CHALAKUDY RIVER DIVERSION SCHEME, KERALA: DOES IT SHOW THE FUTURE OF CANAL IRRIGATION IN INDIA?

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ABSTRACT

During the Green Revolution era, paddy cultivation was promoted with much vigor within Kerala. The canal systems that supplied timely irrigation played an important role in promoting food security within the state as rice self-sufficiency became a political concern. Under changing circumstances, paddy cultivation has seen a drastic downward trend in the last 30 years. One of the reasons for this trend is the irregularity in water supply through canals resulting from the flow fluctuations due to various hydroelectric projects that have come up in the upstream and inefficiencies arising out of low maintenance and performance management. At the same time, farmers in Kerala have largely shifted towards the cultivation of high valued cash crops. This paper presents a case study of the Chalakudy River Diversion Scheme which once served the irrigation requirements of paddy in the Chalakudy river basin. The paper tries to shed light on how farmers have adapted to the evolving nature of CRDS as they continually shift towards cash crops that require better water control. In this process, CRDS has ended up as an entity vastly different from the intent of its planners. The role of canal irrigation, changing from direct flow irrigation to complementing recharge or replenishment of groundwater and surface water storages, may point towards the imminent transformation of canal irrigation in the rest of India.

Keywords: Canal Irrigation, groundwater recharge, high value crop cultivation, conjunctive management, lift irrigation

1. PADDY CULTIVATION AND CANAL IRRIGATION

Paddy is the major food crop cultivated in the southern-most Indian state of Kerala. The area under paddy in 1967-68 was 48% of the total food crop area. This reduced to 15% in 1995-96 and 10% in 2004-05. In the last forty years, there has been a steady decline in Paddy cultivation within the state. The total paddy area during the year 1975-76 was 8.76 lakh hectares which came down to 1.71 lakh hectares in 2016-17, a sharp decline of 80.48% and currently accounting for only 6.63% of the total cropped area in the state (Agricultural Statistics 2017). The present trend shows that the ratio of food crop to non-food crop area is 12:88 indicating a threat to food security within the state (Karunakaran 2014). District wise data also indicates a tremendous decrease in traditional rice growing areas like Palakkad and Alappuzha which have shown a decline of 51.69 percent and 26.46 percent respectively between 1995-96 and 2016-17 (Figure 1)

Agriculture in Kerala has seen a gradual shift from food crops like rice and tapioca to plantation crops like coconut, rubber and coffee. The reduction in area under food crops from 40.23 percent in 1970-71 to 18.74 percent in 1992-93 and 16.52 percent in 2002-03 is a phenomenon that has happened very rarely in any state (Mani 2009). On the other hand, there has been a sizeable increase in the cultivation of cash crops like Nutmeg which has seen an increase of 190% in 2016-17 as compared to 2001-02 (Agricultural Statistics 2017).

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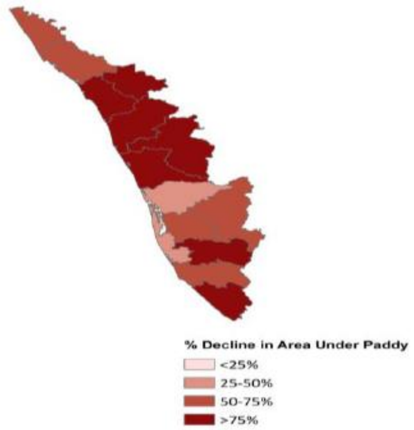


Figure 1. Percentage decline in area under Paddy cultivation (1995 to 2017)
Source: Department of Economics and Statistics

Diversification of crops is the dominant feature of the state today (Karunakaran 2015). Looking at the change in cropping pattern (Figure 2), rice has lost the maximum area, while rubber gained the maximum area (5.23 percent in 1960-61 to 19.69 percent in 2009-10). In recent years, rubber seems to be replacing rice in the plains, coconut in the midland valleys and, coconut and cashewnut in the midland and highland areas (Mani 2009). The drastic reduction in paddy cultivation may be attributed to a number of factors. These may be high cost of cultivation resulting from a steep rise in farm wages, labour shortage, lack of institutional support, delay of payments in government procurement, decline in soil fertility and deteriorating irrigation facilities among others (Suchitra 2015). Another reason is the livelihood diversification that has taken place at the household level leading to an increased dominance of service sector jobs within the state. As farmers become more prosperous with higher quality of life, moving out of food crops like paddy and towards high income crops is only rational as they make maximum use of the already fragmented landholdings.

Three crops of paddy are taken up for cultivation in all districts of Kerala except in Wayanad district where there is no autumn cultivation. However, the major crop which contributes 51 percent of the cultivated area is the winter paddy. In the districts of Thrissur, Ernakulam, Kottayam and Pathanamthitta, 100 percent of the cultivated winter paddy is irrigated (Agricultural Statistics 2017).

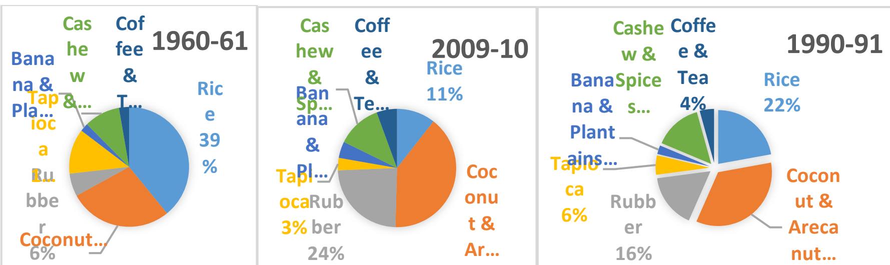


Figure 2. Changes in cropping pattern in Kerala (%) from 1960-2010
Source: Department of Economics and Statistics

Traditionally winter paddy, also known as *Mundakan* paddy, has relied mainly on canal systems which were solely designed keeping in mind the water requirements and irrigation timings of the paddy crop. The irrigation infrastructure in Kerala is divided into storage schemes and diversion schemes which have a combined net

irrigation potential of 2.5 lakh ha. Canal irrigation was promoted widely during the Green Revolution era to improve food security within the state as rice self-sufficiency became a political concern for the leaders of the state. However, similar to most canal systems in India, these schemes have faced degradation over time increasing the IPC-IPU gap within the state. The reasons for this decline include deterioration in planning and management of public irrigation at all levels, failure to adapt to the increase in groundwater irrigation and the challenge of performance management in the new irrigation economy (Shah 2011).

2. CHALAKUDY RIVER DIVERSION SCHEME (CRDS)

River diversion is a traditional method that comprises of a weir constructed across the stream for raising and diverting water from the river for gravity flow irrigation. Of the four major diversion schemes under the irrigation department, the Chalakudy River Diversion Scheme (CRDS), commissioned in 1958, is the largest. It was meant to serve a total ayacut area of 14942 ha that almost entirely comprised of paddy cultivation. The canal system has a length of 100km of main canals and 280 km of branch canals and distributaries. The purpose of the scheme was to facilitate irrigation in 29 Local Self Governments (LSG) in Ernakulam and Thrissur districts. The diversion leads to a Left Bank Canal (LBC) and a Right Bank Canal (RBC) which cover 14 municipalities in total.

Flow of water through the canal initially depended on the flow through Chalakudy River. When CRDS was constructed, there were no irrigation or hydro-electric projects in the upstream. Subsequently three projects have come up in the upstream of the diversion scheme – the upper Sholayar Dam in Tamil Nadu which is in the far upstream, the Poringalkuthu Left Bank Hydroelectric Project (PLB-HEP) in the immediate upstream and the proposed Athirapally Hydroelectric project which would lie in the immediate upstream after PLB-HEP. Thus, currently CRDS is completely dependent on the tail race discharge from PLB-HEP. According to South Asia Network on Dams, Rivers and People (SANDRP) (2013), The PLB-HEP was supposed to function as a base load power station but over the last two decades, the semi-peaking operation of the hydroelectric project has led to daily flow fluctuations in the CRDS as the power scheduling and irrigation scheduling do not match.

Organisations like SANDRP and the Irrigation Department have vehemently opposed the construction of the Athirapally project which is also designed as a peaking station and would lead to further fluctuations in the flow through CRDS thus affecting the 29 LSGs that depend on it for their irrigation as well as drinking water needs. CRDS has also been subjected to poor maintenance and faces seepage of 50 percent leading to an enormous loss in the canal water flow. All these factors add up to the present situation of unpredictable water availability for irrigation which has, among other reasons, led to farmers opting to move out of paddy to other commercial crops.

(a). In 2016, IWMI recruited two IRMA student interns to conduct an exploratory study within

(b). the command area of CRDS. The objective of the study was to ascertain how the recent

(c). shifts in agriculture have shown a change in the pattern of canal water usage and how

(d). farmers have resorted to effective management of water for irrigation in their farms.

3. METHODOLOGY AND STUDY LOCATIONS

A total of six panchayats were identified for the study, Pariyaram, Chalakudy and Aloor belonging to the upper, middle and tail areas of the RBC, and similarly Mukanoor, Melur and Karukutty belonging to the LBC. Four wards were identified from each panchayat, where Focus Group Discussions and semi-structured interviews were conducted with farmers in each ward. The data so collected included crops cultivated, farming and irrigation techniques used, changes in cropping pattern and techniques adopted for effective management of irrigation water.

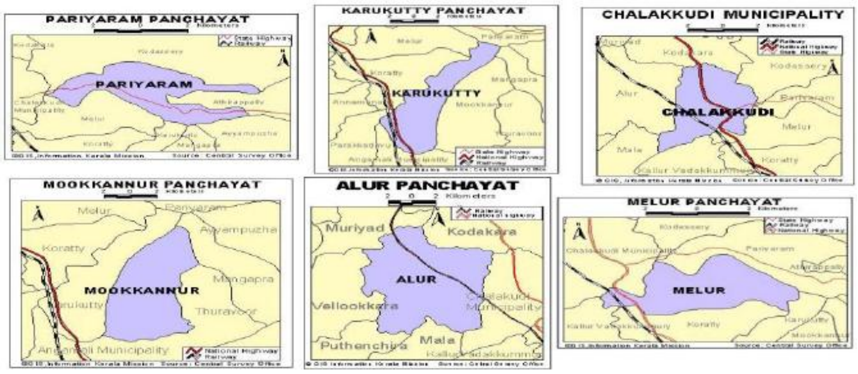


Figure 3. Maps of six panchayats selected for study

4. CHANGES IN THE CANAL COMMAND

The CRDS after its inception had a steady flow of water with a meticulously planned irrigation schedule that was required for paddy cultivation, where flooding of fields has to be done once in 10 days. Since the late 1980s there had been a steady decline in the area irrigated under paddy and at the same time cropping intensity of commercial crops like Coconut, Plantain and Nutmeg had been on the rise, much in line with the scenario in the rest of Kerala. From 2005 to 2015, the area cultivated under paddy reduced from 2400 acres to 1500 acres within the canal command. Of the 24 wards that were surveyed, paddy was no longer the principal crop and was replaced by coconut. Plantain, nutmeg and arecanut followed (refer Table 1).

Table 1. Area under each crop in the 24 wards (*acres*)

Crops	2005		2015	
Paddy	288	26.1%	209	14.6%
Coconut	411	37.2%	508	35.5%
Tapioca	56	5.1%	42	2.9%
Plantain	150	13.6%	339	23.7%
Arecanut	91	8.2%	83	5.8%
Nutmeg	110	9.9%	250	17.5%
Total	1106		1431	

As compared to paddy which is water intensive in nature, coconut and arecanut need to be watered only during the sapling stages after which water is required once in 15 days. Nutmeg on the other hand needs to be watered more frequently than paddy (refer Table 2).

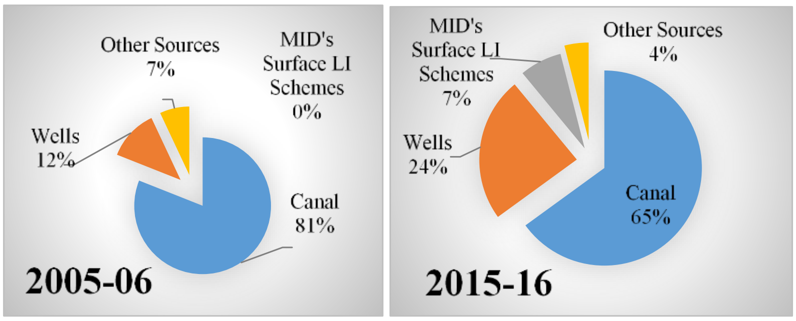
Table 2. Irrigation requirements of major crops grown in the canal command

Crops	***Irrigation requirement***
Paddy	Highly water dependent, requires water in its seedling and transplantation. Best productivity is achieved during the first three months of growth. Flooding fields once in 10 days is shown to produce best results. Delay of 5 days leads to reduction by 15-20 percent and total loss if watered in 20 days.
Coconut & Arecanut	Needs to be watered only during the sapling stages, after which it tends to manage without water for as long as 15 days.
Nutmeg	Needs to be watered once in 7 days, to produce best results. Delaying irrigation can reduce productivity. Irrigation can be extended to once in 10 days, but extending beyond that has seen reduced quality of the fruit and drying of the leaves.

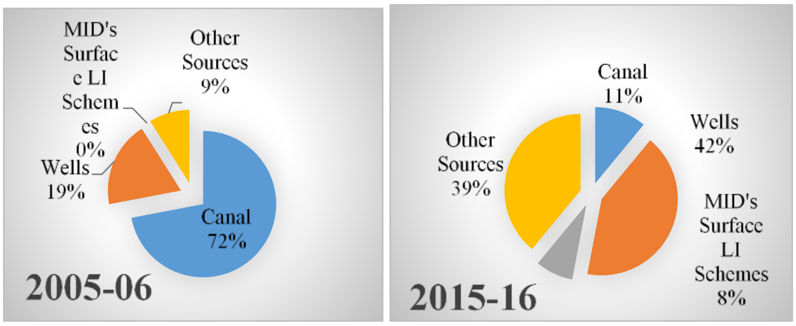
This clearly shows that farmers have adapted to changes in their irrigation pattern given that CRDS was designed exclusively for paddy cultivation. Currently, water release in the RBC happens once in 14 days until January and then this increases to once in 17-18 days in the following months. On the LBC the release happens once in 22 days post January. To accommodate these changes, farmers in all the wards have resorted to alternate measures such as lift irrigation, use of storage tanks, dugwells, panchayat instituted *thodu* (streams/drains) and *chiras* (natural ponds) all of which depend on the indirect recharge or replenishment through canal water seepage.

In the year 2005-06, canal as a source of direct irrigation constituted 80-85 percent of the irrigated area near the head end. This reduced to 60 percent in 2015-16 combined with an increase in dependence on wells and other sources of irrigation such as private or community-initiated lift irrigation structures, ponds and other storage structures. The decrease in dependence on canals was found to be even more severe in the middle and tail ends (see Figure 4). While irrigation through wells is common for nutmeg, tapioca, yam and colocasia; coconut, arecanut and plantains, that require less frequent irrigations, are managed using Lift Irrigation (LI) structures, tanks and ponds. Farmers have unanimously mentioned that inefficiencies in canal irrigation have resulted from poor maintenance of the canals, degradation of sprouts and shutters, absence of proper field channels for fields situated away from the sproutsand inefficient management resulting in improper distribution of water. Tail enders are forced to delay their plantation periods resulting in loss of productivity. Poor performance of CRDS drove farmers away from paddy to crops with variegated irrigation schedules which in turn made canal irrigation secondary, and allowed bureaucracy to relax management processes, thus creating a negative loop within the system.

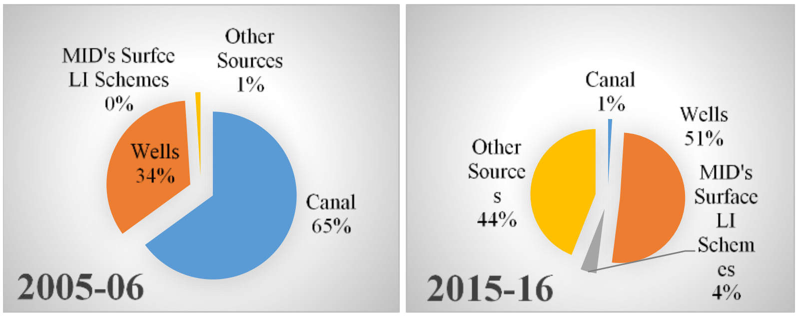
Being a first-generation project, the Command Area Development Authority (CADA) stipulated the setting up of Beneficiary Farmers' Associations (BFA), Canal Committees (CC) and Project Advisory Committees (PAC) to manage the anarchy in the last mile delivery of canal water in the command. This was meant to construct field channels and ensure adequate water supply with equitable distribution. Studies conducted by Chackacherry (1996) and Joseph (2001) on the efficacy of these institutions in Kerala, suggest the failure of such measures due to lack of awareness among farmers, absence of effective leadership for BFAs, corruption, political interference, lack of structural reforms, administrative lapses etc. Interaction with Irrigation Department officials revealed that BFAs are non-existent within the command area and PAC meetings were only held as a formality.



Upper reach – Pariyaram (RBC) and Mukanoor (LBC)



Middle reach – Chalakudy (RBC) and Melur (LBC)



Tail Reach – Aloor (RBC) and Karukutty (LBC)

Figure 4. Area irrigated (%) by different irrigation sources in the 24 wards.

5. INTERVENTIONS TO COPE WITH CHANGE

What we see today in the CRDS command area is a combination of state, private and community led irrigation systems, as the change from subsistence crops to high valued commercial crops requires assured irrigation during critical months.

Wells: Farmers' investment in wells is dependent on two main factors – the type of crop grown and the status of farmers owning the land. In the head regions, large farmers who grow nutmeg, tapioca, plantains and tubers were found to depend more on private dugwells. Since the productivity of these crops depends on timely irrigation, farmers invest up to ₹25,000 - 30,000 for the construction of wells. These are mostly part-time farmers who also own other businesses. George and Mohan (2016) observed that almost every house in the head end had a well/tubewell for irrigation and direct dependence on canal had significantly reduced. It was also found that farmers at the head end over-appropriate the canal water by illegally pumping water into their wells using PVC pipes and 3 hp pumps during summer months. After every

summer, the pipes are destroyed and the pumps are taken back for use during next summer. At the same time it was also noted that tail enders, who do not get sufficient canal water supply during summer months, need to depend on tankers which fill up their wells during these critical months.

Panchayat efforts: Farmers of *Karukutty* panchayat which falls near the tail end of CRDS had been facing extreme water shortage especially during summer months. Through the support of the panchayat, *Manjalithodu*, a natural pond within the panchayat was rerouted to two new storage structures which were constructed between wards 17,12 and 13. Although this solved the problem of water scarcity to some extent, the tanks can only maintain their levels if there is sufficient flow through the canal which would recharge the pond.

Lift Irrigation Structures: As compared to investment in well irrigation which is done at the individual level, lift irrigation has seen widespread collective response. Vis-à-vis canals where water supply depends on scheduling, lift irrigation schemes supply water as per the demand. George and Mohan found that LI pumps were greater in number in the middle and tail ends which were mostly managed by farmer collectives. The chief crops cultivated here were coconut, arecanut and rubber which are less water intensive. Menon *et al.* (2005) studied several lift irrigation schemes in *Meloor* panchayat, which falls under the command area of CRDS, that were promoted by the state, co-managed by state and farmers, and owned and managed collectively by farmers. Efficient allocation through these schemes depend on the presence of water allocation rules, monitoring system, strong organizational set up, and able and fair leadership. One such example is the Naduthuruth Lift Irrigation Unit where the need for alternative supply of water motivated farmers from *Naduthuruth* region of *Meloor* panchayat to set up a lift irrigation project within the village through financial support from the Small Farmers' Development Agency (SFDA). The project lifts water from a natural drain and supplies it in three directions through outlets that work in rotation depending on need. They have also included a pump operator who additionally monitors the time allocation and conducts fee collection. Field channels are repaired by the water users themselves.

The Minor Irrigation Department has also set up over 29 LI schemes within the Chalakudy basin, with a combined ayacut of 1900 ha. The majority of these schemes have come up post 1985 with the weakening of the CRDS and significant decline in paddy area. Using pumps that range from 15 hp to 150 hp, these schemes include both lifting directly from Chalakudy river as well as through the multiple *chiras* within the command. The water is then transported to fields through small canals of 2m width and 75cm depth which use gravity flow or through underground pipelines that transport water to the uplands. These LI schemes function from November to May on a daily basis.

Other institutional advancements: The irrigation department, despite their tight budgets and a meagre annual maintenance fee of ₹1.8 crore, have proposed implementation of additional infrastructure to ensure the timely flow of water through the CRDS. These include the provision of additional sprouts and the construction of two checkdams at Vettilapara and Kunankuzhi which are located in the immediate upstream just after the proposed Athirapally project. Water stored in these checkdams can then be controlled for regularizing the flow through the canal. The department has also proposed a Link Canal project costing ₹75 crores which will connect the main canal of Bhoothanketu barrage to the LBC thus ensuring that water reaches the tail ends even during critical months.

Figure 5. Water lifted through LI schemes from Chalakudy river as well as ponds (chira)

6. CONCLUSION

System design and centralized operation were the cornerstone of large gravity flow systems constructed by the state in India since the colonial times. However, a comprehensive irrigation management regime that enforced rules and minimized head-tail inequity was always critical for managing these systems to their design potential for performance. Post 1990, despite large public investment in canal systems, their relative share in area irrigated showed an absolute decline (Shah 2009). CRDS was one such system that was scientifically designed to match the irrigation schedule of paddy. Over time, anarchy crept in at the last mile arising from acts of commission like the unauthorized lifting of water from the canal by head reach farmers and acts of omission like the failure of BFAs to cooperate in maintenance and repair (Burt and Styles 1999). This was coupled with administrative lapses in maintenance that resulted in the current decrepit state of the canal system. From the viewpoint of irrigators, the performance of an irrigation system is judged by the level of water control it offers (Boyce 1988). In the CRDS command, there is now a lack of homogeneity of farming systems that once existed. Farmers grow different crops with varying scales and schedules of water demand. Head reach farmers who have better water control through reliance on private wells cultivate high value crops that require frequent watering whereas tail end farmers that depend more on collective LI structures grow less water intensive crops.

Much of the blame for flow fluctuations within the canal has been directed towards the hydro-electric power plants in the upstream which have accorded higher priority to power generation in scheduling water releases than the irrigation needs of farmers. However, as farming shifts towards cash crops, an irrigation schedule specifically designed for paddy may not be beneficial. Farmers now have been shown to indirectly depend on irrigation canals which have been converted into recharge canals within the command. This is similar to the case of the Guhai irrigation system in North Gujarat, where canal releases are available only 3-4 times but most farmers irrigate 35-45 times in a year through canal recharge of wells in the command area (Shah, 2010). Therefore, even though the water release is untimely, if enough water flows through the canal during critical months even a few times, it would result in sufficient recharge. Verma (2011) observed, during a field visit to canal commands in Rajkot district, that farmers at the tail end request to release one full irrigation through canal release instead of multiple smaller irrigations, so that it would help recharge wells in the command area through water seepage. This could be one of the ways to salvage more value from the canal system in an era when everybody wants private irrigation. Another way could be inducing seepage through the canal system by making the canal distributaries largely unlined.

Meijer et al. (2006) while studying the UdaWalave irrigation scheme in southern Sri Lanka found that canal seepage accounts for a substantial contribution to groundwater recharge, about 55 percent annually and up to 75 percent in dry seasons. It was estimated that after concrete lining the annual groundwater recharge in the irrigated areas would be reduced by approximately 50 percent. Conjunctive management of surface and ground water could lessen the diseconomies of canal systems and maximise its positive externalities. Shah (1990) argues that establishing a long-term water balance equilibrium over the entire command would require discouraging canal irrigation use and encouraging groundwater irrigation near the head and along the main and branch canals. This could be the most effective way to secure an extensive spread of canal water resources.

Policy makers continue to infuse fresh capital in modernizing flow irrigation systems through programs such as Accelerated Irrigation Benefit Program (AIBP). The CADA act of 1986 also failed to yield positive results in managing anarchy at the last mile. According to Shah (2009) the dependence on unreliable flow irrigation has rapidly eroded because of three changes – a) new opportunities for off-farm livelihoods, b) pressures and temptations to diversify cropping and c) pump irrigation. As farmers grow prosperous, what can be seen in the CRDS command area may be observed in canal commands all over the country.

7. REFERENCES

Agricultural Statistics. 2005.Area, Production and Productivity Trend of Important Crops in Kerala (From 1985-86 to 2004-05). Department of Economics and Statistics, Thiruvananthapuram.Available online: http://www.ecostat.kerala.gov.in/images/pdf/publications/Agriculture/data/old/area_crops_8586_0405.pdf

Boyce, J.K. 1988. Technological and Institutional Alternatives in Asian Rice Irrigation. Economics and Political Weekly 23:13:A6-A22

Burt,C., and Styles,S. (1999). Modern Water Control and Management Practices in Irrigation: Impact on Performance. In Modernization of Irrigation System Operations, edited by D. Renault. Proceedings of the Fifth International IT IS Network Meeting, Aurangabad, India, 28-30 October 1998. Bangkok: Food and Agriculture Organization, RAP Publication 99/43, 93-114

Chackacherry, George. 1996. Irrigation Water Management with Farmer Participation in Kerala, Problems and Prospects. Conference Paper, Thiruvananthapuram: Department of Irrigation

George, S.L. and Mohan, A. 2016. Evolving nature of Canal Systems in Kerala: A study of the Chalakudy River Diversion Scheme. Unpublished Internship Report. IWMI-Tata Water Policy Program, Anand

Joseph,C.J. 2001. Beneficiary Participation in Irrigation Water Management: The Kerala Experience.Discussion Paper No.36. Kerala Research Program on Local Level Development, Centre for Development Studies, Thiruvananthapuram

Karunakaran,N .2014. Paddy Cultivation in Kerala – Trends, Determinants and Effects on Food Security.Artha Journal of Social Science, Vol. 13, No. 4, pp: 21-35

Mani K. P. 2009. Cropping Pattern in Kerala– Spatial Inter-temporal Analysis. In Rajan K (ed) Kerala Economy: Trends during the Post- Reform Period, Serials Publications, New Delhi, pp: 64-84

Meijer,K., Boelee, E., Augustijn,D., Molen, I. 2006. Impacts of concrete lining of irrigation canals on availability of water for domestic use in southern Sri Lanka. Agricultural Water Management 83, p243-251

Menon,V., Paul, A., Nair, K.N. 2005. Dynamics of Irrigation Institutions: Study of a Village Panchayat in Kerala.Economics and Political Weekly

Mythili G. 2006. Supply response of Indian farmers: Pre and post reforms. Working Paper 2006-09, Indira Gandhi Institute of Development Research, Mumbai, pp: 1-36.

SANDRP. 2013. Public pressure leads to changes in Kerala Dam Operation. Available online: https://sandrp.in/tag/chalakudy-river-hydropower-project/

Shah, T. 1990. Managing conjunctive water use in canal commands: Analysis for Mahi Right Bank Canal, Gujarat. In Future directions for Indian irrigation: research and policy issues. Meinzen-Dick, Ruth Suseela; Svendsen, Mark (Eds.). Chapter 19. Pp. 287-306. Washington, D.C.: International Food Policy Research Institute (IFPRI).

Shah, T. 2011. Past, Present and Future of Canal Irrigation in India. India Infrastructure Report

Shah, T. 2009. Taming the Anarchy: Groundwater Governance in South Asia. Resources for the Future, Washington D.C., USA

Shah, T. 2010. Guhai, Sabarkantha: Changing reality of an irrigation system. Field Note (Unpublished).

Suchitra, M. 2015. Rice at risk. Down to Earth, 17 August, 2015. Available online https://www.downtoearth.org.in/coverage/rice-at-risk-43367

Verma, S. 2012. Field notes from visit to canal systems in Rajkot