

Diversification of Cropping Pattern of Itiadh Irrigation Project in Maharashtra for Improving Water Use Efficiency

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KEYWORDS

itiadh irrigation project, cropping pattern, crop water requirement, irrigation water requirement, crop diversification

ABSTRACT:

Command area of Itiadh Irrigation Project falls under high rainfall zone with long term annual average of 1362 mm rainfall, well spread in four months of South-West monsoon (June to September), lowland Rice culture in kharif (monsoon) season is practiced by the farmers throughout the command. Due to favourable climate, assured water supply, comparatively good physical system for water distribution and farmer's know-how regarding rice culture, the average yields of kharif rice are better. As and when water is available for irrigation during Rabi cum Hot weather season, farmer again grow lowland rice, resulting thereby monoculture i.e. kharif rice followed by Rabi cum Hot weather rice. This also results in reduce area under irrigation due to very high water requirement of rice crop in Rabi cum Hot weather season. Therefore crop diversification is essential for increasing water use efficiency, area under irrigation and total monetary returns.

1.0 INTRODUCTION

Maharashtra occupies main portion of the Indian Sub-continent. The geographical location of Maharashtra is bounded between latitude 16.4° to 22.1° N and longitude 72.6° to 90.9° E and has an area of 307.71 thousand Sq. Km. The eastern region of Maharashtra State is consisting of Wainganga Basin. Itiadh Irrigation Project is located at the Eastern side of Wainganga Basin in the Arjuni Mor Taluka of Gondia District of Maharashtra State. Earthen Dam is constructed across the river Gadvi at Gothangaon. Tq. Arjuni Mor, Dist: Gondia. The Project is planed to irrigate an area of 22751 Ha. Culturable Command Area (CCA). The command of Itiadh Project falls under Bhandara, Gondia and Gadchiroli District of Eastern Vidarbha region of Maharashtra which is grouped under "Agro Climatic Zone No: 9" characterized for high rain fall zone. The average values of minimum and maximum temperature, minimum and maximum relative humidity, wind run and bright sun shine hours are 13 to 29° C, 27 to 42° C, 20 to 59 %, 39 to 86 %, 2 to 7 km/hr and 3.1 to 9.3 hours, respectively. Thus the climate of command of Itiadh Irrigation Project is highly favourable for growing different types of crops including lowland rice. Soils of Itiadh Irrigation Project are derived from mixed parent material and are brown to yellowish brown in colour, dominantly deep to very deep in nature (0.5 to 1 m), coarse to medium in texture with good available water storage capacity. The soils are free from any of the problem situations such as water logging, soil salinity, soil sodicity and acidity. Similarly surface (river/canal) water quality for irrigation is "Excellent". Ground water (dug wells) is also of good quality for irrigation. Thus, soil and water resources of Itiadh Irrigation Project are of best quality at present and have high potential for output with scientific management. Since the command area of Itiadh Irrigation Projects falls under high rainfall zone with long term annual average of 1362 mm rainfall, well spread in four months of south-west monsoon (June to September), low land rice culture in kharif is practiced by the farmers throughout the commands. Due to favourable climate, assured water supply, comparatively good physical system for water distribution and farmer's know-how regarding rice culture the average yields of kharif rice are better. The farmers are knowledgeable about planting right age of seedlings with right technique to maintain adequate plant population, intercropping

operations to keep rice fields free from weeds, adequate plant protection measures against pests & diseases. Field to field irrigation is practiced due to bunded basins. As and when water is available for irrigation during Rabi cum Hot weather season, farmers again grow low land rice resulting thereby monoculture i.e. kharif rice followed by R-H.W. Rice. This also results reduced area under irrigation due to very high crop water requirement of R-H.W. rice. Hence crop diversification is essential for high water use efficiency and also for increased area under irrigation. Soils and climatic conditions are also favourable for crop diversification in Itiadh Irrigation Project.

2.0 DESIGN AND EXISTING CROPPING PATTERN

Design cropping pattern of Itiadh irrigation project is presented in Table 1. Existing crop pattern and area irrigated reported by Bagh –Itiadh Irrigation Division Gondia, CADA Nagpur from 1971-72 to 2000-01 vide its evaluation report of Itiadh Project, on an average the Irrigated Command Area of 17980 ha is presented in Table 2. Total 100% ICA is cropped under lowland rice during Kharif season. Since kharif crop of lowland rice is grown during June to November which covers 97 to 100% area of ICA, the area for the Rabi season (October to February) is not available for arable cropping i.e. for non-paddy crops. In Itiadh irrigation project Rabi cum Hot – Weather irrigated rice (December to May) is grown on 7600 ha area out of 17980 ha ICA (Table 5.2) as per evaluation studies by the Irrigation Division (2001) which indicates about 42.37 % of ICA is cropped for R- H.W. rice under canal irrigated condition. This further indicates that command of Itiadh irrigation project is characterized for rice monoculture round the year. This is obvious due to high rainfall zone with adequate water availability for irrigation, which has resulted high water utilization with double cropping. However, there is need for crop diversification for high water use efficiency as well as to avoid demerits of mono cropping.

Table: 1 : Design Cropping Pattern of Itiadh Irrigation Project (1971 –72)

Sr.No.	Crops	Area (ha)	Percent area w.r.t. total area	Base period (days)
1	Perennials (Guava, citrus, etc.)	1147.00	9.40	365
2	Other perennials (Sugarcane, Banana)	163.50	1.34	365
3	Two Seasonals (Vegetables viz. Chilly, Tomato, etc.)	327.00	2.68	165
4	Kharif paddy	8187.54	67.10	130
5	Rabi Seasonals (Wheat, Gram, Jowar)	1637.51	13.42	120
6	Rabi Paddy	737.00	6.04	130
	Total	12202.00	100.00	-
	Cropping Intensity : 100%			

Table : 2 : Existing Cropping Pattern of Itiadoh Irrigation Project :

Sr. No.	Crops	Per cent Area	Area (ha)
1	Kharif season paddy	100.00	17980
2	Follow on H.W. Paddy, Wheat, Cowpea	42.27	7600
	Total	142.27	

3.0 PROPOSED DIVERSIFIED CROPPING PATTERN:

Based on climate, soil, availability of water, availability of processing units for farm produce and experience gained in the adjoining command area of Pench Left Bank Canal, diversified cropping pattern is proposed in Table 3. The percent area under proposed diversified crop pattern very well matches with the water available for irrigation (Table 5).

Table : 3 : Proposed Diversified Cropping Pattern for Itiadoh Irrigation Project

Sr.No.	Crops	Area (ha)	Percent area w.r.t. total area	Base period (days)
I	Perennials:			
1	Orange / Guava	540	03.00	365
2	Sugarcane	360	02.00	365
II	Kharif Seasonals:			
3	Rice	13485	75.00	130
4	Soybean	2697	15.00	110
5	Green manuring (sun hemp)/Fodder maize	899	05.00	50
III	Rabi Seasonals			
6	Wheat	1798	10.00	120
7	Gram	1798	10.00	120
8	Linseed/Mustard	899	05.00	100
9	Vegetables	719	04.00	120
IV	Hot Weather Seasonals:			
10	Rice	2679	15.00	120
11	Chillies	360	02.00	150
12	Groundnut	899	05.00	120
	Total		151.00	

4.0 CROP WATER REQUIREMENT

Reference crop evapotranspiration (ET_o) by modified penman method (FAO, 24) was estimated by using weather data of IMD station located at Gondia recorded for 1965 to 1992 period. Considering 75% dependability ET_o values, crop coefficients, effective rainfall and water applied for special purposes, the Net Irrigation Requirement (NIR) of crops included in proposed crop pattern (Table 4) is worked out and the NIR values for each crop at root zone, at farm head and at canal head are reported in Table 5, considering the appropriate on farm and conveyance irrigation efficiencies. The data presented in this table reveal that there is highest irrigation requirement (1675 mm) of Rabi cum Hot – weather rice. The crop wise irrigation requirement at root zone is also presented in Fig 1. Crop wise area irrigated (ha) in the volume of water required for 1 ha of R – H.W. rice is also shown in fig 2 indicating thereby necessity of crop diversification for dispersal of irrigation benefits to large area and farmers.

The irrigation requirement for proposed crop pattern with 151% cropping intensity is 287.02 Mm³ at canal head which tallies with the net water available (288.57 Mm³) in the reservoir of Itiadh project for irrigation (Table 5).

5.0 CROP YIELD

5.1 Kharif Crops

Rice is the dominant crop grown in the command area of Itiadh project during Kharif season almost on 100% area. Crop Survey was conducted during 2005-07 to obtain crop information in design questionnaires through farmers' interviews for Farmers of the command areas of selected nine Minors of Itiadh project. Farmers could provide reliable information on crop productivity for the years from 2001-02 to 2006-07. The crop yields of Kharif rice ranged from 26.57 to 35.30 q/ha with an average crop productivity of 33.02 q/ha (Table 6). This indicates that the crop productivity of kharif rice in Itiadh project command is almost double than the state average. However, the experimental yield level recorded at Agriculture Research Station, Sakoli District Bhandara is about 40.0 q/ha indicating yield gap of 7.0 q/ha.

5.2 Rabi Crops

At present there are no crops grown in the Rabi season and hence no crop productivity data is available. However, there is practice of growing wheat crop as a follow-on crop after kharif rice in adjoining command area of Pench Left Bank Canal in Bhandara District which revealed quite a good stand of crop on canal water supply with approximate crop productivity as 25 to 30 q/ha.

5.3 Hot – Weather Crops

Rabi cum Hot-Weather Rice is almost grown on 42% area of command of Itiadh irrigation project as a follow-on crop after kharif rice and the crop productivity as revealed through Crop survey of selected nine Minors ranged from 32.16 to 39.20 q/ha with an average value of 36.86 q/ha (Table 6) which is higher than kharif rice. The experimental yield levels recorded at near by Agriculture Research Station, Sakoli District Bhandara is about 50.0 q/ha indicating thereby yield gap of 11.0 q/ha.

Table- 4 : Irrigation Water Requirement by modified Penman method for proposed crops in Itiadhoh Project :

Sr. No.	Crops	Crop period (days)	ET _o (mm)	KC	ET crop (mm)	Land preparation (mm)	P (mm)	Re (mm)	NIR at root zone (mm)	FIR (NIR) 70%Ea for other crops & 95% for Rice	GIR 52% (mm)
1	2	3	4	5	6	7	8	9	10	11	12
I	Perennials										
1	Orange / Guava	365	1646.87	0.69	1136.00	-	1363.50	440.00	696.00	994.29	1912.09
2	Sugarcane	365	1646.87	1.02	1686.00	100.00	1363.50	642.00	1144.00	1634.30	3143.00
II	Kharif Seasonals										
3	Rice	130	668.74	1.05	700.93	*768.00	1245.29	1078.95	390.00	410.50	789.43
4	Soyabean	105	497.73	0.70	346.00	-	1073.00	314.00	-	-	-
5	Green manuring (sunhemp)	50	-	-	-	-	-	-	-	-	-
	Fodder Maize	90	-	-	-	-	-	-	-	-	-
III	Rabi Seasonals										
6	Wheat	120	435.64	0.79	343.00	75.00	48.35	20.00	398.00	568.57	1093.41
7	Gram	105	361.24	0.72	260.00	-	42.14	20.00	240.00	342.85	659.34
8	Linseed /Mustard	105	361.24	0.72	260.00	-	42.14	20.00	240.00	342.86	659.34
9	Vegetables	105	381.04	0.86	327.00	75.00	40.92	34.00	368.00	525.71	1010.99
IV	Hot Weather Seasonals										
10	Rice	120	592.00	1.19	705.71	*963.00	47.68	-	1675.00	2392.86	4601.65
11	Chillies	150	759.52	0.88	667.00	100.00	60.74	8.60	758.40	1083.43	2083.52
12	Ground - nut	120	609.24	0.85	518.00	100.00	43.24	-	618.00	882.86	1697.80

*Land Preparation for Rice in both the seasons includes Puddling requirement + deep percolation losses in the field + standing water in the crop.

Table- 5 : Proposed diversified cropping Pattern with N.I.R.

ICA - 17980 ha.

Water available for Irrigation – 288.57 Mm³

Sr. No.	Crops	% Area	Area (ha)	NIR at root zone (m ³ /ha)	NIR at root zone (Mm ³)	NIR at FC head 0.70 for other corps and 0.95 for Rice (Mm ³)	NIR at out let head (80% Efficiency (Mm ³))	NIR at H.R. (65 % Efficiency) (Mm ³)
1	2	3	4	5	6	7	8	9
I	Perennials							
1	Orange / Guava	03	540	6960	3.76	5.37	6.71	10.33
2	Sugarcane	02	360	11440	4.12	5.88	7.35	11.31
II	Kharif Seasonals							
3	Rice	75	13485	3900	52.59	55.36	69.20	106.46
4	Soya bean	15	26.97	-	-	-	-	-
5	Green manuring/ Fodder Maize	0.5	8.99	-	-	-	-	-
III	Rabi Seasonals							
6	Wheat	10	17.98	3980	7.16	10.22	12.78	19.66
7	Gram	10	17.98	2400	4.32	6.16	7.71	11.85
8	Linseed /Mustard	05	8.99	2400	2.16	3.08	3.85	5.93
9	Vegetables	04	7.19	3680	2.65	3.78	4.72	7.27
IV	Hot Weather Seasonals							
10	Rice	15	2697	16750	45.17	47.55	5944	91.45
11	Chillies	02	360	7580	2.72	3.90	4.88	7.50
12	Ground nut	05	899	61.80	5.56	7.94	9.92	15.26
	Total	151						287.02

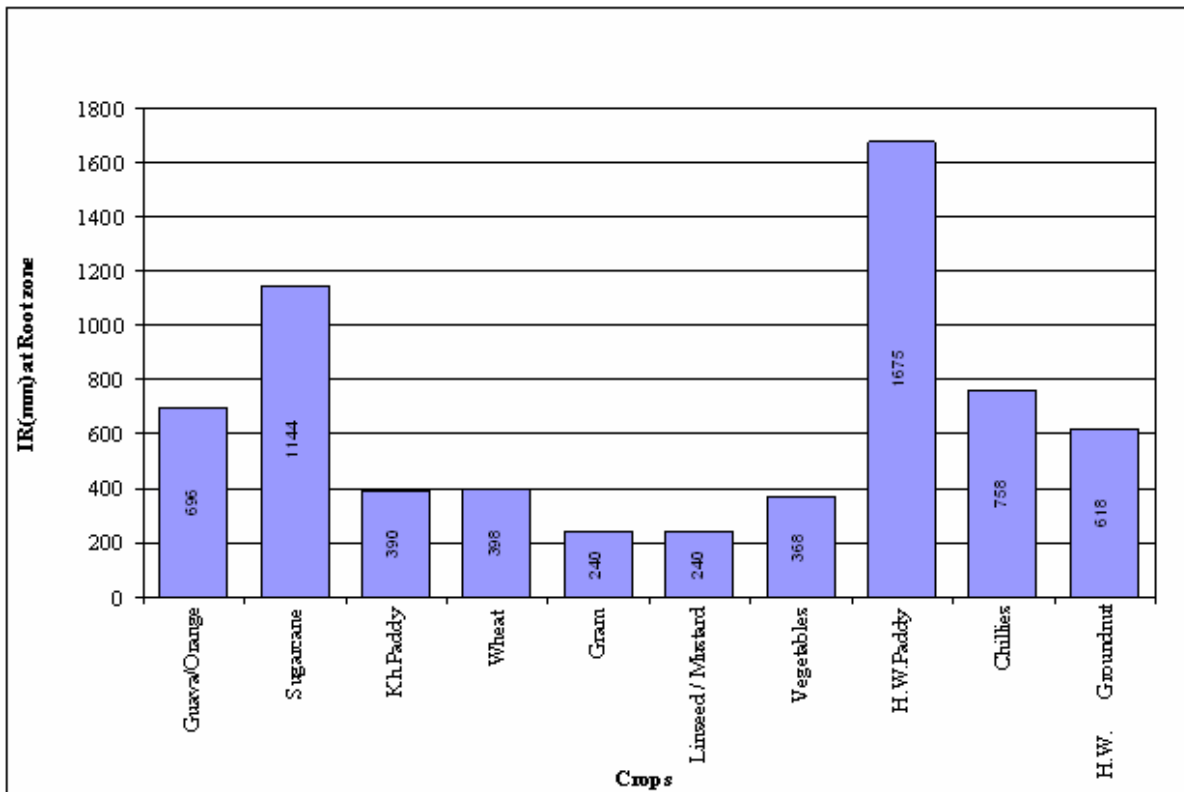


Fig : 1 Irrigation requirement of crops at root zone (mm)

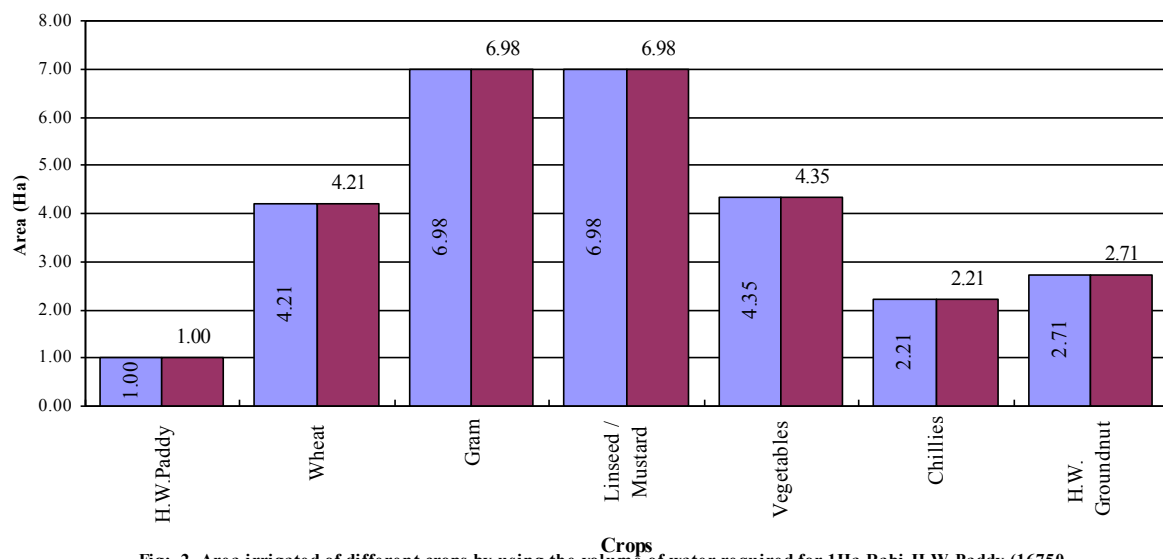


Fig: 2 Area irrigated of different crops by using the volume of water required for 1Ha Rabi-H.W.Paddy (16750 m3) at root zone

Table : 6 Grain yield of Rice with husk in Itiadh Command Area

Sr.No.	Year	Grain yield (q/ha) with Husk	
		Kharif Season	Rabi – Hot weather season
1	2001 - 02	33.50	39.20
2	2002 - 03	34.30	37.80
3	2003 - 04	33.90	38.30
4	2004 - 05	34.60	-
5	2005 - 06	35.30	-
6	2006 - 07	26.57	32.16
	Average	33.02	36.86

6.0 TOTAL MONETARY RETURNS

Considering the average productivity kharif rice and R- H.W. rice as 33.0 q/ha and 37.0 q/ha respectively which is reported earlier, the total crop production in Itiadh project work out to be 87454 tonnes of rice (Table 7). As per farmer's interviews, on an average the rice is sold @ Rs. 6500/ tonne in Kharif and Rs.5500/ tonne in H.W. season in the market. Hence total crop production works out to be Rs. 54.03 Crores (Rs. 5403.3 lakhs or Rs. 540.3 million). This can be stated as output in Rs. 21,123/ha or Rs. 1.87 / m³ indicating thereby economic productivity is 60 to 75 % of the standard norms of Government of Maharashtra. This is as per present crop pattern. The diversified crop pattern proposed indicates total crop production of food grains as 63469.4 tonnes, vegetables as 16540 tonnes, oilseeds as 8540.5 tonnes, fruits as 7560.0 tonnes, and Sugarcane as 28800.0 tonnes. The market value of these produce is Rs.105.33 crores which is an improvement of Rs. 51.03 crores over existing crop pattern. The proposed diversified crop pattern has output of Rs. 38797/ ha and Rs. 3.65 / m³ which also shows significant improvement over existing crop pattern.

Table-7 Total Monetary Returns of Existing and Proposed Cropping Pattern :

Sr. No.	Crops	% Area	Area (ha)	Production (q /ha)	Total Production (q)	Current price Rate(Rs./q)	Gross Income (Rs.)
1	2	3	4	5	6	7	8
Existing Cropping Pattern of Itaidoh Project : (Cropping Intensity – 142.27 %)							
1	Kharif Rice	100	17980	33.00	593340	650.00	385671000
2	H.W. Rice	42	7600	37.00	281200	550.00	154660000
	Total	142	25580	-	874540		540331000
Proposed Diversified Cropping Pattern of Itaidoh Project : (Cropping Intensity – 151.00 %)							
1	Kharif Rice	75	13485	33.00	445005	650.00	289253250
2	H.W. Rice	15	2697	37.00	99789	550.00	54883950
3	Orange / Guava	3	540	140.00	75600	700.00	52920000
4	Sugarcane	2	360	800.00	288000	850.00	244800000
5	Soybean	15	2697	20.00	53940	1300.00	70122000
6	Wheat	10	1798	30.00	53940	1000.00	53940000
7	Gram	10	1798	20.00	35960	2000.00	71920000
8	Linseed/Mustard	5	899	10.00	8990	3000.00	26970000
9	Vegetables	4	719	200.00	143800	800.00	115040000
10	Chillies (Green)	2	360	60.00	21600	800.00	17280000
11	H.W. Groundnut	5	899	25.00	22475	2500.00	56187500
12	Sun hemp (GM)	5	-	-	-	-	-
	Total	151	26252	-	1213139	-	1053316700

REFERENCES

Dorrenbos J & Pruitt W.O. (1977) Guidelines for estimation of crop water requirement, FAO Irrigation & Drainage Paper 24.

Evaluation Report of Itiadoh Irrigation Project by Bagh – Itiadoh Irrigation Division, Gondia, CADA, Nagpur (2001)

Water and Land Management Institute, Aurangabad (2010): Post project performance evaluation study of Itiadoh project.