consolidation - Each Farm Has Two Parcels \**

$F_1P_1$	$F_3P_1$	$F_5P_1$	$F_2P_2$	$F_4P_2$
$F_2P_1$	$F_4P_1$	$F_1P_2$	$F_3P_2$	$F_5P_2$

\* This figure is the author's own formulation.

*Figure 5 After Consolidation - Each Farm Has One Parcel \**

$F_1$	$F_2$	$F_3$	$F_4$	$F_5$
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\* This figure is the author's own formulation.

according to their respective investment shares. [There have been good experiences in combining land consolidation with the overall rural development in Belgium, France, Germany, Greece, India, Japan, the Netherlands, Taiwan Province of China, etc. (Clout 1984: 108-116. Keeler & Skuras 1990: 75. Zaheer 1975: 112-113. Tsuge 1997. Huang, Chieh 1967: 91-95)]

#### **Assignment of new farmland to each household**

The land assigned to each farm should be given the most practical shape possible (in general *rectangular* - the length of the parcel should not be more than three or four times its breadth, and *square* for larger parcels) (Skovgaard 1950: 44. Roche 1956: 541). After the reorganization, each household would privately own one or a few (preferably no more than three) compact farmland unit(s) (see Figures 3.3 and 3.4). The total farm size is more or less the same as before, but the size of land unit (parcel) is larger. For example, a farm previously composed of 10 dispersed parcels (on average 0.1 ha each) can now hold one compact parcel of 1 ha.

Some discreteness of parcels may be rational due to differences in geography, ecology, etc. For example, a farmer may need both summer and winter pasture in certain hill areas, or land suitable for seed nurseries and land for growing of rice, or varieties of soil and situation in certain types of mixed farming to avoid risk of being dependent on one product. There is also local custom of working both an upland parcel and a parcel on river banks and islands where work is done in entirely different seasons. (Binns 1950: 31. Heston & Kumar 1983: 213). Many farms in mountain regions consist of three separate estates - in the plains, in the middle levels and on the high levels. The solution may be to lighten the task and the expense of the peasants by regrouping to the greatest possible extent the lands which they possess at the various levels, and by reducing to a minimum the capital invested in construction. (Swi-Gov 1950: 90). In a village with very distinct qualities of land, exchanging a smaller area of good land with a larger area of poor land to form just one compact land unit for each farm might be difficult. Under such circumstances, different qualities could be classified into a few (e.g., three) classes, and a farmer could retain consolidated parcels of each quality, whose original fragments were in each class. (Heston & Kumar 1983: 209-210, 213). In general, most farms should contain only one parcel, with a few farms holding two or three (Oldenburg 1990: 186. Trivedi & Trivedi 1973: 186. Skovgaard 1950: 43-44).

#### **Application of modern technologies**

A cadastre, which registers not only the boundaries but also the quality and value of real estate, is fundamental to land redistribution. Previously, with hundreds of tiny parcels to delineate, it could take years, often decades, for surveyors to draw and redraw maps to come up with an equitable form of consolidation. Mistakes

occurred, disputes increased, farmers felt imposed on and were reluctant to cooperate. (Nelson 1993: 24)

Now, this work can be much simplified. The government could organize satellite remote sensing for national land cover mapping as a component within a Geographic Information System (GIS), providing land data to each village (Haack & English 1996: 845). An ordinary personal computer equipped with the right program can create a cadastre from aerial photographs and digitalized field notes gathered with high speed by an Electronic Distance Measuring system (EDM). Values of parcels resulting from assessment can also be put in. Using the computer, a surveyor can produce a cadastre in minutes and redraw it just as quickly in response to any number of 'what if' scenarios. It can be done on the spot with the participation of the local farming community. People whose land boundaries are in question can consider the alternatives and explain exactly what they want and do not want at each step. Each household could see the new map including its own future farm in the computer screen and make appeals if necessary before the consolidation scheme is finalized. Once the final version is ready, the information is fed into a larger, more powerful micro-computer capable of drawing the fine lines needed for boundaries and producing a map on durable, high-quality paper. (Nelson 1993: 24). In this way, survey, valuation, calculation, design, allocation, expenditure, etc., could be much facilitated, mistakes reduced, disputes decreased, unfair distribution due to corruption of officials supervised and time shortened.

### **Control of corruption**

Corruption could present a major problem during land consolidation. It is reported that in some areas of India, large land owners paid bribes to the consolidation officials and got land of better quality, near the village and with fewer parcels, while the small owners could not afford to bribe, thus received the opposite and became poorer (Elder 1962: 36). Factions in the villages are commonplace and can stimulate corruption. Except for using computer as mentioned above, thorough and intensive inspection, investigation of appeals on the spot before the whole village assembly and removal of the corrupt officials are necessary for combating this problem. (Trivedi & Trivedi 1973: 185)

### **Appeals**

Appeals should thus be handled, at a maximum of three levels in administrative system (village executive committee, guidance committees of two levels of the local governments above the village), plus two levels in judicial system (primary and appellate courts). A time limit for processing is necessary, because once consolidation has been promulgated, farmers would not improve the original land but wait for the new one (Trivedi & Trivedi 1973: 185).

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In the land consolidation of some areas of India, irrigation experts had to rely on guesswork and conjecture, and consolidation officials made channels on paper which were later discovered to be unworkable when demarcated on the spot (Zaheer 1975: 117).

Administrative processing of appeals should take no more than three months. Courts would take a much longer time and cost much more money. Thus either special tribunals should be set up to speed the processing, or peasants be persuaded not to sue for small bargains (Oldenburg 1990: 185-186) and administrative processing be strengthened accordingly.

### **Expenses**

Expenses are incurred in the above process. For private landholders, some permanent crops, buildings and other infrastructure in the old parcels would have to be removed and compensated, new buildings and other infrastructure in the new farms be built and subsidized. Some peasants might be asked to migrate to other areas and be subsidized as well. Public infrastructure implies public finance. Fees for organizational purposes occurred for setting up ad hoc committees, inviting external experts, etc. and carrying out their activities. These expenses should be borne by the central and local governments, village and landholders in the form of government grants and loans, bank credits, and personal payments. The village and landholders should be involved in decision making and allocation concerning the funds.

### **Population control**

Population control should be strengthened. Otherwise, due to inheritance and other factors, not only the present fragmented small farms would be further fragmented, but also the already consolidated farms would be refragmentized. For example, in India, although land consolidation has been pursued, the problem of re-fragmentation is not prevented (Trivedi & Trivedi 1973: 186).

### **Conclusion**

Based on a mixed economy of private ownership of farmland and public ownership of infrastructure land, dispersed parcels of farms could be consolidated through exchange of private ownership and reallocation in compact land units. In this process, intervention of governments, education of public opinion, active participation of farmers, and combination with overall rural development are necessary, and application of satellite remote sensing and computer technologies is beneficial. Population growth should be controlled in order to prevent re-fragmentation.

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