



CHAPTER-3

Economic Principles Applied in Farm Management Decisions

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✓ Basically *farm management* is the *application of agricultural sciences & economic principles to the organization & operation of a farm business.*

✓ The following are some of the basic principles applied in making rational farm management decisions:

- i. The principle of variable proportions*
- ii. The principle of cost*
- iii. The principle of equi-marginal return*
- iv. The principle of comparative advantage*

1. Law of variable proportion (law of diminishing returns)

- This law was developed by early economists to describe the relationship b/n output & a variable input when other inputs are held constant in amount.
- The law states that
“as equal amount of one input is added to a production process while all other inputs are held constant, the amount of output added per unit of variable input will eventually decrease”.
- The law suggests that there is some ***right amount*** of variable input to use in combination with fixed inputs.

- ✓ The producer should ***neither use too much nor too little*** quantity of variable inputs.
- ✓ This law requires that ***method of production does not change*** as changes are made in the amount of variable input.
- ✓ It ***does not*** apply when all inputs are varied.
- ✓ This law can be explained with the help of the following hypothetical data:

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Units of input (X)	Units of output (Y)	ΔX	ΔY	MP ($\Delta Y/\Delta X$)	AP (Y/X)	MVP ($MP \cdot P_Y$)	M FC (P_X)
5	10	-	-	-	2	-	10
10	25	5	15	3	2.5	15	10
15	45	5	20	4	3	20	10
20	60	5	15	3	3	15	10
25	70	5	10	2	2.8	10	10
30	75	5	5	1	2.5	5	10
35	73	5	-2	-0.4	2.09	-2	10
40	69	5	-4	-0.8	1.725	-4	10

- If price per unit of input & output are birr 10 & 5 respectively, determine the optimum level of input use.

Decision rule

- The optimum level of input use can be determined by using the following criteria:

A. Marginal product = $\frac{\text{Price of factor}}{\text{Price of product}}$ i.e. $\frac{\Delta Y}{\Delta X} = \frac{P_X}{P_Y}$

B. Value of added product = Value of added cost

$$\Delta Y P_Y = \Delta X P_X$$

- If $\Delta Y P_Y > \Delta X P_X$, more quantity of inputs can be used
- If $\Delta Y P_Y < \Delta X P_X$, quantity of variable input needs to be reduced
- If $\Delta Y P_Y = \Delta X P_X$, optimum level of input use is attained.

C. Marginal value product equals marginal factor cost

$$\text{i.e. } MVP = MFC \text{ or } MP \cdot P_Y = P_X$$

- Therefore, the optimum input utilization level for the above example is 25 units of variable input (X).

2. The principle of cost

- Cost of production refers to the total amount of fund used for purchase of different inputs used in the production process.
- Cost of production exists because the supplies of productive resources are scarce & have market value.
- The costs of production usually calculated in relation to a particular amount of product in a particular time period.

Cost categories

1. **Explicit cost** –those expenses that are *actually paid by the producers for purchase of different inputs in the production process.*
 - It is the payments made to those **outsiders** who will *supply labor services, raw materials, transportation services, etc.* to the farm.
2. **Implicit cost:** it is the value of *non-purchased inputs owned & used by a farm in its own production activity.*
 - Eg: the salary of owner manager (farmer) of the farm; depreciation cost of a building, interest foregone when the owner uses his capital in his farm, etc.

- The value of implicit cost is estimated based on **opportunity cost** of that input.
- **Opportunity cost**- is the value of the product which must be given up in the next best alternative use of the resources.
- Eg: suppose that, by using 1 quintal of fertilizer, a farmer can add birr 500 to the total revenue from wheat production & birr 400 to the total revenue from maize production.
 - If that farmer fertilizes his maize, his opportunity cost is birr 500, which he has foregone by not fertilizing his wheat.
 - On the contrary, if that farmer fertilizes his wheat, his opportunity cost will be birr 400, which he has foregone by not fertilizing his maize.

Accounting periods

- Based on the length of period of producing a product, planning/ accounting period can be divided into short run & long run.

Short-run is the period of time over which the amount of at least one input cannot be changed.

- That means we have two major categories of inputs in this period: **fixed** inputs and **variable** inputs.
- Consequently costs are of two types: **fixed** costs and **variable** costs.

Long-run is the period of time over w/c all factors of production can be varied.

i.e. in the long-run, **all inputs** are **variable** and hence **all costs** are also **variable**.

Production Costs in the Short-run

A. Total Fixed Cost (TFC)-is cost associated with using/owing fixed inputs.

- It is **not** affected by the level of output & can **exist** even when there is no production.
- The fixed cost curve starts at some point above the origin & it is horizontal.
- Eg: rent for land, rent for building or machinery, interest on borrowed/own capital, etc.

B. Total Variable Cost (TVC)-associated with the use of variable input.

- It varies with the level of output.
- The TVC curve starts from the origin & it slopes positively upwards.

Eg: costs for raw materials, transportation services, cost of casual labor.

- $TVC = P_X \cdot X$

C. Total Cost (TC)- is the sum of TFC & TVC.

- The TC & TVC curves are **parallel**.
- The distance b/n the two curves is the amount of TFC.

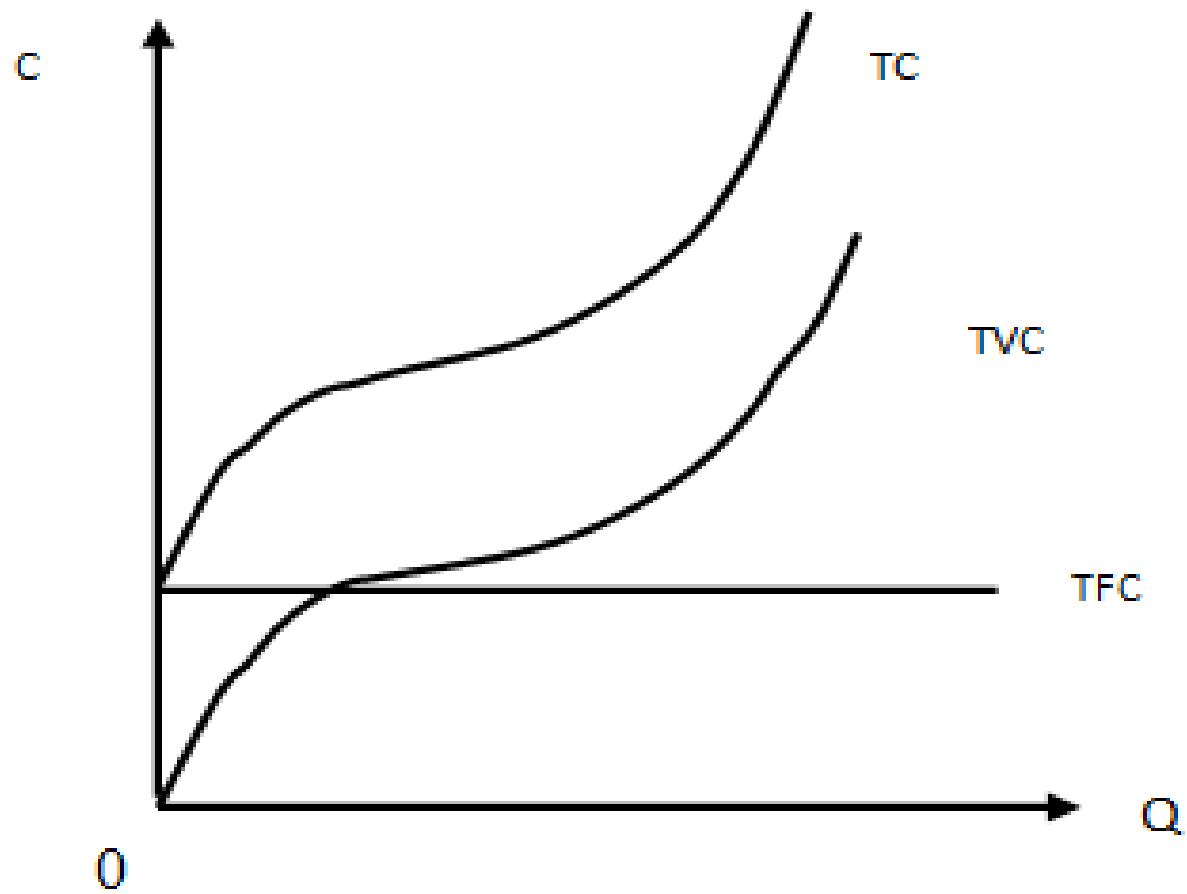


Fig.3.1 TC, TVC and TFC Curves

D. Average Costs

- are unit costs.
- In cost theory, there are 3 averages: AFC, AVC & ATC.

i. Average Fixed Cost (AFC)

$$AFC = \frac{TFC}{Q}$$

- AFC will become smaller & smaller as the level of output increases.
- AFC is down ward slopping throughout its entire length.

ii. Average Variable Cost (AVC)

$$AVC = \frac{TVC}{Q}$$

- For a given production function, AVC will initially decrease, reaches a minimum & then increase as output increases.
- The AVC curve is U-shaped.

iii. Average Total Cost (ATC)

$$ATC = \frac{TC}{Q} = AVC + AFC$$

- ATC has also a U-shape curve.

E. Marginal Cost (MC)-is an extra cost incurred by a firm while producing an extra unit of output.

- It is the change in total cost as a result of the change in output by one unit.

$$MC = \frac{\Delta TC}{\Delta Q} = \frac{dTC}{dQ}$$

- MC depends on *no way upon TFC*.
- It depends on *the change of TVC*.

$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta(TFC + TVC)}{\Delta Q} = \frac{\Delta TFC}{\Delta Q} + \frac{\Delta TVC}{\Delta Q} = \frac{\Delta TVC}{\Delta Q}$$

- MC can be given by the slope of TVC or the slope of TC curves at a given output level.
- MC also has U-shape.

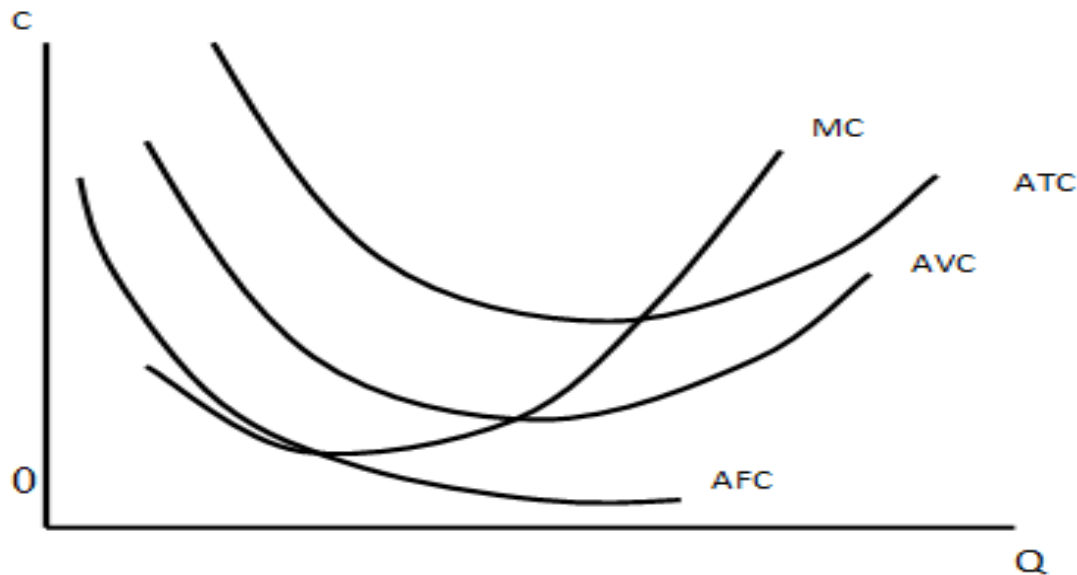


Fig.3.2 Marginal Cost Curve and the Three Average Cost Curves

The Relationship b/n Product & Cost Curves

- Suppose that we have one variable input of X & price of X is P_x . Hence, $TVC = XP_x$.

$$AVC = \frac{TVC}{Q} = \frac{XP_x}{Q} = P_x \left(\frac{X}{Q} \right) = P_x \left(\frac{1}{AP_x} \right), \text{ because average product of labor } AP_x = \frac{Q}{X}$$

$$\Rightarrow AVC = \frac{P_x}{AP_x}, \text{ This shows the inverse relationships between AP and AVC. As AP first}$$

increases, reaches a maximum & then declines, AVC first declines, reaches a minimum & then rises.

- Similarly,
$$MC = \frac{\Delta TVC}{\Delta Q} = \frac{\Delta(P_X X)}{\Delta Q} = P_X \frac{\Delta X}{\Delta Q}$$
$$\Rightarrow MC = P_X \left(\frac{1}{MP_X} \right) = \frac{P_X}{MP_X}$$

- This implies that MC & MP are inversely related.
- As MP first increases, reaches a maximum & then declines, MC first decreases, reaches a minimum & then increases.

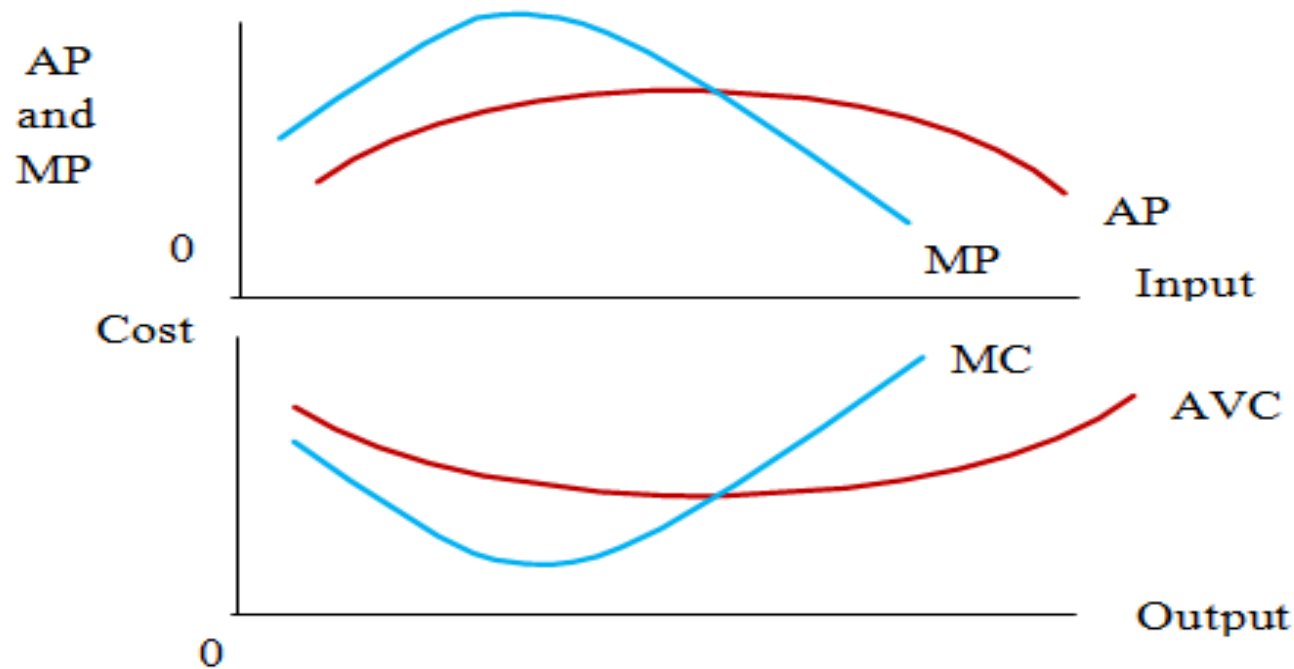


Fig. 3.3 Relationship between Product and Cost Curves

- The MP curve lies above the AP curve in the region where the MC lies below AVC.
- The MP curve lies below AP curve in the region where the MC curve lies above the AVC curve.

The Economic Optimum

- If we use TC-TR approach, the economic optimum of production is reached when the d/c e b/n TC & TR is maximum.
- i.e. $MC = MR$.
- Profits are at maximum when output is at a level where $MC = MR$.
- production of an additional unit is always profitable as long as MC is less than MR because less is added to TC than is added to TR.

- Production of an additional unit is always ***unprofitable*** if $MC > MR$, since more is added to the TC than is added to the TR.
- Therefore, there is a need to decrease production to the point where $MR=MC$.
- **Example:** Based on the following table, determine the profit maximizing output and the maximum profit if the cost per unit of input(X) is birr 5 and the price per unit of output(Y) is birr 3.

X	Y	TFC	TVC	TC	AFC	AVC	ATC	MC	TR	MR	π
0	0	20	0	20	-	-	-	--	0	-	-20
1	2	20	5	25	10	2.5	12.5	2.5	6	3	-19
2	5	20	10	30	4	2	6	1.67	15	3	-15
3	9	20	15	35	2.22	1.67	3.89	1.25	27	3	-8
4	14	20	20	40	1.43	1.43	2.86	1	42	3	2
5	19	20	25	45	1.05	1.32	2.37	1	57	3	12
6	23	20	30	50	0.87	1.3	2.17	1.25	69	3	19
7	26	20	35	55	0.77	1.35	2.12	1.67	78	3	23
8	28	20	40	60	0.71	1.43	2.14	2.5	84	3	24
9	29	20	45	65	0.69	1.55	2.24	5	87	3	22

- The **economic optimum** occurs at an output level of about 28 units, where $MC=MR=P_Y$
- At this level, the total profit become birr 24.

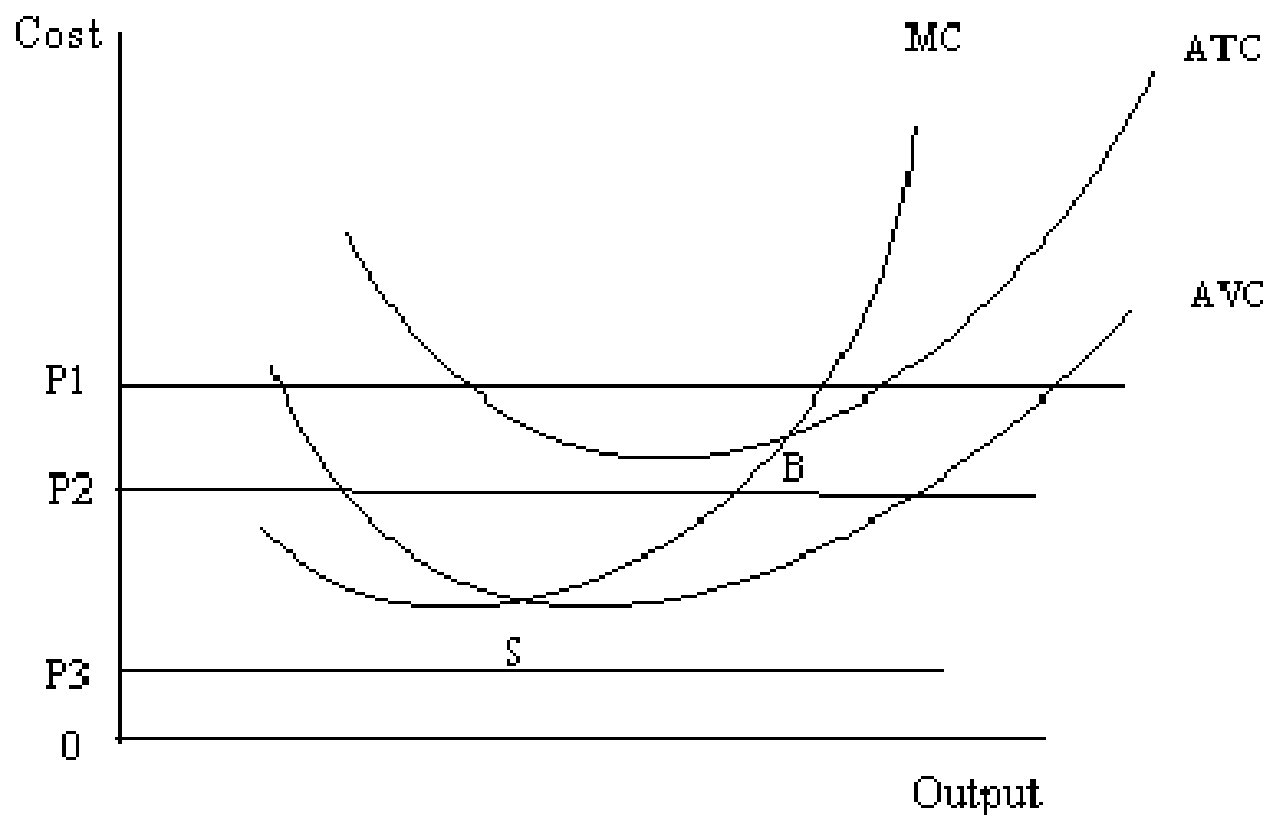
Three rules used for making production decision in the short run:

1. When selling price (P_1) is greater than ATC profit can be made and is maximized by producing where $MR=MC$.
2. When selling price (P_2) is less than minimum ATC but is greater than minimum AVC the income/revenue will not be sufficient to cover total cost.
 - It covers all variable costs with some left over to pay part of fixed costs.
 - The loss can not be avoided and will be somewhere between zero and TFC.
 - Production will continue and the loss is minimized by producing where $MC=MR$.
 - The point where selling price is equal to the minimum ATC is called **break-even point (B)**.

3. When selling price (P_3) is less than minimum AVC the income will not even cover the variable costs.

- The loss is minimized by shutting down.
- This would minimize the loss at an amount to TFC.
- When selling price is equal to minimum AVC, the loss is equal to TFC and the point is called as **shut down point (S)**.

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- **Exercise:** calculate TFC, TVC, ATC, AVC, AFC and MC functions for the following cost function. $TC=100+5Q-0.2Q^2$.

The Law of Equi-marginal Returns

- When resources are limited, expansion of one enterprise generally requires an equivalent contraction in another enterprise.
- The question here is which enterprise or combination of enterprises will give the greatest income?
- Such an optimum choice of enterprises is made based on the principle of equi-marginal returns.
- The principle of equi-marginal returns states that profit from the available limited resources can be maximized by using the resources in such a way that ***the marginal return (the marginal value product) of the last unit of the resource used on each enterprise is equal.***

- Example: Suppose a farmer has birr 5000, which can be invested to grow crops (wheat & barley) and raise dairy & poultry. The farmer's problem is to determine the amount of capital that he should invest on each enterprise to get the highest profit.

Money spend (capital invested)	MVP ₁₀₀₀			
	Wheat	Barley	Dairy	Poultry
1000	1400	1150	1300	1450
1000	1300	1100	1200	1300
1000	1200	1000	1100	1100
1000	1200	900	900	1000
1000	1100	850	800	900
Total return from Birr 5000	6200	5000	5300	5750
Net return/Profit	1200	0	300	750
Average return	1.24	1	1.06	1.15

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- If the farmer follows the law of average returns, he will invest the whole capital for production of wheat to get a gross return of birr 6200 and a maximum profit of birr 1200.
 - However, if the farmer follows the law of equi-marginal returns, where the marginal return in each direction of his investment are equal, he can get a gross return of birr 6750 and a maximum profit of birr 1750.

- Therefore, the farmer should allocate birr 2000 for wheat production, birr 1000 for dairy and birr 2000 for poultry production, which results the maximum profit of birr 1750.
- The Table below shows investment allocation on the three enterprises.

Allocation	Selected enterprises	Added return
The 1 st birr 1000	Poultry	14500
The 2 nd birr 1000	Wheat	1400
The 3 rd ,4 th & 5 th birr 1000	Wheat, Dairy & Poultry	1300 each
Total return from birr 5000		6750
Net profit		1750

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- An allocation based on the equi-marginal return principle has an opportunity cost concept.
- For example, in the above table, if the farmer allocates the available limited capital as 2000 to wheat production, birr 2000 for poultry production and 1000 for barley production, the opportunity cost of the last 1000 is birr 1300 that could be obtained from using the money for dairy production.

4. The Principle of Comparative Advantage

- Consider two regions of equal size: Region 1 & Region 2, both of which produce & consume two agricultural products: maize & wheat.
- A region is said to have an ***absolute advantage*** in the production of a commodity or a group of commodities if it can produce them ***more efficiently than the other region***.
- This means the other region has an ***absolute disadvantage*** in the production of these products.

- However, if there are *differences in relative efficiencies* of producing the different goods in the two regions, we can always be sure that even the *disadvantageous* region can have a *comparative* advantage in those commodities for which it is relatively more efficient.
- Therefore, regional specialization in the production of agricultural commodities and other products is explained by the principle of comparative advantage.

- The principle of comparative advantage states that *individuals or regions will tend to specialize in the production of those commodities for which their resources give them a relative or comparative advantage.*
- While livestock and some crops can be raised over a broad geographical area, the *yields, production costs* and *profits* may be different in each region.
- Thus, it is *relative yields, costs & profits* which are important for this principle.
- An illustration of this principle using yields is shown below.

	Region 1	Region 2
Maize yield per hectare	100	60
Wheat yield per hectare	40	30

- ❖ **Region 1** has an *absolute advantage* in the production of both crops because of the *higher* yields.
- However, **Region 1** must give up *2.5 quintals of maize* for every quintal of wheat it grows while **Region 2** has to give up only *2 quintals of maize* to get a quintal of wheat.
- ❖ **Region 2** has *relative or comparative advantage* in the production of *wheat*, since it gives up *less maize* for a quintal of wheat than Region 1.

- *Wheat farmers in Region 2* would be willing to give up **0.5 quintal of wheat to get a quintal of maize**, and maize farmers in Region 1 would be willing to take 0.4 quintal or more of wheat for a quintal of maize.
- Assume *Region 1* specializes in **maize** production and *Region 2* in **wheat** production.
- Farmers in both regions would be willing to **trade** if 0.4 to 0.5 quintal of wheat could be exchanged for a quintal of maize.
- Farmers in each region could obtain the product from the other region at **less cost** than raising it themselves.
- Therefore, they will tend to specialize in producing the product for which they have **comparative** advantage.

- Specialization can also make the combined regions better off.
- Assume that there is 100 hectare in each region and each region plants one- half maize and one -half wheat.
- If the two Regions produce both products, the total production is 8000(5000 in Region 1 and 3000 in Region 2) quintals of maize and 3500(2000 in Region 1 and 1500 in Region 2) quintals of wheat.
- If Region 1 specializes in maize and Region 2 in wheat production, total production is 10000 quintals of maize and 3000 quintals of wheat.
- As long as the income from an additional 2000 quintal of maize is more than the income lost from a reduced 500 quintal of wheat, ***specialization increases the total value*** of the crops produced.

- *Trade* between the regions allows each to obtain the final desired combination of the two products.
- Thus, the law of comparative advantage directs a farmer in selection of those crop and livestock enterprises, in the production of which available resources have the ***greatest relative***, but not absolute advantage.
- That is why, for example, Dinsho district farmers specialized in barley production while Sinana district farmers specialized in wheat production.
- All these are the result of the operation of this principle.