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Managed Aquifer Recharge in India: Consensual Policy but Controversial Implementation

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ABSTRACT: In the Indian water policy, Managed Aquifer Recharge (MAR) is considered as one of the best supply side water management options to face groundwater depletion. It is expected to optimize the resource as well as attain environmental sustainability and meet water demands and social justice. It is also expected to be implemented with a paradigmatic shift in water management. From policy to practices, at the local level, numerous recharge structures exist, are built or planned and reveal controversial implementation. With a socio-historical approach, our paper analyses the trajectory of MAR implementation in the Pondicherry Region (South India). Through interviews and observations, the trajectories of two local projects are scrutinized, The Tank Rehabilitation Programs in Pondicherry district and a recharge shaft in Kiliyanur. Stakeholders' strategies and values regarding MAR are analysed and how local appropriation leads to adaptation and diversion. Finally, there is no paradigmatic shift going with MAR implementation. Instead, MAR is shown as a consensual policy because it is a possible compromise between groundwater conservation, optimization of the resource, satisfaction of the users and social justice, but controversial positions and oppositions should be acknowledged within implementation. The paper discusses opposed conceptions of MAR: participatory vs. expert driven, demand vs. supply driven and traditional vs. modern.

KEYWORDS: Participation, paradigm, local appropriation, artificial recharge, India

INTRODUCTION: MAR IN INDIA FROM ENTHUSIASM TO CONCERNS

> *Groundwater recharge therefore needs to become the new 'mantra[1]' for India's water policy (Shah, 2009a).*

[1] Mantra : "(Especially in Hinduism and Buddhism) a word or sound that is believed to have a special spiritual power:(...) A word or phrase that is often repeated and expresses a particular strong belief".
https://dictionary.cambridge.org/dictionary/english/mantra, Feb. 2018

The turn toward MAR

On June 6th 2018, The Hindu, one of the most read Indian newspapers, published an article entitled "World Bank nod for ₹6,000 cr.[2] groundwater recharge plan". Indeed, the World Bank granted a loan to the Atal Bhujal Yojana (ABHY) – the National Groundwater Management Improvement Program for India whose objective is to improve the management of groundwater resources in selected states. As the title states the article focuses on recharge among the activities planned. Such a focus is representative of the enthusiasm toward groundwater recharge in India and more specifically toward intentional recharge. From the systematic analysis of the articles on groundwater published by the Hindu between July 2010 and June 2015, we observed a consensus on intentional recharge (Richard-Ferroudji, 2017). Officials and activists who contribute to the newspaper are unanimous on the benefits. Articles report successful experiments. With the same perspective, in the foreword of the Indian Master Plan for Artificial Recharge (2013), Dhruv Vijai Singh, Secretary of the Ministry of Water Resources, asserts: "Artificial Recharge of groundwater by utilizing surplus rainfall runoff is one of the best supply side water management options for providing sustainability to groundwater sources and augmenting depleted aquifer systems" (p.i). In this document, Artificial Recharge is considered as a way to optimize the resource as well as attain environmental sustainability and also to meet water demands. The Master Plan lists potential impacts of AR in positive terms only.[3] AR is distinguished from natural recharge and aims "at augmentation of ground water reservoir by modifying the natural movement of surface water utilizing suitable civil construction techniques" (p. 13). Traditionally practiced through surface spreading techniques, AR now also comprises subsurface techniques such as recharge shafts or injection wells. Intentional recharge is referred to in the Master plan as Artificial Recharge (AR). It can also be referred to as MAR (Managed Aquifer Recharge) or AS (Aquifer Storage), while MAR has become prevalent in the international debate. In this text, these terms will be used indistinctly to encompass any project of intentional recharge.

MAR has developed in India (Sakthivadivel, 2007; World Bank, 2010; Sakthivel et al., 2015; Closas and Molle, 2016; Nättorp et al., 2016). According to Sakthivadivel (2007), up until the 1960s groundwater recharge had been done via traditional water collection infrastructures and schemes, e.g. tank systems. This was driven by local communities, kings, and religious leaders to meet local needs. After the 1990s, schemes were prepared to implement artificial recharge through dug and bore wells, check dams and percolation ponds to a larger scale. Articles analyse how after some recharge movement from the population, such as the Dug Well Recharge in Saurashtra, Gujarat,[4] the Government started to give technical and financial support to farmers and NGOs. It also started to design recharge schemes to be implemented at a national scale, such as the Indian Master Plan for Artificial Groundwater Recharge (2013), guideline (CGWB, 2007; Dillon et al., 2014)[5] and to include

[2] 60.10^9 Indian Rupees, equivalent to US$1000 million, with a US$ 450 million loan from the World Bank, http://projects.worldbank.org/P158119/?lang=en&tab=overview

[3] P. 28-29: "7.4 Impact assessment (…) Conservation and harvesting of surplus monsoon run off (...) The energy consumption for lifting ground water from abstraction structures also reduces. The groundwater structures in the benefited zone of artificial recharge structures gain sustainability and the wells provide water in lean month. (...) The cropping pattern in the benefitted zone may undergo marked change due to augmentation of groundwater. Due to the increase in soil moisture, green vegetation cover may be increased and so is the number of ground water abstraction structures in the zone of influence. (...) The quality of groundwater may also improve due to dilution. Besides, the artificial recharge schemes will generate indirect benefit in terms of decrease in soil erosion, improvement in fauna and flora, influx of migratory birds, etc. The social and economic status of farmers would be substantially improved due to increase in crop production".

[4] Three consecutive years of severe drought from 1985 to 1987 frightened the farmers who decided to organize themselves to take measures to recharge groundwater to their wells helped by NGOs, spiritual and charitable trusts and social activists.

[5] For further manual or guideline published by CGWB, Central Groundwater Board, please see : http://cgwb.gov.in/Manuals-Guidelines.html

artificial recharge projects in related schemes, such as Watershed Management or Rural Development schemes. Since, MAR has increasingly been considered in laws and policies (Sakthivel et al., 2013). For example in Kerala, the Government scheme for dug well recharge in Mazhapolima proposes an original institutional design (Varma, 2017). This scheme aims at encouraging people to construct rooftop water harvesting structures to recharge their private well. Some authors demonstrate the success of groundwater recharge projects carried out by NGOs to rebuild traditional village governance structures and user participation in community-designed and maintained water harvesting structures (Everard, 2015). Studies promote participation and community management strategies (Gale et al., 2006).

From newspapers to scientific literature, intentional recharge appears as a consensual solution to solve water problems. Shah (2008) promotes a shift from recharge by default to recharge by design to achieve climate change adaptation. He sees "managed aquifer storage as the centre pin of water strategy with proactive demand- and supply-side management components" (p.1). He argues for a large-scale groundwater recharge plan promoted by the government. Shah compares four storage alternatives to promote MAR (Shah, 2009): "the first -advocated by environmental and civil society groups-emphasizes numerous small decentralized storages close to the point of use and with short canals" ; "the second – emphasized by government bureaucracies – represents the dominant colonial and post-colonial strategy of creating large reservoirs at hydraulically opportune sites and transporting water through a vast network of surface canals"; "the third represents the groundwater boom India has experienced in which mostly shallow aquifer storage has been relentlessly exploited through atomistic action by millions of small farmers without any demand-side management or a systematic strategy of enhancing aquifer recharge"; the fourth represents an option that is as yet non-existent but can be operationalised with a paradigmatic shift in the country's water management thinking; it recognizes that groundwater demand will increase, but given India's hydrology, aquifer storage can sustain this increase with proactive demand management and a nationwide program of managed aquifer recharge"(p.5). In doing so, Shah distinguishes MAR from traditional water storage through numerous decentralized reservoirs and expects a change of paradigm in water management involving proactive management of the demand and community participation.

Raising concerns: Is MAR a 'mirage'?

From policy to practices, at the local level, numerous recharge structures exist, are built or planned but the impact of these structures remains poorly understood. Critics raise concerns and limitations from environmental, economic and social points of view. In India beyond the consensus, authors are warning about "chasing the mirage" about artificial recharge (Kumar et al., 2008). Some scientists even raise the alarm about some government projects[6] and call to develop sound knowledge to support their decision.

Studies have evaluated the impact of aquifer recharge structures from a hydrological and a hydro-geological point of view, raising issues of water quality, storage, clogging and maintenance (Massuel et al., 2014; Nättorp et al., 2016). Comparing artificial recharge to a 'mirage', Kumar et al., shows that in water-scarce regions of India, runoff harvesting does not offer any potential for groundwater recharge or improving water supplies at the basin scale because of downstream negative hydrological impacts and high inter-annual variability in rainfall (Kumar et al., 2008). Findings from Gale et al., about three study sites in India suggest that recharge can make periodic contributions to redress both the quantity and quality issues but does not provide a sustainable solution and will not solve the depletion problem (Gale et al., 2006). Besides, the investments in the program are often driven by the potential available for groundwater recharge, and not by the need for recharge (World Bank, 2010).

[6] For example, the National Geophysical Research Institute (NGRI) researchers warning in the national press about the Kakatiya tanks rehabilitation program led by Telangana state, Times of India April 25.

Studies raise concern from economic, social and political perspectives. Analysis of available data from pilot projects shows that in many cases artificial recharge structures are quite expensive, with the cost of a cubic meter of recharge water turning out higher than the expected gross return from its use in irrigation; the cost of maintenance is often underestimated and the life of the structures overestimated (Kumar et al., 2008). MAR programs aim at greater equity into water access and social justice. Yet, recharge practices have raised significant equity questions.[7] Most of the time, the beneficiaries of artificial recharge are those with existing land holdings and access to groundwater with wells close to recharge structures (Gale et al., 2006). Groundwater still gets captured largely by well owners (Shah, 2009). Recharge enhancement often leads to more active irrigation wells and prevents from managing the demand (Shah, 2014). Observing a pro-farmer MAR in Gujarat, Mukherji (2006) confirmed that groundwater-related policies have very little to do with the scarcity, depletion or quality of groundwater, and more to do with rural politics. A survey of the preferences and motives of stakeholder representatives in the periphery of Chennai show conflicting interests of stakeholders that may hinder implementation of certain types of MAR methods (Brunner et al., 2014). Brunner observes that to overcome this problem, most stakeholders support the idea of establishing a state authority for licensing groundwater extraction and overseeing managed aquifer recharge. Currently, different agencies of the government appear to act in an uncoordinated manner and without an integrated perspective about MAR (Sakthivel et al., 2013). According to Brunner, the authority should amalgamate responsibilities regarding groundwater and coordinate the MAR programs. Then MAR policy may contribute to the resurgence of the 'resource-state' and the recentralization of policies and institutions that attempt to control decentralized groundwater users and ecologies as observed by (Birkenholtz, 2015). MAR is expected to be participative: "The success of implementation and optimal utilisation of the schemes depends on participation and active contribution of the public" (CGWB, 2007: 171). Yet many authors observe the implementation of government schemes with a top down approach, no participation and no appropriation by the local communities. Gale et al., showed in their case studies that the use of participation mechanisms was limited, restricted to the provision of labour and information and not a true engagement and management of the project by the community. Often, plans to hand over the structures to User Associations fail. The Dug Well Recharge Program implementation also showed: lack of central leadership, poor institutional design, weak participation from civil society and NGOs, daunting fund management and monitoring challenges, weak to non-existent communication strategy, unresolved technical issues with ground-level implementation, free-riding issues, lack of ownership among implementing agencies and incompatible policies (Krishnan, 2012).

Finally, factors that argue for and against artificial recharge are listed (World Bank, 2010) to shade the relevance of MAR which "can give the impression that a simple single solution to groundwater resource problems exists" (p. 27). According to several authors, the 'one-size-fits all' MAR approach is unrealistic. Success depends on a set of location-specific factors, both physical and socioeconomic. Different MAR methods are discussed (CGWB, 2007; Nättorp et al., 2016). MAR can be performed by a multitude of structures. Because of India's long tradition of water harvesting, there are many traditional structures. From a territorial perspective, the 2010 World Bank (op.cit.) report also promotes land use planning to protect recharge areas. Yet, this type of measure is rarely considered in the literature on MAR and policies which focus on structures. The conjunction of MAR with other solutions is also discussed. If Shah (2009) promotes participatory MAR, according to him, it should be combined with management of the energy-irrigation nexus; conjunctive management of rain, surface and groundwater; adaptation to groundwater quality decline and use of micro-irrigation.

[7] Even if it is difficult to assess livelihood improvement due to the lack of longitudinal survey and discrimination of the recharge from other variables (Gale et al., 2006).

A socio-historical approach of local implementation to question justifications of MAR

This article contributes to the analysis of MAR implementation focusing on India and exploring the social depth of groundwater. Groundwater practices are deeply rooted in societies and cultures. Achieving more sustainable management requires a comprehensive understanding of socio-economic, political and institutional structures which are complementary to the technical ones. A good understanding has significant relevance for better governance of groundwater, which has been of increasing concern since the 90s (Ostrom, 1990; Villholth et al., 2017). There is a growing body of literature that studies the social aspects of groundwater resources but with a broad scope of development (Faysse and Petit, 2012; Mitchell et al., 2012; Curtis et al., 2016), especially regarding MAR.

In the field of sociology, with a pragmatist stance, our paper analyses the trajectory of MAR implementation at the local level. What is the legal framework and the administrative structure of MAR implementation? Who is involved in promoting and implementing MAR (state representatives, researchers, NGOs, elected representatives, local communities)? Which are the stakeholders' strategies, values and relationships regarding MAR? How do local actors ignore, circumvent, deflect, appropriate, cope with or adjust to this policy? How does local appropriation lead to adaptation and diversion?

The following hypothesis will be explored. Is MAR contributing to a paradigmatic shift in water management or is it just a new 'nirvana concept' (Molle, 2008)? According to Molle, nirvana concepts, such as IWRM (Integrated Water Resources Management) are attractive yet woolly consensual concepts that obscure the political nature of natural resources management. They are easily hijacked by groups seeking to legitimize their own agenda. But they are also boundary objects that offer opportunities for contestation and negotiation. Position regarding MAR is underpinned by interests, capacities and normative conceptions of groundwater resources management.

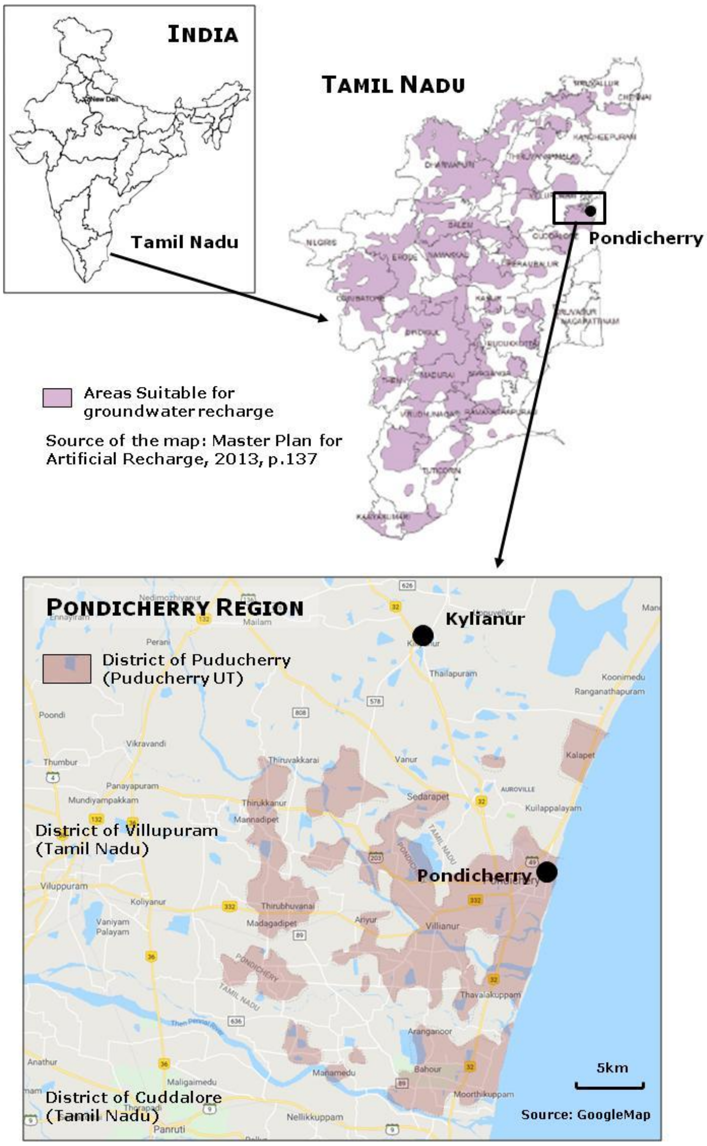
In the field of social sciences, our theoretical framework acknowledges a plurality of values, interests and attachments to water (Thévenot, 1999; Richard-Ferroudji and Barreteau, 2005). In this article, we consider theoretical examination of justification (Boltanski and Thévenot, 2006), which provide a way of analysing how the legitimacy of an action is debated by people. In disputed situations or in the case of criticicism there is a need for justification. Plural orders of worth are to justify good management of groundwater and legitimate measures. In our previous work on groundwater policy related articles published by The Hindu, one of the leading newspapers in India, we identified four typical qualifications of groundwater associated with best management measures: (a) endangered heritage whose access must be regulated, (b) limited resource that must be optimized, (c) issue of survival whose access must be ensured (d) source of emancipation that must be acknowledged (Richard-Ferroudji, 2017). The two last ones condone the overexploitation of aquifers. This led us to advocate careful consideration of the multiple normative perspectives toward groundwater management and emphasize the importance of compromises between conservation and consumption. For example, when it comes to agriculture, the archetypal image of groundwater with its ambivalent meanings is very strong (Kuper et al., 2016). On the one hand, groundwater epitomizes economic development and self-empowerment, but on the other hand, boreholes and their funding can act as a poverty 'trap', leading to further inequality.

The article is based on field work in the Pondicherry Region, which straddles the Tamil Nadu State (Villupuram and Cuddalore district) and the Puducherry Union Territory (Puducherry district). The small district of Puducherry (290 km² – population 947 k (Census 2011)) is part of the Union Territory (UT) of Puducherry but it is an enclave of Tamil Nadu (Figure 1). Rainfall in these areas occurs from August to December and is highly variable. This is followed by rain deficit years with surplus or excess rainfall once in about 5 years or more which creates drought and flooding years for the region. The Puducherry Region is paved with ponds and *tanks* – seasonal lake-reservoir – (see Figure 1) which date back to the Chola period (about 800 AD). Since the 80s, the shift from tank to wells has accompanied a water crisis

(Aubriot, 2013). As per the "assessment of dynamic ground water resources of country" carried out jointly by CGWB and State Ground Water Departments on 31st March 2013, out of the total 1139 numbers of assessment units, 358 units are categorized as 'over-exploited' in Tamil Nadu (31%). In Puducherry UT, the Puducherry assessment unit is categorized over-exploited. In the course of the recent decades, the Pondicherry region has faced rapid changes in land and water uses that may be accentuated by global changes in the future. Agriculture has decreased and a large amount of agricultural land has been converted into urban or fallow land, including real-estate speculation (Venkatasubramanian et al., 2017). This context of urbanization is interesting as the literature on MAR is dealing either with urban or with rural situations.

Case studies in the Pondicherry Region

Figure 1. Situation of the case studies.



Through interviews and observations, the trajectories of two local projects are looked at: the tank rehabilitation programs in the Puducherry district and a recharge shaft in Kiliyanur village, 15 km north-west of Pondicherry (population 6334 – Census 2011, including low cast 3823). Regarding the tank rehabilitation programs, participant observation has been carried out since the 2000s completed with interviews with administrations, tank user association representatives and NGO. In Kiliyanur, intensive field work was carried out in 2014-2015 (Latusek, 2015), updated in 2017 and 2018, with field visits and interviews with farmers, inhabitants, village council representatives, farmers association leader, Public Works Department (PWD) engineers and electricity board engineers.

The article is organized as follows. Part 1 focuses on MAR implementation in the Pondicherry region, describing the legal framework and policy programs. Then trajectories in the two cases are analysed, namely tank rehabilitation programs (2) and the recharge shaft in Kiliyanur village (3). Part 4 discusses and concludes looking at whether MAR is contributing to a paradigmatic shift in water management thinking.

MAR IN THE PONDICHERRY REGION: A FLOURISHING FIELD

Lack of legal framework at the state level but many programs

The Central Government policy on MAR is adapted at the State level. As the Pondicherry region straddles administrative units, it is concerned by two State level policies. The region benefits from administrations, regulations and policies from Tamil Nadu and from Puducherry UT (Figure 2).

Legislation in Puducherry UT does not mention MAR. Tamil Nadu has a limited legislation regarding groundwater recharge, with no mention of it in the 2003 Groundwater (Development and Management) Act, which was withdrawn in 2011 (Latusek, 2015). One section of the Chennai[8] Metropolitan Area Groundwater (Regulation) Act of 1987 is dedicated to the implementation of a recharge scheme. Meanwhile, MAR is promoted through a Rain Water Harvesting regulation. With the 2002 Ground Water (Regulation) Act Amendment and the Tamil Nadu Municipal Laws ordinance, 2003, dated July 19, 2003, the Tamil Nadu Government made rainwater harvesting structures mandatory for every building, new and existing, and forbade any use of urban water bodies other than water storage in order to let them contribute to groundwater recharge. Industries[9] are required to recharge the groundwater they extract. The lack of a legal framework may become an issue regarding MAR, in particular with respect to the quality of the water to be recharged.

Despite a lack of legal framework, MAR is part of many government programs and a wide set of activities in the Pondicherry Region. For example, in recent years, the Tamil Nadu Government Order Ms.No.198 allocated Rs 5.5 10^9 (€65M) to the Public Works Department (PWD), Agricultural Engineering Department (AED), Tamil Nadu Water Supply and Drainage Board (TWAD Board), and the Forest Department to create artificial recharge structures under the Master Plan for Artificial Recharge Scheme (MPARS) (2008-2015). More than 12,000 recharge structures were constructed; mainly check dams, a few recharge shafts and percolation ponds. The Dug Well Recharge Program(2007-2010), funded by NABARD,[10] was carried out in Tamil Nadu, but with some limitations (Krishnan, 2012): lack of central leadership, mismatch of skills, poor institutional design, weak participation from civil society/ NGOs, daunting fund management and monitoring challenges, weak to non-existent communication strategy, unresolved technical issues with ground-level implementation, free-riding issues, lack of ownership among implementing agencies and incompatible policies. In 2016, based on the Artificial Recharge Plans of Tamil Nadu, the CGWB designed objectives to be implemented at the local level, with

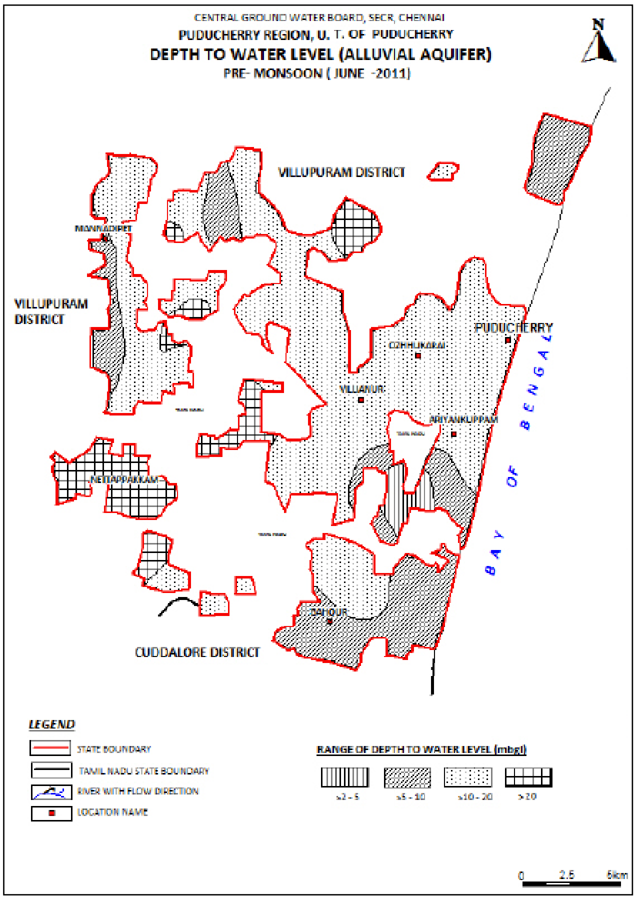
[8] Main city of Tamil Nadu, 150 km north of Pondicherry

[9] Many water-based industries were established in the Puducherry Region during the early 80s because of availability of groundwater and electricity.

[10] National Bank For Agriculture And Rural Development

a scale around 100 km^2. Each of the 81 plans[11] propose interventions including tentative location of artificial recharge structures (map) and water conservation, tentative cost estimation and implication modalities. Technical aspects and costs are detailed. Yet, the plans do not answer the question of who will do what? They recommend assessment and maintenance but with no indication of cost or what the role of government agencies, NGOs or users will be. The national scheme fails to give a clear outline of the pathway to implementation at the local level, as Shah already noticed for the National Master plan (Shah, 2008).

Figure 2. Administration of groundwater within the boundaries of Pondicherry U.T.



Source: CGWB, 2013, District groundwater brochure Puducherry Region, U.T. of Puducherry, by Dr. D. Gnanasundar, p. 4.

MAR activities are not necessarily part of Artificial Recharge schemes and many are performed independently by the line departments, through:

Water management programs: at national and local level, AR was part of the Watershed Development programs comprising the Drought Prone Area Program (DPAP) and the National Watershed Development Program for Rainfed Areas (NWDPRA), the Command Area Development & Water Management Program and water conservation in reserved forest area. Future plans/schemes to reduce the salinity problem also include recharge shaft in water holding areas or check dams in Puducherry and Tamil Nadu. In the coastal area, groundwater recharge is also expected to fight

[11] http://cgwb.gov.in/AR/TamilNadu-ARPlan.html, Feb 2018.

salinisation. Indicators and thematic maps are produced to analyse the impact of artificial recharge in minimizing seawater intrusion and assess the possibility of remedial measures (Sundaram et al., 2008). In Puducherry, the TRPP (Tank Rehabilitation Project of Pondicherry) (2004-2008) implemented with the support of the European Union and the ongoing tank rejuvenation program funded through NABARD included recharge objectives. The next section focuses on this program.

Adaptation to climate change and mitigation programs: aiming at boosting groundwater recharge and preventing flood water from draining into the sea, in 2017 the Water Resources Department (WRD) of Tamil Nadu proposed a project to construct nearly 177 recharge structures across the river basins at a cost of Rs 14.45M (€170,000) under the Green Climate Fund, which is a fund established under the United Nation Framework Convention on Climate Change to support developing countries adapt to and mitigate the impact of climate change. In this project, besides structures across the rivers, there are also plans to build recharge wells and recharge shafts in 52 water bodies.

Agricultural programs: The Department of Agriculture of Pondicherry promotes measures for augmenting groundwater resources through rain water harvesting and artificial recharge with subsidies.[12] The project TN-IAMWARM (Tamil Nadu Irrigated Agriculture Modernization, WAter bodies Restoration and Management) was a multidisciplinary project funded by the World Bank and implemented by the Water Resources Organization (WRO), PWD and Government of the Indian state of Tamil Nadu as the nodal agencies. This 6-year project (2007-2013) aimed to facilitate efficient irrigation practices by local farmers. It included groundwater recharge structures in over-exploited blocks. In practice recharge structures were proposed in some of the rehabilitated tanks. We will later concentrate on one of these structures to understand local appropriation of the project.

Rural development and employment programs: The 2005 Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) guarantees minimum 100 days of wage employment to every rural household for unskilled manual work. It is common to use this rural development program for maintenance of the tanks (reinforcement of the bunds and desilting). In Tamil Nadu, activities planned under MNREGA's 'Mission on Water Conservation' include construction of check dams, farm ponds, subsurface dykes, micro-irrigation infrastructure for agriculture and horticulture crops, community ponds, recharge shafts and summer ploughing. The Artificial Recharge Plans for Tamil Nadu propose to use MNREGA labour while some districts are identified for convergence between Rural Development policies and water policies according to national guidelines. MAR provides work and mobilization of rural landless labourers.

Numerous dispersed promoters

In Tamil Nadu, several governmental agencies are involved in MAR: the Public Work Department, the Agricultural Engineering Department, the Revenue Department, the Tamil Nadu Water Supply and Drainage Board and the Forest Department. In Puducherry U.T.; the Departments of Science, Technology & Environment, Public Works Department and Agriculture Department were involved in the new funded project. The Master Plan for Artificial Recharge is coordinated by the Public Works Department, more particularly by the State Ground and Surface Water Resources Data Centre. According to Latusek's interviews, all departments have a rather similar methodology. The over-exploited blocks or the ones in a semi-critical to critical groundwater situation are targeted. Within these blocks the location for potential Artificial Recharge structures are selected mainly based on geological considerations and land status. Constraints may also come from the funding which may be from different origins, from ministries to national funds (NABARD) or international ones (European

[12] Rs 15,000 (€180) in 2018, for "Construction of structure for rain water harvesting and recharging ground water in fallow wells" and several subsidies for construction of tube wells. http://agri.puducherry.gov.in/quantum.html, consulted on 19/03/2018.

Union, World Bank, etc). As observed in other areas (World Bank, 2010), the investments are often driven by the potential available for groundwater recharge (including funding), and not by the need for recharge.

Witnessing the critical status of groundwater NGOs took initiatives to mitigate aquifer depletion. For example, Siruthuli started to construct recharge shafts in the city of Coimbatore, Tamil Nadu (Latusek, 2015). This NGO worked with CGWB on the construction of more than 200 shafts after the board acknowledged the positive effects of the 150 structures they had built on their own. However, this type of collaboration is an exception. Most of the time even if the efforts of the NGOs are appreciated by the Government Departments, they work side by side without collaboration. One of the reasons given by Government officials for this lack of collaboration is a difference of approach and of scale. While Government Departments should target one particular aspect to develop at the State level or at least the Block/District level, NGOs usually work in a limited area (one or two villages). *Panchayats* – village councils – are involved in Artificial Recharge programs and projects at the local level. Finally, Tank User associations may also contribute.

The MAR field has flourished with many people involved. MAR activities are implemented but with a lack of interaction between promoters (Latusek, 2015) and as a consequence a lack of coordination. In the following sections their positions and points of view are analysed in two case studies.

MODERN VS. TRADITIONAL MAR: CONTROVERSIES OVER TANK REHABILITATION PROGRAMS

Revival of tanks and tank associations to recharge the aquifer

In the district of Puducherry 84 tanks are registered by PWD. According to NGOs, the Union Territory of Puducherry had over 600 ponds. But there is no record today of how many ponds remain. The number of ponds and tanks is diminishing because of a lack of maintenance and because of encroachment by agriculture and urbanization. In the 1990s, decreasing groundwater levels due to over-exploitation fostered the revival of the tank systems in some areas in order to increase rainwater harvesting and aquifer recharge (Aubriot, 2013). One of the justifications of the Tank Rehabilitation Program of Pondicherry (TRPP) was groundwater recharge. An expert even asserted that tank rehabilitation was the best solution for groundwater recharge, giving different types of arguments. According to him:

> The most accurate method for recharging the aquifers is 1) to use in priority surface water for irrigation where available, 2) to desilt the tanks in order to increase the natural percolation downwards the aquifers. So doing a large amount of fresh water will be saved and used for the aquifer replenishment. Moreover, the use of surface water for irrigation will create additional recharge towards the aquifers through the return flow in irrigated areas. Therefore, the water balance will be much less negative. This is the most efficient and the cheapest way for artificial recharge![13]

This point of view has been defended by the Tank Association (TA) supported by NGOs. It fits with the farmer knowledge on groundwater recharge and practices (Janakarajan and Moench, 2006; Aubriot and Prabhakar, 2011).

The TRPP was implemented with the assistance of the European Union's Fund from 1999 to 2004 and extended under Government of Puducherry funds till 2008 with an annual budget of Rs30M (€350k). The Public Works Department along with other departments like Agriculture, Local Administration and Revenue formed a Project Management Unit and started the TRPP. During the TRPP (1999-2008), the Project Management Unit, with the help of reputed NGOs, spearheaded the project

[13] Tank Rehabilitation Project, Pondicherry, Part 1- Hydrogeological Study, Report on the EU Hydrogeologist Expert's Mission, (24 March - 8 April 1999), Dr. Jean-Marie Barrat.

with the formation of Tank Associations (TA) registered under the Societies Registration Act of 1860. The TRPP also saw the revival of stakeholder participation. Tank Associations were created and given the prime responsibility of reviving the system. Tanks and ponds were to be handed over to them for future operation and maintenance (Raghunath and Vasantha, 2008a, 2008b; Aubriot and Prabhakar, 2011). The Tank Associations started the rehabilitation process with the help of NGOs to acquire skills and capacities for understanding the water system, running the association and undertaking civil engineering works. The entire project was planned and monitored by a statutory Steering Committee which sanctioned the annual budgets and took inputs from the stakeholders on an annual basis, whereas the Project Management Unit implemented the decisions and plans. In Pondicherry, the TRPP is considered a success in tank maintenance and preservation and fighting sea water intrusion, according to interviews and literature. After 2008 desilting was restricted to the feeding canals to the tanks and no further action was taken by the government to preserve the tanks due to the limitation of funds allocated in this regard.

Mobilisations against recharge wells

In 2013, the Department of Science, Technology & Environment (DSTE) applied to the Ministry of Environment and Forest for a project for the mitigation of climate change including tank maintenance and artificial recharge. The project was approved by the Ministry and the funding of around Rs 170M (€2M) was routed through National Bank NABARD to finance several water activities. Activity 1.4 was labelled "Sinking of the recharge well: This involves boring of specified diameter using approved drilling method to the required depth based on the available hydrological and lithological data of the tanks including bentonite mud circulation of approved specific gravity".[14] In 2017, the PWD called for tenders to implement these ground water recharging measures through sinking bore-holes inside irrigation tanks. Some Tank Associations mobilized against this project. They considered this proposition highly dangerous because it would pollute the aquifer system with infiltration of water drained from the catchment area which contains chemical fertilizers, pesticides, herbicides and sewage flows from drainage channels. According to those TAs, this artificial recharge would 'poison' the aquifer. They also highlighted the potential negative impact downstream with natural flows of river and canal affected and questioned operation and maintenance plans. They requested and got support from other local NGOs -science and technology-based NGOs and civil society organisations- which enrolled activists and experts at the national level. They wrote petitions to the government and press articles were issued. Finally, the project was abandoned, also because it did not get the support of the MLAs (Member of the Legislative Assembly), the elected representatives.

Tank Associations and NGOs also complained about the lack of a participatory approach, which is considered essential in current MAR guidelines. According to them, the governmental agencies did not consult the Tank Association, neither on the choice of the tanks where MAR was to be implemented nor on the viability of the proposed technology. The State Level Steering Committee (SLSC) formed in 2016 for this project had no members from the Tank Associations or civil society organisations. The latter also criticized the fact that the project had an unwanted important desilting component and no budget for the feeder or supply canals. Still according to them, some of the selected tanks were non-system[15] tanks which fill up very rarely. They argued in terms of technical efficiency and economic performance ("wasting money"). They also criticized the promotion of check dams for groundwater recharging in Tamil Nadu and Puducherry (rivers in the area are shown in Figure 1). They argued that any positive

[14] NABCONS. 2015. Integrated surface water management through rejuvenation of 20 tanks and 32 village ponds for Climate Change Adaptation in Puducherry, Detailed Project Report for funding under National Adaptation Fund for Climate Change DSTE Government of Puducherry, www.moef.gov.in/sites/default/files/Puducherry_0.pdf, consulted Feb. 2018.

[15] Tanks which receive water only from the rain and are not connected to other tanks or river.

impact would be nullified by unchecked sand mining[16] just below the check dams. Since the water is stopped above the check dam, sand miners can freely mine river sand below. As a consequence of the excessive and uncontrolled sand mining, sometimes even damaging the structure/foundations of the check dam above, the river bottom is going down. Due to the sunken level of the river bottom, the water table goes down. To offset this effect, farmers in a neighbouring district increased the horse-power of their motors with a loss of productivity (Selvakumar et al., 2008). Selvakumar et al. suggest imposing restrictions on sand mining and augmenting the groundwater recharge. This solution could become a vicious circle.

Regarding participation, the project submitted envisaged the formation of a Project Management Unit (PMU) in particular to look into the consultation processes.[17] The Management Unit was not formed. When the Tank Associations found out about the project from local newspapers, they wrote several letters to the departments and to the Lieutenant Governor[18] calling for consultations. They pointed out that consultation should have been called before any tank project was taken up. The Steering Committee was eventually called and attended by the 84 Tank Association representatives. The Steering Committee decided that the project would be implemented with the full participation of the Tank Associations. As at 2018 the formation of the Steering Committee was still pending and PWD called for tenders for new works. The Tank User Association filed a case to enforce compulsory consultation.

MAR as a new bone of contention in rural areas distracting from managing water demand

Tank Associations and NGOs have put forward another objection to the project. They denounce collusion between engineers, politicians and contractors who would raise illicit revenue from the program, because according to them such practices already exist with tank rehabilitation activities.[19] Since the end of the TRPP funding in 2008, the works on the tanks ordered by PWD were carried out through private contractors. Tank Associations argue that such a system only breeds corruption. For example, they criticized the time framing of the works. The PWD called for tenders in August 2017 and the tender allows a time period of 4 months for the contractors to finish the works, which is also the peak rainfall season for Puducherry (September-October-November-December). As a consequence, the tanks would either accumulate water, making it difficult to undertake any serious desilting works, or they would be filled just after the completion of the work, making it is impossible to inspect the work. Such practices and such a system of collusion and corruption were described to explain poor performance of canal irrigated agriculture (Wade, 1982). Wade details how some irrigation engineers raise vast amounts of illicit revenue from the distribution of water and contracts, and redistribute part to superior officers and politicians. Such redistribution increases the cost of infrastructure. MAR structures can be seen as new pieces in the system of administrative and political corruption that already involves other water infrastructures (canal irrigation, tanks).

However, some people from the administration sector explain why according to them the work cannot be given to Tank Associations. They complain about the lack of commitment and lack of capacity of water users for tank maintenance and collective management. They argue that Tank Associations should enrol themselves as contractors and bid for the works, which the Tank Associations refuse

[16] In Puducherry district Tank Associations representatives filed a case against sand mining which is illegal but continues.

[17] Consultation is mandatory for any participatory irrigation management program.

[18] Puducherry is a Union Territory, not a separate State, which implies that the governance and administration of the territory falls directly under the federal authority in New Delhi. However, Puducherry is entitled by special constitutional amendments to have an elected legislative assembly and a cabinet of ministers. The federal authority is represented by the Lt. Governor.

[19] See for example, denunciation in the National press in The Wire, "How the Farmers of Puducherry Are Fighting to Save Its Irrigation Tanks", 29/09/2016.

saying that they are not commercial entities but community based organisations. As per the new 2017 General Financial Rules (GFR, 2017) all works must be put out to tender. But Tank Associations point out that through using the emergency clause, the PWD is giving work to private contractors on nomination basis but hesitates to give work to Tank Associations due to political pressure. MAR structures form part of the debate on community and participative water management.

Finally, regarding groundwater recharge and tank rehabilitation, controversy arises first from a technical perspective and secondly from the users perspective. Traditional recharge with tanks is opposed to recharge wells. In this case, Tank Association supported by NGO, experts, and representatives of the administration – including the Lieutenant Governor of Pondicherry- have the capacity to raise voice and argue from a technical point of view considering water as a limited resource that must be optimized and conserved. They bring technical (efficiency), economic (high cost), ecological (pollution) and ethical (fight against corruption) arguments in favour of recharge by tanks and subsequent recharge from the irrigated lands. We have observed farmers' and NGO's resistance to a centralized policy. The MAR project offers opportunity for contestation. Meanwhile, controversy on recharge modalities prevents to manage the demand: better irrigation systems, groundwater regulation when there is water available in the tank systems, promotion of less water intensive crops during water stressed periods, etc. In a context of urbanization and contrasted scenarios for the future -including possible vanishing of agriculture in favour of tourism activities- this issue is acute and requires better technical inputs, policy guidelines and involvement of the stakeholders into the discussions.

A RECHARGE SHAFT TURNED INTO AN OPEN WELL TO SATISFY THE DEMAND

A recharge shaft designed by governmental agencies to improve the groundwater situation in an over-exploited area

Under the IAMWARM program (Irrigated Agriculture Modernization and WAter bodies Restoration and Management), funded by the World Bank, four artificial recharge shafts were built in four neighbouring villages North West of Pondicherry. These villages from the Vanur Taluk, Villupuram District (Tamil Nadu) were located in a critical block regarding groundwater.[20] Within this block, the unit of Kiliyanur was considered as over-exploited. In the area ground water is occurring in phreatic conditions in weathered and fractured gneiss rock formation. The depth of wells in hard rock varies from 6.64 to 17 m bgl. The depth to water level in soft rock varies from 2 to 8 m bgl[22]. Kiliyanur's recharge shaft was constructed in 2013 by the Public Work Department, Cuddalore-Villupuram Division in a hard rock area (charnockites).[21] The shaft is situated in the Peri Eri (Large tank) of the Kiliyanur village (Figure 3). It was constructed in the water spread area near the sluices of the tank. It is a large structure of 26m diameter, which aims at recharging the aquifer to improve groundwater quantity and quality and the conjunctive use of water for irrigation. The shaft (see Figures 4 and 5) was designed with a circular open well with a depth of 10 m, completed by 4 holes drilled in the bottom of the well at 10m deep too, in order to increase the recharge rate. The shaft was built in a high location of the tank. The top of the shaft almost reaches the full tank level. This conception was to guarantee that only the surplus water is recharged to the aquifer.

[20] CGWB, (date missing on the document), Plan on Artificial Recharge to Groundwater and Water Conservation in Kiliyanur Firka, Vanur Taluk, Villupuram District, Tamil Nadu, p.10

[21] PWD. 2006. Rehabilitation and modernization of anicuts, flood banks, supply channels and tanks covered by Varahanadhi sub basin under irrigated IAMWARM Project- Project detailed report. Government of Tamil Nadu PWD (2013).

This design was expert driven. It took into account the fact that surface storage is important for those who do not have a well and rely only on the tank for irrigation. It is argued in the project report:[22]

> Concepts: (…) The social impact / resistance to these projects come out during the lean periods of scanty rainfall, for fear of their due share be arrested by the people in the upstream side. This obstacle is overcome by providing the Injection Wells at about 0.30 m below the full tank level, ensuring that the near surplus flow only in diverted for recharging the groundwater.

The PWD also chose tanks that had experienced surplus water for several consecutive years. However, in the case of Kiliyanur and neighbouring villages, the reasons why the four locations of the project were chosen within the watershed were not explained in the documents.[23] Details on the status of the watershed and its priority for development were not given either. No study of the impact of the structures on downstream users was carried out. During information meetings held in 2013, the PWD engineer explained the intention to the farmers. One of the objectives was to increase the water level of the wells in the surrounding fields and another one was to get enough water in the village bore wells situated close to the tank. Kiliyanur is located adjacent to the tank and the village over head tank supplying drinking water is close to one of the sluices.

Figure 3. Recharge shaft of Kiliyanur.

Source: Google map, Imagery©2015 CNES/Astrium, DigitalGlobe, Mapdata©2015 Google.

Lack of communication and difference of opinion between promoters and 'beneficiaries'

The maintenance of the large tank was an issue in the 2000s. The Kiliyanur farmers association mobilized to get it desilted. First, the government representative and the Panchayat -village council-

[22] PWD, 2006, p. 238.

[23] Location of the tentative structures in the Tamil Nadu's Plan on artificial recharge are not explained either.

rejected this request. They argued that the tank had enough depth and that it had never filled more than 25% of its capacity since the 1991 heavy rain. When the project was drafted, the tank was said to have a capacity of 45.31 Mm^3, the total catchment area spread over 6.18 km², while the *ayacut*[24] under this tank covered 62.7 ha and comprised 3000 farmers. In 2007, money was finally sanctioned under the Drought Prone area fund to desilt the tank. The work was undertaken by the local Panchayat in the north east portion of the tank. The tank was rehabilitated under IAMWARM in 2009 with strengthening of bunds. A Water Users Association was formed to manage and maintain the tank and the channels. The Water Users Association is also responsible for two other small tanks in the village.

Regarding the shaft, field work done in 2015 in Kiliyanur showed that many of the interviewed beneficiaries did not know the purpose of the structures. The PWD claimed that they conducted two sensitisation meetings with the farmers, about the project and the potential benefits for the farming communities. But, most of the villagers thought it was an open well, dug for the purpose of drinking water. A few farmers knew about its role because they got trained on artificial recharge and rainwater harvesting through the Water Users Association.[25] In 2015 representatives of the latter said that they would have preferred a deeper surface storage rather than this recharge structure that they think useless or to use the money to maintain the open wells in the village. When they found out what it was, many beneficiaries considered it useless because it has not rained sufficiently for several years. Stakeholders -users, local officers, local elected- felt they were not consulted and not even informed. Some said they were informed only after completion of the project. The tank was constructed and fenced by an external contractor.[26]

Also in 2015 the shaft experienced maintenance problems: broken fences, waste around the tank -soap samples, papers, etc.- and no desilting. The Shaft construction wing of the PWD had handed over the shaft maintenance to the Village tank maintenance committee. The committee did not have any money for the maintenance and the committee itself was not functioning. According to a Panchayat representative, the PWD was controlling the tank and Panchayat had no role in its maintenance or regulation. He pointed out that the Government did not ask the Panchayat to build the shaft and did not consider their suggestion to drill 5 feet deeper. Officials admitted that maintenance was a problem which had not been given full attention. Local institutions complained about not being involved while the Government representatives complained of a lack of interest by the former (Latusek, 2015). The cost efficiency of the project was also questioned because it was expensive[27] and its efficiency to recharge the bore wells of the zone of influence had not been proven. The PWD planned to monitor groundwater levels around the recharge shaft through five observation wells. But when the shaft was handed over to another division than the one which built it, there was no follow up. In 2015, the officials announced an increase of more than 1 m in groundwater level since the construction of the shaft. Since the monsoon has been bad for the last two years, the 1 m increase in the recorded level in the observation wells is probably due to the structure, but this is only a hypothesis. In 2015, the interviewed beneficiaries did not notice any change. In 2018, a farmer thought that the water level in

[24] The area served by the tank.

[25] In 2014 and 2015, the state government through local administration proposed trainings to the farmers and officials about the concept of rain water harvest and artificial recharge. The district University agricultural centre took selected farmers of the village to different rain water harvest station, to propagate artificial recharge in their agricultural field.

[26] Tamil Nadu IAMWARM – Procurement of Works – Bidding Document - Construction of Artificial Recharge well structure 4 Nos in Nallavur Sub Basin in Villupuram District. The work was costed at Rs 176,9 lakhs (€220k).

[27] Final cost of the Kiliyanur shaft is 43.2 lakhs (around €54,000) according to "the report on Problems of Salinization of Land in Coastal Areas of India and Suitable Protection Measures" Hydrological Studies Organization Central Water Commission New Delhi July 2017, Annexure 3.5A, p 309. The price is justified by the drilling in hard rock. Average cost is 42.5 lakhs/ shaft for the 57 shaft Recharge Wells constructed in Tamil Nadu beyond average estimated costs. Average anticipated cost for recharge shafts in the Master Plan for Artificial Recharge 2014 was 4 lakhs.

his bore well decreased slower thanks to the construction of the shaft. According to him, usually the water level goes down 4 feet in the month of February, but this year it decreased by one foot only.

An acceptable deviation

In 2015, the Panchayat suggested to turn the recharge shaft into a well to supply domestic water to the villagers. In 2016-17, due to the heavy drought, the ground water supply bore wells dried up and there was severe scarcity of drinking water. Then, the Panchayat decided to pump water from the shaft. From a recharge structure, the shaft became a well, named *Eri Kinaru* (the well of the tank). The Panchayat built the pumping infrastructure -motor, pipe, taps, electricity connection- for Rs400k (€4,800), to bring water to the village and fill the overhead tank which supplies the villagers with domestic and drinking water. According to the Electricity Board the connection was temporary and could be removed at any time if required.[28] The Electricity Board wrote to the local PWD irrigation division about the provision of the connection. The irrigation division wrote to the construction wing of the PWD to receive the formal approval. The PWD construction wing gave oral permission to lift the water for drinking purpose. As there was a severe drinking water problem and frequent strikes by the villagers, no department would oppose the Panchayat to pump water from the shaft.

In 2017, the original purpose of the shaft was reconsidered because of a critical water supply situation. The water from the *eri kinaru* was then distributed through the street pipes to supply around a hundred families[29] every 2 days. It was considered of good quality by inhabitants and by the Panchayat president. It supplemented water from the regular overhead tank bore wells. Thanks to the shaft, the available resource for domestic uses increased. The Panchayat maintains the *Eri Kinaru* (Rs150k (€1800) for desilting in 2017). Meanwhile, irrigation issues in the area had changed. Though the tank was desilted in 2007, it did not get enough water from the catchment area. The farmers understood that the overflow of the water from the fields was stopped or diverted by the new highway and buildings. Since 2008, many farmers had dug borewells in their open wells and begun to cultivate mostly paddy and casuarinas trees. In the past, the main crops were groundnut, black gram, tapioca, gingelly and a small portion of paddy, which are water consuming crops but with guaranteed markets. In 2018, the farmers association did no longer concentrate on the tank maintenance.

Finally, this MAR project presents similar problems as the ones already identified in the literature: questionable technical choices, no monitoring, high cost, demand driven, top down approach. After a few years, the original shaft purpose was diverted to increase the resource available in a context of drought. We observed multi-uses of the recharge shaft in Kiliyanur and in the 3 neighbouring villages: people bathing (Photo 3) and washing clothes – samples of soap and shampoo–; leisure -alcohol bottles, cigarette packets – or rituals -pillows belonging to dead people thrown in the tank – . Recharge shafts are appropriated to satisfy multiple demands.

DISCUSSION AND CONCLUSION: A NEW 'MANTRA' BUT NO PARADIGMATIC SHIFT

In the field of social sciences, this article contributes to the literature on the implementation and appropriation of MAR policies. It is based on case studies in the Pondicherry Region, an urbanizing area with increasing demography and decline in agriculture, encroachment on tanks and on recharge areas. First, the flourishing field of MAR was described with many activities in the region which are part of the water, agricultural and rural policies. These activities involve numerous agents: government departments, NGOs, elected representatives. But their roles and responsibilities are fuzzy and there is a lack of coordination regarding MAR activities. Agents' interests, points of view and relationships were

[28] Electricity supply management is a way to regulate groundwater access (Shah, 2009).

[29] Including families from low castes whose houses are encroaching the tank.

Figure 4. Recharge shaft, Kiliyanur, April 2017, deepened, fence repaired, electricity wire and pipe connected to a submersible pump.

Figure 5. Recharge shaft, Kiliyanur, March 2018, full, with fence and pipe.

Figure 6. Recharge Shaft, Ulagapuram, April 2017, fence opened and people bathing.

analysed, focusing on tank rehabilitation programs in the Puducherry district and a recharge shaft project in Kiliyanur. Limitations in the implementation were identified, confirming those already mentioned in the literature: lack of communication, lack of consultation and involvement of local communities, lack of technical preparatory surveys including risk analysis, high public cost, roles unclear, lack of monitoring and impact assessment, inadequate organisation of maintenance and demand driven activities. As stated in the literature, these case studies show that a 'one-size-fits-all' MAR approach is unrealistic. Feasibility guidelines should take into account socio-historical dimensions as well as hydrological, hydro-geological, technical, institutional and financial ones. However, feasibility studies are often limited to assessing institutional and legal frameworks on the one hand and engaging stakeholders and assessing social acceptance on the other hand. The way forward requires a comprehensive understanding of the social and political situation including identification of practices and expectations; interests and values regarding MAR; knowledge and capacities with a historical perspective.

At the local level, we observed the same kind of dynamics with MAR as with irrigation projects, including top down approaches and collusion of interests. From this point of view, in some areas, MAR structures can be seen as new pieces in the system of administrative and political corruption that already involve other water infrastructures (canal irrigation, tanks). In the Puducherry district, Tank Associations representatives and NGOs denounce collusion regarding tank rehabilitation. In the case of Kiliyanur, local appropriation led to turn the recharge shaft into an open well. Although not formally approved, in the context of drought, the diversion of the shaft is not questioned. Solving the drought situation is a priority. Finally, the recharge shaft led to higher water withdrawal than before its construction, but it also provided water to the nearby thirsty village.

With this perspective in mind, artificial recharge can be seen as a consensual solution as it is difficult to be against increasing the volume of water available in a context of water crisis. MAR is also consensual as a possible compromise between groundwater conservation, optimization of the resource, satisfaction of the users and social justice. It can be interpreted from different perspectives. Controversy on tank rehabilitation is an example of such an interpretation. It is indeed a 'nirvana concept' as defined in the introduction (Molle, 2008).

In practice, however, there is no paradigmatic shift, at least for two reasons:

First, while MAR is supposed to be participative, we discussed the lack of community participation. In both cases we observed a top down approach to promote MAR solutions. MAR implementation may contribute to centralizing groundwater governance in India. MAR techniques can form part of the apparatus of the hydraulic bureaucracies to fulfil their 'hydraulic mission' (Molle et al., 2009). Anchored in an ideology of the domination of nature with the help of science, the hydraulic mission is fuelled by technological improvements: high dams, power generation and transmission, large-scale water resources development, and interconnection of water bodies. MAR can fuel the mission today. Hydraulic bureaucracies are used to being challenged by criticism from civil society and academia. In the Pondicherry Region they met resistance from Tank Associations representatives and NGOs, supported by some state representatives, scientists and MLA. In the future, industry may also show opposition, if the requirement to recharge extracted groundwater is implemented. In Kiliyanur, the recharge shaft was a fait accompli for the farmers and local community. Promoters failed to involve the so-called beneficiaries. But the users re-appropriated the shaft.

Secondly, expected paradigmatic shift implies questioning and regulating the demand, for example through regulation of land occupation and land use planning to protect the recharge area. In the Pondicherry Region, this is not on the political agenda. Urbanization is leading to increasing encroachment of the recharge areas. The 2015 floods in Chennai, 150 km north of Pondicherry, raised the issue of maintaining water bodies in the cities. But they are barely taken into account in land planning, whether for resource management or flood management. Empirical evidence in the Pondicherry Region confirms that MAR is not linked to demand management, but it is driven by demand. It even distracts attention from demand management and acts as a substitute.

Finally, opposed conceptions of MAR were identified. In the case of the tank rehabilitation programs, we discussed the mobilization of NGOs and Tanks Associations to define and defend 'good' artificial recharge based on maintenance of a traditional tank system and participative management. MAR issues renew the long-lasting debate on traditional tank system vs. modern management. The paper highlights three opposed conceptions of MAR: traditional vs. modern; Demand driven vs. supply driven; Participatory vs. expert driven. Controversial positions and oppositions should be acknowledged to improve the implementation of this promising solution in India and well beyond.

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