LAND USE DYNAMICS INVOLVING FORESTLAND: TRENDS IN THE U.S. SOUTH

by

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Abstract

Since 1952, U.S. timberland has decreased by about 20 million acres, with about one-quarter of the reduction in the South. Although some of the timberland has been converted to urban and developed uses, Larger amounts of land shifted uses between forest and agriculture because of changes in product markets and policy conditions. We summarize area trends for major land uses, examine recent policy and market developments that are likely to alter competition for land among sectors, and look at related issues such as likely implications of the recent Federal Agriculture Improvement and Reform Act of 1996.

INTRODUCTION

Land resources play a fundamental role in our economic system. Shifts in land uses are influenced by changes in expected economic returns, and expected economic returns are influenced by supply and demand equilibria in land markets. Land-use changes for the two largest uses of land in the United States--forestry and agriculture--can involve millions of acres annually, affecting a number of land-based attributes that include wildlife habitat, rates of soil erosion, recreation and environmental amenities, and carbon sequestration. Agriculture and forestry have both lost land to urbanization and infrastructural development over the past several decades, but historical land base changes are dominated by shifts between the two sectors (Vesterby et al. 1994).

Land use changes are primarily a product of private investment decisions, but public policies have also played an important role. Some programs have directly influenced land reallocation between sectors: the Soil Bank of the late 1950's, and the Conservation Reserve Program (CRP) of Farm Bills in the 1980s and 1990s. Agricultural programs with other primary objectives have indirectly affected land use.

Although some key trends in land use have persisted since the turn of the century, several short term deviations are linked to exogenous events outside of the agriculture or forest sectors. This paper summarizes the recent land area trends and short term deviations that have resulted from competition for land among sectors in the U.S. economy, and assesses the implications of recent changes in policy. These analyses support the 1999 RPA Assessment, which will update earlier area projections by region, private forest ownership, and forest type (e.g., Alig and Wear 1992).

AREA TRENDS FOR MAJOR LAND USES

From 1800 to 1930, U.S. forestland declined by 300-350 million acres (Clawson 1979). Thii reduction was partiiy due to an excess supply of timber in some cases, and prices for cleared land that sometimes exceeded those for forested land of similar quality. Some of the converted forestland was employed for urban and infrastructural developments, but most was cleared and converted to agriculture. These land use changes reflected federal policies of the time to transfer the original public domain to private ownerships and to expand agricultural production. With the public domain disposal, establishment of permanent federal forest, reserves, conversion of most suitable non-government forest lands to *some* form of cropping or pasture, and dramatic improvements in agricultural productivity, the net movement of land between forestry and agriculture has become far less marked. Between 1945 and 1992, U.S. cropland area increased by about 2 percent, pastureland area decreased by 11 percent, forestland area decreased by 7 percent, -and area in urban/developed uses increased by more than 285 percent (USDA ERS 1995).

Although the pre-1930 trends in intersectoral Land shifts havemoderated, rural land use remains mutable in the short-term, with substantial acreages shifting back and forth between uses. Over the last forty years an average of 1.8 million acres per year of cropland and the same area of pastureland have been transferred either into or out of the agricultural base, while 1.5 million acres per year have moved in and out of forestry (USDA ERS 1995). Although about a third of newly converted urban land came from. cropland and pastureland (Vesterby et al. 1994), the majority of land use changes were within and between the forest and agriculture sectors, and mostly on nonindustrial private

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ownerships. U.S. timberland'- area decreased by approximately 20 mihion acres, or 4 percent, between 1952 and 1992 (Powell et al. 1994), with about one quarter of the reduction in the South.

This lability is a reflection of the suitability of a portion of the land base for use in either sector. Classification of land capabilities by the National Resource Inventory (USDA SCS 1989, USDA NRCS 1996) points to the physical potential for land use' competition. Land capability class (LCC) IV-lands designated as marginal for agricultural crops or having severe limitations that restrict choice of crops to be grown--contains over 45 mihion acres of cropland, 60 million acres of forestland, and 25 mihion acres of pastureland. At the extremes of the land capability spectrum are large areas of land that could be shifted to another use. Approximately 45 million acres of forestland are in LCC's I and II--which are potentially prime farmland--and this equals 12 percent of the 1992 cropland base. Conversely, more than 20 million acres of cropland and more than 30 million acres of pastureland are in LCC's V-VIII, land with marginal crop productivity in many cases.

Changes by Region-Over the past six decades, several distinct patterns of land use shifts took place across the ten USDA regions. In all regions, landdevoted to urban and developed uses has increased steadily while pasture land (including range) has declined steadily (USDA ERS 1995). In five regions--the Southern Plains, Southeast, Appalachia Lake States and Northeast--cropland has declined while forest land has increased. In the other five regions--the Corn Belt, Delta, Northern Plains, Mountains, and Pacific--both cropland and forest land have increased. Except for the Corn Belt and Mountain regions, cropland area generally declined from 1950 to 1972. followed by a sharp increase from 1973 to 1985. The Corn Belt and Mountain regions showed a nearly continuous increase in cropland acres since 1945.

Cropland increases have come at the expense of pasture land, and from acres devoted to farmsteads as farm numbers have declined. Increases in forest land have been at the expense of pasture land. All three, major categories-cropland, forestland, and pasture land-have lost area to urbanization. And, while some shii occurs between forestland and cropland, most of the shift is the result of a net shift between cropland, forestland, and pasture land (Mills et al. 1992). That is, cropland increases at the expense of pasture land, and forestland may then be converted to pasture land. The net effect is an increase in cropland and a decline in forestland and pasture land. Thii pattern of shifts may later reverse, such that cropland declines as land moves into pasture and pasture land is planted or reverts to trees.

Epochs and the Policy Environment--The period from 1950-1972 was a period of strong downsizing in agriculture production, while the period from 1973-1995 can be characterized as a period of expansion. The period from 1973 to 1995 is instructive of the impact of changing relative profitability of forest products and crops, and the cyclic nature of past agricultural production. During that period a world-wide drought led to world crop shortages. U.S. crop prices soared along with exports. Between 1972 and 1981 cropland acreage rapidly increased. Wheat acreage increased from 54 million acres to 88 million acres, *corn* acreage increased from 64 mihion to 84 million acres, cotton acres increased from 12 million to 15 million, and soybean acreage increased from 43 million to 71 million acres. In regions where *there* are large amounts of land with a forest-pasture-cropland interface such as the Lake States, Southern Plains, and Pacific, forestland declined sharply during this period. However. the Southeast--with considerable acreage having the potential to move between major land use categories--had only a slight drop in forestland area during this period.

After 1981, crop prices declined as stocks mounted due to falling crop exports. Land again moved out of cropland, yieldmg a net increase in forestland area By 1987.80 million acres of cropland were held idle under various farm programs. The land use shifts that led to an increase of nearly 70 million acres in cropland, induced by the world-wide events of 1973, would be reversed in the 1980s with cropland used for crops returning to the pre-1973 level of roughly 330 million acres.

Theagriculturalpolicyenvironmentcontributed to the decline in cropland acreage during the downsizing from 1950 to 1972, the increase in cropland acreage during the expansionary 1973 to 1981, and again the decline of cropland acreage during the downsizing period from 1982 to 1990. The agricultural policy of downsizing periods promoted movement of resources out of crop agriculture. The 1956 Soil Bank legislation and the Food Security Act of 1985 shifted cropland to pasture or forest land. Price support loans were also used to keep the bottom from falling out of the crop markets and to allow for an orderly decline in resources devoted to agricultural production.

[2]Forestland is land at least 10% stocked by forest trees, and timberland is that forestland capable of producing 20 cubic feet of industrial wood per acre per year and that has not been withdrawn from timber utilization. Ninety-four percent of forestland in the South is classified as timberland.

During the expansionary period of the 1970s agricultural policies promoted increased ou tput through technical assistance and cost-share programs designed to increase the productivity and area of cropland. Low interest loans were given federal backing for the purchase of new equipment and to convert forest and pastureland to cropland. By 1985, agricultural policy returned largely to the policy of the 1950s, attempting to gradually allow resources to move out of agriculture. The Food Security Act of 1985 also marked a major change in policy towards the elimination of direct federal involvement in farm commodity markets. Passage of the Federal Agricultural Improvement and Reform Act of 1996 (FAIR96) represents substantial movement of the federal government away from direct involvement in farm commodity markets.

Prior to the passage of the FAIR96, federal commodity policies assisted in maintaining total supply (stocks plus production) above the quantity that wouid clear the market at a price acceptable to both consumers and producers. Target prices provided production incentives in excess of market incentives, price support loan rates and marketing loans insured a price floor, and government-held stocks assured that total supply would be sufficient to meet demands even in the event that production was reduced as a result of exogenous events. Stock levels were managed with land retirement and demand enhancement prógrams. The constraining of supply volatility assisted in the policy objective of price stabilization, but also constrained the flexibility of producers to choose among various production alternatives.

The FAIR96 has eliminated the target price and land retirement programs (except for the CRP) and has reduced the likelihood of large Commodity Credit Company (CCC) stocks as a result of the price support loan being, both capped and linked to 85 percent of the moving average market price. The absence of CCC stocks will mean that future commodity supplies could be more closely tied to the product of yields and acreage. The absence of both land retirement programs and the need to maintain crop base acreage to obtain government programs enables producers to choose among all potential agricultural production enterprises (except for the production of fruits and vegetables).

Recent changes in forestland and timberland areas reflect, in part, changes in agricultural policies and the resulting impacts on the forestry sector. Between 1987 and 1992, the CRP led to the hugest tree planting program in history for private land, with about 2.6 million acres of afforestation on former cropland. However, that was more than offset by urbanization that converted more than 3 million acres to developed uses (USDA NRCS 1996).

Land Use Analyses-Several analyses have been undertaken within the last decade that have projected land exchanges between the agriculture and forestry. In examinmg policies affecting the two sectors, most studies have markedly simplified interactions that arise through the land interface. The CARD-RCA model (USDA SCS 1989) projected that only three-fifths of U.S. cropland would be required to meet future agricultural demand targets. CARD-RCA projections were based on cost miniiation criteria and in hindsight utilized optimistic 'crop yields. The projections also assumed that farmers would not use land less intensively and adjust the mix of inputs. Moulton and Dicks (1987) projected a 16 million acre increase in forestland between 1985 and 1995, based on assumed large gains from the CRP, Conservation Compliance, Sodbuster, and changes in other farm programs. In the 1989 RPA Assessment, timberland area was projected to decrease by 5 million acres between 1987 and 1995 (Alig and Wear 1992), based on a model in which all major land uses were represented to account for the zero-sum nature of land exchanges. The accuracy of all these projections were affected by major changes in agricultural policy and goals, and to a lesser extent, forest policy, e.g., reductions in public timber harvest (Adams et al. 1996).

Besides affecting overall forest area, agricultural policies can also affect the area allocated to different forest types. The CARD-RCA and Moulton and Dicks' studies did not examine changes in forest type areas. The Study of the South's Fourth Forest (USDA Forest Service 1988) and 1989 RPA Assessment (Alig and Wear 1992) projected that area for the largest planted type--planted pine in the South-would continue to increase through 2040. The projected increase was due partially to projected afforestation of cropland under the CRP and partially to timber management intensification by forest industry owners. Subsequent field surveys by the Forest Inventory and Analysis units have shown that the projected increase between 1985 and 1990 was withii one percent of actual changes.

FUTURE CHANGES IN AGRICULTURE

For the past six decades, agricultural land use was guided or constrained and market prices determined by both farm production decisions and U.S. agricultural stock policies. With the absence of government commodity programs and minimizing of CCC held stocks, land use patterns, especially those in local and regional areas, may change more rapidly from year to year reflecting changes in the market. These local and regional land use changes will impact the local and regional economies, resource use and environmental amenities (e.g., wildlife habitat, water quality), national average yields, totalsupply, and thus prices. Changes in land use patterns will be influenced by several key factors including:

- population growth and migration
- relative profitability of uses
- socioeconomic characteristics.

Population **growth and migration--Over the** next three decades the population of the United States is expected to age and increase by **nearly 50** percent (USDC Bureau of Census 1990). The aging population has the effect of decreasing family size and thus increasing the number of homes per thousand persons. In several states, farm numbers are increasing as a result of the increase in the number of farms with sales of $1,000-$9,999. This is thought to be due in part to the aging population who have elected to retire on small acreages in less hectic rural areas. Another factor may be the decentralization of the business office, enabled by the new computer and telecommunications technologies. Workers are now able in many cases to work in the locations of their choosing.

The aging population is also shifting to the warmer climates of the south. From 1982 to 1992, 1.4 million acres of cropland were lost to urbanization, with roughly one million acres per year beiig lost in the South (USDA NRCS 1996). This change in the distribution of population may continue.

Population growth is likely to add to the fragmentation (breaking up of large holdings into small holdings) of croplands and forestlands. This could reduce the amount of economically harvestable area. Although the land use may still indicate a specific area devoted to a major category, the smaller size of the holding may greatly reduce the likelihood of the commodity being harvested due to economic considerations.

Relative Profitability of Alternative Uses-The land allocation decision in the simplest form is basically one of allocating production activities across Jand types such that the real present value of net returns is maximized (Alig 1985). Changes in relative net returns betweenand within major land use classes will be affected by variations in output prices, productivity, and production costs. Real timber prices have risen relative to those for agriculture over the long term, but growth in agricultural productivity has outstripped that for forestry. This has boosted relative income per acre for some crops. A simii relative change in crop versus livestock income has resulted in more cropland relative to pastureland between 1950 and 1995.

Within agriculture, crop yields show three distinct patterns over the Jast five decades: increasing at an increasing rate, increasing at a decreasing rate, and no distinct trend over the time period (1950-1995). Corn, wheat, and barley yields have demonstrated continuously declining growth rates, while soybeans has demonstrated a continuously increasing yield growth rate. Cotton and sorghum have shown no consistent yield growth rate.

Two important factors have been identified as contributors to the reduced growth in national average crop yields over the last two decades: an increase in the frequency of exogenous factors adversely affecting yields (e.g. weather, pests) and shifts in land use. Maximum crop yields can be defined by the biological limits placed on crop growth under optimal growing conditions. Factors that govern optimal growing conditions include planting time, depth of the seed, row spacing, geographic location, available moisture, and temperature. Increases in yield volatility over time have been observed for corn, wheat, and barley. The yield growth rate has generally declined in each decade since the 1950s, and yield variability for major crops differs considerably between the downsizing period from 1950-1972 and the expansionary 1973-1995 period.

The increase in cropland area in the second period took place alongside the annual loss of about one-half million acres of U.S. prime farmland to urbanization, and pasture lands and forest lands were being shifted into new cropland acres. Thus, the land use shifts between the two periods provide a reason to expect differences in yield growth. The increasing acreage also occurred in areas where weather variability is greater or has a greater impact on crop yields. When the standard deviations in crop yields between the two periods are compared, the second period demonstrates a larger standard deviation than the first period for all crops.

The role of government in reducing price instability and providing a level of yield protection through commodity and disaster assistance programs has been nearly eliminated in the FAIR Act of 1996. However, private industry has begun to develop new risk management instruments for producers covering both price and yield risks. Thus, while price may become more volatile, income may continue to be stabilized through the purchase of the risk management instruments. As a result of the transfer of risk to private investors, farmer's production decisions may continue to be only partially linked to the commodity markets. The exposure of price to yield volatility and the potential for transfer of the risk associated with both price and yield volatility to others through new risk instruments has the potential to induce major land use changes both locally and regionally.

Socioeconomic Characteristics-Although Jarge areas have the potential for conversion from one major Jand use to another or from *one* production enterprise to another within a major land use category, only a subset of these potential acres actually change Jand use. Changes in relative profitability do not always induce

land use changes. Therefore, other factors are constraining the potential land use changes. Several past studies have summarized the socioeconomic characteristics of private non-industrial forest owners (e.g., Johnson et. al 1997, Moulton and Birch 1995). Other studies have analyzed the socioeconomic characteristics associated with the decision to reforest (e.g., Alig 1985. Alig et al. 1990, Fecso et al. 1982). However, a thorough analysis of the socioeconomic characteristics associated with the decision to change among major land use categories has not been undertaken. Although a large number of acres is moving in and out of crop agriculture, pasture, and forestry, the profile of the owners involved is largely unknown.

THE OUTLOOK

The outlook for future land exchanges between forestry and agriculture has been altered by the new farm policy promulgated under the FAIR Act of 1996. The FAIR act eliminates most agricultural subsidies, thereby increasing the likelihood that some marginal agricultural land may revert to forest use, either through natural vegetation succession or by active afforestation. Absence of or greatly reduced government agricultural stocks may lead to upward price spikes that may actually draw more resources, including land, into agriculture during some periods in specific regions.

The passage of the new farm legislation is recent enough that a significant amount of data on resulting land uses have not accumulated yet. However, land use changes within agriculture resulted from higher prices associated with lower production in 1996, as a result of drought and the record low level of stocks that were on hand in tbe 1996 marketing year. Initial indications are that resources are again moving into agriculture as new equipment purchases increased in 1996 and 1997 and planted acres increased. Another year of poor yields in part of the country or overseas would certainly reaffirm landowners' decisions to expand agricultural production and create a new flow of resources into crop production activities. However, resources could flow out if the federal government no longer stands ready to support falling prices.

Other public policies that could affect both agriculture and forestry include any land-based mitigation policies for global warming. Forestry activities, and particularly afforestation, have been proposed. as an important part of international agreements to reduce net emissions or enhance sinks of greenhouse gases, such as discussed at the Kyoto conference in 1997 (Birdsey et al. 1998). Given the intersectoral competition for land in the South, land use analyses will need to account for the agricultural sector's response to afforestation policies involving cropland or pastureland.

If the past is used as a guide to the direction and magnitude of future land use shifts between forestry and agriculture, then the evidence suggests that a range of outcomes are possible in the dynamic setting. For example, during the 1970s. agriculture underwent a major expansion, sometimes through the conversion of forestland (e.g.. bottomland hardwood stands converted for soybean production). In the late 1980s and early 1990s, the shift was in the other direction, with the CRP program and excess -capacity in agriculture. One consistent characteristic has been the passive route by which most "excess" agriculture land reverts to forests, except for major tree planting programs such as the former Agricultural Conservation Program and CRP program.

Over the next ten to fifteen years, the pressure on the southern land base for urban use, timber production, agricultural production, and recreation is likely to increase. Timber supplies are projected to be relatively tight over the next fifteen years and real prices of softwood sawtimber and lumber are projected to rise steadily from current levels up to 2010-2015 (Haynes et al. 1995). Consumption of forest products is projected to increase, led by an increase in paper and paperboard consumption that' is projected to increase by 1.2% per year over next 5 decades. Limited merchantable timber inventories currently exist on private land, which reduces supply possibiities for next 15 years. In the long term, the South will be a major source of any expansion in U.S. softwood timber supply for the next 50 years.

The increasing yield volatility and declining yield growth for the major U.S. crops in the near term, coupled with a return to more erratic weather patterns, may cause crop supply to be more unstable. The consistent increase in domestic and export demand for 'many of these crops may lead to a higher potential for upward price spikes and reverse the trend in declining real prices. Not unlike the period in the early 1970s. a major adverse exogenous shock to supply with the current stock and policy scenario would cause an inflow of resources into agriculture. Increasing demand for red meat as a result of increasing real per capita incomes in large population countries such as China will increase the demand for pasture lands to support a larger cow-calf population

Increasing urbanization and fractionalization of crop, forest, and rangeland areas may reduce the available supply of economically productive lands. Less populated counties and counties experiencing rapid percentage growth rates used an average of more than one acre per household while more populous counties and counties with slower growth rates had marginal land consumption rates of only one-third to one-half acre (Vesterby and Heimlich 1991). Further, numbers of family members per household are projected to decline

while the growth in the number of households is projected to increase (e.g., USDC Bureau of Census 1987). Thus, counties with business centers that are in the initial stages of strong growth will likely experience increasing rates of urban land consumption and rural fractionalization.

The South has a considerable amount of land with the potential for land use changes between major land uses. Impacts of land use changes will be expressed in changing relative prices, environmental amenities, and economic activity. Thus, one future research need is a survey to determine who are the landowners/managers of these lands with the potential for change and what socioeconomic characteristics influence their land use decisions. The fist phase of the research could effectively focus on one State each in the Southeast and South Central regions. The survey should be designed to examine agricultural land holdings with higher land quality in terms of forest production potential, e.g., Mills et al. 1993. Changes in land use are influenced by changes in expected economic returns and risk preferences, and the application of risk theory may have potent applications for acreage allocation decisions. The survey should identify socio-economic characteristics that may enable or restrict land, with the physical potential to convert from one major land use to another, to be converted or held in the current use. Effects of fragmentation on land use patterns should also be considered when designing the survey. If successful, such research would improve our abiity to predict the amount and location of land use changes.

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