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PROGRESS AND PROSPECTS OF IRRIGATION WATER MANAGEMENT IN MAHARASHTRA

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Irrigation is an important crucial factor and is responsible for increasing and stabilising production and productivity of crops. During the last two and half decades, irrigation potential has significantly increased in Maharashtra. It has increased from 1.22 lakh hectares in 1960-61 to 2.24 lakh hectares in 1979-80 with an annual compound growth rate of 2.51 per cent which is significant at one per cent level. During the same period, the proportion of gross cropped irrigated area (GCIA) to the total gross cropped area (GCA) has increased from 6.54 per cent to 12.07 per cent. Under the situation one expects significant positive impact of increased irrigation water on increasing and stabilising productivity, *i.e.*, yield per hectare of important (major) crops grown in the State. With this view in mind this study has been undertaken with the following objectives: (*i*) to examine the progress of irrigation water in Maharashtra as a whole and in its agro-climatic zones, (*ii*) to identify the major crops grown in the State and examine the performance in respect of productivity of these crops and (*iii*) to suggest economically profitable crop sequences under irrigated situation which will increase (*a*) productivity of major crops and (*b*) consume maximum available irrigation water in the *kharif* and *rabi* seasons only.

The performance of gross cropped irrigated area in Maharashtra and in its agro-climatic zones has been examined for the period 1960-61 to 1979-80, the latest year for which official data are available. The performance has been examined in terms of both linear and compound growth rates as well as by working out the proportion of GCIA to GCA.

Twelve crops which account for about 80 per cent of the gross cropped area in the State have been identified as the major crops grown in the State. The data on productivity of these crops have been examined with the help of coefficient of variance (C.V.) for the period 1960-61 to 1979-80. The required data have been obtained from the Season and Crop Reports published by the State Department of Agriculture.

The new crop sequences have been suggested on the basis of experimental evidence. Different types of crop sequence experiments have been conducted in the agricultural universities of the State. Requisite data have been collected from AGRESCO reports of Marathwada Agricultural University, Parbhani.

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As mentioned earlier, GCIA in the State as well as in all its agro-climatic zones has significantly increased during the period 1960-61 to 1979-80. The annual rate of increment and the proportion of GCIA to GCA in different zones for the year 1960-61 and 1979-80 have been presented in Table I.

TABLE I. PERFORMANCE OF GROSS CROPPED IRRIGATED AREA IN DIFFERENT AGRO-CLIMATIC ZONES OF MAHARASHTRA, 1960-61 TO 1979-80

Sr. No.	Agro-climatic zones	Annual growth rate (per cent)		Proportion of gross cropped irrigated area to gross cropped area	
		Linear	Compound	1960-61	1979-80
1.	Konkan	2·15** (0·74)	2·16** (0·76)	2·29	3·84
2.	Poona	9·98* (0·62)	6·95* (0·62)	13·32	17·52
3.	Nasik	6·03** (0·95)	6·52** (0·96)	5·58	13·39
4.	Kolhapur	1·44 (0·44)	1·49* (0·51)	10·35	16·34
5.	Aurangabad	4·08** (0·81)	4·18** (0·83)	3·71	10·37
6.	Amravati	8·74** (0·91)	9·15** (0·94)	0·89	3·79
7.	Nagpur	1·49* (0·59)	1·43* (0·61)	12·08	16·42
8.	State	2·47** (0·92)	2·51** (0·93)	6·54	12·07

* Significant at 5 per cent level.
** Significant at 1 per cent level.
Figures in parentheses are 'R' values.

It is evident from the table that the area under irrigation in the State and in its all agro-climatic zones has significantly increased during the last about two decades. The proportion of GCIA to GCA in the State as a whole has increased from 6.54 per cent in 1960-61 to 12.07 per cent in 1979-80.

It is clear from the above discussion that about 88 per cent of the cropped area in Maharashtra is still under rainfed condition and its performance in terms of production and productivity depends on the vagaries of rainfall. The cropping pattern of the State in general and under irrigated condition for the year 1960-61 and 1978-79 is presented in Table II.

Total cereals and pulses account for about 70 per cent of the GCA in the State. Jowar, both *kharif* and *rabi*, bajra, rice and wheat are the important cereal crops which account for about 52 to 54 per cent of the GCA. This proportion remained mostly unchanged during the last twenty years. Gram and *tur* are the important pulses accounting for about 5 to 6 per cent of GCA.

TABLE II. CROPPING PATTERN OF MAHARASHTRA, 1960-61 AND 1978-79

Sr. No.	Crop	Share of each crop in GCA (per cent)		Share of each crop in GCIA (per cent)		Irrigation water requirement during the crop period (mm./ha.)
		1960-61	1979-80	1960-61	1979-80	
1.	Gross cropped area ('00 hectares)	186,050 (100)	199,146 (100)	—	—	—
2.	Gross cropped irrigated area ('00 hectares) ..	—	—	12,182 (100)	24,045 (100)	—
1.	*Kharif* jowar	13·70	15·16	0·63	3·30	250
2.	*Rabi* jowar	18·08	17·61	21·15	16·22	533
3.	Bajra	8·73	7·91	—	2·76	250
4.	Rice	6·99	7·52	22·33	16·35	532
5.	Wheat	4·87	5·96	11·36	23·23	687
6.	Gram	2·16	2·31	3·10	3·04	366
7.	*Tur*	2·85	3·39	—	—	—
8.	Groundnut	5·82	3·79	1·06	1·69	(986 summer)
9.	Sesamum..	0·68	0·88	—	—	—
10.	Linseed	1·24	1·41	—	—	—
11.	Cotton	13·44	12·59	2·82	3·78	366
12.	Sugarcane	0·84	1·29	12·72	13·00	2,300

The share of oilseeds in GCA has declined from about 8 per cent to 6 per cent in the last two decades. Groundnut is an important oilseed crop grown in the State. The area under groundnut has shown a significant declining trend during the period under study. Cotton is an important fibre crop. It accounts for about 13 per cent of the GCA. The position of cotton in the cropping pattern remained mostly unchanged. Sugarcane is an important perennial irrigated crop grown in the State and its share in GCA has increased from 0.84 per cent in 1960-61 to 1.29 per cent in 1979-80.

As mentioned earlier, GCIA in the State is about 12 per cent of the GCA which varied from 4 to 17 per cent in different zones.

It is seen from Table II that among cereals, the proportion of area under irrigated *kharif* jowar, which is very small, has increased from 0.63 per cent to 3.30 per cent while that of wheat has increased from 11.36 per cent in 1960-61 to 23.23 per cent in 1979-80. In the case of *rabi* jowar and rice, the irrigated area has declined during the last twenty years by about 5 per cent and 6 per cent respectively. The proportion of area under irrigated pulses and groundnut remained practically unchanged while there is a slight increase in cotton. The share of sugarcane in the irrigated cropping pattern remained at 13 per cent.

As regards irrigation water requirement of each crop, during the crop period, sugarcane requires about six to eight times more water than *kharif* jowar and bajra, four to five times more than gram and cotton (sown in June-July), three to four times more than rice and *rabi* jowar, and about three times more than wheat and summer groundnut. The recommended area

under sugarcane in the cropping pattern of command area of Jayakwadi, Purna, and similar irrigation projects is about 3 to 5 per cent only. If the excess area under sugarcane is diverted to short duration, *i.e.*, seasonal major crops like jowar, bajra, rice, wheat, *tur*, gram, groundnut, etc., it will help in increasing and stabilising production and productivity of these crops on a larger area, increase employment, at least, in the two crop seasons and will increase and stabilise income of the majority of small and medium farmers.

The average productivity of the major crops grown in the State for the last one decade is presented in Table III. It is revealed from the table that

TABLE III. AVERAGE YIELD PER HECTARE OF MAJOR CROPS GROWN IN MAHARASHTRA, 1970-71 TO 1982-83

Sr. No.	Crops	Yield (kg./ha.)	C.V.
1.	*Kharif* jowar	858	32·50
2.	*Rabi* jowar	418	29·62
3.	Bajra	350	25·66
4.	Rice	1,261	23·96
5.	Wheat	754	26·70
6.	Total cereals	678	25·76
7.	*Tur*	537	21·43
8.	Gram	315	16·28
9.	Groundnut	647	21·59
10.	Cotton (Lint)	85	20·25
11.	Sugarcane (gur)	8,765	14·63

the average yields of major crops in the State are not only at a lower level but they are also more unstable. These yields are far below the expected yields and also much less than the average yields recorded in the agriculturally developed States in the country. The yields obtained under hybrid and high-yielding varieties (HYV) programme in the State are two to four times more than the recorded yields. The availability of irrigation water is a barrier in the efficient adoption of new technology in the State. If cereals and pulses get their due share in increased irrigation water, it will help not only to increase the productivity but will add to the income of the cultivators.

The results of the crop sequence experiments conducted at research stations on cultivators' farms as well as the results of National Demonstrations on cultivators' fields show that two-crop sequence is equally profitable as compared to sugarcane. Among these two crops, one crop is grown in the *kharif* season which requires protective irrigation while the other grown in *rabi* utilises good deal of water. The results of these experiments are presented in Table IV.

TABLE IV (A). ECONOMICS OF SUGARCANE (*Suru*)

Crop	Variety	Average yield (tonnes/ha.)	Gross income including by-product (Rs./ha.)	Cost of cultivation (Rs./ha.)	Net profit (Rs./ha.)	Input-output ratio
Sugarcane (*Suru*)	CO-740	83·15	14,782·66	7,681·90	7,100·76	1·92

As mentioned earlier, sugarcane is a perennial crop which requires irrigation water throughout the year at particular intervals. The water consumption of sugarcane is much more, *i. e.*, three to six times more than that of seasonal crops. Under normal condition, on an average, the yield of sugarcane is worked out to be 83 tonnes per hectare and net profit at Rs. 7,100 per hectare. The input-output ratio is worked out to be 1:1.92.

In the case of hybrid jowar+wheat and hybrid jowar+gram sequence, hybrid jowar is grown in the *kharif* season and wheat and gram are taken in *rabi*. Hybrid jowar requires protective irrigation water in case of dry spell, whereas wheat and gram require irrigation water at regular intervals. The net income from hybrid jowar+wheat combination works out to Rs. 11,798 per hectare, while that of hybrid jowar+gram combination is Rs. 9,940 per hectare. The input-output ratio in these two systems is 2.39 and 2.35 respectively. These two crop systems give comparatively a higher net income per hectare as well as higher input-output ratios than that of sugarcane [Table IV (B)].

TABLE IV (B). ECONOMICS OF JOWAR, BAJRA, PADDY AND COTTON BASED CROPPING SYSTEMS

Sr. No.	Crop sequence	Variety	Average yield (qtl./ hectare)	Gross income including by-product (Rs./ha.)	Cost of cultivation (Rs./ha.)	Net profit (Rs./ha.)	Input-output ratio
1.	Hybrid jowar +	CSH-9	37·92	10,775·00	3,782·50	6,992·50	2·84
	Wheat	HD-2189	37·00	9,474·50	4,668·83	4,805·67	2·02
			74·92	20,249·50	8,451·33	11,798·17	2·39
2.	Hybrid jowar +	CSH-9	40·65	11,400·00	4,321·25	7,078·75	2·63
	Gram	BDN-93	12·85	5,886·25	3,025·00	2,861·25	1·94
			53·50	17,286·25	7,346·25	9,940·00	2·35
3.	Bajra +	WCC-75	22·40	5,737·50	2,639·00	3,098·50	2·17
	Wheat	HD-2189	32·00	8,208·90	3,871·00	4,337·90	2·12
			54·40	13,946·40	6,510·00	7,436·40	2·14
4.	Bajra +	WCC-75	21·75	5,568·00	2,592·00	2,976·00	2·14
	Safflower	S-4	14·81	5,645·94	2,305·00	3,340·94	2·44
			36·56	11,213·94	4,897·00	6,316·94	2·29
5.	Paddy +	PBN-1	31·87	5,290·42	3,322·50	1,967·92	1·59
	Wheat	HD-2189	37·87	9,715·00	4,573·75	5,141·25	2·12
			69·74	15,005·42	7,896·25	7,109·17	1·90
6.	Paddy +	PBN-1	28·25	4,697·08	2,892·50	1,804·58	1·62
	Sunflower	Modern	16·42	7,226·25	2,620·83	4,605·42	2·75
			44·67	11,923·33	5,513·33	6,410·00	2·16
7.	Cotton +	H-4	8·68	4,426·80	2,800·00	1,626·80	1·58
	Summer groundnut	SB-XXI	29·09	13,963·20	3,300·00	10,663·20	4·23
			37·77	18,390·00	6,100·00	12,290·00	3·01

Bajra is grown in the *kharif* season whereas safflower is taken in the *rabi* season. The water requirement of both these crops is comparatively less. Bajra requires irrigation water when there is a big gap between two rains, particularly at the time of flowering, grain setting, etc. Irrigation water requirement of safflower is less than that of wheat. Thus, with limited availability of irrigation water bajra + safflower combination is a profitable one. Though the net income gained from this combination is somewhat less than that of sugarcane, the input-output ratio is higher than one. The net income and input-output ratio from bajra + wheat combination is higher than that of sugarcane.

Paddy is a *kharif* crop grown under moderate rainfall zones in low-lying areas except Konkan and Nagpur zones where rainfall is comparatively more than the rest of Maharashtra. Irrigation water is given to paddy as and when required depending upon rainfall. Wheat and sunflower are *rabi* crops. Both these crops require irrigation water at regular intervals. The total water requirement of these crops is three to four times less than that of sugarcane. The per hectare net income and input-output ratio from paddy + wheat sequence is at par with sugarcane. Paddy + sunflower combination gives slightly less net income than that of sugarcane but its input-output ratio is higher than sugarcane.

Cotton is sown in the second fortnight of June and harvested by the end of January. Irrigation water is given to the crop as and when required. The frequency of watering depends on the intensity of rainfall. Summer groundnut is an irrigated crop. It is sown in the first week of March and harvested in July. It requires watering at regular intervals. The per hectare net profit as well as input-output ratio from cotton + summer groundnut crop sequence is more than that of sugarcane.

The above discussion points out that jowar, bajra, paddy, and cotton based cropping systems are equally profitable as compared to sugarcane. The duration of these crop sequences is three to four months less than that of sugarcane. Jowar, bajra, paddy and cotton require protective irrigation in the *kharif* season, while wheat, gram, safflower and sunflower make the best use of available irrigation water in the *rabi* season. Groundnut uses good deal of available water in the summer season. The water requirement of these crops is two to three times less than that of sugarcane. If the area under sugarcane is restricted, large area can be brought under irrigation, which ultimately will increase and stabilise the production and productivity of major cereals, pulses and oilseed crops in the State. It will also help in increasing employment and income of the rural masses. This will help to bring about growth and equity in irrigation water use in the State.