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Land Fragmentation in Developing Countries: The Optimal Choice and Policy Implications

INTRODUCTION

In this paper, a model is developed which interprets configuration of farmlands (fragmentation/consolidation) as an economic phenomenon. Many previous studies considered configuration of farmlands as a socio-cultural characteristic with individual farmers powerless to alter configurations. In fact, farmers frequently are able to make adjustments in their land holdings. In such cases, the persistence of fragmented lands represents a decision by farmers that the benefits to consolidating lands are less than the costs incurred by farming scattered plots.

The model presented here considers possible production advantages as well as disadvantages with fragmented land but focuses on farms facing disadvantages. Consolidating lands thus raises short-run farm profits. The model breaks consolidation costs into capital and transaction cost components. Farmers maximising wealth over time will choose optimal quantities of land to consolidate in each period moving them to optimal levels of land fragmentation/consolidation. Optimal levels of fragmentation may differ across farms since individual economic conditions affect each farmer's costs.

Fragmented farmlands are often considered an impediment to agricultural development. Thus several countries have initiated public consolidation programmes. This paper discusses the efficiency of such programmes in light of the optimisation model presented. Alternative policies which affect individual costs and benefits of consolidation are also examined.

The first two sections of this paper provide some background to the fragmentation problem. Section 1 describes how it originates and why fragmentation is a problem. Section 2 identifies the relevant benefits and costs of consolidating fragmented parcels. The model which yields the farmer's decision on consolidation is presented in section 3. This section also summarises how economic factors influence optimal consolidation levels. Section 4 discusses the public role in influencing land consolidation.

1. THE FRAGMENTATION PROBLEM

Land fragmentation is not unique to any specific region of the world. For countries as diverse as Pakistan, Peru, and Syria, the average farm consists of at least four separate land parcels. The FAO's 1970 World Census of Agriculture reported 80 per cent of agricultural holdings worldwide were fragmented (FAO 1981). How farmlands initially became fragmented remains an open question. Many cite the influence of external factors in explaining fragmentation (e.g. Binns 1950, Srivastava 1970). The best received among such factors is an equity oriented inheritance custom where land parcels of differing qualities in the original farm are divided equally among heirs. A second source of fragmentation is a settlement pattern where as families expand, they acquire new plots on the fringes of cultivated lands. Over several generations, a considerable number of parcels could accumulate as available lands become more distant.

The literature dealing with land scattering in medieval Europe focuses on benefits which may lead farmers to fragment lands (Fenoaltea 1976; McClosky 1975). By producing on lands with varying characteristics, farmers may lower exposure to risk or enable a more intensive use of family resources. This is possible if inputs are required at different times. In such cases, farmers gain with fragmentation. However, a farmer who later switches crops or production techniques may no longer obtain benefits and still be left with scattered holdings.

For whatever reason it arises, farming on fragmented lands introduces additional production costs compared to production on contiguous lands. A principal source of extra cost is the need for additional labour and land. Labour time is consumed in travelling and in transporting inputs and outputs to and from scattered plots. Extra labour may also be necessary to supervise crops and livestock adequately on scattered land. More land may be required to compensate for greater 'wastage' in boundary hedges and corners with scattered land.

A second source of greater production expense is that some cost reducing or more productive techniques are not feasible on small and scattered plots. Irrigation and drainage, for example, involve large fixed costs per parcel and are not justified financially on small parcels. Fragmentation also complicates pest control since successful control becomes dependent on the activities of neighbouring farms.

This paper, being concerned with the consolidation issue, focuses on instances where the costs of fragmentation outweigh any benefits. Only fragmentation imposing net costs on farmers is considered. The intention here is not to imply that possible benefits are insignificant but to simplify the discussion for analysis of consolidation policies. Thus, the effective point of departure for this paper is that a large number of farmers are producing on fragmented lands and incurring the consequent added costs.[1]

2. LAND CONSOLIDATION

Exogenous sources of fragmentation such as those mentioned above only initiate the fragmention of land. To explain its persistence, obstacles to consolidation must be examined. Obstacles give rise to adjustment costs which inhibit the consolidation of land. Without these costs, landowners would immediately consolidate to eliminate the fragmentation induced costs. Two characteristics of the economic environment which permit the persistence of fragmentation are the scarcity of farm land and thin land markets. Scarcity of land impedes consolidation by limiting farm expansion in any one year while thin markets restrict opportunities for exchange of parcels. These characteristics are typical of many developing economies.

The effect of land scarcity is that prices for both fragmented and contiguous land are high. Fragmented land represents a valuable asset even with its associated higher production costs. Land scarcity also precludes the possibility of acquiring inexpensive contiguous lands in a frontier settlement area.

The high price of land, in turn, restricts expansions of total acreage in any year. Land acquisition is particularly difficult for small farms with limited capital stocks and limited access to capital. This problem is compounded by land being the principal long-term store of wealth in many regions. The alternative of wealth holding in livestock is complicated on small scattered plots since surrounding farmers' plots restrict access. Also, with high rates of physical depreciation, storage of farm output is only feasible in the short run. The combined effect of high land prices and limited capital means that total farm acreage is relatively stable. Though some farmers may have significant non-land assets and some farms may be expanding, incorporating these features into the model does not alter the conclusions.[2]

Since expansion possibilities are limited, land is most readily consolidated through the simultaneous sale and purchase of fragmented and contiguous parcels. Sales must finance all purchases. In such cases, the total land stock remains fixed except for compensations for variation in land characteristics. For the consolidating farmer, however, since production costs are lower on contiguous land, the exchange represents an improvement in land 'quality'. Note that this quality characteristic is associated with land configuration only. It is tied to how the land is used and thus differs from other features such as drainage, topography, and soil nutrients that are quality characteristics physically linked to a given parcel.

The two types of land, contiguous (A^c) and fragmented (A^f), can be represented in a production function:

$$y = f(x, A^c, A^f) \tag{1}$$

where y is farm output and x is a vector of non-land inputs. The first and second partial derivatives of f(.) with respect to its arguments are positive, and negative respectively. Each input has a positive but decreasing

marginal product. If farm sizes are held roughly constant, the consolidation actions increase A^c by reducing A^f.

The growth in contiguous land acreage (A^c) can be described with a transformation function:

$$\dot{A}^c = g(T) \quad T \geqslant 0 \tag{2}$$

where T is the quantity of fragmented land sold and is the farmer's choice variable. The first partial with respect to T (g_T) is positive and will be greater than, less than, or equal to 1 depending on physical quality characteristics of the parcels exchanged. If the fragmented parcel is superior to the contiguous parcel in terms of soil quality, for example, $0 < g_T < 1$. If the contiguous parcel is superior then $g_T > 1$.

The second important feature of rural economies in many developing countries is that land markets are extremely thin. With infrequent transactions of land and with a static rental market, it is difficult to acquire the appropriate contiguous plot and to sell a fragmented plot in any single period. This transaction difficulty is captured by introducing a premium per unit of land transformed, $\alpha(T)$. Larger transactions aggravate the difficulty, thus, the transformation premium is increasing, $\alpha'(T) > 0$. Increasing transaction costs may take the form of incurring higher search costs, paying a cash premium to transactors, or buying a broker's services. To summarise, the local economic environment may impose constraints on consolidating fragmented land. Consequences of these constraints are illustrated in the two components of consolidation costs. In an environment of land scarcity with little non-land wealth, direct capital costs of acquired acreage are paid for by liquidating fragmented parcels. This is shown in the transformation function above. Additional indirect costs, which accrue due to thin land markets, enter as a premium for market transactions. Unlike the capital cost, the premium is paid out of current farm income.

Consolidation costs are presented here in the context of private land ownership with a market for land. This does not imply that the following model is irrelevant for countries with differing economic structures and ownership patterns. However, the costs of consolidation would then have to be redefined in light of those economic conditions. Policy implications, of course, will differ also.

Aside from the monetary costs described above, a wide range of non-monetary elements may enter the consolidation decision. Farmers may feel emotionally attached to land they have worked for many years or may be reluctant to sell inheritances. Such non-monetary attributes of given parcels of land are omitted from the profit maximising objective presented below. A broader objective function may be employed to capture non-monetary components of utility. The intention of using a profit maximising model (below) is not to subordinate these non-monetary considerations but to demonstrate that there may be financial advantages to fragmented holdings.

3. OPTIMAL LAND CONSOLIDATION

Farmers make two types of decisions regarding their farms. First, farmers maximise current profits by choosing an optimal vector of variable inputs given input and output prices and a fixed land input:

$$\pi(p,w,A^c,A^f) = \max_x pf(x,A^c,A^f) - wx \tag{3}$$

where p and w are the output and input price vectors. The profit function (π) has the usual properties with respect to p and w. Also, π is increasing and concave with respect to A^c and A^f from the earlier assumptions of f(.). The solution to (3) is the vector of optimal inputs $x^*(p,w,A^c,A^f)$ for that period. As stated in section 2, attention is directed in this paper to farms experiencing net costs of fragmentation. Thus, the predetermined level of land fragmentation affects profits principally by raising production costs. For two farms A_0 and A_1 equal in sizes of total farm lands, but differing in configuration, $A^f{}_0 > A^f{}_1$ and $A^c{}_0 < A^c{}_1$:

$$\pi(p,w,A^c{}_0,A^f{}_0) \leq \pi(p,w,A^c{}_1,A^f{}_1) \tag{3}$$

indicating that short-run farm profits are greater with higher levels of contiguous land.

The second type of decision concerns the stock of land. In the long run, the fixity of land configurations is relaxed and farmers choose the rate of land transformation which maximises wealth over all future time periods. An optimal control framework is used here to convert stock benefits to flow benefits and derive optimising conditions for both types of decisions. The value function in each period is current maximised profits less current consolidation expenditure. The discounted value function is maximised over time subject to the equation of motion for the stock of consolidated land:

$$J(p,w,r,\bar{A}^c,\bar{A}^f) = \max_T \int_0^\infty e^{-rt}[\pi(p,w,A^c,A^f) - \alpha(T)T]dt : \dot{A}^c = g(T) \tag{4}$$

Equation (5) is the Hamiltonian of (4) with λ as the co-state variable. Equations (6) and (7) are necessary conditions for maximisation (notation for time periods is suppressed):

$$H = e^{-rt}[\pi(p,w,A^c,A^f) - \alpha(T)T] + \lambda g(T) \tag{5}$$

$$\frac{\partial H}{\partial T} = e^{-rt}\left[\pi_{Ac}\frac{\partial A^c}{\partial T} + \pi_{Af}\frac{\partial A^f}{\partial T} - \alpha - \alpha_T T\right] + \lambda g_T = 0 \tag{6}$$

$$\frac{\partial H}{\partial A^c} = e^{-rt}\pi_{Ac} = -\dot{\lambda} \tag{7}$$

Equation (6) written as (6′) is the decision rule for selecting T:

$$-\lambda = e^{-rt}\left[\pi_{Ac}\frac{\partial A^c}{\partial T} + \pi_{Af}\frac{\partial A^f}{\partial T} - \alpha(1 + \varepsilon(T))\right](1/g_T). \qquad (6')$$

The bracketed term is the net marginal cost of transforming land. Transformation adds to A^c stock but reduces A^f. The net effect on current profits is positive due to lower production costs. The transaction premium is expressed in elasticity form: $\alpha(1 + \varepsilon(T))$, where $\varepsilon(T)$ is the elasticity of the transaction premium and is positive. The bracketed marginal cost is discounted by e^{-rt} and scaled by $1/g_r$. The scaling factor accounts for varying physical qualities of land in the exchange of A^f for A^c. If land qualities are equal, $g_T = 1$. Thus, the left hand side of (6') is the present value of the cost of adding to the stock of A^c.

The farmer selects the path of T so that the present value of cost equals $-\lambda$ where λ is the marginal benefit of adding to the A^c stock. This marginal benefit is the present value of all future benefits to be obtained due to an increase in A^c. This is analogous on the benefit side to the concept of user cost.

Equation (7) states that gain in current benefits due to increases in the stock of A^c must equal $-\dot{\lambda}$, the negative change in benefits, in each period. With a given rate of $\dot{\lambda}$, (7) is a choice rule for the optimal level of A^c. Solving necessary conditions (6') and (7) simultaneously yields the optimising condition for the wealth maximisation problem (4):

$$\pi_{Ac}/r = -\left[\pi_{Ac}\frac{\partial A^c}{\partial T} + \pi_{Af}\frac{\partial A^f}{\partial T} - \alpha(1 + \varepsilon(T))\right](1/g_T). \qquad (8)$$

Benefits derived from adding to the A^c stock are set equal to the costs of additions, thus, (8) is a decision rule stating that in each period the farmer should choose a rate of transformation so that the marginal benefit, which is constant in any one period, equals the marginal cost of transformation, which is increasing in T. Solving (8) for T gives the decision rule:

$$T = h(A^c, A^f, p, w, r).$$

Equation (8) may also be solved for the optimal level of consolidation. Benefits to consolidation fall and costs rise with increasing A^c. This can be demonstrated by differentiating the benefit side and the cost side of (8) with respected to A^c:

$$\underset{(-)}{\pi_{AcAc}/r} \text{ and } -\left[\underset{(-)}{\pi_{AcAc}}\frac{\partial A^c}{\partial T} + \underset{(+)}{\pi_{AfAc}}\frac{\partial A^f}{\partial T}\right]\underset{(+)}{(1/g_T)} \qquad (8')$$

where the level of A^c does not affect the transformation function, the rate of change of A^c and A^f, nor the transaction premium and its elasticity:

$$g_{TAc} = \frac{\partial^2 A^c}{\partial T \partial A^c} = \frac{\partial^2 A^f}{\partial T \partial A^f} = \frac{\partial \alpha}{\partial A^c} = \frac{\partial \varepsilon}{\partial A^c} = 0.$$

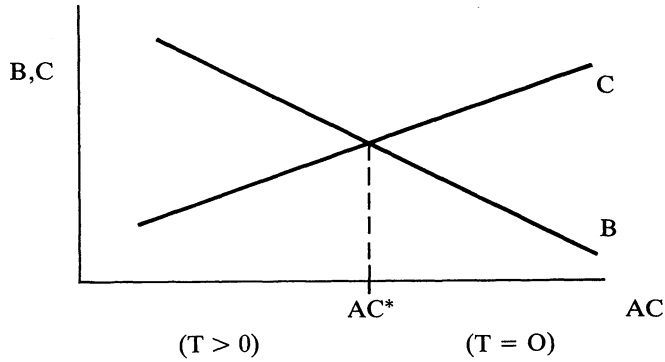

FIGURE 1

The terms in (8′) can be signed as indicated noting that the profit function is concave in A^c. The sign of the cross partial (π_{AcAf}) is ambiguous but it can be assumed to be zero.

The optimal level of consolidation (A^{c*}) is attained when marginal benefits equal marginal costs as shown in Figure 1. The marginal benefit and marginal cost curves (B, C) are the left and right hand sides of (8) respectively. To the left of A^{c*}, benefits of consolidating exceed costs and it pays the farmer to invest in land consolidation; $T > 0$. To the right of A^{c*}, the farmer abstains from transforming fragmented lands; $T = 0$. The relevant region for consolidation is limited to $A^c \leqslant A^{c*}$ since costs of consolidation exceed benefits when $A^c > A^{c*}$. Consolidation will not be observed beyond A^{c*}. However, if the initial stock equals or exceeds A^{c*}, that initial A^c is optimal and no land adjustments occur.[3]

The model above indicates that fragmented land holdings may be an optimal configuration of land for farmers given the economic environment. With high costs of consolidation and relatively low benefits, the efficient decision is to forego consolidation. A number of factors in the economic environment may influence these costs and benefits and thus affect levels of farm fragmentation. Several factors which lead to higher levels of optimal fragmentation and which characterise the economic environment in some developing countries are described here:

1. The first factor is the tendency to underprice agricultural outputs. Low prices suppress marginal profits of the farm sector and benefit urban consumers. Low marginal profits of land reduce both benefits and costs in equation (8); however, the net effect of low output prices is a fall in benefits which in turn increases fragmentation.

2. Marginal profits are also suppressed by weak transportation and marketing infrastructures, and by unavailability of inputs which are not locally produced. Such constraints increase the costs of producing any given level of output. Low output prices and high costs also diminish incentives to invest in other productivity boosting activities. Foregone investment then lowers marginal profits in future periods.

3. A third factor raising fragmentation levels is the high interest rates typically faced by small farmers in developing countries. High r lowers consolidation benefits on the left-hand side of (8). Governments frequently set low interest rate ceilings on institutional lending causing available credit to be rationed among demanders. Credit institutions often lend first to large farmers and non-agricultural borrowers, forcing small farmers who obtain credit to pay considerably higher rates in a secondary credit market. Small farm lending is assumed by credit institutions to entail higher administrative costs and collection risks.

4. A final factor increasing fragmentation in the small farm sector is the thinness of land markets which is typical in rural areas. Thin land markets give rise to higher transaction premiums in consolidation costs and greater premium elasticities. Each serves to increase consolidation cost in (8).

4. PUBLIC LAND CONSOLIDATION POLICIES

The optimal levels of land consolidation established in section 3 are for private farmers who maximise individual wealth. Government planners operate with a wider mandate and maximise social welfare to obtain the socially optimal consolidation level. The social optimum may be higher than that chosen by individual farmers due to positive externalities of private consolidation. Externalities may include: (1) social benefits to higher output such as increasing supply or reducing demand for foreign exchange and (2) social benefits to raising earnings of low-income farmers.

Agricultural output may produce benefits which are not reflected entirely in market prices. If the output is exported, an added benefit is foreign exchange earnings. More important, many developing countries must import food to make up for stagnant production. Output gains may conserve scarce foreign exchange by reducing these food imports. In either case, greater land consolidation adds to a country's production potential.

Consolidation can reduce income disparities if public consolidation programmes are aimed at poor farmers with fragmented lands. Recipient farmers will increase consolidation obtaining higher income streams. In areas where fragmented farms are concentrated among low-income farmers, consolidation need not be aimed to reduce inequalities.

Social optima may also exceed private optima if the social discount rate is lower than private discount rates. Substituting a lower discount rate raises the net present value of consolidation which in turn leads to higher equilibrium levels of land consolidation.

Several governments have initiated public land consolidation programmes to reduce high observed levels of fragmentation. However, most programmes appear to overlook the fact that positive levels of fragmentation may be optimal and that pre-programme land configurations may not be grossly inefficient. The result is consolidation

programmes which maximise land transformations rather than maximising net social returns. Post programme equilibria may be then characterised by both over and under consolidation. Farmers not affected directly by the programme will remain at private optima below the social optimum while recipients of government assistance will often have more contiguous land than it was optimal to invest in.

An alternative approach to move consolidation levels toward the social optimum is to use government resources to relax some of the constraints which inhibit private consolidation. Government actions could include policies to raise prices of farm outputs and to lower interest rates in the agricultural sector. Financial resources could be devoted to improving physical infrastructures in the country. Lower transportation costs raise returns to producers through both output and input prices. Supply of inputs can also be increased and standardised. The government can also finance research institutions concentrating on small farm needs. Finally, policies to strengthen land markets could stimulate private consolidation. Government actions could include clearly defining and enforcing property rights to land and improving the quantity and quality of information about land and land exchanges.

Each of the above policies has been proposed in the development literature as a tool to attain other farm sector goals. For example, higher output prices and land security improve production incentives. Also, infrastructural and research investments can increase farm output and incomes. The policies mentioned here influence consolidation only indirectly by altering the economic environment of farmers. Thus, the goal of increasing private consolidation can be achieved simultaneously with other agricultural development objectives.

CONCLUSION

This paper uses an optimal control approach to model choices of land consolidation by farmers. Given decreasing benefits and increasing costs the optimal level of consolidation could be less than total consolidation of land holdings. This optimal level is sensitive to a number of characteristics of the economic environment.

The fact that socially optimal levels of consolidation may exceed private optima justifies public policies to stimulate private consolidation decisions. This study identifies several policies which help to move private optima closer to social optima by altering the farmer's economic environment. By encouraging consolidation with policies based on a model of maximising behaviour by farmers, governments could move toward the social optimum without introducing new inefficiencies. Such an approach differs significantly from that of traditional consolidation programmes which ignore possible benefits to fragmentation.

NOTES

[1]A broader model whhich jointly considers benefits and costs of scattered lands is

presented in Simons, 'Optimal Land Adjustments: A Dynamic Model of Fragmentation and Consolidation' (1985). The broader model yields a decision rule without the asymmetric property described above.

[2]Actually, marginal expansion of land is another origin of farm fragmentation. When contiguous parcels are unavailable, expansion is only possible by increasing the number of parcels per holding.

[3]The broader model in Simons (1985) endogenises fragmentation as well as consolidation and thus is not limited to unidirectional adjustments.

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DISCUSSION OPENING I – ANDRÈ BRUN

I have four main points to make on the first paper by Clark Edwards.

1. First, I will mention and emphasise the central problem Edwards is tackling. In fact it goes much beyond the role of natural resources in regional agricultural growth. The modesty of the title hides what seems to me an attempt to grasp the whole food problem in a world where surpluses accumulate in some places and malnutrition is endemic in others, if not in the same places. The paper addresses itself to the main challenge that we have to face as agricultural economists. Having such a dramatic situation before us, we are not allowed to make errors. Edwards tries to demonstrate the main sources of misleading considerations that are often made when we try to grasp the world-wide situation of population and food. Even if we all know the limitations of too global figures and measurements, I am pretty sure that at times we forget them and I think we must congratulate the author for reminding us of the necessity to leave the comfort of global judgements.

2. Edwards also indicates directions towards which we have to go in order to face, if not to solve, the growing contradiction between growth problems and distributional ones. The different paragraphs of his paper indicate different sets of variables which it is necessary to consider. Each set of factors individually is fully recognised by the different facets of our discipline; but he demonstrates that we must take them together. We

know that what is simple is wrong and what is complex is of no use. But I think that Edwards, by classifying the different types of oversimplification that we are led to make, shows a way to surmount this uncomfortable position.

3. Going a bit further I would say, from my own experience, that it is probably more useful, when we try to tackle the food problem or regional agricultural growth, to broaden our models by introducing new variables, by articulating different knowledge and theories inside social sciences and beyond, rather than to refine one dimension analysis. If science is progressing by more and more specialised fields and tools, it is urgently necessary to make sciences progress also by synthesis, by enlargement of fields under consideration. To my way of thinking, it is also urgent to introduce institutional considerations, welfare, natural resources and regional economics between these fields and to link them with production and markets, even if the tools and data that we have in the different threads of economics are rather sketchy. This is the lesson that I personally draw from the Edwards paper with which, as you can perceive, I quite agree, since it meets my own experience.

4. I have just one question, I need some clarification on the role he reserves to demand for explaining growth. I certainly recognise the role of multipliers through demand in regional or national economic development. I fully recognise the gap between potential and effective demand. But less clear is the role of natural resources development. If, by natural resources development, we mean more access to land, sustainability of embedded equipment, preventing soil erosion etc., it may generate increased income, but what is the effect on population fertility and effective demand? It depends on one hand on the sharing of the income increment and then on land structures and tenure regulations and on the other hand on the relation between income distribution and effective demand. In other words, how does income distribution, born with natural resources development, affect effective demand and then economic growth? The statements made by Edwards on these questions seems to me a bit contradictory and not convincing, probably because resources development is too broad a concept.

Let me now turn to Scott Simons' paper.

1. The question presented, despite its appearance of being an exercise, is of obvious importance particularly where redistribution problems are concerned. From the French situation where we have nearly 100 million parcels, I can see that it concerns not only tropical countries. Since there are not many analyses on that problem of consolidation, I think we may exchange views in the discussion on the different experiences that we may have about consolidation analysis.

2. Concerning the internal logic of the model, I have nothing with which to disagree. It seemed to me quite coherent, as far as I could judge from a short presentation. Perhaps some questions on the model itself may come in the discussion. For myself, I have only a question on the assumptions, on what seems to me the cornerstone of the model. I mean

the introduction of that premium supposed to reflect the main individual cost of consolidation. It appears to me as an artefact impossible to evaluate. I wonder how the author would do such an evaluation of this premium and its rate of variation with the scale of operations. The results are in fact highly dependent on this rate.

3. I question the possibility for this premium and the function attached to it, to reflect correctly the situation to be analysed. From the experience of France, where consolidation schemes have been applied for decades, I get the impression that consolidation is a collective action or is not. Individual cost of transaction is too short and too Pandora's-box-like a concept to be operational in this kind of situation. From the French experience consolidation simply will not occur significantly – setting aside amalgamation, as the author does – without two elements: First, a collective initiative which can be taken by an agreement between public administration and a significant proportion of landowners. Only in this case, facilitating circular exchanges, transaction costs, which are in fact co-ordination costs, will be sufficiently low to induce exchanges of dispersed parcels according to farming efficiency. Second, in land property matters, the complexity and emotionality are such that without some specific institutional regulations, nothing occurs, even if a collective initiative is taken. Some specific rules of the game are necessary which cannot come through market forces only, all the more so if, as the author mentions, land market is thin, land values are high, and holdings are small.

I would be glad to know the reactions of Simons to this statement and on the sub-optimality equilibrium which can easily be predicted from welfare economics.

4. I would like to thank Simons for obliging us to consider both individual and social costs and benefits – in the French case I am not sure that social costs and benefits have ever been formally compared. This leads me to mention that the benefits are vanishing rapidly from one generation to the next. Fragmentation delays rebirth and the work has to be done again, except if measures are simultaneously taken to prevent a new fragmentation; which, once more, leads us to consider institutional regulations and not only to rely on market forces.

DISCUSSION OPENING II – ERWIN STUCKI

I enjoyed very much reading this interesting paper by Clark Edwards. The author tries to fit together three different aspects of economic growth: natural resources, population growth and technology.

In addition to these classical factors, the author emphasises the need to extend the viewpoint to other major aspects, in particular to the structural and the institutional aspects regarding economic growth. I agree with the author's views. The questions I am going to raise are more likely to complement and refine the theme we are discussing. So one would expect, even in such a short paper, to become more specific, for

instance through a case study which would show how this enlarged concept actually becomes operational in the decision-making process.

Further, I want to raise the question of how the two concepts of 'natural resources' and of 'regional' are defined.

Natural resources: In the paper, natural resources are mainly viewed as a potential for economic production. But as we know, natural resources mean something quite different to a botanist, an agronomist, an ethnologist or to the common citizen. Natural resources have also different functions to achieve. Besides the productive function, natural resources play an important part in conserving other natural resources and for recreational purposes.

Regional: As I understand it, Clark Edwards uses regional on a large-scale basis but we have to take into account that an equilibrium between economic growth and natural resources must be attained locally. This requires an information system which will relate local concerns and observation about natural resources with national and world-wide concerns. Together with the author I want to emphasise that one of the key issues on the topic we are dealing with remains that of combining the short-run concerns for productivity with the long-run concerns for stability and sustainability. Finally, we also have to devote our thoughts to the managing of natural resources in a declining regional economy.

Turning now to the second paper, I agree that land consolidation policies are important, and often controversially handled policies in Third World countries. We must be grateful to the author for trying to tackle this question through a rational, economically based theory. However, Scott Simons' paper raises some questions which I want to share with you.

I am not going to discuss the terms of the equations and the way they are handled. The author introduces the important time factor related to such fundamental decisions as land consolidation by splitting the decision process of farmers into a current profits maximisation and a long-run scale over all future time periods, as he calls it. I believe one has to go further in taking into account the dynamic aspect of the question. As we know, the relative value set for input and for farm output prices varies over time. So how can one take this into account in the optimisation process? Simply by introducing some kind of uncertainty term in the equation, or is the uncertainty so great it cannot be correctly modelled?

The author briefly mentions that there also exists a socially optimal consolidation which in most cases differs from the farmer's individual optimum consolidation. It would be interesting to examine the mathematical formula of this socially optimal consolidating equation and to bring it into relation with the individual optimum equation. Beyond these issues, I would like to raise the following questions:

– How does one handle the question in the numerous rural areas in developed countries where land titles are still missing?
– How can one quantify properly the terms of the equation over a long period of time?

Finally, we have to be aware of the fact that the maximisation behaviour of the farmers in developing countries, as in many rural areas in developed countries, is not a single monetary profit maximisation equation but a multidimensional and complex one.

GENERAL DISCUSSION – RAPPORTEUR: K. L. SHARMA

Questions were raised mainly on the paper by Simons. It was pointed out that the scope of the paper was limited by mentioning developing countries in the title. There was hardly any difference between developing and developed countries as far as collective action for consolidation was concerned. Both faced similar problems in land consolidation actions. Considerable work had been carried out in European countries – particularly in Belgium, West Germany and Eastern Europe – where considerable collective and private funds were invested in land consolidation schemes. In the East European countries there were some indications that the private optimum level of consolidation could exceed the social optimum, mainly due to problems of surplus.

It was brought out in the discussion that land was considered in the paper as a capital asset and not as a socio-cultural asset. The approach used by Simons could not capture the socio-cultural features of land. Also, fragmentation was not merely an accident or simply due to economic factors. It was also the result of past institutional structures which must be considered. The treatment of capital costs in consolidation posed serious problems since their effects were realised over generations. It was noted that equity and income distribution aspect were not discussed in the paper. Concern was expressed on the need for more case studies on land consolidation under different climatic zones and socio-cultural and economic conditions.

In reply Simons pointed out that his paper was intended as a partial analysis focusing mainly on economic factors influencing land fragmentation. But there were also non-economic factors which certainly affected land consolidation decisions.

Participants in the discussion included L. Martens, D. Bromley, L. Drake, C. Arnade, P. M. Raup, G. M. Norton and H. S. Kehal.