Agricultural Drought: Farmers' Perceptions and Combat Strategies

(Policy inputs to the state and district authorities in Karnataka)

White Paper

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Acknowledgment

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I. Introduction:

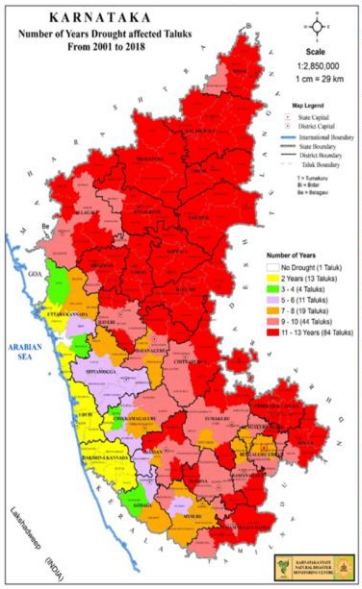
Karnataka being situated on the Deccan Plateau has two serious climatic constraints. First, its large area comes under semi-arid climatic zone. Second, water resources are stressed and frequency of droughts being high, the state has acquired a dubious distinction as historically having second largest area declared as drought-prone (GoI, 1972). The Agricultural Commission of 1976, estimated probability of occurrence of drought in the state at about 25% indicating more than two years a decade under drought. Agriculture in Karnataka is heavily dependent on the southwest monsoon. While only 26.5% of the sown area (30,900 km²) is under irrigation. The state ranks fifth in India in terms of Water availability for irrigation is always under stress (even for drinking water) as available water resources in the state are estimated at 1,608 m3 /person/ year overall (GoK, 2022). Devastation of the economy and livelihood of the population due to droughts has become a regular phenomenon. There are a few districts that confront drought almost every alternate year and have inadequate water resources like Yadgir in North Karnataka. Given the limits of current ultimate irrigation potential, it is essential the Water Policy of Karnataka 2022, emphasised Integrated Water Resource Management approach with emphasis of micro irrigation. While recommending improvement in irrigation efficiency, the water policy document emphasised highly controlled irrigation technologies such as drip and sprinkler. (page 5, GoK, 2022). It is well recognised that micro irrigation should become the key strategy to combat drought related losses and use water more efficiently (Palanisami et all, 2014; Sivanappan, 2016).

II. Status:

Regular visitations of drought have become a usual feature in Karnataka. Entire rain-fed agricultural area of the state is vulnerable to the drought and about 80 per cent of blocks/taluks in the State are drought-prone (KSNDMC). According to the Ministry of Agriculture and Farmers Welfare (MoAFC&W), 16 districts of the state, mostly from North Interior Karnataka, have experienced drought for a period of 10 years during the last 18 years (2001 to 2018). Districts in the North Interior Karnataka region are more prone to the droughts, as inadequate surface water sources has resulted extensive dependence on monsoons. On an average, over last 18 years, about 100 talukas have suffered moderate to severe drought conditions (Figure 1). Drought not only impacts the livelihood system during the year of its incidence but the spillover effect lingers on in the ensuing years taking heavy toll on the overall well-being. It sets back the development clock and perpetuates misery in

the region. The recurring occurrence of drought would impact economic growth and human development and increase the vulnerability of community (Grey, 2007). Nearly 80 per cent of taluks in the State are drought-prone (Map 1). It can be seen that between 2001 and 2018 there were 12 drought years, of which seven years were droughts where on an average 141 taluks were declared as drought affected and there were five moderate droughts where on an average 63 taluks were declared as drought affected. The probability of intense drought in Karnataka thus works out almost 39 per cent and that of moderate drought as 28 per cent. This is far higher than the estimated probability of drought for the state in 1976 (GoI). Last five years, the state received annual average rainfall slightly above the normal (Figure 1), however the drought conditions prevailed in a few of the chronic drought hit regions. In fact, this year (2023) as many as 113 taluks have been identified for drought and joint surveys are being done. On September 4, a decision was taken to declare them as drought-hit as per norms. Another 73 taluks too are facing drought as per reports, so a joint survey has been ordered there too. Fortunately, 2019-22 the state did not face any severe drought, as rainfall was above normal.

Map 1: Drought Vulnerability Details
(Source: KSNDMC)



DROUGHT YEARS		
Year	Drought	No. of Taluks Declared
2001	✓	33
2002	✓	159
2003	✓	162
2004	✓	80
2005	-	-
2006	✓	129
2007	-	-
2008	✓	84
2009	✓	86
2010	-	-
2011	✓	123
2012	✓	157
2013	✓	125
2014	✓	35
2015	✓	136
2016	✓	Kharif-139,Rabi-162
2017	-	-
2018	✓	100-Rabi,156-Kharif

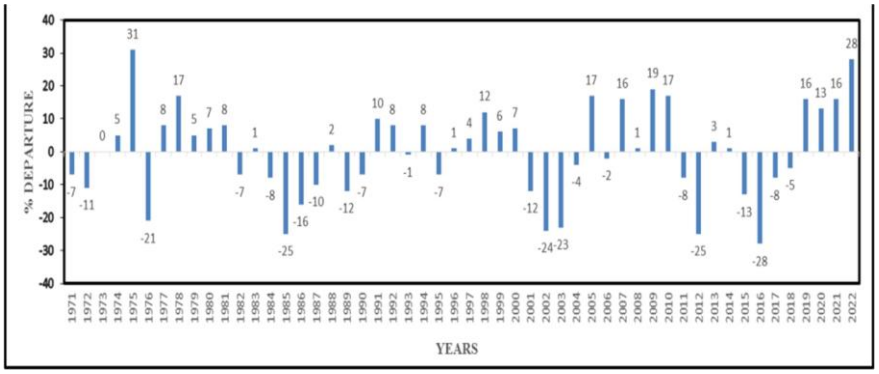


Fig 1: Per cent departure of cumulative rainfall for the period from 1st Jan to 31st Dec in the state
Source: Rainfall, Agricultural Situation, Moisture Index, Reservoir Levels, Minor Irrigation Department Government of Karnataka – 2022

The visitation of drought has become almost a yearly event and the drought monitoring and alleviation measures have to be kept ready. The losses due to drought are significantly high and as can be seen from Table 1, the highest loss suffered was in 2018-19 of ₹ 26,514 crores. The mechanics of drought is far severe than what can be seen as a static loss in the year of its incidence, the spread effects in the succeeding years are quite devastating. There are four effects that linger on over years and create a cascading effect on agrarian distress.

Table 1: Drought Induced Losses in Karnataka

2016-17		2018-19		2019-20	
Area effected (lakh ha)*	**Economic Loss (crores in Rs)***	**Area effected (lakh ha)***	**Economic Loss (crores in Rs)***	**Area effected (lakh ha)***	**Economic Loss (crores in Rs)***
23.77	1637.37	46.77	26514.32	6.56	5234.82

**Area affected= loss of sown area + area affected by disaster-Lakh ha. @Economic Loss = As per Cost of Cultivation in Crores Rs.*

Source: Memorandums submitted by GoK to GoI

It is known that North Karnataka confronts severe agrarian distress both due to frequent visits of drought and inefficient water utilisation. Irrigation has been one of the major strategies for meeting the challenge of drought over years. However, given the present constraints, it is necessary to enhance efficiency of irrigation per unit of water. Presently, the total availability of water 35,916 million m3 (1268 TMC) is from allowable sources of

surface water, most of which is already tapped. The groundwater resources form 26 per cent of the total and out of this, only 405 TMC is for safe utilization during an average rainfall year. It must also be noted that the water availability also fluctuates with the variations in rainfall and in any typical drought year this is reduced from 20 to 30 percent of the normal (GoK, 2022). Adoption of an effective measures such as high water use efficiency and appropriate cropping pattern etc., can only help to drought proofing measures and to better the Human Development Indices (HDI). Micro (drip and sprinkler) Irrigation (MI) was one of the demand-side management strategies, introduced in the state in the early 1990s.

III. Macro Picture of Micro Irrigation in India

Agricultural sector of India has always the 'Sword of Damocles" hanging over its production performance. With limited availability of the remaining potential for irrigation, the demand for irrigation of the sector will not be satisfied. That calls for efficient water use and that 'every unit of water has to be efficiently utilised' is the call that the Water policy document of India and Karnataka have emphasised unequivocally (GoI, 2012 and GoK 2022). It is mentioned in the National Water Policy (2012) that "*Water saving in irrigation use is of paramount importance. Methods like aligning cropping pattern with natural resource endowments, micro irrigation (drip, sprinkler, etc.), automated irrigation operation, evaporation-transpiration reduction, etc., should be encouraged and incentivized. Recycling of canal seepage water through conjunctive ground water use may also be considered*" (GoK 2012 Page 6). Micro-irrigation (drip/sprinkler) becomes obvious technology for sustainable water resource management. Micro-irrigation can contribute to the high water use efficiency, conservation of water resources and help mitigate the impact of unpredictable monsoons, making agriculture more resilient to climatic uncertainties, improving yield rates and sustainable farming practices across the country (Suresh, 2020). Micro-irrigation has emerged as a crucial component of India's agricultural development, fostering economic growth, water conservation, and sustainable farming practices across the country.

Micro-irrigation has been adopted as a strategy in most of the states in the country and the economics of micro-irrigation is quite favourable for this change (Palanisami, 2011). Indian agriculture has witnessed a significant paradigm shift in irrigation sector, with the adoption of micro-irrigation systems emerging as a vital solution to combat the persistent challenges posed by water scarcity and unpredictable rainfall patterns. It is true that micro-irrigation

systems require a large initial investment (Palanisami, 2011) but that was made easy with the policy of providing subsidy under PMKSY.

Table 2: Area Covered under Micro Irrigation PMKSY-PDMC in important States (araea in thousand hectares)

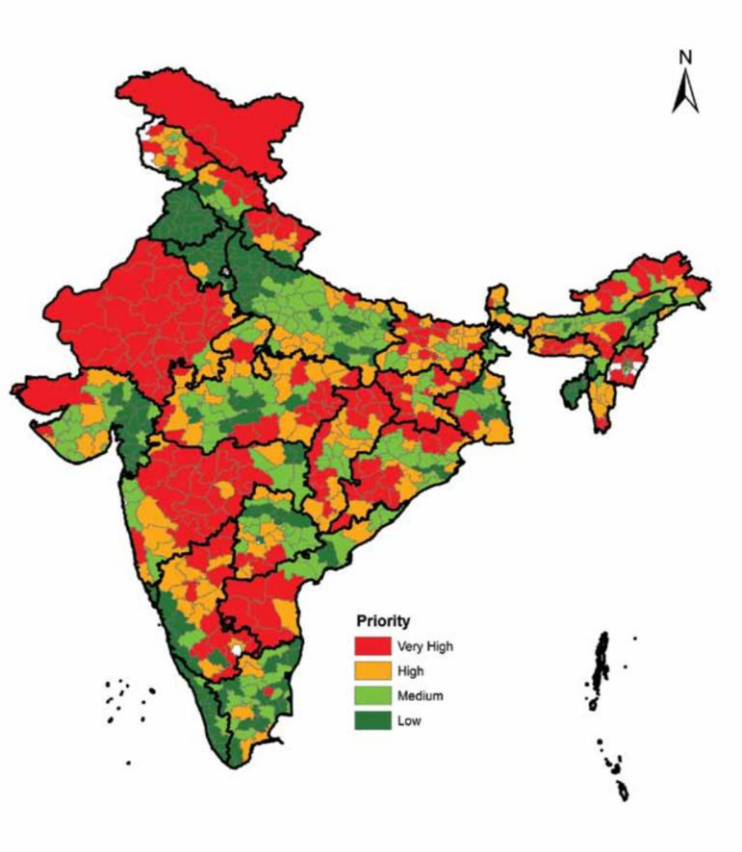
Sl. No.	State-wise	2015-16	2016-17	2017-18	2018-19	2019-20	Total
1	Andhra Pradesh*	94.10	1410.98	1864.41	2002.69	1220.8	7439.92
2	Gujarat*	142.68	1659.48	1431.34	1407.78	1076.49	7001.9
3	Odisha*	2.91	46.11	30.36	100.81	84.98	291.33
4	Karnataka*	64.22	1394.05	2361.07	2348.53	2505.91	9251.76
5	Madhya Pradesh	75.22	543.23	397.61	351.95	145.97	2191
6	Maharashtra*	35.24	1061.72	1328.29	1599.59	1710.97	6052.99
7	Rajasthan*	56.35	476.5	482.05	539.82	585.73	2647.56
8	Telangana*	39.86.4	619.8	894.74	403.81	45.48	2362.47
Grand Total		**572.98**	**839961**	**8399.61**	**10489.34**	**11585.19**	**11725.72**

*Source: data.gov.in. Note: *Major drought-prone states*

There are six prominent states that have recorded high coverage in terms of the cumulative area under micro-irrigation from 2017 to 2021 under the Prime Ministers Krishi Sinchai Yojane (PMKSY). Karnataka tops the list with a significant area of 11.82 lakh hectares, followed closely by Tamil Nadu with eight lakh hectares. Gujarat, Andhra Pradesh, Maharashtra, and Rajasthan also demonstrate substantial implementation of micro-irrigation, highlighting their proactive approach toward efficient water management in agriculture. Together, these states have achieved 41.89 lakh hectares during 2017 to 2021. However, it comes out clearly that the emphasis of the PMKSY is not solely on the rainfed regions, but the spread also has spilled over to the regions that do not need it on priority. The map shows location of micro-irrigation in the drought-prone areas in the India

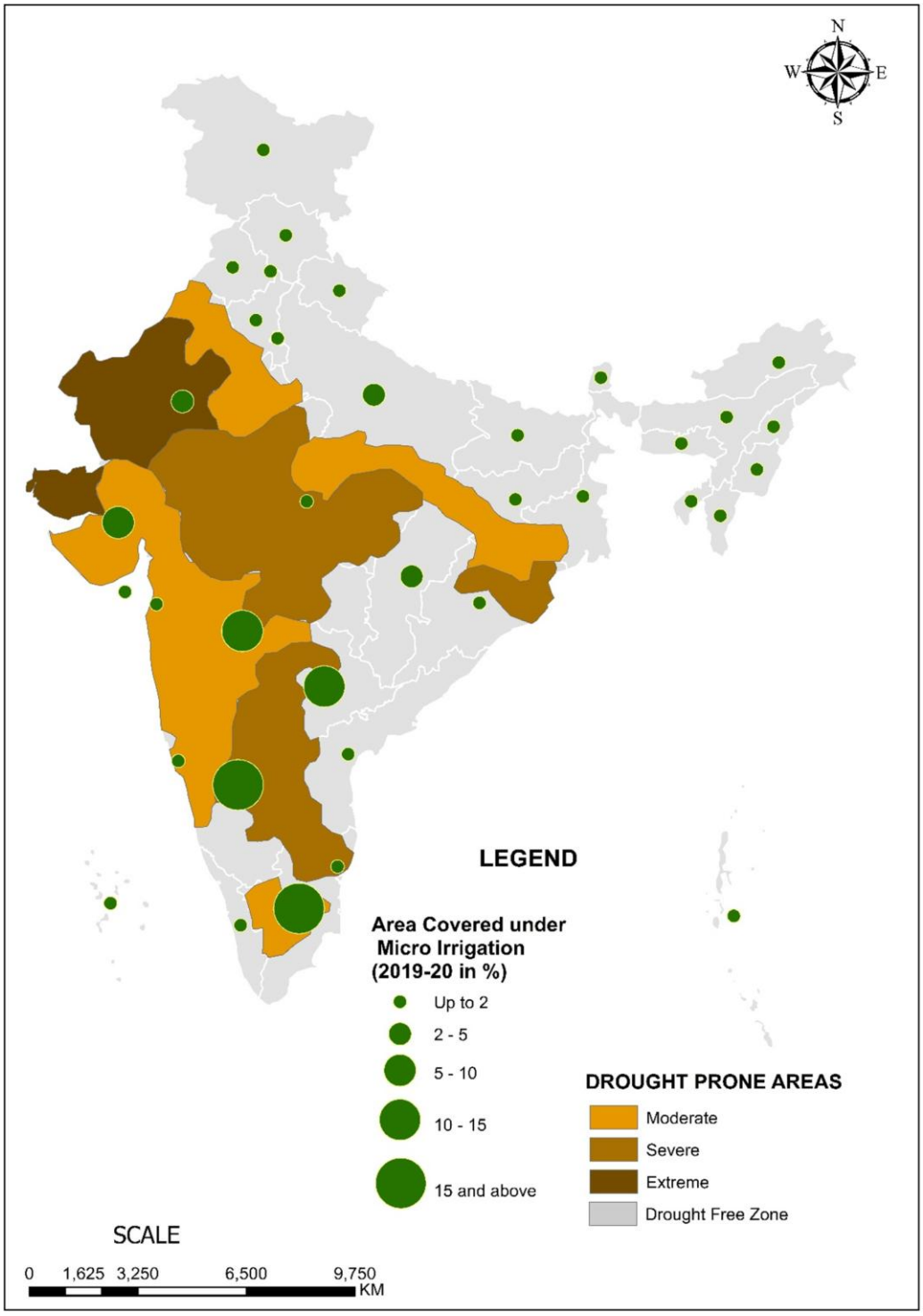
Map 2: Rainfed Area Composite Index indicating Priority {CI}

(Priority Low, Medium and High)



Source: NRAA (2020), Prioritisation of Districts for Development in India: A Composite Index Approach, National Rainfed Area Authority, Ministry of Agriculture and Farmers' Welfare, Government of India, given in Deshpande (2022). Under the Shadow of Development: Rainfed Agriculture and Droughts in Agricultural Development of India, NABARD, Mumbai, Page- 35.

Map 3: Showing the Location of Micro-Irrigation and Drought-prone Areas in India



A comprehensive overview of the area covered under the Pradhan Mantri Krishi Sinchayee Yojana - Per Drop More Crop (PMKSY-PDMC) for Micro Irrigation across various states in India from 2015-16 to 2019-20 is presented in Table 3. It can be seen from the table that are extensive efforts made to enhance the adoption of micro-irrigation techniques, which are crucial for sustainable water management in agriculture. Looking at the data, it is evident that Andhra Pradesh, Karnataka, Tamil Nadu, and Maharashtra have consistently shown a significant progress in the adoption of micro-irrigation practices, with substantial area covered under this scheme over the years. Gujarat also stands out as a state with consistently high coverage. On the other hand, states like Goa, Himachal Pradesh, and Jammu & Kashmir have relatively lower coverage under micro-irrigation, potentially indicating the need for more targeted interventions and support for these regions (Palanisami, 2011).

From Table 3 the progress across states can be seen especially in the states that have covered more than 30 per cent area under micro irrigation. Except Tamil Nadu, Sikkim and Mizoram all the other four states have significant drought-prone areas. This progress signifies the growing recognition of the importance of water-saving technologies in agriculture and the efforts to promote sustainable water usage, which is essential for addressing water scarcity and ensuring food security in the country. Overall, the achievements under PMKSY-PDMC highlights the diverse landscape of micro-irrigation adoption across different states in India, emphasizing the need for continued support and implementation of effective policies to ensure widespread and equitable access to water-saving agricultural technologies.

Table 3: States with more than 30 per cent of the irrigated area under micro-irrigation (As of Feb 3, 2021)

State	Net irrigated area*	Cumulative Area covered under micro-irrigation 2005-06 to 2020-21		
		Drip irrigation	Sprinkler irrigation	Percentage
Sikkim	16	6.35	5.26	73
Andhra Pradesh	2,719	1,388.13	519.17	70
Karnataka	3,104	752.82	1,148.70	61
Maharashtra	3,163	1,314.78	561.65	59
Mizoram	16	5.09	2.45	47
Tamil Nadu	2,385	735.81	311.06	44
Gujarat	4,233	852.02	747.75	38

Source: Ministry of Agriculture and Farmers Welfare (MoA&FW)

*Note: Area in thousand hectares; *Net irrigated area includes irrigating by Government canals, private canals, tanks, tube wells, other wells, and other sources.*

Table 3 presents the constraints in adoption of drip maintenance activities among farmers before and after attending training sessions. The data highlights several key challenges that hinder the effective maintenance and utilization of drip irrigation systems. Before attending the training, a significant percentage of farmers reported constraints such as insufficient knowledge about pressure maintenance (94.70%), fear of acid treatment (90%), lack of technical know-how of maintenance practices (89.30 per cent), and misunderstanding of farmers about drip irrigation technology (88%). These challenges reflect the prevalent gaps in knowledge and technical skills among farmers, which can impede the optimal functioning and sustainability of drip irrigation systems.

The state government through its policy initiatives have taken up a massive programme of micro irrigation and achieved the coverage of more than nine lakh hectares, far ahead of the other drought prone states. However, Karnataka continues to suffer the economic losses caused by drought. The state has miles to go before it reaches the multifold coverage for complete drought proofing.

IV. Process and the Issues in Karnataka

Karnataka has put in place quite a few strategies and processes to meet the challenge of drought. It is in the late eighties the state established Drought Monitoring Cell and that was transformed into Karnataka State Natural Disaster Management Council (KSNDMC). Recently, a long-term Water Policy has also been put in place, besides an ambitious Watershed Development Programme. The KSNDMC monitors rainfall, climatic aberrations and natural disasters including drought on real time basis. It has come out very clearly out of many of the studies that some districts like Yadgir intensely vulnerable to these climatic events. Therefore, the adoption of efficient water use technologies would not only ensure the protective irrigation, but also help in the sustainability of groundwater. However, adoption of these technologies incurs initial capital costs. As small and marginal farmers constitute almost 80 per cent share in Indian land holding; their economic limitations prevent them from adoption of water new technologies like micro irrigation. To overcome this constraint Karnataka government has introduced subsidies (under Pradhan Mantri Krishi Sinchayee Yojane (PMKSY)) for the farmers for adoption of the efficient water use technologies like micro irrigation (drip and/or sprinkler). These subsidies enable the small and marginal farmers to avail the technologies.

The Economic Survey of Karnataka over years have unequivocally recognised that irrigation water is a critical issue for agricultural and horticultural development. It needs no mention that flood method of irrigation largely ends up in water wastage. It is also well known that micro irrigation system (both drip and sprinkler) substantially enhances the water use efficiency, contribute towards boosting yield as also quality of produce, reduce expenditure on inter cultivation and weeding. Government of India's slogan "More Crop Per Drop" was incorporated under PMKSY. State government provides subsidy for installation of drip irrigation under PMKSY as shown in Table 4.

Table 4: Subsidy sharing pattern for micro irrigation programme under PMKSY

Micro Irrigation Component	Category of farmers	Up to 2.00 Hectares (Share of Subsidy)			2.00 Hectares to 5.00 Hectares (Share of Subsidy)		
Shares in Subsidy of State and the Central Governments		**Central Govt**	**State Govt**	**Total**	**Central Govt**	**State Govt**	**Total**
Sprinkler Irrigation Units	Small and marginal Farmers	33	57	90	-	-	-
	Others	27	63	90	27	18	45
Drip Method of Irrigation	Small and Marginal Farmers	33	57	90	-	-	-
	Other category Farmers SC ST TSP	27	63	90	27	18	45
	Other category of General farmers	27	18	45	27	18	45

Source: Karnataka Economic Survey 2021-22, page 200.

In order to encourage the small and marginal farmers to undertake Drip or Sprinkler irrigation, the Government (both State and Central government together) give 90 per cent subsidy, but the entire process is operated through the designated suppliers. While the State Government provides 63 per cent subsidy in sprinkler irrigation, the small and marginal farmers get 57 per cent. The provision of subsidy assists farmers for purchasing the drip and sprinkler instruments, that requires capital investment. Remaining 10 per cent of the capital cost has to be met by the farmers from their own sources.

The subsidy scheme is being operated under PMKSY scheme and over years ₹ 1502 crores have been spent between 2018 and 2021, actually, the highest expenditure was incurred in 2020-21, that remained same in the following year. Table 5 shows the release of funds and actual expenditure in recent three years under PMKSY programme. Expenditure has always stayed above 95 per cent of the releases but in 2019-20 the release was only about 85 percent of the allocation. One important observation is quite captivating which underscores the share of expenditure on micro irrigation as against the other irrigation schemes. The experience during last three years of the programme of micro irrigation in the state as reflected in releases and actual utilisation of funds presented in Table 5 and 6. It

presents the gap between the expectations and the actual implementation. Naturally, given the coverage, it will be small share. There is a need to increase this substantially over years but not happened.

The physical and financial achievements in the recent years are presented in Table 6. Though both fall short of targets, the share of financial achievements to targets is higher in comparison with physical achievements' share of the target. This indicates either the exercise of targeting was faulty or the implementing agencies have overspent and achieved lower targets. That is detrimental to the development of micro irrigation.

Table 5: Allocation, Releases and Expenditure on Micro-irrigation in Karnataka

Micro Irrigation	Financial Year (Rs in Crores)		
	2018-19	2019-20	2020-21
Programme	495.29	518.71	653.87
Releases	447.35 (90.32)	440.79 (84.97)	653.87 (100.00)
Expenditure	440.37 (99.44)	429.53 (97.44)	632.90 (96.79)

Source: Karnataka Economic Survey 2021-22, Page 201 (figures in paranthesis indicate percent to the budget)

Table 6: Recent Progress under Micro Irrigation in Karnataka

Period	Physical Achievements (In Lakh Ha)			Financial (Rs in Crores)		
	Target	Achievement	%	Target	Achievement	%
XI Plan	1.93	1.57	81.3	570.89	444.87	77.9
2018-19	0.70	0.59	84.3	445.25	375.87	84.4
2019-20	0.68	0.51	75.0	349.57	347.93	99.5
2020-21	0.70	0.51	72.9	537.28	397.19	73.9
2121-22*	0.62	0.19	30.6	537.28	397.19	73.9
		*Up to the end of November 2022				

Source: Karnataka Economic Survey 2021-22, Page 221

It was reported that around 4700 hectare area is covered under drip irrigation benefitting 4,600 farmers across the state, including, 1,130 SCP and 955 TSP beneficiaries (GoK, 2022). The success of these technologies has been quite encouraging but surely did not either spread on its own across regions or there were implementation bottlenecks. Karnataka government also has another program named as Chief Minister's Sookshma Neeravari Yojane, through which about ₹ 311 crores were spent in the year 2022-23. The spread of micro-irrigation across the state is quite encouraging. It is however, important also to see if the benefits of PMKSY have gone to the districts where it was needed intensely. The last three years benefits under PMKSY are seen in Table 7, presenting the data pertains to area covered as well as the number of beneficiaries under the scheme. It is necessary to see, if, the perpetual drought prone districts have got the major share of the benefits under PMKSY.

The district wise performance of micro irrigation is presented in Table 7. It is quite evident from the data that the average number of beneficiaries across districts have increased from 42,952 in 2019-20 to 2,66,619 in 2020-21 and to 3,14,308 in 2021-22. Actually, during the year 2021-22 the expenditure has increased on the scheme.

Table 7: Physical Achievement and number of Beneficiaries of Micro Irrigation under PMKSY (2019-20 to 2021-22)

District	2019-20		2020-21		2021-22	
	Area in Ha	Beneficiaries (Nos)	Area in Ha	Beneficiaries (Nos)	Area in Ha	Beneficiaries (Nos)
Bagalkot	9035	2966	10068	9669	10659	10666
Bangalore Rural	542	209	1180	1242	1326	1334
Bangalore Urban	373	55	670	644	542	523
Belgaum	17595	6075	13691	12814	16432	16065
Bellary	8393	1682	8304	8304	12273	12272
Bidar	6012	1199	10775	10569	10494	10484
Vijayapura	11692	2350	24883	24715	22166	18894
Chamarajanagar	4370	651	6959	6959	12957	12950
Chikkaballapur	1699	1392	4491	4598	4813	4727
Chikkamagaluru	3907	574	6141	6141	11416	12420
Chitradurga	9543	1404	13293	13293	18754	18754

Dakshina Kannada	1794	275	3736	3736	4057	4057
Davanagere	8445	1570	11315	11315	11619	11619
Dharwad	6804	973	7278	7278	9074	9071
Gadag	3125	629	5512	5499	6350	6350
Kalaburgi	17341	2783	10175	8893	14897	13067
Hassan	6772	1002	20125	20128	30233	30233
Haveri	9851	2325	18792	18779	18529	18533
Kodagu	2231	363	2322	2322	2036	2036
Kolar	900	799	1189	1090	2257	2262
Koppal	3846	612	10454	10446	11875	11871
Mandya	9202	2001	10366	10554	8737	8869
Mysore	20720	3603	17848	17826	20748	20761
Raichur	6445	1172	9400	9400	7763	7761
Ramanagara	2754	480	4677	4678	7164	7050
Shimoga	21445	3005	13167	13167	16015	16015
Tumkur	5512	872	10518	10518	11834	11720
Udupi	1141	169	890	890	2418	2433
Uttara Kannada	2877	436	3569	3567	4573	4573
Yadgir	7078	1325	7585	7585	6938	6938
Total	**211442**	**42952**	**269372**	**266619**	**318948**	**314308**

Source: Department of Minor Irrigation, Government of Karnataka, Bangalore.

The districts that got highest funds under micro irrigation are Vijayapura, Bagalkot, Chitradurga, Kalaburgi, Davanagere, Mandya, Haveri, and Belgaum. It can be seen that some of the chronic drought affected areas did not receive the required support in micro-irrigation either due to the erroneous process of allocation or the lack of absorbing capabilities of the farmers from these districts. The districts like Kolar, Uttara Kannada, Yadgir, Gadag and Raichur deserve special focus due to their severe drought-proneness, inadequate water resources and stress created by frequent droughts on livelihood. This indicates an inadequate preferential subsidy budget allocations to the areas prone to drought, to encourage the adoption of micro irrigation. Moreover, the focus of MI subsidy allocation is more towards productive irrigation than the protective irrigation, thus enhancing the regional

imbalance with reference to the drought proofing. Actually, need is more for providing protection against drought and sustaining the livelihood system under the threat of droughts. This may further aggravate in future as the State Action Plan for Climate Change (SAPCC) (2011) projections (SRES A1B scenario), indicates that average temperatures may increase further by 1.7°C to 2.2°C at the 2030s. Projected increase in temperature are more pronounced in the northern districts. It was inferred that overall reduced precipitation and continuous warming is possible. The regions that already witness less rainfall and higher temperatures such as north interior districts, will further experience a lesser rainfall and increase in average temperatures (SAPCC 2013). A few very pertinent observations come out here are as follows:

- The strategy of using micro irrigation as a safety net programme need to be used effectively for the regions (States or Districts) which need at the most. It should be demand based rather than supply pushed.
- Allowing even spread of the funds across spatial regions will starve the most vulnerable regions and the investment is likely to go where it is not acutely needed.
- It is observed that regions (State or districts) selected to receive the subsidies and the allocation of budget for subsidies to these regions (State or districts) are made not based on the vulnerability to the drought, albeit other factors seem to have received the considerations.
- In spite of several 'low hanging fruits' and facilities such as subsidies, higher yields, lower costs, progressive farmers, and warning bells, adoption rates remained limited to less than 33 per cent of the total potential area (2.7 million hectares) in the state (Lok Sabha 2020).
- The implementation and operational problems at the field level also assume importance in spread of the programme.

V. Micro level Concerns

In order to probe deeper into the operations of micro irrigation under PMKSY at district level, Yadgir district was selected from the northern drought prone areas of Karnataka. Yadgir is predominantly an agricultural district and remains vulnerable to drought. It is divided into two agro-climatic zones namely Eastern Transition and Northeastern Dry Zone, indicating its dependence on rain. According to the Drought Vulnerability Composite Index (DVI) computed on the four indices (CI, CSI, CCI and LI), about 33 per cent of the district

falls under Class 4 of DVI and 67 per cent under very highly vulnerable Class 5. Normal rainfall of the district is 699 mm. The district suffered drought conditions for 14 years in the period of 2000-2018, and again in 2023. Recently, the state government has declared the district as drought affected. Given the constraint on surface water sources availability for assured irrigation, Yadgir depends on groundwater for irrigation. Thanks to the provision of subsidy under PMKSY, Yadgir has made a rapid stride in adoption of micro irrigation (Table 8).

Table 8: Achievements under PMSKY in Yadgir district in 2020-21 & 2021-22

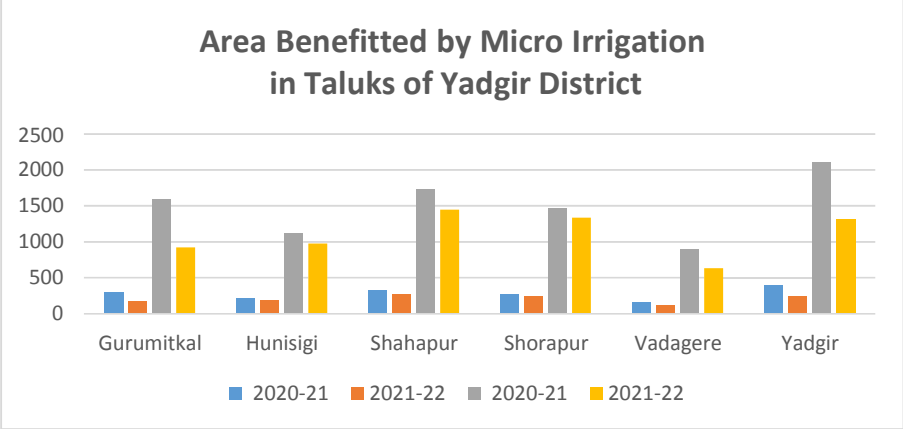
(Rs in Lakhs)

Taluka	General		SC		ST		NABARD	Total
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2020-21
Gurumitkal	192.18	106.54	84.98	57.35	16.52	8.25	4.33	298.01
Hunisigi	96.89	105.58	64.48	47.33	42.47	28.32	5.22	209.06
Shahapur	172.23	140.71	103.33	94.1	36.57	34.83	9.67	321.80
Shorapur	93.8	132.85	89.64	71.55	83.13	44.72	7.67	274.24
Vadagere	87.31	69.78	56.92	32.11	19.11	16.69	4.26	167.6
Yadgir	263.34	131.65	90.12	76.21	26.31	37.9	7.43	392.2
Total	**910.75**	**910.75**	**489.47**	**378.65**	**224.11**	**170.71**	**38.58**	**1662.91**

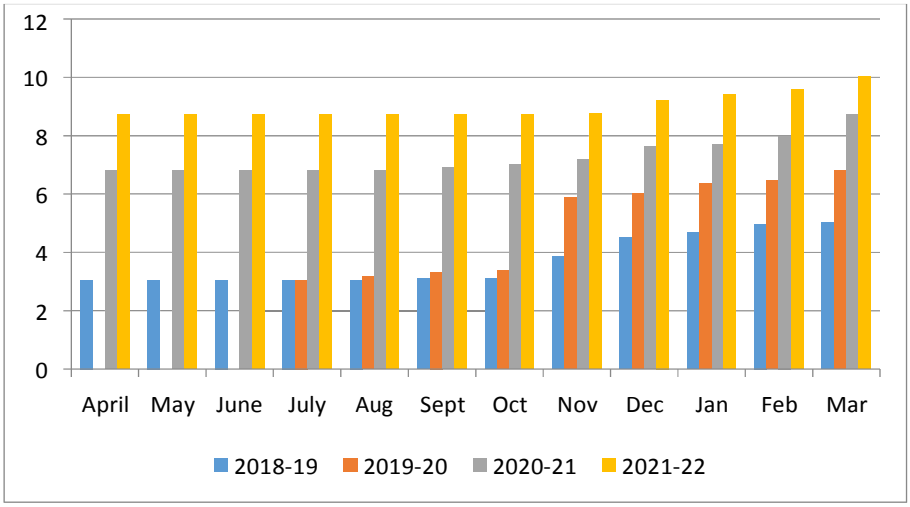
Source: Joint Director of Agriculture, District Agricultural Department Office, Yadgir.
Note: NABARD funding is available for General Community. No Funding was available in 2021-22

During 2020-21 and 2021-22, the district received an investment of Rs 1662 lakhs for micro-irrigation. Whereas four taluks namely Gurumitkal, Hunisingi, Shahapur, and Shorapur could spend between 2 to 3 crores in these two years; Vadagere and Yadgir taluks could share smaller part of the total funds spent. The question of allocation based on the demand again comes up here as Shahpur and Shorapur taluks have access to surface irrigation sources. It is essential to ascertain the demand at least by using proxies (instead of asking individual farmers) and plan a short-term programme to insure the farmers against the impact of drought. The best proxy would be the average losses incurred by a farm household during

last three visitations of drought. It is certain that these households need support for micro irrigation, intensely. Similarly, while drawing the programme of the PMKSY for the district, the allocations should be done in proportion to the average losses incurred in the last three droughts. The pattern or timeliness observed across months over years indicates domination of March month domination and that is usually the rush of the government officers to complete the target before the financial year closure.



Source: District Agricultural Office, Yadgir



Per cent Area under Micro Irrigation in Yadgir

The status of groundwater in the entire Yadgir district is worrisome. Even within the district, there are a few blocks that are critical and hence require an urgent attention to enhance micro irrigation especially for those who have already created irrigation facilities.

Table 9: Status of Groundwater Table in Yadgir District (2013)

Taluk	Semi critical	Safe	Over exploited
Shahapur	--	Safe	--
Shorapur	--	85	15
Yadgir	60	40	--

Source: Central Groundwater Commission

Among the micro level concerns, four important observations need to be underscored.

1. It is necessary to create a demand schedule across taluks and even up to villages depending on a Criticality Index of Ground water situation.
2. A special programme can be crafted for these critical areas, wherein the subsidy approach should be more focused on the criticality of need along with socio-economic backwardness. An index of criticality can be worked out giving 60 per cent weight to the criticality of groundwater situation and 40 per cent to the socio-economic background of the beneficiary.
3. A clear time scheduling be done in implementation of the programme across talukas in the drought prone districts.
4. There should also be a provision to get another grant after a few years of successful operation of the micro irrigation system operated by the farmers. This support could be made available for replacement of volves and tubes or parts thereof.

VI. Perceptions from Field

The perceptions of the beneficiaries about the operations of the scheme help in understanding the behavioral and socio-economic constraints as well as administrative bottlenecks confronted during implementation (Hatch et al, 2011). For exploring into the farmers perception about measures to combat drought and effectiveness of micro-irrigation, a simple random survey was conducted during the last quarter of 2022 in the Yadgir block. The sample farmers were categorized into four typologies based upon their position with reference to the subsidies availed/provided by the government for adoption of micro irrigation practices (Box 1).

Box 1: Categorization of Farmers

- **Category I**: Farmers who have benefitted from the State interventions,
- **Category II**: Farmers who have applied for the subsidies but waiting to receive the benefits,
- **Category III**: Farmers who have adopted an efficient water use measures with their own cost and
- **Category IV**: Farmers who were not interested in water use efficiency due to various reasons.

The enquiry about the perceptions was not only to understand the operations of the scheme on the ground but also to look at the changes that the farmers have brought in their cropping pattern after shifting to micro irrigation. The proposed changes were also asked to those who were intending to get into the micro-irrigation system. The enquiry was aimed at understanding the changes, additional area brought under cultivation, impact of MI on the cost of cultivation, changes in yield levels before and after the adoption of MI. The respondents were requested to share their opinion about the adoption of micro irrigation (to those farmers who have adopted MI) or their expectations about the MI (those farmers awaiting the subsidies from State to acquire the MI infrastructure). A common perception was to move towards commercial cash incentive crops and that would lead to increase in the cost of cultivation. Rarely, the respondents preferred the similar cropping pattern to continue after adopting micro irrigation. It was indicated that the cash component in the cost of cultivation would increase which will be compensated by the decline in the expenditure on inter-cultivation and weeding. The respondents opined that there will be increase in the net income provided the prices do not fluctuate abruptly. It was suggested that the repairs and maintenance of the instruments would require some support after taking up the scheme.

Towards the dependency on the rains, farmers were also enquired about the necessity of adoption of water-use efficiency measures. With reference to their exposure to the water stress, Category I and III farmers have expressed that their exposure would have been high but for the MI adoption. The MI has helped them tide over the water stress periods in vegetative growth stage. On the other hand, the Category II and IV farmers have revealed that the exposure of their crops to water stress is very high and so is their vulnerability to the water stress conditions. It was communicated by the Category II and VI farmers that MI

could play a very important role in protection of their crops. Similarly, it is suggested that the resilience of the Category I and III farmers, is high compared to the Category III and VI farmers. However, most surprising element is awareness about the adoption of measures that would reduce their exposure and vulnerability to water stress conditions, but none of the farmers have reported adoption measures. Most significant finding of the survey is that adequate mobilization of farmers is essential for sustainability of MI adoption and optimization of resources spent on it. The prime aspect of mobilization should be for the groundwater table recharge measures. Our results are comparable with the study done by Palaniswami (2014) and results of that study are presented in Table 10.

Table 10: Constraints in Adoption of the Drip Maintenance Activities

Before attending the training	% of farmers	After attending the training	% of farmers
Insufficient knowledge about pressure maintenance	94.70	High cost of water-soluble fertilizers	80.00
Fear of acid treatment	90.00	Non-availability of pressure gauge	50.66
Lack of technical know-how in maintenance practices	89.30	Reluctance to invest in Venturi (instrument to understand the flow)	12.00
Misunderstanding of farmers about drip irrigation technology	88.00	Non-availability of water-soluble fertilizers locally	41.33
		Lack of confidence in using the correct concentration of acid	24.00

Source: *Palanisami et al., 2014*

Table 11: Farmers Perception about Vulnerability and Adoption of MI (in %)

Variable	Crop Season	Exposure	Vulnerability	Resilience	Adoption
Category I	Kharif	40	45	60	Absent
	Rabi	40	50	55	Absent
Category II	Kharif	70	85	40	Absent
	Rabi	90	85	35	Absent
Category III	Kharif	50	45	60	Absent
	Rabi	45	50	50	Absent
Category IV	Kharif	90	85	80	Absent
	Rabi	90 High	100	10	Absent

Source: Based on the perceptions obtained.

There were 445 minor irrigation tanks in the district. Shahapur and Shorapur Taluks have benefited from surface source irrigation, Yadgir Taluk has 65 per cent of the irrigated area (primarily groundwater based) and all these are subject to the vagaries of monsoon. Yadgir district administration with the help of line departments like agriculture, forest, water resources, minor irrigation, among others, identified waterbodies and their feeder channels, majority of them required desilting, widening or deepening. It has identified about 350 water structures for water restoration.

Picture 1: Degraded Pond

Picture 2 : Pond Degradation

VII. Way Forward

Micro-irrigation is a multipronged strategy to deal with several issues varying from water use efficiency, per drop more crop, optimization of fertilizer usage etc. It helps the agricultural sector in drought prone areas on five different components. Most significant finding of the survey is that adequate mobilization of farmers is essential for sustainability of MI adoption and optimization of resources spent on it.

First, it is vital to enhance water-use efficiency along with sub-optimal water use practices like traditional flood irrigation.

Second, prioritization of PMKSY to those regions, for instance, drought prone Yadgir district to provide subsidy for drip and sprinkler adoption

Third, subsidies be provided on time in order to establish the system.

Fourth, it is necessary to operate the entire subsidy scheme on demand based - considering the vulnerability levels at village level and also the groundwater table status.

Lastly, Groundwater recharge measures should be integrated into PMKSY scheme. Efforts of all the line departments should dovetail to ensure the sustainability of groundwater rable.

References:

- Deshpande, R S (2022). Under The Shadow: Rainfed Agriculture and Droughts in Agricultural Development of India; NABARD, Mumbai.
- Government of India (1972). Second National Irrigation Commission, Ministry of Irrigation, New Delhi.
- Government of India (1976). National Commission on Agriculture – Climate and Agriculture. Vol. IV, Ministry of Agriculture and Cooperation, New Delhi.
- Government of India (2012). National Water Policy (2012), Ministry of Water Resources, Government of India, New Delhi.
- Government of India, (2017). *Agricultural Statistics at a Glance*, Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, 2017.
- Government of Karnataka (2022). State Water Policy- (2022), Water Resources Department, Government of Karnataka, Bengaluru.
- Gulati, A., Zhou, Y., Huang, J., Tal, A., & Juneja, R. (2021). *From Food Scarcity to Surplus*. Springer Singapore.
- Hatch, N. R., Daniel, D., & Pande, S. (2022). Behavioral and socio-economic factors controlling irrigation adoption in Maharashtra, India. *Hydrological Sciences Journal*, *67*(6), 847-857.
- NRAA (2020). Prioritization of Districts for Development Planning in India, NRAA, Department of Agriculture, Cooperation and farmer Welfare, Ministry of Agriculture and farmer Welfare, NASC, DPS Marg, New Delhi.
- Palanisami, K., Mohan, K., Kakumanu, K. R., & Raman, S. (2011). Spread and economics of micro-irrigation in India: evidence from nine states. *Economic and Political Weekly*, 81-86.
- Palanisami, K., Ranganathan, C. R., Sureshkumar, D., & Malik, R. P. S. (2014). Enhancing the crop yield through capacity building programs: Application of double difference method for evaluation of drip capacity building program in Tamil Nadu State, India. *Agricultural Sciences*, *2014*.
- Sivanappan, R. K., Goyal, M. R., Chavan, V. K., & Tripathi, V. K. (2016). Micro Irrigation Technology in India: A Success Story. *Innovations in Micro Irrigation Technology, under the Book Series "Research Advances in Sustainable Micro Irrigation*, *10*, 1-46.
- Suresh, A. (2020). Micro-irrigation development in India: challenges and strategies. *Suresh, A. and Manoj, P. Samuel (2020) Micro-irrigation development in India: challenges and strategies, Current Science*, *118*(8), 1163-1168.

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