REGULATING COMMON POOL GROUNDWATER UNDER FUGITIVE SURFACE WATER LAW: LIMITATIONS IN LAWS AND REGULATIONS IN NEPAL

Submitted to:

Jalsrot Vikas Sanstha/ Global Water Partnership Nepal

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A. Introduction

Groundwater has become a very important source of water in the modern world. Compared to surface water sources, municipal water supplies around world depend more on groundwater than surface water mainly because of its reliable supply and higher water quality. Globally, over sixty percent of urban water demand is met with groundwater. Advancement in groundwater science and innovations in its extraction technology have made groundwater an easily accessible and affordable resource for common people. Irrigational use has become more common and groundwater extraction has increased astronomically in volume all over the world. In the USA, for example, groundwater meets fifty percent of the country's total water demand. Withdrawal of groundwater has increased tremendously in South Asia, and Nepal is also in the same path, though lately.

History of groundwater utilization in Indian subcontinent goes back to ancient time. Mention of groundwater use in drinking water supply and supplementary irrigation are found in Vedic literature. Introduced by the west Asians, the Persian Wheels provided an easy-to-operate technology for groundwater extraction, and brought a revolution in popularizing groundwater irrigation in north Indian plains. For political reasons at that time, this technology stopped from spreading in the eastern parts of the north Indian plains. Invention of mechanized water pumps and their market availability in modern times brought yet another revolution in groundwater utilization all throughout world. Groundwater became the most easily accessible and widely used source of water for both domestic supply as well as irrigation purposes.

Within the past 50 years, shallow borewells fitted with simple hand pumps became a common scene in domestic water supply in the Indian subcontinent, especially in the rural areas. Here, pump irrigation from open wells, bore wells, and even rivers or ponds has proliferated since the 1960's. Around 1960, there were fewer than 200,000 pump irrigation systems in India, but this number grew very rapidly during the "Green Revolution" period, and reached to an official figure of 18.5 million in 2001 (Government of India, 2005). Though somewhat delayed, similar trend in growth has taken place in the neighboring Pakistan, Bangladesh and Nepal. The growth curve has steeped up sharply particularly during the past two decades. According to a study, an estimated 23 million pumps were in operation in India, Pakistan, Bangladesh and Nepal Terai in 2000 AD; more than half of those pumps were installed after 1990 (Shah et al. 2006, quoted in Shah, 2009).

In Nepal, borewell technology was introduced in the 1960's as an induction effect from the neighboring states of India. Systematic investigation of groundwater resources also began around the same time with the investigation of groundwater potential in Kathmandu valley by the then Bureau of Mines. Later on in 1969, Groundwater Resources Development Board (GWRDB) was established to investigate groundwater potential in the Terai plains. Since then, this organization has been engaged in exploration and development of groundwater resources for irrigation in Terai. A large number of irrigation tubewells have been developed under various government programs, and private investment in shallow irrigation tubewells has also gone up substantially in the last one decade. Further, almost all the population in Terai depends on groundwater for their domestic water supply, whether through municipal or community supply systems or through household wells. Recently, with the opening up of the market and easy availability of cheap electric pumps in the market, groundwater extraction for all use purposes has grown very rapidly in Nepal. Most of this recent growth has taken place in the private sector; the information on this new development is however not available.

Numerous formal and informal sources indicate that well drilling activity is on the rise even in the hilly region in Nepal. Urban centers like Pokhara, Hetauda, Dharan and some agriculturally developed areas such as Panchkhal, Udaypur and others are some of those areas where private sector is already known to be extracting groundwater for various use purposes. The exact situation of groundwater extraction in these areas is however not known because there is no legal requirement or institutional mechanism to collect their information. For the past two decades or more, groundwater extraction, or rather over-extraction has been known in Kathmandu valley. A public interest litigation was filed in the Supreme Court by Pro-Public, an advocacy organization, in 2060 BS (2003), and the apex court, in its verdict in 2065 BS (2008 AD), has directed the government to immediately take stock of the groundwater resource in the valley and make necessary policy and institutional arrangement for sustainable utilization and management of groundwater resources in the whole country.

Although several water-related laws and regulations exist, groundwater has practically remained an “unregulated resource” in Nepal. The present study has been carried out in this context with the objectives of analyzing the existing legal provisions under various water related Acts and Regulations to identify the shortcoming and the gaps in them for proper regulation and management of groundwater resources in the country.

B. The Groundwater Resources Base

Before discussing groundwater resource base or groundwater reserve, some theoretical aspects of groundwater resource are discussed here for better understanding of the subject of this study. Groundwater is essentially a dynamic resource. It has two components, namely active and passive recharge zones. The annual renewable groundwater resource is the recharge or replenishment in the active recharge zone or dynamic zone. Dynamic recharge zone is the unconfined aquifer where recharge takes place from the rainfall and other sources infiltrating directly to the water table. Aside from the aquifers of the active recharge zone which get recharged every year, there are deeper aquifers below the zone of water level fluctuation. These deeper aquifers are the passive recharge zone and they contain vast quantity of water. The water in these aquifers is accumulated over many years. This water is often called ‘static’ water though in reality it also flows, though much slowly. In the alluvial areas, these resources are renewable and get replenished over long period from recharge areas flanking the mountains; for example, in the Bhabar zone in the Terai. However, in some cases like in Kathmandu Valley, the storage groundwater in deep aquifers comprises fossil water, which is non-renewable in near future. It is worth pointing out that not the entire passive or 'static' groundwater resource could be made available for extraction due to physical properties of water and technological limits. In common usage, groundwater reserve constitutes both the dynamic and static recharge.

B.1. Groundwater Resource in Terai Region

Various estimates are available for the dynamic or active groundwater recharge in Terai region. According to Duba (1982), the total annual dynamic recharge is 11, 598 MCM in Terai; nearly one-third or 2,761 MCM, of this recharge takes place in the Bhabar Zone and the remaining (8,837 MCM) in the main Terai plains. On the other hand, a later study by McNellis et al. (1993) has estimated 8,800 million cubic meters (MCM) as the total annual recharge for the whole Terai region. According to another study by GDC (1994), the total annual recharge in the Terai region is 14,300 MCM. The passive or static groundwater recharge in Terai has not been studied and hence is not known.

B.2. Groundwater Resource in other Regions

The annual dynamic groundwater recharge in the mid-hills region of Nepal is estimated to be about 1,723 MCM (Kansakar, 2002). Groundwater resource of the northern mountain region has not been studied and hence is not known. Groundwater in the hills and mountain regions are manifested in the forms of spring and seepage discharges. Groundwater in these regions has two important aspects; (i) springs discharges provide safe drinking water supply, and sometime even irrigation water supply, to the people who live there, and (ii) they sustain the base flow in the streams and rivers. Groundwater in the mountain slopes has short storage life although the storage period may be longer in the valleys within them. Groundwater in the hills and mountains, though widely used in Nepal, has not been studied properly. Among several valleys, Kathmandu is the only valley where groundwater resource has been investigated to a large extent. No systematic investigation and scientific data exist on groundwater resources of other valleys, even though groundwater utilizations in those valleys have been known to be rising.

A number of earlier workers have estimated the annual active groundwater recharge in Kathmandu valley. According to Gautam & Rao (1991), the dynamic groundwater resource is 4.75 MCM (13,000 cu.m./day), and the passive or 'static' resource is 21.60 MCM. Similarly, a study by JICA team has estimated the annual active recharge at 5.5 MCM (15,000 cu.m./day) (JICA, 1990). Binnie & Partners (1989) has estimated that the active groundwater resource in the valley is between 11 MCM and 15 MCM. In contrast, a study by AMEC/Nepal Consult (2001)[1] has postulated that the static groundwater resource of Kathmandu valley is 15 BCM

[1] AMEC/Nepal Consult. 2001. Water Optimization Pilot Project, Kathmandu Valley, Nepal. Position Paper. Unpbl. p10

(billion cubic meter), and that between 2 to 3 BCM of this passive resource may be available for extraction.

C. Status of Groundwater Extraction

C.1. Groundwater Extraction in Terai Region

Groundwater is important for the lives and livelihoods of the entire population in Terai. Almost all the population in Terai and Inner Terai valleys depends on groundwater for their daily water requirement. According to Department of Water Supply and Sewerage, an estimated 1,050,000 domestic shallow borewells are in use in Terai for daily domestic water supply. These wells extract groundwater mostly from phreatic or unconfined aquifers. The municipal and community water supply systems in Terai mostly tap groundwater from the deeper aquifers. The exact number of deep tubewells and the volume of groundwater extracted from them for drinking water supply in Terai are not known.

For the present purpose, the WHO recommended figure for per capita daily water requirement for rural life style, i.e. 45 liters per day per capita, has been used to estimate the total volume of groundwater extraction for domestic use purposes in Terai. The population projection for Terai region for the year 2011 AD is 14,048,710 (source: http://www.cbs.gov.np/Population/Projection/Table%2016.htm). For this population size, the total annual domestic water requirement is 231 MCM. Since the Terai population depends solely on groundwater, it may safely be assumed that this is also the volume of groundwater that will be extracted for the purpose of domestic use in Terai in the year 2011 AD. Allowing an equal amount of water for daily consumption by domestic cattle population, which is also large in Terai, the total volume of annual groundwater extraction for all domestic uses is estimated at 462 MCM.

Since the past three decades, government of Nepal has actively promoted groundwater irrigation in Terai region. According to the government record, 87,117 shallow tubewells and 863 deep tubewell irrigation systems have been installed in Terai during this period *(GWRDB, personal communication, August 2011)*. Though not applicable in the case of deep tubewells, shallow tubewell irrigation has attracted private sector financing, particularly since 1999 AD when the government removed direct capital cost subsidy on irrigation STW and opened up the pump market. Expansion of rural power supply network and easy availability of cheap electric pumps in the local market has made STW irrigation more accessible and affordable to even small farmers. Therefore, privately financed irrigation STWs exists in large numbers in Terai. Due to lack of institutional mechanism for recording well installation in Nepal, their numbers, however, cannot be determined. As a conservative estimate, at least 21,000 numbers of privately installed STWs may be safely assumed to exist at present in the Terai region (this is about 25% of the total STWs installed under government programs).

Assuming that all the shallow tubewells are operated in an average for 200 hours in a year (Shrestha & Uprety, 1995), and that the average well discharge is 10 liters per second (average design discharge for a government assisted STW), the total annual groundwater extraction by irrigation shallow tubewells in Terai, at present, is estimated to be 792 MCM. Again, assuming that irrigation DTWs are operated in an average for 1,000 hours per year and that the average well discharge is 60 liters per second (GDC, 1994), the total volume of groundwater extracted by all the existing irrigation deep tubewells in Terai is estimated to be 186 MCM per year. Therefore, the total groundwater extraction for irrigation purpose in Terai is estimated to be 978 MCM per year.

Almost all the industries in Terai depend on groundwater for their water requirements, but no data exists on the number of tubewells or the volume of groundwater extracted by their wells. Since industrialization in Nepal is still at a low level, the total volume of groundwater extraction by industrial sector may be considered to be little compared to the available resource.

The present situation of groundwater balance in Terai is given in Table 1. At present, only 16% of the available dynamic groundwater recharge in Terai is being utilized. In 1996, this figure was only about 10% (Kansakar, 1996).

Table 1. Groundwater Balance at Present in the Terai Region (including Inner Terai Valleys).

Available Annual Groundwater Recharge (Dynamic Groundwater Reserve)	**8,800 MCM***
Pumping Discharge for Irrigation	
By STWs	792 MCM
By DTWs	186 MCM
Pumping Discharge for Domestic Uses	462 MCM
Annual Balance =	**+ 7,360 MCM**

**The most conservative figure among the all available estimates for dynamic recharge is used here.*

The Agricultural Perspective Plan, in implementation since 1995, has an ambitious plan for groundwater irrigation development in Terai. It has a target of irrigating about one-half of the total irrigable land in Terai (i.e. 612,000 ha) by groundwater, mainly through STWs. It has envisaged bringing 223,000 shallow tubewells and 750 Deep Tubewells into operation for irrigation by the end of plan period, i.e. 2015 AD. Kansakar (1996) has projected two scenarios of groundwater balance in Terai when this target is achieved; one for the low level of STW utilization as it is at present (Table 2), and the other for an improved situation of STW utilization rate when the agricultural policy and market becomes favourable (Table 3). Projections for both the scenarios show that the available dynamic groundwater recharge can support the planned growth in groundwater irrigation development in Terai.

Table 2: **Projection of Groundwater Balance in Terai with APP – Low Level Use Scenario.**

Irrigation Use	
Pumpage by STWs	2,399 MCM
Pumpage by DTWs	269 MCM
Sub-Total	2,668 MCM
Domestic Uses	
Total Domestic Water Requirement	590 MCM*
Total Groundwater Extraction	3,258
Available Annual Recharge	8,800 MCM
Annual Balance =	**+ 5,542 MCM**

** Modified after Kansakar (1996)*

Table 3. **: Projection of Groundwater Balance in Terai with APP – Improved Level Use Scenario.**

Irrigation Use	
Pumpage by STWs	6,414 MCM
Pumpage by DTWs	269 MCM
Sub-Total	6,710 MCM
Domestic Uses	
Total Domestic Water Requirement	590 MCM*
Total Groundwater Extraction	7,300 MCM
Available Annual Recharge	8,800 MCM
Annual Balance =	**+ 1,500 MCM**

** Modified after Kansakar (1996)*

C.2. Groundwater Extraction in Kathmandu Valley

Sophisticated community water supply infrastructures based on groundwater resources had been developed in the medieval period in the Kathmandu valley. Many of these infrastructures are functioning even at present. It was only in 1891 AD that the modern technology of piped drinking water supply system (popularly known as *Bir Dhara*) was introduced in Kathmandu city. After the 1960's, the piped water supply systems were further developed in other towns and communities in the valley. These systems are based on surface water source. The traditional water supply systems like *Dhunge Dhara* (stone water-spouts), wells and springs, which are based on groundwater sources, were neglected when piped water supply systems were expanded, but the importance of groundwater grew again from 1980's when the available surface water sources could not meet the water demand from the ever-increasing population in the valley.

The then Nepal Water Supply Corporation (NWSC), the state agency responsible for municipal water supply, and now the Kathmandu Upatyaka Khanepani Limited (KUKL), began extracting groundwater in 1980 AD in order to supplement surface water sources in the municipal supply systems. In 1989, there were 60 numbers of high capacity production wells in operation in the valley; NWSC operated 28 of them. As the municipal water supply systems became insufficient to meet the ever-increasing water demand, private sector began to extract groundwater for meeting their own water requirements. Initially, it was mainly by the industrial establishments but gradually groundwater extraction became common even among the household users. In 1991 AD, there were already 334 tubewells recorded in the valley; 188 shallow tubewells and 146 deep tubewells. Among them, the 234 wells, which were recorded to be in operation at that time, were extracting about 49.59 million liters of groundwater on a daily basis. A large share of this extracted groundwater (76.61% or 37.99 MLD) was used for drinking and domestic use purposes. Groundwater extraction from NWSC wells accounted for 35.56 MLD (CES, 1992).

A recent study carried out for Groundwater Resources Development Board has documented 379 deep tubewells, but it has speculated that there could be as many as 700 tubewells in the valley. Among those documented wells, only 49 wells belonged to KUKL (IDC, 2009). All the remaining wells were owned by private sector. An earlier study had estimated that, in 1999 AD, more than 5,000 privately owned small diameter shallow borewells (operated with manual or small mechanised pumps) and unknown number of open dug wells were in use in the valley (Metcalf & Eddy, 2000)[2]. The numbers of household level wells must have increased since then, because the gap between water demand and supply has further widened during the past one decade.

The population of Kathmandu valley had increased from 1,064,899 to 1,546,000 between 1991 AD and 2001 AD. The population at present is officially projected at 1,949,000, but some surveys have indicated that the actual population could be double of this projected figure. According to KUKL, the daily water demand in the valley was 280 MLD, but it was able to supply only 105 MLD in 2009 (it could be actually only 65.1 MLD when system leakage, officially acknowledged at 35% loss, is taken in account). Nearly one-fourth of this supplied water (23.5 MLD) came from groundwater source. It is obvious that this huge gap between demand and

[2] Metcalf & Eddy. 2000. Urban Water Supply Reforms in Kathmandu Valley. Melamchi Water Supply Development Board.

municipal water supply was fulfilled by the private sector, mainly from the groundwater sources such as tubewells and natural spring sources. Sharp increase in the number of private tubewells and proliferation of water market in the valley amply attests this derivation. A recent study on the water market in the valley has shown that, in an average, 25.5 MLD of water was sold in the market during dry seasons and 8.5 MLD during other seasons during the year 2009 AD (Shrestha & Shukla, 2010). Spring water sources in the surrounding hills and the tubewells in the peri-urban areas are the main sources of water for these water sellers. All these new developments strongly establish that groundwater has become the most important source of water for the people in Kathmandu, and that groundwater extraction by private sector far exceeds in volume compared to that by the municipal wells operated by KUKL.

The estimated volume of groundwater extracted in the year 1990 AD was about 14 MCM (JICA, 1990). The studies at that time by the JICA team (1990) and Gautam & Rao (1991) had already recognized the situation of groundwater over-extraction, but the growth in groundwater extraction has continued unabated. The estimated volume of groundwater extraction was 18 MCM in 1991 AD, (CES, 1992), which had further increased to 22 MCM in 2004 AD[3] (quoted in IDC, 2009). In the light of the officially acknowledged gap between water demand and supply, the present day volume of groundwater extraction in the valley is only anyone's guess. Complicating the situation further, groundwater irrigation is in a rising trend in the valley, but no study has been carried out on this aspect. Therefore, the gap between the annual groundwater recharge and the extraction is at present huge and is increasing. This deficit is being supplied, at present, from the static groundwater resource. In other words, it is the situation of groundwater mining. The adverse effects of groundwater mining has already been manifested in the forms of declining water level (Metcalf & Eddy, 2000)[4] and diminishing spring discharges or their disappearances altogether (for example, *Balaju Bais Dhara*). Likewise, numerous culturally and archeologically important stone water-spouts in the valley have gone dry. Household shallow borewells and dug wells often go dry during summer seasons and an increasing trend of sinking deeper wells is seen among the valley dwellers. Besides the problem of resource depletion, the present situation of groundwater extraction has raised several legal issues with respect to the provisions in the existing Water Resources Act 2049 BS and Water Resources Regulation, 2050 BS.

C.2.1. Some Legal and Regulatory Issues in Kathmandu Valley

The present situation of groundwater extraction has raised several legal issues related to regulation and management of groundwater resources in Kathmandu valley. Some of them are highlighted below:

1. Drinking water is first priority use of any water resource in the country (Water Resources Act, 2049; section 7). According to this provision, municipal, community and household users of groundwater should get the highest priority over industrial or commercial uses, but increasingly large volume of groundwater is extracted from high capacity private deep tubewells that are

[3] Optimizing Water Use in Kathmandu Valley Project. 2004. Quoted in Inter Disciplinary Consult 2009.
[4] Metcalf and Eddy. 2000. Urban Water Supply Reforms in Kathmandu Valley. Melamchi Water Supply Development Board.

operated by industrial and commercial establishments and are affecting the domestic users adversely (WRA, 2049; section 4.3). This poses a problem with the 'beneficial use of water' provision in the Act.

2. Drying up of traditional water supply sources such has *Dhunge Dharas* and natural springs have deprived the prior use right of the users of these traditional water sources (WRA, 2049; section 4.3). Similarly, the small sized household well operators, who have the legitimate right over access to groundwater which occurs underneath their property, suffer because their wells become dysfunctional when the water table goes down below their well depth and pumping capacity (WRA, 2049 BS; section 4.2.e).

3. Due to increased depth to water table, sinking of deep wells becomes the only option left for accessing groundwater. The high capital and operating costs involved in extracting groundwater from deeper aquifers excludes the economically weaker section of society from access to groundwater, because they cannot afford the necessary investments. Thus, equity in access and distribution of groundwater resource is in question (WRA, 2049; section7.2, 10).

4. Due to urban growth, tubewell drilling activity has been intense recently in the northern and southern groundwater districts. Increased extraction of groundwater from the main recharge zone, i.e. northern groundwater district, has long term but direct impact on the well discharges from deep aquifers in the central groundwater district, where a majority of the older deep tubewells have been in operation since the 1980's and the 1990's. With new groundwater withdrawals from recharge area, the prior use rights established by the WRA 2049 BS in at risk.

5. Urban growth in the north in the main recharge zone results into 'shrink' in the effective recharge area. This has direct and irreversible impact on the deep groundwater system in the valley. Furthermore, the human activity associated with urbanisation process could cause adverse effect on quality of groundwater that gets into the recharge system (WRA, 2049 BS; section 19).

6. Recently, groundwater extraction has also increased in the southern groundwater district, where groundwater potential is known to be low (JICA, 1990). A recent study has recorded 26 deep tubewells within this zone (IDS, 2009). High rates of groundwater extraction from poor potential zone may cause long term adverse impact on environment, such as loss of soil moisture that affects agriculture and vegetation across the zone, drying up of springs, and land subsidence (WRA, 2049 BS; section 20, Environmental Protection Act, 2053; section 2.d).

Since there is no legal requirement of obtaining permission before sinking a new well, and since no law exists to control location, depth or volume of groundwater extraction, groundwater is in practice an unregulated resource. Groundwater in Kathmandu valley is an ideal case of unregulated open access common pool resource which is already at risk.

D. Some Theoretical Aspects of Groundwater Regulation

The history of utilization and management of surface water resources goes back to the time when settled agriculture based human civilization first started. Since then, mankind had been dealing with the concepts of property rights, first over the land, and then over surface water. Therefore, there is a wealth of knowledge and experience with mankind in this field. On the other hand, the use of groundwater resources in the early days were limited to tapping spring water sources and manually operated dug wells particularly in arid regions to meet their drinking and other domestic requirements. Since the extraction was small in quantities, there did not arise any need for regulating or controlling this resource. It is only during the past 60 years or so that the management of this resource has surfaced as a new problem, mainly because the advancement in science and technology has made its large scale extraction an increasingly common practice and the serious depletion of this resource became a possibility. Developed countries and developing countries alike have remained in a common struggle in devising appropriate mechanism for regulating and conserving their groundwater resources, because the lives and livelihoods, economic development and environmental protection, social justice and public health, and even political stability and national security ultimately became increasingly at stake. Different models of laws and regulations have evolved in the world for addressing the problem of natural resource management, including water resources. These models are guided by the divergent development history, different philosophical approaches to natural resource management policy, and their socio-political ecology. It is therefore important to understand those theories and principles of natural resource management in general, and water resources in particular, before analyzing laws and regulation related to groundwater in Nepal.

D.1. Water (and Groundwater) as a Natural Resource

A resource is a resource only when it is useful to people, that is when its existence or possession or use is of *value* to some human being (Howe, 1979)[5]. *"Value"* may be aesthetic and spiritual values as well. In conventional usage, the term natural resources is confined to naturally occurring resources and systems that are useful to humans or could be useful under plausible technological, economic, and social circumstances. Water is a natural resource because it can meet this definition under certain situations.

Natural resources may be divided into non-renewable or stock resources and renewable or flow resources. It is not always easy to determine whether a resource is renewable or not. At the extremes it is easy to decide; for example, a certain mineral deposit has a definite finite life that ends if it is continually mined and used. The renewability of a lake water resource (e.g. Aral Sea), however, depends on whether it is managed for short-term profit or for long term sustained yield. There are obviously many choices to be made in natural resources policy, and the range of choices becomes more complex as one progress from obvious cases of non-renewability to situations in which a policy choice helps define the resource itself.

Both renewable and non-renewable resources can be further categorized as resource that are easily held as private property, common pool resources, and fugitive resources. Since human societies have a long history of dealing with property rights for land, most natural resources

[5] Howe, Charles W. 1979. *Natural Resources Economics: Issues, Analysis, and Policy.* New York, John Wiley.

that could be definitively located on or under the earth's surface fell automatically under society's system of land property rights.

Fugitive resource, such as water, animals, and fish, eluded simple land prescriptions. Fish and animal wildlife (for food rather than aesthetic and psychological purposes) posed very difficult problems because they were in the commons for anyone to take. Often it was no one's interest to protect and sustain the animal population unless a powerful ruler appropriated the wildlife to himself and brought it under his protection. For other fugitive resources, such as flowing rivers, it was natural to assign property rights as an extension of neighboring (riparian) land properties.

Common pool resources fall between fully private and fugitive resources by the definition of user's rights. Examples of common pool resources are oil, natural gas, and groundwater, where many property owners on the surface may own the rights beneath their own property but excessive abstraction would reduce the resource holdings of their neighbors. Oil and natural gas are essentially nonrenewable, while groundwater, if properly managed, is renewable.

The boundaries of these categories are sufficiently elastic that some resources may be categorized in more than one way depending upon the size of the holding, on the definition of the resource itself, and on the actual scale of the intervention. Water flowing in streams is generally considered a fugitive resource, whereas groundwater is generally considered a common pool resource although subsurface flow of groundwater has some fugitive resource properties.

D.2. Water as a renewable and nonrenewable resource

Water is traditionally viewed as a renewable resource, because water is not used up by human and other users in the environment – it always becomes available again at some point in the not too distant future. Groundwater often appears to be nonrenewable because if groundwater is exploited by many parties acting at the same time without coordination and consideration of its recharge mechanisms, it can lead to overdrafting until the groundwater is apparently used up. However, under such condition, use may decline and natural recharge can eventually refill the aquifers. This is called the 'natural homeostatic mechanism'.

But groundwater and surface water can become so badly polluted that for all practical purposes they are unusable. This is particularly true of groundwater and is the basis for many of the current initiatives to control groundwater pollution. Theoretically, it is simply an economic decision whether cleaning the water to a given level of purity is worth the cost. There is nothing that we add to water, either intentionally or inadvertently, that cannot be removed at some cost. The assessment of a given source of water as renewable or nonrenewable, therefore, depends upon the use to which it will be put and the cost of replacing or cleaning it.

D.3. Theories Underlying Natural Resources Policies

Laws and regulations are the instruments of the State used for effective implementation of its national policies. Natural resources policies are formulated on the basis of some basic assumptions or philosophic approaches. There are four main philosophical approaches to natural resources, each of which dictates how policies are formulated. The first three approaches are broadly economic approaches and the fourth is based on "ethical natural science". Which theory is used, or believed, radically influences the policy tools chosen for resource management.

Theories based upon property rights: Much of the discussion about natural resource use converges on the question of property rights. Property is also called as the "the primary economic institution" and is of great importance to resource use, in its own right and because of several "derived" economic institutions such as tenancy, credit, and taxation. The "theory of efficient natural resource use" is based upon property rights. The market and neoclassical theories in economics draws their ultimate justification from this theory.

Theories based upon scarcity: The earliest theories about natural resources can be traced to David Ricardo and Thomas Malthus. The scarcity theory of resource use has been disproved by technological innovations, adaptive human changes to use fresh combinations of resources, and the adaptive behavior of human beings with respect to their own reproduction.

Theories based upon neoclassical economics: This theory basically states that the principals of production and market alone can solve the problem of efficient allocation and utilization of the resources. This theory looks for economic efficiency through pricing and taxation. However, this theory is based on several assumptions that are troublesome while dealing with water resources because of the inherent characteristics and externalities associated with water.

Theories based upon ecology: Theories based upon ecology approach to natural resources are based upon the principal that under natural conditions the resources of a region tend to be in balance and to remain relatively stable over long periods of time (Maass, 1968, p. 274)[6]. The ecological theories provide a counterpart to the economic-based theories, although it subscribes to the economic theories of scarcity enunciated by Malthus and Ricardo.

Water as a public or private good

Water has a dual characteristic. The common social perception is that water is a common pool resource, or a public good, which belongs to everyone at once with a right of access for all. As a result, it is customary to treat water as a free good. However, water has all the properties of an exclusive economic good; for example irrigation and municipal supply. Except in extreme cases for example, bottled water when water becomes a pure private good, natural water resources falls somewhere in between these two extremes. Access to water is generally linked to rights

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[6] Maass, Arthur. 1968. *Conservation: Political and Social Aspects.* In David L. Sills, ed., *International Encyclopedia of the Social Sciences, vol. 3, pp. 271-279.* New York: Macmillan.

over land, and the quality of return flow (for example, from irrigation or household/municipality areas) may not be of a quality usable for certain purposes by downstream riparians. The question of who has access becomes very important and hinges upon the different doctrines governing water rights.

D.4. Doctrines of Water Rights

According to Maloney and Yandle (1983)[7], "alienation" of natural resources from the environment takes place in the process of creating wealth from scarcity. This process is guided by the definition, transferability, and protection of the rights over the natural resource. They believe that over time, one can observe a shift along a sequence of four basic property institutions:

Institution	Example
Common access without scarcity	No rationing, free access
Common property	Rationing by excluding non-group members
Public property	Exclusionary rules, user privileges, and enforcements
Private property	Fully tradable, fee-simple rights

Generally speaking, as resource becomes scarce, common access ceases to be appealing and the resource then tends to be held as a common property of a group that excludes some users, or potential users. As demand increases for use of the resource, social pressure grows to have it become public property, to which the state regulates access, or be defined as private property, to which individual owners regulate access.

Markets are based on a system of property rights to scarce goods and the right to exclude other users of the resource. A private market exists only if the property rights can be transferred. Hence, private transferability of property rights is the distinguishing feature of markets, as apposed to other methods of allocating scarce resources.

D.4.1. Surface Water Rights

The three prevalent doctrines in surface water use rights are: riparian rights, prior appropriation rights, and hybrid system. Riparian right is common among those countries that have been under the influence of English common law and the French civil code. The hybrid system is a combination of the above two doctrines.

[7] Maloney, M.T. and Bruce Yandle. 1983. "Building Markets for Tradable Pollution Rights." Chapter 9 in Anderson, Terry L., ed. 1983. *Water Rights: Scarce Resource Allocation, Bureaucracy, and the Environment.* Cambridge, Mass.: Ballinger

D.4.2. Groundwater Rights

Groundwater is more complex and fundamentally different form surface water in many ways. While the interrelationship between the two sources of water may be intimate, the management and regulation of groundwater presents a separate and complex set of issues that relate to the spatial and temporal dimensions of its occurrence, and the way societies and their economies organize themselves around its use. Therefore, the legal regime of groundwater rights is also complex. In the US, for example, five doctrines or principles are followed in the groundwater legislations of its states. They are: (i) absolute ownership, (ii) prior appropriation, (iii) groundwater as a public resource, (iv) reasonable use, and (v) correlative rights. The doctrine of absolute ownership simply grants possession of water found under private property to the land owner. The prior appropriation doctrine in groundwater is the counter-part to the surface water doctrine of the same name, i.e. the first person to use a specific groundwater source acquires defendable rights to its usage over subsequent users. Most states treat groundwater as a public resource, which means that it cannot be privatized. Even the states, where groundwater is considered as a public resource, rarely allow absolute ownership. Instead, they turn to the reasonable use doctrine. The reasonable use doctrine allows a landowner to withdraw water for reasonable beneficial uses on the overlying land without liability for harm to adjoining landowners. Correlative rights takes the reasonable use doctrine one step further by allocating each other's reasonable share of available groundwater according to each individual's land acreage over the groundwater source.

The property rights doctrines also extend to cover water quality and its safety as a drinking water source. The concept of physical quantity of water as property is easier to understand and regulate than "quality" and "safety" as property rights.

Some Unique Features of Groundwater

Groundwater resource has some peculiar characteristics and innate complexities which make it distinct from surface water resources. Some of those features are described in below.

a. Visibility: The first and the foremost distinction from surface water resource is that groundwater occurs underneath the surface and is not visible to us until it is extracted. Without thorough scientific investigation, it is therefore difficult to visualize all the processes and mechanisms that are associated with the occurrence and movement of groundwater.

b. Physical demarcation of the resource base: Demarcating physical boundary of a surface water resource is a straight forward process. For example, defining geographic boundary of a river basin or the catchment area of a river or stream or a lake is simple. On the contrary, a groundwater reservoir or a basin may not follow the simple geographic boundary. The natural physical and chemical processes associated with groundwater that take place underneath the earth surface are even more complex to establish.

c. Multiple resources character: A surface water resource can generally be treated as an individual body of water, with only one variation, that is, their scale. On the contrary, groundwater can occur as multiple resources even under one location, because it may occur in more than one aquifer underneath the same area. Depending upon the nature of aquifers, i.e. whether it is unconfined or semi-confined or confined aquifers, these aquifers may differ from each other in terms of source areas, and the processes and the mechanisms of occurrence and movement of groundwater within them. The issues involved in the management and regulation of those different aquifers may differ although they probably are interconnected with each another at some point.

d. Source area: Unlike in the case of surface water bodies, the source (or recharge) area of a groundwater resource may not always be definitively delineated. Shallow phreatic aquifers are generally recharged by direct vertical infiltration; in other words, the land surface area lying directly above the aquifer is the recharge area. On the other hand, the source area for groundwater in a deep confined aquifer may be at such great distances that it may sometimes be difficult even to be recognized. Close inter-relationship of groundwater with surface water bodies such as rivers, lakes, ponds and other wetlands and dynamic nature of this inter-relationship with seasonal or other changes further complicates the task of source area delineation in groundwater.

e. Flow of groundwater: The flow of water in a surface water body has a definitive two spatial dimensions, i.e. upstream-downstream notion. On the other hand, groundwater runs in all three spatial dimensions, with an additional lagged temporal dimension. Therefore, the typical 'solutions of continuity' that could be applied while regulating surface water resources cannot be applied in the case of groundwater. For example, groundwater may in some cases have such low a flow velocity that it can take the form of fossil groundwater resource. In such cases, groundwater behaves almost like a non-renewable stock resource.

f. Quality of groundwater: Quality of natural groundwater in one aquifer may differ from the other and it may vary from one place to another. For regulating groundwater quality, preventing pollution at the source areas is not sufficient; protecting contamination from one aquifer to other is also equally important. For example, in some parts of Terai, shallow aquifers are known to be contaminated with naturally occurring arsenic, but the underlying deep confined aquifers are free from the contamination. Therefore, protecting deep aquifers from overlying arsenic contaminated shallow aquifers is an important issue of groundwater quality management in such areas. Again, unlike in surface water, it takes longer time to detect pollution in groundwater because there is a time lag in groundwater movement.

g. Land property above groundwater reservoir: Under the Common Law, groundwater is considered as part of the soil in which it exists. It is founded on the idea that a landowner should have dominion over the percolating groundwater that underlies his/her land in the same way that he/she has dominion over the other elements in his/her subsoil[8]. Land is generally

[8] *Roth v Driscoll*, 20 Conn. 533, 540 (1850) that, 'Each owner has an equal and complete right to the use of his land, and to the water, which is in it. Water combined with the earth, or passing through it, by percolation or by infiltration, or chemical attraction, has no distinctive character of ownership from the earth itself; not more than the metallic oxides of which the earth is composed. Water, whether moving or motionless in the earth, is not, in the eye of law, distinct from the earth. The laws of its existence and progress, while there, are not uniform, and cannot be known or

regulated under the property rights regime. Ownership on land generally falls under three categories, namely public property, private property, and community or common property (distinct from public property, as defined by Olstrom). Groundwater rights, therefore, also tend to follow the same property rights regime, unless otherwise specified as in some countries. In contrast, the land areas occupied by surface water bodies are generally owned by no one, and thus falls under the state or public ownership (except for man made water ponds of small sizes, there is no example of privately owned natural water bodies in Nepal).

g. Property rights over water: Water flowing in a stream can be generally treated as a fugitive resource. Over fugitive resource like stream water, 'natural monopoly' condition can be imposed in its exploitation and use/services through a single source such as a dam. Legal instruments like license or water use rights and the economic instruments like market could then be applied for efficiency in resource allocation and utilization. Groundwater, on the other hand, is a typical common pool resource. By the definition of user's rights, common pool resources fall between fully private and fugitive resources, because many property owners on the surface may own the rights over the resources beneath their own property. Every land property owner above an aquifer can sink wells independently of each other. In a situation of abundance, groundwater resource can therefore be distributed in an equitable manner to all the owners of land above an aquifer. Excessive abstraction would, however, reduce the resource holdings of the neighbors. In a situation of scarcity, imposing 'monopoly' over its exploitation as in the case of surface water is not possible or easy. Groundwater could then become the most inequitably distributed resource, because only a few of those who could afford would get the access by drilling deeper well, and thus alienating the poor people from their right to access.

h. Vulnerability of the resource: Groundwater resource is more vulnerable to pollution than surface water, because disposal of waste and over-extraction of groundwater can affect neighboring users in ways that are often difficult to predict and quantify. Regulating exploitation and contamination of groundwater is complex because groundwater flow is slow and it takes place in the subsurface (thus is difficult to establish the source of contamination).

i. Externalities in Groundwater Resource Management: Compared to surface water, groundwater extraction is highly decentralized because it usually takes place on private land and often with private equipment. Large scale extraction from deeper depths and complex sub-surface geology has become all the time more possible as a result of advancements in science and technology. Therefore, managing large number of decentralized users in the private sector demands more innovative approaches outside the physical boundary of groundwater resource. The use and over-use of groundwater resource is determined by numerous externalities such as (i) pricing of the resource itself, (ii) pricing of the other inputs necessary for groundwater extraction such as, pump, tubewell, and energy, and (iii) the national policy on other sectors such as water supply, agriculture, industry and others.

regulated. It rises to great heights, and moves collaterally, by influences beyond our apprehension. These influences are secret, changeable and uncontrollable, we cannot subject them to the regulations of law, or build upon them a system of rules, as has been done with streams upon the surface.'

E. Evolution of Water Laws and Regulations in Nepal

During early days, water in Nepal used to be treated as a common property, which was open for all to access. Water diversion for irrigation use was minimal, and the principal use of water was in the domestic sector. For boosting national revenue, the early rulers used to encourage its people to exploit water resources (mainly surface water) for irrigation[9] by granting water use rights and exempting for specified time periods land tax to those who invested in the irrigation infrastructures[10]. Prior use rights and riparian rights were customarily exercised. Disputes over water resources were few and used to be resolved at local level. As water usage increased, particularly in irrigation, disputes over water resources also emerged. The National Code of 1910 BS (1853 AD), the first comprehensive statutory law of Nepal, established in law the customary rights over water resources, namely the riparian rights and prior use rights. This was the first instance when the State officially established water resource as public property in its law.

The Irrigation Act 2018 BS (1961 AD) is the first sector specific water law of Nepal. Its successor, the Canal, Electricity, and Related Water Resources Act 2024 BS (1967 AD), expanded the legal coverage to regulate the use of surface water resources in irrigation and hydropower purposes. For the first time, provision of license was made in this act for granting water use right. Though limited to piped water supply systems, the concept of water tax was also introduced in Nepal through the Water Tax Act 2023 (1966).

E.1. Water Resources Act (2049 BS)

The Water Resources Act 2049 BS (1992 AD) is an umbrella act that was enacted to regulate all forms of water resources[11]. in the country for their rational utilization, conservation and management[12]. Beneficial use and equity in access are the important principles adopted by this Act in the allocation and re-allocation of water resource in the country. Following the doctrine of public trust, the State has been vested with absolute ownership over all the water resources within its territory. This state ownership over water resources is not transferable. Water right is confined to the “right to utilize water resource”. While recognizing the customary prior use rights and the riparian rights, priority order has been set for the utilization of water resources. Beneficiary use and equity in water allocation is determined through this priority order in water resource utilization.

A license is mandatory for utilizing any water resource, but it is exempted when it is the individual or collective use for the purposes of drinking and domestic supply and irrigation, or in

[9] Prithvi Narayan Shah, Dibbya - Upadesh. *“If the land is fit for paddy field, shift houses in any other place and develop system for irrigation, develop a paddy field over there and develop a cultivating land.”*

[10] Prithvi Narayan Shah, Dibbya - Upadesh

[11] *“The ownership of the water resources available in the Kingdom of Nepal shall be vested in the Kingdom of Nepal” (WRA 2049, Section 3)*

[12] *"Water Resources" means the water that is available in the kingdom of Nepal in the form of surface water, underground water or in whatsoever form” (WRA 2049, section 2a).*

the case of surface water, for running water-mill or water grinder as cottage industry and for the use of boat on personal basis for local transportation. Any person or corporate body may obtain a license. For collective use of water resource, there is a provision of Water Users' Association, which is treated as a Corporate body (Section 6). Being the "trustee", the state is vested with the power to utilize or develop water resources on its own for the purpose of extensive public uses or benefits. Thus, according to this Act, water resources in Nepal are the public domain natural resources which are to be maintained by the state for public use unless alternative restrictive or private use of the resource has larger benefit to the society. This is a hybrid doctrine of property rights. Under the trustee-ship of the state, water as a resource remains a public property, but it may be turned into a common property or even a private property (to the extent of the right to use water only) when there is a potential larger benefit to the society.

For the first time in Nepal, the Water Resources Act 2049 BS has brought under regulation the aspects of prevention and protection of water resources from pollution (WRA, 2049 BS; section 19), and protection of environment from adverse impact from utilization of water resources (Section 20). The State has the power to fix water quality standards for different uses of water (Section 18) and to formulate relevant rules and regulations related to this effect (Section 24). Accordingly, various regulations such as Water Resources Regulation 2050 BS (1993), Irrigation Rules, 2056 BS (2000 AD), Electricity Regulation, 2050 BS (2000 AD), and Electricity Tarff Fixation Regulation, 2050 BS (2000 AD) have been formulated under this Acts.

F. Analysis of Existing Laws and Regulations for Groundwater Regulation in Nepal

F.1. Constitutional Provisions

The Constitution of Nepal 2063 BS (Interim Constitution, Amendment 2066) has enshrined the rights to health, healthy environment, and livelihood as the fundamental rights of every citizen. It has also established the right of every citizen to own property. The State has the responsibility of utilizing its natural resources for the benefit of the nation. The State policy is to ensure priority of the local community over the utilization of natural resources, to conserve natural environment and to develop agriculture as an enterprise. With regard to groundwater, access to groundwater for agriculture (irrigation), drinking water and sanitation purposes are the fundamental rights of every citizen, and the local community has the priority over the resource.

F.2. Ownership over Groundwater Resources

Since groundwater comes under the definition of water resources, the ownership over all groundwater resources within the country also lies with the State (WRA 2049 AD; section 3). Through licensing process, right to utilize (ground) water may be exercised (WRA 2049 AD; section 4), but not the ownership over the resource itself (WRA 2049 AD; section 2a). Groundwater is thus a public property. Being the Trustee, the State has the power and duty to regulate it in the larger interest of the public. Individuals or community may utilize it for the prescribed purposes without obtaining a license (Section 4). All other purpose uses require a license, which is granted through due procedure with some prescribed terms and conditions. It is the responsibility of the licensee to ensure "beneficial use" of this water. Hence, all rights derived from such licenses create the prescriptive rights over groundwater resource use. This right is protected or guaranteed against third party intervention or any other outside interferences and is enforceable by law[13]. A license to use a water resource can be sold or transferred (WRA 2039 BS; section 8.6). Thus, groundwater resource can become a private property (to the extent of right to utilize water) when it is utilized with a license under this Act.

For a brief period of time, ownership over water resources was assigned to the local government bodies (Local Development Act 2048 BS). The tasks of conservation and regulation of water resources were also entrusted to the Village Development Committees[14], Municipalities[15] and District Development Committees[16]. This provision of ownership over water resources has been repealed under the Local Self-Governance Act, 2055 BS (1999 AD). The roles of the local government bodies are now confined to maintenance and protection of water related infrastructures, prevention of water resources from pollution and protection of environment. License to utilize water resource is now issued by the respective District Water Resources Committee (Chapter 3, Rule 8, Water Resources Rules, 2050 BS). A joint meeting of the concerned District Water Resources Committees exercises this power when the water resource is shared by more than one district.

F.3. Right to Utilize Groundwater or Groundwater Right

As stated above, the Water Resources Act 2049 BS recognizes water rights only to the extent of "right to utilize water resource". For all use purposes, the right to utilize water resource is acquired only through a way of license (WRA 2049 BS; section 4.1), which is transferable (WRA 2049 BS; section 8.6). Individual or collective rights over groundwater resource for such purposes as drinking water and domestic uses and irrigation are protected by means of waiver from the licensing requirement (WRA 2049 BS; section 4.2). Again, the right of the land owners to utilize water resource confined within his/her property for prescribed uses (WRA 2049 BS; section 4.2.e) implies that the right of the land owner over the groundwater that occurs underneath one's land property is also protected.

Through the provision of licensing, the Water Resources Act 2049 BS has guaranteed a sort of "monopoly" condition, though to a limited extent, to the license holders, so that economic instruments like market mechanisms could be applied for efficient use of the resource. But, this mechanism is problematic in the case of groundwater, because a license holder cannot truly exercise a 'monopoly' condition (like a dam or a canal over a river) over a common pool resource like groundwater; the reason being many property owners on the land surface also hold the right over the same resource that occur underneath their property.

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13 *Water Resource Regulation, 2050, Rule 22*
14 *Village Development Act, 2048 Section 38 (1) b*
15 *Municipalities Act, 2048 Section 40 (1) b*
16 *District Development Committee Act, 2048 Section 24 (1) b*

The responsibility of regulating and controlling the use of groundwater resources in Kathmandu valley, including the authority to issue license to withdraw groundwater, has been given to Kathmandu Valley Water Supply Management Board (KVWSMB) under the Water Supply Management Board Act, 2063 BS (2006 AD) and Kathmandu Valley Water Supply Management Board Regulation, 2064 BS (2007 AD). Exercising this authority, the KVWSMB has initiated to issue license for groundwater extraction in the valley. Accordingly to KVWSMB, about one-third of the recorded total of 379 wells have already acquired their licenses till date (78 wells belongs to KUKL and 48 wells in the private sector) (*Personal communication, KVWSMB, 2011*).

Ideally, this licensing mechanism could be an effective legal instrument to control and guide the utilization of fugitive natural resources like a stream water, in the manner as has been perceived by the Water Resources Act, viz. enforcing priority in drinking water use, protecting individuals' right to access for domestic uses, equity in access over the resource, and protect and manage the resource for its sustainability. The reality is that groundwater is a common pool resource and it is already an over-exploited (scarce) resource, on which the entire population of the valley depends, one or the other way, for their daily water requirements. License is a legal instrument that establishes the right of the license holder to utilize water to his benefit. In Kathmandu valley, industrial and commercial sectors extract groundwater in large quantities through their high capacity deep wells for their benefit, but this has caused depletion of common pool groundwater resource, adversely affecting household well owners. Being owners of the land above the resource, and being domestic users, the household well owners have priority in rights over the underlying groundwater resource. If licenses are issued indiscriminately without any control, and if extraction is allowed without any limits, the risk is that this common pool resource may gradually be converted into 'private property' of those limited few who hold the licenses, and that this scarce resource will be gradually controlled by industrial and commercial establishments for their profit than for supplying domestic water to a large population. Since there is no law to control sinking of new wells, nor the mechanisms to control the volume of groundwater extraction from even those wells for which licenses have been issued, protecting water rights of early license holders will also be difficult under this Act.

With this initiative by the KVWSMB, it may be expected that all the industrial and commercial establishments in Kathmandu valley will eventually obtain licenses for withdrawing groundwater from their wells. However, the situation is different elsewhere. Although the Water Resources Act 2049 BS has made license mandatory for utilizing water resource for any purpose other than specified uses, the Industrial Enterprises Act, 2049 BS (1992 AD) has a contradictory provision. According to the latter Act, it is the obligation of the Government to make "…… available infrastructural services such as …. water …. required for the industries"[17]. Industries, therefore, cannot be asked to obtain license to utilize any water resource when it develops water supply infrastructure at their own cost. Due to this provision in the Industrial

[17] "To make recommendations as may be required for making time-bound provisions on making available infrastructural services such as electricity, water, means of telecommunications, land, road, and so on required for the industries" (Functions, Duties and Powers of (one-window) Committee, Industrial Enterprises Act 2049 (1992), Section 18.b.1)

Enterprises Act, 2049 BS (1992 AD), even the water based industries such as beverage industries and bottled water industries have no obligation to obtain license to utilize any water resource. Adverse impacts on groundwater table and environment from excessive withdrawal of groundwater by beverage industries have been experienced in the valley since many years ago, but no law or regulation exists to control their water withdrawal.

The Industrial Enterprises Act 2049 BS (1992 AD) does not regulate the location of any type of industries in Nepal. Because of the accessibility and other advantages, a large number of industries are situated in the Terai region, mostly in the Bhabar Zone along the highways. Groundwater is the source of water for most of these industries. Apart from volume of groundwater extraction, monitoring and regulation of industrial waste disposal is also poor in Nepal. Bhabar zone is the main recharge area for deep aquifers which are tapped for drinking water supply in the main Terai plains in the south. Groundwater pollution, if any, from industrial wastes in the Bhabar zone poses threat to the public health of the people living in the south. It must be recognized that pollution of drinking water at source is the denial of fundamental right of the people who use it "downstream".

F.4. Water Rights Fee

The concept of water tax was introduced through the enactment of the Water Tax Act, 2023 BS (1966 AD). This Act was enacted mainly for collecting 'water tax' from the receivers of water supply service through a tap. In 2032 BS, this concept of 'tax' was abandoned and instead adopted the concept of "water charge" under the Water Tap Charges (Realization) Rules, 2032 BS, which came into force under the Administrative Procedures (Regularization) Act, 2013 BS. The Nepal Water Supply Corporation Act 2046 BS (1989 AD) (Section 6) and the Water Supply Management Board Act 2063 BS (2006 AD) (Section 6.k) brought some further refinements in the regulation of service charge that is collected by a service provider in drinking water supply sector. In essence, these Acts covered only the fee in return of the service of drinking water supply provided by a service provider, not the 'fee' on water resource itself.

The concept of 'fee' on water resource, or the 'value' of water is introduced for the first time under the Water Resources Act, 2049 BS. The annual fee charged to a license holder (WRA 2049 BS; section 8.5) is actually the "price" of water that is paid to the State for gaining the exclusive right to use a publicly owned natural water resource as his own property. He exercises this right to use the resource for his own benefit (under the terms and conditions specified in the license). In order to facilitate him in exercising this right, the license holder is given the power of fixing service charge for the service generated from water resource utilization and also to realize the same from the users of the service (WRA 2049 BS; section 13). Thus, this Act has made a clear distinction between the "value" of water, which is collected by the State, and the "value" of water service collected by the service provider by virtue of being a license holder.

In principle, the WRA 2049 BS has guaranteed the license holder a kind of "monopoly" over a water resource within the specified sphere. Protecting this 'monopoly' of the license holder is the obligation of the State. But it is difficult to fulfill it because State cannot deny a large number of property owners who also hold the right to extract groundwater from the same resource. This is the fundamental problem and the most difficult challenge in strictly applying this economic tool in regulating groundwater resource in Kathmandu valley.

The Kathmandu Valley Water Supply Management Board, under the Water Supply Management Board Act 2063 BS (2006) (Section 7.c)[18] has begun to issue license to deep tubewell operators in the valley, irrespective of whether the extracted groundwater is used for drinking water or other purposes. Using well depth as criteria, license fee has been fixed at Rs. 10,000 for wells that have less than 100 m depth and Rs. 20,000 for those wells that are more than 100 m deep. The KVWSMB, at the moment, has not decided whether this fee will be collected on an annual basis (i.e. price of water) or it will a one time registration fee *(KVWSMB, personal communication, 2011*). The KVWSMV has issued license to KUKL for operating 78 tubewells that were handed over by the Nepal Water Supply Corporation (NWSC) under the management contract between KVWSMV and KUKL. The KUKL pays an annual fee to KVWSMB as per the agreement, but there is no clear cut distinction of whether the fee is for utilizing the (ground) water resource or for utilizing the pre-existing water supply infrastructures.

There is another problem with the present licensing procedure. Among those who are required to or who have already obtained license from KVWSMB, some wells are in use for domestic water supply in the housing complexes. This use falls into the category of "collective use of water resource for prescribed uses" (in this case, domestic use). Since the Water Resources Act 2049 BS has waived such users and uses from license requirement (WRA 2049 BS; section 4.2), the licenses issued to them are in contradiction to the WRA 2049 BS.

No doubt an encouraging positive step, this initiative of licensing deep tubewell operations cannot bring any tangible result with regard to the larger problem of controlling groundwater overdraft in the valley. It is simply for the reasons that (i) the permitted volume of groundwater extraction from a well is based on the well capacity, which is the "safe yield" of the well, not the "safe yield" of the groundwater reservoir; hence, no reduction in groundwater withdrawal can be expected from this mechanism in any case, (ii) though licenses are issued with a permit to extract only a prescribed volume of groundwater from a well, the KVWSMB neither has the program nor the institutional capacity to monitor the actual groundwater withdrawal from those wells, (iii) there is no prescription or restriction on the depth or diameter of a well nor on the groundwater extraction equipments when a license is issued, (iv) there is no provision to restrict groundwater extraction from any particular aquifer/s. The general practice during well construction in Nepal is to tap as many productive aquifers as possible, unconfined or confined. Since aquifer interconnection is common in wells, deep tubewells withdraws groundwater not necessarily from deep aquifers alone; therefore, there will be no relief to the users of shallow groundwater, (v) there is no provision or plan to control or regulate design of new wells (vi) there is no legal provision to control new tubewell constructions, and (vi) there are an unknown

[18] "Except as otherwise mentioned in the prevailing laws, to regulate, control or prohibit the extraction and use of water from groundwater resources within its geographical area, and, as per necessity, to give license, as prescribed, to extract or use such water" – Water Supply Management Board Act 2063 BS (2006 AD), Section 7(c)

but a very large number of shallow tubewells in operation at household levels. A large section of the society depends on these wells, but they are exempted from the registration or license requirements, and (vii) there is no common definition that that can technically distinguish a shallow tubewell from a deep tubewell.

F.5. Beneficial Use of Groundwater Resource

Equity and beneficial use of water resources are the core principles of the Water Resources Act 2049 BS. In this Act, beneficial use is defined as "rational uses of water resources with the available means and resources without causing damage to others". Beneficial (or rational) uses of water resources are to be enforced through the provision of priority order of water resource utilization set by the Act. Any dispute over allocation or re-allocation of water resources is to be settled on the basis of these principles of beneficial use and equity. The priority order set in the Act (WRA 2049 BS; section 7), when applied to groundwater utilization, translates to the following:

a. Drinking water and domestic uses;
b. Irrigation;
c. Agricultural Uses such as animal husbandry and Fisheries;
d. Cottage Industry, industrial enterprises and mining uses,
e. Recreational uses;
f. Other use.

Imposing this priority order in groundwater utilization requires that the resource be recognized, in the first place, as a common pool resource. The next logical step is to appreciate that regulation of this common pool resources requires some special legal instruments and mechanisms that are different from those used in surface water. The existing laws and regulations in the country seriously lack in making this distinction. As a result, the existing legal instruments have been ineffective in regulating groundwater.

F.6. Protection of Groundwater Recharge (Source) Area

There are two aspects in the protection of groundwater source area – protection of recharge area and protection of groundwater from pollution. Specific provision for protecting recharge area does not exist in any law or regulation. The Essential Goods Protection Act, 2012 BS (1955 AD) defines "source of drinking water developed by the Government of Nepal or any other institution or developed with the permission of the Government of Nepal or other institution" as the "essential goods" (Section 2.e), but all the provisions in the Act deal only with the drinking water infrastructures and are applicable mostly in surface water based systems. It does not cover the protection of watershed area or groundwater recharge area on which the supply of drinking water depends.

Conservation of watershed area is dealt under Soil and Watershed Conservation Act, 2039 BS (1982 AD), but the main objective of this Act is not to protect water source area, but to control natural calamities such as flood, landslide and soil erosion and to control river water pollution from soil erosion (all surface water related issues). When necessary, this Act gives power to the concerned government department to declare certain geographically defined area as "Conserved Watershed Area" (Section 3). Within such area, collecting, blocking, or diverting water, including groundwater, in any way will be prohibited (Section 10). However, this Act cannot be activated for the purpose of protecting groundwater or surface water source area.

In some areas particularly in hilly terrain in Nepal, mining is one human activity that may potentially pose threat to groundwater by damaging or destroying the recharge area. An example is the sand mining activity that is taking place in some parts of Kathmandu. Section 11.A in the Mines and Minerals Act 2042 BS (1985 AD) prohibits mining activity from causing 'significant adverse impact on environment' and section 12 gives power to declare an areas as 'prohibited for mining operation' if there arises concerns of "national security, public interest or historical importance". However, it is difficult to activate these provisions for protecting groundwater recharge area. Similar is the situation with the provision of declaring "Environment Protection Area" (Section 10) under the Environment Protection Act, 2053 BS (1997 AD).

The Environment Protection Act, 2053 BS (1997 AD) has brought under regulation all "development works or physical activities that may bring about change in the existing conditions, or any plan or program or project which changes the land uses" (Section 2.d). Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) is required for any such activities (Section 3). This Act also requires that examination or assessment is carried out on the source of water to be used and the impact of waste and pollution to be emitted through the implementation of a "proposal on water". With respect to water, pollution is the main concern of this Act, and avoiding significant adverse impact on environment from development activities sustainable management of natural resources are the main objectives. If groundwater is adequately established as an integral component of environment, then this Act could have some relevance in protecting groundwater recharge areas.

F.7. Protection of Groundwater Quality

The sources of groundwater pollution may be categorized into two - (i) non-point sources and (ii) point sources. Agriculture is the most common non-point source of groundwater pollution. Improper sanitation in dense human settlement areas is another. Examples of point source of groundwater pollution are the localized facilities such as industries, mines, municipal waste disposal sites etc. In Nepal, non-point sources of groundwater pollution like agriculture are not regulated. Even household sanitation is not regulated although building construction is.

F.7.1. Non-point sources of groundwater pollution

The Civil Code *(Muluki Ain)* 2019 BS is confined to managing storm water from buildings; it is the responsibility of the owner of the building. This Act maintains that "natural flow of water should not be prevented in anyway" (Chapter on Housing)[19]. Even the recent Act, the Building Act, 2055 BS (1988 AD), is limited to safety of buildings from natural disaster, in particular the earthquake.

Expansion or reconstruction of existing towns and development of new towns is under the jurisdiction of Town Development Committees or the local bodies, according to the Town Development Act, 2045 BS (1988 AD). These bodies have been given the responsibilities of "regulating, controlling or prohibiting any act that may cause adverse effect on public health or may cause environmental pollution" (Town Development Act, 2045 BS; section 9). These bodies have the power of (i) specifying necessary conditions or standard in land use area for physical development, (ii) classifying the land area on the basis of land use, (iii) setting up guideline for institutions or local body upon prescribing condition or standard for the physical development of land, (iv) prescribing condition on construction and other activities to be carried out in forest, stream, riverside and water area for the protection of nature and environment of town planning region, and to perform and cause to perform the act as per the said conditions, and (v) prohibit the use of natural resources that causes adverse effect on nature (Town Development Act, 2045 BS; section 11). It will be highly optimistic to expect that town development committees or local bodies will exercise these powers to control town development activities (urbanization process) or groundwater extraction activities (e.g. in the northern and southern parts of the Kathmandu valley, or in Bhabar zone in Terai) when their main mandate is to expand or develop new towns.

F.7.2. Point sources of groundwater pollution

Industrial activities and their waste disposals, municipal waste disposals, and mining activities are some of the human activities that may have significant impact on groundwater quality.

The Water Resources Act, 2048 BS has prohibited pollution of water resources by "using or putting any litter, industrial waste, poison, chemical or toxicants" (WRA 2049 BS; section 19.2). Pollution of water resources by anyone causing to exceed the prescribed tolerance limit is punishable under this law (WRA, 2049 BS; section 22). However, pollution tolerance limits are yet to be prescribed for any water body in the country.

According to the Industrial Enterprises Act, 2049 BS (1992 AD), any industry that may "significantly cause adverse effect on the security, public health and the environment" are required to obtain special permission (Industrial Enterprises Act, 2049 BS; section 9.1.). The Industrial Promotion Board is the responsible body to "cause to follow the ways and means for the prevention of the environmental pollution by putting more emphasis on the avoidance of effects on the environment and the public health" (Industrial Enterprises Act, 2049 BS; section 13.d). There is an incentive for investment in environment protection and pollution control measures (Industrial Enterprises Act, 2049 BS; section 15.k). Up to 50% reduction in the taxable

[19] *"Owner of a building is obliged to build the roof as well as to arrange drainage for rainwater coming from it on his own land and to make necessary arrangement to public sewerage without affecting his neighbor (Muluki Ain, Chapter on Housing)*

income could be granted on such investments, and this amount could be deducted in lump-sum or in installments within three years of investment. However, in the absence of prescribed pollution tolerance limit for the concerned water body or resource, implementation of these provisions is difficult or at best, arbitrary.

Pollution of water resources from mining activities is dealt in a general manner only in the Mines and Mineral Act, 2042 BS. This Act has required that mining license holders utilize water resources in such manners that their mining activities do not cause substantial adverse effect on environment such as "soil erosion, landslide or similar other effects" (Mines and Mineral Act, 2042 BS; section 20). It has prohibited pollution of water resources while excavating or dumping mining wastes (Mines and Mineral Act 2042 BS; section 11, and Mines and Minerals Rules, 2056; Rule 33). The qualifications included in these provisions are more specific to pollution of surface water. The adverse impacts on groundwater quality and quantity are not mentioned, although mining activities can cause impact on quality and quantity of groundwater resources.

The Solid Waste Management and Resource Mobilization Act 2044 BS (1987 AD) is enacted only for the three metropolitan cities in Kathmandu valley, namely Kathmandu, Bhaktapur, and Lalitpur. Established under this Act, the Solid Waste Management and Resource Mobilization Center is given the responsibility of making "necessary arrangements to prevent air, soil or water pollution resulting from solid wastes". This provision is too general to be effective in preventing groundwater pollution from solid waste disposals.

The Environment Protection Act, 2052 BS prohibits "pollution in such manners as to cause significant adverse impacts on the environment or likely to be hazardous to public life and people's health, or dispose or cause to be disposed sound, heat radioactive rays and wastes from any mechanical devices, industrial enterprises, or other places contrary to the prescribed standards" (Environment Protection Act, 2052 BS; section 7.1). The Environment Protection Rules 2054 BS (1998 AD) has a provision of Pollution Control Certificate also to those who comply with the environment standards (Environment Protection Rules, 2054 BS; Chapter 3).

There is sufficient ground to treat water (and groundwater) quality as a matter of 'public life and people's health' concerns. On this ground, many of the above mentioned Acts and Regulations could be brought into force. However, establishing pollution and identifying the source of pollution has to be in reference to the pollution tolerance limits, as provided in the Water Resources Act 2049 BS (WRA 2049 BS; section 19.1). At present, prescribed pollution tolerance limits does not exist for any water body, surface or groundwater, in the country.

Water Resources Act, 2049 BS has made a provision of Water Resources Utilization Inquiry Committee for resolving any dispute that may arise from the utilization of water resources (presumably, it also covers dispute over groundwater pollution). This is a three member committee comprising of a representative from Ministry of Water Resources as the Chairman, and one representative each from the concerned District Development Committee and the Regional Office of the National Planning Commission (Water Resources Regulation, 2050 BS;

Rule 28). One important deficiency in Water Resources Act, 2049 BS is the absence of any provision or mechanism to monitor whether the terms and conditions prescribed in a water utilization license are complied by the license holder or not. This dispute resolution mechanism comes into effect only when a complaint is duly filed, but it is also not clear where this complaint is filed. The issues covered by Rule 28 are related more with water allocation (i.e. quantity) than water quality. The provision of hearing the grievance of local people against the impact of "running of any project" could be extended to cover the issue of water or groundwater pollution (Water Resources Regulation, 2050 BS; Rule 28.3.b).

Establishing 'significant adverse effect' on quantity or quality of groundwater (i.e. impact on environment and public health respectively) is much more complex than in the case of surface water. Groundwater poses several unique challenges when it comes enforcing this provision. (i) In a common pool resource, it is difficult to establish an offender when the users are many, (ii) the effect on water quality does not appear immediately because groundwater moves slowly, and may take years before it is detected, and most importantly, (iii) the natural groundwater quality of one aquifer may differ from the other; setting pollution tolerance limits for each and every aquifer is not practical. Without pro-active institutional mechanisms in place, enforcing the existing legal provisions is difficult.

G. Summary and Conclusions

1. Groundwater extraction has escalated in Nepal during the past couple of decades. With the availability of cheap pumps in the market and expanded network of electricity supply systems, groundwater has become an easily accessible and affordable option for water supply in both domestic uses as well as in irrigation sectors. Growing water demand from ever-rising urban populations and insufficient municipal water supply has impelled private investment in groundwater extraction for drinking and other purposes. Again, as a result of modernization in agriculture sector and high demand for agricultural products from the rising population, irrigation water demand has also grown tremendously during the period. Most of this demand is being met with groundwater through shallow wells. After the abolition of capital cost subsidy policy of the Government in 1999 AD, it is the private sector funding that has supported all the recent growths in shallow tubewell installations in Terai and elsewhere, but the scale of this recent development is unknown. Explosion of pump market since 1999 AD sufficiently indicate that this growth has been much higher compared to the earlier periods, but there is a serious lack of institutional and legal mechanisms to keep track of this development in the country.

2. Quantity-wise, the available groundwater resource base in Terai is much larger compared to its present use. It can also support the planned growth in groundwater irrigation in the Terai under the on-going Agricultural Perspective Plan. It should be, however, remembered that almost the whole population of Terai also depend on the same resource for their basic daily water requirements. Again, there are a sizable number of industries that also use the same groundwater resource. Un-regulated development or exploitation of this common pool resource may create problems like the issues of beneficial use of the resource, equity and protection of groundwater quality.

3. Groundwater exploitation has also increased in other parts of the country, but there is no institutional mechanism to collect their information. Among other areas, groundwater in Kathmandu valley has been known to be over-extracted since the past two decades, and there is no immediate sign that this problem will be abated in any near future. Static 'fossil' groundwater reserve is currently supplying the extraction over and above the annual recharge, and the status, at present, is a typical case of a non-renewable common pool resource.

4. There are several characteristics of groundwater that are uniquely distinct from surface water resources. Among others, the most important one is that groundwater is a common pool resource whereas surface water is a typical fugitive resource. This important distinction has not been recognized in the existing laws and regulations related to water resource in Nepal.

5. The main principles for water resources utilizations adopted by the Water Resources Act, 2049 BS, are the principles of the beneficial use, economic efficiency and equity. It has embraced a hybrid doctrine in the allocation and/or re-allocation of water resources in the country. Following the doctrine of public trust, water resources have been treated as a public property under the trustee-ship of the State. Applying the economic principles of "efficient natural resource use", legal instrument, namely licensing mechanism, has also been provided to establish the property right over water (utilization) in the law.

6. A straight forward enforcement of licensing mechanism cannot be effective in regulating groundwater exploitation, because unlike over a fugitive surface water resource, a license holder cannot always be protected from "third party intervention or other outside interferences" particularly when a groundwater resource becomes scarce, and when a large number of other legitimate holders of water rights also exploit the same resource simultaneously. The situation of groundwater exploitation in Kathmandu valley is an example to this.

7. The licensing mechanism that has recently been enforced in Kathmandu valley must be welcomed as a first positive step, but without other supporting legal and institutional mechanisms, this step could lead to several other legal, economic and social problems that the existing Water Resources Act, 2049 BS had intended to avoid. For example, there is a danger of converting the scarce common pool property into the private property of a limited few license holders and thus denying the legitimate rights of the landholders who own the property above the resource. Again, this scarce groundwater resource may increasingly be used in industrial and commercial sectors benefitting those limited few while depriving the valley dwellers at large from their basic and fundamental right to water for their daily domestic needs.

8. At present, many ambiguities exist in the implementation of this mechanism by the Kathmandu Valley Water Supply Management Board. It even contradicts the Water Resources Act, 2049 BS in certain cases.

9. The legal provisions available for protecting and controlling the quantity and quality aspects of water resources are highly scattered at present. At times, they are even contradictory to one another. Again, those existing provisions are directed mainly towards regulating the surface

water resources. Bringing those provisions into effect to control and protect groundwater resources is difficult, if not impossible.

10. Conservation and protection of water source areas (that includes groundwater recharge areas) have not been covered directly by any of the laws in Nepal, including the Water Resources Act, 2049 BS. A number of other Acts, such as Essential Goods Act, 2012 BS, Industrial Enterprises Act, 2049 BS, Mines and Minerals Act, 2042 BS, Town Development Act, 2045 BS and most importantly the Environment Protection Act, 2053 BS have some indirect reference towards this effect, but they are inadequate for effective enforcement.

11. The beneficial use, equity and the economic efficiency are the core principles of the Water Resources Act, 2049 BS, which require that innovative legal, economic and institutional instruments are devised to satisfy the unique character and characteristics of groundwater resources. Last but not the least, it is very important that pro-active institutional mechanisms are in place to apply those instruments.

References:

1. Agricultural Perspective Plan, 1995, APROSC and John Mellor Associates Inc. 1995
2. AMEC/Nepal Consult. 2001. Water Optimization Pilot Project, Kathmandu Valley, Nepal. Position Paper. Unpbl. p10
3. Binnie & Partners, 1973. Kathmandu Water Supply and Sewerage Scheme. Appendix 4.5, Groundwater Investigation. World Health Organization – Project Nepal 0025. Unplublished.
4. Binnie & Partners, 1989.
5. Duba, D. 1982, Groundwater Resources in the Terai of Nepal, Water and Energy Commission Secretariat Report.
6. Gautam, R. and G.K. Rao, 1991. Groundwater Resource Evaluation of the Kathmandu Valley. Jour. Nep. Geol. Soc., vol. 7. pp. 39-48
7. GDC, 1994, Reassessment of Groundwater Development Strategy for irrigation in the Terai. 6 Volumes.
8. Howe, Charles W. 1979. *Natural Resources Economics: Issues, Analysis, and Policy.* New York, John Wiley.
9. IDC. 2009. Study on the Status of Groundwater Extraction in Kathmandu Valley and its Potential Impacts. Final Report. Inter Disciplinary Consultant. A report submitted to Groundwater Resources Development Board, Kathmandu, Nepal. Final Report.
10. JICA, 1990. Groundwater Management Project in the Kathmandu Valley. Final Report. Unpublished.
11. Kansakar, D.R. 1996. Report on Hydro-Geology. Water Resources Strategy Formulation Program. Phase I.HMG/The World Bank (JGF) Project, Nepal. Unplublished.
12. Kansakar, D.R., 2002. Groundwater in the Mountains and Hills of Nepal: Resource Potential and Development. Jalsrot Bikas Sanstha, Nepal.
13. Maass, Arthur. 1968. *Conservation: Political and Social Aspects.* In David L. Sills, ed., *International Encyclopedia of the Social Sciences, vol. 3, pp. 271-279.* New York: Macmillan.

14. Maloney,M.T. and Bruce Yandle. 1983. “Building Markets for Tradable Pollution Rights.” Chapter 9 in Anderson, Terry L., ed. 1983. *Water Rights: Scarce Resource Allocation, Bureaucracy, and the Environment.* Cambridge, Mass.: Ballinger
15. McNellis, J., Tuladhar, R.M., Shrestha, R., Amatya, S.C., Shrestha, I., Kansakar, D.R., 1993, Ground Water in the Terai, Nepal. UNDP/HMGN, Shallow Ground Water Investigations in Terai. Technical Report No. 33.
16. Metcalf & Eddy. 2000. Urban Water Supply Reforms in Kathmandu Valley. Melamchi Water Supply Development Board. In association with CEMAT Consultants. P. 53
17. Prithvi Narayan Shah, Dibbya – Upadesh. Source, Nepal Law Commission
18. *Shah, T.2009. Taming the Anarchy: Groundwater Governance in South Asia.* Resources for the Future. Earthscan.
19. *Shrestha, D and A. Shukla. 2010. Private water Tanker Operators in Kathmandu: Analysis of Water Services and Regulatory Provisions.* A Paper present in Regional Conference on Water & Governance, organized in Bhutan, SaciWATERs,
20. Shrestha, J. L. and Uprety, L. P., 1995, Study of Group Shallow Tubewell Irrigation. Poverty Alleviation Project in Mid and Far Western Terai. FAO/UN. 1995

List of Acts and Regulations reviewed:

1. Administrative Procedures (Regularization) Act, 2013
2. *Building Act, 2055 (1998)*
3. *Canal, Electricity, and Related Water Resources Act, 2024*
4. *District Development Committee Act, 2048*
5. *Environment Protection Act, 2053 (1997)*
6. *Environment Protection Rules, 2054 (1998)*
7. *Essential Good Protection Act, 2012 (1955)*
8. *Hotel, Lodge, Restaurant, Bar and Tourist Guide Rules, 2038 (1981)*
9. *Industrial Enterprise Act, 2049 (1992)*
10. *Interim Constituting of Nepal, 2063*
11. *Irrigation Act, 2018 (1961)*
12. *Irrigation Rules, 2056 (2000)*
13. *Kathmandu Valley Water Supply Management Board Rules, 2064 (2007)*
14. *Local Development Act, 2048*
15. *Local Self Governance Act, 2055 (1999)*
16. *Local Self Governance Rules, 2056 (1999)*
17. *Mines and Minerals Act, 2042 (1985)*
18. *Mines and Minerals Regulation, 2056*
19. *Muluki Ain (National Code), 1910 (1853)*
20. *Muluki Ain (National Code), 2019*
21. *Municipalities Act, 2048*
22. *Nepal Water Supply Corporation Act, 2046*
23. *Soil and Watershed Conservation Act, 2039 (1982)*

24. *Solid Waste (Management and Resource Mobilization) Act, 2044 (1987)*
25. *Tourism Act, 2035 (1978)*
26. *Town Development Act, 2045 (1998)*
27. *Village Development Act, 2048*
28. *Water Resource Regulation, 2050*
29. *Water Resources Act, 2049*
30. *Water Supply Management Board Act, 2063 (2006)*
31. Water Tap Charges (Realization) Rules, 2032
32. *Water Tax Act, 2023 (1966)*