

The contested common pool resource: Ground water use in urban Kathmandu, Nepal

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Groundwater has always played a critical role in meeting the water demands of traditionally water-short areas of urban Kathmandu. Studies show that ground water level is depleting and is under immense pressure due to over-extraction. The current study focuses on existing situation of ground water availability and use in urban Kathmandu, conflicts among households for ground water use and changing social setting and policy implementation. The study found that the traditional culture of using public well and sharing and optimizing groundwater resource is gradually fading due to scarcity of water. Private deep wells are being constructed inside house for household use altering traditional social setting of a public well and culture of sharing public resource is declining. There is no authority and policy to control and monitor the ground water extraction for private use. The increasing number of groundwater extraction, uncontrolled and unregulated use for private and commercial use has contested the use of common pool resource and traditional social setting.

Keywords: Common pool resource; drinking water problem; groundwater user; Kathmandu municipality; open access; private use; public policy; social conflict

Introduction

Theory of Common Pool Resource also commonly termed as common property resource, (CPR) refers to natural resource which is physically and legally accessible to more than one user and said to be free-for-all (Wantrup & Bishop, 1975). One of the influential model on use of common natural resource by individual is defined by Hardin (1968). He illustrates that degradation of the environment is expected whenever

increasing number of individuals use a scarce resource in common. Exclusion (difficulty in controlling access to users) and Subtractability (reduction in resource availability with increasing number of users) are considered as two basic characteristics of CPR (Ostrom, 1990, 2008; Berkes, 2006). Management of CPR is another issue which has been long discussed. Some argue that Government institutions should manage CPR to prevent their destruction; others recommend that privatizing those resources will resolve the problem. It is also emphasized that understanding traditional social structures and relationships (cooperation) and how it shapes the common pool resource use as number of users increase (competition) is essential for evaluating resource use and management for sustainability (Sick, 2008).

Ground water is one of the major sources of drinking water in Kathmandu, and about 50% of the water used in the city is derived from groundwater (Aryal, 2011). The supply is however, facing acute shortage due to increasing urbanization. The combined production of the in-valley surface water sources and ground water is insufficient to meet the ever increasing demand of the water supply. Rapid urbanization has become major characteristics of Kathmandu Valley with 4.45 growth-rates as compared to 1.34 national growth rate. Over the last decade the population increased by 61.2% (CBS, 2012). This process of urbanization and subsequent expansion of the built-up area has increased demand of household water use. In spite of Nepal having abundant water resources, water demand is ever increasing with increasing population. A study shows that projected water demand for 2016 for Kathmandu Municipality was 195mld whereas water availability from all sources is 104.5 mld in wet season and 58mld during dry season (Sada et al., 2013). It is projected that by 2021, the water demand is expected to increase to 540.3 mld (Udumale, et al., 2016). This shows the big gap between production and demand. The short supply in municipal level has forced people to look for alternative sources of water supply and excessive extraction and use of groundwater is becoming common in urban Kathmandu. Besides, inequitable distribution of water across the Kathmandu is another problem which has forced ground water extraction for household use.

Water is also regarded as CPR and both social and economic good. One argument is that water is basic resource, and should be regarded as social good on the other hand it is regarded as economic good and commoditized. With the increasing population, scarcity of resource is more common and in this context most of the resources which were shared earlier are now being sold (Jaffee, D. & Newman, S., 2012). Access to resources has been restricted or in other cases controlled by group of people where no legal or state institution exists and CPR is bound to be over-exploited in the absence of

an external enforcer such as legal state institution (Wade, 1987). This paper discusses the existing situation of ground water availability and use in ward number 28 of Kathmandu municipality and its effect on the social relation and role of public institutions on public policies and their implementation.

Approach and methodology

The current paper is based on the aforementioned concept and framework of common pool resource management and follows integrated approach using both primary and secondary data sources. GIS tool is used for mapping of groundwater storage volume and public wells. Spatial data layers such as ward boundary, building footprints and courtyard location of ward no 28 was obtained from Kathmandu Municipality. Public well mapping (well in public court yard, side of the road, dug by community people, social service groups or state authority) is carried out through field observation, using structured field protocol and checklist and data are recorded in data sheet and wells located in a map. Key informant interview and informal discussion are conducted for exploring traditional social setting of public resource management and current trend. A checklist is developed for key informant interview and informal discussion with locals and institutional officials of the study area. Review of reports, policy documents and relevant journal articles is carried out and concerned institution visited and officials consulted in order to examine existing policies and role of institutions.

Water resource mapping and water resource data at lower spatial scale i.e. ward level is non-existence for Kathmandu valley. In this context, secondary data available for Kathmandu valley and municipality is used as reference for ward level analysis beside field survey.

Study area

Kathmandu has been a densely inhabited urban center from historical times. Ward no 28 of Kathmandu municipality is no exception. Ward No. 28 occupies less than 6.8 hectares of area and the total household of the ward is 1370 and population is 5611 which comprises 2920 male and 2691 female population (CBS, 2012). Population density of the ward has increased from 802 people per hectare during 2001 to 825 persons per hectare in 2011. Geographically, it is surrounded by ward number 18 in the west and south, ward no 17 in the north and ward no 27 in the east. Drinking water supply from water supply authority is irregular and out of the total area, 5 percent of the ward doesn't have drinking water service. There are five public taps on the side of the

road and total of 68 courtyard with public well. However, among total, 15 are in good condition (water availability during wet and dry season), 25 are in fair condition (water availability during wet season only) and 28 are in poor condition (low water during wet season) (KMC, 2005). Among identified five serious problems of the ward, drinking water problem ranks the first.

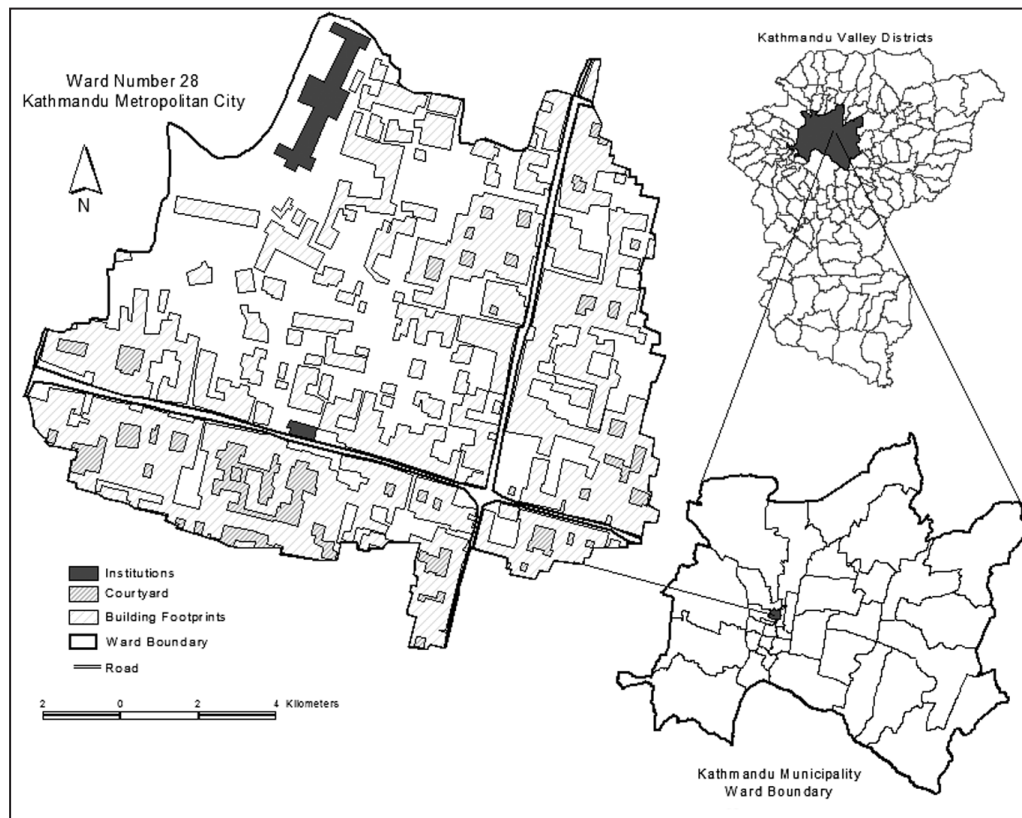


Figure 1. Location map of the study area

Results and Discussion

Ground water availability and use

Geographically, northern part of the Valley is richer in ground water storage which decreases gradually from north-east to south-west. The swallow aquifer is thicker towards northern part whereas deep aquifer is thicker towards central and southern part of the valley and the estimated volumes is 7260 and 56813 million cubic meters respectively (Pandey & Kazama, 2011). In terms of deep aquifer (Figure 2) ward number 28 lies in

the zone of lower storage capacity (100-200m³) whereas in terms of swallow aquifer (Figure 3), it lies in the zone of medium storage capacity (800-200 m³). Ground water use in Kathmandu is either for commercial or for household

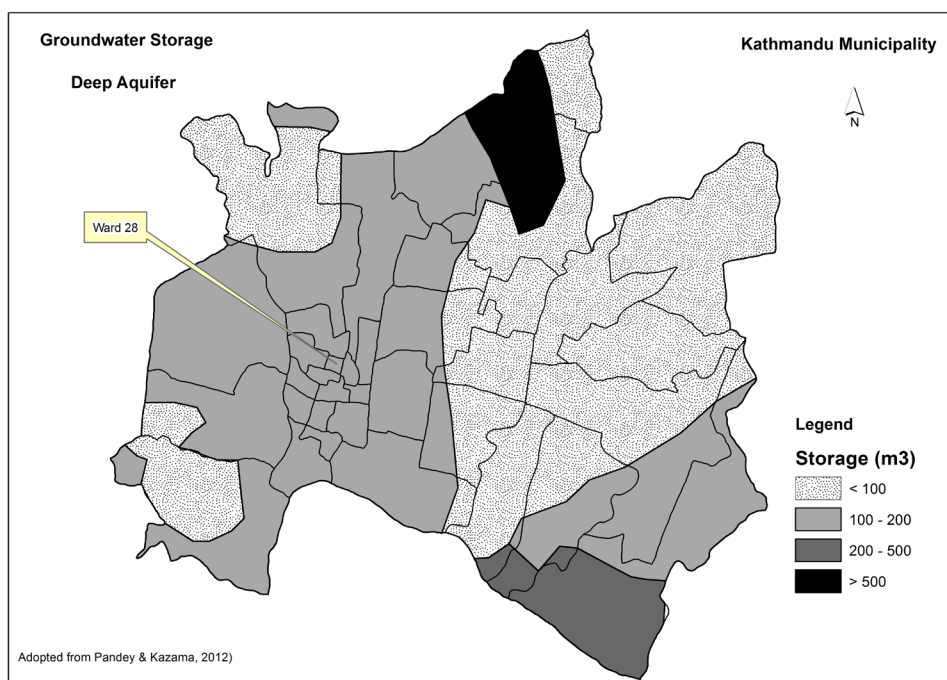


Figure 2. Ground water storage volume – deep aquifer

purpose. Commercial use includes use by hotels/restaurants, industries and private water supply companies. However, in ward no. 28 most of the ground water use is for household purpose. The traditional urban housing layout of Kathmandu city is characterized by an arrangement of residential courtyards with public well located at the center. In ward 28 also, there are 68 public courtyards. Among them, public tube wells or dug wells existed in 49 courtyards. According to ward official and field survey, it is estimated that more than fifty percent (51.05%) people use these public water source.

It is found that in ward number 28, dependence on public water source is higher than in urban Kathmandu in general. About 32% of water consumed within urban Kathmandu originates from non-government sources such as public well, stone spout and private well (Sada et al., 2013). Beside Surface water from Bagmati and Manohara rivers water supply authority was using 89 deep tubewells, 14 dug wells,

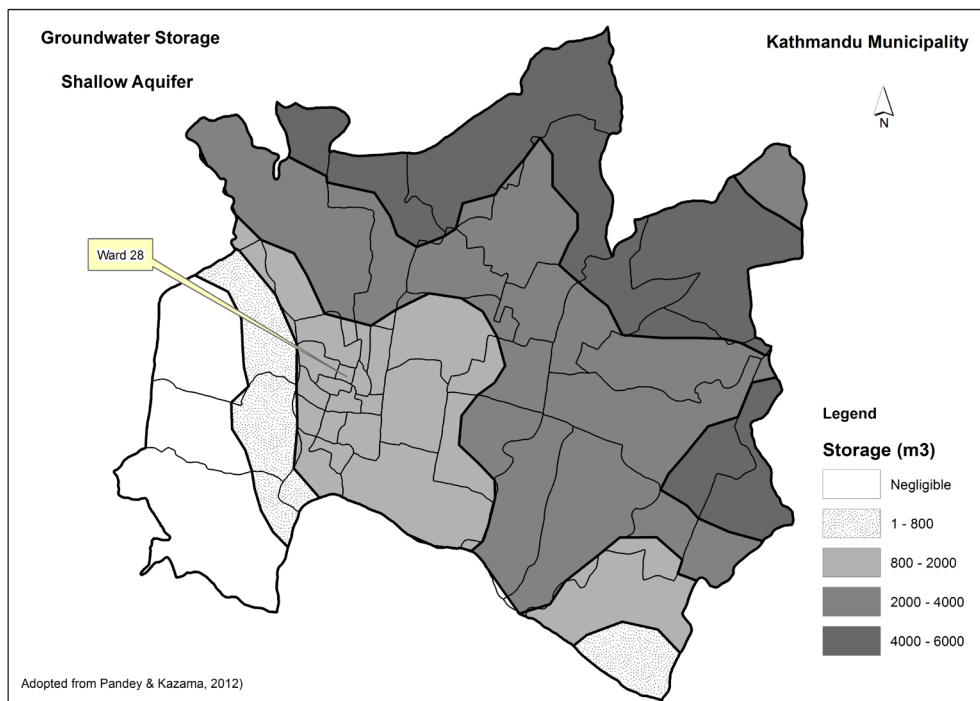


Figure 3. Ground water storage volume – swallow aquifer

and 22 Service Reservoirs for supply of drinking water in Kathmandu Valley (SAPI, 2004). It is also estimated that more than 90% of the water supplied by tankers was extracted from groundwater resources mostly from the peri-urban areas (Shrestha, 2011). Though, nearly half of water supply in wet season and up to 70 percent during dry season comes from groundwater (ICIMOD, 2007), the distribution system is developed without considering resource distribution over space and time which has resulted annual extraction exceeding recharge leading to depletion in groundwater levels (Pandey et al; 2012). Inequitable distribution of water across ward number 28 is also evident which has forced over extraction of ground water. It is found that anthropogenic factors such as over-exploitation of ground water are major drivers that exert pressures on groundwater environment which has lowered the groundwater levels and raised concerns on risks of land subsidence in area with high compressible clay and silt layers (Pandey et al., 2010).

From public resource use to privatization of public resource

In study area, it was reported that during 2005 there were 68 public wells, but during field survey in 2015, only 49 existed (Table 1). Among 49 tubewells, only 13 were functioning, 6 were already abandoned and 23 have dried out and 7 new were added within period of 2010 -2015. Those public wells were dried out when private wells and deep wells were constructed in the surrounding houses. People has started digging private wells inside their houses when new house is constructed. It is found that total of 55 new deep tube wells were constructed within recent five years (till March, 2015) and all of them are functioning. It is estimated that 80% new building construction started with the digging of deep wells inside the building within the study area (Field survey, 2015). In the courtyards where public well dried up, most of the people has dug deep wells up to 25 meter depth inside their houses. This on the other hand caused drying up of some of remaining public wells. Such extraction has an immediate consequence of drying out or low flow volume of dug wells, hand pumps, and traditional stone spouts (Shrestha, 2009). However in 7 courtyards new public tube wells were also constructed and maintained by the community.

Table 1. Distribution of public well by status

SNo	Status	Number
1	Abandoned	6
2	Functioning	13
3	Dried out	23
4	New	7
5	Total	49

Traditional culture in the study area was social arrangement regulating the preservation, maintenance, and consumption of ground water and so was along urban Kathmandu (Kansakar, 2011). However, the traditional culture of using public well i.e. culture of sharing and optimizing common natural resource is gradually fading due to scarcity of water resource. It is found that sharing of water from public well has become conditional in most of the courtyards having public well. The user should be of the same courtyard and should not exceed certain quantity i.e. not more than 3 buckets of 10-15ltr capacity. Though people residing in the same courtyard are allowed to use water whereas people outside the courtyard are allowed to use the resource only if they pay for it. In some areas even the tube wells are locked. This has created conflicts among people residing in the house facing towards courtyard and whose house doesn't. The locals who

cannot afford to pay and reside in courtyard without public well are affected most in the study area. The traditional social setting and relation among locals have thus changed. Location of public well is depicted in the Figure 4 and courtyard having private deep wells are depicted in Figure 5.



Figure 4. Location of public wells

It is also found that water is used from public well for the construction purpose, but once the construction is complete maintenance of public well is neglected because deep tube-well constructed inside houses fulfills the household water need. The social relation of sharing and cooperation between lower income people and people who have constructed new deep tube well inside houses in the same courtyard has deteriorated due to such tendency. However, in some courtyards community maintained wells are functioning well and no private well is constructed inside houses. Deep Boring for commercial purpose in three places within a ward is found which were constructed during the periods of 2013-2015. Water is sold per liter basis by these vendors in two different modes, namely, providing piped supply delivered to the house and from the deep boring source itself. The study on vulnerability and capacity assessment of

different wards of Kathmandu valley also concluded that in ward number 28, supply of drinking water by the government institution is short and people have to depend upon existing spring, private well and deep tubewell boring but these are not systematic and hygienic (NRCS, 2015). The community lacks safe drinking water and turbid water supply during rainy season are major problems. In case of any disaster, water sources and distribution pipes are at high physical risk aggravating the water distribution problem.

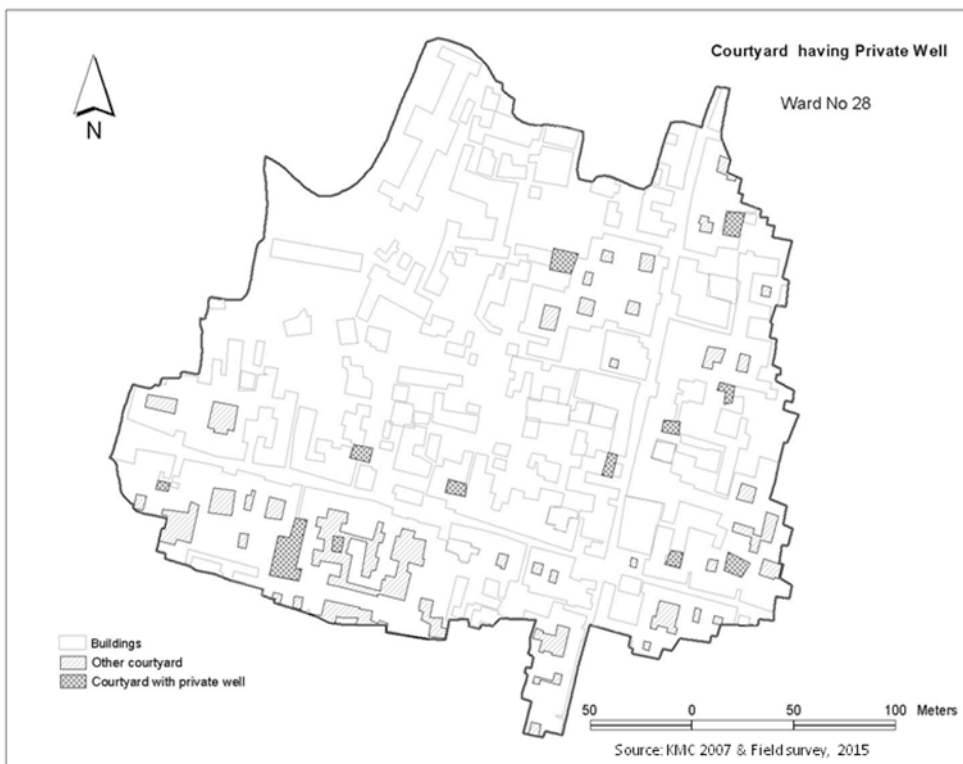


Figure 5. Courtyard having private wells

Cooperation versus Competition and open access to common pool resource has been major line of argument in literatures regarding use of common pool resources (Ostrem, 2008). Studies suggest that the proper solution of the over-exploitation of common resources, is to internalize its costs by making the public resources private (Runge, 1985) because with the private property, an individual will rationally manage resources. It is also assumed that markets are always best means of allocating public resources because competition leads to appropriate management (Vernon, 1988). However, in the study area, water extraction for commercial purpose (i.e supply to houses

for household purpose) is increasing gradually, competition rather than cooperation in groundwater extraction is perceptible. There is competition rather than cooperation in groundwater extraction from both shallow and deep wells which is increasing for private household use by individual household in the study area though for commercial use by hotels and other service providers (hospitals etc) and for public supply by Government institutions is not found within the study area.

Many scholars and public officials have relied upon the conventional analysis to justify the need for centralized control of all common-pool resources (Sick, 2008). The Government's National Water Supply and Sanitation Sector Policy of 1998 supports the involvement of the private sector in the operation and management of water supply and sanitation services in Kathmandu Valley towns and the establishment of a regulatory agency for economic regulation of service providers. Legislation for the creation of the regulatory agency do not exist yet. Similarly, though water-related laws and regulations do exist, specific policy and institutional arrangement for sustainable utilization and management of groundwater resources do not exist to date in the urban Kathmandu. Because there is no institutional mechanism and legal requirement for groundwater extraction, every new construction is starting with deeper dug well and deep tube well construction with decreasing water level and drying out of older wells during dry season in the study area.

Though over-extraction of groundwater is a major problem in the urban Kathmandu, potentials of water resource availability is not void. Estimation of ground water storage and potential recharge area for the Kathmandu valley based on GIS analysis show potential to store water in the empty space in between current and assumed upper limit of the groundwater level. If the groundwater reserve is used at the same rate as in 2001 (i.e., 21.56 Million m³/year), the reserve would be emptied in less than 100 years. On the other hand, if the shallow aquifer could be managed properly (by regulation of groundwater development as well as augmentation of recharge), it has potential to meet most of the water demand in the valley (Pandey et al., 2010). Similarly, it is also estimated that approximately 1.2 billion m³ per year (i.e. 3353 mld) of rainwater falls in the 640 sq.km of valley area. It is estimated that if only 10% of the Kathmandu Valley area was to be used for rainwater harvesting, 128 million m³ peryear could be recharged (Shrestha, 2009). This in turn will solve water shortage problem of household water demand of the study area and secondly, increasing the recharge potential of the ground water storage in the valley as well as in the study area. Together with conjunctive management of surface and groundwater sources including direct and indirect recharge

and rainwater harvesting the problem of water shortage could be managed (Dixit & Upadhaya, 2005).

Role of institutions

Extraction of ground water at institutional level through shallow and deep aquifer was promoted during 1970s with the expansion of number of municipalities in the country, though more than 20% urban population still relied on traditional stone spouts for household water supply (Shrestha et al., 2012). Though traditional stone spouts are regarded as heritage and managed by Kathmandu Metropolitan City, no authority is found responsible for management of ground water in the study area.

There is no specific policy for ground water use and no rules and regulations for construction and digging public and private wells. Public wells can be constructed in any public places with consent of municipal ward offices. No registration or permit is required for construction of private well and use of groundwater for household use. However, registration of community user group at District Water Resource Committee is required for surface water use from the source by community which is not prevalent in the study area. This trend of registration of water user group for surface water source use is more common in rural areas of the valley.

Within urban areas including ward number 28 of Kathmandu, different government agencies are operating in water sector. Nepal Water Supply Cooperation (NWSC) is responsible for piped water supply whereas for construction and repair permission should be taken from Metropolitan City Office and Department of Roads. Department of Water Supply and Sewerage (DWSS) is responsible for overall ground water management but it doesn't operate inside urban area. This has created confusion for people who want to go through legal procedure for ground water use. Because no single agency is responsible for ground water management in the study area including other urban areas, people has started constructing bore holes and selling water using private water tanker. This has resulted drying up of many nearby public well on which low income and poor people are dependent. These people are deprived of using water because in one hand they cannot afford to construct private well and on the other are not able to purchase water hence, they have to spend much of their time in search for drinking water. This has resulted deprivation of using common pool resource by poorer social group increasing the social divide.

Conclusion

Distribution of resource i.e. resource location, availability for use, affordability by local people and presence of regulatory authority exhibit a variety of responses to resource extraction. The increasing number of groundwater extraction, uncontrolled and unregulated use for private and to extent commercial use in the study area has contested the use of common pool resource and existing social setting. It is hence, essential to limit groundwater extraction by exploring the possibilities of augmenting groundwater supplies by implementing alternatives and institutional arrangements. This will also restore the traditional social setting of cooperation and relationships of common pool resource and user as basic resource and social good.

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