

HISTORICAL PERSPECTIVE OF CULTURAL PRACTICES
IN RELATION TO PRODUCTIVITY AND DROUGHT - Part I

by

D. R. Cameron, Normac A.E.S. Ltd., Swift Current

J. W. Hamm, darWall Consulting, Saskatoon

W. W. Gamble, FarmWest, Saskatoon

This study was conducted as part of a much larger study for developing a long-term strategy for water development, drought proofing, and regional economic expansion within Saskatchewan. It was funded by the Canada-Saskatchewan Agreement administered by P.F.R.A. and Saskatchewan Environment.

This paper will present a brief summary of Part I of the overall study and will deal primarily with historical trends.¹ Part II of this study deals with projecting trends in cultural practices and productivity in Saskatchewan to 1900 and 2000 A.D. and has been summarized within these proceedings.²

Saskatchewan's major settlement took place between 1900 and 1930. During these years population increased from 90,000 to 900,000. It has more or less remained the same since 1930. Total farmland area increased from 3 million acres in 1900 to 53 million in 1930 and improved land climbed from 1 million to about 31 million acres.

Since 1930 total farmland area has increased very slowly and appears to be leveling off (Figure 1a). Improved land area has increased steadily since 1930 and this trend will most likely continue (Figure 1b). Farm population in all the soil zones has declined since the 1930's, however, this now appears to be stabilizing (from 1981 statistics, not shown) (Figure 2a). Similarly, the number of farms in Saskatchewan has been declining, but now appears to be leveling out and stabilizing (Figure 2b). As a result of the above trends, farm size has been increasing since 1931 and as of 1981 the average farm size for the Brown, Dark Brown, Thin Black, and Black-Grey Wooded soil zones were 1360, 950, 820, and 735 acres, respectively. However, farm size tends to be leveling off in the Brown and Dark Brown soil zones and this trend is expected to continue (Figure 3a). The average number

1. Cameron et al. 1983. Part I - Historical trends, drought and cultural practices, Study Element #8, Saskatchewan Drought Proofing Study. P.F.R.A., Regina.
2. Hamm, et al. 1983. Part II - Cultural practices in 1990 and 2000 and effects on Productivity. P.F.R.A., Regina. (summary paper in proceedings)

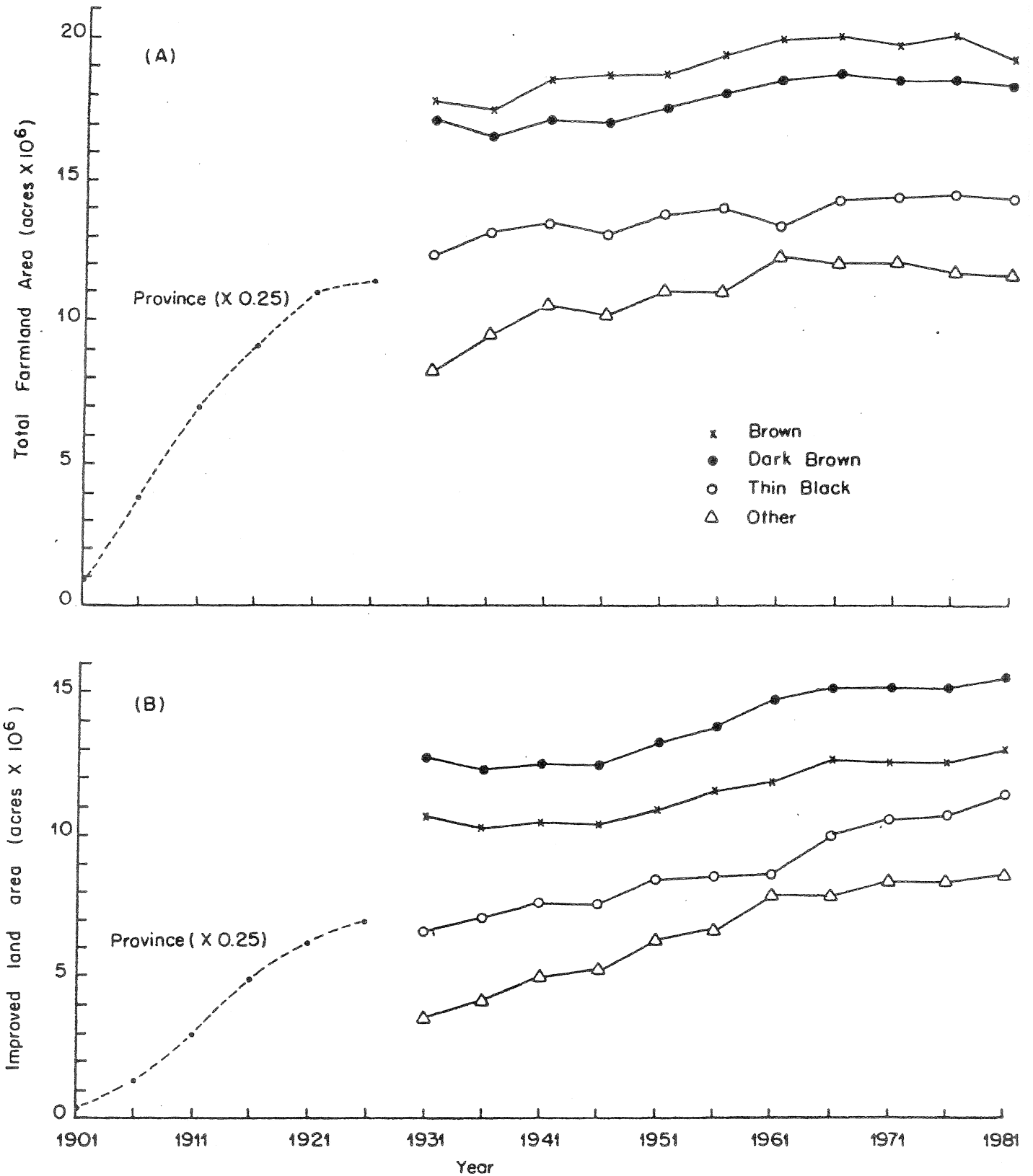


FIGURE 1(A). TOTAL FARMLAND AREA IN EACH SOIL SOIL VERSUS YEAR.

FIGURE 1(B). IMPROVED LAND AREA IN EACH SOIL ZONE VERSUS YEAR.

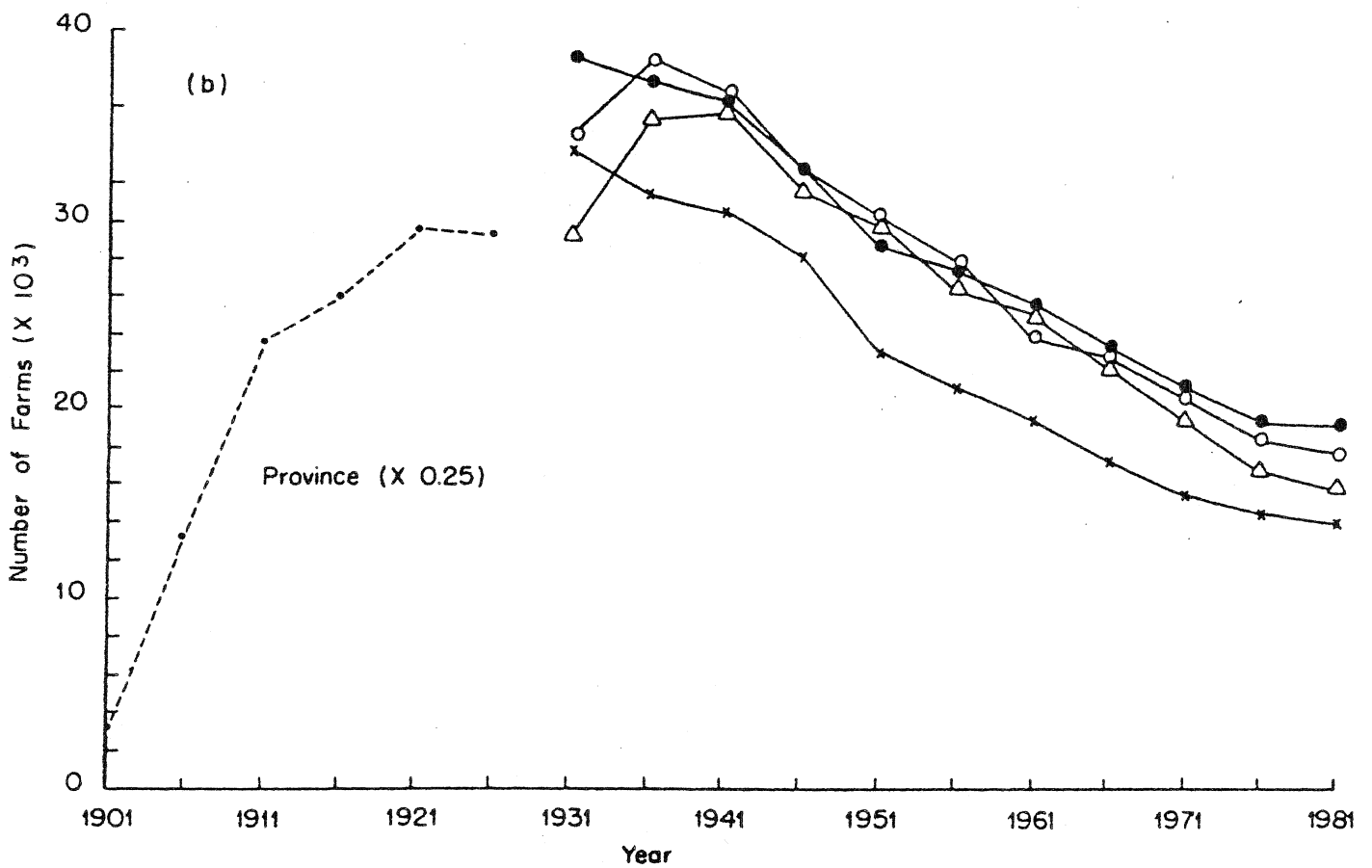
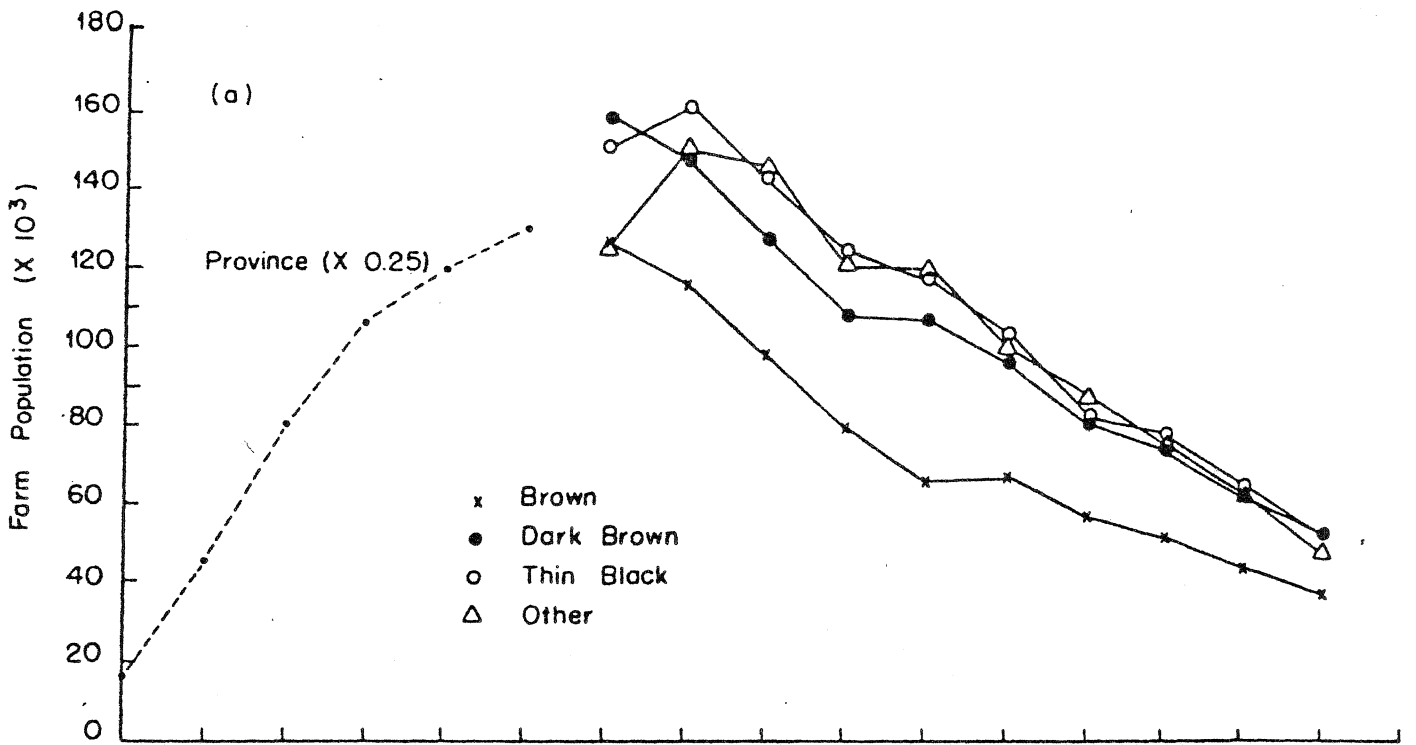


FIGURE 2(a). FARM POPULATION FOR THE SOIL ZONES VERSUS YEAR.

FIGURE 2(b). NUMBER OF FARMS FOR THE SOIL ZONES VERSUS YEAR.

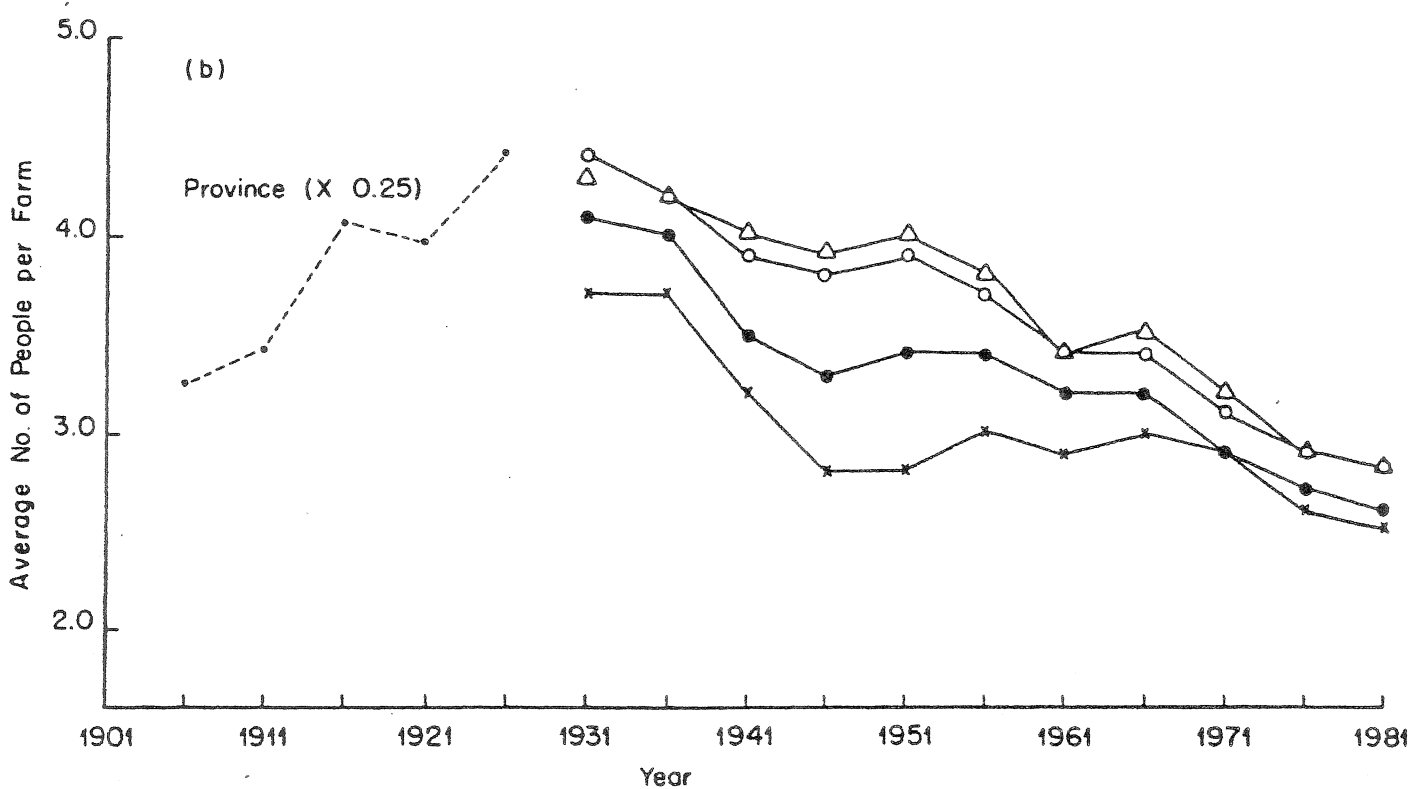
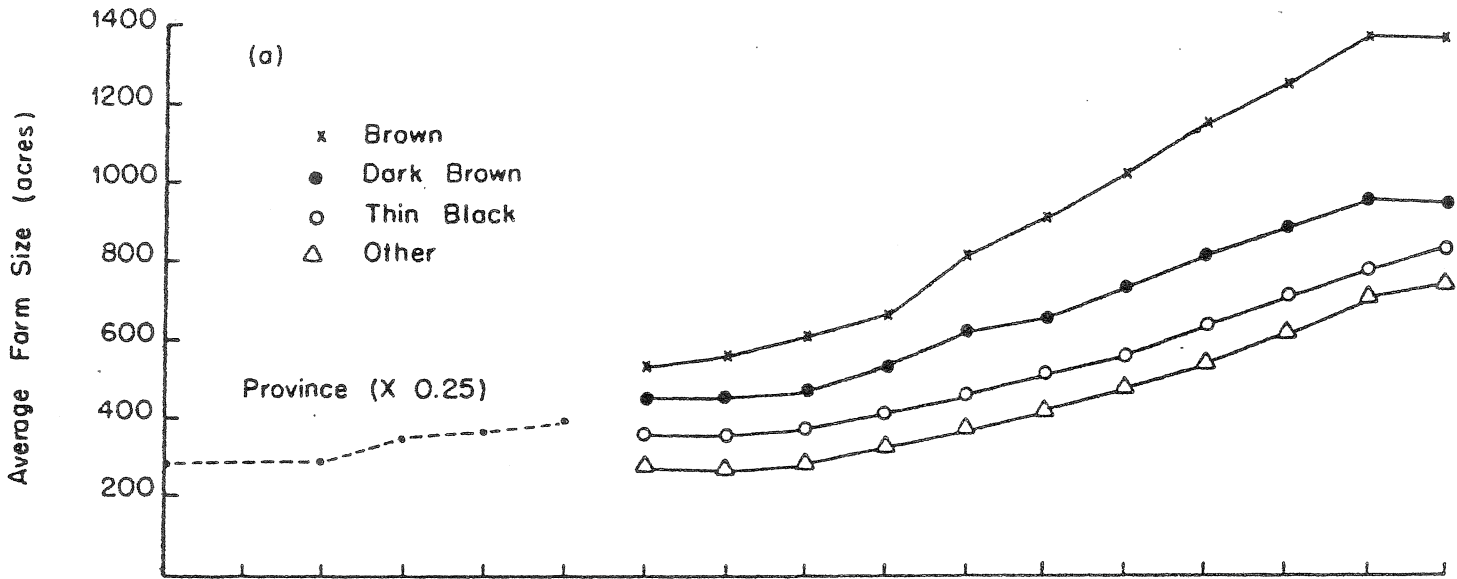


FIGURE 3(a). AVERAGE FARM SIZE FOR FARMS IN EACH SOIL ZONE VERSUS YEAR.

FIGURE 3(b). AVERAGE NUMBER OF PEOPLE PER FARM FOR EACH SOIL ZONE VERSUS YEAR.

of people per farm has also been declining, but as farm population stabilizes so will the average number of people per farm (Figure 3b).

The 1981 statistics for farmland and improved land area for the four soil zones is given below:

	Brown	Dark Brown	Thin Black	Black & Grey
	(millions of acres)			
Total Land Area	20.8	19.8	18.0	20.0
Farmland Area	19.4	18.4	14.6	11.8
Percent of Total Land Area	93%	93%	81%	59%
Improved Land Area	13.1	15.5	11.4	8.7
Percent of Total Farmland Area	67%	85%	78%	74%

In terms of total farmland area, the two southern soil zones have exhausted the available land base. The northern soil zone has the largest room for expansion but this will be limited by poor soils and cold climate. The Dark Brown soil zone has the largest amount of improved land area, but the Brown soil zone has the largest potential for improved farmland. However, the improved land expansion in the Brown will be limited, as much of the native grassland and wasteland which makes up part of the farmland is not suitable for intensive production because of poor soils, arid conditions, and droughts. The Thin Black and Black & Grey soil zones offer the largest potential for increased acreages of improved land.

Farm tenure trends have also changed over time. The number of farms that are solely owned has decreased over time as have the number of farms that are solely rented (Figures 4a and 4b). The trends during the past 50 years have been towards farms that include a combination of owned and rented land (Figure 4c).

Once the decade of dry years 1930-1940 was past, the farming system in Saskatchewan made some very dramatic changes. Summer-fallow became more widespread and the wheat-fallow cropping system came to play a dominant role, especially in the Brown and Dark Brown soil zones. It was a major advance in terms of drought-proofing Saskatchewan and it provided an economic stability to farming in southern Saskatchewan. Closely tied to this change was the adoption of the stubble mulch method of farming and the passing of the dust mulch concept with its plows and disc-harrows. Thus, the one-way become a common farm implement for fallow, later

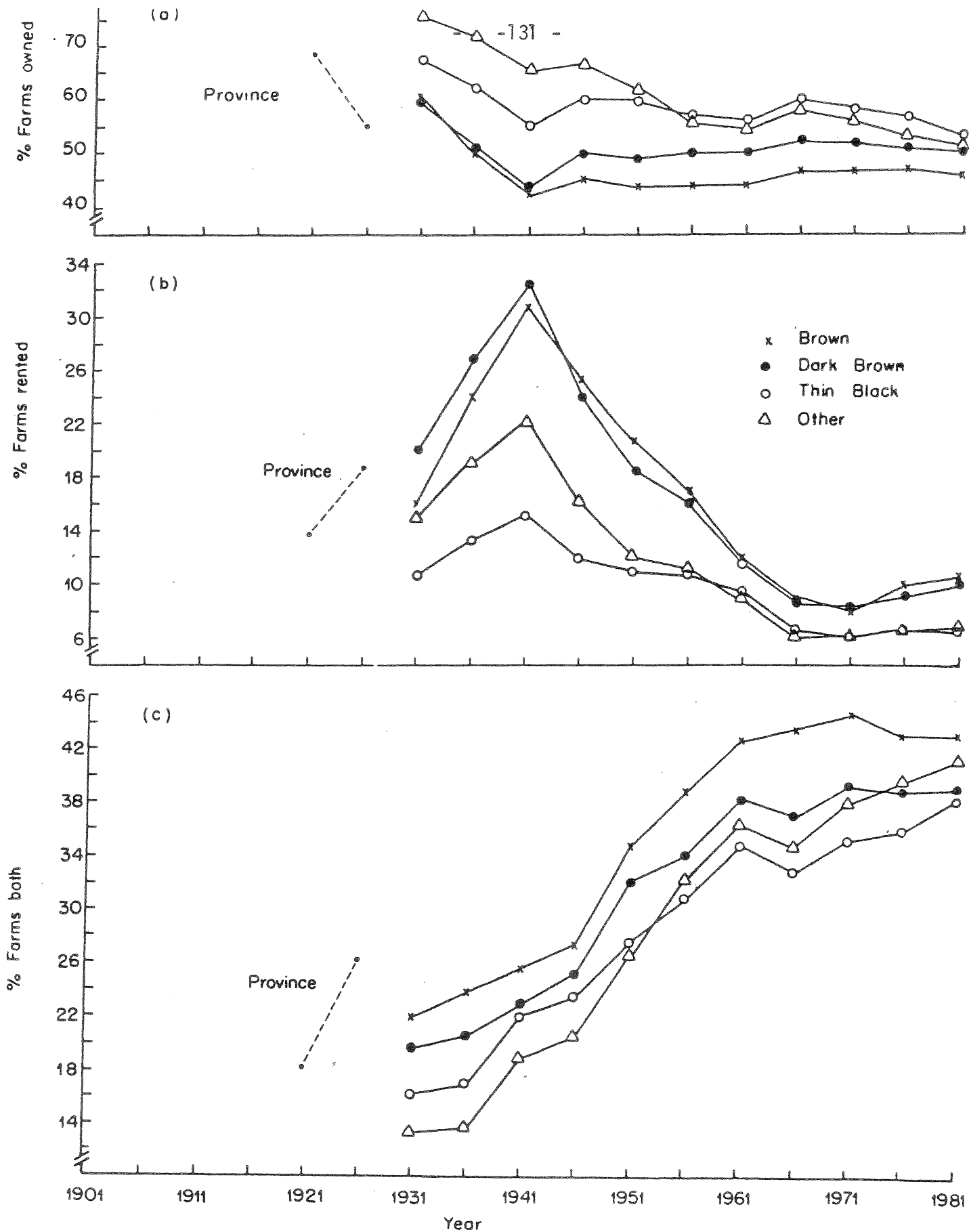


FIGURE 4 (a). PER CENT FARMS SOLELY-OWNED.

FIGURE 4 (b). PER CENT FARMS SOLELY-RENTED.

FIGURE 4 (c). PER CENT FARMS OPERATED BY OWNER-RENTER (BOTH).

to be replaced by the discer with flexible gangs and the Noble blade, and finally the heavy duty cultivator.

From the 1940's to the 1960's farm mechanization was on the upswing. Tractors replaced horses (Figure 5). Combines replaced binders and threshing machines (Figure 6). There was a 5 to 10 year lag period as the combines moved from the southern soil zones to the northern soil zones. In terms of soil conservation, the combine offered the major advantage of leaving the residual straw trash in the field where it could be worked into the stubble mulch.

Cropping changes were also taking place. Spring wheat markets, quotas, and prices were not always stable and there was shift in production from spring wheat in the more northern soil zones to rapeseed and barley. Durum production increased in the two southern soil zones, off-setting the loss in spring wheat acreage (Figure 7a and 7b, Figures 8a and 8b). During this same time period, the cropped and fallow acreages in Saskatchewan both increased corresponding to the increase in improved land (Figure 9a and 9b). However, the 1976 and 1981 period may have been a start of a change where cropped acreages increase and fallow acreages decrease as more producers find higher returns from extended rotations. The trend towards more intensive cropping is expected to take place in the two northern soil zones and to a lesser extent in the two southern zones. Another indicator of the divergence in crop rotation length can be seen from the recent trends in percent fallow cropped to wheat in each of the soil zones (Figure 10). From 1977 to 1980 there appeared to be a sharp drop in wheat seeded to fallow, particularly in the two northern soil zones and the Dark Brown soil zone. Although this trend is expected to fluctuate with wheat prices, it is expected that the dominant long term trend will be to increased stubble cropping.

Thus, the above discussion has very briefly touched on the trends in land use, farm mechanization, and changing cultivation and cropping patterns and some of the trends have been quantified in graphical form. However, in order to specifically relate the importance of past cultural practices on drought mitigation and their effect on the land resource base it was felt that a brief qualitative summarization of these historical trends would be in order. Thus, a tabular summary of the cultural practices that prevailed in the decades between 1900 and 1980 and their effect on drought mitigation and soil degradation is presented in tabular form at the end of this paper.

In reviewing the cultural practices, one often finds that the effect of a certain cultural practice may be beneficial to drought mitigation but deleterious to the soil resource, or visa versa. Summerfallow is a prime example. There is no doubt that the promotion of summerfallowing during the 30's and 40's decreased the impact of drought in the Brown and Dark Brown soil zones and stabilized grain production in the years to come. Although, this was a positive drought mitigation step, it was not necessarily a wise move in terms of soil resource. It has not only increased

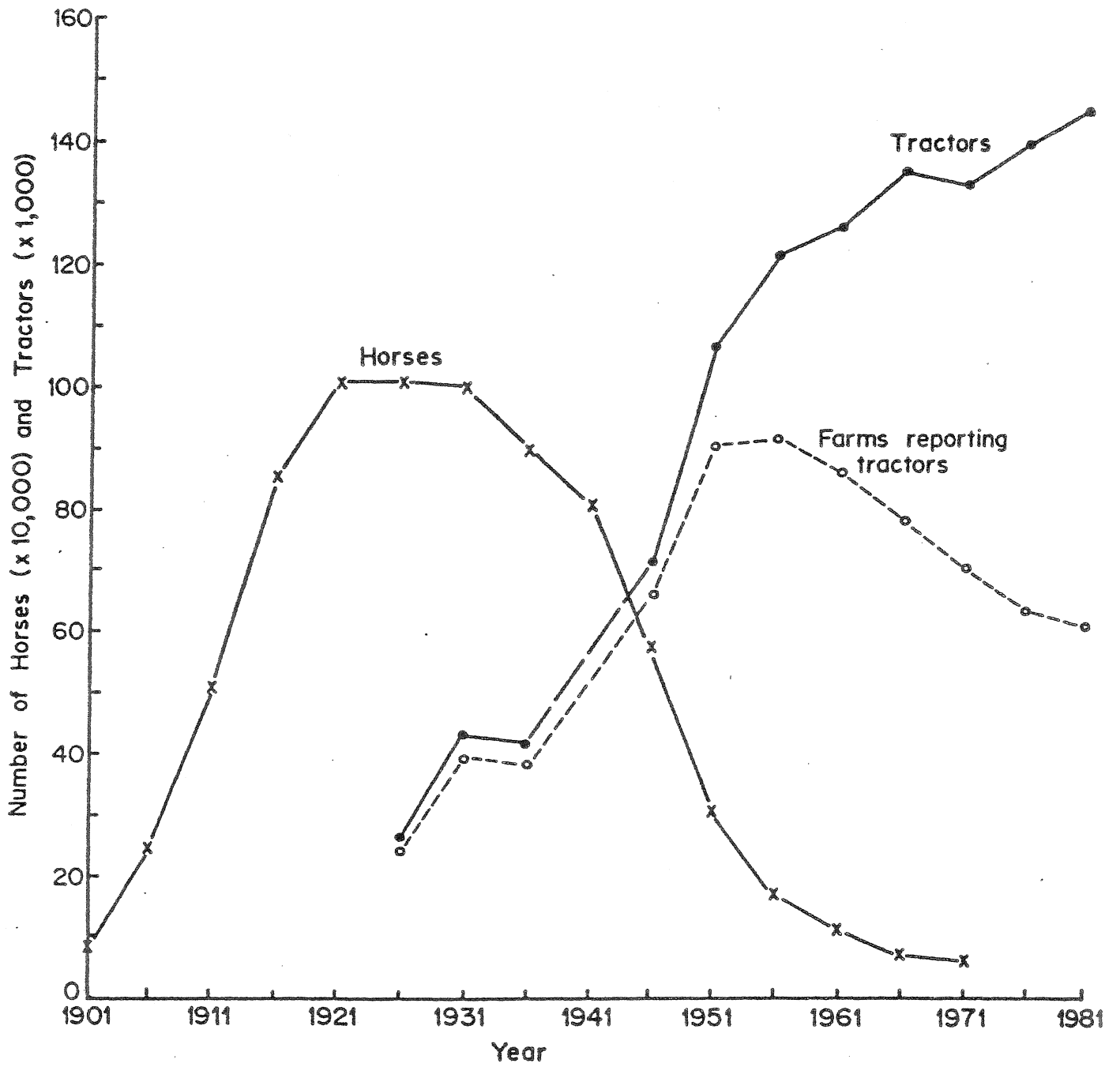


FIGURE 5 HORSE POPULATION, NUMBER OF TRACTORS, AND NUMBER OF FARMS REPORTING TRACTORS IN SASKATCHEWAN, 1901 to 1981.

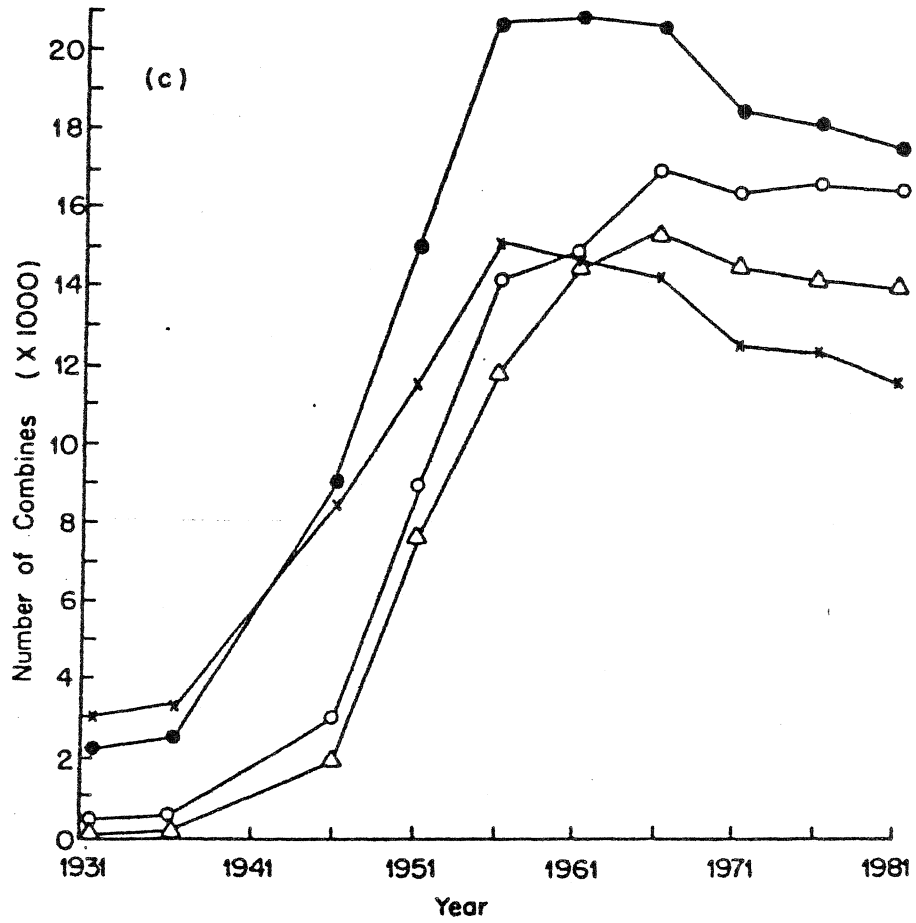


FIGURE 6

NUMBER OF COMBINES.

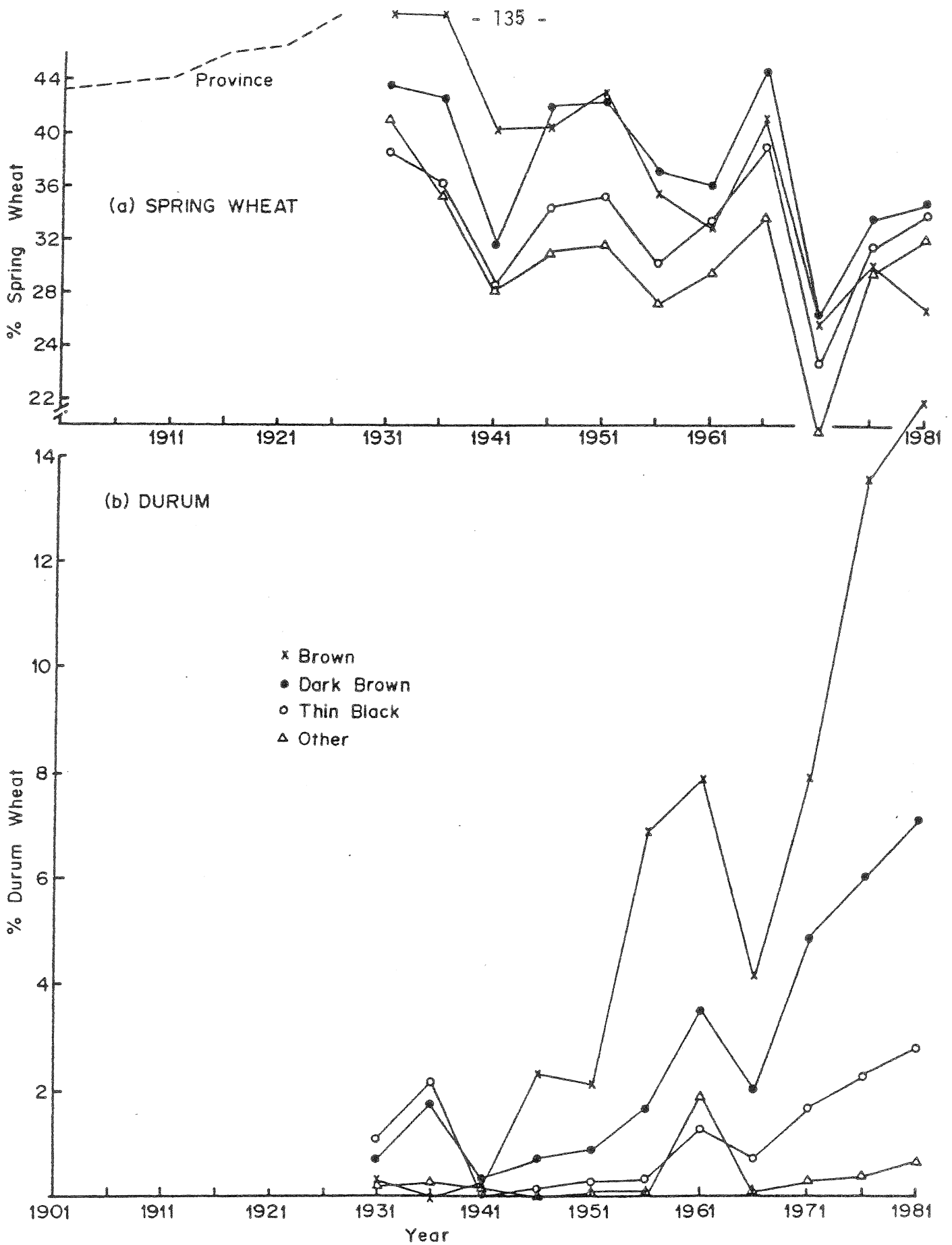


FIGURE 7 TRENDS IN PERCENTAGE (A) SPRING WHEAT AND, (B) DURUM OCCUPYING IMPROVED LAND FOR THE FOUR SOIL ZONES IN SASKATCHEWAN.

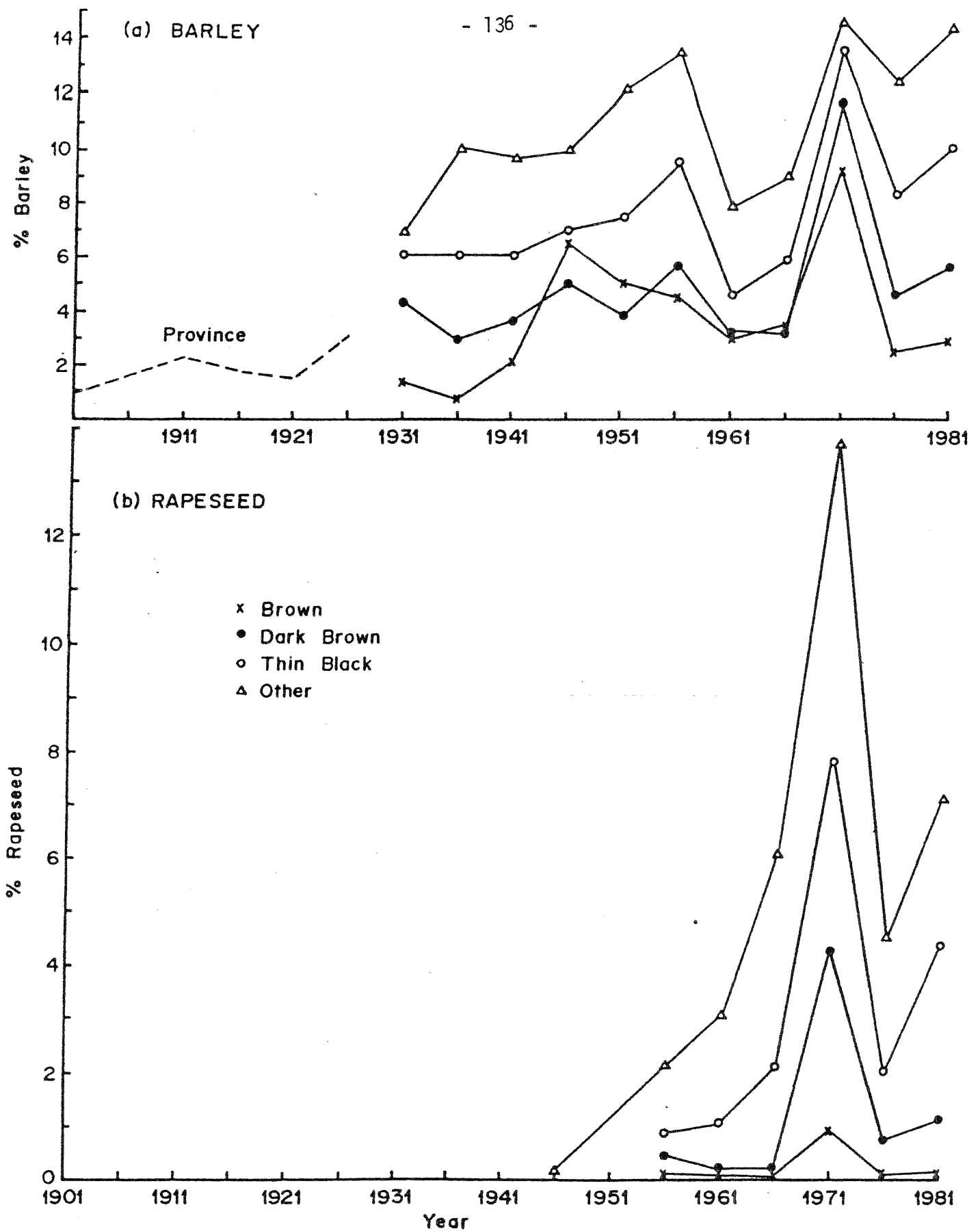


FIGURE 8 TRENDS IN PERCENTAGE OF (A) BARLEY AND, (B) RAPESEED SEEDING ON IMPROVED LAND FOR THE FOUR SOIL ZONES IN SASKATCHEWAN.

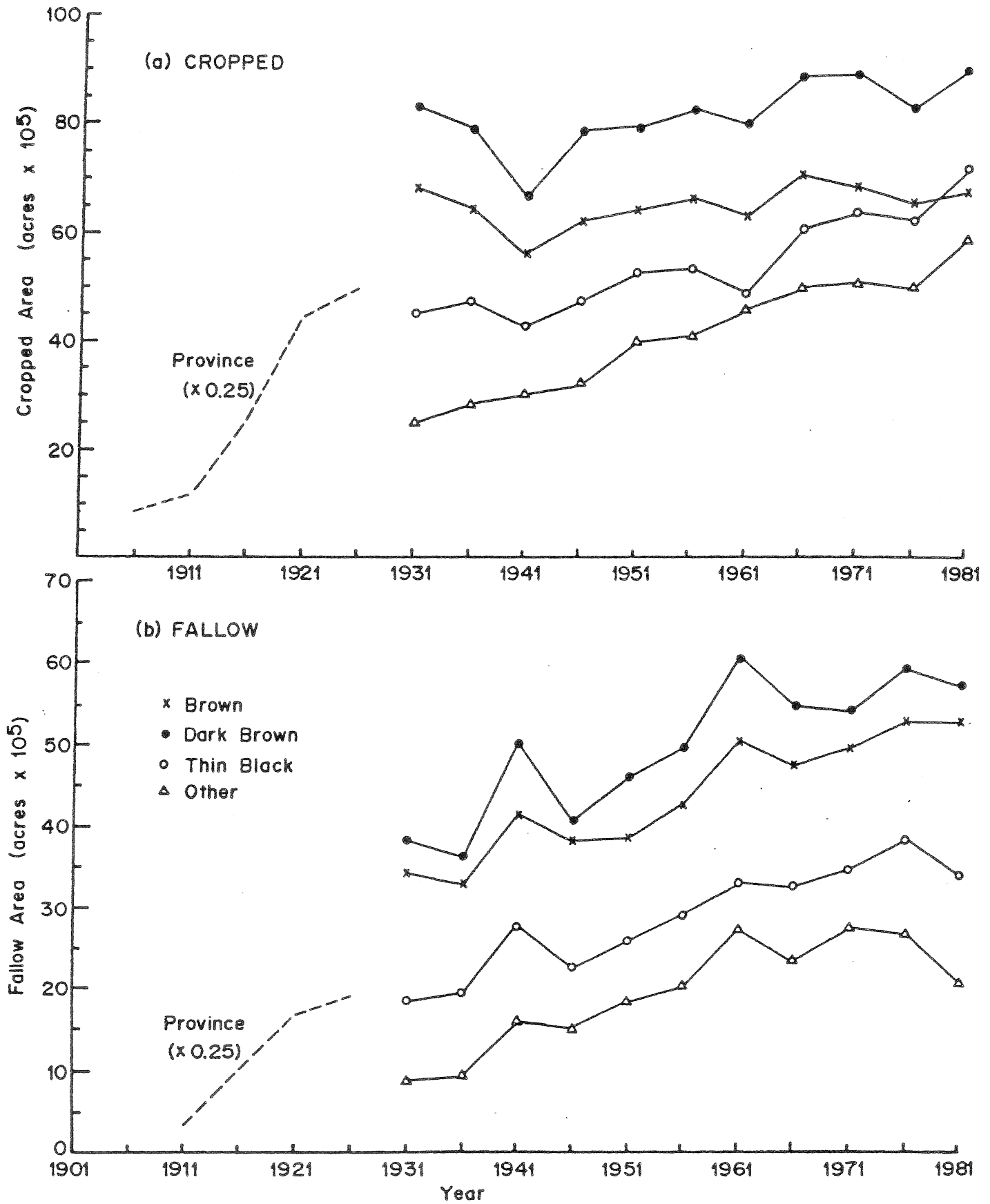


FIGURE 9 (A) AREA OF CROP LAND FOR THE FOUR SOIL ZONES AND, (B) AREA OF FALLOW FOR THE FOUR SOIL ZONES.

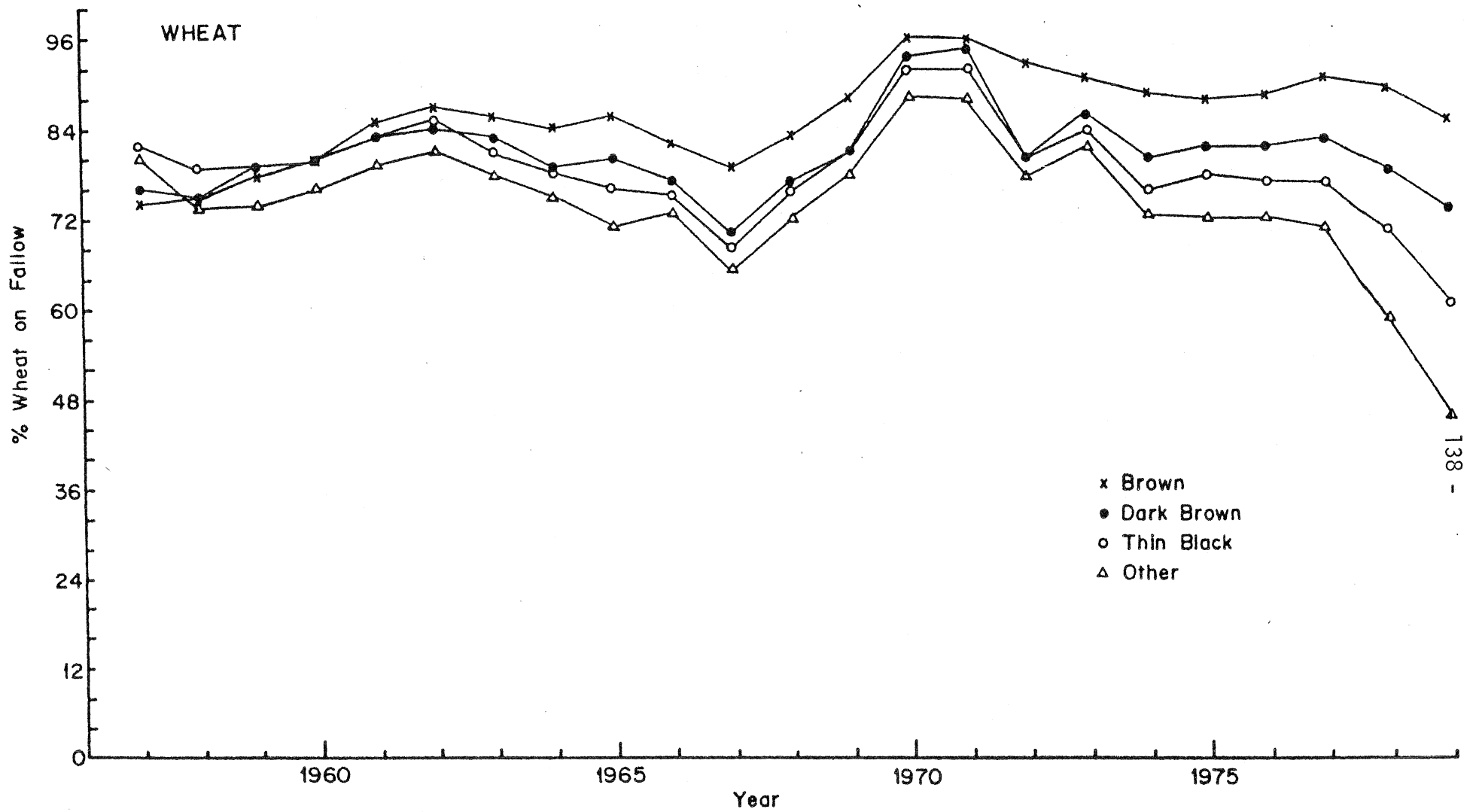


FIGURE 10 PER CENT WHEAT SEEDING ON FALLOW FOR EACH OF THE FOUR SOIL ZONES IN SASKATCHEWAN, 1957-1979.

the susceptibility of soils to wind and water erosion, but it has changed the overall hydrological regime in many areas and is presently believed to be one of the primal causes of the increased salinity now seen in Saskatchewan. However, the system is quite complex. The "stubble mulching" concept which evolved with increased summerfallowing was a positive aspect. It provided a much improved situation for prevention of erosion and did allow for more snow trapping than the conventional "dust mulch" concept that was dominant until the 1930's.

<u>Decades</u>	<u>Prevailing Practices</u>	<u>Effects on Drought Mitigation</u>	<u>Effects on Soil Resources</u>
1900-1920 Era of Farmland Settlement	Era of immigration and settlement, new breaking, improved land area increased from 1.2 million to 24 million acres - mainly Brown and Dark Brown soil zones	Start of the drought problems which were severe 1912-13 and 1917-1920 when dust blowing made its appearance	Start of soil deterioration with rapid oxidation of O.M. by ploughing and tillage. Hydrological cycle changed with introduction of monocultural tillage system - more deep percolation eventually leading to land salinization
1920-1930 Drought Warnings, WW I	Land ploughed fall and spring, then disk-harrowed - "dust mulch" concept prevailed	Lack of standing stubble for snow trap, probably better infiltration of water, but drying out of seedbed in spring	No protective cover - soil prone to wind and water erosion; tillage enhanced O.M. breakdown which gave good fertility
	Horses dominant form of draft power	Timeliness in seeding hampered and drying out seedbed may have been problem	None
	Primarily stubble cropping - fallow ranged from 10-25%	More prone to drought with severe yield reductions where insufficient moisture storage between fall and spring	Good (relative to a fallow-crop system) - growing crop utilizes mineralized NO ₃ which could have been otherwise lost and provides protective cover against erosion
	Treshing Machines	None	Straw residue removed from field - protective cover and organic matter
	Burning Stubble	None - stubble was ploughed anyway and burning facilitated this work	Loss of organic residue

<u>Decades</u>	<u>Prevailing Practices</u>	<u>Effects on Drought Mitigation</u>	<u>Effects on Soil Resource</u>
1930-1940	Cropping patterns suggest two years of cropping and one year of fallow - summerfallow promoted	Extra acreage of summerfallow beneficial to drought mitigation	Increased O.M. loss and erosion problems
Dirty Thirties	Plow and disc-harrow primary forms of tillage - stubble mulching being promoted, but lack of suitable equipment	None	Continued soil degradation, although stubble mulching and listing would help prevent wind erosion
	Decrease in farms owned, increase in farms rented	Probably negative	Negative - difficult to quantify relative to solely owned farms
	Farm capital continues to decline	Negative - no money to spend on innovative techniques	Negative - land not worth as much
	Tractors replacing horses (rubber tires replace steel clogs)	Better timing of operations	More tillage operations possible, more deterioration
	Emmigration of farmers from Brown and Dark Brown soil zones, increased in land acreages in the northern soil zones	Less suitable, blowing lands abandoned, new homesteads started in wetter area - positive effect on overall productivity	Positive
	PFRA Established - real effects were more apparent in the 40's	(see next page)	

<u>Decades</u>	<u>Prevailing Practices</u>	<u>Effects on Drought Mitigation</u>	<u>Effects on Soil Resource</u>
	<ul style="list-style-type: none"> - Seeding blowing lands - Irrigation and dugouts - A.I.A. - Shelterbelts 	<ul style="list-style-type: none"> - positive - positive - positive - positive 	<ul style="list-style-type: none"> - positive - generally positive - generally positive - positive
	Research Stations and University	Technology transfer and research on improved farming methods	Positive except for increased summerfallowing
1940-50	Wheat Acreage Reduction Program - 1941 - the fallow-wheat rotation dominates in southern soil zones	Good - increased fallow acreage gave assurance of more stable crop yields	Bad - increased rate of O.M. decomposition, NO ₃ -N leaching, and erosional losses - hydrological cycle altered further to favor increased salinization of lands
Agricultural Mechanization	Stubble mulching practiced - Noble blade more common in south, one-ways replace moldboard plow	Indirect - permits fallowing without burying trash	Good - prevents blowing
	Combines replace threshing machines	None	Good - leave straw on field - more organic residue, more protection
	Land ownership levels-off, farms rented decreases, farm capital increases	Positive - better land stewardship, more conscious of value and fragility of resources	Positive - difficult to quantify
	Farm population decreases, number of farms decrease, farm size begins to increase noticeably	Unknown - reflection of increasing farm mechanization	Unknown

<u>Decades</u>	<u>Prevailing Practices</u>	<u>Effects on Drought Mitigation</u>	<u>Effects on Soil Resource</u>
	Weed Control - little chemical control	Fallowing provided good weed control, better yields, better timeliness with mechanization	Unknown
	Insect Control (Grasshoppers)	Positive effect on yields, grasshopper populations are often highest in dry years	None
	New Varieties	Positive - more rust resistance and drought tolerant	Positive - utilize available NO ₃ -N and P, better stubble crop
	Quota system introduced	Increase tendency to fallow in low quota years	Not positive - stubble cropping not promoted by old quota system
1950-60	Farm mechanization peaks - trend towards bigger machinery and tractors	Generally good - better timing of operations, better equipment to carry out farm operations	Unknown - perhaps increased amount of tillage due to ease of this operation
	Trucks and grain loaders continue to increase	None - easier to transport and store grain	None
	Field cultivators and heavy duty cultivators begin to replace one-way discs - in 1940's discs were used for seeding and this trend continues with less usage for fallow operations	Positive - tend to leave a ridge and more trash for snow trapping	Positive - leave more surface trash than discers, less soil pulverization

<u>Decades</u>	<u>Prevailing Practices</u>	<u>Effects on Drought Mitigation</u>	<u>Effects on Soil Resource</u>
	Fall cultivation decreases, stubble burning ceases (this was also taking place in 1940's and relates to the availability of tractor power and larger, better equipment)	Good - trash left to trap snow, more moisture for next crop	Good - less cultivation
	Weed control - 30% cropped area sprayed	Good - better crop yields	Unknown
	Rural electrification - increased from 17,000 to 60,000 farms	None - standard of living improved, probably indirect social effects	None
1960-70	Total farmland area levels off, improved land in northern areas increases	Positive - total wheat production less affected by local droughts in southern Saskatchewan	Unknown - opening up more improved farmland immediately starts depleting soil O.M. but its a price we have lived with so far
	Percent farmland area rented drops to low of 25% of total, farms operated by owner-renter become more common	Unknown, but thought to be a positive trend	Positive - generally better stewardship of your own land
	Percent farmers with some off-farm work reaches 20-25%, percent farmers not residing on farms increases	Unknown	Unknown
	Farm capital increasing slowly, relative land capital increases as machinery	Unknown - more awareness of value of land, but more pastures converted to grainland	Unknown

Decades

Prevailing Practices

Effects on Drought Mitigation

Effects on Soil Resource

and livestock capital decreases

Farm size continues to grow in all soil zones

Summerfallow acreage peaks during low grain market years (1953-61) and cropped acreages peak during high grain market years (1962-66)

Crop diversity increasing - durum replacing spring wheat, barley acreage increasing, rapeseed production becoming more important in north

Fertilization - increases dramatically, especially when market and cash returns are good

Weed Control - 75% of cropped acreage treated

Unknown - general feeling that farms are becoming too large to manage properly

None - drought effects would be more pronounced on stubble cropped lands

Tendency for more stubble cropping - therefore more drought prone

Positive - increased production

Positive - less weed competition, less loss of water to weeds, better yields

Unknown - perhaps a tendency to rush over fields to get the job done, more pulverization of soil

Already discussed

Stubble cropping is positive, but rape stubble leaves little crop residue

Positive - better yields, less mining, more stubble cropping

Positive - more opportunity for stubble cropping because of better weed control

<u>Decades</u>	<u>Prevailing Practices</u>	<u>Effects on Drought Mitigation</u>	<u>Effects on Soil Resource</u>
	Irrigation - SSRIP and others expanding	Positive - insufficient ppt. no longer a problem	Positive generally, but increasing occurrence of salinity
1970-80	Operation - LIFT - 1970	Good - more summerfallow, better moisture reserves, better yields for next year	Bad - fallow acreage increased by 6 million to 24 million in 1970
	Farm capital increases very rapidly	Unknown - speculative land buying	Unknown - land becomes more precious, wider consciousness of salinity and erosion problems; effort to achieve economical production with high cost of inputs
	Fertilizer use climbs dramatically; weed control expands to cover 80-85% of cropped area	Positive	Positive
	Irrigation continues to expand	Positive	Generally positive
	Farm size levels off in two southern soil zones	Unknown	Unknown - probably positive - better management of existing land base
	Cropped acreages increase dramatically in northern soil zones	Unknown - these zones are not as subject to drought as southern zones	Positive - better use of soil resource

<u>Decades</u>	<u>Prevailing Practices</u>	<u>Effects on Drought Mitigation</u>	<u>Effects on Soil Resource</u>
	Continued crop diversity - cash crops to stabilize income in bad wheat market years	Unknown	Positive in that the land is being utilized, negative in the aspects of trash residue
	Soil incorporated weed control (Treflan, etc.)	Positive - as weed control, better yields	Negative - excessive tillage leaves no cover on land
	New techniques; air seeders, deep banding, chemical fallow, snow trapping, 0-till, etc.	Untested, but should be positive	Any technique that promotes stubble cropping or less tillage should be positive