Private Agricultural Land Base By Producing Areas For Year 2000

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I. INTRODUCTION

A prime resource in the production of agriculture commodities is land. Individuals throughout the United States have become increasingly concerned over the loss of agricultural land to nonagricultural purposes such as urban sprawl, roads and airports facilities and mining etc. Reduction in the agricultural land base due to urban expansion and other nonagricultural uses could result in less agricultural production unless the reduced land base is compensated by other resources in production. Over time, two viewpoints on this issue have surfaced, one group feels the reduction of agricultural land will be a definite threat to agriculture in the future. Because once a piece of land is converted for urban build-up or any other use; chances of reclaiming that land to agricultural production are slim. Another group feels that the conversion rate of agricultural land to other uses is not significant enough to affect future agricultural production. With increasing research on crop genetics and resource substitutions, compensation for the loss of land can occur. Few studies have been carried out at regional or at national levels that determine the extent of loss of land and its effect on agricultural production. The objective of this study is to estimate the loss of agricultural land in years ahead. These estimates will be incorporated in the Center for Agricultural and Rural Development linear programming models or right-hand-sides. They will serve as production restraints on the agricultural system.

Therefore, the objectives of this study are:

1) to update conservation needs inventory (CNI 1967) county land base by National Resource Inventory (NRI 1977) statewise agricultural land base data;
2) to project probable conversion of private agricultural land to nonagricultural uses to year 2000; and
3) to estimate private agricultural land base by 105 producing areas in year 2000 using updated Conservation Needs Inventory and projected land conversion to nonagricultural uses.

Methodology

The methodology section can be categorized into two steps--development of the current land base and estimation of future changes. Figure 1 explains the steps involved in each of these steps.

This study considers private agricultural land only. The private agricultural land is divided into eight land groups by type of land (dry or irrigated) for eight land uses categories 1) crop land, 2) hay land, 3) pasture land, 4) rangeland, 5) forest grazed, 6) forest nongrazed, 7) other land in farms, and 8) other land not in farms. The land groups are derived by grouping various land capability class(es) (Table 1).

As suggested in the schematic (Figure 1), Step I updates the 1967 Conservation Needs Inventory (CNI) data base with the 1977 National Resource Inventory (NRI) data base.[1] The county and state data of the CNI and the state data of the NRI are aggregated to the land groups by

[1]The CNI is reliable to the county level whereas the NRI is reliable only to the state level.

Figure 1. Schematic of the private agricultural land base estimation process.

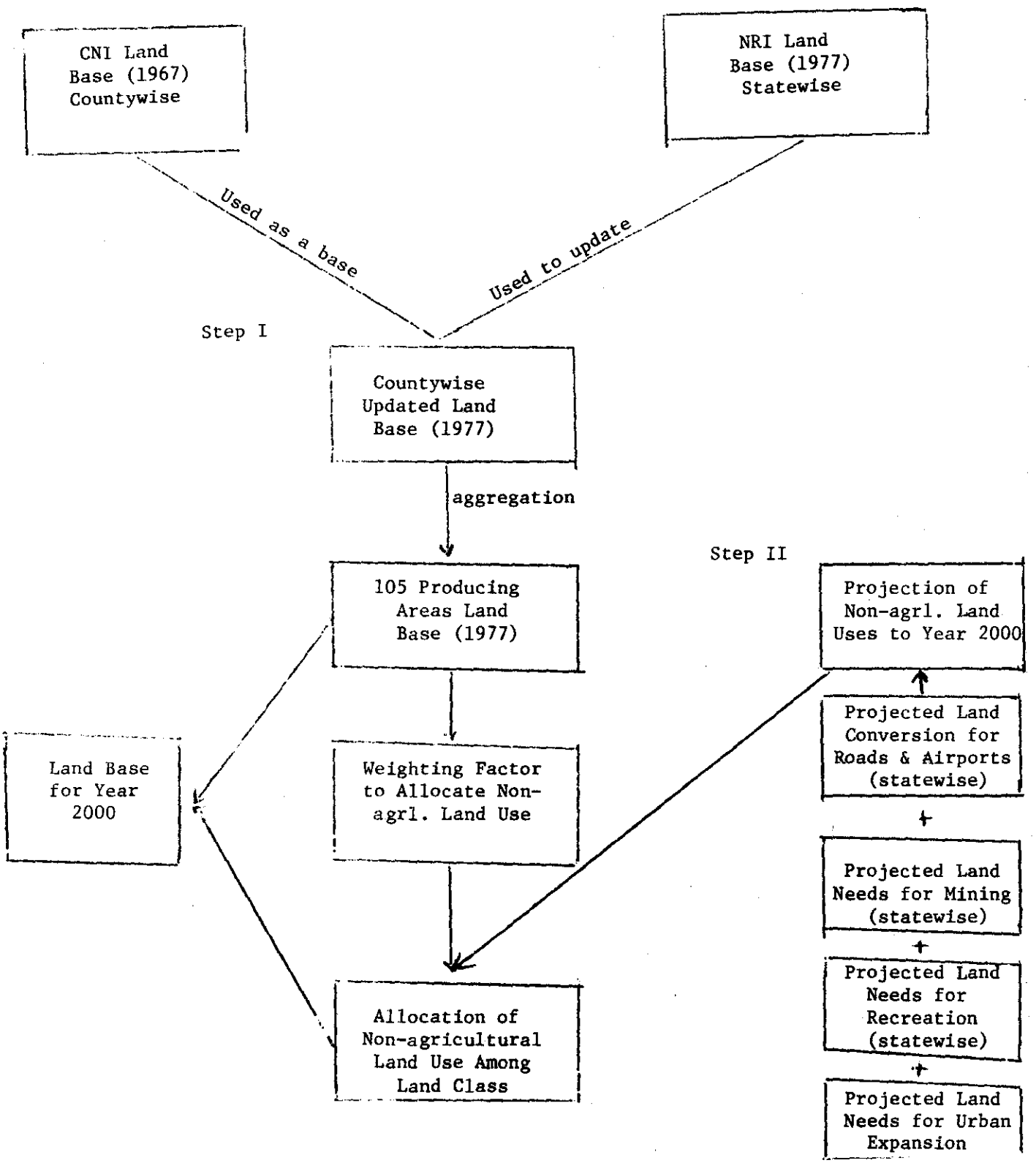

Table 1. Definition of land groups by land capability class/subclass[a]

Land Group	Land Capability Class and Subclass
I	I, II_{wa}, III_{wa}[b]
II	II_e
III	III_e
IV	IV_e
V	II_c, III_c, IV_c
VI	II_s, III_s, IV_s
VII	II_w, III_w, IV_w
VIII	V, VI, VII, VIII

[a]The Soil Conservation Service defines eight land capability classes. Within the I to VIII classes, subclasses are defined for climate (c), erosion (e), subsoil (s), or wet (w) production limitations.

[b]wa indicated that the wetland problem is adequately treated.

land use. Assuming that the changes in the agricultural land base from 1967 to 1977 are homogeneous across the state, the change is shared proportionately by each of the state's counties. Thus, the 1967 CNI is updated using the 1977 NRI data base.

With

$$LA^{1977}_{ijkyz} = \frac{LA^{1967}_{ijkyz}}{\sum_y \sum_k \sum_j \sum_i ST^{1967}_{ijkyz}} * \sum_k \sum_j \sum_i ST^{1977}_{ijkz}$$

i = 1, 2 for dry or irrigated

j = 1, ..., 8 for the eight land groups

k = 1, ..., 8 for the eight land use categories

y = 1, ... for the county number in a state

z = 1, ... 48 for the 48 contiguous states

where:

LA^{1977}_{ijkyz} is the estimated land area in acres for the yth county in state (z) for the ith type, jth land group, and kth land use;

LA^{1967}_{ijkyz} is the land area estimated by the 1967 CNI (in acres) for the yth county under type (i), land group (j), land use (l) in zth state;

ST^{1967}_{ijkyz} is the land area estimated by the 1967 CNI for state (z) under type (i), land group (j), and land use (k); and

ST^{1977}_{ijkyz} is the land area estimated by the 1977 NRI for state (z) under type (i), land group (j), and land use(k).

The weighting scheme results in proportionate increase or decrease in county land areas. The weighted county data are aggregated to 105 producing areas to get the 1977 land base defined at the producing area level.

Once the 1977 land base is developed, estimates in land use changes are made for urban expansion, roads and airports, mining and recreation. The methods used in the estimation procedure are explained below and incorporated in the schematic (Figure 1) under Step II.

Urban Expansion

Urban sprawl is considered to be the main activity that takes a major portion of agricultural land out of crop production. Few studies designed to determine the factors involved in urban sprawl and its effect on agricultural production and the environment have been initiated on a regional level. However, some of the significant factors involved in urban sprawl include population growth, housing expansion and other industrial developments. Further Spaulding (1974) conducted a county survey on urban land areas in years 1960 and 1970 and aggregated the areas to the 105 producing areas. Using this data and knowledge about factors involved in urban sprawl a statistical relationship between urban land areas and explanatory factors including intercept dummy variables for year differences in data and regional dummy variables for twelve major regions in United States (Figure 2) is established.

The functional form of the relationship is

$$U_A = f(X_1, X_2, X_1^2, X_2^2, X_1 * X_2, D_1, Z_1 - Z_{12})$$

where

U_A is urban land area acres in a producing area;

X_1 is population in a producing area;

X_2 is number of housing per thousand population (includes vacation homes) in a producing area.

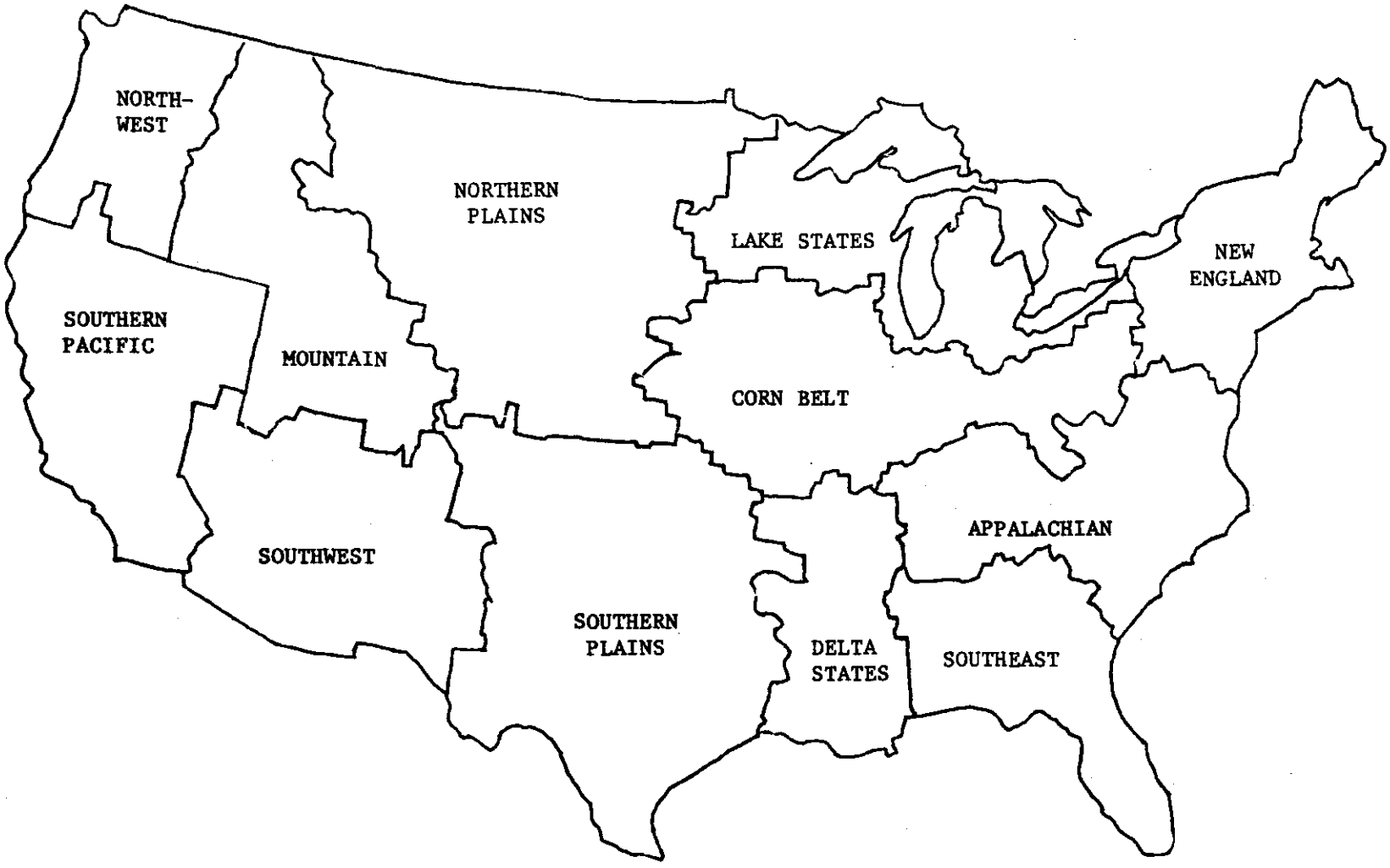

Figure 2. The 12 reporting regions.

D_1 is 0 for 1960 observations and 1 for 1970 observations; and

$Z_1 - Z_{12}$ are dummies for major regions (New England, Appalachian, etc.).

Proc stepwise regression techniques without an intercept (SAS routine) is used to select variables at the five percent significant level. The estimated equation is then used to project urban land areas into the future for a given population level and a housing intensity level. State population projections are assumed as projected by the Current population Reports (No. 785, 1978). It is assumed that producing areas within a state will also have the same population growth rate. If a producing area crosses state boundaries, the average growth rate among states is considered as the population growth rate for that producing area. In case of housing, data on housing trend is obtained from the general characteristic housing (Census of Housing, 1970). Future housing projections are estimated by using a moving average of historical growth rates. Further housing growth trends in a producing area follows the state growth trend. From those above projections, a growth Index for population and housing is developed assuming 1960 as the growth rates base year. Population and housing are projected using this index and actual population and housing numbers in the year 1960. The projected data is used to estimate urban areas in future.

Roads and airports

A survey analysis is used to determine future land requirements for roads and airports. Each state transportation department is contacted

for the necessary information regarding their future transportation plans. In studying their plans, the right-of-way of each road, and the historical land used for roads, an estimate of future land needs for roads is developed. For example, if a state plan to expand a primary collector by 100 miles within 10 years, then land used for these expansions will be 100 * right of way of primary collector. If a particular state didn't plan for the future, we took historical trend of land used for roads by using published statistics at National Transportation Statistics (1970-1979). For example, if for last three years, a state used 3,000, 2,000 and 500 acres (a change of 1,000 and 500 between years) for transportation facilities, a projection for next year will be $(1{,}500 - \frac{(1000-500)}{2}) = 1{,}250$ acres.

The airports land requirements are estimated from National Airport system plan revised statistics 1980-1989. The amount allocated for land purchase is converted in terms of land area by using land values in each state (Farm real estate market developments, 1970-1980) with an adjustment for inflation. We assumed that the land requirements between 1990-2000 will be the same as the area estimated bewteen 1980-1989.

Mining

Surface mining disturbs the agricultural land base more than any other type. A few regional studies have been carried out to show the effect of surface mining in agriculture and the environment. The published figures in coal development in rural America (Wallage McMartin, 1981) and land utilization and reclaimation in the mining industry (U.S. Department of Interior, 1930-71), a net loss of land to mining is estimated. The procedure involved in estimating net loss is $NL_z = AL_z * (1-\frac{RCP_z}{100})$

where

NL_z is net loss of land to mining per year in zth state;

AL_z is average loss of land to mining per year in zth state[1]; and

RCD is historical mining land reclaimation percentage in zth state.[2]

The net loss of agricultural land to mining in year 2000 is calculated in the following way

$$NL_z^{2000} = NL_z * 24.$$

Recreation

Private recreation facilities are closely related to population and income level. In 1975 National Association of Conservation Districts (NACD) surveyed the private recreation facilities. Based on the area under private recreation and the existing population level, a per-man recreation land needs coefficient is developed. We assumed this land needs coefficient remains constant over time. Private land needs for recreation includes this projected land need coefficient as well as the population level.

$$RLA_z^{2000} = \frac{RLA_z^{1975}}{Pop_z^{1975}} * Pop_z^{2000}$$

where

z is 1 to 48 for the 48 states;

RLA_j^{2000} is the recreation land needs in year 2000 for zth state;

POP_z^{2000} is the projected population level in year 2000 for zth state.

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[1] Calculated from coal development in rural America, 1981.

[2] Published in Reclaimation in the Mining Industry, U.S. Dept. of Interior, 1930-71.

Estimation of Year 2000 Land Base

The final step in determining the land available to agricultural sector involves updating the 1977 Land Base to year 2000.

State land needs for mining, roads and airports, recreation are summed together. Projected land conversion for urban expansion is obtained from the estimated equation. These projected quantities of land conversion are to be distributed among land use' and land group combination. It is assumed that if a particular land use group occupies 10 percent of the total land area in a state or in a producing area then 10 percent of the land conversion will come from that particular group. The projected producing area land base for year 2000 is calculated by two steps. For converted land other than that in urban expansion, the following equation is used to distribute the land.

$$PPA^{2000}_{ijkyz} = \frac{PA_{ijkz(1977)}}{ST_{z(1977)}} * PNA_z$$

where

i is 1, 2 for dry and irrigated;

j is 1 ... 8 for the eight land groups;

k is 1 ... 8 for the eight land use categories;

z is 1 ... 48 for the 48 contiguous states;

PPA_{ijkyz} is the projected land (in acres) taken for nonagricultural (except urban expansion) uses from ith land type, jth group, kth class, and yth producing area in zth state;

PA_{ijkz} is the portion of producing area land (in acres) in state (z), type (i), land group (j), and land use (k);

ST_z is total private agricultural land area (in acres) in state (z); and

PNA_z is projected state land loss to mining, recreation, roads, and airports between 1977-2000 (in acres).

For urban conversion, the following equation is used.

$$B) \quad UPA^{2000}_{ijky} = \frac{PA^{1977}_{ijky}}{PA^{1977}_{y}} * (\text{Urban land conversion in acres between } 1977\text{-}2000)$$

where

i is 1 to 2 irrigated and dry;

j is 1 to 5 land groups;

k is 1 to 8 land use;

y is 1 to 105 producing areas;

UPA_{ijky} is the portion of urban land area (in acres) loss allocated to producing area y and land type (i), group (j), and use (k); and

PA is the producing area land total in acres.

PPA_{ijkz} is summed over producing areas crossing state boundaries ($\overline{PPA}^{2000}_{ijk}$). Total land loss in a particular land type-group-use combination is calculated by summing the $\overline{PPA}^{2000}_{ijky}$ and UPA^{2000}_{ijky}. The estimated figure is subtracted from 1977 producing area land base to get the year 2000 producing area land base.