Climatic Change and Indigenous Knowledge and Practices with Reference to Traditional Water Resource Management in the Kathmandu Valley, Nepal

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Abstract

Researchers have demonstrated evidence of changes in the climatic conditions over the time. This paper reviews indigenous knowledge and practices, with reference to traditional water resource management, in view of the climate change impacts on traditional water resources, especially stone spouts, which have been practiced over many centuries in the Kathmandu Valley of Nepal. There is a need to document and preserve the existing indigenous knowledge and practices.
Key words: *indigenous knowledge and practices, water resources, stone spout, climate change, Newars*

1. Introduction

1.1 Indigenous Knowledge

The relationship between indigenous knowledge (IK) and sustainable resource management is termed to be complex, although there are many pieces of evidence of harmonious and balanced relationships. Nepal is a mountainous country in South Asia that is considered as one of the richest countries in terms of indigenous knowledge and practices because of its diverse geography (Practical Action, 2009), multiethnicities with rich socio-cultures, biodiversity and associated indigenous knowledge, and practices, which have contributed to sustainable use, conservation and restoration of natural resources. Most of the communities have different indigenous knowledge and practices associated with their livelihood and well-being (Sharma, Bajracharya and Sitaula, 2009).

Indigenous peoples in Nepal also referred as indigenous nationalties, are highly depended on ecosystems and natural resources management for their sustainable livelihood (Magar, 2007). Magar (2007) underscores that relationship between biodiversity and knowledge of indigenous peoples and their understanding related to its conservation as indigenous knowledge. Similarly, a research study of Maden, Kongren and Limbu (2008) on indigenous knowledge, skill and practices of Kirata, (one of the ethnic groups in Nepal) with a special focus on biological resources also mentions IK as any knowledge produced by and/or distinctive to a particular cultural group or any loosely defined group of resource users in a given area. It is usually produced informally by only people actually practicing a skill or working directly with a resource, as opposed to paid knowledge professionals.

Newars is one of the indigenous nationalities of Nepal with the Kathmandu Valley as their ancestral domain making the majority of population even today. According to 1952-54 Census, the total population of Newars in Nepal was 0.383 million, out of which 0.226 million used to live in the Kathmandu Valley, constituting about 59% Newars population (Nepali, 1988).

This ethnic group is rich in its indigenous knowledge and practices. It has the unique socio-economic organization in the

form of *Guthi.* There are mainly of three types of *Guthi* - religious, public service and social works. It is a kind of "common trust", consisting of cultivated lands as assets (Bista, 2000). *The Newar Guthi* is a social institution that has its own specific characteristics (Toffin, 2007). In fact, *Guthi* binds Newars together at different levels of caste, patrilineal grouping, and territory (Nepali, 1988). *Guthi* has also constructed several stone spouts, commonly called *loan hiti* in Newar language. Stone spouts and dug wells are main water sources used by Newars in the valley to meet their water demand (UN HABITAT, 2008).

1.2 Climate change

Climate science was not invented or developed overnight. Research studies have demonstrated that there has been evidence of changes in the climatic conditions over the time. IPCC (2011) defines climate change as a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It elaborates that climate change may be due to natural internal processes or external forces, such as variation of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use. Likewise, UNFCCC (1992) describes climate change as changes because of direct or indirect human interventions that alter the composition of the global atmosphere and also the natural climate variability observed over comparable time periods. The UNFCCC (1992) has established a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural process over the time period.

As per scientific studies, global warming is an increase in the concentration of Greenhouse Gases (GHGs) due to human-led activities, resulting to an increase in the average global temperatures, and contributing to the climate change. Climate Change and Global Warming Introduction (2013) mentions that climate change has a high potential to increase the intensity of extreme weather, rising sea levels, storms, floods, landslides, droughts. A similar scenario is expected in Nepal as well. MoSTE (2015a) emphasizes on more extreme rainfall and devastating floods in recent decades. Devkota (2014) found the similar climatic trends in their studies. MoSTE (2015a) also reinforced on the contribution of indigenous knowledge and practices of local communities to adapt to the climate change risks.

Most likely, the climatic variations have been continued since the evolution of the earth and people have been trying in a traditional ways to adapt to those climatic variations, undoubtedly applying their indigenous knowledge and practices. As substantiated by a number of researchers, providing a strong basis that indigenous knowledge and practices have played a vital role in adapting to the climatic variations as well as to increase their resilience towards the climatic changes. Perhaps, the understanding of those climatic variations was not the same as that of the recent scientific understanding or definition of climate change, a change in the chemistry of the climate due to anthropogenic emissions of Greenhouse Gases (GHGs).

Nepal has been identified as one of the most vulnerable countries to the impacts of climate change. The emission share of Nepal is only 0.025% in the total global emissions (IUCN, 2013). However, a global ranking of climate vulnerability and impacts of 170 countries over the next 30 years, positions Nepal as the 4th most vulnerable country (Maplecroft, 2011). The impacts of climate change have been evident in the various sectors affecting to people's livelihoods, and water resources are one of them. Jha (2012) stresses that climate change has already been observed in Nepal, and its impact could affect the water supply. Most of the rivers in Nepal, providing water to millions of people, originate from the mountains. However, climate change has caused a reduction in water flows in some of the rivers, resulting in water scarcity in both urban and rural areas, further stressing that water security in Nepal has witnessed an unprecedented increase in the number of natural and climate induced disasters. In many cases, the communities have adapted the situation utilizing indigenous knowledge and practices by changing management practices.

2. Knowledge gap

Indigenous knowledge and practices are invaluable resources for the best use of natural resources. However, in Nepal, there are limited studies and documentation of indigenous knowledge and issues in its national policies, often neglected and forgotten in the planning process. Negligible efforts are made by the government in systematic understanding and documentation of such invaluable knowledge and practices (Sharma, Bajracharya and Situala, 2009). There is a consensus that climate change is one of the most critical challenges. Researchers have also mentioned that indigenous knowledge and practices based climate change adaptation practices are expected to be more effective to help people and manage the impacts of climate change. It is also claimed that indigenous knowledge has been instrumental in coping with the climatic variations. In Nepal, the communities have been dealing with natural climatic variability and other stresses by innovating, enriching and improving IK and skills for centuries by succeeding generations. In that sense, it is being tested through local ways of experimentations based on the local needs and priorities (MoSTE, 2015a).

In recent years, there are arguments that IK is an effective means to cope with the impact of climate change. Nyong & Osman

(2007) emphasize the need to integrate IK into mitigation and adaptation policies, whilst examining adaptation strategy to combat adverse impact of climate variability in African Sahel. IPCC (2011) states that "incorporating indigenous knowledge into climate-change policy can lead to the development of effective adaptation strategies that are cost effective, participatory and sustainable". Indigenous knowledge can involve an awareness of stewardship of water resources, and also contribute to conservation and sustainable use of resources (Alexander et al., 2011).

Sharma, Bajracharya and Situala (2009) highlight that communities survived in the past under extreme conditions based on their indigenous knowledge and practices. Despite its importance, indigenous knowledge and practices are often neglected and considered as unscientific. In particular to Nepal, there are limited researches and studies about indigenous knowledge and practices with reference to climate change impact on water resources (Sharma, Bajracharya and Situala, 2009). The rapid development and intensive urbanization are the powerful forces for destroying old socio-economic bases and indigenous knowledge and practices (UN HABITAT, 2008). Many of traditional water sources are dried up and reduced the water flow due to the lack of attention on the conservation of indigenous knowledge and practices.

3. Research Objective

This paper examines indigenous knowledge, climate change and traditional water resource management, with a focus on stone spouts, which have been practiced over many centuries in the Kathmandu Valley of Nepal.

4. Literature Review

4.1 Indigenous knowledge

Knowledge, in general, can be defined as knowing and understanding something that can be taught, learnt, and shared (Gupta, 2011). It is a relationship between cause and effect that is dynamic and contextual. IK is also dynamic in nature and exists in a local context, anchored to a particular community in a particular location and time (Grenier, 1998; Mercer et al., 2009). New knowledge is continuously added to indigenous knowledge, which, in general, is influenced by internal creativity, experimentation, and external contact, to fit the local conditions through innovation, internalization, use and adaptation to external knowledge (Grenier, 2009; Mercer et al., 2009). Indigenous knowledge is often concrete (real), not necessarily be as abstract (theoretical) as scientific knowledge (Gupta, 2011). Nakashima et al. (2012) refers indigenous or traditional knowledge as knowledge and know-how accumulated across generations, and renewed by each new generation, which guide human societies in their innumerable interactions with their surrounding environment. There is an abundance of labels for indigenous knowledge co-exist in the literature, however the terms appear common but are not limited to indigenous knowledge, traditional knowledge, traditional ecological knowledge (TEK), local knowledge, farmers' knowledge, folk knowledge and indigenous science, hence used the terms traditional, indigenous or local knowledge interchangeably throughout the report for the sake of simplicity.

Various theorists, researchers and organizations define IK in a number of ways. It is unique traditional, and local specific that exists within and around the specific conditions of indigenous peoples to a particular geographic area. Ajibade (2003), quoted in IPCC (2011), IK as a term to describe the knowledge systems developed by a community as opposed to the scientific knowledge/ modern knowledge. Mugabe (1999) & Mercer et al. (2009) found IK in several names, such as, folk knowledge, traditional knowledge, local knowledge, Indigenous Technical Knowledge (ITK), Traditional Environmental/Ecological Knowledge (TEK), etc., Indigenous knowledge has acquired extensive attention in international events and fora, however, universally accepted definition has not been concluded yet, despite numbers of attempts defining them (Mugabe, 1999). Many kinds of literature explicitly define IK as a knowledge practiced by the indigenous peoples or communities (Sharma, Bajracharya and Sitaula, 2009; Magar 2007; Maden, Kongren and Limbu 2008). It is also termed to Traditional Knowledge (TK), referring to indigenous peoples' knowledge, innovations and practices, which are applied either in a traditional form or modified form, blended with modern technologies, having potential to assist in addressing vulnerabilities (McLean, 2010). Traditional Knowledge (TK) is knowledge, know-how, skills and practices that are developed, sustained and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity (WIPO, 2010). IK is a knowledge that an indigenous or local community accumulates over generations of living in a particular environment (Anyira, Onoriode and Nwabueze, 2010).

Many theorists and researchers', various international organizations have also attempted to define IK as per their understanding, which again is not consistent. UNESCO (2016) defines local and indigenous knowledge as understandings, skills and philosophies developed by societies, which has a long history of interaction with their natural environment, and form an integral part of their cultural diversity. The World Bank (2013) states IK as a local knowledge, unique to every culture or society, and provides a basis for local-level decision making in a number of sectors such as agriculture, health care, food preparation,

education, natural-resource management, etc. as well as problem solving strategies for communities.

Nevertheless, it is found that abovementioned definitions of IK are not homogeneous. These definitions give enough space to argue that the definition of IK is not confined to a particular set of knowledge or theory, similar to that of generated by scientific study or research. TK is even not uniform within small communities (Alexander et al., 2011). Mugabe (1999) underscores that TK and IK have been defined by different authors depending on their intellectual persuasion and professional interest, and used as interchangeable concepts. Maden, Kongren and Limbu (2008) define IK against TK and highlight that although the concepts of IK are used synonymous to TK, both these terms are distinctively different. There is no single definition for indigenous peoples, which is highly diverse group, living in all regions of the world and occupying or using natural resources on some 22% of the global land area (Nakashima et al., 2012).

IK is found to be changing as per time and circumstances, most likely in progressive ways, adapting or adjusting the local environment and context. IK changes as per the changing needs of peoples (Agrawal, 2014). An understanding of IK may not necessarily be limited to a knowledge that has been used for many years. Evidences show that IK has been improved or blended with new or modern technologies and being continued. As time progresses, the IK has been blended with modern knowledge and technologies as well, for efficiency improvement and cost effectiveness (Lwogi, Ngulube and Sitwell, 2010). Traditional knowledge systems and blending them with modern technology enhanced the ecological sustainability of the results, leading to production increase, better-quality and new products, underscoring that soil and water conservation played an instrumental role to boost the productivity and enhance the resilience of the concerned indigenous communities (IFAD, 2003).

In summary, IK differs according to their existence and as practiced by a community of a particular settlement and portrayed by the theorists, and authors. In fact, many authors have described IK based on their individual observation, empirical evidence, literature reviews, facts, experiences, interviews, discussion and so on, to address their research question from the particular study area(s).

The review of the above-mentioned literature provides sufficient ground to argue that the definition of the IK does not vary according to the time and place. In general, it can be understood that the definition of IK remains same globally, although the understanding and interpretation can be different on a case-by-case basis. Therefore, the definition of IK cannot be different for Nepal. As mentioned by various authors, there are equal chances that a particular IK has been improved or blended with modern technologies over the years and is continued. The statements cannot be ascertained until it is verified through observation and empirical evidence from the particular study area. Also, it is necessary to examine how the particular knowledge has been continued or transmitted in that particular area for many years.

4.2 Indigenous knowledge and water resource management systems

Newars are the indigenous nationalities rich cultural heritage, festivals, rituals, costumes, lifestyles and associated indigenous knowledge and are the foremost holders of the local indigenous knowledge about the traditional water systems. Sharma, Bajracharya and Sitaula (2009) have reviewed indigenous knowledge in Nepal, and water resources management practices was one of them, highlight significant contribution of indigenous knowledge largely by women to climate change adaptation as well as importance of indigenous knowledge, and opined that neglecting IK on the basis of lacking explanation is not justified since local knowledge of farmers, in the past, have helped them to survive under extreme conditions. They have also listed some of the beliefs in practice – should not cut trees surrounding the source of water and should not throw litter around the water shade. Further, they have indicated that unpleasant incident might occur to those, who fail to obey those beliefs, which seems helpful to conserve or protect water sources.

UN HABITAT (2008) mentions that Newars of the valley have very good skills of managing historical water supply systems, and has listed traditional water management system in Lalitpur. It highlights five components of traditional water systems, grouping into two major components - directly and indirectly associated, stone spouts falls under directly associated component, which is a downstream components, surface or sub-surface structure bringing water to the spout and waste water drainage allowing the utilisation of the resource. Ranjitkar (2013) highlights the importance of celebrating *Sithi Nakha* on the bright fortnight of May-June to clear all water sources such as wells, stone spouts, ponds and springs. It is the driest day of the year and that's the reason of cleaning water sources on that day as the water level goes down to the minimum.

Further, Newars believe that during *Sithi Nakha* period, *Nagas (Serpents)*, the rulers of water sources, leave the water sources for other destinations because of the low level of water until the monsoon rains start. Thus, Newars clean all sorts of water sources in absence of *Nagas* (Ranjitkar, 2013). Superstitions and beliefs were used for the management and regulations of stone spouts. This local belief of *Nagas* and deities related to stone spout are linked to the cleaning and management, and people have a strong belief on the possible mishaps by the furious deities when their habitat is damaged, and even opening and cleaning water conveyance channels. Therefore offering *Puja* to *Nagas*, cleaning the complex and opening the drain are the measures, which are

taken when people get sick (UN HABITAT, 2008). This cleaning up of wells, ponds and stone spouts by Newars on a particular day has great importance both culturally and environmentally in the community. In recent years, it is observed that environment advocates have also realized that the festival links with indigenous knowledge, social and environmental awareness issues.

Guthis were formed for the management of the overall water supply system and their maintenance, in fact, cleaning of traditional water sources, especially on the *Sithi Nakha* festival every year (ICIMOD, 2007; UN HABITAT, 2008; Shrestha, 2009). The management is formed primarily by the founders or designated to a particular group. However, the maintenance of stone spouts was not limited to the *Guthis* only, but the whole neighbourhood used to be mobilized, in order to participate in the water supply system cleaning initiatives. Different auspicious days were selected for the *Puja* and maintenance of stone spouts by the *Guthis*. For example: *Yenya Punhi* (the full moon in September) and *Khai Sahnu* (New year day of *Bikarm Sambat*), *Nag Panchami* (5^{th} day of the new moon in August), *Fagu Punhi* (full moon in March), *Karunamaya atra* day, *Disi Charhe* (the day before full moon in January) are some of the days selected to perform *Puja* in various stone spout by the respective *Guthis* (UN HABITAT, 2008). However, this knowledge and practice of cleaning water sources even on the occasion of *Sithi Nakha* are disappearing. Many young generations are unaware of the importance of cleaning water sources on *Sithi Nakha*. It appears difficult to continue celebrating the *Sithi Nakha* as in the past due to modernization of the society and culture. Manandhar (2011) mentions that the essence of these festivals among the Newar community is being gradually deteriorating, and there are visible shreds of evidence of drying up of water resources.

4.3 Indigenous knowledge and climate change

Indigenous knowledge has been already recognized in the various fields, such as agroforestry, traditional medicine, biodiversity, resource management, impact assessment and natural disaster preparedness and response, however emerging area of interest for climate scientists, although the exchange of knowledge between scientists and indigenous peoples dates back to the very origins of science (Nakashima et al., 2012). Jha & Shrestha (2013) have analyzed water supply situation of the Kathmandu Valley, facing acute water supply problems, highlighting that urban population is relying heavily on water supply by water tanker and bottled water that comes from ground water resources and other sources far from the city, stressing on climate change impacts to have affected these sources. The paper also analyzes the adaptive capacity of local authorities of Kathmandu to cope with the impacts of climate change on drinking water supply. However, the paper does not highlight clearly what are other sources, linking with indigenous knowledge and practices. Most importantly, the paper has not examined the indigenous knowledge and practices of water use, and its potential, in particular, stone spouts, which are still playing a major role in contributing to meet water demand in the Kathmandu Valley.

Climate variability and climate change trend remains highly uncertain (Jha & Shrestha, 2013). IPCC (2007) states that water supply is expected to decrease due to the increase in variability of precipitation, decrease in snowfall, rapid melting of glaciers in the long run and reduced groundwater recharge, and the situation is expected to worsen worldwide, to be seen as a impact of climate change, which ultimately will reduce the water supply and increase water demand. Adger (2003) quoted in Jha and Shrestha (2013) states from the research findings that societies have been adapting to a changing climate in the past, and the process will continue in future due to their natural capacity to adapt to climate change. Traditional institutions such as *Guthi* have played a significant role in enforcing water resource management practices, with reference to the Kathmandu Valley of Nepal (MoEST, 2015a).

4.4 Impact of climate change on water sources

It is clearly observed that water resources in the valley have been drying up over the years, not only the traditional resources such as stone spouts, wells and ponds, but also the rivers and streams. The areas that used to have water availability for twenty-four hours, also have faced the water scarcity nowadays. For instance, some parts of Kirtipur Municipality, especially the southern parts, were known for 24 hours water availability, but nowadays, the communities have already faced the water scarcity in those areas as well. There are many areas in the Municipality, which lack drinking water (Dahal, 2009). The situation in Kathmandu, Lalitpur and Bhaktapur is even getting worst. Many factors contribute to this problem such as difficult terrain, lack of insufficient capacity of water storage and less rainfall to recharge the ground water that is the cause of drying wells and ponds (Dahal, 2009).

Figure 1 and Figure 2, assist in explaining climatic variations in the Kathmandu Valley over the last 37 years. Figure 1 shows yearly average temperature trend of the Kathmandu Valley from 1978 to 2015. The average temperature has increased with a coefficient of 0.051 and R^2 value of 0.58, indicating that the average temperature of the Kathmandu Valley has increased significantly compared to the global average temperature trend. The Figure shows that maximum temperature is increasing with a coefficient of 0.056 and R^2 value of 0.66. Similarly, minimum temperature is seen increasing with a coefficient of 0.048 and R^2 value of 0.33, indicating that there is an increase in extreme weather pattern, day-time temperature is increasing significantly[1].

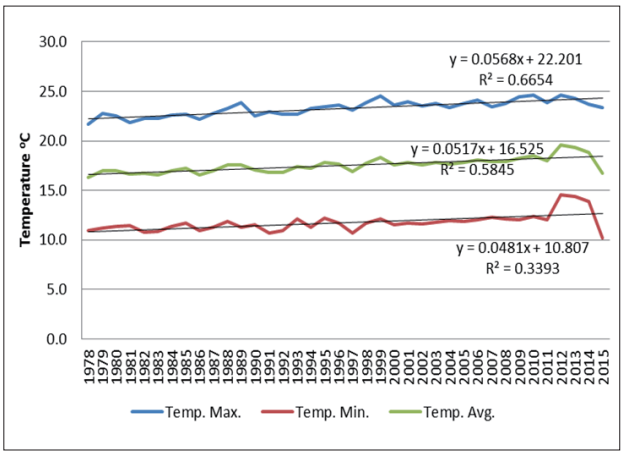

Figure 1. Temperature trend of the Kathmandu Valley (1978-2015)

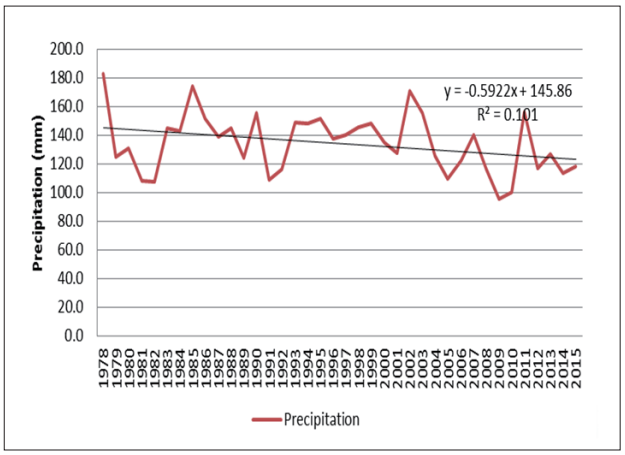

Figure 2. Precipitation trend of the Kathmandu Valley (1978-2015)

Similarly, Figure 2 shows a precipitation trend of the Kathmandu Valley from 1978 to 2015, which is not significant. The trend shows that it is erratic in nature and seen decreasing though not significant trend with a coefficient of -0.59 and R^2 value of 0.101, indicating that weather of the Kathmandu Valley is becoming more extreme in nature, i.e. some periods with heavy rainfall whilst some periods without rainfall, very dry in nature. The rising temperature and decreasing precipitation as seen in both Figures 1 and 2, demonstrate that there is a possibility of affecting water sources and their natural recharge process in the Kathmandu Valley. Besides increasing temperature and decreasing precipitation, the study conducted by the MoSTE (2015b) highlights the drying of sources and loss of water conduits recently because of increasing population and changing lifestyles.

Local people believe that drying of water sources is because of lack of water recharges from rainwater and other water sources. Although, communities have restored some stone spouts and established or reformed water management committees to operate and maintain them but still the water supply is not as it used to be in the past, which is mainly due to less water at the source. It is evident that Newars have been managing the traditional water conveyance and resources through the use of indigenous knowledge and skills for generations. They were efficient in recharging the local aquifers through conveyance canals from ponds popularly known as *Dey dhah or Raj kulo* with the system of natural filters. This system and architecture of water management show the indigenous knowledge of Newars in the Kathmandu Valley (MoSTE, 2015b).

5. Conclusion

The water sources are drying up and ground water level has gone down to the bottom without recharging the aquifers because of the change in temperature and precipitation patterns. In addition, rapid urbanization and climate change impacts have severely impacted the water resources and associated indigenous knowledge. Indigenous knowledge provides a better understanding of a deep and long established relationship between local people, water resources and climate change. It offers a potential to combine with scientific knowledge, and new ways of engaging local communities in response to climate change. Nepal's rich indigenous knowledge and practices are endangered because of rapid urbanization and population growth. Moreover, indigenous knowledge and practices with reference to water resources management in the Kathmandu Valley have not been documented properly. As a result, indigenous knowledge and practices are deteriorating or disappearing over the years. It is necessary to put more effort collecting and disseminating indigenous knowledge and practices, in relation to water resource management, as water resources are one of the highly vulnerable sectors of climate change impacts.

In view of the climate change adaptation activities in the Kathmandu Valley, which has an enormous amount of traditional water resources has a lot of potential to meet water demand of people in the valley hence needs conservation efforts. In absence of timely action, there is a high risk of disappearance these indigenous knowledge and practices, which could play an instrumental role towards the climate change adaptation practices. Therefore, documentation and dissemination of these indigenous knowledge and practices, managing traditional water resources are urgent and necessary to avoid the risk of vanishing forever.

Endnote

[1] faster than night time temperature

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