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How to analyze an investment in farmland
WREP 34
HOW TO ANALYZE AN INVESTMENT IN FARMLAND

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Introduction

This publication shows how to analyze a proposed investment in additional farmland. The methods discussed can help determine these points: (1) the value of additional land to the investor, and (2) the maximum price an investor can pay for additional land, given the cash available to make payments on added real estate debt and a specified downpayment. Worksheets are provided for both purposes.

The land purchase decision is unique among the numerous business problems that farmers must resolve. It is unique because it usually involves considerable capital and happens infrequently. Farmers who have little or no experience in making land purchases with heavy capital commitments at stake should take a thorough look at the factors involved with making a land investment decision.

Four factors stand out: (1) the market price of the land, (2) the value of the land to the present business in terms of the stream of annual returns, liquidation value, and buildup of equity to support additional borrowing, (3) various financing constraints, and (4) risk of financial loss.

The market price of land, the first factor, is, of course, not determined until the land is actually sold. Prospective investors, however, should obtain an estimate of the market price prior to the sale. Such an estimate is valuable in formulating a bargaining strategy and in assessing the financial attractiveness of purchasing the property. Farmers may obtain market price estimates by checking on comparable sales themselves or by hiring a professional appraiser.

The second important aspect of analyzing a land purchase is determining the value of the property to the farmer's business. Such a determination permits the consideration of all the variables that are specific to the farmer's business and personal judgement (for example, enterprise selection, crop yields, cultural practices, product and input prices, rate of inflation, income taxes, length of planning period, and existing land, machinery, labor, and management resources, etc.). In addition, the valuation procedure requires that the farmer specify the particular after-tax rate of return desired for the land investment. The computed value of land thus indicates the price that can be paid for the property while yielding the prescribed rate of return. If the market price exceeds the value, the farmer must accept a return below that specified in the valuation process, or justify the purchase for various non-economic reasons.

The third concern in a land investment analysis is the financial feasibility of the proposed purchase. Financial feasibility refers to the ability of the business to finance the acquisition with equity and/or debt capital; and if the latter is involved, the ability of the business to service that debt. Since large amounts of debt are commonly used, it is important to make cash-flow projections to determine if sufficient funds will be available to make principal and interest payments on the real estate loan. If the amount of added real estate debt supportable by the farm's projected cash flow, plus the downpayment, sum to more than the market price, the land investment is financially feasible. However, if cash flow projections indicate difficulty in servicing the added debt, the investment will not be an attractive one.

A fourth consideration is how the land investment will affect the farmer's risk-bearing position. Typically, large amounts of debt capital are used to finance a land purchase. Thus, additional strain is imposed on the farm's cash flow as a result of making principal and interest payments on the land loan. Such fixed financial commitments, coupled with the uncertainty of future prices, yields, and land values, may increase the risk of financial loss beyond a level the farmer and/or the lender is willing to assume.

This publication assists farmers and agricultural lenders in analyzing the second and third

NOTE: The authors express appreciation to the Western Farm Management Extension Committee and in particular to Dr. A. Gene Nelson and Dr. LeRoy Luft for their numerous helpful comments. The WFMEC members are: Scott Hathorn, Jr. and Charles E. Robertson (Arizona); Kent D. Olson and Edward A. Yeary (California); Harry E. Crim (Colorado); Herbert K. Marutani (Hawaii); James Graves and Neil L. Meyer (Idaho); Walter J. Armbruster and James Hildreth (Illinois); LeRoy Luft (Montana); Gordon L. Myer (Nevada); Gene Ott (New Mexico); Dave Holst and A. Gene Nelson (Oregon); Larry K. Bond (Utah); Richard W. Carkner, Herb Hinman, and Gayle S. Willett (Washington); Buel Lanpher (Washington, D.C.); and Douglas E. Agee and Harlan Hughes (Wyoming).
concerns noted above. Procedures are outlined for answering two critical questions farmers should raise about the purchase of additional farmland: (1) What is the land worth to my particular business? and (2) Can I pay for the land?

The Value of Additional Land to the Farm Business

Land has a value because it entitles the owner to a set of future rights to that land. Such rights include a claim to land earnings and the right to sell property. Thus, the economic value of additional land to a farmer is dependent upon these factors:

1. The stream of after-tax returns earned by the land.
2. The after-tax value of the land at the end of the farmer’s planning period.

The value of land is the sum of these future benefits, discounted by the farmer’s required rate of return. Discounted future benefits, thus, represent the maximum price the farmer is willing to pay for the land (more on this later).

A procedure for valuing land according to its projected flow of income (annual earnings and liquidation value) is outlined in Worksheet 1.

Variables

The valuation procedure includes the following variables:

1. Annual return to land and projected annual rate of change in the return. The return to land is obtained by subtracting all production expenses, except interest on land investment, from gross receipts. To accurately estimate land returns, it is necessary to prepare detailed budgets for the crops to be produced on the land. Where the investor intends to rent out rather than farm the land, returns to land may be estimated by subtracting real property ownership costs (for example, property taxes, improvement repairs, insurance), except interest on the land investment, from the rent received.

Land returns should be estimated for the current year, based on yields, prices, and costs existing under normalized circumstances. In recognition that returns are likely to change over time, however, the valuation procedure gives the farmer an opportunity to indicate average annual percentage change in land returns anticipated for the planning period.

2. Annual rate of change in land value. Since the land’s market value at the end of the ownership period is a component of the stream of returns on which the land’s value is based, it is important that anticipated changes in the land’s market value be considered in the valuation analysis. Such changes can be expected to result from variation in land use, production technology, price relationships, and availability and terms of financing. If land use is restricted to agricultural enterprises, the change in the land’s market value should be similar to the rate of change estimated for annual agricultural returns. Where land is subject to a growing demand for industrial, urban, or recreational uses, however, the rate of change in market value will exceed that estimated on the basis of agricultural use. Thus, it is important that farmers study closely the factors potentially affecting the land’s market value.

The land’s market price at the time of the proposed purchase is used as the starting point for computing annual changes in the value and the estimated sales price at the end of the ownership period. Farmers will, therefore, want to obtain an estimate of recent sales prices for nearby and comparable land.

3. Annual rate of change in the general price level. It is necessary to account for changes in the general price level when valuing land, since these changes affect the purchasing power of the income realized from the land investment. Purchasing power and wealth are determined by real, not inflated, dollars. If, for example, a land investment yields a 6% return during a period of 6% general price inflation, the wealth position of the farmer has not changed. In effect, the farmer has received a zero real rate of return on the investment.

To insure that valuation reflects the former’s desired real rate of return, it is necessary to include in the analysis an estimate of the average annual rate of general price inflation occurring during the period of land ownership. A good measure of inflation would be the anticipated rate of change in the consumer price index or the implicit price deflator for the gross national product.

4. Number of years in the farmer’s planning horizon. Since the value of land is based on total earnings realized during the ownership period, the length of that period is an important determinant

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1A technical description of the valuation model appears in Appendix A.
2Additional detail on how to budget returns to land is presented in the example to follow.
of value. The ownership period used in the analysis must be determined by each farmer in light of his or her age and business objectives. An older farmer about to retire and liquidate property may have less than a 5-year planning horizon. On the other hand, a 25-year-old farmer about to purchase his or her first piece of property could have a 40-year planning horizon.

5. Income taxes paid on annual land returns and on capital gains when land is sold. Federal and state income taxes paid on ordinary income generated annually by land and on capital gains when appreciated land is sold reduces the stream of earnings attributable to land. Thus, like production expenses, income taxes reduce the value of land to the farmer.

To identify the impact of income taxes on land values, an estimate of the appropriate marginal tax rate is necessary. The marginal tax rate is the rate at which additional income from the land investment is taxed. Tables 4 and 5, Appendix B, present Federal income tax rates for married individuals filing a joint return and for corporations, respectively. These tables should be helpful in estimating marginal tax rates. Since the tables indicate only Federal tax rates, the rates should be increased to reflect state income taxes where such a tax is applicable.

6. Income tax savings from deductions of interest paid on debt capital. Interest paid on money borrowed to finance land is a tax-deductible expense. Therefore, assuming a profitable business, interest deductions reduce income tax liabilities and increase the after-tax stream of earnings accruing to land. The size of these tax benefits can be substantial as illustrated by a $1,000 per acre loan with a 9% interest rate and a 20-year amortization period. Average annual interest for this loan would be $59.54 per acre. Assuming a 32% marginal tax rate, the annual income tax savings per acre are $19.05 ($59.54 x .32). The actual impact of interest tax savings on land values will, however, depend on the interest rate relative to the discount rate (discussed later) and the marginal tax rate.

7. Required after-tax real rate of return on the land investment. Once the after-tax stream of earnings accruing to land has been estimated, the earnings must be discounted to obtain the land’s present value—the value of the land to the farmer at the time of the proposed purchase. Discounting (reducing in value) is necessary, since the earnings are realized at future rather than current points in time. Future dollars are worth less to the farmer than current dollars, even assuming a zero rate of inflation and overlooking the added uncertainty of ever receiving those future dollars. The reason future returns are worth less is the opportunity one has to reinvest dollars on hand and realize returns accruing with the passage of time. Thus, future dollars should be discounted at a rate equivalent to the earnings sacrificed by not having the money on hand immediately to reinvest.

The discount rate used to value land is, in effect, the rate of return required on the land investment. Therefore, an important part of the valuation process is selection of a required real rate of return. A profit-oriented farmer will want the rate of return to be high enough to ensure a profitable land investment. This means the investment must yield a rate of return exceeding the cost of capital. Consequently, the cost of capital is commonly used as the minimal required real rate of return (discount rate) in valuing land.

Since the cost of capital (discount rate) has a sizable impact on land value, farmers should exercise care in estimating that cost. The cost should be at least as high as the after-tax cost of debt capital used to finance the land purchase. The after-tax cost of debt is calculated in the following manner:

\[
\text{After-tax cost of debt} = \text{Effective before-tax interest rate} \times (1 - \text{marginal tax rate})
\]

Thus, a loan with a 9% effective rate of interest, used by a farmer in the 24% marginal tax bracket, has an after-tax cost of 6.84%, i.e., 9% x (1 - .24). A tax adjustment is necessary to reflect the income tax deductibility of interest expenses.3

To facilitate computation of land values using the above information, Worksheet I was constructed. The Worksheet provides step-by-step directions about the required information and computations. Tables containing interest factors for adjusting land earnings and values to reflect the time value of money appear in Appendix B. Directions as to when and how the tables should be used are on the Worksheet.

3Technically, the interest rate should also be reduced by the amount the lender has added to the real cost of capital to protect against loss of income due to general price inflation. This inflation premium, however, will be difficult to identify. Thus, since higher cost equity capital is commonly used with debt to finance land, basing the required rate of return on the after-tax cost of debt, unadjusted for inflation, should not result in a serious error.
# WORKSHEET I—ANALYSIS OF LAND VALUE

1. Enter average annual before-tax gross receipts $__________
2. Enter average annual before-tax costs. Do not include interest on land loan or investment $__________
3. Subtract line 2 from line 1 $__________
4. Enter 1.00 minus your marginal income tax rate (Appendix B, table 4 or 5). Express as a decimal
5. Multiply line 4 times line 3 $__________
6. Enter your required after-tax real rate of return on the land investment %__________
7. Enter your estimate of the average annual rate of general price inflation during the land investment planning period %__________
8. Enter your estimate of the average annual rate of change in the land returns appearing on line 5 %__________
9. Add lines 6 and 7 and subtract line 8 from total %__________
10. Enter interest factor from table 2, Appendix B, for interest rate on line 9 and number of years in land investment planning period
11. Multiply line 10 times line 5
12. Enter the proportion of the purchase price to be financed with debt. (IF NO DEBT USED, SKIP TO LINE 20).
13. Enter interest factor from table 2, Appendix B, for interest rate equaling before-tax contractual rate of interest on loan and number of years in loan repayment period
14. Divide line 12 by line 13
15. Divide line 12 by number of years in loan repayment period
16. Subtract line 15 from line 14
17. Multiply line 16 times your marginal income tax rate
18. Enter interest factor from table 2, Appendix B, for interest rate equaling line 6 plus line 7 and number of years in loan repayment period
19. Multiply line 18 times line 17
20. Enter interest factor from table 3, Appendix B, for interest rate equaling line 6 plus line 7 and number of years in planning period
21. Enter interest factor from table 1, Appendix B, for interest rate equaling your estimate of annual rate of increase in land market price and number of years in planning period
22. Enter estimated market price of land $__________
23. Multiply line 21 times line 22 $__________
24. Enter your capital gains tax rate (express as a decimal)*
25. Multiply line 23 times line 24 $__________
26. Subtract line 25 from line 23 and multiply answer times line 20 $__________
27. Multiply line 20 times line 24
28. Add lines 19 and 27
29. Enter 1.000 minus line 28
30. Add lines 11 and 26 $__________
31. LAND VALUE (line 30 divided by line 29) $__________

*The capital gains tax rate for individuals can be estimated by taking 40% of the marginal ordinary income tax rate. For regular corporations, the capital gains tax rate can be approximated by using the full corporate marginal income tax rate or 28%, whichever is less.
A Case Farm Illustration

The valuation procedure and use of the Worksheet can be illustrated by the farmer considering the purchase of a nearby 160 acres of cropland. The land, if purchased, will be used to grow a 4-year rotation of (winter) wheat—(spring) barley—(winter) wheat—dry peas. Preliminary figuring indicates the farmer can handle the added cropland with existing machinery resources.

One of the major problems confronting the farmer is determining the value of the land to the business, given the desired after-tax real rate of return. Once that value has been determined, it will be easier to assess the likelihood of acquiring the land. Also, the farmer can more effectively negotiate a price with the seller.

Before using Worksheet I, the farmer should prepare enterprise budgets for the three crops to be grown on the land. The farmer has grown wheat, barley, and dry peas for several years on land quite similar to that coming up for sale. Consequently, the farmer's records and experience will provide a good basis for estimating costs and returns for the crops. The budgets should be prepared assuming normalized current yields, costs, and returns. Estimates of future changes in land returns and general price inflation are made on the Worksheet.

Enterprise budgets prepared by the farmer are summarized in table 1. The cost estimates should include only those outlays expected to increase as a result of the land purchase. Thus, estimates should be made for such operating expenses as fuel, lubrication, machinery repairs, hired labor, seed, fertilizer, herbicides, insecticides, custom services, crop insurance, and interest on the added operating capital.

Certain overhead costs will also increase when additional land is purchased. If additional machinery is purchased, depreciation, interest on the investment, property taxes, and insurance costs for the machinery should be estimated. Even if additional machinery is not needed, some increase in machinery overhead expenses can generally be expected. This increase results from greater machine use and an associated shortening of the useful life. A shorter useful life causes annual depreciation expenses to rise. This increase, however, will be small compared to the added overhead cost when additional machinery is purchased. Excess machine capacity and cost economies realized through greater machine use is one of the leading reasons why many farmers are interested in buying additional land.

Other overhead costs increasing when more land is purchased are property taxes on the land and various miscellaneous items, including telephone, travel, accounting, utilities, etc. Since the added acreage normally requires more labor and management by the owner-operator, the cost of this effort should also be identified. Interest on the investment in added land should not be included, since this cost is accounted for by the discounting procedure used on the Worksheet.

As indicated in table 1, by subtracting the added operating and overhead costs from the added gross receipts, the example farmer has estimated a return to land of about $68 per acre. This return is the farmer's estimate of what will be earned during the first year the 160 acres is farmed, assuming normal yields, product prices, and costs. All costs and returns are on a before-tax basis, since income tax adjustments are made on the Worksheet.

Other assumptions the example farmer must make before proceeding with the valuation analysis are these:

1. Marginal income tax rate for the joint return filed with spouse (see table 4, Appendix B) = 37%.
2. Required after-tax real rate of return on the potential land investment = 7%.
3. Estimate of the average annual rate of general price inflation = 5%.
4. Estimate of the average annual rate of change in returns to land = 6%.
5. Length of the planning period = 25 years.
6. Estimate of average annual rate of change in market price of land = 7%.
7. Proportion of purchase price financed with debt = 80%.
8. Interest rate on loan with a 20-year repayment period = 9%.
9. Estimated market price for recent and comparable land sales = $1.200 per acre.

Estimates of the rates of change in the general price level, returns to land, and land values are made by studying past trends and giving careful thought as to how these trends might change over the 25-year planning period. The estimates reflect the farmer's judgment that the annual rate of increase in the land returns from farming, 6%, will stay slightly ahead of general price inflation, 5%. Also, because of the land's proximity to a growing community, it is expected that its value will in-
Table 1. Estimated annual receipts, costs, and returns for a 160-acre addition to the example farm, wheat-barley-wheat-dry peas rotation.

<table>
<thead>
<tr>
<th>Crops in rotation</th>
<th>Total 160 acres</th>
<th>Per rot. acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Wheat</td>
<td>Barley</td>
</tr>
<tr>
<td>1. Gross receipts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acres</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Yield per acre</td>
<td>65 bu</td>
<td>1.5t</td>
</tr>
<tr>
<td>Price</td>
<td>$3.60/bu</td>
<td>$70/t</td>
</tr>
<tr>
<td>Gross receipts</td>
<td>$17,680</td>
<td>$4,200</td>
</tr>
<tr>
<td>2. Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Operating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machinery (fuel, oil &amp; repairs)</td>
<td>$1,028</td>
<td>$526</td>
</tr>
<tr>
<td>Hired labor</td>
<td>454</td>
<td>215</td>
</tr>
<tr>
<td>Seed</td>
<td>680</td>
<td>304</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>2,643</td>
<td>475</td>
</tr>
<tr>
<td>Herbicides &amp; Insecticides</td>
<td>570</td>
<td>285</td>
</tr>
<tr>
<td>Custom services</td>
<td>260</td>
<td>130</td>
</tr>
<tr>
<td>Crop insurance</td>
<td>237</td>
<td>74</td>
</tr>
<tr>
<td>Interest on operating capital</td>
<td>222</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td>$6,094</td>
<td>$2,041</td>
</tr>
<tr>
<td>B. Overhead</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machinery depreciation</td>
<td>$736</td>
<td>$355</td>
</tr>
<tr>
<td>Real estate taxes</td>
<td>480</td>
<td>240</td>
</tr>
<tr>
<td>Operator labor &amp; mgmt.</td>
<td>910</td>
<td>285</td>
</tr>
<tr>
<td>Miscellaneous*</td>
<td>305</td>
<td>104</td>
</tr>
<tr>
<td>Total</td>
<td>$2,431</td>
<td>$984</td>
</tr>
<tr>
<td>3. Total cost (A+B)</td>
<td>$8,525</td>
<td>$3,025</td>
</tr>
<tr>
<td>4. Returns to land (1-3)</td>
<td>$9,155</td>
<td>$1,175</td>
</tr>
</tbody>
</table>

*Includes telephone, utilities, travel, accounting, legal costs, etc.

crase at a slightly faster rate, 7%, than its return from farming activities, 6%.

Utilizing the budget information and the previous assumptions, the farmer is now ready to complete Worksheet I on either a per-acre or 160-acre basis. Lines 1 through 5 of the Worksheet utilize information on land receipts (line 1), costs (line 2), and the farm's marginal tax rate to compute the annual after-tax land return (line 5). As indicated, that return is $42.85. Lines 6-8 request the farmer to designate the required after-tax real rate of return on the land investment, rate of general price inflation, and rate of change in land returns, respectively. From that information, the rate used to discount future land returns is computed on line 9 (6% for the case farm illustration). Next, the interest factor corresponding to the discount rate is inserted on line 10. Multiplication of the interest factor times the annual after-tax land returns (line 5) gives the after-tax present value of future land returns (line 11). Thus, the value of the land to the hypothetical farmer, excluding income tax benefits from interest and liquidation value, is $547.75 (line 11).

Information used to compute income tax savings from the deduction of interest paid on the land loan appears on lines 12 through 19. These steps can be omitted if no debt is used. Lines 20 through 26 request data for computing the after-tax liquidation value of the land. After completing the mathematical adjustments directed by lines 27 through 30, the final value of the land is computed on line 31.

As indicated on line 31 of the completed
## WORKSHEET I—ANALYSIS OF LAND VALUES
(Case Farm Illustration)

1. Enter average annual before-tax gross receipts $ 161.13
2. Enter average annual before-tax costs. Do not include interest on land loan or investment $ 93.11
3. Subtract line 2 from line 1 $ 68.02
4. Enter 1.00 minus your marginal income tax rate (Appendix B, table 4 or 5). Express as a decimal .63
5. Multiply line 4 times line 3 $ 42.85
6. Enter your required after-tax real rate of return on the land investment 7%
7. Enter your estimate of the average annual rate of general price inflation during the land investment planning period 5%
8. Enter your estimate of the average annual rate of change in the land returns appearing on line 5 6%
9. Add lines 6 and 7 and subtract line 8 from total 6%
10. Enter interest factor from table 2, Appendix B, for interest rate on line 9 and number of years in land investment planning period 12.783
11. Multiply line 10 times line 5 $ 547.75
12. Enter the proportion of the purchase price to be financed with debt (IF NO DEBT USED, SKIP TO LINE 20) .80
13. Enter interest factor from table 2, Appendix B, for interest rate equaling before-tax contractual rate of interest on loan and number of years in loan repayment period 9.129
14. Divide line 12 by line 13 .088
15. Divide line 12 by number of years in loan repayment period .040
16. Subtract line 15 from line 14 .048
17. Multiply line 16 times your marginal income tax rate .018
18. Enter interest factor from table 2, Appendix B, for interest rate equaling line 6 plus line 7 and number of years in loan repayment period 7.469
19. Multiply line 18 times line 17 .134
20. Enter interest factor from table 3, Appendix B, for interest rate equaling line 6 plus line 7 and number of years in planning period .059
21. Enter interest factor from table 1, Appendix B, for interest rate equaling your estimate of annual rate of increase in land market price and number of years in planning period 5.427
22. Enter estimated market price of land $ 1,200.00
23. Multiply line 21 times line 22 $ 6,512.40
24. Enter your capital gains tax rate (express as a decimal)* .148
25. Multiply line 23 times line 24 $ 963.84
26. Subtract line 25 from line 23 and multiply the answer times line 20 $ 327.37
27. Multiply line 20 times line 24 .009
28. Add lines 19 and 27 .143
29. Enter 1.000 minus line 28 .857
30. Add lines 11 and 26 $ 875.12
31. LAND VALUE (line 30 divided by line 29) $ 1,021.14

*The capital gains tax rate for individuals can be estimated by taking 40% of the marginal ordinary income tax rate. For regular corporations, the capital gains tax rate can be approximated by using the full corporate marginal income tax rate or 28%, whichever is less.
Worksheet, the land is worth $1,021 per acre to the hypothetical farmer. It can be concluded that if the farmer pays $1,021 for the land, an after-tax real rate of return of 7% will be realized on the investment. If more than $1,021 is paid for the land, a lower rate of return can be expected. Alternatively, a higher return is implied if the land is acquired for a price below $1,021. Since the market price was estimated to be $1,200, the farmer may have difficulty purchasing the land at a price providing the desired profit.

The farmer would be well advised to complete several worksheets to determine the impact of adopting different assumptions for such key variables as (1) required rate of return, (2) returns to land (such as wheat price and yield), (3) rate of appreciation in land value, and (4) level of general price inflation. This would provide a good indication of the risk associated with buying the land, as well as identifying flexibility in negotiating a price with the seller.

**Determining the Financial Feasibility of A Land Purchase**

After determining the value of a potential land purchase to the business, a farmer will want to consider the financial feasibility of the acquisition. More specifically, the question must be examined as to whether available equity capital reserves and unused borrowing capacity are sufficient to finance the purchase at the expected market price. Furthermore, where large amounts of debt capital are involved, the ability of the business to service that debt should be identified.

Worksheet II provides a procedure for determining the maximum financially feasible price the farm business will be able to pay for additional land. The Worksheet should be completed for the expanded (current-plus-added-land) business on a total farm basis. The Worksheet assumes the maximum financially feasible price is determined by the equity funds available for a downpayment, plus the maximum amount of debt the farm's cash flow can service. It is further assumed the latter is dependent upon (1) the amount of cash farm earnings retained in the business, (2) pre-expansion financial commitments that must be serviced, (3) the rate of interest on the new real estate loan, and (4) the number of years over which the loan is amortized.

Where the maximum price the business can pay for the land (line 22, Worksheet II) exceeds the probable market price, the purchase is financially feasible. Alternatively, where the market price is likely to exceed the maximum price, there is a strong likelihood the business will experience cash flow difficulties if the land is purchased.

**The Case Farm Revisited**

Thus far, the example farmer has determined that the 160 acres of land is worth approximately $1,021 per acre to the business. The farmer should now analyze the ability to pay for the land. That analysis can be made by completing Worksheet II.

The analysis in Worksheet II is based on annual projections made by the farmer for the expanded (current and added land) business. The cash expense projection (line 2) does not include such non-cash costs as depreciation, interest on equity capital investment, and operator and family labor. Also, interest paid on debt used to finance the land purchase is excluded at this point.

An estimate of depreciation (line 4) and personal exemptions and zero bracket amount or itemized deduction (line 5) is necessary for the determination of income tax savings.

After-tax earnings generated by the farmer's expanded business are estimated to be $42,078 (line 11). Before determining the amount of additional debt the business can service, however, these earnings need to be reduced by several additional financial commitments, i.e., annual principal payments on long-term (over 1 year) debt assumed prior to the land purchase (line 12), an annual depreciation reserve (line 13), self-employed social security taxes (line 14), and family living expenses (line 15). After making these adjustments, the amount of cash available to make principal and interest payments on additional real estate debt is $8,980 (line 17).

The interest factor indicating how much debt a $1 annual payment will support can be found in table 2, Appendix B. The interest factor should be selected for the interest rate equaling the after-tax interest rate on the land loan and for the number of years in the loan repayment period. For the case at hand, that would be 7.0% and 20 years, i.e., 9% x (1-.22 average tax rate). The corresponding interest factor is 10.594 (line 18), which, when multiplied times $8,980, gives the $95,134 of debt the expanded business can support (line 19). Assuming $35,200 of cash (equity capital) is available for a downpayment (line 20), a total of $130,334 ($95,134 + $35,200) can be

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1A technical description of the procedure used in the Worksheet appears in Appendix A.
WORKSHEET II—ANALYSIS OF ABILITY TO PAY FOR LAND

1. Enter average annual before-tax gross cash receipts from all enterprises in the expanded business $ ______

2. Enter average annual before-tax cash costs for all enterprises in the expanded business* $ ______

3. Subtract line 2 from line 1 $ ______

4. Enter average annual depreciation deducted for income taxes paid on expanded business $ ______

5. Enter income tax deduction for personal exemptions and zero bracket amount or itemized deduction $ ______

6. Add lines 4 and 5 $ ______

7. Enter your average income tax rate for expanded business (express as a decimal) † ______

8. Multiply line 7 times line 6 $ ______

9. Enter 1.00 minus your average income tax rate (line 7) ______

10. Multiply line 9 times line 3 $ ______

11. Add lines 10 and 8 $ ______

12. Enter average annual principal payments on long-term debt (over 1 year). Do not include debt on land purchase $ ______

13. Enter average annual depreciation reserve‡ ______

14. Enter social security taxes paid on self-employment income § $ ______

15. Enter annual family living expenses $ ______

16. Add lines 12, 13, 14, and 15 $ ______

17. Subtract line 16 from line 11 $ ______

18. Enter interest factor from table 2, Appendix B, for interest rate equaling after-tax contractual rate of interest on loan and number of years in loan repayment period|| $ ______

19. Multiply line 18 times line 17 $ ______

20. Enter equity capital available for downpayment on land purchase $ ______

21. MAXIMUM PRICE THAT CAN BE PAID FOR TOTAL ACREAGE (line 19 plus line 20) $ ______

22. MAXIMUM PER-ACRE PRICE (line 21 divided by number of acres in land purchase) $ ______

*Cash costs should include hired labor, fuel, lubricants, repairs, all materials (e.g., seed, fertilizer, herbicides, pesticides), custom services, rent on machinery and/or land, crop insurance, property taxes, general overhead (e.g., telephone, utilities, travel, accounting, legal), and interest paid on all loans. Interest paid on the loan to finance the land purchase should not be included. If livestock enterprises are present, cash costs related to these enterprises should be included.

†Can be estimated by subtracting line 6 from line 3 to obtain taxable income and referring to Appendix B, table 4 or 5, for the average tax rate on that taxable income.

‡Estimate of annual capital needed to replace depreciable assets.

§Can be estimated by subtracting line 6 from line 3 and multiplying difference by the appropriate social security tax rate. The tax should not exceed the legal maximum.

||The after-tax interest rate equals the before-tax rate multiplied by 1 minus the average income tax rate.
WORKSHEET II—ANALYSIS OF ABILITY TO PAY FOR LAND
(Case Farm Illustration)

1. Enter average before-tax gross cash receipts from all enterprises in the expanded business ........................................ $133,000
2. Enter average annual before-tax cash costs for all enterprises in the expanded business* ........................................ $ 83,600
3. Subtract line 2 from line 1 ............................................................... $ 49,400
4. Enter average annual depreciation for income taxes paid on expanded business ......................................................... $ 9,120
5. Enter income tax deduction for personal exemptions and zero bracket amount or itemized deduction ................................ $ 7,000
6. Add lines 4 and 5 ........................................................................... $16,120
7. Enter your average income tax rate for expanded business (express as a decimal)† ...................................................... .22
8. Multiply line 7 times line 6 ............................................................ $ 3,546
9. Enter 1.00 minus your average income tax rate (line 7) ......................................................................................... .78
10. Multiply line 9 times line 3 .......................................................... $38,532
11. Add lines 10 and 8 ....................................................................... $42,078
12. Enter average principal payments on long-term debt (over 1 year). Do not include debt on land purchase .................. $ 7,000
13. Enter average annual depreciation reserve‡ ........................................ $10,000
14. Enter social security taxes paid on self-employment income§ .......................................................................................... $ 2,098
15. Enter annual family living expenses .............................................. $ 14,000
16. Add lines 12, 13, 14, and 15 ........................................................ $33,098
17. Subtract line 16 from line 11 ......................................................... $ 8,980
18. Enter interest factor from table 2, Appendix B, for interest rate equaling after-tax contractual rate of interest on loan and number of years in loan repayment period|| ......................................................... 10.594
19. Multiply line 18 times line 17 ....................................................... $ 95,134
20. Enter equity capital available for downpayment on land purchase ........ $ 35,200
21. MAXIMUM PRICE THAT CAN BE PAID FOR TOTAL ACREAGE (line 19 plus line 20) .................................................. $130,334
22. MAXIMUM PER-ACRE PRICE (line 21 divided by number of acres in land purchase) ....................................................... $ 815

*Cash costs should include hired labor, fuel, lubricants, repairs, all materials (e.g., seed, fertilizer, herbicides, pesticides), custom services, rent on machinery and/or land, crop insurance, property taxes, general overhead (e.g., telephone, utilities, travel, accounting, legal), and interest paid on all loans. Interest paid on the loan to finance the land purchase should not be included. If livestock enterprises are present, cash costs related to these enterprises should be included.

†Can be estimated by subtracting line 6 from line 3 to obtain taxable income and referring to Appendix B, table 4 or 5, for the average tax rate on that taxable income.

‡Estimate of annual capital needed to replace depreciable assets.

§Can be estimated by subtracting line 6 from line 3 and multiplying difference by the appropriate social security tax rate. The tax should not exceed the legal maximum.

||The after-tax interest rate equals the before-tax rate multiplied by 1 minus the average income tax rate.
paid for the land (line 21). The maximum per-acre price is $130,334 divided by 160 acres, or $815 (line 22).

It is suggested that several Worksheets be completed using different assumptions for such key variables as (1) crop prices and yields, (2) cash production costs, and (3) real estate loan terms. By expanding the analysis in this manner, the farmer can obtain a better feel for the range of debt (and therefore, maximum land prices) that the farm can support under various business circumstances.

Interpretation of Analysis

Once Worksheets I and II have been completed, the farmer is in a good position to assess the financial advisability of buying the land. If the analysis indicates the land's value and maximum financially feasible price both exceed the expected market price, the land purchase will appear attractive. Alternatively, if the value and/or maximum financially feasible price falls below the likely market price, the land investment will not yield the desired profit and/or present cash flow problems.

The case farm analysis provides a good example of a financially unattractive land investment. Both the maximum financially feasible price ($815) and value ($1,021) lie below the expected market price ($1,200). The sizable difference between $815 and $1,200 indicates the farmer is in an extremely weak position to obtain the land. Under the adopted assumptions, purchase of the land at a competitive price (for example, $1,000 to $1,200) would involve considerable risk of being unable to service the added real estate debt.

Limitations of Analysis

While the analysis outlined in this publication is considerably more detailed than traditionally used, certain factors were, nevertheless, omitted in an attempt to keep the discussion manageable. The more important limitations are three:

1. The valuation procedure (Worksheet I) does not consider the income tax benefits stemming from depreciation and investment credit. Thus, where depreciable improvements (such as orchards, irrigation equipment, buildings) are included in the investment, the value computed by Worksheet I will be understated.

2. The possible recapture of depreciation and/or investment credit when the property is sold is not considered.

3. Land values, returns to land, and general price levels are assumed either to remain constant or to increase at a constant annual compound rate. The valuation analysis, for example, does not allow a given rate of increase in land values for a certain number of years to be followed by either a zero or different rate of increase in later years.

References


APPENDIX A

Land Investment Analysis Models

1. Land Valuation Model

\[ V = A_{i} \times \left[ \frac{(R-C)}{(1-T_{o})} \right] + A_{i} \times I \times T_{o} + \left( \frac{1}{(1+d)^n} \right) \times \frac{[P(1+a)^n - P(1+a)^n - V]}{(1-T_{c})} \]  

The following notation is used in the model:

\[ V = \text{After-tax present value on one acre of land.} \]

\[ A_{i} = \text{Present value of a } \$1 \text{ annuity realized for } n \text{ years and discounted at a } d \text{ rate of interest per year.} \]

\[ d = \text{Annual rate used to discount land rent (i.e., R-C).} \]

The rate equals the farmer's required after-tax real
APPENDIX A (Continued)

rate of return on land investment plus annual rate of general price inflation minus annual rate of change in land rent.

\[ n = \text{Number of years in the farmer's planning period.} \]

\[ R = \text{Average annual before-tax gross receipts per rotation acre.} \]

\[ C = \text{Average annual before-tax costs per rotation acre, except interest on land loan or investment.} \]

\[ T_c = \text{Marginal income tax rate on ordinary income.} \]

\[ A_{ilm} = \text{Present value of a $1 annuity realized for } m \text{ years and discounted at an } e \text{ rate of interest per year.} \]

\[ e = \text{Annual rate used to discount income tax benefits from deductible interest payments and after-tax value of land at the end of the planning period.} \]

\[ m = \text{Number of years in the repayment period of the loan used to finance the land acquisition.} \]

\[ I = \text{Average amount of interest paid per year during the land loan repayment period.} \]

\[ D = \frac{DV}{A_{ilm}} - P \]

\[ P = \frac{DV}{m} \]

\[ P = \text{Price per acre received for recent sales of comparable land.} \]

\[ a = \text{Annual rate of change in land value.} \]

\[ T_c = \text{Income tax rate on capital gains.} \]

2. Model for Analysis of Ability to Pay for Land.

\[ V = \left[ (R_c - C_c) (1 - t) + (d + p) (1 - t) - (P + D + S + F) \right] A_{ilm} + E \]

Notation used in specifying the model is as follows:

\[ V = \text{Maximum financially feasible price that can be paid for land.} \]

\[ R_c = \text{Average annual before-tax gross cash receipts for expanded business.} \]

\[ C_c = \text{Average annual before-tax costs for expanded business, excluding interest paid on debt used to finance added land.} \]

\[ t = \text{Average income tax rate on ordinary income.} \]

\[ d = \text{Average annual depreciation deducted for income taxes.} \]

\[ p = \text{Average annual income tax deductions for personal exemptions and standard or itemized deductions.} \]

\[ P = \text{Average annual principal payments on long-term (over 1 year) debt, excluding debt used to finance added land.} \]

\[ D = \text{Average annual funds set aside for replacement of depreciable assets (i.e., depreciation reserve).} \]

\[ S = \text{Average annual social security taxes paid on self-employment income.} \]

\[ F = \text{Average annual family living expenses.} \]

\[ A_{ilm} = \text{Present value of a $1 annuity realized for } m \text{ years and discounted at an } i \text{ interest rate per year.} \]

\[ i = \text{After-tax contract rate of interest on loan used to finance the land acquisition.} \]

\[ m = \text{Number of years in the repayment period of the loan used to finance the land acquisition.} \]

\[ E = \text{Equity capital available for downpayment on land purchase.} \]

---

APPENDIX B

Supporting Tables For Investment Analysis

Table 1. Compound value of $1 at the end of selected years and for various rates of interest.

<table>
<thead>
<tr>
<th>Interest Rate</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
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<tbody>
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<td>15</td>
<td>2.011</td>
<td>4.046</td>
<td>8.137</td>
<td>16.367</td>
<td>32.919</td>
<td>66.212</td>
<td>133.176</td>
<td>267.864</td>
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<td>14</td>
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<td>3.707</td>
<td>7.138</td>
<td>13.743</td>
<td>26.462</td>
<td>50.950</td>
<td>98.100</td>
<td>188.84</td>
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<td>93.051</td>
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<td>2.839</td>
<td>4.765</td>
<td>8.062</td>
<td>13.585</td>
<td>22.892</td>
<td>38.575</td>
<td>65.001</td>
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<td>6.727</td>
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<td>17.449</td>
<td>28.102</td>
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<td>1.967</td>
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<td>1.629</td>
<td>2.079</td>
<td>2.653</td>
<td>3.386</td>
<td>4.322</td>
<td>5.516</td>
<td>7.040</td>
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<td>2.191</td>
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### Table 2. Present value of a $1 annuity per year for selected years and rates of interest per year.

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<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
</tr>
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<td>5.251</td>
<td>5.258</td>
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<td>5.092</td>
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<td>5.467</td>
<td>5.517</td>
<td>5.529</td>
<td>5.548</td>
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<tr>
<td>17.0</td>
<td>3.119</td>
<td>4.659</td>
<td>5.324</td>
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</table>

Source: Michels and Van Ruben. Interest Tables.

### Table 3. Present value of $1 due in selected years and rates of interest.

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<td>.002</td>
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Source: Michels and Van Ruben. Interest Tables.
### Table 4. Average and marginal federal income tax rates for married individuals filing joint returns, selected taxable incomes, 1980.*

<table>
<thead>
<tr>
<th>Taxable Income</th>
<th>Average Tax Rate†</th>
<th>Marginal Tax Rate‡</th>
</tr>
</thead>
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<tr>
<td>$ 3,400</td>
<td>0</td>
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</tr>
<tr>
<td>5,500</td>
<td>5.3</td>
<td>16</td>
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<tr>
<td>7,600</td>
<td>8.3</td>
<td>18</td>
</tr>
<tr>
<td>11,900</td>
<td>11.8</td>
<td>21</td>
</tr>
<tr>
<td>16,000</td>
<td>14.2</td>
<td>24</td>
</tr>
<tr>
<td>20,200</td>
<td>16.2</td>
<td>28</td>
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<tr>
<td>24,600</td>
<td>18.3</td>
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<td>29,900</td>
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<td>45,800</td>
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<tr>
<td>215,400</td>
<td>54.6</td>
<td>70</td>
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</table>

*Tax rates reflect the code as amended by the 1979 Revenue Act. These rates are occasionally changed by Congress.†Equals the tax paid on the taxable income in column 1 divided by that taxable income.‡Equals the rate at which taxable income in excess of column 1 is taxed.

### Table 5. Average and marginal federal income tax rates for regular corporation, selected taxable incomes, 1980.*

<table>
<thead>
<tr>
<th>Taxable Income</th>
<th>Average Tax Rate†</th>
<th>Marginal Tax Rate‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 0</td>
<td>0%</td>
<td>17%</td>
</tr>
<tr>
<td>25,000</td>
<td>17.0</td>
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</tr>
<tr>
<td>50,000</td>
<td>18.5</td>
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</tr>
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<td>75,000</td>
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<td>100,000</td>
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</tr>
<tr>
<td>120,000</td>
<td>30.0</td>
<td>46%</td>
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<tr>
<td>140,000</td>
<td>32.3</td>
<td>46%</td>
</tr>
<tr>
<td>160,000</td>
<td>34.0</td>
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<td>180,000</td>
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<td>36.4</td>
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</tr>
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<td>300,000</td>
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</tr>
<tr>
<td>400,000</td>
<td>41.2</td>
<td>46%</td>
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</tbody>
</table>

*Tax rates reflect the code as amended by the 1979 Revenue Act. These rates are occasionally changed by Congress.†Equals the tax paid on the taxable income in column 1 divided by that taxable income.‡Equals the rate at which taxable income in excess of column 1 is taxed.$The average tax rate for $1 to $25,000 taxable income is 17%.