**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.

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

There are about 11.3 million private forest owners in the United States; of those, 10.4 million are family forest owners (Butler, 2008). 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.

Butler (2008) classified private forestland owners in the most recent family forest ownership study as industrial, other non-industrial, and family forest. Since most data comes from 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 (Butler, 2008).

Family forests have long been recognized as crucial to maintaining sustainable forests in the United States and crucial to the nation’s timber supply (Best, 2002). 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

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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
(Majumdar et al. 2009).

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” (Baker, 1933).

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 (Folweiler, 1944; Folweiler and
Vaux, 1944; James et al., 1951). 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 (Straka,
2011).

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 (Dana and Fairfax, 1980). 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” (USDA Forest Service, 1920). 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 (Cubbage, O’Laughlin, and Bullock, 1993).

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 rational forest management (Dana and Fairfax, 1980). By mid-century,
small forest owners were identified as “the heart of the problem” (USDA Forest
Service, 1948). 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” (USDA Forest Service, 1948).

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, rational behavior, and economic expectations (Le Master, 1978; Clawson, 1978; Clawson, 1979). Some researchers even questioned if researchers were properly identifying NIPF owner objectives (Royer, 1980). Considerable research since then has confirmed NIPF owners tend to follow economically rational 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 (Schaaf and Broussard, 2006; Davis and Fly, 2010.).

The Classic NIPF Literature

Research on the small landholding or nonindustrial private forest (NIPF) began about 1940. Stoddard (1942) is 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. Other studies specifically listed size of forest holding as a variable impacting forest management (Barraclough and Rettie, 1950; McMahon, 1964; Porterfield and Moak, 1977; Marlin, 1978; Holmes and Diamond, 1980), 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 (Folweiler and Vaux, 1944; James, Hoffman, and Payne, 1951). 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 (Chamberlin, Sample, and Hayes, 1945; Poli and Griffith, 1948; Southern and Miller, 1956; Somberg, 1971).

Today parcelization is a major forestry problem that results from urban development and other pressures that decrease forest tract sizes. Size of forest holding concerns were about the same influences of average tract sizes. Size of forest holding was recognized as a factor controlling forest management options; depending on forest owner objectives, forest practices may be limited by these small tract sizes. Stoddard (1942) 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” (Stoddard, 1942).

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) (Folweiler 1944). Chamberlin et al. (1945) noted that most owners of nonindustrial private forestland found their acreages were too small to adopt forest management practices. 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” (Folweiler and Vaux 1944). 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 (James, Hoffman, and Payne, 1951; Perry and Guttenberg, 1959; Cole and Smith, 1960; Worley, 1960; Hutchinson and McCauley, 1961; McClay 1961; McMahon, 1964; Fontenot and Marlin, 1974; Kingsley, 1976; Marlin 1978; Birch and Butler, 2001; Leatherberry, 2001).

Tract size or size of forest holding was also a focus of European forestry research in the 1960’s and 1970’s. 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 (Zivnuska, 1959). By this time some NIPF researchers were questioning the marginal value of additional research on the subject (Keniston, 1962) and issues like absentee ownership expanded the discussion (Mullins, 1960; Quinney, 1962; Noreen and Hughes, 1968). 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 (Preston, 1956; Quinney, 1961; Plair, 1962; Yoho, 1962; Stoltenberg and Gottsacker, 1967). By the late 1970’s and 1980’s the NIPF problem was even being called a myth (Glasscock, 1978; Gould, 1978; Sedjo and Ostermeier, 1978; Clawson, 1979; Kaiser, Birch, and Lewis, 1982).

Royer (1980), 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. The dependent variables that were being measured were typically derived as those that were “publicly desirable rather than individually rational levels of performance” (Royer, 1980). Many of the studies in this category focused on psychogenic determinants of landowner behavior, like age, education, race, and occupation, and ignored sociogenic determinants. 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 (Duerr, 1948; Clawson, 1957; Row, 1978; Cubbage, 1983; Straka, Wisdom, and Moak, 1984).

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 (Cubbage, 1982; Cubbage, 1983; Karppinen, 2005). 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 (Duerr, 1948; Straka and Wisdom, 1983). A classic study in Sweden (Streyffert, 1957), and other studies in the United States, focused on the effects of tract size (Knight, 1978; Gunter, 1979: Thompson and Jones, 1981; Fecso et al., 1982; Wiersum, Elands, and Marjanke, 2005: Bliss and Kelley, 2008; Zhang et al., 2009). The most recent NIPF studies and reports continue to examine this variable (Butler, 2008; Straka, 2011).

**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 (DeCoster, 1998; Sampson and DeCoster, 2000; Mehmood and Zhang, 2001; Best, 2002; Germain, Anderson, and Berilacqua, 2007; Moldenhauer, and Bolding, 2009; Haines, Kennedy, and McFarlane, 2011). Surprisingly, parcelization showed up in the classical literature as early as the early 1960’s (Schallau, 1962; Schallau, 1965). The use of the word “fragmentation” should not be confused with the more current issue of forest fragmentation which refers to a disruption in the continuity of natural landscapes as NIPF land is divided among more owners or converted to more developed uses (Tyrrell and Dunning, 2000). 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
courage 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 (Kluender and
Walkingstick, 2000; Megalos, 2000; Stein, 2001; Greene, Straka, and Dee, 2004;
Daniels et al., 2010). 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 (Royer, 1987; Bliss and Martin, 1989; Hyberg and
Holthausen, 1989; Lorenzo and Beard, 1996; Amacher, Conway, and Sullivan, 2003;
Arano and Munn, 2006). 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 (Bliss et al. 1997; Gunter et al., 2001;
Kilgore and Blinn, 2004).

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 (Muench, 1965). One researcher suggested technical
assistance would be more effective if it was leveraged through coordinated
management of forest ownerships (Cloud, 1966). 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 (Guttenberg, 1950; Redman, 1956; Bethune and LeGrande, 1960; Coutu,
1960; Herrick, 1960). From early on, forestry cooperatives were seen as a means to
achieve economies of scale of small forest properties (Altonan, Herr, and
Barraclough, 1938; Cope, 1943). Various efforts were attempted at locations across
the country and the concept is still popular today. Usually its advantages lead to
increased technical assistance, better information, and increased (combined)
economies of scale (Josephson, 1963; Stodnard, 1964; Dempsey, 1967; Simon and
Scoville, 1982; Rosen, Kaiser, and Baldeck, 1989; Sturgess, Zeuli, and Rickenbach,
2004; Hull and Ashton, 2008). Successful applications of forestry cooperative
association techniques from other countries have been applied in the United States
(Kittredge, 2005).

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 (Duerr, 1974; Cubbage, 1982; Kuuluvinen, Karppinen, and Ovaskainen, 1996; Butler, 2008).

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 (Duerr, 1948; James, 1950; Lord, 1963; McMahon, 1964; Birch, 1996). Consistently, income, education, and ownership objectives were correlated with forest management intensity, harvest and reforestation activities, and the use of cost-share assistance (Duerr, 1948; McMahon, 1964; Marlin, 1978; Kaiser, Birch, and Lewis, 1982; Straka and Wisdom, 1983; Eagan, Gibson, and Whipkey, 2001; Wicker, 2002; Belin et al., 2005; Butler and Zhao, 2011). 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 (Streyffert, 1961; McClay 1961 Turner, Finley, and Kingsley, 1977; Kingsley, 1976; Bliss and Kelly, 2008). 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 (Straka, Wisdom, and Moak, 1984). 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 (McMahon, 1964; Marlin, 1978; Williams, Voth, and Hitt, 1996; Eagan, Gibson, and Whipkey, 2001; Butler, 2008). 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 there could be timber supply problems and higher timber prices. Over time the complexity of the family forest and even the “problem” was realized. Perhaps, economically-rational family forest owners should not be producing forest products.

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, and disincentives to practice forestry.
The National Woodland Owners Survey (NWOS) is the official census 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 (Butler and Leatherberry, 2004). Butler summarized the characteristics of landowners and size of forest holdings in a publication based on the most recent NWOS (Butler, 2008). 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
- **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

**Parcelization**

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 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 (2000) suggested the need for management strategies for small parcels and questioned what parcelization might do to conservation easement agreements. 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 that 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 (Harris and DeForest, 1984; Shands, 1991; Wear et al., 1999); Best, 2002; Harrison et al., 2002; Rickenbach and Gobster, 2003; Butler and Leatherberry, 2004; Zhang et al., 2009; Haines et al., 2011; Robinson, 2012). The relationship of parcelization to population increases at the urban fringe or urban/rural interface are many, along with future implications (Vaux, 1982; Bradley, 1984; Macie and Hermansen, 2002; Kline et al., 2004; Nowak and Walton, 2005; Germain et al., 2007).

Creighton et al., (2004) looked at landowner characteristics of urban migrants 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. They also clearly define the differences between forest fragmentation and forest parcelization. Cleaves and Bennett (1995) in a SOFEW paper discussed unit, parcel, and ownership elements of holding size. 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 (2001) is one of the best examples of the interaction of parcelization and size of forest holding. They looked at “causes of parcelization in the existing literature,” then, with minor exceptions, examined little of the size of forest holding literature. Their definition of parcelization was large landholdings shifting to smaller landholdings and they expected the process to lead to timber supply problems. They almost redefined the traditional NIPF problem in defining parcelization. They anticipated an increase in harvesting and transaction costs and a greater diversity of landowner objectives (less likely to include timber harvesting and forest management). 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 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 (2003) describes 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. 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 (Kittredge et al., 1996; Zhang et al., 2004; Moldenhauer and Bolding, 2009; Moss and Hedderick, 2012). 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.

Conclusion

About 75 years of research literature has developed around the NIPF or family forest problem. 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 be economically rational. It is the nature of forest property to become parceled over time. 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.

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 background 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.
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