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A. Increase in Yield and Income

There are number of factors, e.g., soil, climate, seeds, fertilizer, availability of water, etc., influence the agricultural yield and, hence, income. But the water is the most important factor which alone can bring a considerable improvement in the financial conditions of agriculturists. Once, the supply of water is assured the farmers can go in for high yielding varieties of seeds, use fertilizers, put more efforts the cumulative effect of which is an increase in yields. It is a common experience.

The high yielding varieties of seeds require both the fertilizers and water. If a sufficient quantity of water is not available, the fertilizer generates excessive heat which destroys the costly seeds. Thus a fertilizer produces adverse effects and even a normal yield would not be available. As a result, the farmers from the non-irrigated areas abstain themselves from using high yielding varieties of seeds and chemical fertilizers. They use common seeds and cow-dungs as fertilizer. Consequently, their yields are very low.

A Case Study

In order to prove this common experience a separate case study has been undertaken in Uruli-Kanchan
area of Haveli taluka (Poona district). A group of
five farmers were interviewed from the village Shindavane.
The village is situated five kilometers south of Uruli-
Kanchan. Shri Dattatraya Namdeo Shitole could give
reliable information. Again his case has the following
special features -

i) He has 12 acres of land out of which only
2 acres come under well irrigation for cultivating the
remaining 10 acres he has to depend entirely on the
vigaries of monsoon.

ii) The well has been dug only last year at
the cost of Rs.12,000, and electric motor of 5 H.P.
strength has been installed at the cost of Rs.4,500.

iii) The well irrigates only 7 acres of land.
It is owned commonly by three cultivators who have
contributed according to the area irrigated. It is a
kind of Community Well. All farmers have jointly
mortgaged their lands with the Land Mortgage Bank, for loan.

iv) The water is taken to the field with the
help of earthen channels ( ). The pipes can also
be used for this purpose. But the cost is almost
prohibitive, viz., Rs.10.25 per ft. And, hence, this
group of farmers preferred the earthen open channels.
Shri Shitole has supplied the following information both for irrigated and non-irrigated lands with a special reference to cropping pattern, yields and incomes. The information can be summarised as follows –

**Non-Irrigated Area**

**Total Area**: 10 Acres

Due to non-availability of water he takes only one crop in a year in this area. He has made two plots of five acres each of this land. He is taking the following combined crops in each plot as follow –

**I - Plot**: Area - 5 Acres

- **Crops**: Bajari and Mataki

**Expenditure**:
- Ploughing: ... ... 200.00
- Seeds, Cow-dung, transport, etc.: 275.00

**Total** = 475.00

**Total Income**:
- Bajari: 500 kg x Rs.2/- per kg. = 1,000.00
- Mataki: 100 kg x Re.1/- = 100.00

**Total** = 1,100.00

**Net Income**: Rs.1,100 - 475 = 625.00

**Net Income per acre**: Rs.625 ÷ 5 = 125.00
II - Plot : Area - 5 acres

Crops : Jwari and Kardai

Expenditure : Ploughing ... ... 200.00
Seeds, Cow-dung, etc. ... ... 185.00

Total : 385.00

Total Income :

Jwari: Due to insufficient water yield was very low, viz., 300 kgs.
Total Cost ... ... 600.00

Kardai: Due to pests and other diseases, the yield was very low.
Total cost ... ... 300.00

Total : 900.00

Net Income : Rs. 900 - 385 = Rs. 515.00
Net Income per acre = Rs. 515 \div 5 = Rs. 103.00

Total Net Income per acre of Plot I and II (Rs. 125 + 103 = 228 \div 2) = Rs. 114.00

Well-Irrigated Area

Availability of water facilitates cultivation of both the Kharif and Rabi crops in this area of two acres. Shri Shitole has used this land in the following ways:
### Kharif-Bajari: Area - 2 acres

<table>
<thead>
<tr>
<th>Expenditure</th>
<th>Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ploughing</td>
<td>120.00</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>600.00</td>
</tr>
<tr>
<td>Other cultivation</td>
<td>225.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>945.00</strong></td>
</tr>
</tbody>
</table>

Total Income:
- Bajari: 1,200 kgs. x Rs. 2/- per kg. = 2,400.00
- Fodder: 160.00

**Total:** 2,560.00

Net Income = 2,560.00 - 945.00 = 1,615.00

Net Income per acre from Kharif Bajari only is 812.50

### Rabi - Crops in One - Acre:

#### Wheat: Area - 1/2 acre

<table>
<thead>
<tr>
<th>Expenditure</th>
<th>Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ploughing</td>
<td>30.00</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>115.00</td>
</tr>
<tr>
<td>Other charges</td>
<td>70.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>215.00</strong></td>
</tr>
</tbody>
</table>

Total Income:
- 450 kgs. x Rs. 2.00 per kg = 900.00

Net Income = 900.00 - 215.00 = 685.00

#### Rabi-Jwari: Area - 1/2 acre

<table>
<thead>
<tr>
<th>Expenditure</th>
<th>Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ploughing</td>
<td>30.00</td>
</tr>
<tr>
<td>Fertilizer (uria)</td>
<td>40.00</td>
</tr>
<tr>
<td>Other charges</td>
<td>70.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>140.00</strong></td>
</tr>
</tbody>
</table>
Total Income

Jwari : 480.00 kg @ Rs.2.00 per kg = Rs. 960.00
Fodder ... ... 125.00
Total :- 1,085.00

Net Income : Rs.1085 - 140 ... Rs. 945.00

Total Net Income from Rabi-Wheat and
Rabi-Jwari = Rs.685.00 + Rs.945.00 = Rs.1,630.00

Total Net Income per acre irrigated land both from
Kharif and Rabi crops = Rs.812.50 + Rs.1630.00 = Rs.2,442.50.

One acre irrigated land has now been brought
under the cultivation of sugarcane. Shri Shitole
anticipates that the newly constructed well would supply
water sufficient for sugarcane.

The monetary yield or income in terms of money
received from non-irrigated and well irrigated areas can
be compared. In case of non-irrigated area income per
acre is Rs.114.00 while for well-irrigated area income
per acre is Rs.2,442.50. It would speak itself for the
benefits generally derived due an assured supply of
water.
The wells are being largely used by farmers to irrigate their lands, and the motors, electric pump sets and diesel engine pump sets are the common devices employed for lifting water from wells. Naturally, it is in the interest of the farmers at large, to know which is the cheaper device. And, hence, this study of costs of operations has been undertaken. In addition to comparison of costs, the study would certainly reveal the means through which the farmers can use their meagre resources for reaping the maximum gains. As a result, this study has become imperative.

The Salient Feature

Common Costs

(I) Cost of Wells

It varies according to the depth; which is popularly measured in terms of "Purush", i.e., a depth of 7 ft. and 6 inches. At present in Uruli-Kanchan area the cost of digging a well is Rs.1,500 per Purush and generally a depth of a well is never less than 20 ft. Thus, the cost of digging is approximately Rs.4,000. The cost of lining and other constructions varies between Rs.1,000 and Rs.1,500. Thus, the cost of a usable well is generally Rs.5,500. For all cases of comparison of costs of operations, this cost of well has been commonly used.
(II) Cost of Excavation and Maintenance of Field Channels

It varies with the area irrigated but never exceeds Rs.100/- per year per acre of the irrigated area. Due to movement of men, cattle and carts and other agricultural appliances major repairs have to be undertaken to the field channels. Many labour-days are spent in keeping these water courses clean otherwise unchecked growth of weeds obstruct the speedy movement of water. This cost, like the cost of well, is taken common for undertaking cost comparison in all cases.

(III) Interest on Investments

It has been calculated 10 per cent per annum on the amounts invested in different devices under consideration.

From the details stated above the following statistical tables have been prepared.
Table No. 1: Comparative Study of Costs of Investments, Repairs and Depreciations of Mot, Diesel Engine and Electric Motor Pump Sets.

<table>
<thead>
<tr>
<th>Item of Expenditure</th>
<th>Note</th>
<th>Pump Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>1,200</td>
<td>5,325 4,950</td>
</tr>
<tr>
<td>Annual Expenditures</td>
<td></td>
<td>Diesel</td>
</tr>
<tr>
<td>i) Interest on Investment @ 10% per annum</td>
<td>120</td>
<td>532 495</td>
</tr>
<tr>
<td>ii) Repairs and Maintenance</td>
<td>40</td>
<td>200 450</td>
</tr>
<tr>
<td>iii) Depreciation</td>
<td>115</td>
<td>266 247</td>
</tr>
<tr>
<td>Total Expenditure (Item Nos. I, II &amp; III)</td>
<td>275</td>
<td>990 1,192</td>
</tr>
<tr>
<td>* Costs per Effective working day</td>
<td>2.29</td>
<td>13.30 15.89</td>
</tr>
</tbody>
</table>

* It has been observed that during the rainy season, i.e., at least for a period of four months, generally water lifting devices are not used. Again, a period of about two months is necessary for farmers to undertake the different cultivation works like ploughing, etc. during which water is not supplied to fields. Thus, during a period of about six months at least, the water lifting devices remain idle. It is, therefore, logical to appportion these fixed annual costs only for a period which these devices are effectively used. And, this period is only six months in a year.
In case of diesel engine and electric pump set it has been noted that these devices are used maximum to 3 times in a week. Thus, for a period of six months these devices would be generally used for 72 times, and under no circumstances these would be used for more than 75 times.

Therefore, the annual costs have been divided equally for 75 effective working days and those costs have been considered while computing the costs of operating these devices.

The motors are used more extensively. But even in that case maximum effective working days would not exceed 120 days. And, hence, the annual cost has been divided equally for 120 effective working days.

Table No.2: Comparative Study of Cost of Operation of Mot, Diesel Engine and Electric Motor Pump Sets. (Amount in Rs.)

<table>
<thead>
<tr>
<th>Item of Expenditure</th>
<th>Mot</th>
<th>Diesel Engine</th>
<th>Electric Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td>-</td>
<td>8.64</td>
<td>-</td>
</tr>
<tr>
<td>Oil</td>
<td>-</td>
<td>0.60</td>
<td>-</td>
</tr>
<tr>
<td>Electric charges</td>
<td>-</td>
<td>-</td>
<td>17.00 *</td>
</tr>
<tr>
<td>Wages</td>
<td>8.00</td>
<td>7.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Other Expenses</td>
<td>5.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>13.06</td>
<td>16.24</td>
<td>27.00</td>
</tr>
</tbody>
</table>

* Please refer to a note given in table No.1 Annual electric charges are Rs.1,200/-. These are equally apportioned for 75 days.
Table No.3: Comparative Study of Total Costs of Operation of Mot, Diesel Engine and Electric Motor Pump Sets - per Effective Working Day.  

<table>
<thead>
<tr>
<th>Item of Expenditure</th>
<th>Mot</th>
<th>Diesel Engine</th>
<th>Electric Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Cost (Table No.1)</td>
<td>2.29</td>
<td>13.30</td>
<td>15.89</td>
</tr>
<tr>
<td>Cost of Operation (Table No.2)</td>
<td>13.06</td>
<td>16.24</td>
<td>27.00</td>
</tr>
<tr>
<td>Total Cost</td>
<td>15.35</td>
<td>29.54</td>
<td>42.89</td>
</tr>
</tbody>
</table>

Table No.4: Comparative Study of Water Lifting Capacity of Mot, Diesel Engine and Electric Pump.  

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Mot</th>
<th>Diesel Engine</th>
<th>Electric Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Hour</td>
<td>1,000</td>
<td>10,200</td>
<td>10,200</td>
</tr>
<tr>
<td>Per Effective working day (Eight hours)</td>
<td>8,000</td>
<td>81,600</td>
<td>81,600</td>
</tr>
</tbody>
</table>

* Time Taken to Irrigate One Acre Inch of Land
  - in Hours: 24.00, 2.35, 2.35
  - in Days: 3.00, 0.3, 0.3

* One-Acre-Inch Irrigation means supplying water one acre of land with a depth of one-inch. It requires 24,000 gallons of water. It is taken as a base for further calculations.
Table No.5 : Comparative Study of Costs Incurred on Irrigating One-acre-inch of land by Mot, Diesel Engine and Electric Motor Pump Sets.

( Amount in Rs.)

<table>
<thead>
<tr>
<th>Items</th>
<th>Mot</th>
<th>Diesel Engine</th>
<th>Electric Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost per Effective Working day ( Rs.)</td>
<td>15.35</td>
<td>29.54</td>
<td>42.89</td>
</tr>
<tr>
<td>Time in terms of Day taken to irrigate one-acre-inch of land</td>
<td>3.00</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Cost of Irrigating land ( Rs.)</td>
<td>46.05</td>
<td>8.87</td>
<td>12.87</td>
</tr>
</tbody>
</table>

Charges Incurred in the Operation of Mot System

A) Investment in Mot System

In order to facilitate the smooth operation of 'mot' a big slanting slope is prepared. At the edge of the well the height of the slope is about seven ft. and the length is about fifteen ft. It is an ordinary earthen construction costs at least Rs.500.

The second major items of cost of mot is the costs of poles, pulley and ropes. At present, in Uruli-Kanchan areas these items cost Rs.200.

Third item is the cost of mot itself. The leather bag costs Rs.300 while the galvanized iron sheet bucket costs Rs.500. The life of the leather bag is about five years. The bucket lasts at least for ten years.
Specially during rainy season tar is applied at the bottom of the bucket to protect it from getting rusted. Other repairing charges are minor, viz., Rs.20 per year. For the purpose of our study, we would consider the use of bucket only, as it is being commonly used. A use of leather bag is getting fast out dated.

Thus, the total capital investment in the mot is Rs.1,200.

B) Cost of Repairs of Mot System

In addition to minor repairs to iron bucket costing not more than Rs.20 per year, another charge of equal amount is incurred on maintenance and repairs of the slope specially prepared for the operation of the mot. On an average at least four to five labour days are spent in a year to remove the grass, fill the pits and maintain the tracks on the slope. At present, in Uruli-Kanchan area, the labour charges are Rs.4/- per day. Thus, the total cost of repairing the mot system never exceeds Rs.40/-per year.

C) Depreciation Charges in Mot System

The slope lasts for 20 years the cost of construction of which is Rs.500. The depreciation is Rs.25/- per year.
The poles, pulley and ropes are generally replaced after five years. Their costs is Rs.200 and depreciation is Rs.40 per year.

The life of the iron bucket is ten years. Its cost is Rs.500/-. Thus, the depreciation comes to Rs.50/- per year.

The total depreciation comes to Rs.115/-. 

D) Cost of Operation of Mot

At least two workers and a pair of bullocks are required for the operation of mot. One worker is required to operate the mot proper, i.e., a water lifting device and other worker is necessary to take water to the proper fields. At the present rates, prevailing in Uruli-Kanchan area, the labour cost for one day would be at least Rs.8/- per day.

A pair of bullocks costs at least Rs.2,000 at the prevailing market prices. It is used extensively for all agricultural works. Again, its effective working life also cannot be ascertained. And, hence, its share in the cost of operation of mot cannot be found out. But an interest on this investment at the rate of Rs.10/- per annum (the rate of interest on savings account) can be considered as a charge of operation. It comes to Rs.0.56 per day.

A pair of bullocks needs to be well fed. A green grass or 15 bundles of fodder worth Rs.3/- per day
is required together with "Pend" worth Rs.1.50 per day is necessary for them. Thus, total cost of their maintenance comes to Rs.4.50 per day and the total cost of operation of mot comes to Rs.13.06 per day.

E) Water Lifting Capacity of Mot

A water lifting capacity of mot is very limited. The iron bucket has a capacity to lift 50 gallons of water in one instalment. On an average a period of 3 minutes is taken for the completion of one rotation, i.e., in one hour twenty rotations are completed and water of 1,000 gallons is lifted from the well. Generally, the mot is operated for eight hours in a day lifting water to the extent of 8,000 gallons.

Charges incurred in Operating Diesel Engine Pump Set

The various charges incurred in this connection can be summarised as follows -

A) Investment in Diesel Engine Pump Set

Generally, 5 H.P. engine is installed on wells by the cultivators for their private use. At present it costs at Rs.5,325/- including Pump set, minimum pipe line of 50 ft. and other minimum accessories. Thus, the total investment in the diesel engine pump set is Rs.5,325/-.
B) **Cost of Operation**

The cost of operation of a diesel pump set is comprised of the following three major elements -

a) **Cost of Diesel Consumed**

Generally, 5 H.P. engine consumes diesel at a rate of 1 litre per hour. According to the prevailing market rates, diesel costs Rs.1.08 per litre. On an average, at a time, engine is run for 8 hours. Thus, the total cost of diesel would be Rs.8.64 per day.

b) **Cost of Oil**

In crank-case - a part of diesel engine - some lubricating oil is necessary for the smooth running of engine. A specific level of this oil has to be maintained in the crank case. The operator checks this level before the engine is started. The cost of this oil is not more than Rs.0.60. In eight hours the entire oil is consumed.

c) **Wages of Operator**

It is a variable element and depends on number of factors. But the operator is paid at least Rs.6/- per day.

d) **Wages of Assistant**

Generally, the operator looks after the distribution of water to fields. In this work he is assisted by an unskilled child labour who is paid Rs.2/- per day.
C) Cost of Repairs and Maintenance

It is also a variable element depends upon the manner in which machinery is handled. But on an average Rs.200/- per year are spent on this item of expenditure. Specially, after a period of five years the cost of repair increases. Various parts have to be replaced. It is a costly affair. Thus, with the growing age of engine, cost of repairs and maintenance also increase.

D) Depreciation Charges

An effective working life of an engine is generally assumed on 20 years. Thus, an annual depreciation comes to Rs.266.25. An exception to this assumption has also been experienced. It has been observed that Shri Patil - a farmer in Uruli-Kanchan - is using his AVI - Kirloskar 5 H.P. engine for last 30 years. The said engine is in the best conditions and is rendering a satisfactory service.

E) Water Lifting Capacity

A water lifting capacity of 5 H.P. engine is 170 gallons per minute, i.e., 10,200 gallons per hour and for eight hours - for a full working day - it would be 81,600 gallons.
Advantages of Engine

a) Easy Movement

Now a trolley-mounted engines are available, and, hence, these can be easily moved to any place and at any time as per the requirements.

b) Hire - Income

It has been observed that the engines are generally hired by their owners. Its easy movement facilitates this. On an average Rs.150/- are earned per year.

c) No Expenditure on Engine House

Since the engine is movable, during rainy season it can be shifted to a proper place. It avoids expenditure on engine house.

d) Dependable Water Lifting Device

Now the diesel is easily available and its supply is dependable, even in rural areas and farmers can purchase it as per their requirements. The services of mechanics are also available. As a result, the chances of putting the engine out of use due to break down have been considerably minimised. Naturally, engine can be used whenever necessary. Thus, it has now proved to be a dependable water lifting device.
Charges Incurred in Operating Electric Motor Pump Set

A) Investments

An investment in electric motor and pump set amounts to Rs.4,100/- and the cost of pipe line of a minimum length is about Rs.700/-. Thus, the total investment goes to Rs.4,800/-. Another item of expenditure in investment is the cost of wiring. It varies with the length type of wiring, viz., two phase or three phase wiring. But on an average Rs.150/- are spent by farmers in Uruli-Kanchan area. Thus, an investment amounts to Rs.4,950/- including the cost of wiring.

B) Cost of Operation

It includes the following two elements -

a) Electricity Charges

Annual electricity charges for 5 H.P. electric motor amount to Rs.1,200/-. These are almost fixed charges. Those who use motor extensively have to pay more charges. I have interviewed about seven farmers in this connection. It was revealed that the electricity charges vary between Rs.1,100 and Rs.1,630/- and average comes to Rs.1,200/-. 
b) **Wages**

For proper distribution of water at least two workers, popularly termed as Darulas, are required. They are generally paid @ Rs.5/- per worker per day, i.e., Rs.10/- per day is the total expenditure incurred on them.

c) **Cost of Repairs and Maintenance**

It has been observed that on an average Rs.400/- per year are spent on repairs of motor and another sum of Rs.50/- per year has to be spent on maintenance. Thus, the total cost of repairs and maintenance becomes Rs.450/- per year.

D) **Depreciation Charges**

Generally the life of electric motor is estimated to 20 years. Properly maintained motors can work effectively for a period even more than this. But it is assumed on a normal period of effective working life. As a result, the annual depreciation comes to Rs.247.60.

E) **Water Lifting Capacity**

Its water lifting capacity is similar to diesel pump set, viz., 81,600 gallons per day for a period of eight hours.

**Difficulties in Operating Electric Motor Pump**

a) It is immovable. And, hence, during the rainy season some special arrangement has to be made to protect it from getting rusted.
b) It's operation depends upon the availability of electricity. In rural areas supply of electricity is uneven insufficient and hence, undependable. Naturally, the electric motor pump can not be said to be a dependable water lifting device.

c) In rural areas good electricians are not available who can undertake repairs efficiently.

Conclusions

The discussion outlined above leads to the following conclusions.

i) **The Cheapest Device - Diesel Engine**

Out of all water lifting devices the diesel engine pump set is the cheapest. In a period of 2 hours and 20 minutes, it irrigates one acre inch area at a cost of Rs.8.87.

ii) **The Costly Device - Jet**

It has proved to be the costly device among all devices for which comparative study has been made. It takes a period of three days to irrigate one acre inch area, the cost of which comes to Rs.46.05.

iii) **Encourage Use of Diesel Engines**

From the available statistics it can be concluded that the use of diesel engine be encouraged.
Tagai loans and other facilities be given on a larger scale for purchasing diesel engines.

Again, these engines are operated on diesel, the slow progress of electrification of rural areas would certainly not affect/hamper the smooth working of these engines.

iv) Lowering the Cost of Production

An employment of this device would lower the cost of production of produce, leaving sufficient and increasing profit margin for cultivators.