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Water Acquisition for Urban Use from Irrigation Tanks: Can Payment for Ecosystem Services Produce a Win-Win Outcome?

L. Venkatachalam*

Abstract

Conflicts over land acquisition and their political and economic consequences in the Indian context have been well articulated in development economics literature. In recent years, many Indian states have begun to 'acquire' irrigation water for non-agricultural purposes, but the economic and environmental consequences of the same are not adequately highlighted in the relevant literature. Water acquisition takes place in two different ways, resulting in welfare loss: when agricultural land is acquired for development purpose, farmers lose certain non-agricultural benefits associated with irrigation water that goes along with land; and, when governments forcibly acquire irrigation water from traditional sources for urban use, the farmers with riparian water rights are forced to sacrifice such rights as well as various other benefits attached to it. In both the cases, the farmers are not compensated for their possible welfare loss arising from repudiation of their water rights. Forceful water acquisition would crowd-out farmers' incentives to manage water bodies on an inter-temporal basis. Hence, the present article explores the possibility of introducing Payment for Ecosystem Services so that water acquisition can produce a non-zero sum outcome for farmers, governments and urban consumers in an efficient, equitable and sustainable manner.

1. Introduction

In India, conflict over land acquisition for development projects has become a profound issue as it creates political unrest among states and produces economic consequences that are detrimental to regional

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sustainable development. Such conflict diminishes economic welfare of especially those 'unwilling' farmers (Ghosh, 2012) and landless agricultural labourers who are driven away from their principal source of livelihood; welfare loss will stay at a much higher level if the affected parties lack alternative economic opportunities. A major economic issue over land acquisition is related to level of compensation to be provided to land owners, especially when their *Hicksian equivalent variation* (i.e., the minimum willingness to accept compensation (WTA) for selling the land) is greater than the *Hicksian compensating variation* (i.e., the maximum willingness to pay (WTP) value offered by the buyers) (see Bateman *et al.* 2000). The WTA value will be greater than the WTP value: a) when *income effect* (Willig, 1976) is positive (i.e., when the price of land is high, the marginal WTP for additional land will be low and the commensurate marginal WTA compensation will be high); b) when *substitution effect* (Hanemann, 1991) is low (i.e., when the seller has got less substitutable land, selling land will generate more disutility); and c) when *endowment effect* (Kahneman *et al.* 1991) exists (i.e., when the seller has a unique value attached to the land, her disutility of selling it will be high). Higher WTA value would also arise when the preferences of the sellers not only embed private benefits but also social benefits associated with water and agriculture. Eliminating individuals' WTP/WTA disparity (arising especially due to water) through 'voluntary negotiations' between parties, governed by appropriate institutional arrangements with negligible transaction costs, is expected to achieve equilibrium price that could produce a win-win outcome for the parties involved (see Coase, 1960).

In this article, we explore the possibility of introducing 'payment for ecosystem services' (PES) scheme that combines Coasian bargaining solution and Hicks-Kaldor compensation criterion to address the conflict arising from water acquisition. The article is organized as follows: Section 2 discusses the sources of water acquisition for non-agricultural use and its possible economic consequences; Section 3 explains various problems faced by the irrigation tanks at present and how the institutional vacuum created in the tank command can be overcome by way of introducing the PES scheme; section 4 describes the concept of PES and the nuances of implementing the PES scheme based on the empirical literature; section 5 analyses conditions for implementing the PES scheme in the Indian context and Section 6 concludes the findings of the study.

2. Water Acquisition and Its Economic Consequences

Traditionally, water for urban use has been drawn largely from the rivers and sub-surface sources. In recent years, the governments acquire water, in certain cases forcibly, from traditional irrigation sources (such as, irrigation tanks) and transfer it for the benefit of urban consumers - in certain cases resulting in huge social cost[1]. It should be noted that while the issues associated with land acquisition are being widely debated and discussed both in the political and academic spheres (e.g., Ghatak *et al.* 2013; Singh, 2012), the economic and environmental impacts of water acquisition do not get adequate attention in the existing literature on water and development. Water acquisition takes place in two different ways: a) when irrigated land is acquired for development purpose (under both 'compulsory' and 'voluntary' arrangements), water entitlement associated with the land is being taken away from the farmers. Because of it, those non-irrigation ecosystem benefits enjoyed by different stakeholders in villages, including farmers, are lost; and b) when water is directly acquired from traditional irrigation sources for high value urban use, the farmers are forced to sacrifice their riparian water rights there by losing all benefits from water. As far as point (a) is concerned, a bulk of literature dealing with compensation for land acquisition simply ignores the importance of 'explicitly' taking into account the economic value of various non-agricultural benefits associated with irrigation water, in computing total compensation[2].

When the agricultural land is converted for other purposes, it would increase either the social benefits or social costs, depending on what happens to water previously used for irrigation purpose. The outcome will be beneficial if the transferred water is utilized for alternative, high value uses. If it is not utilized for productive use, it can potentially impose the following types of social costs: increased opportunity cost in water-scarce regions which would have been benefited from water transfer; damage costs of water logging or flooding caused by unutilized irrigation water if it is an already water-logged region; positive transaction costs arising from efforts to cultivate remaining agricultural lands due to change in the irrigation regime and land-use pattern; environmental costs arising from altering the agricultural, ecological and ecosystem services enjoyed by different economic agents; sunk cost in terms of investment already incurred on irrigation facilities that becomes unutilized; and, additional costs incurred to augment alternative irrigation facilities (e.g., bore-well irrigation). In addition, there may be downstream economic impacts, such as, reduced stream flows and increased sediment transport due to changes in water and land-use pattern in the upstream area. So, computing compensation for land acquired fails to take into account the relevant benefits and costs of water, which makes the estimated compensation to be socially sub-optimal.

'Compulsory' or 'forcible' water acquisition from irrigation sources can increase social costs in many other ways as well. Water acquisition may result in negative impact on economic welfare, and such impact is usually *nonlinear* in nature (see Barbier *et al.* 2008). Unlike agricultural land, water sources generate multiple benefits - also called, *ecosystem services* (TEEB, 2010) - that are utilized by innumerable farm and non-farm users spread across wide geographical regions. These services are classified into four categories: a) Provisioning services that include food, freshwater, fiber, fuel, biochemical and genetic materials; b) Regulating services consisting of climate regulation, hydrological regulation, water purification and wastewater treatment, erosion regulation and regulation of pollination; c) Cultural services comprising spiritual, inspirational, recreational, cultural and educational values; d) Supporting services originating in the form of soil formation and nutrient recycling. Ecosystem services contribute both directly and indirectly to different stakeholders. For instance, farmers are benefited directly from irrigation use; village households utilize water for various extractive and in-situ uses; landless households rearing ducks and livestock are (indirectly) dependent on irrigated agriculture, especially during post-harvest period; and so on. In addition to the above direct and indirect benefits, environmental economists identified *non-use values* - such as, *option value*, *quasi-option value and existence value* - that generate utility to individuals and households which are expressed in terms of either their WTP for preserving these benefits or WTA compensation for foregoing them (Freeman, 1993). The non-use values become positive whenever households attach cultural and religious values to some unique water sources (e.g. temple tanks) in villages. The nature and size of all the above benefits differ across different water sources. Therefore, acquiring even a small quantity of water can reduce a larger quantity of ecosystem benefits currently being enjoyed by innumerable users. Similarly, while agricultural land generates mainly 'private benefits' which can easily be identified and quantified in monetary terms that facilitate payment of compensation, most of the benefits from water are 'public goods' and they also possess 'intangible' and 'non-market' characteristics; therefore, identification, quantification and economic valuation of these social benefits for monetary compensation become a challenging task. As a result, the total welfare loss from both land and water acquisition is grossly underestimated. While land is a private property, water portrays multiple property rights depending on the characteristics of water sources: surface water in an irrigation tank is a *common property resource*[3], but water in an aquifer is an *open-access resource*[4]. Since any compensation is linked to the underlying property rights, water users are rarely compensated as they have no well-defined property rights. Indeed, the government acts as the custodian of water resources and it can forcibly acquire irrigation water without any consideration for preferences of current users. Traditionally, land is considered a non-renewable resource while water is treated as a renewable resource; though 'renewable', water is a finite resource. Moreover, water is becoming a 'non-renewable resource' due to reasons that include monsoon failure and climatic variations. Therefore, treating water as renewable resource and acquiring it without due consideration for its future availability would also impose additional social costs, not only for the present generation but also for the future ones.

In recent years, many governments are indiscriminately diverting water from distant irrigation tanks and lakes to cities because water sources around these cities have either dried up or disappeared (Sreenivasan and Kanagavalli, *forthcoming*). Though the supply of freshwater to cities from existing sources is dwindling rapidly, the demand for water is increasing exponentially, leading to an ever-widening supply-demand gap. In Tamil Nadu, diversion of irrigation water for urban use is becoming a common phenomenon. For example, an amount of over 180 mld (million litres per day) water is being drawn from Veeranam tank, a large irrigation tank in the state, to meet the supplementary water requirements in Chennai Metropolitan region (http://chennaimetrowater.gov.in/). In addition, many drinking water schemes currently being implemented in Chennai draw bulk water from neighbouring irrigation sources namely, Palar river and Chembarambakkam lake, depriving of traditional users' accessibility to water from these sources. As the size of urban population is expanding rapidly, diverting water from traditional water bodies is likely to accelerate in the coming years, potentially causing trade-offs in economic welfare among diversified water users.

In a water-scarce economy, diverting water from a low-value use (e.g., irrigation) to a high-value urban use would result in efficiency gains and can produce positive beneficial effects at aggregate level. In a strict economic sense, maximum benefits from water diversion could be achieved only if water is diverted on the basis of equi-marginal principle (i.e., marginal benefits of an extra-unit of water allocated across all the users are maximised). It is claimed that with careful and systematic planning, a significant quantity of water from agriculture sector can be diverted for non-agricultural purposes without any marginal reduction in production and productivity in agriculture. Indeed, transferring irrigation water from certain agricultural zones would generate non-zero sum outcomes as well. For example, moving away water from excess-irrigated or water-logged areas would reduce soil salinity and raise productivity thereby increasing the marginal benefits in the sectors concerned. In rural areas, certain structural changes are taking place due to changes in the socio-economic and educational status especially among the farm households, resulting in shirking of agricultural activities. In recent years, the 'gross irrigated area' and 'net irrigated area' under tank irrigation are also declining significantly (Narayanamoorthy, 2004) due to reasons that include farmers giving up agricultural activities, agricultural land being converted for real-estate purpose, etc. As a result, the water used previously for cultivation purpose now becomes 'free' and efficiency gains can be accomplished if the government identifies and diverts such unutilised and low value water for urban use. Nonetheless, an unplanned and arbitrary approach currently being adopted by government authorities to forcefully divert irrigation water can certainly result in trade-off in economic welfare. Moreover, water acquisition from already 'deteriorated tanks' will have devastating impacts on the remaining agricultural activities still depending on such tanks. Since water scarcity is identified as a key factor causing distress among many Indian farmers at present (see Reddy and Mishra, 2009), command-and-control method of water acquisition would make the condition of the farmers much worse-off. In the following section, we discuss various problems faced by the irrigation tanks in India, potential constraints in transferring water for urban use and institutional arrangements that can make such transfer more welfare enhancing and sustainable in future.

3. Institutional Issues in Managing Irrigation Tanks

Tanks have been functioning as an important source of irrigation, but empirical evidences suggest that in the recent past the land area irrigated by these tanks has declined significantly. Out of about 2,08,000 tanks existing in India, Andhra Pradesh, Karnataka, Tamil Nadu and the Union Territory of Puducherry accounted for about 60 per cent - i.e., 1,20,000 tanks; the total area irrigated by tanks in these states declined from 2.4 m ha in 1960-61 to 1.7 m ha in 1996-97. In Tamil Nadu, tanks irrigated about 38 per cent of the cultivable area in 1960-61 and it dwindled to 19.47 per cent in 2000[5]. At the national level, the net irrigated area served by the tanks declined sharply from 18.49 per cent to 4.73 per cent during the above period (Narayanamoorthy, 2004). Such a decline is attributed to a 'vicious cycle', characterized by 'rehabilitation-poor maintenance-deterioration-rehabilitation' (Centre for Water Resources, 2000). The data available from the government sources reveal that, though the total number of tanks in the state has indeed increased over a period of time, the area irrigated by tanks has decreased (see Table-1). Such contradiction needs to be scientifically studied. Nevertheless, anecdotal evidences suggest that not only the area under tank irrigation has decreased but the number of tanks also has decreased, especially at regional level. Out of a sample of 1350 tanks studied in Thiruvallur and Kancheepuram districts in Tamil Nadu, 90 tanks were found to be abandoned and 210 tanks completely encroached upon (*The Hindu*, 6 September, 2013). Extinction of water bodies is becoming widespread around large cities in India. For instance, there were more than 40 water bodies around Chennai city, but their number has dwindled to less

Table 1: *Trend in Total Number of Tanks, Gross Area Irrigated (GIA) and Net Area Irrigated (NIA)in Tamil Nadu.*

Year	Tanks		Total Number of Tanks	Area Irrigated by Tanks (000' ha)	
	With Command area of 40 ha. or more	With Command area of less than 40 ha.		GIA	NIA
2001-02	7529	31837	39366	607	537
2002-03	7529	31837	39366	461	422
2003-04	7529	31837	39366	419	385
2004-05	7933	32386	40319	504	465
2005-06	7933	32386	40319	641	575
2006-07	7982	33278	41260	569	531
2007-08	7982	33278	41260	546	506
2008-09	7984	33278	41262	580	540
2009-10	7984	33278	41262	534	503
2010-11	NA	NA	NA	573	533
2011-12	NA	NA	NA	567	528

Source : Season and Crop Reportof Tamil Nadu, Department of Economics and Statistics, Various years.

than 25 at present (*The Hindu*, 17 July, 2013). In Hyderabad, out of 170 lakes 30 of them have disappeared and 40 were on the verge of extinction by the year 1995 (Ramachandraiah and Prasad, 2004). Prasad *et al.* (2009) found that between 1989 and 2001, approximately 19 per cent of the area under water bodies around Hyderabad had disappeared. Most of these water bodies served as drinking water source as well. Several studies on irrigation tanks in the nineties identified various factors contributing to general deterioration of tanks, such as growth of tube-well technology, change in the land-use pattern in the catchment area, heavy siltation of tanks due to the negative externality caused by the upstream activities (e.g., over-grazing), encroachment of catchment areas, changing pattern of rainfall, poor governance, fractured village institutions, change in land ownership and conversion of agricultural land under the tank command for non-agricultural purpose (Narayanamoorthy, 2007). Tanks and lakes closer to cities experience 'irreversibility' problems arising from discharge of sewage and industrial pollution, dumping of urban solid waste, encroachment by industrial and commercial establishments and so on.

In order to cope with water scarcity, few state governments have ventured into restoring and rehabilitating the traditional irrigation tanks. In Tamil Nadu, for instance, 569 tanks under the public works department (PWD) and 80 ex-zamindari tanks (out of 39,200 tanks) were rehabilitated and modernized under European Union assistance, with a financial outlay of Rs 1793.90 million. These tanks served a command area of 73,161 ha. and the cost of rehabilitation worked out to be Rs 25,000/ha (Sakthivadivel et al. 2004). Similarly, the Tamil Nadu government has initiated measures to restore and rehabilitate its various system and non-system tanks through the World Bank assisted Irrigated Agriculture Modernization and Water Bodies Restoration and Management Project (IAMWARM) at the cost of Rs. 25470.00 million (www.wrd.tn.gov.in/gos/pwd_e_57_2013.pdf). Despite these measures, a major issue that remains unanswered is: how to manage these rehabilitated tanks on a sustainable basis? A larger part of the recent literature on irrigation tanks claims that collapse of traditional institutions governing irrigation tanks is one of the major reasons for their disappearance or poor performance at present (see Palanisami et al. 2010). How to fix institutions that can not only revive the tanks but also manage them on an inter-temporal basis has become a serious policy question. On the other hand, Kumar et al. (2012) argue that the existing literature gives too much importance to sociological issues of tank management, neglecting other issues - such as, hydrology of the tank systems, land-use pattern changes and groundwater exploitation in the upper catchment areas that cause negative impact on tank performance. This means that institutional arrangements in future need to address rather larger issues associated with irrigation tank management.

As we have already seen, institutions governing irrigation tanks determine efficiency, equity and sustainability of tank management. However, identifying appropriate institutions and making them to work in the field became a challenging task. Sakthivadivel *et al.* (2004) identified stylized facts or preconditions for institutions governing tanks to perform effectively. They selected 41 tanks from 22 districts in 8 Indian states, with command areas ranging from 50 to 1600 ha. These tanks have been managed by a variety of institutions: traditional (10), traditional and registered (5), registered WUAs (17), fishermen cooperatives (5) and informal institutions (4). The tanks studied differed in terms of sources of water supply: 20 tanks are rain-fed; 12 tanks are river-fed; and 9 tanks are rain-fed cascades. The authors used the following indicators to evaluate the performance of the tanks: (a) institutional performance; (b) tank contribution to livelihood; (c) enabling conditions; (d) agricultural performance; (e) objective-based impacts; and (f) institutional sustainability. The results reveal that each of the best performing tanks has its own techno-institutional mechanism for water acquisition and the success accomplished by the traditional institutions depended largely on a decision-making process that involved all stakeholders, and the final decisions reached through consensus were accepted by all as 'fair'. It was found that lack of cohesiveness, non-inclusiveness and fraction-ridden institutions cause low performance of the tanks. A similar conclusion emerged from an earlier study in the context of tanks in Rajasthan (Shah and Raju, 2001); the study found lack of commonality of interests amongst key stakeholders to maintain the rehabilitated tanks. For example, the command area farmers, tank-bed farmers, fishermen and the village groups as a whole were found to have no common interest in terms of managing the tanks. Jegadeesan and Koiji (2011) attributed deterioration of village tanks to emerging contradictions within the caste-based society which once played a crucial role in managing those tanks. From limited number of studies reviewed, it emerges that the irrigation tanks are already experiencing management-related problems and water acquisition from these tanks for urban use may not be feasible - unless or until new institutional arrangements are put in place to improve their performance.

Recent studies on water governance pertaining to irrigation tanks focus mainly on participatory irrigation management (PIM). Many of these studies found the modern water users' associations (WUAs) to produce beneficial effects (Pant, 1998) and therefore, prescribe creating the replica of the vanished traditional village institutions, in the form of modern WUAs as an 'enabling environment' (Pant, 2008). With a possible 'selection bias' (i.e., selectively choosing successful cases) contaminating the results, it is doubtful if the institutional panaceas manufactured from such studies can be replicated to other sites (see Meinzen -Dick, 2007). Moreover, a close look at the institutional prescriptions reveals that they are based on lack of understanding of how institutions evolve in the environmental domain. The evolutionary theory of efficient institutions predicts that if an institution is efficient in terms of either maximizing net benefits or minimizing transaction costs, it will replace the existing inefficient institutions on a regular basis (see North, 1990). What is actually happening in the tank command reflects what the evolutionary theory predicts. A significant number of rational farmers moved away from tanks to bore-wells, because: the marginal benefits (costs) of bore-well (tank) irrigation have been relatively higher (lower); and, the 'transaction costs[6]' of bore-well (tank) irrigation have been relatively lower (higher) - though the initial investment on bore-wells is significantly high. As a result, the required number of farmers for maintaining the tanks falls below the 'tipping point' where deterioration begins. Similarly, certain structural changes in rural systems, which are brought about by exogenous institutions (e.g., macroeconomic policies) also pave way for a significant number of agricultural labourers to move away from the farm sector towards more remunerative non-farm activities. As a result, the farm sector deteriorates and the derived demand for irrigation also declines. So, artificially creating and deploying WUAs in an institutional vacuum without taking into account the entire dynamism in agriculture and rural areas (as well as changing scenarios outside) result in social costs exceeding social benefits. Similarly, roles of the modern WUAs are not visibly well-defined; even if they are visible to all farmers, they are either mis-interpreted or being frequently violated due to elite capturing and non-cooperation within WUAs (Reddy and Reddy, 2005). Moreover, when nature of ecosystem benefits from traditional irrigation tanks gradually transforms itself from a single irrigation service to a larger multiple ecosystem services, WUAs consisting only the farmers with a narrow irrigation management objective become irrelevant and ineffective. So, restoring collective action requires identifying larger stakeholders and deploying incentive-based institutional mechanisms that favourably change the relative benefits and costs of tank management *vis-a-vis* the transfer of water for urban use. In addition to government, communities and WUAs, a market-based institutional mechanism, namely payment for ecosystem services, can play a significant role in enhancing effective governance system to manage tanks in the coming years.

4. Payment for Ecosystem Services (PES) Scheme

As Ackermann (2013) points out, 'é .there is scope for meaningful laws and regulations in urban areas where water pricing and tradable water rights among agricultural, urban, and industrial users could usefully be developed' (p. 161). Some of the existing studies on economics of environmental management suggest that PES scheme, if appropriately combined with other relevant institutions, can promote collective action among stakeholders for trading environmental/ecosystem services in an efficient and sustainable manner (see Kosoy et al. 2007). The PES has been defined as (1) *voluntary* transaction where (2) a *well-defined ecosystem* service (ES) (or corresponding land use) is (3) being 'bought' by a (minimum one) ES buyer (4) from a (minimum one) ES *provider* (5) if and only if ES provision is secured (*conditionality*) (see, Wunder, 2008). In a strict sense, the PES combines both Coasian bargaining solution and Hicks-Kaldor compensation criterion to address an environmental trade-off. It creates a market for buying and selling environmental services (i.e. Coasian solution) where the gainers or buyers of the service could compensate the service providers by still remaining the gainers (i.e. Hicks-Kaldor compensating criterion). At the same time, the PES also ensures conservation of the primary environmental resource on a sustainable basis (Engel et al. 2008). Vatn (2009) points out that the PES scheme aims not only at creating a market but also at reconfiguring other equally important institutions - namely, government and user groups - for facilitating exchange of environmental goods and services.

Empirical evidences around the world demonstrate that the PES scheme has been successfully implemented for managing certain critical environmental resources in general and water resources in particular (e.g., Clements et al. 2010; Engel *et al.* 2008; Lipper et al. 2009; Locatelli et al. 2008; Pagiola, 2002). In north-eastern France, for instance, the Vittel water company has been successfully compensating the farmers for adopting to 'best practices' in dairy farming (measures such as abandoning agrochemicals, composting animal waste and reducing animal stocks) to improve the quality of raw water obtained from the catchment areas of Vosges Mountains (Perrot-Maitre, 2006). In Bolivia, an in-kind compensation programme encourages the upstream farmers to protect cloud forests and provide water services to a conservation donor and downstream farmers (Asquith and Wunder, 2008). In Central America, Costa Rica pioneered in PES programme (called, Pago por Servicios Ambientales, PSA) with which the land-owners are compensated for implementing sustainable forest management plans so that increase in hydrological services, along with such benefits as reduced greenhouse gases and increased biodiversity, could be accomplished (Pagiola, 2002 and 2008). Mexico's Payment for Hydrological Services scheme implemented in different segments of the forest areas aims at conserving the forests for the sake of maintaining the quantity and quality of water (e.g., Fisher *et al.* 2010; Munoz-Pina *et al.* 2008) and it is found that in some areas, the scheme increases the participation of especially the poor in conservation activities thereby reducing poverty (Alix-Garcia *et al.* 2008). In South Africa, the Working for Water (WfW) programme, a PES version, has been fruitfully implemented to restore mountain catchments enhancing water supply; though funded by the government, the water users also contribute to the programme through a 'water fee' (Turpie *et al.* 2008). In Uganada, it is found that the PES scheme can potentially play a critical role in protecting wetlands and enhancing its ecosystem services to support the livelihoods of a significant number of poor households (Nalukenge *et al.* 2008). In China, two nationwide programmes - the Sloping Land Conversion Programme (SLCP) and the Forest Ecological Services Compensation Fund (FESCF) - have already incorporated payment for water services to protect major river basins against siltation and floods (Huang *et al.* 2009); in addition, Tang et al. (2012) have found that payment for water services can potentially lead to water conservation in specific river basins, such as Shiyang River Basin in northwest China. Programmes that device payment for water services are in different stages of implementation in other countries in Asia, including Indonesia, the Philippines, Vietnam and Nepal (Huang *et al.* 2009).

India has already liberalized its economy by allowing market-based institutions to allocate private goods and services; it is also introducing market-based instruments (MBIs) in a significant way in select areas of environmental management (MoEF, 2006). In this regard, there exists a tremendous scope for adopting PES for protecting and allocating some of India's critical environmental resources, including water (Behera *et al.* 2011). Indeed, PES type institutions are already in operation in different parts of the country. For example, an arrangement to share benefits (an in-kind payment) among villagers who participated in protecting upstream water sources from siltation in the Sukhomajri watershed region in northern India has been a classic example of how the PES type scheme could work efficiently in the Indian context (Kerr, 2002; Huang *et al.* 2009). Similarly, in Maharashtra unutilized water from incomplete irrigation projects is being successfully transported, with the help of private operators, through networked pipes (mostly, underground), to supply water to the needy farmers; there are around 100000 such schemes successfully operating in Maharashtra (Ackermann, 2013). In Tamil Nadu, there are village groups utilizing market-based instruments to manage irrigation tanks and to allocate water services in an efficient and equitable manner. For example, Sakthivadivel et al. (2004) report that the Rettaikulam tank in Thirunelveli district of Tamil Nadu exemplifies an efficiently functioning water tax system. The user groups managing the tanks levies 'Ayacut Vari' (a tax based on landholding) and utilize the tax revenue to meet the financial requirements for maintaining the tanks. The tax rate per acre is determined by the groups, based on the extent of repair and maintenance work to be done and the level of fund required for such work. The tax is collected from the owners of bore-wells located in the tank command. Some empirical studies demonstrate that farmers in certain river basins in south India are willing to trade their excess water to other needy farmers, provided they are adequately compensated for doing so (e.g. Biswas, 2010; Venkatachalam and Narayanamoorthy, 2012). Similar kind of trade can take place among farmers and high-value water users as the compensation in this case may be much higher than that of water trade across farmers themselves. Such practices are based on 'user-pays-principle' (a fundamental principle of MBIs) which provides financial self-sufficiency and incentives for the groups to sustain conservation efforts collectively. Since the user groups act as 'utility maximizing individuals', introducing PES within an appropriate institutional set-up (Asquith and Wunder, 2008) generates adequate 'economic incentives' for conservation of critical resources as well as for further scaling-up. Water transfer from irrigation tank is a classic example where PES has greater potential to generate win-win outcome for farmers, municipalities and urban dwellers.

5. Conditions for Implementing PES Scheme

The PES scheme is not free from problems. The very fact that it has not yet percolated deeply in the environmental domain suggests that there are constraints in it. However, it is found that it can work better under certain conditions that include conducive ecological settings, nature and quantum of services and their continuous provision, well-defined and secure property rights, appropriate legal framework and trust among the parties involved (Behera *et al.* 2011). Broader guidelines have emerged from several PES schemes implemented in other parts of the world (Adhikari, 2009; Alix-Garcia et al. 2008; Asquith and Wunder, 2008; Huang et al. 2009; Pagiola, 2002). The pre-requisites for the PES scheme for water transfer to work efficiently are: a) 'water accounting' in physical units (Perry, 2013); b) economic valuation of water; and c) institutional arrangements for facilitating voluntary trade on water services. Before implementing the PES scheme for tanks, accounting for water resources - both in physical as well as in economic units -will have to be systematically established. In the case of system tanks, a river basin level water accounting will be more appropriate as the hydrological changes taking place in the entire river basin have profound impact on the water dynamics of the system tanks. In the case of physical accounting for water, both the 'stock' and the 'flow' components of water resources get into the accounting matrices. While the stock account takes into account the stock of water resources in the opening and closing periods, the flow account captures the 'additions' that increase the level of stock, namely total precipitation, inflow from tributaries, return flow from use sector and import from other basins; and, 'subtractions' that reduce the stock, namely evaporation, evapotranspiration, deep percolation, amount of water withdrawn for various economic and non-economic entities, water exported to other basins and water drained into the ocean. The net change (surplus or deficit) in the stock of the water in physical units between accounting periods can be arrived at from the stock account; the flow account depicts what happens to the available water in the basin, how much water is used for productive purposes, where does the unproductive water go, how much surplus water available for acquisition, etc. Though the 'physical accounts' are necessary condition for water allocation decisions, the 'economic accounts' fulfill the sufficient condition since allocation decisions are to be based on marginal value of water allocated. Economic accounts try to place a monetary value not only on the net change in the stock but also on different levels of service/benefit from water; it helps assessing the marginal efficiency of water used in a particular sector as well as the marginal gains and losses of allocating water from an unproductive to a productive use or from an inefficient use to a more efficient use. Monetary value of the water can be estimated by using non-market valuation techniques in case the value has to be generated through a fresh economic valuation study; or, such values can be generated by using a 'benefit transfer method' (Plummer, 2009) as the economic values for water-related ecosystem services have been already estimated by a significant number of non-market valuation studies in the Indian context (e.g., Kumar et al. 2012; Mukherjee and Kumar, 2012).

Institutional arrangements for an efficient PES scheme and its sustainability depend largely on how different institutions - formal and informal, external and internal, modern and traditional -are effectively combined to enhance trade in environmental services (see Greiber, 2009). However, 'bounded rationality' acts as a constraint on our cognitive ability to identify an appropriate combination of different institutions that can produce first-best outcomes. Path dependency guides us when our decisions are governed by bounded rationality traits. Drawing lessons from experiences, we can broadly outline the additional institutional arrangements required for PES schemes. First of all, identifying the sellers and buyers of water and assigning property rights over water resources in the irrigation tanks are pre-requisites for effective implementation of the PES schemes. In the case of tank water, the buyers are municipalities and the sellers are the farmers' groups. If the farmers have to do land use changes in the tank commands in order to generate additional water for urban use, then WUAs can be assigned with the property rights over tank water and therefore, they become the owners of the selling rights. Though WUAs have been created in different states, the underlying incentive and disincentive structure for efficient functioning of WUAs is not well-defined. So, the PES scheme can make WUAs to work more efficiently without a requirement for additional transaction cost since the PES scheme is to be built on the already existing WUAs. As the resource to be managed is relatively small, the WUAs have comparative advantages in monitoring and regulating water use (Fisher *et al.* 2010), thereby reducing the act of 'free-riders'. If WUAs do not exist or if the irrigation tank belongs to the local panchayat[7] (that includes not only farmers but also the landless labourers and unemployed youths), then the property rights over the tank water should be assigned with the panchayat and therefore, the panchayat has the selling rights; the households should unanimously decide about how to utilize the sales revenue through negotiations (see Turpie *et al.* 2008).

The PES scheme works well if: (a) the buyers are rich and sellers are poor; (b) the opportunity cost of supplying water services should be either lesser or equal to the amount paid to the service providers (see Kosoy *et al.* 2007); in pure economic terms, the scheme can work smoothly only when the WTP value is greater than or equal to the WTA value; c) the transaction cost involved is negligible (Tacconi, 2012). In the Indian context, some empirical studies have demonstrated that urban consumers are already paying a significant amount of their income on water and are willing to pay more for improved water supply (e.g., Venkatachalam, 2014). The PES scheme has potential to generate 'additional' income to the local farmers and can contribute to alleviate poverty as well (Tang *et al.* 2012). For example, Balasubramanian and Selvaraj (2003) argue that it is largely the poor who depend on the tanks for their livelihoods and the share of the benefits from the tanks in the total income of the poor households is greater than that of the rich. So, the PES scheme can generate more benefits to more number of poor people. If a required minimum number of stakeholders is not available for maintaining the tanks, then tank management becomes futile because of increased marginal cost of maintenance to be borne by the remaining users. On the other hand, some farmers withdrawing themselves would release more benefits to the remaining farmers, who happen to be the poor. Efficient management of tanks by the poor, therefore, depends mainly on the 'net benefit' that they derive.

6. Conclusions

Land, as a natural resource, is being acquired for non-agricultural purposes and the issues involved in land acquisition are well articulated in the development literature. When the agricultural land is acquired, the irrigation water is lost and is not accounted for anywhere in the system. When water is acquired for urban use, the issues involved in it are not adequately addressed in the development literature. Increased gap between supply and demand in urban areas forces the governments to acquire water from distant irrigation sources; in most cases, the irrigation sources happen to be small water bodies, namely irrigation tanks and lakes. Acquisition of water from irrigation sources is forcefully done by the governments and as a result, the farmers depending on the water sources become the net losers. The trade-off between agricultural use and urban use can be made a win-win outcome in case innovative and efficient institutions are introduced to acquisition water. In this article, we argued that the PES approach can be effectively utilized for making the water acquisition beneficial to both the farmers as well as the urban consumers. Though PES scheme is relatively more efficient than the current command and control method of water acquisition, the effectiveness of operationalizing the concept depends largely on the institutional arrangements combining the role of market, government, non-governmental and user groups appropriately. We emphasized that either the WUAs or the panchayat system managing the irrigation tanks should be assigned with the property rights over water so that the benefits of managing and transferring water would be fairly distributed among all involved in water management. It should be noted that there are no standard panaceas; all negative externalities cannot be internalized with a typical model (Ostrom *et al.* 2007). As Muradian *et al.* (2010) pointed out, effectiveness of PES schemes depends mainly on how complexities related to uncertainty, distributional issues, social embeddedness, and power relations prevailing especially at the regional and local levels are appropriately taken into account in designing such schemes, in the coming years.

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Notes

1 Though groundwater is also transferred in a similar manner, the present article focuses mainly on the issues related to transfer of surface water.

2 Even though the market price of land, utilized for computing compensation, is supposed to capture the surrogate value of irrigation water, in reality it may not fully capture such a value due to the purpose for which the land is acquired. For example, in agriculture-dominated area an irrigated land purchased for crop cultivation may fetch a higher market price compared to a dry land; on the other hand, in an industrial or urban area a dry land purchased may command a higher market price compared to a neighbouring irrigated land. In reality, however, prevailing market price does not reflect the true value of land and land value is not assessed on the basis of its market price alone.

3 Possessing non-excludability and subtractability conditions, but exclusion of non-members outside user groups and avoiding subtraction of resource base are possible through stringent norms adopted by the well-defined user groups.

4 Exclusion of potential users of the resource is difficult which leads to subtraction of resource base.

5 Computed from various issues of Tamil Nadu Economic Appraisal.

6 The opportunity cost of augmenting water from tanks when there is a great uncertainty in the availability of water from tanks.

7 Elected village administration.

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