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Review

The Size of Forest Holding/Parcelization Problem in Forestry: A Literature Review

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Abstract: In the early nonindustrial private forest (family forest) research literature, size of forest holding was identified as a critical variable impacting the propensity of family forest owners to invest in and manage small forest properties. This literature discusses relationships between size of forest holding and variables like forest owners' financial and asset positions, forest management objectives, use of a forest management plan and professional forestry advice, and use of forestry cost-share funding. Since then, the literature has expanded and now relates to the major problem of forest parcelization. We reviewed this literature for historical themes, technical considerations, and continuing ownership problems, emphasizing the current circumstances of forest parcelization and its historical roots in the size of forest holding problem. Many of the sociological, economic, financial, and technical relationships identified earlier as foundations of the size of forest holding problem are shown to be also fundamental to the parcelization problem in forestry. We suggest that today's parcelization issues are partially a continuation of the size of forest holding problem and that earlier research may be relevant to parcelization problems. We provide a detailed literature review that relates parcelization to the size of forest holding problem.

Keywords: size of forest holding; nonindustrial private forest (NIPF); family forest; tract size; parcelization; private noncorporate forest owner

1. Introduction

There are about 11.3 million private forest owners in the United States; of those, 10.4 million are family forest owners [1]. In the recent past, these ownerships were generally called nonindustrial private forests (NIPF). Large amounts of forest industry timberland shifted ownership to nonindustrial owners over the last few decades requiring a shift in definition to capture these family ownerships that tend to be smaller and individually owned.

The most recent family forest ownership study classified private forestland owners as industrial, other non-industrial, and family forest. Since most data comes from U.S. Department of Agriculture (USDA) Forest Service surveys, the definitions of these terms are relevant: NIPF owners are defined as "family and individuals who own forestland and corporations and other private groups that own forestland, but do not own and operate a primary wood-processing facility". This group is a subset of private forest owners, while family forest owners are defined as "families, individuals, trusts, estates, family partnerships, and other unincorporated groups of individuals that own forestland." NIPF owners are a subset of private forest owners and family forest owners are a subset of NIPF owners [1].

Family forests have long been recognized as crucial to maintaining sustainable forests in the United States and crucial to the nation's timber supply [2]. Early forestry literature calls them small forests (as many of them are small in size; over 60% of family forests are less than 10 acres in size), farm forests (many of the early family forests were parts of farm operations), and eventually NIPFs. The forestry literature now mainly uses NIPF and family forest to identify these forests.

There are regional differences in family forests across the country. This is due to factors like federal forestland ownership patterns, varying silvicultural practices, and mill patterns. Family forests control over a third of the nation's forested land and are important in all regions. These regional ownership patterns control many of the parameters that lead to owners practicing sustainable forest management. For example, in regions with many small family forests, it is more difficult to practice sustainable forestry with tracts containing just a few acres. Plus, the large number of family forest owners means there are a diversity of ownership and management objectives. Encouraging sound forest management has always been a challenge on these family forests. It is important to understand the motivations, limitations, and management objectives of family forest owners because they own a large portion of the nation's forestland and account for much of the nation's forest outputs [3].

2. Family Forest Ownership

The ownership of small forests has been a fundamental issue in American forest policy since the early twentieth century. The owners of NIPFs, as they were called at the time, were thought to be managing their forests less intensively than other ownership groups and, since they controlled much of the nation's most productive timberland, timber supply problems were likely to result. The NIPF has

always been recognized as a critical component of national timber supply; the result of the NIPF not producing its potential contribution of timber would be a severe "timber famine" [4].

For the first few decades of the twentieth century the forestry problem was the concentration of timberland ownership by a few timber barons. Often the practice of these timber barons was to "cut and run". That is, they abandoned cut-over timberland and moved on to other tracts. Eventually this forestland moved into smaller private ownerships. Some of the earliest NIPF research studies concentrated on the growing stock on these smaller private ownerships and used a stocking index to compare management with other ownership classes [5–7]. While these indexes were arbitrary and did not take NIPF owner motivations and objectives into account, they led to an issue that still continues today: how to encourage better management of these small forests [8].

The forestry problem came down to a choice between federal regulation of private forestlands or some sort of federal-state cooperative effort to encourage improved forest management practices, especially in terms of reforestation and fire protection [9]. The Capper Report in 1920 found "the kernel of the problem lies in the enormous areas of forestland which are not producing the timber crops that they should" and urged legislation "which will permit effective cooperation between the Federal Government and the several states in preventing forest fires and growing timber on cut-over lands" [10]. In 1924, Congress settled the argument with the passage of the Clarke-McNary Act that authorized federal-state cooperation in forest fire protection, tree planting, and forest extension [11].

A second major USDA Forest Service report in 1933, the Copeland Report, continued to stress timber depletion and exploitation by the private forest owners, but suggested state-federal cooperation and public aid to private forest owners to encourage proper forest management [9]. By mid-century, small forest owners were identified as "the heart of the problem" [12]. Key concerns were the lack of technical knowledge by forest owners and the problem of small average tract size. The picture in 1948 was defined as "largely one of mismanagement, of exploitation on millions of small properties adding up to exploitation on a grand scale" [12].

Gradually the NIPF problem was more thoroughly researched and the complexity of the "problem", if there was one, was realized. The conventional view changed from one of imminent timber supply problems to NIPF owner motivations, expected behavior, and economic expectations [13–15]. Some researchers even questioned if researchers were properly identifying NIPF owner objectives [16]. Considerable research since then has confirmed NIPF owners do have patterns to their behavior and some variables, like income and the size of their forest holding, are determinants of behavior. Plus, other factors like individual motivations control behavior. All forest landowners are not alike and they have different objectives and views of their land [17,18].

3. The Classic NIPF Literature

Research on the small landholding or nonindustrial private forest (NIPF) began about 1940 with one of the earliest NIPF landowner studies that mention size of forest holding as a factor that influenced a forest owner's forest management behavior [19]. Other studies specifically listed size of forest holding as a variable impacting forest management [20], but most of the classical NIPF landowner studies measured the quality of forest management with devices like pine stocking index to determine if these important forestlands were being properly managed [6,21]. Great weight was placed

on certain forest owner variables in these early studies, like farm ownership, occupation, and education. The studies were simple surveys and little effort was extended to determine which variables exerted the most influence or might be correlated [22–25].

Today parcelization is a major forestry problem that results from urban development and other pressures that decrease forest tract sizes. Those same pressures caused the concern over size of forest holding and decreases in average forest tract sizes. Size of forest holding was recognized as a factor limiting forest management options; depending on forest owner objectives, small tract size can limit the economic viability of some forest practices. Stoddard proposed that perhaps a "centralized operating organization" might be necessary to address "the difficulties of technical direction, marketing, and logging" inherent with small tract sizes. Parcelization as a concept is certainly what he described in 1942: "It should be pointed out that the larger concerns have followed the policy of selling off small parcels after an area has been logged. This practice has resulted in breaking up large forest units into tracts too small for efficient forest management. Many of the small-sized tracts are held for recreational purposes or used as farm woodlands. Nevertheless, the breaking up of larger tracts into many ownerships has tended to render numerous areas into units too small for economic forest operations, even though these units have not been and probably will be put into any other use" [19].

These early timber production studies noted that size of forest holding was a critical variable in terms of reforestation of cutover lands and quality of forest management (often measured with a pine stocking index) [5]. Most owners of nonindustrial private forestland found their acreages were too small to adopt forest management practices [22]. Their pine stocking index-based studies found this not to be the case. Similar studies in the same region found size of forest holding to be a key characteristic controlling timber production and that "larger nonindustrial holdings" were in an "appreciably more productive condition than the smaller ones" [6]. While not all early family forest owner studies identified size of forest holding as a crucial variable influencing timber production, most did recognize it as a significant determinant of forest management intensity by this ownership group.

Gradually the focus of NIPF research moved from surveys of NIPF landowner characteristics to determining the relationship of these ownership characteristics to forest management practices and landowner behavior. Asset and financial position surfaced as a critical variable. Other variables that were obviously correlated with a forest owner's financial position gained importance: forest owner age, length of land tenure, inheritance of land, and education level. Better asset and financial position equated to better capital availability and, thus, more opportunity to manage the forestland [26–34].

Tract size or size of forest holding was also a focus of European forestry research in the 1960s and 1970s. Restricted capital for investment was a limitation for forest management on many properties; returns from forest management did not justify the investment in the eyes of many NIPF owners or limited markets for forest products discouraged tree intensive forest management [35]. By this time some NIPF researchers were questioning the marginal value of additional research on the subject [36]. The NIPF problem remained part of the literature, but it moved beyond the landowner characteristics studies, and many authors questioned the definition of the problem [37–41]. By the late 1970s and 1980s the NIPF problem was even being called a myth [15,42–45].

Royer reviewed NIPF research studies and identified the dependent variables used to assess the landowner's performance and noted that the earlier surveys appeared to have been somewhat misleading to policymakers [16]. The dependent variables that were being measured were typically derived as

those that were "publicly desirable rather than individually rational levels of performance" [16]. Royer noted that many of the earlier studies in this category focused on psychogenic determinants of landowner behavior, like age, education, race, and occupation, and ignored sociogenic determinants (especially important ones like asset position). Later studies showed sociogenic variables were better predictors of forest owner behavior. Not surprisingly, asset or financial position (or a proxy for asset position, like size of forest holding) often was found to be an important determinant of landowner behavior [46–50]. Some of these psychogenic variables (like education) were correlated with financial position and may have been indirect determinants of forest owner behavior.

As the NIPF problem was being redefined, NIPF research was refocusing on actual management behavior of NIPF landowners. The importance of size of forest holding as a limiting factor in terms of economies of scale available to a forest owner in the establishment, management, and harvesting of timber became more apparent [49,51,52]. In addition, size of forest holding is known to be closely correlated with the forest owner's asset position, impacting their availability of capital to invest in and manage forest land [46,53]. A classic study in Sweden [54], and other studies in the United States, focused on the effects of tract size [55–61]. The most recent NIPF studies and reports continue to examine this variable [1,8].

4. Current Family Forest Literature

The classic NIPF problems still exist today but they are sometimes defined differently. One thing that is certain is that there is a better understanding of their foundations. The family forest continues to be important and modern versions of the same problems constantly surface. Parcelization is a very good example of this. It is the decrease in average family forest tract size as owners gift or sell forest holdings. Multiple heirs might be a reason for parcelization. Urbanization is one of the main causes of parcelization and it is most pronounced at the urban-rural interface. Of course, the fundamental problem is that average tract size decreases and the economies of scale inherent in a larger tract are lost. Also, as forest owners change, oftentimes new owners have different management objectives [2,62–67]. Surprisingly, parcelization showed up in the classical literature as early as the early 1960s [68,69]. The use of the word "fragmentation" should not be confused with the more current issue of forest fragmentation which refers to the loss of forest cover and wildlife habitat as NIPF land is divided among more owners or converted to more developed uses [70]. It is possible for parcelization to occur without forest fragmentation as long as the adjoined parcels retain their continuity without major disruption.

Forestry incentives developed as federal and state forest policies shifted to encourage forest management practices on family forests (especially reforestation and fire control). These incentives ranged from cost-share payments, technical assistance, technical advice, and favorable property and income tax policies. Most recipients of cost-share funding were timber-oriented family forest owners [71–75]. Cost-share recipients tend to be better educated and have higher incomes than the average family forest owner. Size of forest holding is one of the best predictors of cost-share use [76–81]. NIPF and family forest owners have been provided additional forest management assistance through education and technical assistance programs. Like other assistance programs, certain landowners tended to receive most of the aid. Forest owners with higher levels of education and income were most

likely to receive this type of assistance, and size of forest holding, again, was highly correlated with use of technical assistance [82–84].

Size of forest holding and characteristics related to size of forest holding like occupation, education, and land tenure are positively related to landowner adoption of incentive-based forestry practices [85]. One researcher suggested technical assistance would be more effective if it was leveraged through coordinated management of forest ownerships [86]. One problem was that family forest owners were not generally aware of forestry incentive programs and participation rates were not high. A second serious problem was that many family forests were very small and lacked the basic economies of size necessary to implement some forestry practices [87–91]. From early on, forestry cooperatives were seen as a means to achieve economies of scale of small forest properties [92,93]. Various efforts were attempted at locations across the country and the concept still shows some popularity today with a few family forest owners. Usually its advantages lead to increased technical assistance, better information, and increased (combined) economies of scale [94–100]. Successful applications of forestry cooperative association techniques from other countries have been applied in the United States [101].

Current family forest research continues to stress size of forest holding as a key forest owner characteristic that influences forest management on family forests. Even the current family forest literature continues to show size of forest holding to be strongly correlated with many variables related to forest management, especially forest owners' technical knowledge, educational levels, and attitudes towards timber harvesting. These values and attitudes may be linked to the better asset position of these forest owners [1,51,102,103].

Over time NIPF and family forest research has focused on timber production foregone due to lack of owner knowledge, insufficient capital, inefficient tract size, or a simple lack of interest [30,46,104–106]. Consistently, income, education, and ownership objectives were correlated with forest management intensity, harvest and reforestation activities, and the use of cost-share assistance [46,53,107–110]. While key variables influencing forest management activities by family forest owners are well-known, the relationship between these variables and the controlling variables is less well-defined [60,111–113]. Owner income, asset position, occupation, and education are all positively correlated with size of forest holding. On an operational basis, size of forest holding is an easy statistic to obtain. Does size of forest holding exert strong influence on private forest management practices, or is it merely correlated with other variables that exert that influence? Size of forest holding has been shown to be an excellent proxy variable for these other variables [50]. For example, a professionally-prepared forest resource management plan is highly correlated with timber harvesting and reforestation activities, but also is positively correlated with size of forest holding [1,114].

There are over 75 years of NIPF or family forest research literature and there has been a consistent family forest problem. That problem is that family forests are a huge proportion of private forestland in the United States and, due to many factors, there are doubts they will produce the forest products that may be required by society. In terms of timber, if family forests did not produce their "proportionate share" of timber, there could be timber supply problems (less timber at any price). This would mean higher lumber prices and costlier homes for Americans, something Congress did not desire. Timber was definitely the early focus and later the problem extended to the multiple products of the forest. Over time the complexity of the family forest and even the "problem" was realized. That is, that the

problem involved many resources, not just timber, and family forest owners had no obligation to produce the mix of forest products that society deemed optimal.

One fundamental relationship became apparent over time; family forests tended to be small and the trend over time was for them to become even smaller (parcelization). Size of forest holding quickly became one of the controlling variables. It apparently had much influence over a family forest owner's ability and motivation to practice forestry. If size of forest holding was not a controlling variable, it clearly was correlated with variables that impacted forest management. The forest parcelization problem is based on the same foundation as size of forest holding as a family forest problem: small forest tracts, lack of economies of scale, disincentives to practice forestry, and general apathy by many family forest owners.

The National Woodland Owners Survey (NWOS) is the official survey of forest owners in the United States. It is created and maintained by the USDA Forest Service. The NWOS provides useful information in understanding who owns forestland, the size they own, insight into why they own forestland, and how they manage it, future intentions, owner demographics, and other questions concerning the current state and future state of their forestland [115]. Butler summarized the characteristics of landowners and size of forest holdings in a publication based on the most recent NWOS [1]. His summary of size of forest holding relationships includes the following key variables from the NIPF/family forest literature:

- **Land tenure:** as the size of forest holding increases, the length of land tenure increases.
- **Land transfers:** as the size of forest holding increases, transferred forestland increases (land ownership transfers more often).
- **Ownership objectives:** vary by the size of forest holding.
- **Timber management objectives:** as the size of forest holding increases, the probability that the owner has timber management objectives increases.
- **Leasing:** as the size of forest holding increases, leasing by owners increases.
- **Cost-share programs:** as the size of forest holding increases, participation in cost-share programs increases.
- **Management plan:** as the size of forest holding increases, the percentage of owners with a management plan increases.
- **Management advice:** as the size of forest holding increases, the likelihood of an owner seeking management advice increases.
- **Absentee ownership:** as the size of forest holding increases, the percentage of absentee ownership increases.

It is important to stress that the NIPF problem or family forest problem, both of which are based on the technical problems resulting from decreasing average size of family forest holdings [47–56], are not the same problem as parcelization. There is an interrelationship as the same socioeconomic factors are driving both processes; both have foundations of owner attitudes towards forest management that are impacted by tract size and affect much more than timber supply, including the whole array of ecosystem services, like wildlife habitat and clean water [109]. It is the combined impact of forest conversion and parcelization that are decreasing the number of forested acres, increasing the number of family forest owners, and impeding the ability to manage smaller and smaller forest holdings [116,117].

Size of forest holding represents a distribution of family forest owners by forest holding size [115] and that distribution has a tremendous impact on forest management due to the family forest owner attitudes and motivations towards important variables that control intensity of management, like ownership objectives, cost-share programs, management plans, and management advice [1].

5. Parcelization

Parcelization is the tendency for large forest holdings (parcels) with a single owner to divide into smaller forest holdings with multiple owners. This leads to problems of economic efficiency in forest management, disincentives for investment in forest practices, and greater management problems related to wildlife, water, recreational opportunities, soils, and ecosystem services. Parcelization has the potential to lead to fragmentation, where forest land is fragmented to widely dispersed blocks that limit ecological processes [118].

Parcelization is the trend for number of family forest owners to increase, while average size of forest holding decreases, due to death, urbanization, income, regulatory uncertainty, and financial assistance for family forest owners [64]. This is a general trend from a few landowners with large forest holdings to many landowners with small forest holdings. Size of forest holding relationships provide the results of parcelization: increases in harvesting and transactions costs, more diverse forest owner objectives, and more diverse owner motivations and attitudes. The impact is on potential timber supply (the traditional concern), but also all ecosystem services, including wildlife habitat, water quality, aesthetics, and recreation [64–67]. Parcelization is a temporal process and size of forest holding a resulting relationship. That is our basis for suggesting that researchers make this connection.

It has two distinct dimensions: (1) an activity (the subdivision of a larger forest land parcel into two or more smaller parcels) and (2) an outcome (a landscape that has, with repeated subdivision of larger forested parcels, become parcelized. Parcelization is difficult to measure. Of course, most measures are temporal and center on how size of forest holding (parcel size) shifts over time. There are other types of metrics that have been used to measure this change and none have been shown to be perfect [119].

The NWOS does a good job of summarizing key family forest/size of forest holding relationships. The NIPF/family forest literature supports the survey results and from the prior discussion more relationships could be identified. Our point is that this valuable prior research can be applied to the related problem of parcelization today. Forest parcelization is an on-going process and will continue into the future; the process ensures that size of forest holding will remain a central concept in family forest management. It is the current term for the small tract problem and urbanization is keeping the problem visible. There is a rich body of NIPF and family forest research literature and tract size relationships are destined to continue to be a focus of this research.

Parcelization has been incorporated into the general forestry literature. Often authors mention a size of forest holding article when discussing the background of parcelization, but often they seem unaware of this connection. Sampson and DeCoster suggested the need for management strategies for small parcels and questioned what parcelization might do to conservation easement agreements [63]. This is an early example of an excellent discussion of parcelization that touches on many aspects of the size of forest holding problem without ever mentioning the earlier version of the problem.

There are many parcelization articles from the turn of the century that introduce the current version of the parcelization problem [2,61,67,120–125]. The relationship of parcelization to population increases at the urban fringe or urban/rural interface are many, along with future implications [65,126–130] and how parcelized forest landscapes are characterized.

One study looked at landowner characteristics of urban immigrants in Washington state (or new small parcel owners) and analyzed the implication of variables like occupation, income (household and investment), management objective, and social responsibility [131]. They also clearly define the differences between forest fragmentation and forest parcelization. Cleaves and Bennett discussed unit, parcel, and ownership elements of holding size [132]. They defined parcels as separate units in the ownership unit and noted that smaller ownerships have a greater variety of harvesting and silvicultural problems. Their article was technically not on parcelization, but shows that size of forest holding was still considered a problem as the parcelization problem was developing.

Mehmood and Zhang's 2001study is one of the best examples of the interaction of parcelization and size of forest holding [133]. They looked at "causes of parcelization in the existing literature," then, with minor exceptions, ignored the huge body of literature on the subject of size of forest holding. Parcelization causes the distribution of size of forest holding and the literature on size of forest holding would provide huge insights into the results of parcelization. Granted, size of forest holding is not a cause of parcelization, but a result of it. However, as size gets smaller, it probably reaches a point where small becomes smaller, as there are limits on what can be done with a small tract. Their definition of parcelization was large landholdings shifting to smaller landholdings and they expected the process to lead to timber supply problems. They almost restated the traditional NIPF problem in defining parcelization. They anticipated an increase in harvesting and transaction costs and a greater diversity of landowner objectives (making forest owners less likely to include timber harvesting and forest management in their objectives). Factors impacting parcelization were the same ones impacting size of forest holding: land tenure (as death rate increases, so does parcelization), taxes (increased taxes lead to increased parcelization, urbanization (increased urbanization leads to parcelization), income (as income increases so does parcelization), uncertainty (as environmental friendliness increases, so does uncertainty over ability to harvest timber and to perform other forest operations), and cost-share programs (forestry incentives make timber growing more profitable and parcelization less likely). All of these relationships could have been determined from a review of the family forest literature.

Other authors cover parcelization in the general context of the size of forest holding problem. Bliss described the two fundamental shifts leading to parcelization: changes in the structure and pattern of private forest ownerships and changes in the social values of the United States as it changes from rural to urban to suburban [134]. He does define the traditional NIPF problem of poor forest management on family forests, leading to poor forest productivity, and the unpredictable behavior of family forest owners. Other researchers see the implications of parcelization as increased harvesting costs, increased prescribed burning costs, increased regulation, cost-share funding shifting to urban areas, and general forest operations limitations [66,135–137]. The general idea is that small parcel size increases production cost per unit in harvesting operations, plantations, and general forest management. This means timber supply is generally positively correlated with parcel or holding size.

Despite concerns about the adverse impacts of parcelization, there has been no standardized convention developed to tell when or if a landscape has become parcelized in the first place, or

whether it has passed a threshold such that adverse impacts begin to occur. For example, one study was based on digitized historical parcel maps from plat books for three Michigan counties and calculated parcelization as the change in average parcel size between three time periods [138], while another study was based on quantified parcelization for one New York county using digital tax maps and six different area classes to track the total number and area of parcels between 1975 and 2000 [139].

Researchers have also constructed life histories of parcels using "parent and child relationships," the former referring to pre-parcelization and the latter referring to post-parcelization parcels. Other researchers developed a parcelization typology to characterize different types of parcel split or aggregation events using digitized historic plat maps to track ownership changes in two townships in Indiana between 1928 and 1997 [140,141]. Although these studies provide detail on the sequence change in specific landscapes over time, and in some cases, important drivers of these changes, they fail to provide insight into when or where thresholds of parcelization concern may exist, or how to effectively measure the degree or severity of parcelization in a landscape at any given point in time.

Few authors have focused specifically on measuring the degree to which a private forest landscape is parcelized. One study estimated the distribution of private forests and ownership in Massachusetts in different size class categories for one year to develop a proxy measure for parcelization, noting that average parcel size, as a measure of parcelized landscape, has deficiencies because it can be greatly skewed when a landscape has a large number of small parcels [118]. Other researchers used multiple metrics to examine the distribution of timberland holding size at the county level for 55 counties in Alabama. They found that several metrics must be used because the sole use of average parcel size cannot adequately capture information about the distribution of parcel ownership [119].

Other researchers stressed the importance of selecting metric, scale, and threshold when characterizing a parcelized forest landscape. They evaluated four metrics (average parcel size, Gini coefficient, Shannon Entropy index, and adjusted mean parcel size) for their usefulness in characterizing the extent to which a forested landscape has become parcelized. Applying these measures to 410 forested townships in a contiguous, six-county area of northern Minnesota, their analyses show that each metric typically describes a different pattern of parcelization due to each capturing different aspects of ownership patterns within a landscape. They demonstrate that choice of metric, landscape scale, spatial and physical ownership features, and threshold for determining when a landscape is parcelized can greatly influence conclusions regarding parcelization [142]. Thus, researchers must give careful consideration to these factors when attempting to analyze a parcelized landscape and use caution when interpreting and comparing parcelization studies where one or more of these factors vary. Some studies focus on parcelization as a process and others as an outcome [118,119].

6. Conclusions

About 75 years of research literature has developed around the NIPF or family forest problem [143]. It has centered on the quality and intensity of management practiced on family forest lands, the behavior and motivations of family forest owners, and the implications for timber supply and forest sustainability. Gradually the motivations of these forest owners were shown to follow normal patterns of self-interest. It is the nature of forest property to become parceled over time. Some acquire land and some holding sizes do increase, but those that subdivide vastly outnumber those that acquire.

Larger forest holdings are divided into smaller ones as estates are apportioned or development takes place. Clearly, population increases are leading to urbanization and increased parcelization at the urban/rural interface.

Size of forest holding for family forest owners is important it represents a distribution of forest owners that is closely related to crucial forest management practices that will impact future timber supply and the vast array of ecosystem services provides by family forests. Land tenure and transfers are a key impact and one that "feeds" the process. Larger holdings tend to be more stable in terms of ownership. Forest owner management objectives vary by size of forest holding, with larger tracts more likely to receive intensive forest management and to have timber management objectives. Owners of larger holdings are more likely to use cost-share funding, have a management plan, and seek forest management advice [1]. Parcelization is the process that is driving the change to the size of forest holding distribution. Authors discussing parcelization should realize that there are decades of forest economics research addressing that distribution and it should be part of their discussion of the process.

The issue of parcelization has been in the literature for about twenty years and has become a major issue in the last ten years. It has attracted research. Often, the related size of forest holding problem that is well-researched is not part of the foundation for current parcelization studies. We show the relationship between the size of forest holding and parcelization and alert forest economists to this historical body of knowledge.

The trends causing parcelization are not likely to be abated. Death of family forest owners is a certainty and each death creates a situation where ownership will change and often shift to multiple new owners. Urbanization is a constant threat to forestland and it too will occur with certainty. Rising income and regulatory uncertainty encourages parcelization. Cost-share assistance can make forest management more attractive and slow down the process [64]. Researchers dealing with parcelization should recognize the role that resulting size of forest holding distribution plays in developing the consequences of the process. In discussing those consequences, the literature dealing with size of forest holding as an issue needs to be included as relevant background to complementary research topics.

As better metrics are developed to measure this shift in the size of forest holding pattern (parcel size pattern), better definitions will be needed to identify the land units involved. It is a complex problem, as parcelization is related to fragmentation. Fragmentation leads to a second set of ecological problems beyond the original ones caused by parcelization. Both processes are well-established in the literature and have been following predictable patterns. Thus, action now can help avoid the certain consequences that are developing around us.

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