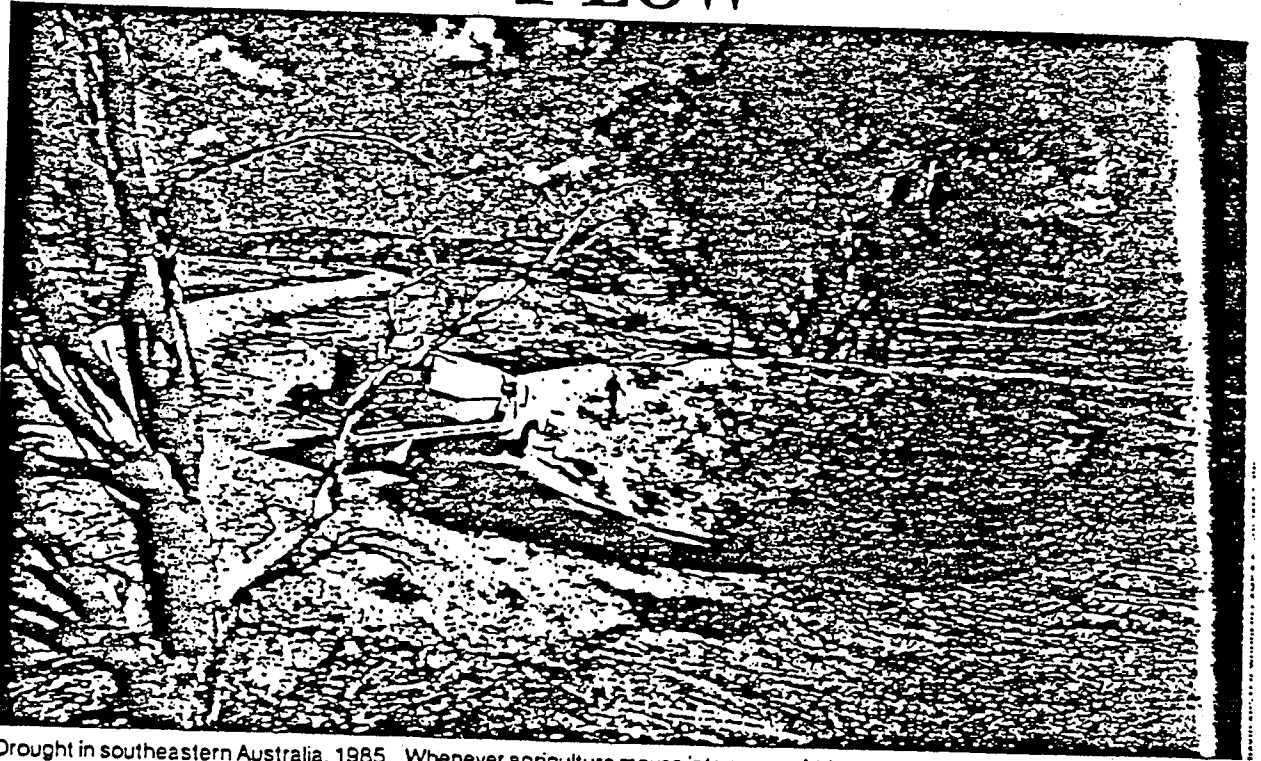


DROUGHT FOLLOWS THE PLOW



Drought in southeastern Australia, 1985. Whenever agriculture moves into areas of highly variable rainfall, the risk of eventual drought conditions is inescapable.

Growing populations and the scarcity of arable land will force people to depend increasingly on marginal lands for food production.

MICHAEL H. GLANTZ

Almost a century ago the belief that "rain follows the plow" was a popular one that accelerated population movements into the region now known as the American Great Plains. Until the mid-1800s, this region was considered a wasteland, useless for agriculture and human settlement, an inhospitable obstacle to settlers in search of the promised land in the western part of the North American continent.

At the same time that settlements crept westward

after the Civil War in the 1860s, rainfall became more prevalent. Suddenly, what had previously been considered a barren waste was seen as a potential garden and a breadbasket for the eastern part of the country. Many attributed the increased rainfall to the effects of human settling activities, which included plowing fields, creating ponds, irrigating dry areas, and planting trees on what essentially had been a treeless grassland. The railroad companies

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and land speculators seized on this explanation to convince easterners to move to the Midwest. The advertising campaigns successfully produced waves of immigrants who came to the sparsely populated plains seeking their fortunes.

During the 1890s a severe, multiyear drought dispelled the rain-follows-the-plow theory. Thousands of settlers abandoned their homesteads to seek livelihoods elsewhere. It seemed that much of the support for the assumption of a causal relationship between rain and population was simply exaggerated by the railroads and other land speculators, intent on selling land at higher prices than it was worth. Before long, people realized that dry and wet periods commonly alternated and that the region's first surge of settlers had accidentally coincided with the onset of a lengthy wet spell. With the return of a prolonged drought, the credibility surrounding the rain-follows-the-plow theory itself evaporated.

The scientific reasoning behind the belief is that a region's atmospheric circulation is positively affected by increased sources of evaporation. These derive from breaking the ground with the plow, creating open bodies of water (ponds and tanks), and planting trees whose roots suck the scarce moisture from the ground and whose leaves allow the water to evaporate into the atmosphere, which ultimately returns the moisture as rain.

Today the scientific literature is still filled with articles and studies on how land use has either brought about or eliminated rainfall in a region. The belief in the rain-follows-the-plow concept still lives, although the number of its supporters appears to be small. The latest resurgence of interest in this idea resulted from the 17-year drought that began in 1968 in the West African Sahel. It was argued that the reverse process, the removal of vegetation, could create a desertlike environment. The overgrazing by livestock on vegetation and the collecting of firewood as the only available fuel ensured these conditions in the Sahel. Responding to the plow-rain theory, the United Nations and ALESCO (the Arab League Economic, Scientific and Cultural Organization) suggested that tree belts be built along the northern and southern edges of the Sahara desert to arrest its encroachment, put moisture back into the air, and bring rainfall to desiccated areas.

It is my contention, however, that as agriculture moves into increasingly marginal areas, drought, not rain, is following the plow. Most of the world's best

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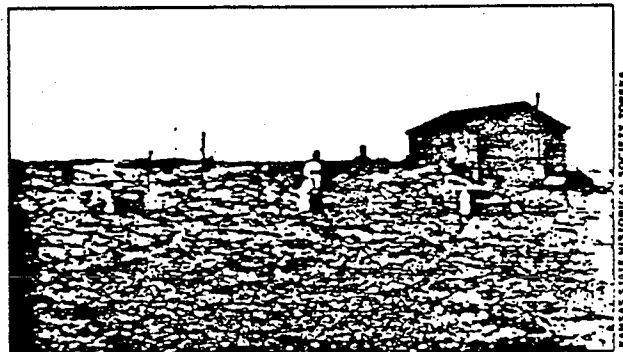
THE KANSAS STATE HISTORICAL SOCIETY, TOPEKA

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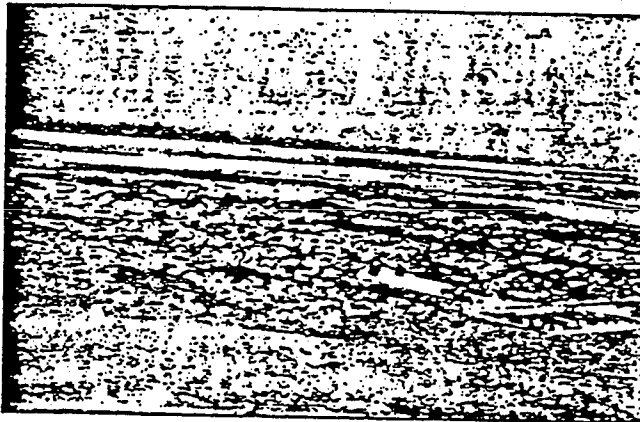
SCHOOLS AND CHURCHES

Unusually high rainfall after the Civil War turned the American Great Plains into a potential breadbasket for the eastern part of the country. Railroad companies made exaggerated claims to sell the land at high prices.



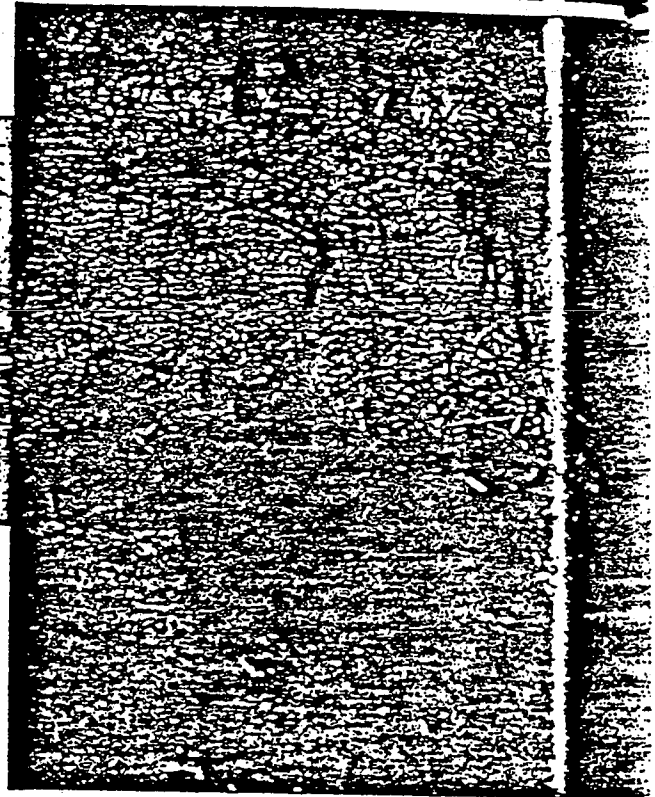
The Plains have suffered numerous droughts throughout recorded history. A multiyear drought in Kansas during 1907-9 left families such as this one destitute.

KANSAS STATE HISTORICAL SOCIETY, TOPEKA



Above: Herdsmen and farmers abandoned their lands in the early 1970s to seek food aid in refugee camps outside Nouakchott, the capital of Mauritania in West Africa.

Right: Cattle are a problem in arid areas like the Sahel. They overgraze on the vegetation and trample the ground, making it compact and difficult for rainwater to permeate.



rain-fed agricultural land is already in production or unavailable to production for political or other reasons. Increasing the amount of land for agricultural use requires the destruction of forests, the use of irrigation in arid areas, or the movement of people into marginal agricultural areas.

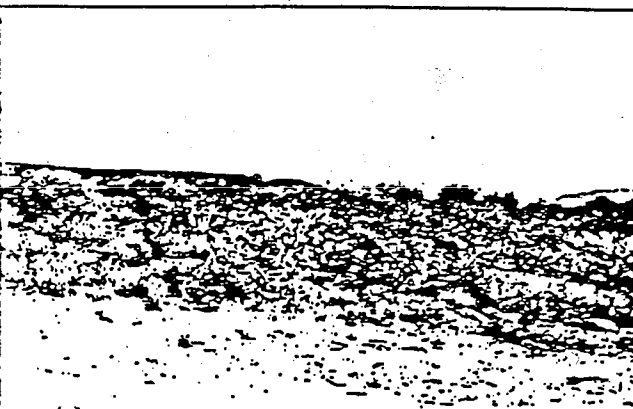
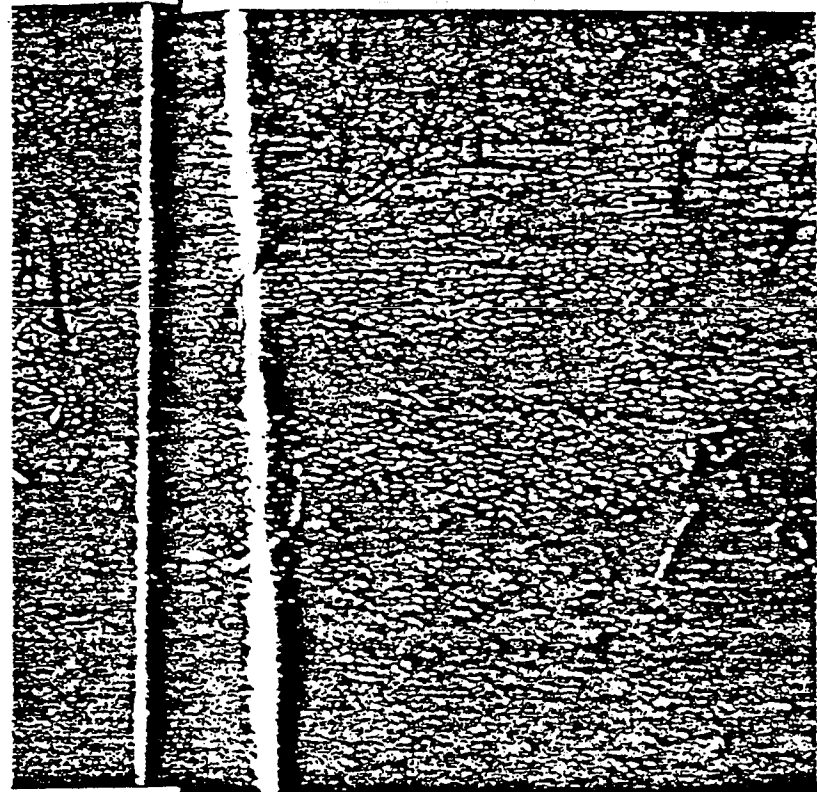
Recall that only thirty years ago, Nikita Khrushchev, then secretary of the Communist Party of the Soviet Union, launched his virgin lands scheme in an attempt to surpass U.S. grain production. The scheme's success would have demonstrated to the developing world that the USSR was as much an agricultural force as an industrial power.

The plan "encouraged" people to move into Soviet Central Asia and Kazakhstan and put arid and semiarid land under mechanized agricultural production. Soon stories of the failure of this approach reached the press, as people began leaving the virgin areas to return home. Drought conditions plagued the virgin lands areas, and since that time rain-fed agriculture has been supplanted by irrigation farming. The architects of the virgin lands strategy failed to take seriously the marginality of the climate for sustained production; they paid for it at the time, with humiliation in the economic development community. In fact, Leonid Brezhnev was intimately involved in the scheme's implementation and later wrote a book about the problems encountered in the virgin lands areas.

The following examples are only representative of the drought-following-the-plow process that is occurring today in developed and developing countries.

THE WEST AFRICAN SAHEL

The 1950s and 1960s were relatively wet across the West African Sahel. During this period the increased rainfall encouraged cultivators to move farther north toward the southern edge of the Sahara. The areas that they came to occupy, often with the encouragement of their governments, had traditionally been used as rangelands for livestock herds of pastoralists. Annoyed and harassed by these new settlers, the pastoralists shifted their herding activities farther north. With the increased regional rainfall, more vegetation was now available farther north, so the pastoralists had what appeared to be equally good conditions. During this wet period, herds grew larger and required more rangelands and watering points. The new technology of drilling deep wells opened up even more land as seasonal pastures became usable with the availability of permanent sources of water. As the wet period continued, more and more cultivators came to the region and began clearing the land for cultivation.



Above: Rain is unpredictable in the semiarid *sertão* region of northeastern Brazil. The soils and existing vegetation have become extremely vulnerable due to climatic variability and inappropriate land-use practices.

In 1968, an extended drought began, which some argue has lasted more than 17 years. The first intense drought episode lasted from 1968 to 1973, claiming about 100,000 human lives and 12.5 million livestock. With the failure of the rains to move far north into the Sahelian zone, pastoralists and their herds became stranded at the deep wells. The cattle eventually consumed all edible vegetation near the wells. As a result, experts have suggested that most of the livestock that died during the drought perished from hunger, not from thirst.

When the drought wiped out their herds, many pastoralists went into refugee camps. Governments then sought to convert them to farming so that their contribution to the national economy could be encouraged and their production taxed. As pastoralists, they were perceived by their governments as independent, and thus a threat to the central governments. Moreover, they were hard to tax and only reluctantly participated in the modern sector of the economy.

It was in the West African Sahel that the image of the deserts on the march was first formulated. Speculation abounded that the region's climate was indeed changing. Rumors suggested that the desert's rate of advance was up to 50 kilometers a year.

Closer investigation showed that the overgrazing of the southern edge of the Sahara during the wet period and the cultivation of areas deemed to be only marginally arable had created patches of desertlike conditions and caused sand dunes to form. With little vegetative cover, the dunes encroached on settlements.

In some of the regions where the government had encouraged cultivation, farmers planted grains and resorted to farming practices that did not anticipate the long-term climatic conditions. When the drought recurred, as the region's rainfall history suggested it should, the farmers believed they were the victims of a natural disaster. Instead, they were victims of poor planning and a lack of understanding of the region's climatic record. After all, the 1968 drought was the third major one this century. Clearly, what had happened was that drought followed the plow in the West African Sahel.

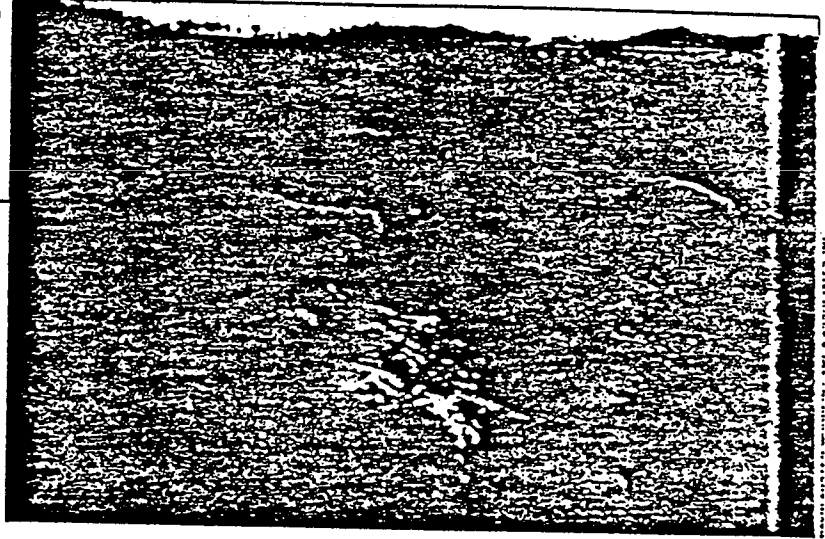
BRAZIL

The plight of the inhabitants of the drought-plagued Brazilian Nordeste (northeast) has inspired many classic Brazilian novels, such as deCunha's *Rebellion in the Backlands*. Current patterns of land ownership and land use were established hundreds of years ago during Brazil's colonial period. Cattle ranching along the coast was supplanted by sugar

representative of that is occurring in these countries.

set across the period the inability to move farther north of the Sahara. With the traditional livestock herds of these new herding activities used regional available farther appeared to be in a wet period. Angelands and drilling deep personal pastures of permanent continued, more ion and began

Increasing development of New South Wales in Australia has brought agricultural practices that demand greater rainfall than the climate usually provides. Occasional wet periods in the normally arid interior of the province have lulled people into a temporary, false sense of security.



cane production, forcing ranchers farther inland into the heart of the semiarid *sertão*.

Land ownership in the Nordeste is a key factor in the ability of different segments of society to cope with severe drought. There are basically two types of ownership in the region: large estates and small subsistence landholdings. Estates are extremely large, sometimes encompassing a few hundred thousand square miles. In contrast, the poor are restricted to the marginal areas of this semiarid region for subsistence food production and ranching. The scarcity of productive land is primarily a socioeconomic phenomenon; 60 percent of the population holds less than 10 hectares of land and 3 percent own about 70 percent of the land.

Subsistence farming takes place on small landholdings or on land leased to poor farmers on the large estates. Even during years of good rainfall, the small farmer population is in danger because of low agricultural productivity. The growth of the population and of livestock herds in the region has forced farmers into increasingly marginal areas and has heightened the region's dependence on food produced on these lands. The soils and existing vegetation in these areas have thus become extremely vulnerable to climatic variability, explaining their persistently low and ever-declining levels of productivity.

The region is known to be plagued by recurrent short-term drought, as well as devastating multiyear dry spells. The poor farmers are the first to be hurt by drought, since they barely grow enough food for their own consumption. They must also find work to supplement their income, which they often do by working on the large estates as laborers. During extreme drought, however, the *latifundistas* (large landowners) lay off their workers as a temporary cost-saving measure, making the workers' plight even worse. While the federal and state governments

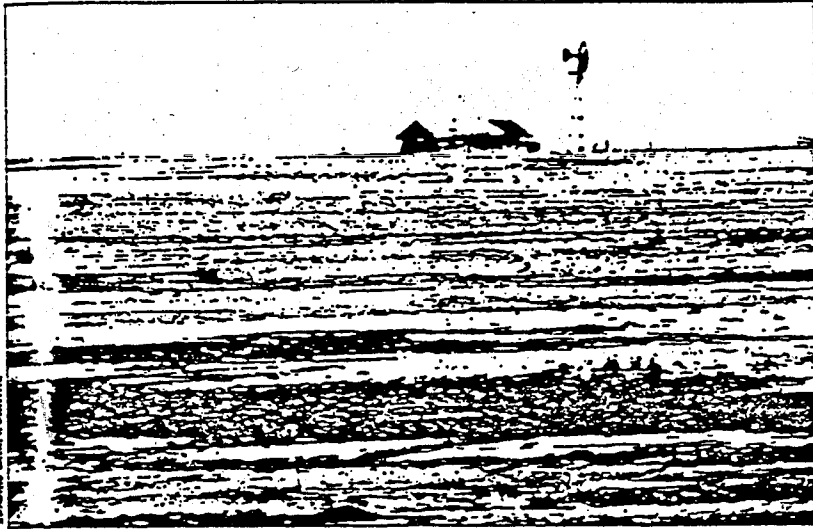
implement work programs to construct roads and dams for minimal wages, many men abandon their homes in search of work in other parts of Brazil.

The basic problem in the Nordeste appears to be one of land ownership: an expanding population trying to sustain itself on a dwindling resource base. More and more, we hear about the frequency and intensity of droughts and, correlatively, about the prospects of a changing climate. The question remains open, however: Are we not witnessing the effects of a change in land use rather than in the climate, a situation in which drought once again has followed the plow?

AUSTRALIA

Australia has a long history of drought. In 1982-83 it witnessed its worst drought in more than one hundred years, with property and other losses estimated in the hundreds of millions of dollars. Brushfires were rampant, consuming homes as well as vegetation. One might wonder why a developed country like Australia is still so vulnerable to the impacts of drought.

Since the onset of European settlement in southeastern Australia, regional industry has shifted from sheep ranching to growing cereals and dairying. These early changes in land use, often driven by market demands and prices, began a process of climatic vulnerability, which advanced with the settling movement from the humid southern and east-



The drought in eastern Colorado during the spring of 1977 caused all kinds of dislocations in the western United States. Is the climate changing or are people undertaking land-use activities that the climate cannot support in the long run?

of a natural disaster.

CONCLUSIONS

The attempt to cultivate borderlands tends to marginalize both land and people. Most often, either a push or a pull into these areas initiates the process. Push factors include population pressure, environmental degradation, and gov-

ernment policies. As populations continue to grow in Third World countries and especially in sub-Saharan Africa, the natural per capita resource base decreases. If the best land is already in production, new farmers must move into previously farmed areas, which become further impoverished by overuse and misuse. Clearly, future generations will find it more and more difficult to support themselves from the land at all.

The pull factors are relatively few. As mentioned earlier, climates fluctuate, sometimes with long wet or dry spells alternating. During wet periods in arid and semiarid areas, the normally dry areas appear to be capable of sustaining agricultural production. Thus encouraged to move there, farmers often displace pastoral herders who have traditionally used these areas as rangelands.

The drought-follows-the-plow idea is based on the belief that increased pressures on currently used agricultural areas cause population movement into less productive, often marginal, areas. Consequently, we can expect to hear more in the future than we have in the past about droughts and their impacts on humankind. ■

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ern coasts toward the semiarid and arid interior. In other words, human settlements were working their way down the rainfall gradients to regions where the climate was only barely supportive. Population pressures mounted to put rangelands under the plow. As the wheat farmers moved down the rainfall gradient, they encountered increasing likelihood of drought. The influx of farmers was eventually reversed, as many abandoned their land when the intermittent dry conditions, characteristic of the region, returned.

While government programs, which bought out farmers on the edge of bankruptcy, alleviated some of the pressures on the land, new technologies encouraged them to plant wheat. This reliance on wheat production further increased their vulnerability in a region known to be drought-prone.

The severity of drought-induced crises in New South Wales can be attributed to the fact that farmers have moved into such a region and have thus put themselves at risk. The same is true for livestock owners who overstock their ranges and make themselves equally vulnerable.

A variable climate in that area caused prospective farmers to believe the climate had changed in favor of sustained agricultural or livestock production. Once drawn there, however, they were surprised by what they should have expected: a return to drier conditions. Yet, invariably, wet periods in the arid and semiarid interior of New South Wales have lulled people into a false security, and when drought returns, farmers believe themselves to be the victims

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