PROCEEDINGS

48th Annual Meeting

WESTERN AGRICULTURAL ECONOMICS ASSOCIATION

Reno, Nevada

July 20, 21, 22, 1975

William D. Gorman, Editor

IMPACT OF ADOPTION OF FOUR-WHEEL DRIVE 140 HP AND LARGER TRACTORS BY DRYLAND GRAIN FARMERS IN SOUTHEAST WASHINGTON

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Washington State University

For several years the farm machinery industry magazine *Implement and Tractor* has pointed to an increase in the horsepower of tractors sold in the United States.[1] As farms have become larger, farmers have apparently demanded larger tractor units to insure continued timeliness of field operations. *Implement and Tractor* defines a 4-wheel drive tractor as "one that has all four driving wheels of the same size tires."[2] This eliminates from the statistics those two wheel tractors with 4-wheel drive as an optional drive. The trend is clearly to a four wheel tractor for horsepower in the 140 plus range.

There are apparently several reasons for farmers to go to 4-wheel drive tractors at the larger horsepower. One of these is to increase the traction efficiency. As horsepower increases in 2-wheel drive units, so does the wheel slippage; the slippage can be practically eliminated by going to 4-wheel drives as defined above. Another reason is the move to minimum tillage equipment which, because of greater draft, requires more horsepower for timely operation.

The movement to larger tractors poses several questions which have a potential for changing the structure of the farm industry. Among the more important of these are:

1. What happens to the cost structure of the farm when a 140 Hp plus 4-wheel drive tractor is incorporated into the farm machinery inventory?

2. Is there a greater potential for increasing the size of the farm unit with the 4-wheel drive tractor than would be the case with a conventional tractor?

This paper is addressed to both of these questions with specific reference to Southeastern Washington dryland grain farms.

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[1]Implement and Tractor 1968-1973 Annual Survey of Tractor Hp.

[2]Charles S. Floyd, "Four-Wheel Drive Tractors: How Many and Why," *Implement and Tractor.* May 7, 1970, p. 26.

Economies Associated with 4-Wheel Drive Tractors

An illustration of the economies available as tractor size increases appears in Tables 1, 2, and 3. The tables compare seven sizes of tractors with farm sizes increasing in 100 acre increments. Table 1 shows the total labor requirement for the same farm sizes while Table 2 shows the moldboard plow sizes required to provide the primary tillage on these wheat-pea-fallow farms. Table 3 shows the total machinery costs per acre associated with the seven tractors. In each table the primary constraint on farm size is the number of hours available for the primary tillage operation. The time available for plowing was assumed to be 300 hours. No effort was made to apply time constraints to the other operations.

For all tractor sizes machinery costs per acre decrease up to the acreage size limit as expected. Also as expected the total hours of labor required increase as size increases up to the acreage size limit. These relationships are shown in Tables 1 and 3. Table 2 shows the moldboard plow size associated with each tractor size and each acreage size. As can be seen from Table 2, small farms of the type illustrated in these tables require the same plow size regardless of tractor size. As calculated, the 4-bottom plow is suitable for farming up to 800 acres on a wheat-pea-fallow farm where no more than 75 percent of the ground is plowed each year. Using Table 3 it is possible to illustrate the economies associated with large tractors. From Table 2 it can be observed that a 70 dbhp tractor pulling a 4-bottom plow will handle 800 acres assuming 300 hours available for plowing. A 168 dbhp tractor using the same 4-bottom plow will handle 1100 acres in the same time period. From Table 3 we can see that at 800 acres the 168 dbhp tractor has a higher machinery cost associated with it than the smaller tractor. The cost per acre of operating the larger tractor does not go below that of the smaller tractor on 800 acres until approximately 1100 acres are covered. At that point

Table 1. Hours of labor required by tractor size and farm size, Southeastern Washington farms with a wheat-pea-fallow rotation

Size of Farm	70 dbhp	90 dbhp	125 dbhp	146 dbhp	168 dbhp	228 dbhp	262 dbhp
acres	hrs	hrs	hrs	hrs	hrs	hrs	hrs
400	594	588	469	420	430	373	314
500	744	735	586	505	531	466	393
600	892	884	705	595	622	559	473
700	976	963	821	663	691	653	552
800	1085	1074	940	760	791	747	631
900	1052	1042	988	837	876	843	711
1000	1108	1093	1070	896	938	935	789
1100	1160	1139	1015	1083	1007	962	870
1200	1235	1229	1047	966	936	1049	950
1300	1262	1240	1117	1023	1061	1088	960
1400	1314	1291	1161	1102	1129	1028	1035
1500	*	1346	1244	1086	1080	1040	1082
1600		1283	1259	1200	1238	1096	1055
1700		1364	1274	1262	1302	1114	1058
1800		1381	1337	1245	1261	1179	1064
1900		1357	1294	1281	1318	1232	1108
2000		1381	1304	1217	1221	1282	1163
2100		1415	1335	1313	1303	1272	1171
2200		1464	1364	1324	1327	1293	1227
2300		*	1379	1313	1354	1351	1270
2400			1388	1372	1380	1272	1278
2500			*	1399	1335	1278	1253
2600				1376	1384	1329	1303
2700				1353	1375	1361	1341
2800				1402	1420	1381	1305
2900				1428	1469	1400	1309
3000				1392	1415	1357	1305
3100				*	1444	1369	1320
3200					*	1377	1363
3300						1415	1376
3400						1456	1388
3500						1390	1345
3600						1407	1378
3700						1413	1383
3800						*	1382
3900							---
4000							---

the farmer must move to a larger plow. The economies are clear, the larger tractor enables the farmer to farm approximately 200 additional acres without changing implements at a slightly higher cost or approximately 300 additional acres at a slightly lower cost per acre. Beyond this further economies are available with larger implements.

Diseconomies with the larger tractor are also clear. Purchasing a larger tractor to use on the same size farm may lead to significantly higher per acre costs if all costs are charged against the enterprise. Savings are available in labor costs using the larger tractor and the time saved may be critical. However, if the size of implements used on the farm are matched to the tractor and to a known time constraint, the farmer replacing a small tractor with a larger tractor may be buying excess machinery capacity; an excess capacity that has a high cost per acre associated with it. For example, taking the same 800 acre farm the move to the larger tractor without a subsequent move to a larger farm size will cost the farmer $3.98 per acre in machinery cost. The labor savings of 294 hours per year may have a significant bearing on the purpose of the larger tractor; however, in dollar terms the potential savings of $1.47 per acre for labor at $4.00 per hour hardly compensates for the $3.98 per acre lost in other machinery costs. This cost can be recovered only by moving to a larger farm size.

The extent of economies that are potentially available with large tractors is evident from the data calculated for other crop rotations used in Southeastern Washington. In each situation the larger tractor can be shown to be capable of handling a larger acreage at a lower labor cost than the smaller tractor.

In 1969 the average farm size cropland acreage in

Table 2. Moldboard plow sizes by tractor size and farm size, Southeastern Washington farms with a wheat-pea-fallow rotation

Size of Farm	70 dbhp	90 dbhp	125 dbhp	146 dbhp	168 dbhp	228 dbhp	262 dbhp
acres	bottoms						
400	4	4	4	4	4	4	4
500	4	4	4	4	4	4	4
600	4	4	4	4	4	4	4
700	4	4	4	4	4	4	4
800	4	4	4	4	4	4	4
900	5	5	4	4	4	4	4
1000	5	5	4	4	4	4	4
1100	6	6	5	4	4	4	4
1200	6	6	5	4	5	4	4
1300	7	7	5	5	5	4	4
1400	7	7	6	5	5	5	4
1500	*	8	6	5	6	5	4
1600		8	7	6	6	5	4
1700		8	7	6	6	6	5
1800		9	7	7	7	6	5
1900		10	8	7	7	6	5
2000		10	8	7	8	6	5
2100		11	9	8	8	7	6
2200		11	9	9	9	7	6
2300		*	10	9	9	7	6
2400			10	9	9	8	6
2500			*	9	10	8	7
2600				10	10	8	7
2700				11	11	9	7
2800				11	11	9	8
2900				12	11	10	8
3000				12	12	10	8
3100				*	12	10	9
3200					*	11	9
3300						11	9
3400						11	10
3500						11	10
3600						12	10
3700						12	10
3800						*	11
3900							11
4000							--

Whitman County, Washington was 835 acres. This compares to an average of 695 acres from a sample of ASCS records in this county of farm operators in 1965 and 924 acres for these same operators in 1975. This increase represents a growth of approximately 33 percent in the 10-year period 1966-1975. In that 10-year period 15 percent of the operators increased their farm operations an average of 743 acres from an average size of 623 acres to an average of 1366 acres. Projecting the size of the sample farms to 1985, the farm size increases to 1043 acres, a 10 percent increase. The analysis supports the widely held hypothesis that farms are getting larger. In 1975, 60 percent of the farm operators had farms larger than 500 acres; by 1985 this figure is expected to grow to 68 percent. The analysis of the sampled farms further indicates that 22 percent of the farmers will enlarge their farms in the projected period (1975-1985) and will increase their farm sizes by 792 acres to an average size of 1435 acres. Will purchasing a large 4-wheel drive tractor enhance the ability of farm operators to enlarge their farms? The data presented in Table 4 would suggest that farmers who purchase the larger 4-wheel drive tractors are in a position to expand their operation by 40 percent with the prospect of reducing costs per acre and with no additional implement purchases.

In the sample of farm operators 15 percent were not farming in 1966. Of the new entrants with farms larger than 800 acres, 14 percent are projected to have farms with acreage greater than 2,000 acres. The data presented in Table 1 would indicate that perhaps for the first time individuals can consider a 2000 acre farm as a one man farm in Southeastern Washington. Indeed, the very large tractors will theoretically allow one man to operate up to 2500 acres and do so using less than 1300 total hours of tractor time and less than 300 hours of time required for primary tillage.

Table 3. Machinery costs per acre by tractor size and farm size, Southeastern Washington farms with a wheat-pea-fallow rotation

Size of Farm	70 dbhp	90 dbhp	125 dbhp	146 dbhp	168 dbhp	228 dbhp	262 dbhp
acres	dollars						
400	41.79	47.44	51.92	36.03	49.27	53.22	54.17
500	36.30	41.11	44.75	31.31	42.39	45.60	45.05
600	32.61	36.79	39.81	27.92	37.67	40.38	39.68
700	29.78	33.59	36.10	25.58	34.37	36.56	35.81
800	27.70	31.18	33.23	23.68	31.68	33.67	32.87
900	25.97	29.11	30.96	22.22	29.58	31.39	30.54
1000	24.61	27.57	29.15	20.95	27.81	29.61	28.70
1100	23.38	26.09	27.43	20.03	26.47	27.96	27.14
1200	22.38	24.96	26.29	19.16	25.08	26.71	25.87
1300	21.53	23.89	25.09	18.28	24.00	25.52	24.65
1400	20.74	22.99	24.06	17.64	23.06	24.28	23.71
1500	*	22.15	23.21	17.07	22.19	23.44	22.84
1600		21.16	22.35	16.51	21.49	22.63	22.07
1700		20.58	21.64	16.04	20.87	21.79	21.10
1800		20.05	21.05	15.61	20.09	21.21	20.46
1900		19.41	20.13	15.21	19.59	20.64	19.88
2000		18.83	19.62	14.81	18.94	19.88	19.41
2100		18.43	19.14	14.33	18.13	19.47	18.79
2200		18.07	18.73	13.90	17.86	18.99	18.40
2300		*	18.38	13.75	17.47	18.64	18.00
2400			17.89	13.50	17.14	17.65	17.36
2500			*	13.34	16.66	17.39	17.03
2600				13.08	16.36	17.09	16.74
2700				12.81	16.01	16.80	16.45
2800				12.62	15.75	16.50	15.84
2900				12.47	15.54	16.21	15.39
3000				12.20	15.14	15.75	15.21
3100				*	15.03	15.50	14.95
3200					*	15.18	14.75
3300						14.97	14.51
3400						14.80	14.29
3500						14.43	13.92
3600						14.34	13.74
3700						13.91	13.56
3800						*	13.30
3900							13.15
4000							-----

Table 4. Equipment purchases required to move from an 800 acre farm using 70 dbhp crawler tractor to 1100 acres using a 168 dbhp 4-wheel drive on a Southeastern Washington farm with a wheat-pea-fallow rotation

Equipment required in rotation	New Purchases Yes	New Purchases No	Size of addition
Moldboard plow		X	
Offset disk		X	
Tandem disk		X	
Spiketooth harrow	X		5 feet
Springtooth harrow		X	
Center drive rodweeder		X	
Unitized weeder		X	
Disk drill		X	

CONCLUSIONS

Analysis of the economies of size associated with the large 4-wheel drive tractors in Southeastern Washington suggests the following general conclusions:

1. While economies of size are available with the large 4-wheel drive tractors farm operators may be purchasing excess tractor capacity and inadvertently excess machinery capacity when they acquire a new 4-wheel drive tractor.

2. The purchase of a 4-wheel drive tractor will enhance a farm operator's ability to enlarge his farm since he may do so with no further capital outlay for machinery.

3. The new 4-wheel drive tractors enable one operator to farm as much as 2000 acres within the constraint of less than 300 hours used for primary tillage and less than 1300 total tractor hours.

REPORTS AND MINUTES
WESTERN AGRICULTURAL ECONOMICS ASSOCIATION

Reno, Nevada

Committees of the
Western Agricultural Economics Association 1974-75

EXECUTIVE COMMITTEE

President	Walter R. Butcher
President-Elect	Harold O. Carter
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Past President	Albert N. Halter
Secretary-Treasurer	John E. Trierweiler

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William Gorman

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Nominations	A. N. Halter, Chairman John E. Trierweiler Walter Butcher William Martin Harold O. Carter

Business Committees (Cont.)

Journal Publications	Thomas Clevenger, Chairman Richard Clark Robert Young William Gorman
Council Restructuring	Gene Quenemoen, Chairman William Champney John Riley
Tellers	Craig Infanger, Chairman John E. Trierweiler
Local Arrangements Committee	William Champney, Chairman John McNeely, Jr. Richard Garrett

Minutes of the Meeting of the WAEA
Executive Committee
Reno, Nevada
July 20,1975

President Butcher called the meeting to order at 2:30 pm in room B Pioneer Auditorium, Reno, Nevada.

The following were in attendance:

W. Butcher,	President
A. Halter,	Past President
W. Gorman,	Editor
J. Trierweiler,	Secretary-Treasurer

President Butcher reviewed the agenda for the WAEA Business Meeting.

The Committee briefly discussed the suggestions of the ad hoc Committee on Journal publication. The appropriateness of changing the name of the association to reflect broader interest of the members was also discussed.

The question of time required for initial review and editing of papers was discussed by W. Gorman. It appeared that 4 - 6 months "free" time would be required, however Gorman pointed out that much of this could be accomplished by secretarial assistants.

Halter pointed out the need for a commitment from administrators of the institution publishing the proposed Journal.

Meeting adjourned at 3:00 pm.

Minutes of the Meeting of the WAEA Council
Reno, Nevada
July 20, 1975

President Butcher called the meeting to order at 3:10 pm. Those present were:

W. Butcher,	President
A. Halter,	Past President
H. Carter,	President-Elect
W. Gorman,	Editor
R. Firch,	Arizona
J. Riley,	Kansas
J. Thompson,	South Dakota
T. Manning,	Alberta
B. Godfrey,	Idaho
B. Beattie,	Texas
D. Menkhaus,	Wyoming
D. Cocheba,	Saskatchewan
J. McNeely, Jr.,	Nevada
E. Jensen,	British Columbia
D. Kraft,	Manitoba
W. Renberg,	Washington
G. Quenemoen,	Montana
D. Reed,	California
D. Anderson,	Nebraska
J. Johnson,	North Dakota
N. Patrick,	New Mexico
J. Wyckoff,	Oregon
J. Trierweiler,	Secretary-Treasurer

The Secretary-Treasurer's report was approved and accepted as presented.

Gorman reported the progress of the 1974 Proceedings. The 1974 Proceedings were mailed two weeks before the 1975 meetings. Carter suggested that more stringent rules be established as to the timing of paper submissions so that the printing and distribution of the Proceedings could be hastened. Gorman discussed some of the details that slowed up the Proceedings. It was decided that the editor could make requirements regarding page length for invited papers in order to hasten the Proceedings to the members.

Gorman as spokeman for the ad hoc Committee on Journal publication reported the recommendations of the Committee:
The following actions are recommended:

That the WAEA establish a journal to be called Western Journal of Agricultural Economics.

That the WAEA Council appoint an Editorial Committee, establishing who the officers should be and terms of membership.

That the Editorial Committee establish journal procedures concerning content, review of manuscripts and publication.

That the WAEA Council implement means of financing the journal.

After considerable discussion, Halter made the motion that the Council accept the report of the Committee on Journal publication and that the Council recommend to the membership the acceptance of the four recommendations in the ad hoc Report. Motion seconded and after lengthy discussion carried.

Firch moved to amend the motion of Halter to limit the proposed Journal of WAEA to one issue per year for the first two years rather than the biannual publication in ad hoc committee report. The amendment was seconded and passed. It was further recommended that the Council set forth some stringent policies relative to the publication of the Journal and that these would be submitted to the membership for a mail ballot in the near future.

Quenemoen reported the recommendation of the ad hoc committee on restructuring of the Council.

The following changes in the WAEA Constitution are recommended:

ARTICLE IV. OFFICERS

There shall be a President, a President-Elect, a Vice-President, an Editor, a Past President, a Secretary-Treasurer and four Directors. These shall constitute an Executive Committee with the Editor and the Secretary-Treasurer serving in a non-voting capacity. The Executive Committee shall have full power to. . .

. . . willingness of the nominees to serve if elected. A mail ballot for the purpose of electing a President–Elect, a Vice President, and two Directors shall be conducted by . . .

ARTICLE V. COUNCIL

The Council shall consist of the elected officers, and, in addition, one member from each of the nineteen Western States and four Provinces. Such members as represent the States and Provinces shall be selected by the members of each of the several States and Provinces. The Council member . . . appoint a member from such a state.

At the annual meeting, the Council shall nominate four Directors from the current membership of the Council. Two Directors shall be elected to serve a two-year term by the general membership as outlined in ARTICLE IV.

Quenemoen moved that the Council recommend to the membership that the above changes be made in the WAEA constitution. Motion seconded by Thompson and carried by voice vote.

Patrick moved that a committee be formed to update the WAEA constitution incorporating new operating procedures and amendments that have been passed since it was last published in 1968. Motion seconded by Halter and carried by voice vote.

Future meetings of WAEA are scheduled as follows:

1976 - Fort Collins, CO, July 18 - 20
1977 - San Diego (joint AAEA - WAEA)

Minutes of the Annual Business Meeting of WAEA
Reno, Nevada
July 22, 1975

President Walter Butcher called the meeting to order at 8:30 AM.

A motion passed that the minutes of the 1974 annual meeting of WAEA and the financial report be accepted as submitted by the Secretary-Treasurer. Motion seconded and passed.

SECRETARY–TREASURER'S REPORT

Part 1 – Finances

Financial Statement for Calendar Year 1974

Cash on Hand, January 1, 1974		$1,412.07
Receipts:		
Membership Dues	$ 2,346.00	
Proceedings Sales	37.45	
Contributing Members	50.00	
Excess 1974 Meeting Funds	750.00	$3,183.45
		$4,595.52
Expenditures:		
1974 Awards Program	$ 266.69	
Postage	128.71	
Stationary Supplies	120.25	
Speaker Expense 74 Program	450.59	
Miscellaneous	12.00	$ 978.24
Transfer to Savings		$2,255.00
Cash on Hand – Checking Account – December 31, 1974		$1,362.29
Savings Account Balance – January 1, 1974		$4,444.76
Transferred from Checking Account		$2,255.00
Interest Received		$ 299.32
Savings Account Balance – December 31, 1974		$6,999.08

Part II – Memberships

Calendar Year Totals 1968 - 786; 1969 - 715; 1970 - 702; 1971 - 578; 1972 - 471; 1973 - 464; 1974-438

1974 Membership by States or Provinces and Type of Member

State or Provinces	Junior Member	Regular Member	Total Members
13 Western States			
Alaska	--	4	4
Arizona	1	19	20
California	2	69	71
Colorado	--	19	19

State or Provinces	Junior Member	Regular Member	Total Members
Hawaii	-	8	8
Idaho	-	13	13
Montana	1	18	19
Nevada	1	5	6
New Mexico	1	11	12
Oregon	4	25	29
Utah	-	16	16
Washington	8	37	45
Wyoming	-	13	13
Total	18	257	275
6 Plains States			
Kansas	-	4	4
Nebraska	-	12	12
North Dakota	-	6	6
Oklahoma	-	11	11
South Dakota	-	7	7
Texas	1	20	21
Total	1	60	61
4 Canadian Provinces			
Alberta	-	11	11
British Columbia	-	-	-
Manitoba	1	1	2
Saskatchewan	-	1	1
Total	1	13	14
D.C., Maryland & Virginia	-	43	43
Other States	-	36	36
Other Countries	-	9	9
Total	-	88	88
Grand Total	20	418	438

The Editor's report was presented and accepted by voice vote of the membership.

Eugene Quenmoen reported the recommendation of the Council that the membership vote to make the changes in the WAEA constitution proposed by the ad hoc committee on restructuring the Council. Motion seconded, and after some discussion motion carried by a show of hands, and the WAEA Constitution was changed as proposed.

The Recommendation of the Council to the membership to accept the four recommendations as amended of the ad hoc Committee on the Journal Publication was reported by Walter Butcher. William Gorman further explained the recommendations and the Council amendment to the Report.

Following the Council's recommended procedure a motion was made by Albert Halter, that the ad hoc Committee on establishment of a journal be continued and that they spell out editorial policies and financial arrangements for a journal. That the Secretary-Treasurer prepare a ballot, with the options of establishing or not establishing a journal, to be sent out to all paid up members for a mail vote. The option with the majority of votes will be adopted. Motion seconded and carried.

Motion was made that the minutes of the association show our appreciation to the Division of Agricultural and Resource Economics, and the University of Nevada, Reno for the excellent arrangements they made for the 1975 WAEA meetings and to the City of Reno for the fine facilities and excellent hospitality that they provided. Also that the President be instructed to convey appreciation and thanks to the individuals and organizations involved. Motion seconded and carried.

Richard McConnen on behalf of Montana State University extended an invitation to the association to host and provide facilities for the 1978 Annual Meeting of WAEA.

E. Cabacungan made motion that a placement bureau be established at future WAEA meetings. Motion referred to the Executive Committee.

Craig Infanger reported for the Tellers Committee. The new officers were President-Elect William Martin and Vice President Norman Whittlesey.

New officers were sworn in by President Walter Butcher. President, Harold Carter; Past President, Walter Butcher; President-Elect, William Martin; Vice President, Norman Whittlesey; Secretary-Treasurer, Jack Trierweiler; and Editor, William Gorman.

Melvin Jansen reported to the membership on behalf of the AAEA National Employment Service.

President Carter adjourned the Business Meeting at 9:45 a.m.

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