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Feasibility Analysis of Irrigation System in terms of Agricultural, Financial and Water Use Performance : A Case Study of Khor village of Daund Taluka, Pune

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ABSTRACT

This study is regarding the feasibility study of irrigation system of Khor Village in Daund Taluka, Pune district of Maharashtra in terms of Agricultural Performance, Water Use, and Financial aspects. Various indicators are used to evaluate agricultural water use and financial performance of irrigation system. The Agricultural indicators reveal that only for summer season output per crop area is good because of growing crops of high prices otherwise for Kharif and Rabi season the results are not acceptable. The Water use indicator reveal that for Kharif and Summer season more or less water demand and water supply is meeting but for Rabi season the crops are not getting enough water to meet their demand. The result of financial indicators is not upto a satisfactory level.

Keywords: Feasibility Studies, Relative Water Supply, Water Scarcity, Crop Area, O&M Cost.

I. INTRODUCTION

Due to increasing population, demand of food and fiber is increasing day by day. On the other hand, resources of water and per capita land are decreasing at scaring rate. Water is an important natural resource, which is used for agriculture, domestic, industrial and recreation purpose. Due to population growth and industrialization the demand and utilization of water is increasing which further increases pressure on the resources of water. In the present scenario we are just exploiting the resources of water keeping in mind the future demand.

For the development of Country, Agriculture is considered as major engine. As irrigation is the process of applying water artificially to the crop for the effective growth of the crop. Irrigation plays an important role in stabilizing the prices of food stuff and thus removing the worrying concern of food security. Irrigation not only helps in securing and increasing food production but helps in creating opportunities of decent life for their rural population. Over the last few years, it has been observed that there is drastic increase in the facility of the irrigation in the world and also in India. Minor irrigation project serves a good purpose for irrigation in India, but due to seasonal deficiency of availability of water for irrigation most of the minor irrigation project experience low efficiency and cropping pattern. The main reason for such a failure is the improper utilization and planning of irrigation water. To get more benefits from land, some farmer increase the coverage of their field, increase the intensity of crop in their fields, but due to non-availability of water during the crop growing period, the production decline and hence this invite the loss of the farmer.

In order to access the feasibility analysis of existing irrigation system in Khor Village, various indicators are used in this study. There are various domains for evaluating the performance of small scale irrigation. But in this study the performance of irrigation system of Khor village is evaluated in terms of Agricultural, Water Use and Financial. In order to assess the performance of the agricultural output, the agricultural performance indicators such as Output per cropped area, Output per unit command area, Output per unit irrigated supply, Output per unit water consumed will be used. The Water Use performance will be proposed to calculate by water performance indicators such as Relative Water Supply, Relative Irrigation Supply. The

Financial feasibility of the existing irrigation scheme will be accessed by financial indicator which is Operation and maintenance cost per unit area, Operation and maintenance cost per unit volume of water supplied, effectiveness of fee collection. By evaluating these indicators we came to know how efficiently system is installed, operated and maintained.

Literature

P.M. Ingle et al. in 2013-2014 in his research, performance of Kalwande Minor Irrigation Scheme (KMIS) in Chiplun, Ratnagiri district of Maharashtra using various indicators such as water consume output per unit cropped area, related to yield with land and water. The analysis of agricultural performance indicators showed that the production value of different crops grown in command area were lower than that of the recommended package of practices. The analysis of water use indicators showed that RIS and RWS were calculated as 1.27 and 2.49. This value represents that the total water supply is enough to meet the crop demand. The Financial Self Sufficiency (FSS) was 0.83 reveal that the revenue collected from irrigation was not sufficient for maintenance and operation of the project. The analysis of financial or economic indicators showed that the scheme had a serious problem about the collection of water fees i.e. irrigation charges or revenue collected from scheme were less than that of total operation and maintenance expenditures. The existing prospective of command area was not fully utilized.

Suryawanshi S.D. and Kapase P.M. (1985) have analysed in their research paper on 'Impact of Chod Irrigation Project on Employment of female Agricultural Labour' that agricultural labour and farm cultivation as the main areas of economic activities for rural women. The National Sample Survey has shown that the percentage contribution of women in agriculture is higher than men, where most of the key operations at farm are done by them.

II. INFORMATION OF STUDY AREA

A. Location of Study area

Khor village belongs to Desh or Paschim region of Maharashtra state. This is a village located between the latitudes of 18.402088 N and 74.324938 E in Daund Taluka of District Pune. The location of study area is shown in fig. 1.

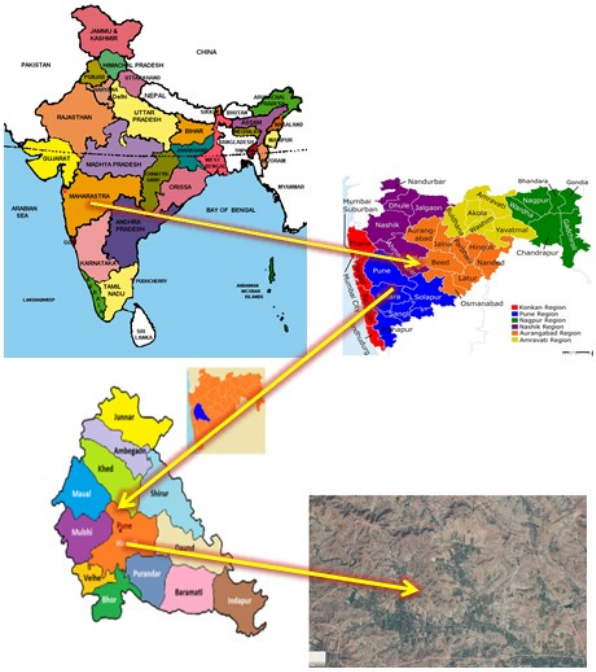

Figure 1. Location of study area

B. Climatic conditions in Khor village

The geographical area of Khor village is 2555 ha and has command area of 1399 ha (54.76 percent of geographical area) and cropping area of approx. 1020 ha. The total population of Khor village is 3280.

The climate of Khor village is generally hot and dry. May is the hottest month with an average temperature of 31.2 degree Celsius and the coldest month of the year is December with an average temperature of 21.4 degree Celsius. The area receives most of the rainfall during June to September and rest of the year the village is dry. The average annual precipitation in the village is about 410mm. There is no canal in the village for irrigation purpose. The water for irrigation is drawn from 228 wells and these are privately owned. The water is distributed in the fields through long and narrow channels called furrows as shown in figure 2. The water from ground resource is available for 8 to 9 months i.e. mostly from May - June to January – February. For the rest 3 to 4 months no irrigation is performed, even for drinking purpose water tankers are invited in village to meet drinking water demand.

Figure 2. Furrows in the fields

C. Cropping season and pattern

In the Khor village there are three cropping seasons *Kharif, Rabi* and *summer.* The Kharif season starts from July and ends in October, Rabi season starts from October and ends in November. For kharif season Bajra, gram and some vegetables are grown. For Rabi season Vegetables, Jowhar, Wheat and onion are grown. For the period between Kharif and Rabi season there comes summer season and Pomegranate, Anjer, Lemon, Custard apple, vegetables are grown. The cultivation of summer season is the cultivation of cash crops. Sugarcane remains in field for whole year and is cultivated in area not more than 17 ha due to less availability of water. From the five year analysis (from 2011 to 2015) it has been observed that out of the total cropped area, kharif crop is grown on about 300-350 ha of land. 450-550 ha of land is under Rabi cultivation and on 140 – 168 ha of land various fruits and vegetables are grown during the summer season.

III. METHODOLOGY

During the reconnaissance survey, agricultural offices, revenue offices, Sarpanch and some farmers of the village were consulted for general condition of the village from agricultural point of view. The data required to carry this study i.e. Cropping pattern, water supply, crop prices, operation and maintenance expenditure of irrigation infrastructure, revenue collected from farmers etc., was collected from responsible bodies, local farmers, offices at village level, taluka level and district level. The local prices of the crops were investigated at village market and Daund market. Interviews were conducted with farmers to get information about the irrigation methods, distribution and water scarcity problems of the village. As this work is done under Unnat Maharashtra Abhiyan (UMA) much effort has been made through survey and observation of different record at different areas to check accuracy and consistency of data. Following indicators are used to evaluate the irrigation performance of Khor village:

1. Output per cropped area $\left(\frac{\text{Rs}}{ha}\right) = \frac{\text{Production (Rs)}}{\text{Irrigated Cropped Area (ha)}}$
2. Output per command area $\left(\frac{\text{Rs}}{ha}\right) = \frac{\text{Production (Rs)}}{\text{Command Area (ha)}}$
3. Output Per unit I S $\left(\frac{\text{Rs}}{m3}\right) = \frac{\text{Production (Rs)}}{\text{Irrigation water supply (m3)}}$
4. Output per unit water consumed $\left(\frac{\text{Rs}}{m3}\right) = \frac{\text{Production (Rs)}}{\text{Volume of water consumed by ET(m3)}}$
5. Relative Water Supply (RWS) = $\frac{\text{Total water Supplied (m3)}}{\text{Crop Demand (m3)}}$
6. Relative Irrigation Supply (RIS) = $\frac{\text{Irrigation supply (m3)}}{\text{Irrigation demand (m3)}}$
7. O & M cost per unit area $\left(\frac{\text{Rs}}{\text{ha}}\right) = \frac{\text{O \& M Cost (Rs)}}{\text{Total area (ha)}}$
8. O & M cost per unit volume of water supplied $\left(\frac{\text{Rs}}{\text{m3}}\right) = \frac{\text{O \& M Cost (Rs)}}{\text{Total volume of water supplied (m3)}}$
9. Effectiveness of fee collection $\left(\frac{\text{Rs}}{\text{Rs}}\right) = \frac{\text{Collected fee (Rs)}}{\text{Total fee (Rs)}}$

Where,

Production is output of area in terms of gross value of production.

I S is irrigation Supply

ET is Crop evapotranspiration

IV. RESULTS AND DISCUSSION

Output per crop area: The output per crop area is higher for summer crops due to cultivation of crops of high value. The major factor affecting output per crop area is the production values, values of crop grown, cropping pattern and intensity. Table 1 shows output per

crop area from 2011 to 2015. Graphically increase in output per command area is shown in Figure 3 below.

Table 1: Output per crop area

	Kharif	Rabi	Summer
2011	17990	20790.55	52659
2012	21053.1	21892.48	60312.3
2013	24025.7	22131.36	61042.52
2014	26182.38	25792.5	61246.5
2015	25624.24	20621.28	63787.08

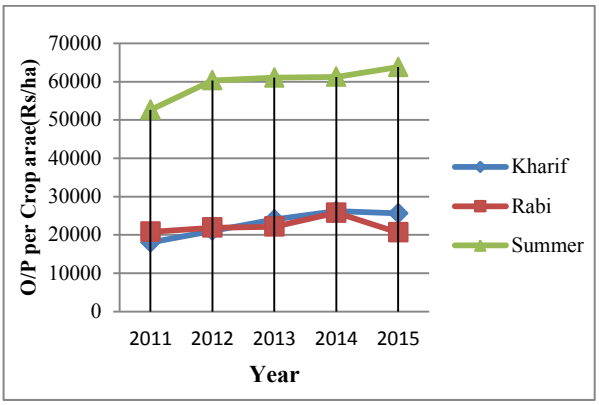

Figure 3. Showing Output per crop area

Output per command area:

The output per command area fluctuates for different years are shown in table 2 below. There fluctuation in values of output per command area and this fluctuation is due to change in cropping intensity, economic value of cultivated crops, amount of area chosen for cropping and irrigation ratios. Graphically Output per command area is shown in figure 4.

Table 2: Output per command area

	Kharif	Rabi	Summer
2011	3765.358	7644.547	5328.84
2012	4480.9	7780.683	6846.27
2013	5896.49	8792.5	5918
2014	5527.8	7680.728	7033.3
2015	6044.37	8033.3	7067.189

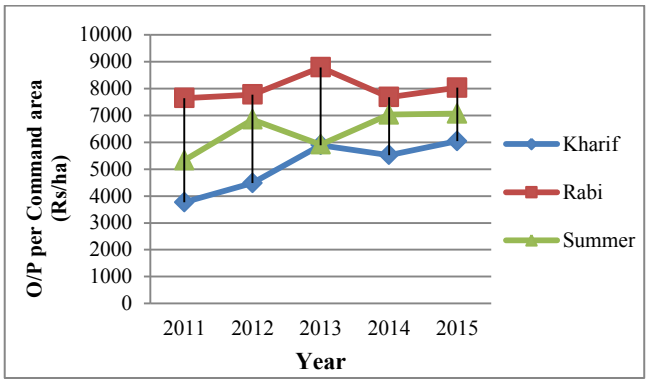

Figure 4. Showing Output per command area

Output per Irrigation supply:

The output per irrigation supply shows output for unit water supply. The average output per irrigation supply for Kharif, Rabi and summer season comes out to be 13.4 Rs/m^3, 21.8 Rs/m^3, 21.6 Rs/m^3. The output per irrigation supply is high for Rabi season; this is due to less availability of water for this season.

For summer season value is 21.6 Rs/ha. This value is higher than the Kharif season because of highly priced cash crops.

Output per Water consumed:

The average output per unit water consumed comes out to be 7.2 Rs/m^3, 9.6 Rs/$m^3$and 13.6 Rs/m^3 for Kharif, Rabi and summer season respectively. The output per unit water consumed value for summer season comes to be 13.6 Rs/m^3. This value is higher than the output per unit water consumed for kharif and summer season due to the cultivation of cash crops. As crops grown in summer season were sold at high price than the crop grown in other seasons.

Relative water supply:

The value of relative water supply was more than one indicates that the supply is enough to meet the crop demand. In case of Khor village it has been calculated that the on average relative water supply for Kharif, Rabi and summer season comes out to be 1.08, 0.671, 1.08 respectively. For the Rabi season RWS comes to be 0.671 indicating that about two third of the crop water demand is met from irrigation and rainfall, rest the crops are not meeting with the demand of water they need for their growth. This indicates that there is water scarcity in the village for the Rabi season

Relative irrigation supply:

RIS gives information how well supply of irrigation and demand of irrigation area matching. The relative irrigation supply for Kharif, Rabi and summer season comes out to be 1.18, 0.48 and 1.15 respectively. For kharif and summer season irrigation supply is just meeting the irrigation requirement but the water needs to be used wisely, efficiently and economically. For the Rabi season there are certain months in this season for which sufficient water for irrigation is not available so the RIS comes out to be 0.48 indicating that crops are not getting enough water for the Rabi season. Thus, the irrigation system of Khor village greatly suffers from inadequate irrigation water supply due to non-availability of water for irrigation of fields.

Operation and Maintenance Cost per unit Area:

The operation and maintenance cost for irrigation system in Khor village is Rs 1664400. For 1030 ha of crop irrigated area, the Operation and Maintenance Cost per unit Area of the system comes out to be 1616 Rs/ha and this value is 34% above the state norms. The high value is due to use of pump, need of electricity to run individual pump thus increasing operation cost. According to state noms the operation and maintenance value should not exceed 1210 Rs/ha.

Operation and Maintenance Cost per unit volume of water supplied:

The Operation and Maintenance Cost per unit volume of water supplied comes out to be Rs 1.04 / m^3. This value is much higher than the state norms. This higher value is due to the well irrigation as pump is used and pump operates on electricity. Operation and Maintenance Cost per unit volume of water supplied, is less for surface /canal irrigation and is higher for well irrigation.

Effectiveness of fee collection

Effectiveness of fee collection for the Khor village comes out to be 0.288, this indicates that effectiveness of fee collection is not at a satisfactory level and this low value is due to the low production from farms, less water availability and also the fee was exempted by government due to low production, as certain cases of farmers suicide is observed in the village few years back. The poor farmers could not able to pay fee. There is no serious sanction to farmers of village on paying fee to the government.

V. CONCLUSION

The study was done to introduce the concept of performance indicators such as agricultural, financial and water use indicators as a tool to evaluate the performance of irrigation system of Khor village. The result shows that output per crop area is good for summer because of growing crops of high prices otherwise for Kharif and Rabi season it is very less. The RWS and RIS for summer season 0.671 and 0.48 respectively indicate the problem of scarcity of water. Land was not the limitation in Khor village but the major problem in village is lack of sufficient water for irrigation, poor rain water utilization. The operation and maintenance values per unit area and O & M per unit water supplied comes out to be higher for the system according to the state noms and also the effectiveness of fee collection is very poor because of low production values. There is lack of awareness among the farmers in the village about techniques for improving performance of irrigation system and effectively utilization of water for irrigation by different irrigation methods such as drip irrigation, sprinkler etc.

The limited amount of water availability in Khor village can be overcome by the provision of construction of reservoir. These reservoirs will collect rain water during the monsoon season i.e. from Jun to September and then that water is utilized for the purpose of irrigation during the period of water scarcity especially during the Rabi season. From the survey it was observed that there are certain water bodies that were contaminated and not maintained from a long time, those water bodies can be used for the purpose of secondary reservoir if modified, cleaned and maintained properly. Effective water shed management study is required for the village and structures for recharging ground water should be designed and constructed so that water for irrigation can be drawn from wells throughout the whole year. The farmers should be trained for techniques to improve performance of irrigation system for increasing the crop production and removal of the water scarcity problem.

VI. REFERENCES

[1] P. M. Ingle, S.E. Shinde , M.S. Mane, R.T. Thokal and Ayare B.L 2012-2013 , "Performance Evaluation of a Minor Irrigation Scheme ; Research

Journal of Recent Sciences", ISSN 2277-2502,Vol. 4(ISC-2014), 19-24 (2015)

[2] Vyas V.S. and Mathai G. (1978), "Farm and Non-farm Employment in Rural Areas: Perspective for Economic Planning", Economic and Political Weekly, Vol. 28(6, 7), p.85.

[3] Ghumman A.R., R.A. Khan, H.N. Hashmi, M.A. Kamal, and I.T. Khan (2011), "Performance assessment of canal irrigation in Pakistan", African journal of agriculture research, ISSN: 1991-637X, vol. 6(12), Issue June, 18, 2011, page no. 2692-2698.

[4] Irajpoor A.A. (2011), "Performance of Irrigation Projects and their impacts on poverty reduction and its empowerment in arid environment", article, Int. J. Environmental science & technology, ISSN 1735-1472, vol.8 (3), page no. 533-544.

[5] Suryawanshi S.D. and Kapase P.M. (1985), "Impact of Chod Irrigation Project on Employment of female Agricultural Labour", Indian Journal of Agricultural Economics, Vol. XL, No. 3, July- September, page no..240-244.

[6] H.P Singh, M.R Sharma, Quamrul Hassan and Naved Ahsan, "Performance Evaluation of Irrigation Project-A case study of Lift Irrigation Scheme Sirsa Manjholi in Solan area of Shivalik Himalayas", Asian Journal of Adv. Basic Science, ISSN: 2347-4114, vol. 1(1), August 26,2013, page no. 79-86.

[7] Hayrettin Kuscu, Filiz Eren Boluktepe and Ali Osman Demir, "Performance assessment for irrigation water management: A case study in the Karacabey irrigation scheme in Turkey", African Journal of Agricultural Research, ISSN: 1991-637X, vol. 4(2), February 2009, page no. 124-132.

[8] H.P Singh, M.R Sharma, "Performance Evaluation of Bhabour Sahib Medium Irrigation Project", Asian Journal of Adv. Basic Science, ISSN: 2347-4114, vol. 2(2), June 2014 page no. 59-65

[9] Indicators for comparative performance of Irrigated Agriculture System by David J. Molden, R.Saakthivadivel, Christopher J. Perry and Charlotte de Fraiture

[10] Hiremath K.C. (1984), "Report on Socio-Economic Impact of Irrigation Projects", Indian Journal of Agricultural Economics, 39(3) p.559.

[11] Sanjay S. Phadnis and Mukul Kulsreshtha, "Benchmarking As a tool for Improvement of System Performance: A Case Study of Samrat Ashok sagar Irrigation project, Madhya Pradesh, India", Journal of Environmental Research And Development, ISSN: 0973-6921, vol. 5 No.4, April-June 2011 page 984-996

[12] Yusuf Kedir Hassen , Assessment of small scale irrigation using comparative performance indicators on two selected schemes in upper Awash river valley.

[13] M. Sener, S.Albut, "Irrigation Performance Assessment in Turkey: Thrace region Case Study" Bulgarian Journal of Agricultural Science, ISSN: 1310-0351, vol. 17(No.4), 2011, page no. 521-530

[14] Taqveem Ali Khan and Adil Abbasi.M, "Synthesis of parameters used to check the suitability of water for irrigation purposes" International Journal of Environmental Sciences, ISSN: 0976-4402, volume 3, No.6, 2013

[15] W.A.S. Lakmali , E.R.N. Gunawardena and N.D.K. Dayawansa, "Comparative Performance Assessment of Major Irrigation System in Upper Dedura Oye Basin", Tropical Agricultural Research vol. 26 (2): 343-354 (2015)

[16] Deepak Padekar, T. Bhattacharyya, S.K. Ray,"P.Tiwary and P.Chandran, Influence of irrigation water on black soils in Amravati district, Maharashtra" Special Section: Soil and water management.

[17] D Isidoro, D Quilez and R Aragues,"Water balance and irrigation performance analysis: La Violada irrigation district (Spain) as a case study", Agricultural Water Management, Vol. 64, Issue 2, 15 January, 2004, pages 123-142.

[18] Dr. C.N. Kokate and Mr. Ganesh Bade, "Participatory Irrigation Management: A Case Study"Proceeding of International Conference SWRDM-2012.

[19] Todkari G.U., Patil B.D., "Kamble S.S and Patil P.N., Irrigation Pattern in Solapur district of Maharashtra: A Geographical analysis" Geoscience Research ISSN: 0976-9846, vol. 1 issue 2, page- 22-27.

[20] B.S Katkar and Milind C. Ahire, "A study on adoption of drip irrigation system in Maharashtra State", International Journal of Agricultural Science, vol. 2 no.2 January 2006, page 335-337.

[21] http://www.cglrc.cgiar.org/iwmi/perform.htm