Agroforestry and Climate Change Adaption

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Agroforestry and Climate Change Adaptation: Lessons from the Prairie States Forestry Project

By Thomas J. Sauer

Agroforestry systems integrate woody perennial plants with agricultural crops or animal production on the same land area (Fig. 1). A distinct advantage of agroforestry is that the combination of trees with plants or animals produces more total food, forage, and fiber than any one production system individually. Agroforestry systems thus increase per-land-unit area productivity as the trees exploit resources (light, water, and nutrients) through their multi-layered canopies, extensive rooting, and long growing seasons that are not captured by annual crops. The tree components of agroforestry systems are often managed to enhance the local microclimate by providing a barrier to wind or in providing shade (Stigter, 1988; Brenner, 1996; Cleugh and Hughes, 2002). The inherent benefits of agroforestry also include enhancement of a host of ecosystem services, increased ecological and economic diversity, and the restoration of degraded soils.

Fig. 1. Some examples of common agroforestry practices. Clockwise from top left, alley cropping, a riparian forest buffer, field windbreak or shelterbelt, forest farming, and silvopasture. Photos courtesy of USDA-Natural Resource Conservation Service, USDA National Agroforestry Center, and University of Missouri Center for Agroforestry

With and ever-increasing urgency regarding global climate change and food security, many practices are being investigated for their ability to build more resilient agricultural systems and adapt existing systems to climate change. Global climate change has two primary features that affect agricultural production. These are trends in mean annual or seasonal temperature and precipitation and the increasing occurrence of extreme events like severe storms, floods, and droughts. In the second instance, agroforestry has already been successfully applied as an adaptation practice when a climate-related environmental challenge created a major environmental crisis. An extended drought, poor soil management, and widespread wind erosion in several U.S. Great Plains states created the so-called “Dust Bowl” in the 1930’s. The drought, coupled with a deep economic depression, produced severe economic and social disruption for millions of Americans. The federal government considered several large-scale relief programs to bring physical and economic assistance to rural populations in the most severely-affected areas. One of the key programs was the Prairie States Forestry Project (PSFP, Fig. 2).

The PSFP, which was often referred to as the “Shelterbelt Project” had multiple goals but

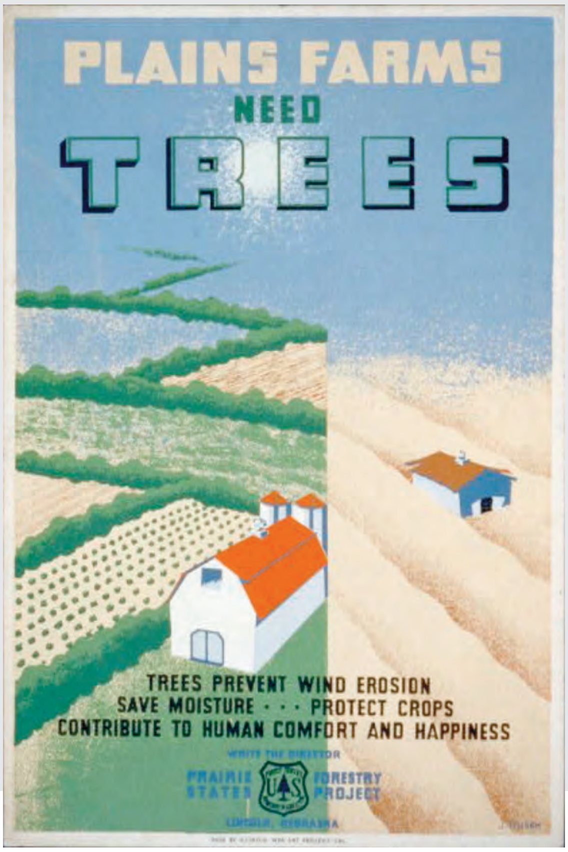

Fig. 2. Poster promoting the Prairies States Forestry Project

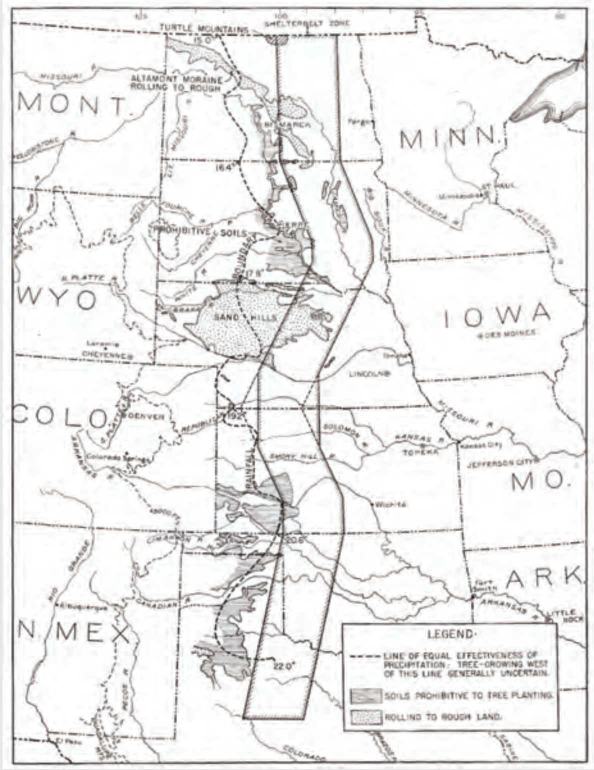

Fig. 3. Map of the shelterbelt zone, the 100 mile (160 km) wide by 1150 mile (1800 km) long area targeted for windbreak planting. From U.S. Forest Service (1935)

foremost among them was alleviating the severe drought conditions by planting tree windbreaks to stabilise the soils and create a more favorable microclimate for crops and livestock (Droze, 1977). During the seven years of the project (1935-42) PSFP employees planted more than 217 million trees in almost 30,000 km of shelterbelts in the states of North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas (Figs. 3 and 4).

Besides being a very successful tree planting program, the PSFP had several remarkable characteristics. For instance, it was conceived, organised, and implemented with surprising speed for such a large government program. President Franklin D. Roosevelt (FDR) announced the creation of the PSFP in July of 1934. Within a year a comprehensive report on the challenges and merit of the project was published (U.S. Forest Service, 1935) and nearly 2 million trees were already planted. A critical aspect of the PSFP's success was the personal attention and direct involvement of FDR. His personal interest in turn likely encouraged project staff and managers to devote special attention to the project. On the other hand, many details regarding seedling supply, land preparation, and tree planting techniques were developed and perfected at the field level. Thus, both top-down and bottom-up information flow and management decisions were used simultaneously with considerable success.

The PSFP was the largest afforestation program in U.S. history. It was also unique for the sustained and focused effort by a federal agency (U.S. Forest Service) to address a specific climate-related challenge. Although global climate change is a much more complex phenomena, there are lessons to be learned from the PSFP. Jared Diamond's bestselling book Collapse – How Societies Choose to Fail

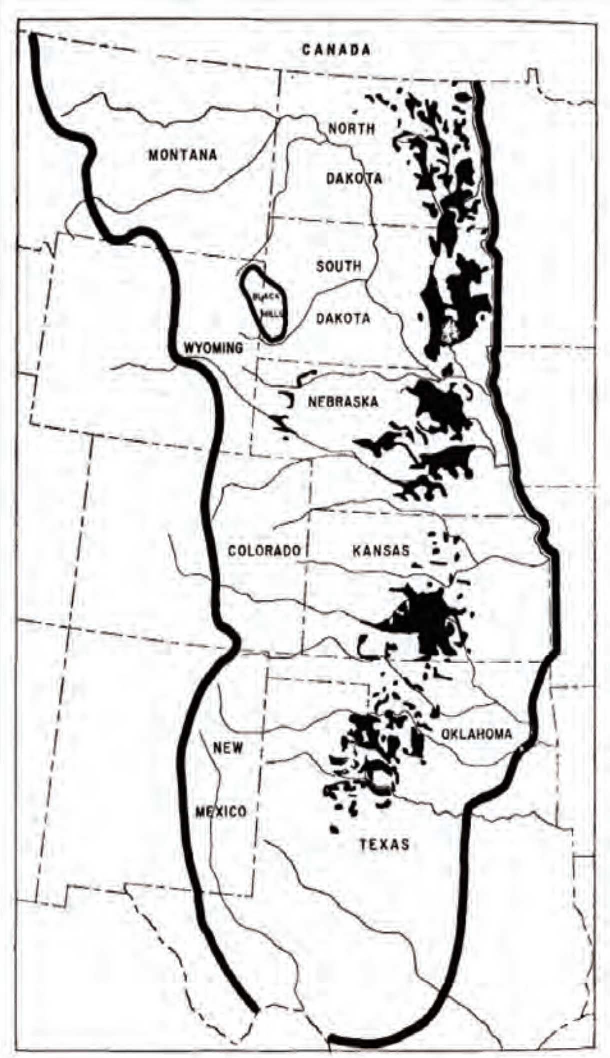

Fig. 4. Shaded areas show locations of concentrated PSFP plantings. From Read (1954)

or Succeed (Diamond, 2005) discusses societal decision-making in the face of environmental crises. Using Diamond's model, management of the PSFP has the qualities of a highly successful decision-making process. His two keys for successful decision-making are 1) long-term planning and 2) a willingness to reconsider core values. A major criticism of the PSFP was that poor establishment and slow growth of the trees would be not effectively relieve the drought conditions. Proponents argued that the potential benefits may indeed take several years to reach their full effect but the reduced wind erosion and improved microclimate effects would improve with time and persist indefinitely if the windbreaks were properly managed. To support their views, the Forest Service commissioned field surveys in 1944 and 1954 ((Munns and Stoeckeler, 1946; Read, 1958) to provide data on tree growth characteristics and identify future research needs. Thus, scientific metrics were available that could be interpreted to assess each step of windbreak establishment from site selection to post-planting management.

In Collapse, Diamond focuses on religion when discussing core values. In the case of the PSFP, the core value under intense debate was whether federal resources should be deployed on private land. Prior to the PSFP, the U.S. Forest Service had never been involved with forestry practices outside of a federally-owned national forest. Ultimately, the unwavering confidence in the project by U.S. Forest Service scientists Carlos Bates, Raphael Zon, and Paul Roberts and the personal support from Secretary of Agriculture Henry A. Wallace and President Roosevelt enabled the project to go forward (Droze, 1977). As a result of the PSFP and other federal programs of the era, it is now commonplace for federal staff and resources to be committed to assist in the management of private lands in the U.S.

The causes and consequences of global climate change are the subjects of intense research and policy discussion. Observed climate trends are likely due to a complex combination of natural cycles and anthropogenic effects. Any successful climate change mitigation strategy must include reductions in greenhouse gas (GHG) emissions and current atmospheric GHG concentrations. More simply, there is a pressing need to reduce GHG sources and increase carbon sinks. Successfully addressing global climate change will require holistic, long-term thinking that utilises multiple approaches over a range of spatial scales and time horizons. The PSFP of the 1930's showed how bold and innovative leadership at high levels of government can overcome significant obstacles and resistance to successfully address a climate-related threat. Similar daring leadership will be needed to reduce net GHG emissions and increase global carbon sinks. Agroforestry practices as part of an extensive reforestation/afforestation program represent a land use alternative with proven ability to not only improve microclimate but also sequester carbon (Kort and Turnock, 1999; Hernandez-Ramirez et al., 2011; Chendev et al., 2015) enhance landowner economics, improving local esthetics, and expand renewable energy sources (Schoeneberger et al., 2012). The challenge is to engage successful decision-making as described by Diamond and demonstrated by the PSFP to combat the drought of the 1930's to create effective policies and programs for addressing global climate change.

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Photo credit: Aleksandr Petin, Belgorod State University

Sauer in wheat field near tree windbreak at Streletskaya Steppe, Russia

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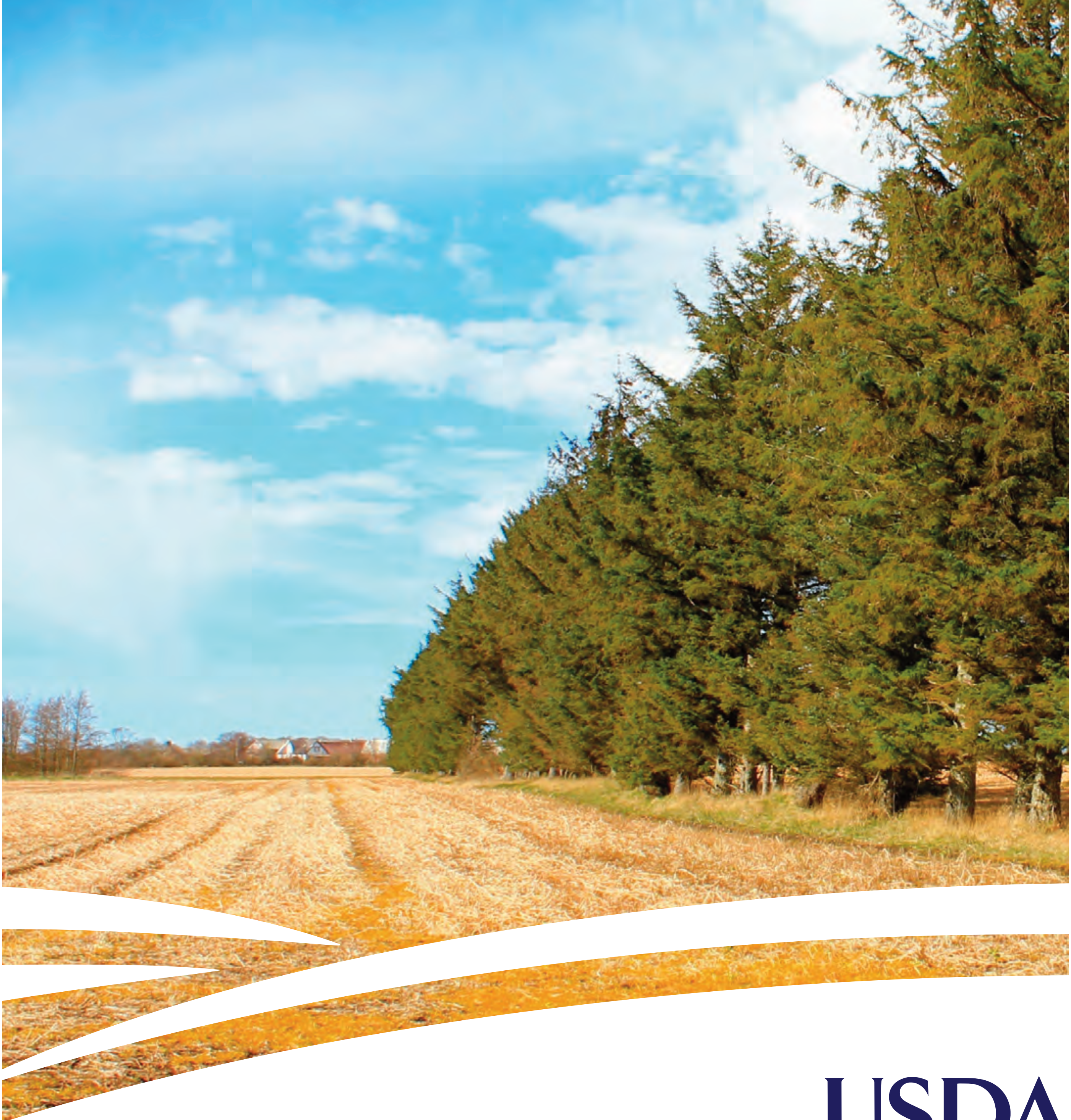

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