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DERIVED LABOR REQUIREMENTS FOR
WESTERN KANSAS IRRIGATED AND DRYLAND CROPS*

LARRY N. LANGEMEIER, KIM WITT AND CHRIS AKHIMIEN**

April 1990
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Department of Agricultural Economics]

[Kansas State University.

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DERIVED LABOR REQUIREMENTS FOR WESTERN KANSAS IRRIGATED AND DRYLAND CROPS*

Larry N. Langemeier, Kim Witt, and Chris Akhimien[†]

Agriculture has changed significantly as a result of decreased labor required per crop acre. By continuously shifting to larger crop machinery and equipment, producers can handle more crop acres. Between 1975 and 1988, hours of labor available for crop production decreased 10.8 percent on Kansas Farm Management Association, S.W., farms; total crop acres increased 4.8 percent.¹

Producers, agri-business firms, and others need current information on crop-labor requirements. When considering new machinery investments, additional land purchases, enterprise analyses, and cost-of-production budgets, managers need labor information on various crops. The rapid changes in machine sizes and field operations call for current crop-labor standards.

DATA CONSIDERATIONS AND METHODOLOGY

Information on tillage, planting, and harvesting-machine operations were obtained from Area Extension Economists. Also, machinery dealers provided information on small, average, and large machine sizes for their trade areas and their expectations on future machine sizes. Specific information required for each crop was: type of machine operations, machine sizes, months machines were used, and number of times over a given acre for each machine (see Appendix Tables 1-9).

Machine sizes vary by farm size. Three farm sizes were considered based on farms enrolled in the southwest (S.W.) and northwest (N.W.) Farm Management Associations: small (200 to 750 crop acres); average (750 to 2,300 crop acres); and large (more than 2,300 crop acres). Among the three farm sizes, only the machine size was adjusted.

*Contribution No. 90-398-D from the Kansas Agricultural Experiment Station.

[†]Professor, and Graduate Assistants, respectively, Department of Agricultural Economics, Kansas State University, Manhattan, Kansas.

¹Larry N. Langemeier, "The Annual Report, Management Information, 1975 and 1988," Department of Agricultural Economics, Cooperative Extension Service, Kansas State University, Manhattan, Kansas 66506.

²Mark E. Nelson, Extension Agricultural Economist, N.W., provided most of the information on machine sizes and operations.

A computerized machinery investment generator program was used to develop the "field time" or "machine hour" requirements for each crop, considering machinery type and size and number of tillage, planting, and harvesting operations. Machine hours--hours that a machine must be operated to complete a specific operation for one acre--were computed by this formula:

$$\text{Hours per acre} = \frac{1.0}{((S) \times (W) \times (E)/8.25)}$$

Where, S - Average speed (mph) a machine travels
W - Machine's capacity in feet
E - Field efficiency of the machine.

Field efficiency is the ratio of the actual capacity of a machine to its theoretical capacity. The field efficiency factor accounts for overlap and failure to use the machine's full operating width, turning time, and such machine servicing as filling seed boxes. Field efficiencies vary with sizes and shapes of fields and field conditions.

Field-labor hours were obtained by multiplying total machine hours by 1.20 to reflect additional time to travel to and from the field, adjust equipment, lubricate, and do repairs and maintenance work. Labor standards for each crop included an indirect labor charge of .10 (.075 for alfalfa hay and .05 for sorghum silage) times field labor hours for time required for accounting, managing, attending meetings, marketing, using auto and pickup, and purchasing repair parts.³

The machinery investment generator program was used to develop hours of irrigation labor requirements for each irrigated crop, considering acre-inches of irrigation water used, hours of labor required per acre-inch, and the amount of water applied each month. Two irrigation systems were considered: self-propelled sprinkler and flood (surface). Acre-inches of water applied and hours of labor required per acre-inch were the same for all farm sizes.

DERIVATION OF CROP LABOR REQUIREMENTS

Irrigated Crops

Table 1 (sprinkler irrigation) and Table 2 (flood irrigation) show irrigation and field-labor hour requirements by month for each irrigated crop. Though labor distribution during the year varies from farm to farm (depending on weather, field conditions, and when a given machine operation is done), total field-labor-hour requirements for a given crop will not be changed by shifting a machine operation from one month to another.

³The field-labor-hour adjustment and indirect labor charge factors are 1.30 and .15 for eastern Kansas; 1.25 and .125 for central Kansas.

Table 1. Estimated Irrigation and Field-Labor Hours* per Acre for Indicated Crops (Sprinkler Irrigation), Small, Average, and Large Farms, Western Kansas, 1989**

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflowers	Alfalfa hay***
Small-size farm							

Tillage-harvesting:							
January							
February							
March		0.22					
April		0.82		0.19	0.22	0.22	0.05
May		0.14	0.39	0.38	0.38	0.38	0.74
June	0.70	0.24	0.41	0.36	0.36	0.36	0.74
July	0.37						0.87
August	0.30						0.09
September	0.43						0.45
October							
November		0.99	0.74	0.70	3.00	0.70	
December							
TOTAL	1.80	2.40	1.54	1.62	3.96	1.66	2.94
Irrigation:							
May	0.05						0.04
June	0.07	0.04	0.09	0.09	0.09	0.09	0.14
July		0.15	0.08	0.08	0.08	0.08	0.10
August		0.15	0.07	0.07	0.07	0.07	0.11
September	0.05	0.07	0.08	0.08	0.08	0.08	0.12
October	0.05	0.02					0.02
TOTAL	0.22	0.43	0.32	0.32	0.32	0.32	0.53

Table 1. Estimated Irrigation and Field-Labor Hours* per Acre for Indicated Crops (Sprinkler Irrigation), Small, Average, and Large Farms, Western Kansas, 1989** (Continued)

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflower	Alfalfa hay***
Average-size farm -----							
Tillage-harvesting:							
January							
February							
March		0.18					
April		0.59		0.17	0.17	0.17	0.05
May		0.18	0.33	0.27	0.31	0.31	0.68
June	0.61	0.18	0.27	0.24	0.27	0.27	0.68
July	0.28						0.63
August	0.28						0.03
September	0.13						0.41
October							
November		0.74	0.66	0.61	3.00	0.61	
December							
TOTAL	1.30	1.86	1.26	1.29	3.75	1.36	2.49
Irrigation:							
May	0.05						0.04
June	0.07	0.04	0.09	0.09	0.09	0.09	0.14
July		0.15	0.08	0.08	0.08	0.08	0.10
August		0.15	0.07	0.07	0.07	0.07	0.11
September	0.05	0.07	0.08	0.08	0.08	0.08	0.12
October	0.05	0.02					0.02
TOTAL	0.22	0.43	0.32	0.32	0.32	0.32	0.53

Table 1. Estimated Irrigation and Field-Labor Hours* per Acre for Indicated Crops (Sprinkler Irrigation), Small, Average, and Large Farms, Western Kansas, 1989** (Continued)

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflower	Alfalfa hay***
Large-size farm							

Tillage-harvesting:							
January							
February							
March		0.18					
April		0.41		0.11	0.12	0.12	0.05
May		0.06	0.24	0.22	0.25	0.25	0.65
June	0.54	0.12	0.20	0.06	0.18	0.18	0.65
July	0.18				0.15	0.15	0.53
August	0.20						0.02
September	0.19						0.36
October							
November		0.66	0.57	0.54	2.91	0.54	
December							
TOTAL	1.10	1.43	1.01	0.93	3.61	1.24	2.27
Irrigation:							
May	0.05						0.04
June	0.07	0.04	0.09	0.09	0.09	0.09	0.14
July		0.15	0.08	0.08	0.08	0.08	0.10
August		0.15	0.07	0.07	0.07	0.07	0.11
September	0.05	0.07	0.08	0.08	0.08	0.08	0.12
October	0.05						0.02
TOTAL	0.22	0.41	0.32	0.32	0.32	0.32	0.53

*Field-labor hours (tillage-planting-harvesting) were computed by multiplying total machine hours-field time-by 1.20 to reflect the additional time required for traveling to and from the field, adjusting equipments, maintenance, lubrication, etc.

**Estimates are for 1989 using best sources available supplemented by actual farm information, although previous years' experiences would influence estimates.

*** Tillage and planting operations for alfalfa hay were pro-rated over a 5-year period.

Table 2. Estimated Irrigation and Field-Labor Hours* per Acre for Indicated Crops (Flood Irrigation), Small, Average, and Large Farms, Western Kansas, 1989**

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflower	Alfalfa hay***
Small-size farm -----							
Tillage-harvesting:							
January							
February							
March		0.22					
April		0.82		0.19	0.22	0.22	0.05
May		0.14	0.39	0.38	0.38	0.38	0.74
June	0.70	0.41	0.44	0.36	0.36	0.36	0.74
July	0.37		0.08	0.17	0.17	0.17	0.87
August	0.30						0.13
September	0.55						0.45
October							
November		0.99	0.74	0.70	3.00	0.70	
December							
TOTAL	1.93	2.58	1.65	1.80	4.13	1.83	2.97
Irrigation:****							
May	0.12						0.09
June	0.16	0.08	0.21	0.21	0.21	0.09	0.31
July		0.34	0.17	0.17	0.17	0.08	0.23
August		0.33	0.16	0.16	0.16	0.07	0.25
September	0.12	0.16	0.17	0.17	0.17	0.08	0.28
October	0.10	0.04					0.04
TOTAL	0.50	0.95	0.71	0.71	0.71	0.32	1.20

Table 2. Estimated Irrigation and Field-Labor Hours* per Acre for Indicated Crops (Flood Irrigation), Small, Average, and Large Farms, Western Kansas, 1989** (Continued)

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflower	Alfalfa hay***
Average-size farm							

Tillage-harvesting:							
January							
February							
March		0.18					
April		0.59		0.17	0.17	0.17	0.05
May		0.18	0.33	0.27	0.31	0.31	0.68
June	0.61	0.32	0.32	0.24	0.27	0.27	0.68
July	0.28		0.07	0.15	0.15	0.15	0.63
August	0.28						0.09
September	0.43						0.41
October							
November		0.74	0.66	0.61	3.00	0.61	
December							
TOTAL	1.59	2.01	1.38	1.44	3.90	1.50	2.55
Irrigation:****							
May	0.12						0.09
June	0.16	0.08	0.21	0.21	0.21	0.09	0.31
July		0.34	0.17	0.17	0.17	0.08	0.23
August		0.33	0.16	0.16	0.16	0.07	0.25
September	0.12	0.16	0.17	0.17	0.17	0.08	0.28
October	0.10	0.04					0.04
TOTAL	0.50	0.95	0.71	0.71	0.71	0.32	1.20

Table 2. Estimated Irrigation and Field-Labor Hours* per Acre for Indicated Crops (Flood Irrigation), Small, Average, and Large Farms, Western Kansas, 1989** (Continued)

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflower	Alfalfa hay***
Large-size farm -----							
Tillage-harvesting:							
January							
February							
March		0.18					
April		0.41		0.12	0.12	0.12	0.05
May		0.06	0.24	0.22	0.25	0.25	0.68
June	0.54	0.22	0.26	0.16	0.18	0.18	0.68
July	0.18		0.10	0.10	0.10	0.10	0.63
August	0.20						0.06
September	0.29						0.41
October							
November		0.66	0.57	0.54	2.91	0.54	
December							
TOTAL	1.20	1.53	1.17	1.14	3.57	1.19	2.53
Irrigation:****							
May	0.12						0.09
June	0.16	0.08	0.21	0.21	0.21	0.09	0.31
July		0.34	0.17	0.17	0.17	0.08	0.23
August		0.33	0.16	0.16	0.16	0.07	0.25
September	0.12	0.16	0.17	0.17	0.17	0.08	0.28
October	0.10	0.04					0.04
TOTAL	0.50	0.95	0.71	0.71	0.71	0.32	1.20

*Field-labor hours (tillage-planting-harvesting) were computed by multiplying total machine hours-field time-by 1.20 to reflect the additional time required for traveling to and from the field, adjusting equipments, maintenance, lubrication, etc.

**Estimates are for 1989 using best sources available supplemented by actual farm information, although previous years' experiences would influence estimates.

*** Tillage and planting operations for alfalfa hay were pro-rated over a 5-year period.

****Labor requirements for flood irrigation are higher than for sprinkler irrigation because of the additional time required to lay and move lateral pipe, as well as the lower efficiency.

Table 3 (sprinkler irrigation) and Table 4 (flood irrigation) show irrigation and field-labor hour "standards" by month for each crop. The standards were derived by weighting the hours for small, average, and large sized farms by the proportion of total cash crop-irrigated farms in the 200-750, 750 to 2,300, and more than 2,300 crop acre categories, respectively, in Farm Management Associations, S.W. and N.W. Labor requirements per acre for wheat and row crops ranged from 1.28 hours for soybeans to 1.91 hours for corn under sprinkler irrigation and from 1.40 hours for wheat to 2.05 hours for corn under flood irrigation. Table 5 (sprinkler irrigation) and Table 6 (flood irrigation) show irrigation and field-labor hour standards for each crop on a percentage basis. Percentages would become important should labor standards change in the future.

Table 7 (sprinkler irrigation) and Table 8 (flood irrigation) present the tillage-planting, harvesting, irrigation, and indirect-labor requirements for the small, average, and large farms and the weighted standards.⁴ Harvesting hours were similar for wheat, soybeans, and grain sorghum because only combine speed was varied. Crop yields, plant lodging, and field conditions are other factors that affect field efficiencies and, therefore, change harvesting-time requirements.

Table 9 shows irrigation and field-labor hour "standards" by month for each crop for combined sprinkler and flood irrigation. The standards were derived by weighting the standards for sprinkler (Table 3) and flood irrigation (Table 4) by .25 and .75, respectively. Labor requirements per acre for wheat and row crops ranged from 1.37 hours for soybeans to 2.07 hours for corn. Table 10 presents the tillage-planting, harvesting, irrigation, and indirect labor requirements for the small, average, and large farms and the weighted standard for combined sprinkler and flood irrigation. Derived labor standards for irrigated crops ranged from 2.13 hours for wheat and soybeans to 4.67 hours for sorghum silage.

Dryland Crops

Table 11 shows field-labor hour requirements by month for each dryland crop for the small, average, and large farms and weighted standards. We derived the standards by weighting the hours for small, average, and large sized farms by the proportion of total cash crop-dryland farms in the 200 to 750, 750 to 2,300, and more than 2,300 crop acre categories, respectively, in Farm Management Associations, S.W. and N.W. Labor requirements per acre for wheat and grain sorghum included the additional machine operations for summer-fallowed land.

Table 12 shows field-labor hour standards for each crop on a percentage basis. Table 13 presents the tillage-planting, harvesting, and indirect-labor requirements for the small, average, and large farms and the weighted standards. Derived labor standards for dryland crops ranged for 1.14 hours for wheat to 2.56 hours for alfalfa hay.

⁴Custom tillage, planting, or harvesting operations were not considered. Indirect labor (derived as .10 times field-labor hours) did not involve the hours of irrigation labor.

Table 3. Derived Irrigation and Field-Labor Hour per Acre Standards for Indicated Crops (Sprinkler Irrigation), Western Kansas, 1989*

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflowers	Alfalfa hay
Derived Standards							

Tillage-harvesting:							
January							
February							
March		0.19					
April		0.61		0.16	0.17	0.17	0.05
May		0.15	0.33	0.29	0.32	0.32	0.69
June	0.61	0.18	0.29	0.23	0.27	0.27	0.69
July	0.28			0.00	0.03	0.03	0.67
August	0.27						0.04
September	0.21						0.41
October							
November		0.78	0.66	0.61	2.98	0.61	
December		0.00					
TOTAL	1.38	1.91	1.28	1.30	3.77	1.40	2.55
Irrigation:							
May	0.05						0.04
June	0.07	0.04	0.09	0.09	0.09	0.09	0.14
July		0.15	0.08	0.08	0.08	0.08	0.10
August		0.15	0.07	0.07	0.07	0.07	0.11
September	0.05	0.07	0.08	0.08	0.08	0.08	0.12
October	0.05	0.02					0.02
TOTAL	0.22	0.43	0.32	0.32	0.32	0.32	0.53

*Derived by weighting hours in Table 1 for small, average, and large farms by the proportion of total farms represented by the number of cash crop-irrigated farms with 200-750, 750-2,300 and more than 2,300 crop acres respectively, in Kansas Farm Management Associations, S.W. and N.W.

Table 4. Derived Irrigation and Field-Labor Hour per Acre Standards for Indicated Crops (Flood Irrigation), Western Kansas, 1989*

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflower	Alfalfa hay
Derived Standards -----							
Tillage-harvesting:							
January							
February							
March		0.19					
April		0.61		0.17	0.17	0.17	0.05
May		0.15	0.33	0.29	0.32	0.32	0.70
June	0.61	0.32	0.34	0.25	0.27	0.27	0.70
July	0.28		0.08	0.14	0.14	0.14	0.69
August	0.27						0.09
September	0.43						0.42
October							
November		0.78	0.66	0.61	2.98	0.61	
December							
TOTAL	1.60	2.05	1.40	1.46	3.89	1.52	2.64
Irrigation:							
May	0.12						0.09
June	0.16	0.08	0.21	0.21	0.21	0.09	0.31
July		0.34	0.17	0.17	0.17	0.08	0.23
August		0.33	0.16	0.16	0.16	0.07	0.25
September	0.12	0.16	0.17	0.17	0.17	0.08	0.28
October	0.10	0.04					0.04
TOTAL	0.50	0.95	0.71	0.71	0.71	0.32	1.20

*Derived by weighting hours in Table 2 for small, average, and large farms by the proportion of total farms represented by the number of cash crop-irrigated farms with 200-750, 750-2,300, more than 2,300 crop acres respectively, in Kansas Farm Management Associations, S.W. and N.W.

Table 5. Derived Irrigation and Field-Labor Hour per Acre Standards on a Percentage Basis for Indicated Crops (Sprinkler Irrigation), Western Kansas, 1989

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflowers	Alfalfa hay
Derived Standards (%)							

Tillage-harvesting:							
January							
February							
March		9.80					
April		32.00		12.62	4.60	12.36	1.94
May		7.92	25.83	22.23	8.37	22.51	27.08
June	44.61	9.42	22.80	17.96	7.23	19.43	27.08
July	20.68				0.71	1.90	26.20
August	19.58						1.60
September	15.14						16.12
October							
November		40.86	51.37	47.19	79.10	43.80	
December							
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Irrigation:							
May	22.73						7.55
June	31.82	9.30	28.13	28.13	28.13	28.13	26.42
July		34.88	25.00	25.00	25.00	25.00	18.87
August		34.88	21.88	21.88	21.88	21.88	20.75
September	22.73	16.28	25.00	25.00	25.00	25.00	22.64
October	22.73	4.65					3.77
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 6. Derived Irrigation and Field-Labor Hour per Acre Standards on a Percentage Basis for Indicated Crops (Flood Irrigation), Western Kansas, 1989

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflower	Alfalfa hay
Derived Standards (%)							

Tillage-harvesting:							
January							
February							
March		9.11					
April		29.74		11.34	4.46	11.40	1.87
May		7.36	23.57	19.68	8.11	20.76	26.37
June	38.40	15.82	23.88	17.16	7.01	17.92	26.37
July	17.81		5.67	9.89	3.73	9.53	26.00
August	16.85						3.43
September	26.94						15.97
October							
November		37.98	46.88	41.92	76.70	40.39	
December		0.00					
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Irrigation:							
May	24.00						7.50
June	32.00	8.42	29.58	29.58	29.58	28.13	25.83
July		35.79	23.94	23.94	23.94	25.00	19.17
August		34.74	22.54	22.54	22.54	21.88	20.83
September	24.00	16.84	23.94	23.94	23.94	25.00	23.33
October	20.00	4.21					3.33
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00

 *Derived by weighting irrigation and field-labor hour per acre for sprinkler (Table 3) and flood irrigation (Table 4) by .25 and .75, respectively.

Table 7. Tillage-Planting, Harvesting, Irrigation, and Indirect Labor Requirements per Acre for Indicated Crops (Sprinkler Irrigation), Western Kansas, 1989.

Crop	Small-sized farm					Average-sized farm				
	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total
Wheat	1.10	0.70	0.22	0.20	2.22	0.69	0.61	0.22	0.15	1.67
Corn	1.42	0.99	0.43	0.28	3.12	1.13	0.74	0.43	0.23	2.52
Soybeans	0.80	0.74	0.32	0.19	2.05	0.61	0.66	0.32	0.16	1.74
Grain sorghum	0.93	0.70	0.32	0.19	2.14	0.68	0.61	0.32	0.16	1.77
Sorghum silage	0.96	3.00	0.32	0.21	4.49	0.75	3.00	0.32	0.20	4.27
Sunflowers	0.96	0.70	0.32	0.20	2.17	0.75	0.61	0.32	0.17	1.84
Alfalfa hay	0.14	2.80	0.53	0.26	3.73	0.05	2.44	0.53	0.23	3.25
	Large-sized farm					Derived standards**				
Crop	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total
Wheat	0.56	0.54	0.22	0.13	1.45	0.76	0.61	0.22	0.16	1.76
Corn	0.77	0.66	0.41	0.18	2.02	1.13	0.78	0.43	0.23	2.56
Soybeans	0.45	0.57	0.32	0.13	1.47	0.62	0.66	0.32	0.16	1.76
Grain sorghum	0.40	0.54	0.32	0.13	1.38	0.69	0.61	0.32	0.16	1.78
Sorghum silage	0.70	2.91	0.32	0.20	4.13	0.79	2.98	0.32	0.20	4.30
Sunflowers	0.70	0.54	0.32	0.16	1.71	0.79	0.61	0.32	0.17	1.89
Alfalfa hay	0.05	2.22	0.53	0.21	3.01	0.07	2.48	0.53	0.23	3.32

*Indirect labor was derived as .10 (.05 for sorghum silage and .075 for alfalfa hay) times field-labor hours to account for accounting, management, attending meetings, marketing, using auto and pickup, and purchasing repair parts.

**Standard labor requirements were derived by weighting hours for small, average, and large farms by proportion of total farms represented by the number of cash crop-irrigated farms with 200-750, 750-2,300 and more than 2,300, crop acres respectively, in Kansas Farm Management Associations, S.W. and N.W.

Table 8. Tillage-Planting, Harvesting, Irrigation, and Indirect Labor Requirements per Acre for Indicated Crops (Flood Irrigation), Western Kansas, 1989.

Crop	Small-sized farm					Average-sized farm				
	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total
Wheat	1.23	0.70	0.50	0.19	2.62	0.99	0.61	0.50	0.16	2.25
Corn	1.59	0.99	0.95	0.26	3.78	1.27	0.74	0.95	0.20	3.16
Soybeans	0.91	0.74	0.71	0.16	2.52	0.73	0.66	0.71	0.14	2.23
Grain sorghum	1.10	0.70	0.71	0.18	2.68	0.83	0.61	0.71	0.14	2.29
Sorghum silage	1.13	3.00	0.71	0.21	5.05	0.90	3.00	0.71	0.19	4.80
Sunflowers	1.13	0.70	0.71	0.18	2.72	0.90	0.61	0.71	0.15	2.36
Alfalfa hay	0.21	2.76	1.20	0.22	4.39	0.16	2.39	1.20	0.19	3.94

Crop	Large-sized farm					Derived standards**				
	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total
Wheat	0.67	0.54	0.50	0.12	1.82	0.98	0.61	0.50	0.16	2.26
Corn	0.87	0.66	0.95	0.15	2.63	1.27	0.78	0.95	0.20	3.20
Soybeans	0.60	0.57	0.71	0.12	2.00	0.75	0.66	0.71	0.14	2.25
Grain sorghum	0.60	0.54	0.71	0.09	1.94	0.85	0.61	0.71	0.14	2.32
Sorghum silage	0.65	2.91	0.71	0.18	4.45	0.91	2.98	0.71	0.19	4.79
Sunflowers	0.65	0.54	0.71	0.12	2.02	0.91	0.61	0.71	0.15	2.38
Alfalfa hay	0.13	2.40	1.20	0.19	3.92	0.16	2.48	1.20	0.20	4.04

*Indirect labor was derived as .10 (.05 for sorghum silage and .075 for alfalfa hay) times field-labor hours to account for accounting, management, attending meetings, marketing, using auto and pickup, and purchasing repair parts.

**Standard labor requirements were derived by weighting hours for small, average, and large farms by proportion of total farms represented by the number of cash crop-irrigated farms with 200-750, 750-2,300 and more than 2,300, crop acres respectively, in Kansas Farm Management Associations, S.W. and N.W.

Table 9. Derived Irrigation and Field-Labor Hour per Acre Standards for Indicated Crops (Irrigation), Western Kansas, 1989*

MONTHS	Wheat	Corn	Soybeans	Grain Sorghum	Sorghum Silage	Sunflower	Alfalfa hay**

Derived Standards							

Tillage-harvesting:							
January							
February							
March		0.19					
April		0.61		0.17	0.17	0.17	0.05
May		0.15	0.33	0.29	0.32	0.32	0.70
June	0.61	0.29	0.32	0.25	0.27	0.27	0.70
July	0.28		0.06	0.11	0.12	0.12	0.68
August	0.27						0.08
September	0.38						0.42
October							
November		0.78	0.66	0.61	2.98	0.61	
December							
TOTAL	1.54	2.01	1.37	1.42	3.86	1.49	2.62
Irrigation:							
May	0.10						0.08
June	0.14	0.07	0.18	0.18	0.18	0.09	0.27
July		0.29	0.15	0.15	0.15	0.08	0.20
August		0.29	0.14	0.14	0.14	0.07	0.22
September	0.10	0.14	0.15	0.15	0.15	0.08	0.24
October	0.09	0.04					0.04
TOTAL	0.43	0.82	0.61	0.61	0.61	0.32	1.03

*Derived by weighting irrigation and field-labor hour per acre for sprinkler (Table 3) and flood irrigation (Table 4) by .25 and .75, respectively.

Table 10. Tillage-Planting, Harvesting, Irrigation, and Indirect Labor Requirements per Acre for Indicated Crops (Irrigation), Western Kansas, 1989.

Crop	Small-sized farm					Average-sized farm				
	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total
Wheat	1.20	0.70	0.43	0.20	2.52	0.91	0.61	0.43	0.16	2.11
Corn	1.55	0.99	0.82	0.26	3.62	1.24	0.74	0.82	0.21	3.00
Soybeans	0.89	0.74	0.61	0.17	2.40	0.70	0.66	0.61	0.14	2.11
Grain sorghum	1.06	0.70	0.61	0.18	2.55	0.79	0.61	0.61	0.15	2.16
Sorghum silage	1.09	3.00	0.61	0.21	4.91	0.86	3.00	0.61	0.20	4.67
Sunflowers	1.09	0.70	0.61	0.19	2.58	0.86	0.61	0.61	0.15	2.23
Alfalfa hay	0.19	2.77	1.03	0.23	4.23	0.13	2.41	1.03	0.20	3.77
	Large-sized farm					Derived standards**				
Crop	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total	Tillage-Planting	Harvesting	Irrigation	Indirect*	Total
Wheat	0.64	0.54	0.43	0.12	1.73	0.93	0.61	0.43	0.16	2.13
Corn	0.85	0.66	0.82	0.16	2.48	1.24	0.78	0.82	0.21	3.04
Soybeans	0.56	0.57	0.61	0.12	1.86	0.72	0.66	0.61	0.15	2.13
Grain sorghum	0.55	0.54	0.61	0.10	1.80	0.81	0.61	0.61	0.15	2.18
Sorghum silage	0.67	2.91	0.61	0.18	4.37	0.88	2.98	0.61	0.20	4.67
Sunflowers	0.67	0.54	0.61	0.13	1.94	0.88	0.61	0.61	0.16	2.26
Alfalfa hay	0.11	2.36	1.03	0.19	3.69	0.14	2.48	1.03	0.21	3.86

*Derived by weighting tillage-planting, harvesting, irrigation and indirect labor requirements per acre for sprinkler (Table 7) and flood irrigation (Table 8) by .25 and .75, respectively.

Table 11. Estimated Field-Labor Hours* per Acre for Indicated Crops (Dryland),
Small, Average, and Large Farms, Western Kansas, 1989**

MONTHS	Wheat	Grain Sorghum	Alfalfa hay	MONTHS	Wheat	Grain Sorghum	Alfalfa hay
Small-sized farm				Average-sized farm			
-----				-----			
January				January			
February				February			
March				March			
April	0.14			April	0.09		
May		0.28	0.74	May		0.21	0.67
June	0.58	0.12	0.74	June	0.51	0.09	0.67
July		0.24	0.74	July		0.24	0.67
August	0.41	0.14	0.11	August	0.31		0.06
September	0.18		0.45	September	0.09		0.41
October	0.09			October	0.04		
November		0.74		November		0.66	
December				December			
TOTAL	1.39	1.51	2.78	TOTAL	1.04	3.70	2.50

Table 11. Estimated Field-Labor Hours* per Acre for Indicated Crops (Dryland), Small, Average, and Large Farms, Western Kansas, 1989** (Continued)

MONTHS	Wheat	Grain Sorghum	Alfalfa hay	MONTHS	Wheat	Grain Sorghum	Alfalfa hay
Large-sized farm				Derived Standards ***			
-----				-----			
January				January			
February				February			
March				March			
April	0.08			April	0.10		
May		0.17	0.64	May		0.22	0.68
June	0.45	0.06	0.64	June	0.51	0.09	0.68
July		0.18	0.64	July		0.23	0.68
August	0.26		0.06	August	0.32	0.03	0.07
September	0.06		0.39	September	0.10		0.41
October	0.03			October	0.05		
November		0.54		November		0.65	
December				December			
TOTAL	0.88	0.94	2.39	TOTAL	1.09	1.22	2.54
-----				-----			

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*Field-labor hours were computed by multiplying total machine hours-field time--by 1.20 to reflect the additional time required for traveling to and from the field, adjusting equipment, maintenance, lubrication, etc.

**Estimates are for 1989 using best sources available supplemented by actual farm information, although previous years' experiences would influence estimates.

New Labor Standards

Table 14 shows new and previous labor standards for irrigated and dryland crops and percentage changes. The new labor standards were 10.23 to 28.76 percent less than previous standards for irrigated crops and 4.00 to 24.58 percent less for dryland crops. The large differences were even more significant in that only 78.15 percent of the derived labor standards reflects field time.

ACCURACY OF NEW CROP LABOR STANDARDS

A representative farm (25 beef cows, 115 feeder cattle, 1,532 tillable acres, 1.06 operators, 1,540 hired-labor hours, and 373 acres of custom harvest, as noted in Table 15) was formulated from the records of Farm Management Association, S.W. and N.W. farms to test the accuracy of the new, crop-labor standards.⁵

Total operator labor available per man per month was assumed to be 210 hours. That is probably too many hours considering the number of good field workdays available each month. Because only 78.15 percent of the new crop-labor standards reflects actual field time, then 164.12 hours of every 210 hours available must be spent in field operations. Given a 10-hour day, weather and soil moisture conditions would need to permit 16.41 days of every month for field work. In addition, labor requirements for feeder cattle were removed primarily from operator labor hours, November through March, to leave more time for crop work (Table 15).

Operator and full-time hired labor available for crop enterprises is shown in Table 15. Using the new labor standards and monthly percentages, hours required each month to handle crop production on the representative farm were computed. We used the difference between "hours required" and those "available" as deficit labor hours.

If crop-labor standards represent actual field conditions, then the total crop labor used to handle production on a given farm must be similar to the labor required as computed from the labor standards. Using the new labor standards, total deficit operator and full-time hired labor hours were 60, or a 230-hour surplus with 290 hours of part-time hired labor available. Such a surplus is minor because the number of good workdays used was optimistic.

⁵The representative farm was derived from the 1988 average net income farms in the Farm Management Associations, S.W. and N.W. Larry N. Langemeier, "The Annual Report, Management Information, 1988," Department of Agricultural Economics, Cooperative Extension Service, Kansas State University, Manhattan, Kansas 66506.

Table 12. Derived Field-labor-hour Standards on a Percentage Basis
for Indicated Crops (Dryland), Western Kansas
1989

MONTHS	Wheat	Grain Sorghum	Alfalfa hay
Derived Standards % -----			
January			
February			
March			
April	9.16		
May		17.91	26.92
June	47.03	7.61	26.92
July		18.57	26.92
August	29.59	2.53	2.95
September	9.52		16.29
October	4.69		
November		53.39	
December			
TOTAL	100.00	100.00	100.00

Table 13. Tillage-planting, Harvesting, and Indirect Labor Requirements per Acre for Indicated Crops (Dryland), Western Kansas, 1989.

Crop	Small-sized farm				Average-sized farm			
	Tillage-Planting	Harvesting	Indirect*	Total	Tillage-Planting	Harvesting	Indirect*	Total
Wheat	0.82	0.58	0.14	1.53	0.53	0.51	0.10	1.14
Grain sorghum	0.74	0.74	0.15	1.62	0.66	0.66	0.13	1.44
Alfalfa hay	0.11	2.67	0.21	2.99	0.06	2.43	0.06	2.56

Crop	Large-sized farm				Derived standards**			
	Tillage-Planting	Harvesting	Indirect*	Total	Tillage-Planting	Harvesting	Indirect*	Total
Wheat	0.43	0.45	0.09	0.96	0.58	0.51	0.11	1.20
Grain sorghum	0.40	0.54	0.09	1.04	0.63	0.65	0.13	1.41
Alfalfa hay	0.06	2.32	0.18	2.56	0.07	2.46	0.12	2.66

*Indirect labor was derived as .10 (.075 for alfalfa hay) times field labor hours to account for accounting, management, attending meetings, marketing, using auto and pickup, and purchasing repair parts.

**Standard labor requirements were derived by weighting hours for small, average, and large farms by the proportion of total farms represented by the number of cash crop-dryland farms with 200-750, 750-2300, and more than 2,300 crop acres, respectively, in Kansas Farm Management Associations, S.W. and N.W.

Table 14. New (1989) and Previous Labor Standards per Acre
for Indicated Crops (Irrigated and Dryland), Western Kansas

Crop enterprise	Sprinkler irrigation	Flood Irrigation	New irrigation Standard	Previous irrigation standard*	Change
Irrigation:	(hour)	(hour)	(hour)	(hour)	(%)
Wheat	1.86	2.26	2.13	2.50	-14.80
Corn	2.59	3.20	3.04	3.44	-11.63
Soybeans	1.81	2.30	2.13	2.96	-28.04
Grain sorghum	1.60	2.32	2.18	3.06	-28.76
Sorghum silage	4.30	4.79	4.67	5.21	-10.36
Sunflowers	1.89	2.30	2.26	0.00	0.00
Alfalfa hay	3.31	4.04	3.86	4.30	-10.23

Crop enterprise	New dryland standard	Previous dryland standard*	Change
Dryland:	(hour)	(hour)	(%)
Wheat	1.20	1.25	-4.00
Grain sorghum	1.35	1.79	-24.58
Alfalfa hay	2.78	2.78	0.00

*Orlan H. Buller, Larry N. Langemeier, and John L. Kasper, "Labor Requirements of Western Kansas Irrigated and Dryland Crops", Contribution No. 591, Department of Agricultural Economics, Kansas State University, Manhattan, Kansas.

Table 15. Labor Requirements for a Representative Farm
Using New Crop-Labor Standards, Western Kansas

Representative Farm*

Livestock (head):

Beef Cows 25.0
Beef Feeders 115.0

Labor available (hours):

Operator 2,650 (1.06 men)
Hired labor 1,250
Part-time labor 290

Crops (acres):

	<u>Irrigated</u>	<u>Dryland</u>
Wheat	87	441
Corn	103	---
Grain sorghum	47	81
Soybeans	30	---
Sorghum silage	13	---
Alfalfa hay	26	40
Summer fallow	<u>69</u>	<u>595</u>
Total crop acres	375	1157

Custom harvest (acres):

Wheat 270
Corn 103

Month	Operator labor hours**	Hired Labor employee hours	Available labor hours	<u>New standards</u>	
				Hours required	Deficit hours
January	94	105	199	0	0
February	94	105	199	0	0
March	94	105	199	22	0
April	146	105	251	129	0
May	146	105	251	129	0
June	146	105	251	285	34
July	146	105	251	155	0
August	146	105	251	276	25
September	146	105	251	166	0
October	146	105	251	50	0
November	94	105	199	147	0
December	94	105	199	0	0
Deficit labor hours					60
Part-time labor hours available					290
Surplus (deficit) labor hours					230

*Operator labor per man was assumed to be 210.0 hours per month. One half-time employee was assumed because of the large hired labor expense, and part-time labor would not be available throughout the year for that many hours. Part-time hired labor hours were calculated using a \$6.00 per hour wage rate. Custom work for crops was assumed to be 90.0 percent of machine hire, with custom work allocated to wheat and corn harvest.

**Livestock labor requirements were removed from operator labor hours as follows: 60.0 percent of feeder cattle labor requirements (7.2 hours per head) allocated to November through March with the remaining 40.0 percent allocated to the other seven months; beef cow labor requirements (8.0 hours per cow) were allocated evenly to each month.

SUMMARY

A computerized machinery investment generator program only approximates irrigation labor and machine hours for the tilling, planting, and harvesting operations a crop requires. But the new crop-labor standards computed using the technique--4.0 to 28.76 percent below those previously used--compared favorably with labor used on the representative farm.

A total of 21.85 percent of the labor time was used for repairs, lubrication, accounting, management, etc. Undoubtedly, nonfield hours are influenced by size and type of farm operation, so the percentage likely would not be the same for different sized farms. Additional study of nonfield hours per crop acre is required.

APPENDIX TABLES

Table 1. Machinery Size and Operation per Acre for Winter Wheat
(Dryland) Western Kansas, 1989*

Machine	Machine Size			Times over	Months
	Small farm	Average farm	Large farm		
Sweep	20 ft.	30 ft.	35 ft.	2.00 1.00	Aug** Apr
NH3 application	20 ft.	30 ft.	35 ft.	1.00	Aug
Drill / fertilizer	13.33 ft.	26.66 ft.	40 ft.	.67 .33	Sept Oct
Combine, self-prop.	20 ft.	24 ft.	30 ft.	1.00	June
Two trucks***	.34	.31	.29		June
Tractor	120 h.p.	150 h.p.	225 h.p.		
Tractor	70 h.p.	125 h.p.	150 h.p.		

* Additional machine operations for summer fallow land included.
 ** The August sweep operations apply to summer fallow wheat only.
 *** Hours per acre.

Table 2. Machinery Size and Operation per Acre for Winter Wheat
(Sprinkler and Flood Irrigation), Western Kansas, 1989

Machine	Machine Size			Times over	Months
	Small farm	Average farm	Large farm		
Twisted shank	12 ft.	16 ft.	25 ft.	1.00	July
Tandem disk	16 ft.	21 ft.	32 ft.	1.00	July
NH3 application knife	12 ft.	16 ft.	25 ft.	1.00	Aug
Dry fert. spreader	50 ft.	50 ft.	50 ft.	1.00	Aug
Disk tandem	20 ft.	30 ft.	35 ft.	1.00	Sept
Drill	13.33 ft.	26.66 ft.	40 ft.	1.00	Sept
Bed shaper*	18 ft.	21 ft.	30 ft.	1.00	Sept
Combine, self-prop.	20 ft.	24 ft.	30 ft.	1.00	June
Two trucks**	.46	.41	.38		June
Tractor	120 h.p.	150 h.p.	225 h.p.		
Tractor	70 h.p.	125 h.p.	150 h.p.		

* Additional operation for flood irrigation.

** Hours per acre.

Table 3. Machinery Size and Operation per Acre for Corn (Sprinkler and Flood Irrigation), Western Kansas, 1989

Machine	Machine Size			Times over	Months
	Small farm	Average farm	Large farm		
Stalk shredder	14 ft.	14 ft.	14 ft.	1.00	Nov
Tandem disk	16 ft.	21 ft.	32 ft.	1.00	Nov
Dry fert. spreader	50 ft.	50 ft.	50 ft.	1.00	Nov
NH3 application, knife	12 ft.	16 ft.	25 ft.	1.00	Nov
Field cultivator	20 ft.	30 ft.	35 ft.	1.00	Apr
Planter	15 ft.	20 ft.	30 ft.	.50 .50	Apr May
Row cultivator	15 ft.	20 ft.	30 ft.	1.00	June
Bed shaper*	18 ft.	21 ft.	30 ft.	1.00	June
Combine, self-prop.	15 ft.	20 ft.	30 ft.	1.00	Nov
Two trucks**	.65	.50	.50		Nov
Tractor	120 h.p.	150 h.p.	225 h.p.		
Tractor	70 h.p.	125 h.p.	150 h.p.		

* Additional operation for flood irrigation.

** Hours per acre.

Table 4. Machinery Size and Operation per Acre for Soybeans (Sprinkler and Flood Irrigation), Western Kansas, 1989

Machine	Machine Size			Times over	Months
	Small farm	Average farm	Large farm		
Tandem disk-spike-tooth	16 ft.	21 ft.	32 ft.	1.00	May
Dry fert. spreader	50 ft.	50 ft.	50 ft.	.50 .50	May June
Field cultivator	20 ft.	30 ft.	35 ft.	1.00	May
Planter	15 ft.	20 ft.	30 ft.	.50 .50	May June
Row cultivator	15 ft.	20 ft.	30 ft.	1.00	June
Bed shaper*	18 ft.	21 ft.	30 ft.	.50 .50	June July
Combine, self-prop.	20 ft.	24 ft.	30 ft.	1.00	Nov
Two trucks**	.50	.46	.41		Nov
Tractor	120 h.p.	150 h.p.	225 h.p.		
Tractor	70 h.p.	125 h.p.	150 h.p.		

* Additional operation for flood irrigation.

** Hours per acre.

Table 5. Machinery Size and Operation per Acre for Grain Sorghum
(Dryland), Western Kansas, 1989*

Machine	Machine Size			Times over	Months
	Small farm	Average farm	Large farm		
Sweep	20 ft.	30 ft.	35 ft.	1.00	July
NH3 application				1.00	Oct
				1.00	March
				1.00	May
Planter	15 ft.	20 ft.	30 ft.	.50	May
				.50	June
Row cultivator	15 ft.	20 ft.	30 ft.	1.00	July
Combine, self-prop.	20 ft.	24 ft.	30 ft.	1.00	Nov
Two trucks**	.50	.46	.38		Nov
Tractor	120 h.p.	150 h.p.	225 h.p.		
Tractor	70 h.p.	125 h.p.	150 h.p.		

* Additional machine operations for summer fallow land included.

** Hours per acre.

Table 6. Machinery Size and Operations per Acre for Grain Sorghum
(Sprinkler and Flood Irrigation), Western Kansas, 1989

Machine	Machine Size			Times over	Months
	Small farm	Average farm	Large farm		
Tandem disk	16 ft.	21 ft.	32 ft.	1.00	April
Dry fert. spreader	50 ft.	50 ft.	50 ft.	.50 .50	April May
Anhy. applicat./sweep	20 ft.	30 ft.	35 ft.	1.00	May
Field cultivator	20 ft.	30 ft.	35 ft.	1.00	May
Planter	15 ft.	20 ft.	30 ft.	.50 .50	May June
Row cultivator	15 ft.	20 ft.	30 ft.	1.00	June
Bed shaper*	18 ft.	21 ft.	30 ft.	1.00	July
Combine, self-prop.	20 ft.	24 ft.	30 ft.	1.00	Nov
Two trucks**	.46	.41	.38		Nov
Tractor	120 h.p.	150 h.p.	225 h.p.		
Tractor	70 h.p.	125 h.p.	150 h.p.		

* Additional operation for flood irrigation.

** Hours per acre.

Table 7. Machinery Size and Operations per Acre for Sunflowers
(Sprinkler and Flood Irrigation), Western Kansas, 1989

Machine	Machine Size			Times over	Months
	Small farm	Average farm	Large farm		
Tandem disk	16 ft.	21 ft.	32 ft.	1.00	April
Dry fert. spreader	50 ft.	50 ft.	50 ft.	.50 .50	April May
NH3 applic./sweep	20 ft.	30 ft.	35 ft.	1.00	May
Field cultivator	20 ft.	30 ft.	35 ft.	1.00	May
Planter	15 ft.	20 ft.	30 ft.	.50 .50	May June
Row cultivator	15 ft.	20 ft.	30 ft.	1.00	June
Bed shaper*	18 ft.	21 ft.	30 ft.	1.00	July
Combine, self-prop.	20 ft.	24 ft.	30 ft.	1.00	Nov
Two trucks**	.46	.41	.38		Nov
Tractor	120 h.p.	150 h.p.	225 h.p.		
Tractor	70 h.p.	125 h.p.	150 h.p.		

* Additional operation for flood irrigation.

** Hours per acre.

Table 8. Machinery Size and Operations per Acre for Sorghum Silage
(Sprinkler and Flood Irrigation), Western Kansas, 1989

Machine	Machine Size			Times over	Months
	Small farm	Average farm	Large farm		
Tandem disk	6 ft.	21 ft.	32 ft.	1.00	April
Dry fert. spreader	50 ft.	50 ft.	50 ft.	.50 .50	April May
NH3 applic./sweep	20 ft.	30 ft.	35 ft.	1.00	May
Field cultivator	20 ft.	30 ft.	35 ft.	1.00	May
Planter	15 ft.	20 ft.	30 ft.	.50 .50	May June
Row cultivator	15 ft.	20 ft.	30 ft.	1.00	June
Bed shaper*	18 ft.	21 ft.	30 ft.	1.00	July
Silage cutter	6 ft.	6 ft.	6 ft.	1.00	Nov
Four trucks	1.6	1.6	1.6		Nov
Silage packer* (Small tractor)	.18	.18	.18		Nov
Tractor	120 h.p.	150 h.p.	225 h.p.		
Tractor	70 h.p.	125 h.p.	150 h.p.		

* Additional operation for flood irrigation.

** Hours per acre.

Table 9. Machinery Size and Operations per Acre for Alfalfa Hay
(Sprinkler and Flood Irrigation), Western Kansas, 1989

Machine	Machine Size			Times over*	Months
	Small farm	Average farm	Large farm		
Tandem disk	16 ft.	21 ft.	32 ft.	.20 .20	July Aug
Land plane**	18 ft.	21 ft.	21 ft.	.20	Aug
Drill	13.33 ft.	26.66 ft.	30 ft.	.20	Aug
Dry fert. spreader	50 ft.	50 ft.	50 ft.	1.00	April
Swather, self-prop	14 ft.	16 ft.	16 ft.	1.00 1.00 1.00 .60	May June July Sept
Baler-PTO				1.00 1.00 1.00 .60	May June July Sept
Sack wagon	14 ft.	14 ft.	16 ft.	1.00 1.00 1.00 .60	May June July Sept
Stacking oper'ions***	.21 .21 .21 .13	.21 .21 .21 .13	.18 .18 .18 .11		May June July Sept
Tractor	120 h.p.	150 h.p.	225 h.p.		
Tractor	70 h.p.	125 h.p.	150 h.p.		

* Times over for tillage operations pro-rated share over a 5-year period.

** Additional operation for flood irrigation.

*** Hours per acre

