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From the Editor

In the recent entrance examination held at *nec*, the students were asked to write a short essay on whether they felt it was preferable to promote Bachelor of Engineering programs at the cost of polytechnic education (Diploma programs). The subject seemed innocuous enough. However, while scrutinizing their answer books, it became quite apparent that the subject had much more gravity than previously thought. The majority of the students could not even differentiate between the two programs, let alone comprehend the relevance of these programs in the national context. Their answers invariably were arguments in support of lowering the cost of engineering education to make it more affordable for the general public. Some were even pleading with *nec* to lower its fees by half.

Looking at the national scenario of the engineering profession in Nepal, it seems rather ironic that while engineers are finding it more and more difficult to get employment, much of the country does not have adequate manpower to implement even the simplest of engineering projects. This situation has arisen mainly because the engineering graduates are reluctant to leave the cities while much of the works being implemented in the rural areas do not really require high levels of technical expertise. For engineers to work in the rural areas looks almost like a situation of overkill.

The diploma programs were specifically designed to address this issue. The programs are of shorter duration, less expensive and of lower technical level. More people, hopefully many from the non-urban areas, were expected to take up these studies and fill this void of technical skill in the rural areas of Nepal. The Institute of Engineering initially had only Diploma level programs and its graduates could be found all over the country. Today it still runs Diploma level programs but the demand is dwindling. Most of the private institutes today offer only Bachelor level programs and their graduates are really not expected to bridge the divide between the urban and rural areas. The country requires greater number of overseer level manpower but for some strange reason, the current educational market seems to indicate otherwise. Hopefully, the free market economy will automatically correct this anomaly in the near future.

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FACTORS AFFECTING VARIATIONS IN CHEMICAL CONCENTRATIONS IN MANOHARA RIVER

Hari K. Shrestha*

ABSTRACT

A study on the factors affecting variations of chemical concentrations in Manohara River at Changunarayan VDC was made. The concentration of various environmentally sensitive agricultural chemicals were assessed all through a year, and correlated to the application of organic and chemical fertilizers. The effects of variations in river discharge were accounted for. The study found that the variations in the concentrations of ammonia and nitrate/nitrite in the samples of river water were mainly affected by (a) time difference between the application of the fertilizers and the sampling date, (b) the variations in river discharge, and (c) the mobility of chemicals in groundwater environment.

1.0 Introduction

The pollution of natural resources, including river water, comes from two types of sources (a) point pollution and (b) non-point pollution. The source of point pollution is readily identifiable such as drain outlets of industries or a sewage treatment plant. The non-point pollution comes from many different sources. Rainfall or snowmelt moving over and through the ground causes non-point pollution. The types of pollutants from non-point pollution include excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas (USEPA, 1994).

In the Nepalese context, and specifically in the context of the study area, the only source of non-point pollution is the effluent from agricultural fields. The study area lies in a rural setting; there are no industries and construction activities are negligible. So, this research focused primarily on the factors affecting the changes in the concentration of the chemicals related to the fertilizers in the water of Manohara River.

1.1 Trend Shown by Recent Studies

Several recent studies have found an elevated level of chemicals normally associated with non-point pollution sources in the river water and groundwater of Nepal. In some water samples taken from Bagmati and Bishnumati rivers in Kathmandu, the estimated daily load of $\text{NH}_4\text{-N}$, $\text{NO}_3\text{-N}$ and $\text{PO}_4\text{-P}$ were found to be 5612, 512, and 679 kg d^{-1} , respectively (Shakya, 2001). In a 3-years long water quality study of various rivers of Kathmandu Valley, the Department of Hydrology and Meteorology found all the rivers in its studies as severely polluted and concluded that the degree of river pollution is beyond the biodegradation capacity to clean (DHM, 1996). The water quality studies of rivers in other parts of the globe have indicated a consistent rising trend of agricultural chemicals.

Researchers in their examination of the relation between use of fertilizers and nitrate have found an excessive increase in nitrate concentration in groundwater due to intensive use of fertilizers (Gunatilake, 1999).

1.2 Chemicals of Concern

The farmers in Nepal use domestically produced organic fertilizers (animal and human waste

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mixed with vegetation compost) to augment chemical (inorganic) fertilizers. The organic fertilizers contain organic nitrogen. The process of conversion of organic nitrogen to NH_4^- is known as ammonification. Through the process of nitrification, NH_4^+ is converted to NO_3^- by oxidation. Ammonification and nitrification normally occur where organic matter and oxygen are abundant (Freeze and Cherry, 1979). Nitrite is not normally found in unpolluted water. Nitrite in river water is more an indication of fecal pollution. It is a strong fish poison.

Nitrate (NO_3^-) occurs naturally and is also manufactured as a component of fertilizer. Nitrite (NO_2^-) is a less stable salt and will generally become nitrate in fairly short time. Once in the soil, nitrate can contaminate surface and groundwater and eventually reach humans or animals through various pathways. Although nitrate itself is not toxic, the conversion of nitrate to nitrite is of concern for health reasons. In the relatively high-pH (5-7) environment of the stomach in a human infant, bacteria are present that can reduce nitrate to nitrite. This nitrite can oxidize the iron (II) in hemoglobin to iron (III), resulting in the formation of methemoglobin, which binds oxygen less effectively than normal hemoglobin. The subsequent decreases in blood oxygen levels can lead to shortness of breath, diarrhea, vomiting, and even death in young children. (Hage, et al, 1998). The United States Environmental Protection Agency warns that having nitrate in excess of 10 mg/L or nitrite in excess of 1 mg/L in the drinking water may cause methemoglobinemia (blue baby syndrome).

Ammonia can exist as ammonium (NH_4^+) or as ammonia (NH_3), depending only on pH. In groundwater and soils, it is mostly in the form of ammonium. It is very soluble in water. It is toxic to aquatic organisms even in low concentration; however, the toxic levels are both pH and temperature dependent. Ammonia is a very unstable compound. It quickly becomes nitrite and then nitrate. If it is found in nature, it is most often found as the result of decay of organic matter. One of the main causes of presence of ammonia in Nepalese rivers is the application of human, bird and animal waste as part of fertilizers. The World Health Organization standard for the concentration limit of ammonia is 1.5 mg/L for drinking purpose.

Phosphate in natural water is almost non-existent (up to 0.1 mg/L); it occurs in natural water and wastewater almost solely as phosphates. It is an indicator for pollution with sewage, detergents, fertilizers and human and animal waste. Phosphorus is not a harmful constituent in drinking water. Phosphates may enter water from agricultural run-off and as biological and industrial waste. They may be added to water in municipal and industrial water treatment processes to control corrosion. A certain amount of phosphate is essential for most plants and animals, but too much phosphate in fresh water bodies like streams and lakes can contribute to eutrophication especially when large amounts of nitrogen are also present. Eutrophication causes the oxygen content in water to drop, causing negative impact on aquatic environment.

Therefore, this research focused on finding the factors affecting the variation in concentration of nitrate, nitrite, ammonia, and phosphorus in Manohara River. An attempt was made to associate the variations in chemical concentration with agricultural practices.

1.3 The Study Site

The site selected for this study was Manohara river section at Changunarayan VDC, Ward No. 9. This site lies at the border between the Changunarayan VDC and the Duwakot VDC in Bhaktapur District and directly across the Mulpani VDC of Kathmandu. Figure 1 is a rough sketch of the location of the study site. The watershed of the Manohara River upstream of the proposed study site is relatively underdeveloped and hence there is little industrial pollution in this river upstream of the proposed study site. The population density is also thin. From the beginning of the Spring season until April or May, the river essentially flows clean at the

study site. After the commencement of the rice plantation season, the river water becomes very turbid, and the concentration of various environmentally sensitive chemicals in the river suddenly begins to rise.

2.0 Methodology

2.1 Hydrological Data Collection

The primary hydrological data required for the study of non-point pollution of a river are the river stage and discharge. To obtain these data, a hydrological data collection station was established at the left bank of Manohara River. The river stage data were obtained by manually monitoring the river stage two to three times a day.

Periodic discharge measurements on Manohara River were conducted using the Price-type AA vertical-axis current meters (Teledyne Gurley, Model No. 622). The one-point wading method of discharge measurement was used. The number of revolutions of the cups of the current meter were converted to the point velocity (V_i) of the subsection using the following (current meter calibration) relations.

$$V = 0.6671 n + 0.01168 \quad 0.0 < n < 1.0$$

$$V = 0.6787 n - 0.00031 \quad 1.0 < n < 2.0$$

$$V = 0.6764 n + 0.00519 \quad n > 2.0$$

where, n = number of revolutions / time, and V = water velocity (m/sec)

The area (A_i) of each subsection was obtained using Trapezoidal method. The velocity-area method ($Q_i = V_i \times A_i$) was used to calculate the river discharge of each subsection. The sum of the discharge from each subsection provided the total discharge of the river.

2.2 Sampling and Chemical Analysis of Water

Water quality data were obtained by sampling the river water on seasonal basis. The timing of the water sample collection was based on the changes in agricultural activity and its expected impact on the river water. The standard procedures, as mentioned in the book Standard Methods for the Examination of Water and Waste Water, for water sampling and water quality analysis were followed to find the concentration of chemicals associated with effluents from agricultural fields.

2.3 Agricultural Data Collection

Data on agricultural practices at the study area were collected by field visits and interviews. Several field visits were made to observe the application of chemical and organic fertilizers. The chemical fertilizers are applied during or immediately after the plantation. The types of agricultural data collected consisted of approximate date of application of fertilizers and type of fertilizers (organic and chemical). The farmers do not follow any guidelines or standards during fertilizer application. Each farmer's experience was the only guide in timing, type, and amount of fertilizer to be applied. Even in the chemical fertilizers, various brands of chemical fertilizers were mixed, depending upon availability and price. The approximate quantity of the chemical fertilizers, rather than their chemical contents, mattered to the farmers more.

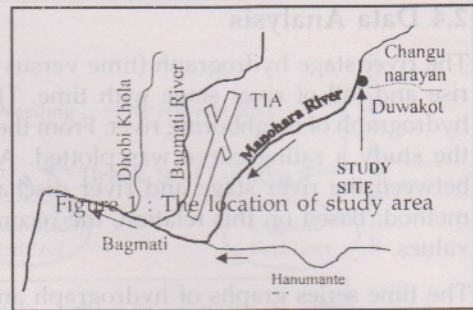


Figure 1: The location of study area

2.4 Data Analysis

The river stage hydrograph (time versus river stage) was plotted to observe the trend of the rise and fall of river stage with time. The river stage hydrograph was compared with the hydrograph of neighboring river. From the periodic discharge measurements conducted during the study a rating curve was plotted. A best fit relation in the form of a power equation between the river stage and river discharge was obtained by using the least squared error method. Based on this relation, the recorded stage data were converted into daily discharge values.

The time series graphs of hydrograph and chemical concentration were plotted. The plot of the application of organic and chemical fertilizers versus time was superimposed on the other time series plot. Based on these plots, the qualitative relation among agricultural practices, and changes in river discharge and concentration of fertilizer related chemicals in the river immediately downstream of the agricultural fields at Manohara River was assessed.

3.0 Results and Discussions

3.1 Agricultural Practices on the Banks of Manohara River

There are mainly three agricultural patterns in the fields at study area, namely (a) Rice-Wheat-Rice Cycle (figure 2), (b) Rice – Potato – Potato – Rice Cycle (figure 3), and (c) Rice – Potato – Tomato – Rice Cycle (figure 3). For all three cycles, farmers apply organic fertilizers two to

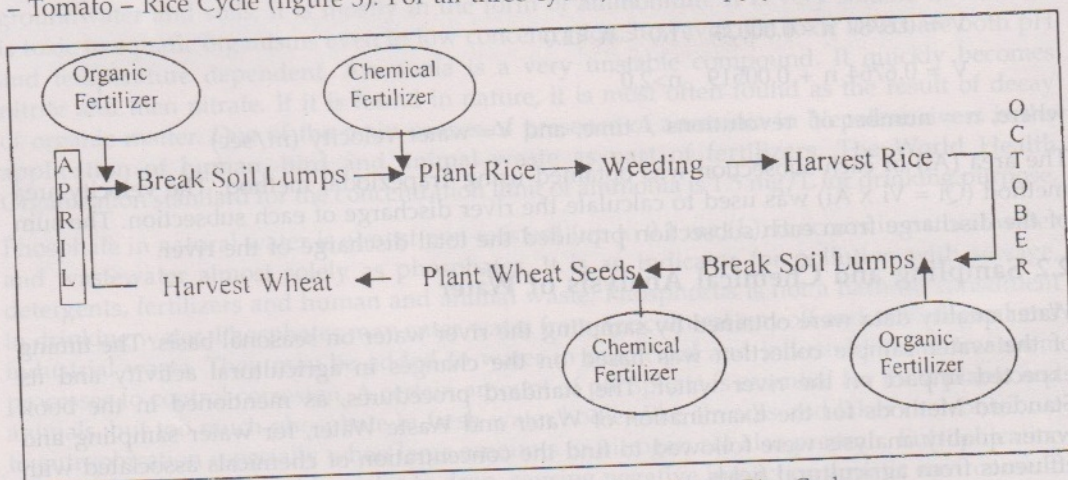


Figure 2: Agricultural Activities of Rice-Wheat-Rice Cycle

four weeks before the plantation. The chemical fertilizers are applied during or immediately after plantation. This practice makes sense because organic fertilizers release nutrient at relatively slower rate (Osmond, 2004). For rice plantation, the average amount of organic and chemical fertilizers applied per ropani (about 0.05 hectare) is 300-kg and 10-kg, respectively. For potato and tomato plantation the amount of chemical fertilizers applied is up to 50% higher compared to the amount used for rice. The farmers use various brands of pesticides during the growing season of potato and tomato. The use of pesticides for rice and wheat were not observed.

The data on exact type and quantity of fertilizer application could not be determined. The organic fertilizers contain various animal wastes (mainly cattle dung), straw, leaves, and other household organic wastes. Human wastes were also used as organic fertilizers for potato plants. The proportion of the mix varied in every farmer family. Several other researchers have

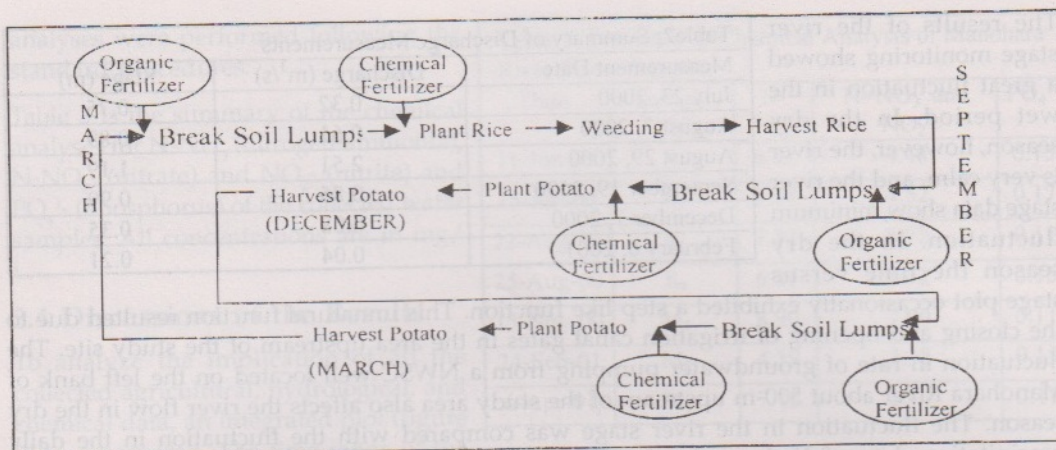


Figure 3: Agricultural Activities of Rice-Potato/Tomato-Potato-Rice Cycle

faced similar problem when dealing with organic fertilizers. For example, Barton (1995) writes that the content of available nitrogen and other nutrients in organic fertilizers is often unknown and the level of nutrient in unprocessed organic materials, bulk sources or organic material produced at home is anyone's guess. Also, the chemical fertilizers are not weighed before application. Farmers use their experience from previous years to increase or reduce the amount of fertilizers to be applied; however, they mix the units of measurements. Sometimes they use the kilogram and sometimes they use the Pathi (a local volume unit). Further, the kilogram and Pathi are not actually measured, it is only guessed. Many farmers also mix various brands of chemical fertilizers without any consideration for their chemical contents. The price and availability, rather than its chemical content, determined the use of chemical fertilizers. This created a lack of reliable data on the chemistry of fertilizers. Hence, quantitative analysis between the amount and type of fertilizers and change in chemical concentration of various chemicals in the river water was not carried out.

The summary of the approximate time of application of organic and chemical fertilizers in one-year duration of the study period, for all three cycles, is given in table 1. The Cycle (a) applies the organic and chemical fertilizers twice a year while the Cycles (b) and (c) apply these fertilizers three times a year.

3.2 Hydrology of Manohara River

The Manohara River is a meandering river with very high sinuosity. It has a history of changing its river course. A study found that this river shifted 200-m in 16 (from 1971 to 1987) years at Koteshor area of Kathmandu (WECS, 1988). The bed and bank materials consist of essentially alluvial deposit of fine to coarse silty-sand. The Manohara valley itself consists of loose sandy alluvial deposits. Most of the bed materials consist of eroded bank materials. The catchment area of Manohara at the study site is 35 km². The approximate bed slope of Manohara River is 2.5 m/Km. Due to the recent activities of sand mining from the Manohara River, however, the rate of degradation is accelerating.

Table 1: Approximate Time of Fertilizer Application

Cycle (a)		Cycle (b) and (c)
Month	Type of Fertilizers Applied	Month
March	Organic	April
June	Chemical	May
October	Organic	August
November	Chemical	September
	Organic	December
	Chemical	January

The results of the river stage monitoring showed a great fluctuation in the wet period. In the dry season, however, the river is very calm, and the river stage data show minimum fluctuation. In the dry season the time versus

Table 2: Summary of Discharge Measurements

Measurement Date	Discharge (m^3/s)	Stage (m)
July 23, 2000	0.32	0.75
August 7, 2000	0.61	0.89
August 29, 2000	2.51	1.19
September 19, 2000	0.85	0.99
December 7, 2000	0.08	0.35
February 6, 2001	0.04	0.21

stage plot occasionally exhibited a step like function. This unnatural function resulted due to the closing and opening of irrigation canal gates in the area upstream of the study site. The fluctuation in rate of groundwater pumping from a NWSC well located on the left bank of Manohara River about 500-m upstream of the study area also affects the river flow in the dry season. The fluctuation in the river stage was compared with the fluctuation in the daily precipitation data of Kathmandu at Tribhuvan International Airport (TIA), Station Index Number 1030, collected by the Department of Hydrology and Meteorology. The results show that the stage data of Manohara River is consistent with the related data.

The results of the discharge measurements of Manohara River showed a wide range of discharge value between its low and high flow. The lowest recorded discharge value was $0.04 \text{ m}^3/\text{s}$, while the highest value was $2.51 \text{ m}^3/\text{s}$. The very low discharge value results from the fact that in the dry season all the river water is diverted to the agricultural fields. In fact, during the dry period, in some sections of the river, the whole riverbed looked dry on surface. However, a little digging on the surface revealed that the river is flowing underneath the sand surface. Table 2 is the summary of the discharge measurements at Manohara River conducted during the study.

The measured discharge values were plotted to obtain a rating curve (figure 4) of Manohara River at the study site. The best-fit relation between the river stage (S) and discharge (Q) was found to be or, taking natural logarithm on both sides, $S = 0.24 \ln Q + 0.99$. This relation, developed from limited data points, was assumed to hold good for all recorded range of stage data, and was used to convert the river stage data into river discharge data.

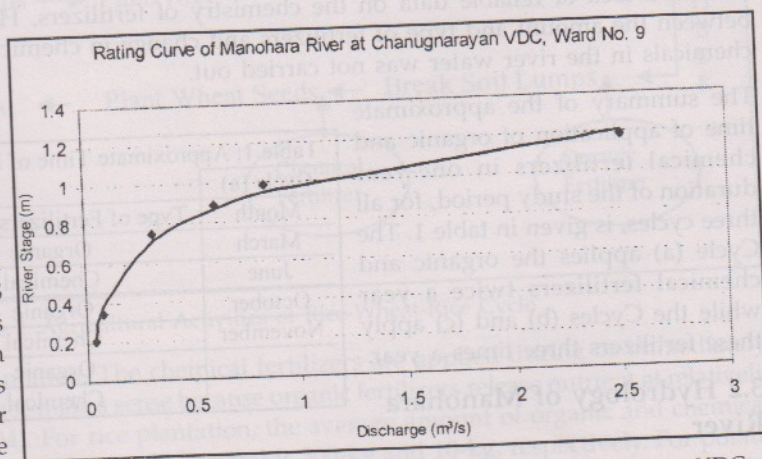


Figure 4: Rating Curve of Manohara River at Changunarayan VDC

3.3 Chemistry of Manohara River

Water samples were periodically collected during the study period. The study focused on three basic indicators of non-point pollution, the nitrogen ammonia, the total nitrogen (nitrate and nitrite) and phosphorus. A total of seven sets of water samples were collected. The chemical

analyses were performed following the standard procedures.

Table 3 is the summary of the chemical analyses for N-NH₃ (nitrogen-ammonia), N-NO₃⁻ (nitrate) and NO₂⁻ (nitrite) and PO₄³⁻ (Phosphorus) of the collected water samples. All concentrations are in mg/L.

3.4 Discussions of the Results

To analyze the implication of all the collected agricultural, hydrological, and chemical data, an integrated plot (figure 5) was prepared. The time range of the plot in x-axis begins from March 15, 2000 when the study started, to April 6, 2001 when the final river water sampling was conducted. However, no hydrological data exists for Manohara river at the study site before May 2, 2000. The reason for not sampling river water in the beginning period of the research was that no hydrological station was established at that time. So, the chemical concentration data could not have been associated with hydrological data.

The primary y-axis of figure 5 represents the discharge value (m³/sec) and the secondary y-axis represents the concentration of various chemicals (mg/L). The blank and filled squares plotted along the top grid line of the plot area indicate the approximate application time of organic and chemical fertilizers, respectively. This integrated plot facilitates analysis of all related agricultural, hydrological, and chemical parameters of the research by presenting them in one chart.

The figure 5 indicates several interesting phenomenon. The concentrations of the chemicals at Manohara River were different than initially expected; however, they made sense when all the parameters were considered. A weak link between the agricultural practices and the changes in the concentration of the chemicals was found. Any strong link, if there is, between the agricultural practices and the changes in the concentration of the selected parameters in river water, was dampened by the changes in river discharge. Further, the Kathmandu Valley experienced the highest recorded 24-hour rainfall in 2000. This type of intense rainfall and consequent rise in river discharge affects the concentration of chemicals in river water sample.

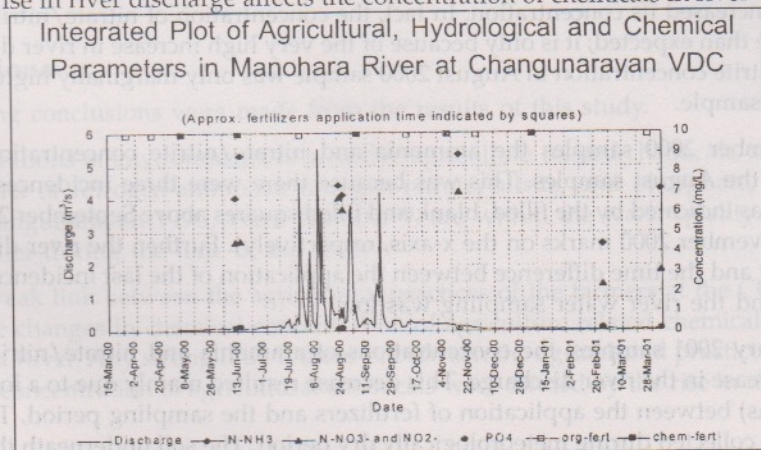


Figure 5: Integrated Plot of Agricultural, Hydrological and Chemical Parameters

Date	Sample No.	N- NH ₃	N- NO ₃ ⁻ and NO ₂ ⁻	PO ₄ ³⁻
11-Jun-00	S ₁	6.72	4.48	0.15
15-Jun-00	S ₂	8.84	4.52	0.17
22-Aug-00	S ₃	7.33	6.72	0.11
25-Aug-00	S ₄	6.85	6.12	0.15
15-Nov-00	M ₁	8.90	7.00	0.11
24-Feb-01	M ₂	4.39	2.38	0.15
6-Apr-01	M ₃	7.15	3.10	0.11

The concentrations of all the parameters in Manohara River during this study were within the normal values to be expected in a natural river system. The lower than expected nitrate/nitrite concentrations in Manohara river are due to the fact that rivers have a natural purification mechanism, which works through aeration of water, adsorption, decomposition by microbes, and absorption through plant roots. Thus, a considerable portion of nitrogen components is fixed in the river sediment or returned to the air. The vegetation on the riverbanks activates the microbes by supplying organic carbon, thus promoting the process of denitrification (Tanaka, 2002). Nitrogen components are transformed and are removed or reduced as they flow through the sediment (Montgomery et al., 1997).

Due to the lack of reliable data on the amount and type of chemicals of organic and chemical fertilizers the farmers use, the effects of agricultural activities in variations in chemical concentration was carried out only qualitatively. An observation of figure 5 shows that nitrate/nitrite concentrations in June 2000 were relatively high. This was because the application of the organic and chemical fertilizers preceded the sampling time, and the river discharge was relatively low. The farmers following Cycle (a) apply organic and chemical fertilizers in March and May, respectively, as indicated by the blank and filled squares (above the March 2000 and May 2000 mark on x-axis) in figure 5. Similarly, the farmers following Cycle (b) apply organic and chemical fertilizers in April and June, respectively, as shown by the blank and filled squares (above the April 2000 and June 2000 mark on x-axis) in figure 5. Since nitrate is a relatively fast traveler in the underground environment, the excess irrigation water quickly took it underneath the irrigation field and reached the river water quickly. Due to low discharge in the river, the concentration of nitrate in the June 2000 sample was relatively high. The relatively high concentration of ammonia in the same period was also due to agricultural and hydrological factors.

Between the June 2000 sampling and the August 2000 sampling, there is only one application of fertilizer, as indicated by the blank square above the July 2000 mark on the x-axis. In the August 2000 sample, there is a slight decrease in the ammonia concentration, despite application of organic fertilizer. This decrease in ammonia concentration is attributed to the rise in river discharge, only one application of the fertilizer, time difference between the application of fertilizers and sampling date, and the unstable nature of ammonia. However, the nitrate/nitrite concentration increased slightly compared to the June 2000 sample. The reason for this stability of concentration of nitrate/nitrite is that it comes out at a steady rate from the soils beneath the agricultural fields. Further, due to its rapid mobility, the application of fertilizers in July 2000 increased its concentration. In fact, the concentration of nitrate/nitrite was lower in this sample than expected; it is only because of the very high increase in river discharge that the nitrate/nitrite concentration in August 2000 sample was only marginally higher compared to June 2000 sample.

In the November 2000 samples the ammonia and nitrate/nitrite concentration increased, compared to the August samples. This was because there were three incidences of fertilizer applications (as indicated by the filled, blank and filled squares above September 2000, October 2000, and November 2000 marks on the x-axis, respectively). Further, the river discharge was relatively low and the time difference between the application of the last incidence of fertilizer application and the river water sampling was low.

In the February 2001 samples, the concentrations of ammonia and nitrate/nitrite decreased despite a decrease in the river discharge. This decrease resulted mainly due to a long gap (one-to two-months) between the application of fertilizers and the sampling period. The February samples were collected during meteorologically dry period. The soil underneath the farmlands

was unsaturated, which retarded the mobility of nitrate/nitrite. So, the river water was not being replenished with nitrogen from the soil at a steady rate, and there was a long gap between fertilizer application and sampling date. Hence a lower concentration of nitrate/nitrite resulted in the November water sample.

The increase of the concentrations of ammonia and nitrate/nitrite in the April 2001 sample is due to the application of organic fertilizers for the next annual cycle before the sampling period, as indicated by the blank square above the March 2001 time scale in the x-axis. The time difference between the fertilizer application and the river water sampling was low. The low discharge in the river is another reason for the concentrations to rise.

Thus, it was found that the concentration of the chemicals was being affected by three major factors (a) the difference in time between the application of the fertilizers and the sampling of water, (b) the mobility of the chemicals in the groundwater, and (c) the river discharge. As the difference in time between the application of the fertilizers and the sampling of water is increased, the concentration of the tested chemicals in the river water decreased, everything else being constant. As the mobility of the chemicals in the groundwater increased, the concentration of the tested chemicals in the river water increased. As the river discharge increased, the concentration of the tested chemicals in the river water decreased, again, everything else being constant.

4 Limitations of the Research

The following were the limitations of this study.

The study was carried out in a limited physical area and for a limited duration of 14 months. The year 2000 proved to be a wet-year, with highest recorded 24-hour precipitation in 25 years of records. Hence, any conclusion drawn from this study does not represent the long-term trend.

The farming practices of the local area were evaluated based on the farming practices of a few farming families. Hence the research does not represent the agricultural practices of the area as a whole.

The chemical constituencies of different types of fertilizers were not known. The amount of fertilizers used was estimated. The organic fertilizers are applied without any specific rate. The specific effect of the organic fertilizers could not be accounted for.

5 Conclusions

The following conclusions were made from the results of this study.

The concentrations of environmentally sensitive agriculture related chemicals, specifically the concentrations of nitrogen-ammonia, nitrogen-nitrate/nitrite, and phosphate, in Manohara River at Changunarayan VDC, Ward Number 9, are within the water quality standards for drinking water during the time of the study.

There is a weak link between the agricultural practices of the farmers at the Changunarayan area and the changes in chemical concentration of agriculture related chemicals in the water of Manohara River. Any strong link, if there is, between the agricultural practices and changes in chemical concentration of agricultural chemicals were diluted by the rise in river discharge.

In general, as the difference in time between the application of the fertilizers and the sampling of water is increased, the concentration of the tested chemicals in the river water decreased. As the mobility of the chemicals in the groundwater increased, the concentration of the tested chemicals in the river water also increased. As the river discharge increased, the concentration of the tested chemicals in the river water decreased. So three independent variables were responsible for concentration of chemicals in river water.

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THE OUTER RING ROAD - A PLANNING TOOL?

*By Arun Dev Pant**

The proposed outer ring road for Kathmandu has created quite a stir by fuelling strong passions, both for and against the proposal. Residents in the outlying areas of the capital are hoping to reap the benefits of improved access and increased land values. Land speculators see this development as a bonanza for their investments and are looking to purchase land around the proposed road but are somewhat cautious as the alignment has yet to be finalized. The potential economic benefits have villagers lobbying to bring the road to their districts. Environmentalists, on the other hand, warn that increased pollution and uncontrolled urbanization would result from this development and insist that the plans be scrapped immediately. Still others believe that more crucial development projects should receive the priority and that the outer ring road is yet another example of the government serving the relatively privileged residents of the capital.

In the midst of such emotions, it will help to take a step back and look at the facts. There is no doubt that Kathmandu valley is growing at a rapid pace and already the effects of traffic congestion, pollution and haphazard growth are beginning to take their toll. Paradoxically, the urban density is still quite relatively low and there is a danger of unsystematic growth leading to leapfrogging of development and generating an uncontrolled urban sprawl resulting in costly and inefficient provision of urban services. The Chinese government has offered to build the road but a lot of the homework has to be done by the Nepalese institutions regarding the planning and the desired outcome of the project. This is an opportunity to develop a variety of planning mechanisms such as growth control, urban growth boundary, and specific zones for commercial centers. Infrastructure and urban services planning along with traffic management could provide the much needed relief to the city.

Planning Tools

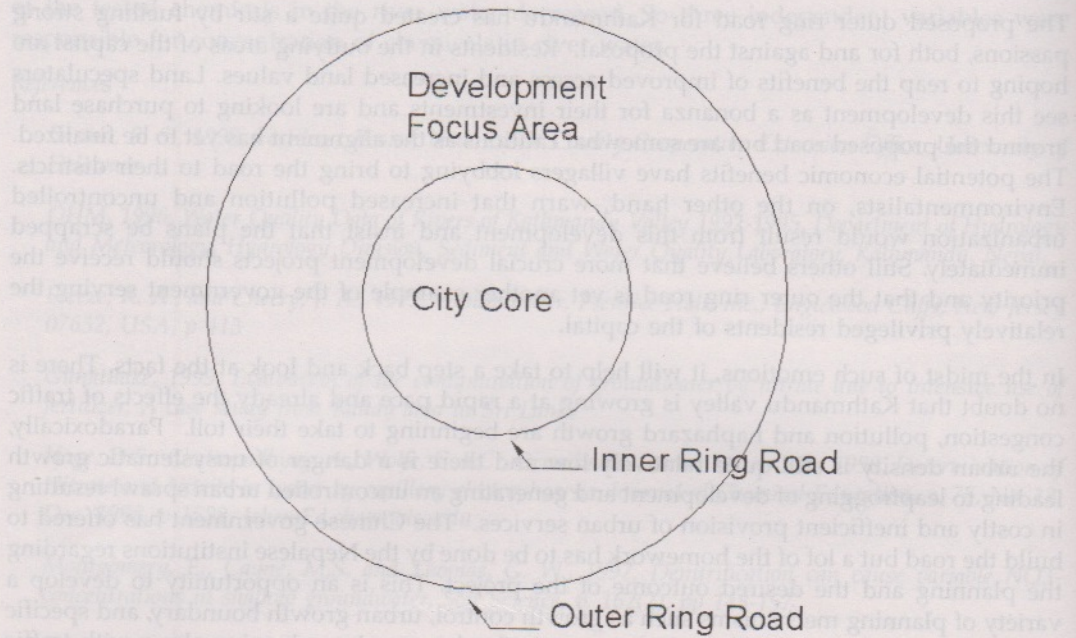
A number of planning tools are available to planners and the selection of the right mechanism is an important starting point. The opportunity provided by the proposed outer ring road means that some of these mechanisms could be integrated into the overall planning scenario. In the context of the outer ring road, these mechanisms could be part of two broader efforts at providing systematic development. One of these thrusts would be to largely limit the urban growth within a specified region - say between the inner and outer ring roads. The other would be to develop specialized zones where specific activities would be encouraged. A proper combination would allow for an optimized growth till the time that a target density has been achieved. Subsequently, the growth areas will need to be expanded and a new development focus area be delineated.

A. Growth Control

Systematic growth of a city requires proper planning of infrastructure and services thereby leading to optimal budget allocations for the development of services. The concept of a growth boundary has been used to control the transition of land from rural to urban use in many places. These urban growth boundaries are often kept in place till a certain density of settlements and related infrastructure is achieved and is subsequently relaxed by shifting it outwards as per demand. The main aim is to control urban sprawl and leapfrogging of

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settlements that generally occur along main roads radiating out from the existing urban center. In such cases, the city spends substantial amounts for providing water supply, electricity, and sewerage facilities while large tracts of centrally located land remain empty. The outer ring



Outer Ring Road as Urban Growth Boundary

road is an opportunity to have a physical growth boundary that clearly delineates the areas that can come under development focus as indicated in the figure below:

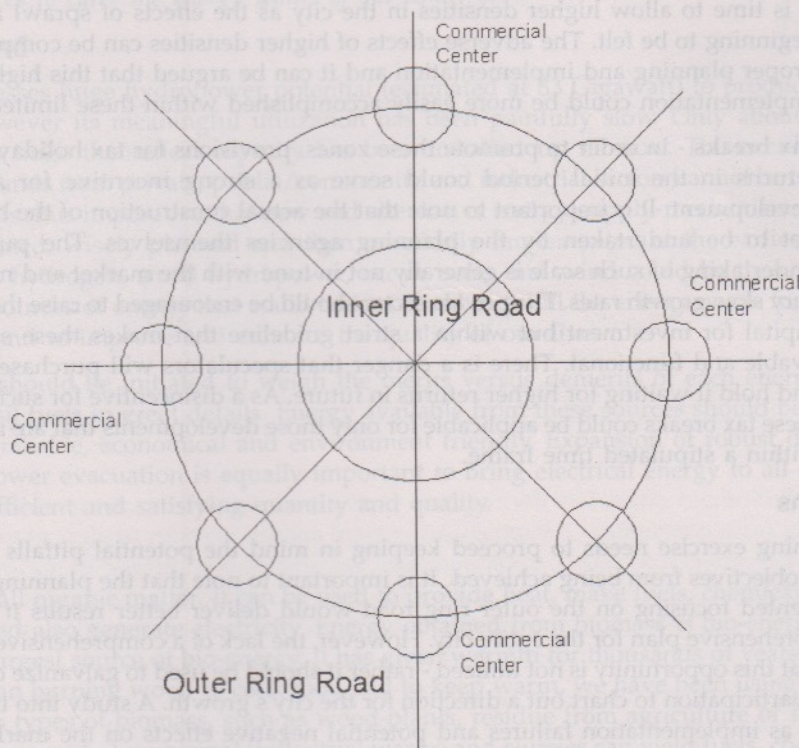
Planning mechanisms have to be in place to discourage the random haphazard growth that currently characterizes Kathmandu. Examples of mechanisms to limit the growth within the boundary could include additional development taxes for certain uses outside this boundary or prioritizing infrastructure investments within the boundary especially in the case of private developer or community initiatives. Tools like matching funds for priority areas are especially relevant when such initiatives are made.

It may be argued that such growth boundaries could be hypothetical and a more optimum one could be devised based on the actual conversion from rural to urban land uses. However, in a country where access to information is limited and projects on land mapping remain incomplete, physical delineation brought about by the road itself is perhaps a much more workable option. Not only would the general public be aware where the development focus is but also the implementation would be much simpler and less subjective in the areas close to the growth boundaries. The amount of development beyond this boundary also needs to be monitored, as there will come a time when this growth restriction needs to be relaxed and a new boundary would have to be defined. However, by that time, the allocation of infrastructure within the development focus area would have to be more or less complete and

optimized. The currently unfinished parcel mapping exercise undertaken by the Kathmandu Valley Mapping Project would aid significantly towards implementing this boundary. It is imperative that this project be completed in conjunction with the planning of the ring road and would allow for detailed monitoring of land transactions, conversions and scale of development.

B. Specialized Zones

The concept of land pooling (reorganizing land parcels for more efficient use and systematic provision of infrastructure) has been successfully implemented in various areas within the valley. The same concept is to be applied to acquire land for the outer ring road and the accompanying green belt. This means that in the process of reorganizing the parcels, excess land areas will be available to the government and these can be strategically located for specialized uses. These specialized uses could be zoned for dense commercial activities and located at transportation junctions - especially in the radials that link it to the inner ring road



Specialized Commercial Zones on Outer Ring Road

(see figure below). Such zones would tend to draw traffic away from the existing crowded roads in the city center towards the newly developing areas. If these zones are self sustainable, newer centers of growth in the periphery will appear.

Incentives for development in these specialized areas are varied and a few examples are listed below:

- a. **Provision of infrastructure** - The planning agency could provide services such as

drainage systems, a good road network, electricity, and communication facilities for such specialized zones. If these areas are well planned with enough parking and open spaces, then there is little doubt that private developers will opt to fill such spaces first. Such incentives work even more when offered together with higher development fees for other areas outside the growth boundary. The sale of land to private developers would enable the city to generate the funds for this provision of infrastructure. Additionally, a healthy tax base will develop that would add income to the municipality through rental and property taxes.

- b. **Higher density permits** - These areas could be made more attractive for commercial developers by increasing the total built up areas for a given parcel. Normally the current floor area ratios (FAR) range from 1.5 to 2.5 times the land area. This has been increased to 3.0 for apartment buildings. The same increased ratio could apply to these specialized zones which not only increases the land potential but also reduces the infrastructure costs by servicing more users within these limited zones. It is time to allow higher densities in the city as the effects of sprawl are already beginning to be felt. The adverse effects of higher densities can be compensated by proper planning and implementation and it can be argued that this higher level of implementation could be more easily accomplished within these limited zones.
- c. **Tax breaks** - In order to promote these zones, provisions for tax holidays on rental returns in the initial period could serve as a strong incentive for accelerated development. It is important to note that the actual construction of the buildings is not to be undertaken by the planning agencies themselves. The public sector undertaking of such scale is generally not in tune with the market and manifests in very slow growth rates. The private sector should be encouraged to raise the necessary capital for investment but within a strict guideline that makes these spaces both livable and functional. There is a danger that speculators will purchase such land and hold it waiting for higher returns in future. As a disincentive for such activities, these tax breaks could be applicable for only those developments that are undertaken within a stipulated time frame.

Precautions

Every planning exercise needs to proceed keeping in mind the potential pitfalls that could prevent the objectives from being achieved. It is important to note that the planning tools that are implemented focusing on the outer ring road would deliver better results if integrated with a comprehensive plan for the entire city. However, the lack of a comprehensive plan does not mean that this opportunity is not utilized - rather it should be used to galvanize discussions and public participation to chart out a direction for the city's growth. A study into the adverse effects such as implementation failures and potential negative effects on the market growth along with financing constraints should be made before planning control tools are in place. A transparent strategy to achieve the targets of this controlled growth needs to be in place and fine-tuned through a series of public hearings and institutional consultations. The outer ring road project may be implemented in the near future and the exercise is already under way. It would be far more beneficial if the planning opportunity that it presents be consciously developed into mechanisms that could better guide the city's future growth.

HARNESSING ENERGY FROM BIOMASS

- Rishi Shah*

ABSTRACT

Although Nepal is rich in hydropower, its meaningful production to spur the all round development has been relatively slow. Energy demand (electrical, thermal and mechanical) from households, industries and community is rising continuously. To balance the energy consumption with supply elegantly, efforts are being seriously made to increase the energy-production also from other renewable energy-sources. Harnessing energy from biomass and emulating distribution infrastructure (technical and managerial) for utilizing bio-energy for our appropriate needs could be attentively conceptualized and pragmatically implemented. Biomass energy could be one viable option for augmenting and complementing our energy-generation. Attempt will be made in this paper to advocate, justify and highlight why biomass should be granted great priority for consideration for exploitation as future energy sources to cater the energy wants of our country.

Background

Nepal possesses huge hydropower potential (estimated at 83 Gigawatt) to produce electrical energy. However its meaningful utilization has been painfully slow. Only about 609 Mega watt of this huge theoretical capacity has been installed up till now. The ever-burgeoning energy demands from private, public/community and industrial sectors cannot be comfortably matched. It is thus imperative that new and alternative energy supply-mechanisms have to be now postulated, wisely planned and then practically implemented at the earliest. Biomass, geothermal, hydrogen, small hydropower, ocean, solar and wind could be those alternative renewable sources of energy that could be harnessed to fulfill the energy needs for our future prosperity and to improve and enhance the quality of our lives.

Endeavors should be initiated to weigh the merits versus demerits of each energy resource even of fossil fuels in great details. Energy available from these sources should be abundant, technically reliable, economical and environment friendly. Expansion of robust distribution-grids for power evacuation is equally important to bring electrical energy to all demanding users in sufficient and satisfying quantity and quality.

Biomass

Biomass is all organic matter. It can be used to provide heat, make fuels, chemicals and other products and also generate electricity. Energy obtained from biomass is bio-energy. Wood is by far the largest source of bio-energy. It has given warmth for thousands of years. Ever since people began burning wood to cook food and to keep warm, we have been using bio-energy. Many other types of biomass, such as wood-plants, residue from agriculture or forestry and organic component of municipal/industrial wastes and slurries can yield fuels, chemicals and power. An even fume from landfills is usable biomass energy source.

Biomass is defined as all plant and plant-derived matter, into which essentially all energy is originally captured by the famous natural process of photosynthesis. It is unrivaled and wonderful carrier of energy stored from our Sun. It is totally unique renewable resource. While using it for power-generation, fuels and for manufacturing other objects, it hardly emits obnoxious greenhouse gas that trigger climate change. The released carbon dioxide (CO₂) during its combustion outweighs the captured and accumulated carbon dioxide in its growth-

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period. Biomass energy immensely reduces greenhouse gas emissions. Biomass generates about the same amount of carbon dioxide as fossil fuels, but every time new plant grows, carbon dioxide is actually removed from the atmosphere. Use of biomass for energy is the reversal of photosynthesis. Equation of Photosynthesis reads as $\text{CO}_2 + 2\text{H}_2\text{O} = \text{CH}_2\text{O} + \text{H}_2\text{O} + \text{O}_2$.

Biomass is all organic fossilized substances. They include plants and animals and their by-products. Scientifically, its connotation with living matter, denotes products derived from living organisms like wood from trees, harvested grasses, plant-parts and residues such as twigs, stems and leaves, as well as aquatic plants and animal wastes. All earth's biomass exists in thin surface-layer designated as the biosphere representing minute fraction of total mass of earth. It is an enormous store of energy as fuel and food that replete continually. The Sun is the predominating supplier of energy. Even though a tiny fraction of solar energy reaching the earth each year is transformed into biomass, it is equivalent to over five times the current total world energy consumption.

Bio-energy

Bio-energy also dubbed wood-energy is the dominant source of energy for circa half of the world's populace, utilizing it mainly for cooking and heating purpose. Since it is not always easy for the poor population to gain access to electricity and other expensive or even to subsidized fuels for assisting them in income generation and to improve their living standards, bio-energy is a quasi blessed option for them. Presently, some fifteen percent of worldwide energy-consumption is supplied by biomass. In some developing countries to up to ninety percent of their energy need is covered by biomass. Refer to world energy statistics expressed on slides of diagrams and figures in the annex. Total energy and net electricity consumption of the world in 2001 were about 404 quadrillion Btu and 13.3 trillion kilowatt-hours respectively.

Biomass resources could be filled-up again through the cultivation of energy crops and fast-growing trees and grasses (biomass feed-stocks). Unlike other renewable energy sources, biomass can be converted directly into common liquid bio-fuels for transportation like ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) and bio-diesel.

In nature, all biomass ultimately decomposes to its elementary molecules generally releasing heat. Energy from conversion of biomass into useful energy imitates natural processes but at faster rate. This energy recycles carbon and does not add carbon dioxide to the environment, in contrast to fossil fuels. Net energy received in biomass when it is combusted ranges from about 8 Mega Joule (MJ)/kg for green wood to 20MJ/kg for oven dry plant matter and to 55MJ/kg for methane as compared with about 23 - 30MJ/kg for coal.

In bio-energy, biomass is flamed to furnish heat energy and electricity. Biomass energy (bio-energy) includes any solid, liquid or gaseous fuel or any electric power or handy chemical product derived from organic matter, whether directly from plants or indirectly from plant-derived industrial, commercial or urban wastes or from agricultural and forestry residues.

Bio-power

Biomass power (bio-power) is generation of secondary energy from biomass. Six major bio-power systems are currently active. They are direct-fired, co-firing, gasification, anaerobic digestion, pyrolysis and small modular.

In direct-fired systems bio-energy is directly scorched to raise steam. Generator transposes steam into electricity. Steam from some power plant is used for manufacturing procedures or

to heat buildings in addition to generating electricity. They are recognized as cogeneration or combined heat and power (CHP) facilities. Wood-waste brings both electricity and steam at paper mills.

Coal-fired power plants service co-firing systems to significantly check discharge of sulfur dioxide (SO_2). Co-firing involves using bio-energy as supplementary energy source in high efficiency boilers. Gasification with high temperatures and in oxygen-starved environment transmutes biomass into gaseous mixture of hydrogen (H_2), carbon monoxide (CO) and methane (CH_4). The gas fuels gas turbine (like jet engine), which turns electrical generator

In landfills, wells are drilled to release methane from the decaying organic matter. Pipes from each well carry gas to central point where it is filtered and cleaned before spending. Methane can be produced from decaying biomass through impressive action identified as anaerobic digestion. Anaerobic digestion involves using bacteria to decompose organic matter in absence of oxygen. Many facilities burn methane in boiler to provide steam for electricity-generation. Micro-turbines and fuel cells are methane-using novelties.

Pyrolysis occurs when biomass is heated almost in absence of oxygen (O_2). Biomass alters into liquid called pyrolysis-oil, which can be ignited like petroleum to generate electricity. Small, modular-system generates electricity up to five megawatts. They are designed for small town community or for farmers for generating electricity from municipal or farm waste.

Bio-power technologies are well proven electricity and steam generation options at present. Direct-combustion technology is mature and dominating today. Efficiency improvements are underway in existing conventional coal-firing boilers, gasification installations, fuel cell and in modular systems.

Bio-power or biomass power-system deploys biomass feed stocks instead of usual fossil fuels (natural gas or coal) producing electricity. Bio-fuel or liquid biomass fuel mostly for transportation-system substitutes petroleum products such as gasoline or diesel. Biomass energy crops are trees and perennial grasses grown specifically to provide raw feedstocks for energy-producers and industry.

Bio-products

Importance of bio-products is overwhelming. Bio-products are made from renewable sources. They require less energy to contrive commercial items than those drawn from petroleum-based fossil fuels. Researchers have recognized operations for making antifreeze, plastics, glues, artificial sweeteners and gel for toothpaste. When biomass is singed with a small amount of oxygen, carbon monoxide (CO) and hydrogen (H_2) are set free profusely. This mixture is named biosynthesis gas, which is essential for creating and manufacturing plastics, acids, photographic films, textiles and synthetic fabrics. Phenol could be extracted from pyrolysis oil. Phenol is intrinsic for wood adhesives, molded plastic and foam insulation.

Assessment of biomass

With biomass technologies, national economies could be moved more towards sustainable basis, because they drive end-users away from dependency on fossil fuels. Biomass can substantially decrease dependence on imported crude oil. Biomass is more evenly and securely distributed over the earth's surface than other finite energy sources.

Producing biomass and using agricultural residues cleverly for biomass technologies would stimulate rural development associated with farming, forestry and service industries. New

products, markets and jobs would be created. Rural economic growth would then consequently follow. Arable lands when tilled in balanced ways, could support agricultural and forestry production, environmental preservation, human and wildlife habitats and biomass production.

Biomass technologies are environmentally friendlier than those conventional fossil fuel-relying energy technologies. Fossil fuels contribute significantly to many environmental problems as greenhouse gases, air pollution and water and soil contamination. Biomass technologies could help us break our conventional utilization-pattern of energy to improve the quality of our environment. Biomass alternatives can lessen streaming out of nitrogen oxides (NO), sulfur dioxides (SO₂) and other air pollutants in connection with fossil fuel-use.

Increased worrisome greenhouse gases emitted from fossil fuels, especially carbon dioxide, has created serious problems infamously known as global climate change or global warming. Biomass technologies submit very low (or almost nil) amounts of carbon dioxide. Soil conservation issues in conjunction with biomass production include soil erosion control, nutrient retention, carbon sequestration and stabilization of riverbanks.

Biomass technology may have impacts on watershed stability, groundwater quality, surface water run-off and local water for crop irrigation. Altering land-use to support increased biomass production may result in modifications in habitat and in levels of biodiversity.

Conclusion

Bio-energy is one of the most important renewable energy today and yet it is largely unknown. Collectively bio-energy promoters have to embark on educative awareness and advocate campaign to inform and convince general public of bio-energy's real benefits. Transition from fossil to renewable fuels is more evolutionary than revolutionary. Bio-energy offers an opportunity to drive towards sustainable energy economy while maintaining and improving quality of life. We have to set timely ambitious and courageous targets for growth of bio-energy. Long-term energy supply-scenario suggests that by 2050 bio-energy could be supplying energy equal to 50 % of the world's total 1990 energy demand of some 349 quadrillion Btu.

In Nepalese context, biomass raw material is lavishly available from private and public/municipal sectors. CRE could stimulate entrepreneurs for managing them economically, technically and legally for producing bio-energy from proto-type or demonstration plant. CRE is vouching to promote wider knowledge and understanding of bio-energy, which will inspire people, industry and government to accept the challenges and grasp immense opportunity that bio-energy bestows. Development of major new land based renewable energy industry is a Herculean task and requires involvement of a broad range of stakeholders including governmental organizations (GOs), private companies, farming and forestry sector and interested Non-Governmental organizations (NGOs) and consumer groups.

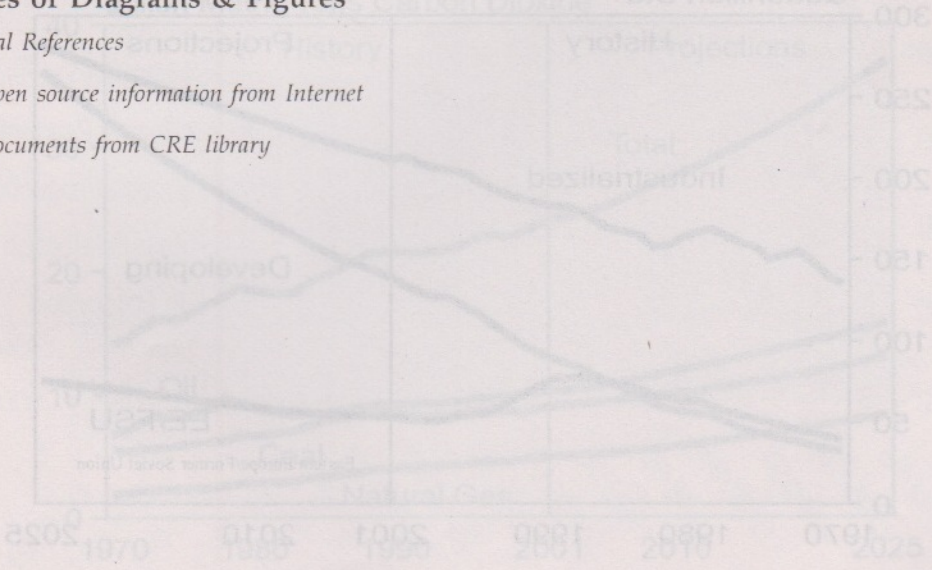
CRE is one leading NGO with expertise and experience on issues related to renewable energy. It has completed many projects on renewable energy in various parts of Nepal in collaboration with local and international agencies. It has commenced its Light for All campaign to replace kerosene lamps, which are coupled with health hazards and carbon dioxide emission, with solar-powered lights. Economical benefits from this action could be highlighted, as consumption of subsidized fossil fuel would be diminished. CRE is actively profiling and evaluating diverse forms of renewable energy on their strength and weakness and is raising awareness and articulating these findings to the people through modern communication medium, workshops, seminars and conferences. CRE as catalyst is facilitating and establishing firm alliance with many institutions actively operating in the energy sector to learn from each other and to share

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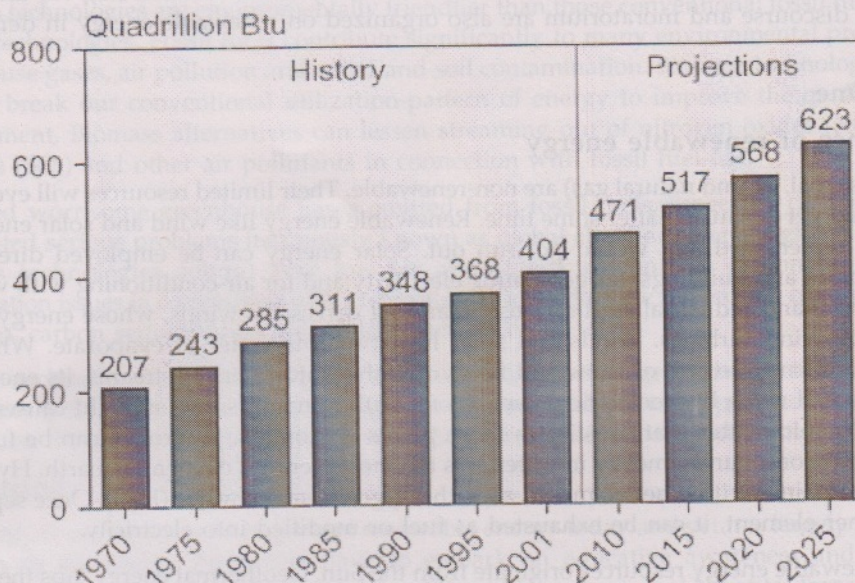
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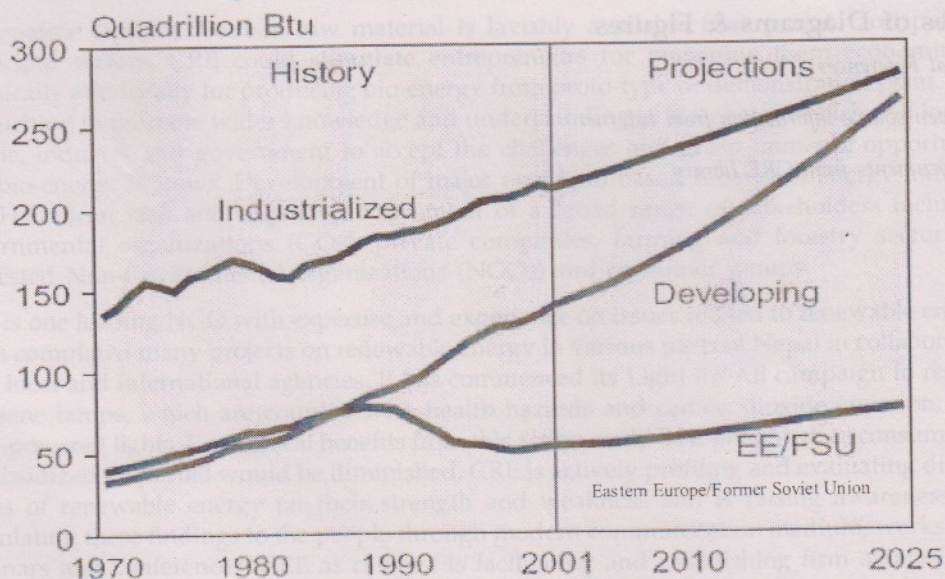
- Open source information from Internet
- Documents from CRE library

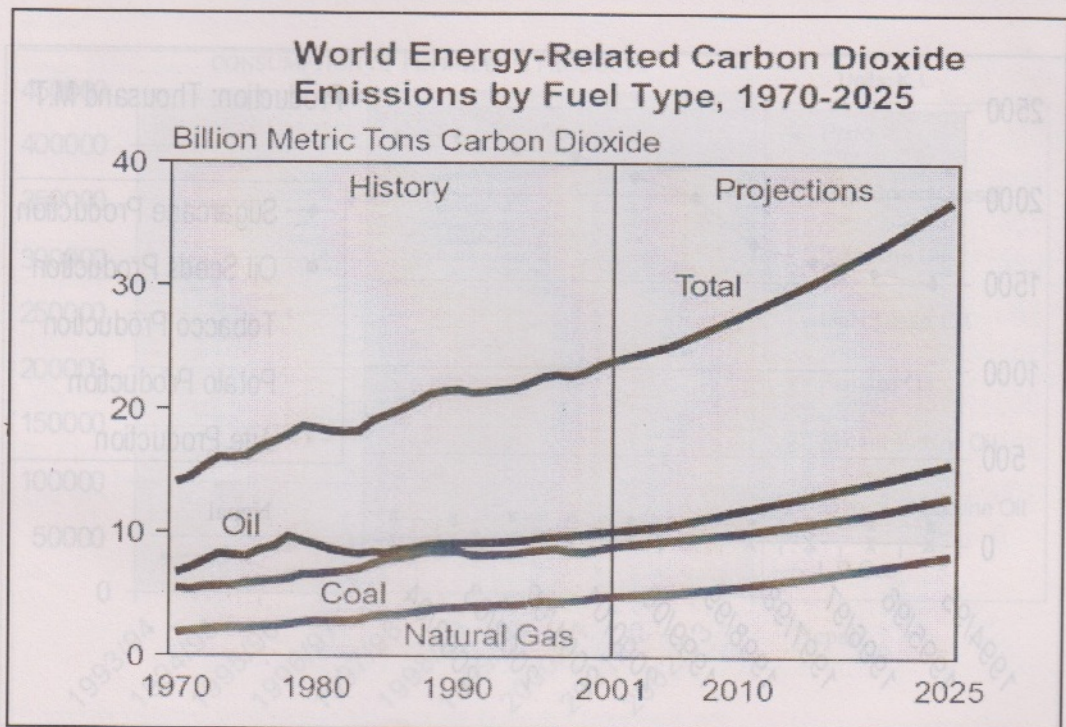
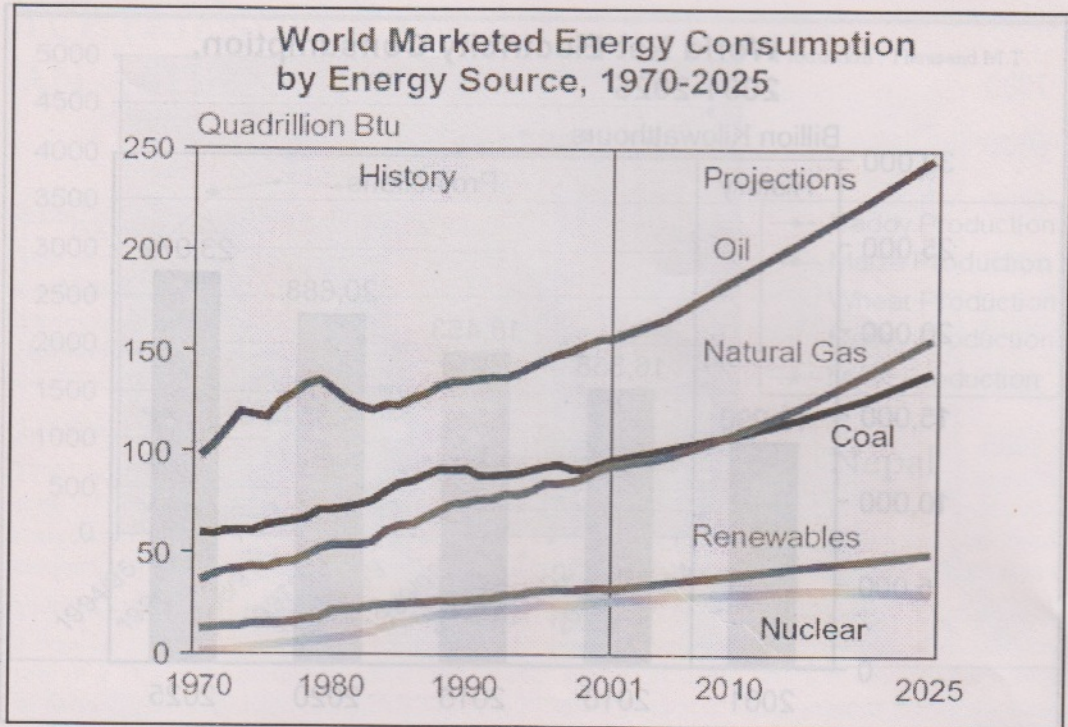


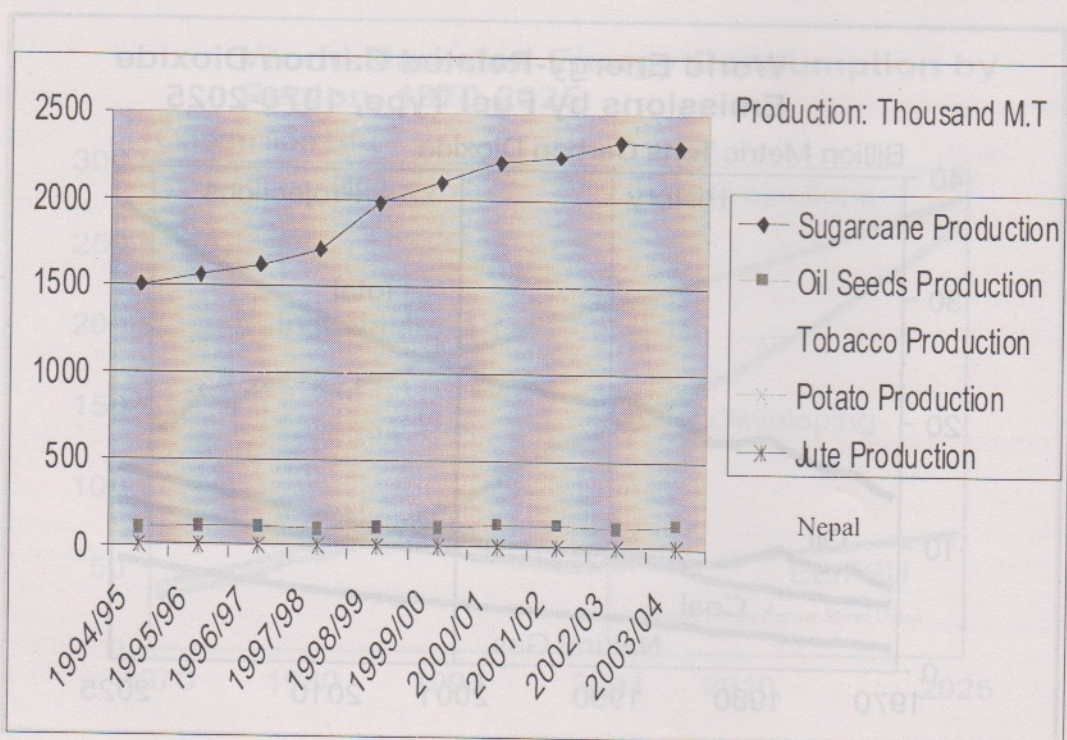
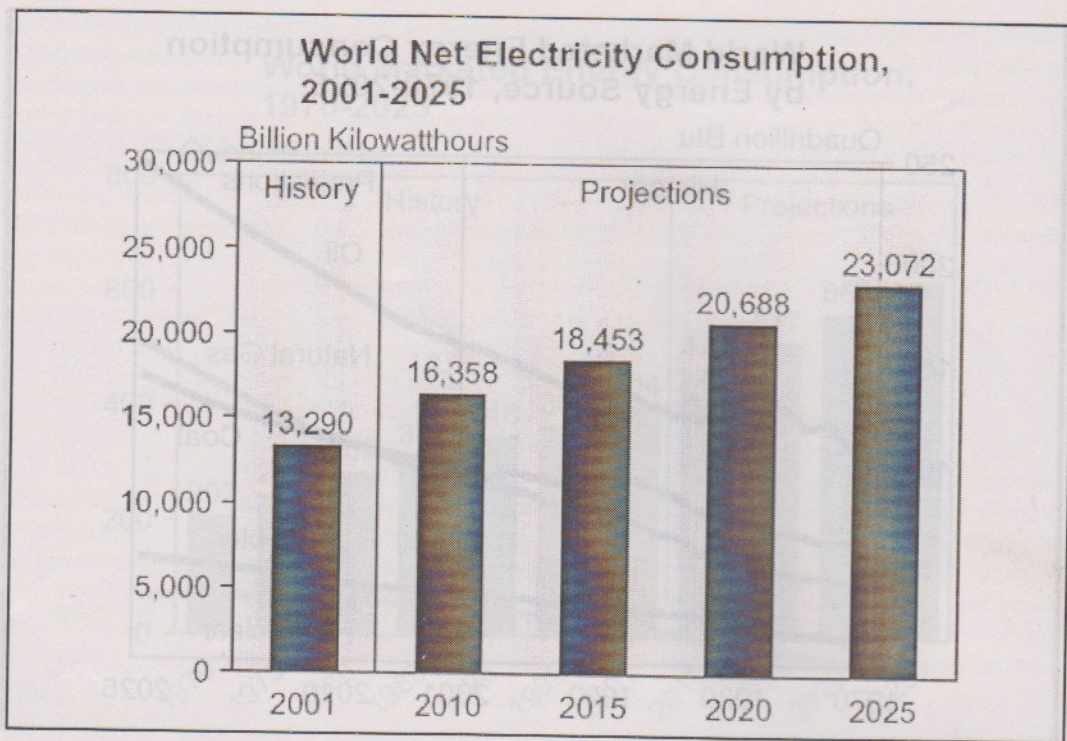
World Marketed Energy Consumption, 1970-2025

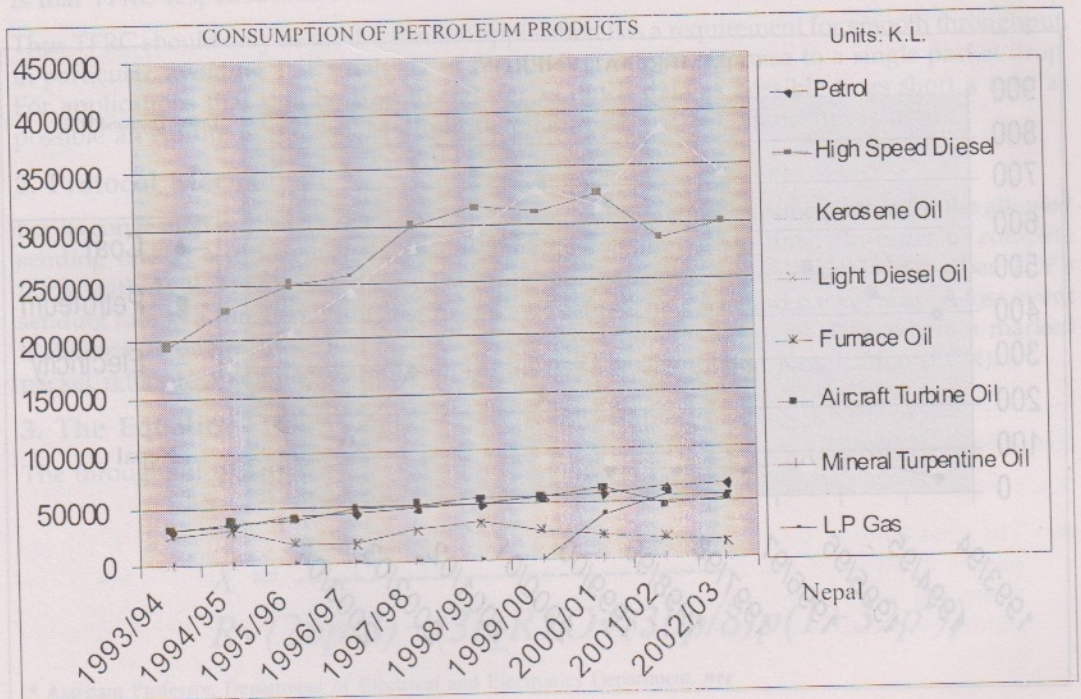
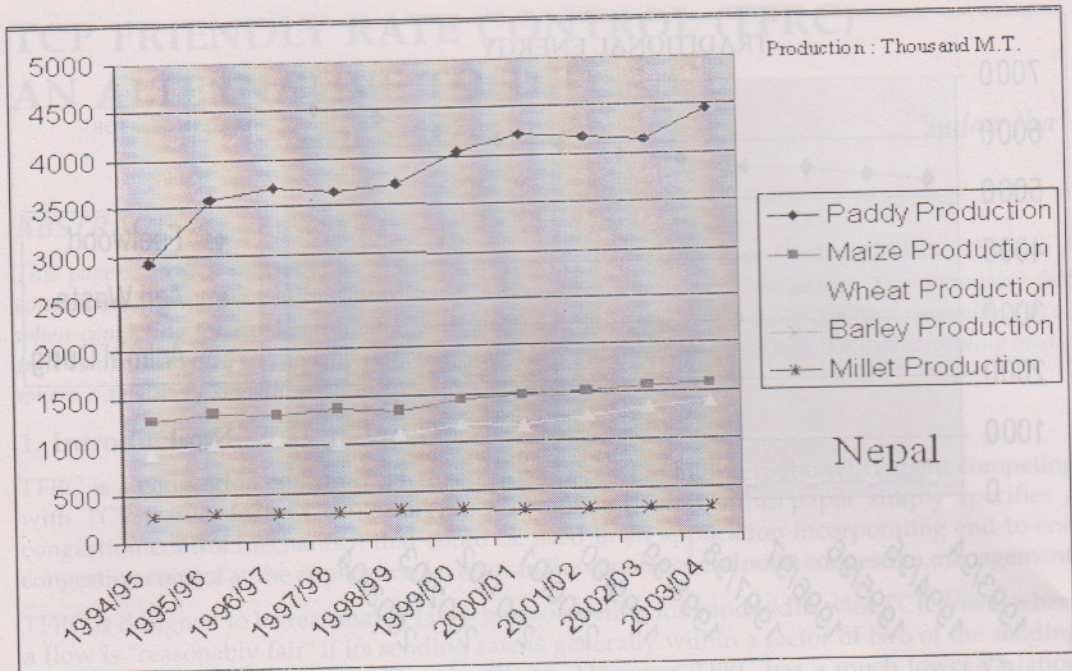


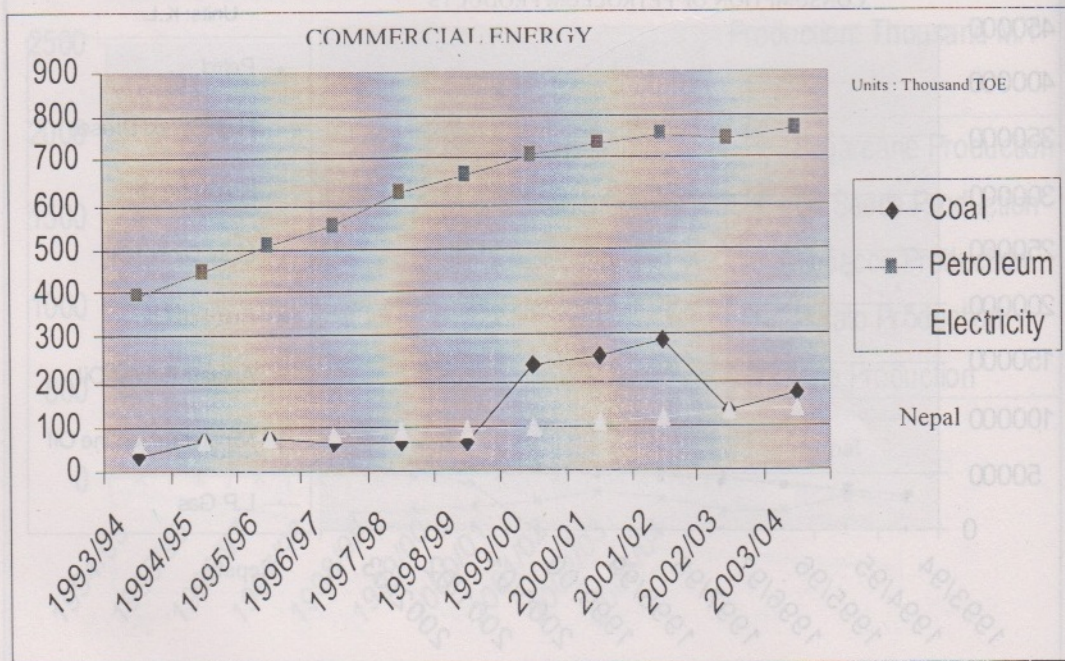
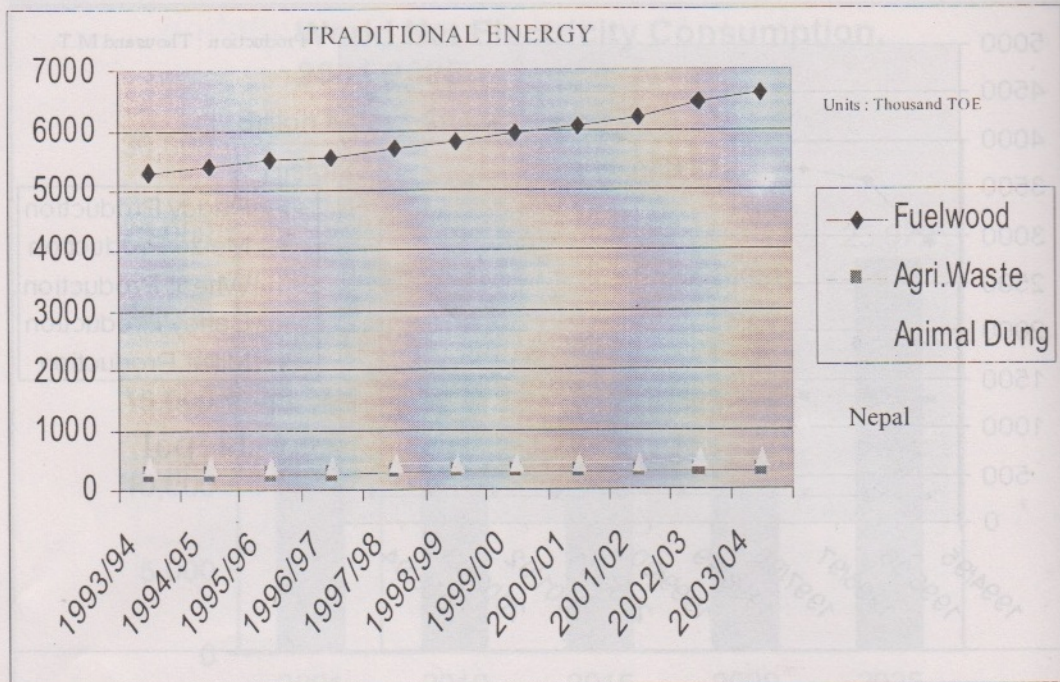
World Marketed Energy Consumption by Region, 1970-2025











TCP FRIENDLY RATE CONTROL (TFRC) AN ALTERNATIVE TO TCP

Sudan Jha*

ABSTRACT

This paper specifies Transmission Control Protocol (TCP)-Friendly Rate Control (TFRC). TFRC is a congestion control mechanism operating in a best-effort Internet environment. It is reasonably fair when competing for bandwidth with TCP flows, but has a much lower variation of throughput over time compared with TCP, making it more suitable for applications such as telephony or streaming media where a relatively smooth sending rate is of importance.

1. Introduction

TFRC is a congestion control mechanism that operates in an Internet environment competing with TCP traffic. Instead of specifying a complete protocol, this paper simply specifies a congestion control mechanism that could be used in an application incorporating end-to-end congestion control at the application level, or in the context of endpoint congestion management.

TFRC is designed to be reasonably fair when competing for bandwidth with TCP flows, where a flow is "reasonably fair" if its sending rate is generally within a factor of two of the sending rate of a TCP flow under the same conditions. However, TFRC has a much lower variation of throughput over time compared with TCP, which makes it more suitable for applications such as telephony or streaming media where a relatively smooth sending rate is of importance. The penalty of having smoother throughput than TCP while competing fairly for bandwidth is that TFRC responds slower than TCP to changes in available bandwidth.

Thus TFRC should only be used when the application has a requirement for smooth throughput, in particular, avoiding TCP's halving of the sending rate in response to a single packet drop. For applications that simply need to transfer as much data as possible in as short a time as possible an Additive-Increase, Multiplicative-Decrease (AIMD) algorithm is used.

2. Protocol Mechanism

For its congestion control mechanism, TFRC directly uses a throughput equation for the allowed sending rate as a function of the loss event rate and round-trip time. In order to compete fairly with TCP, TFRC uses the TCP throughput equation, which roughly describes TCP's sending rate as a function of the loss event rate, round-trip time, and packet size. A loss event is defined as one or more lost or marked packets from a window of data, where a marked packet refers to a congestion indication from Explicit Congestion Notification (ECN).

3. The Equation

The throughput equation is:

$$X = \frac{S}{R\sqrt{(2bp/3)} + (3t_RTO\sqrt{(3bp/8)p(1+32p^2)})}$$

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Where:

- X is the transmit rate in bytes/second.
- s is the packet size in bytes.
- R is the round trip time in seconds.
- p is the loss event rate, between 0 and 1.0, of the number of loss events as a fraction of the number of packets transmitted.
- t_{RTO} is the TCP retransmission timeout value in seconds.
- b is the number of packets acknowledged by a single TCP acknowledgement.

4. Mechanism

The contents of the data packets sent by the sender and feedback packets sent by the receiver are noted in terms of their sequence number, timestamp, sender's current estimate of the round trip time.

Data Packets: Each data packet sent by the data sender contains the following information:

- A sequence number: This number is incremented by one for each data packet transmitted. The field must be sufficiently large that it does not wrap causing two different packets with the same sequence number to be in the receiver's recent packet history at the same time.
- A timestamp indicating when the packet is sent: This is denoted by ts_i the timestamp of the packet with sequence number i . The resolution of the timestamp is measured in milliseconds. This timestamp is used by the receiver to determine which losses belong to the same loss event. The timestamp is also echoed by the receiver to enable the sender to estimate the round-trip time, for senders that do not save timestamps of transmitted data packets. It is found that as an alternative to a timestamp incremented in milliseconds, a "timestamp" that increments every quarter of a round-trip time would be sufficient for determining when losses belong to the same loss event, in the context of a protocol where this is understood by both sender and receiver, and where the sender saves the timestamps of transmitted data packets.
- The sender's current estimate of the round trip time: The estimate reported in packet i is denoted by R_i . The round-trip time estimate is used by the receiver, along with the timestamp, to determine when multiple losses belong to the same loss event. Sender sends a coarse-grained "timestamp" that increments every quarter of a round-trip time and it is found that the sender does not need to send its current estimate of the round trip time. Hence subsequent time interval is reduced. The reduction is 50% in statistical data analysis.

Feedback Packets

Each feedback packet sent by the data receiver contains the following information:

- The timestamp of the last data packet received: It is denoted by $t_{rcvdata}$. If the last packet received at the receiver has sequence number i , then $t_{rcvdata} = ts_i$. This timestamp is used by the sender to estimate the round-trip time, and is only needed if the sender does not save timestamps of transmitted data packets.

- The amount of time elapsed between the receipt of the last data packet at the receiver: The generation of this feedback report is analyzed. It is denoted by t_{delay} .
- The rate at which the receiver estimates that data was received since the last feedback report was sent. It is denoted by X_{recv} .
- The receiver's current estimate of the loss event rate: is calculated and it is denoted by p .

Data Sender Protocol

The data sender sends a stream of data packets to the data receiver at a controlled rate. When a feedback packet is received from the data receiver, the data sender changes its sending rate, based on the information contained in the feedback report. If the sender does not receive a feedback report for two round trip times, it cuts its sending rate in half. This is achieved by means of a timer called the nofeedback timer.

The sender-side protocol is specified and was implemented in the following steps:

1. Measurement of the mean packet size being sent
2. The sender behavior when a feedback packet is received
3. The sender behavior when the nofeedback timer expires
4. Oscillation prevention (optional)
5. Scheduling of transmission on non-real time operating systems

Measuring the Packet Size

The parameter s (packet size) is normally known to an application. This may not be so in two cases:

The packet size naturally varies depending on the data. The internet Monitoring (IPMP) tool was used to measure the data packet. The packet size was changed rather than the number of packets per second to perform congestion control. It was performed by changing the packet size in audio applications where a fixed interval of time needs to be represented by each packet.

Sender Initialization

To initialize the sender, the value of X is set to 1 packet/second and the nofeedback timer is set to expire after 2 seconds. The initial values for R (RTT) and t_{RTO} are undefined until they are set as described below. The initial value of t_{ld} , for the Time Last Doubled during slow-start, is set to -1.

Sender behavior when a feedback packet is received

The sender knows its current sending rate, X , and maintains an estimate of the current round trip time, R , and an estimate of the timeout interval, t_{RTO} . When a feedback packet is received by the sender at time t_{now} , the following were performed:

1. Calculate a new round trip sample.

$$R_{\text{sample}} = (t_{\text{now}} - t_{\text{recvdata}}) - t_{\text{delay}}$$

2. Update the round trip time estimate:

If no feedback has been received before

$R = R_sample;$

Else

$R = q*R + (1-q)*R_sample;$

TFRC is not sensitive to the precise value for the filter constant q ,

but we recommend a default value of 0.9.

3. Update the timeout interval:

$t_RTO = 4*R.$

4. Update the sending rate as follows:

If ($p > 0$)

Calculate X_calc using the TCP throughput equation.

$X = \max(\min(X_calc, 2*X_recv), s/t_mbi);$

Else

If ($t_now - tld \geq R$)

$X = \max(\min(2*X, 2*X_recv), s/R);$

$tld = t_now;$

It was noted that if $p == 0$, then the sender is in slow-start phase, where it approximately doubles the sending rate each round-trip time until a loss occurs. The s/R term gives a minimum sending rate during slow-start of one packet per RTT. The parameter t_mbi is 64 seconds, and represents the maximum inter-packet backoff interval in the persistent absence of feedback. Thus, when $p > 0$, the sender sends at least one packet every 64 seconds

5. Reset the nofeedback timer to expire after $\max(4*R, 2*s/X)$ seconds.

6. Expiration of nofeedback timer: If the nofeedback timer expires, the sender should perform the following actions:

- a. Cut the sending rate in half. If the sender has received feedback from the receiver, this is done by modifying the sender's cached copy of X_recv (the receive rate). Because the sending rate is limited to at most twice X_recv , modifying X_recv limits the current sending rate, but allows the sender to slow-start, doubling its sending rate each RTT, if feedback messages resume reporting no losses.

If ($X_calc > 2*X_recv$)

$X_recv = \max(X_recv/2, s/(2*t_mbi));$

Else

$X_recv = X_calc/4;$

The term $s/(2*t_mbi)$ limits the backoff to one packet every 64 seconds in the case of persistent absence of feedback.

- b. The value of X must then be recalculated as described under point (4) above. If the nofeedback timer expires when the sender does not yet have an RTT sample, and has not

yet received any feedback from the receiver, then step (1) can be skipped, and the sending rate cut in half directly:

$$X = \max(X/2, s/t_{mbi})$$

- c. The nofeedback timer was restarted to expire after $\max(4*R, 2*s/X)$ seconds.
- d. It was noted that when the sender stops sending, the receiver stops sending feedback. This caused the nofeedback timer to start to expire and decrease X_{recv} . If the sender subsequently starts to send again, X_{recv} will limit the transmit rate, and a normal slowstart phase will occur until the transmit rate reaches X_{calc} .
- e. If the sender has been idle since this nofeedback timer was set and X_{recv} is less than four packets per round-trip time, then X_{recv} was halved in response to the timer expiration. This ensures that the allowed sending rate is never reduced to less than two packets per round-trip time as a result of an idle period.

7. Preventing Oscillations

To prevent oscillatory behavior in environments with a low degree of statistical multiplexing it is useful to modify sender's transmit rate to provide congestion avoidance behavior by reducing the transmit rate as the queuing delay increases. To do this the sender maintains an estimate of the long-term RTT and modifies its sending rate depending on how the most recent sample of the RTT differs from this value. The long-term sample is R_{sqmean} , and is set as follows:

If no feedback has been received before

$$R_{sqmean} = \sqrt{R_{sample}};$$

Else

$$R_{sqmean} = q^2 * R_{sqmean} + (1-q^2) * \sqrt{R_{sample}};$$

Thus R_{sqmean} gives the exponentially weighted moving average of the square root of the RTT samples. The constant q^2 should be set similarly to q , and we recommend a value of 0.9 as the default. The sender obtains the base transmit rate, X , from the throughput function. It then calculates a modified instantaneous transmit rate X_{inst} , as follows:

$$X_{inst} = X * R_{sqmean} / \sqrt{R_{sample}};$$

When $\sqrt{R_{sample}}$ is greater than R_{sqmean} then the queue is typically increasing and so the transmit rate needs to be decreased for stable operation.

5. Observation

The equation is designed for applications that use a fixed packet size, and vary their sending rate in packets per second in response to congestion. Some audio applications require a fixed interval of time between packets and vary their packet size instead of their packet rate in response to congestion.

The loss event rate at receiver is calculated by the data receiver that well suits to an application where the sender is a large server handling many concurrent connections, and the receiver has more memory and CPU cycles available for computation.

Setting t_{RTO} to $4*R$ ($t_{RTO} = 4*R$) gives a more accurate calculation of t_{RTO} . Secondly, t_{RTO} is set to $4R$ per second ($t_{RTO} = \max(4R, \text{one second})$), to match the recommended minimum of one second on the RTO.

Many current TCP connections use delayed acknowledgements, sending an acknowledgement for every two data packets received, and thus have a sending rate modeled by $b = 2$. However, TCP is also allowed to send an acknowledgement for every data packet, and this would be modeled by $b = 1$.

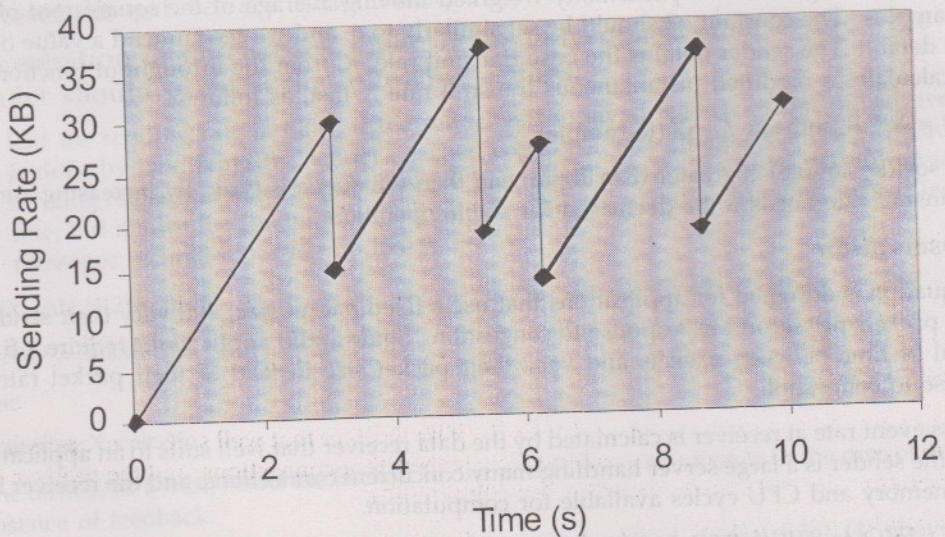
In future, different TCP equations may be substituted for this equation. The requirement is that the throughput equation be a reasonable approximation of the sending rate of TCP for conformant TCP congestion control.

Generally speaking, TFRC's congestion control mechanism works as follows:

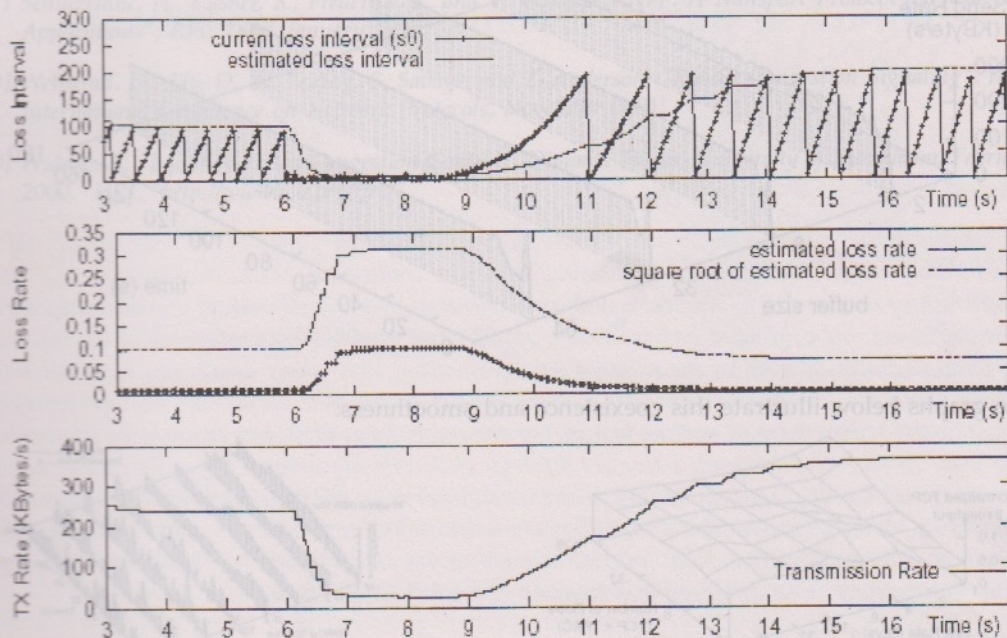
- The receiver measures the loss event rate and feeds this information back to the sender.
- The sender also uses these feedback messages to measure the round-trip time (RTT).
- The loss event rate and RTT are then fed into TFRC's throughput equation, giving the acceptable transmit rate.
- The sender then adjusts its transmit rate to match the calculated rate.
- The dynamics of TFRC are sensitive to how the measurements are performed and applied.

Observation 1:

TCP Saw Tooth Pattern

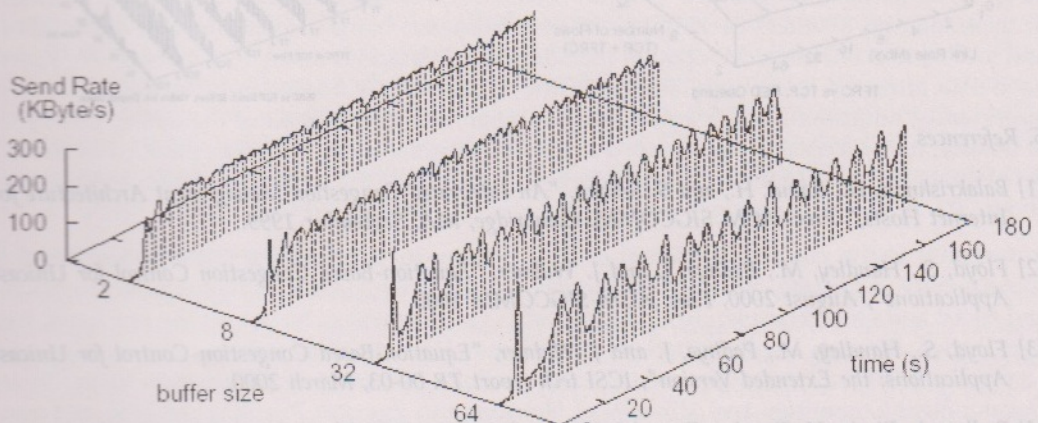


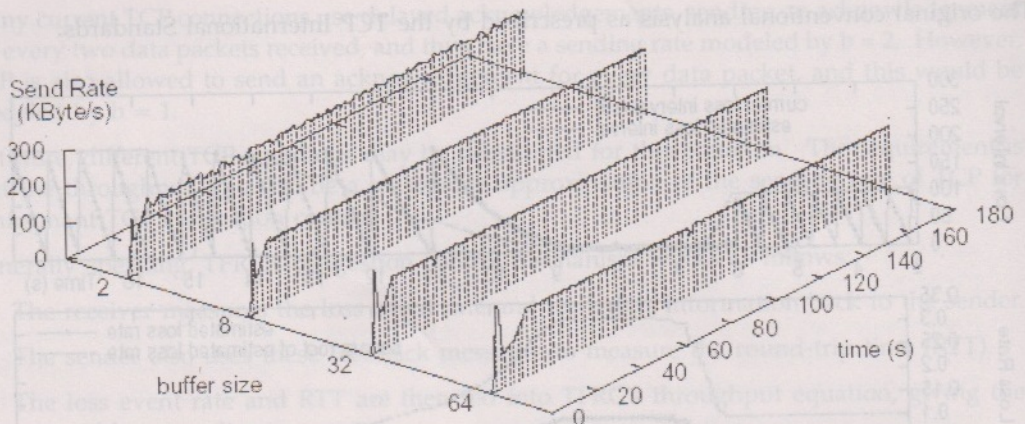
The original conventional analysis as prescribed by the TCP International Standards.



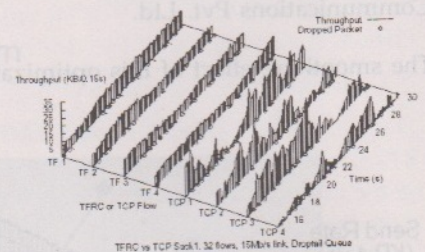
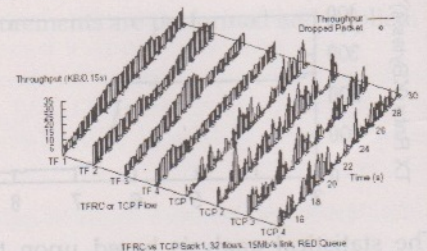
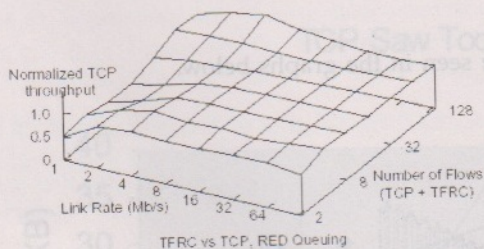
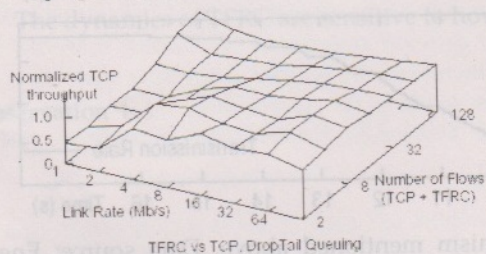
The statistical analysis based upon the mechanism mentioned above. Data source: Enet Communications Pvt. Ltd.

The smoothing effect of this optimization can be seen in the graphs below.





The graphs below illustrate this coexistence and smoothness.



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POST-MODERN BUILDINGS IN THE KATHMANDU VALLEY

- failure in public dimension of architecture -

Bijaya K. Shrestha*, Ph. D

ABSTRACT

The present trend of post-modern architecture in the Kathmandu Valley is not only unsuccessful in achieving cultural continuity by linking with the traditional Malla architecture but also unsatisfactory in terms of public realm and socio-cultural dimensions. Instead of addressing these alarming issues, the concerned bodies namely professional organisations, educational institutions and public agencies as well as the existing legal framework have given continuity to the present adverse trend of development thereby destroying the traditional social fabrics and forming unsustainable urban form as well as hampering the public education and community awareness programs. To reverse this trend, a twofold strategy of developing urban design plan focusing on environmental quality, natural hazard and cultural heritage to manage urban growth in the Kathmandu Valley at macro level and within this broader framework, development of site specific guidelines for 'public dimension' of architecture in regulating building industry including incorporating them both in theory and practice at local level, is essential.

Overview and Study Objectives

After the end of Rana autocracy in 1951, lifting of Rana's policy of restricting entry to the Valley, influx of foreign aid tripling with each passing decade, opening of highways linking the Valley to the Indian (1956) and Tibetan borders and beginning of air services in 1974 resulting in growth of commerce and tourism, establishment of industries (particularly carpet and garments) in the late 1970s and during the 1980s and the restoration of democracy in the early 1990s, all have contributed to rapid urbanisation in the Kathmandu Valley. In addition to these, natural disasters causing loss of properties and homes, environmental degradation and low socio-economic development including recent Maoist's insurgency outside the Valley have also attracted huge population into the capital city of Kathmandu for better income opportunity, education, health and safety and other services. Instead of regulating this trend of urbanisation, successive governments in the past adapted centralised policy and concentrated development projects in the Valley causing growth of annual 6% urban population and housing about 20% of the total national urban population in Kathmandu (Figure 1).

In response to the rapid urbanisation of the Kathmandu Valley in the last few decades and subsequently increasing demands of serviced lands, new shelters, infrastructure provisions and social and emergency services, His Majesty's Government of Nepal, on the one hand, has been acting through implementations of different land development techniques (site and services, guided land development and land pooling), formation of Kathmandu Valley Town Development Committee and Ministry of Housing and Physical Planning (in 1988 and now converted into Ministry of Physical Planning and Construction), formulation of National Building Code and Joint Apartment Act including encouraging participation of private sector

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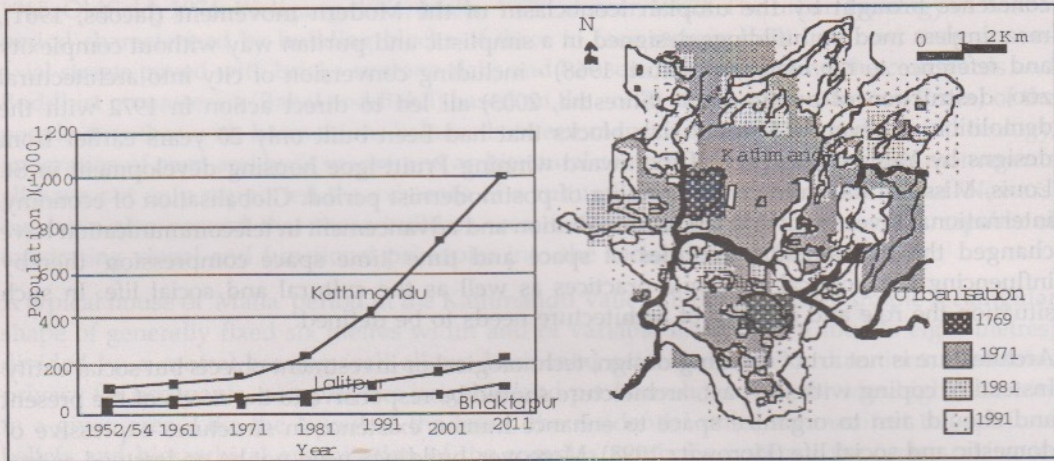


Fig. 1. Population growth and Urbanisation in the Kathmandu Valley (1952/54 - 2011)

in housing development. On the other hand, transformation of economic base from agriculture to information and service orientation, change in people's lifestyles, flow of information, availability of different construction materials and technologies including variety of fixtures and furniture have numerous implications on urbanism and built environment of the medieval cities of the Kathmandu Valley. Among them emergence of a new trend of architectural design and building construction particularly from 1991 onwards popularly known as 'post-modern architecture' - building of irregular shapes in plan and elevation with mixing up of many elements such as arches, bay windows, Corinthian columns with pediment base, combination of flat and sloped or 'pagoda style' roof, etc. in one structure - is the major concern. Majority of new structures coming up both in the redevelopment of the historic core areas as well as in the peripheral areas of both planned and unplanned settlements are influenced from post-modern characters but their formation process under the existing legal and institutional frameworks, their linkage to the traditional Malla architecture and their numerous consequences are yet to be analysed. Hence, this paper aims to fulfil this gap with fourfold objectives. First, it studies numerous literatures on post-modern architecture and urban design to develop a theoretical framework which provides a basis for analysis. Second, it identifies the salient features of traditional 'Malla' architecture of the valley. Third, it analyses the numerous consequences of post-modern buildings of the Kathmandu Valley and finally draws a conclusion and proposes the key recommendations.

Theoretical Framework

Though architectural history slowly evolved on incremental basis - from formal to romantic and then to classical styles - with each phase having strong roots in the previous era, modern architecture after the industrial revolution discarded the evolutionary process of the earlier development trend and cultural continuity. Considering city as a machine for living, modern architecture with faith on technology encouraged architects to design an architectural object (a building) for an ideal man rather than for real people and to seek for a universal solution. As building form was dictated by internal function and structural requirements irrespective of local culture, climate and geographical location, modern buildings did not enhance the local landscape but had isolated themselves in terms of architectural style, construction technique and other detailing. The dissatisfaction with Modern architecture - destruction of urban

coherence brought by the utopian iconoclasm of the Modern movement (Jacobs, 1961), meaningless modern buildings designed in a simplistic and puritan way without complexity and reference to the history (Venturi, 1968) - including conversion of city into architectural zoo, destruction of public realm (Shrestha, 2003) all led to direct action in 1972 with the demolition of several 14-storey slab blocks that had been built only 20 years earlier from designs by Yamasaki as part of the award-winning Pruitt-Igoe housing development in St. Louis, Missouri indicating the beginning of postmodernist period. Globalisation of economy, international investment and labour distribution and advancement in telecommunication have changed the fundamental qualities of space and time 'time space compression' thereby influencing the political-economic practices as well as the cultural and social life. In such situation the role and identity of architecture needs to be defined.

Architecture is not art of building design, technological or investment objects but social entity. Instead of coping with the past, architecture should be responsive to the needs of the present and should aim to organize space to enhance human existence in structures expressive of domestic and social life (Horowitz 1998). Moreover, buildings need not be understood as free standing works of art like pieces of sculpture, created by a romantic artistic genius and are not to be judged via photographs of beautiful facades, as expression of pure geometry but they are the three-dimensional compositions designed for human use and their interior spaces are as important as their exterior masses (ibid.). The primary role of architecture in the post-modern world is to comprehend individual nature and community and to create structures which break the monotony of the surroundings (Architectural Review, 1995). Understanding of traditional architecture, honed immemorably by humankind's relationship to nature and integrating architecture with urban and landscape planning help achieve sustainable buildings and social justice (Davey, 2002). The statement 'Less is more' made by Mies van der Rohe and its contradictory 'Less is bore' by Robert Venturi describes the transformation of architectural trend from the early to later half of twentieth century: from a simple and pure modern language to a richer, more complex and pluralistic form (Chan, 1998). Postmodernist architects explore the incompatibilities of style, form, texture, and ornamentation and want an architecture which is more responsive to its context and more relative in style (Sarup, 1993). As a complex relation exists between building form, function and social context, architecture, instead of going into luxury of whim or aestheticism (Davey, 2002) should respond to culture, context and time including linking nature and human kind (Norri and Hawkins, 1996), inner and outer realities (Pallasmaa, 1994) and function and meaning. Therefore, the treatment of the 'transition space' between the public street (open space) and the private house, layout design of building on the plot and the architectural characters of dwellings that define the building density, shape the public space and express the socio-economic status of the inhabitants are equally significant as the interior space organisation. After reviewing numerous literatures on architecture, urban design and urbanism, a theoretical framework to evaluate the impacts of post-modern architecture in the Kathmandu Valley can be established as: (a) Private aspect (internal space layout, functional aspect, climatic and energy efficiency, and so on), (b) Public realm (place making, architectural meaning, earthquake resistant construction, and so on), and (c) Socio-cultural dimension (public education and community awareness).

Salient Features of Traditional Buildings of Malla Period

The early human settlements (grama) located on fallow high ground in the 'Kirata' period (pre-historic time) with expansion into commercial centre (dranga) during the 'Lichchavi' era were further extended, connected by roads and fortified by gates and walls during the 'Malla' time leading to the formation of the medieval town centres in the Kathmandu Valley (Regmi,

1965; Oldfield, 1974; Wolfgang, 1976; Malla, 1978; Slusser, 1982). The urban typology of 'Malla' period characterised by building blocks of three to four storeys built in a row, narrow non-axial streets paved with bricks or stone slabs and houses clustered around the courtyards and Buddhist monasteries (Bahal and Bahil) based on the social status and profession (Jaata) of the people, together with harmonious balance between man-made structure and natural ecology, integration of open and built spaces, and architectural composition of buildings and monuments all have not only supported the existence of a culturally advanced urban society of 'Newars' but have also proved that those builders were extraordinarily skilful as well as capable of integrating visual and functional principles into the social needs (Hosken, 1974).

A typical house of 'Malla' period in the Kathmandu Valley characterised by simple rectangular shape of generally fixed six metres width and of variable length (from four to eight metres) divided by a central bearing wall allows horizontal extension in both directions, maintains privacy for occupants, occupies less irrigable land per household and provides higher density in a given area. Like the layout of the town, the residential units too manifest the spiritual beliefs and hierarchical organisation of the complex symbolic system - the house taking its roots in the underground world, rising above the earth (where people live) and pointing towards the celestial regions; each part of house has also symbolic values such as the foundations representing the King of Snakes, the windows indicating the eyes, the bricks as ninety million stars, and so on together with the religious meaning of domestic objects (Barani, 1994).

The vertical room arrangement in the house is based on the functional requirement of each activity - ground floor (Chelli) acting as a zone of transition where impure castes can enter and is a place for carrying on business (workshop for craftsmen or shop on the street front) as well as for storing agricultural products; first floor (Maata) for sleeping with small lattice windows; second floor (Chota) for multifunction such as working, recreating and entertaining or drying the farm products, with large bay window, and the top floor (Baiga or half storey attic) for kitchen and eating area with family chapel (agama) in a separate room- the most exclusive and the purest area of the dwelling (Figure 2a).

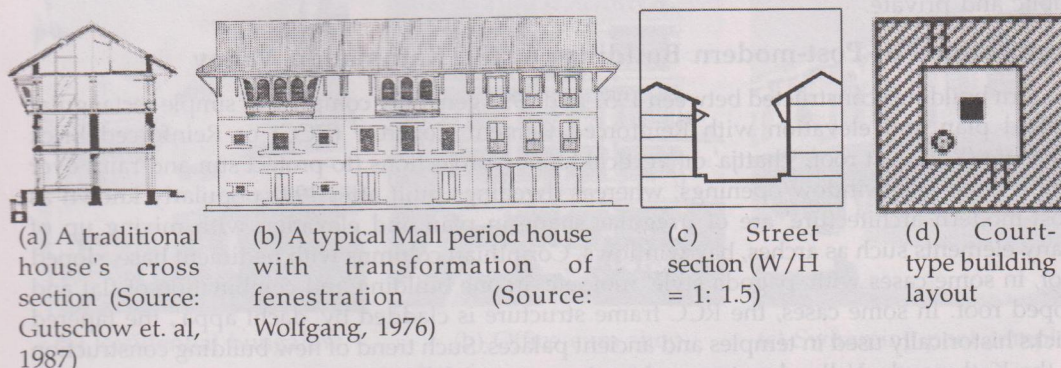


Fig. 2. Salient features of traditional buildings of Malla period

¹The political historic periods of Kathmandu Valley (and Nepal): Kirata period (prehistoric), Lichchhavi period (1st - 9th century), Malla period (13th - 18th century) and Shah period (18th century - now and the Rana ruled between 1846 to 1951).

As numerous daily activities such as eating, working and sleeping used to take place at the floor level in the past, low floor height (1.7 m - 2.0 m), narrow ladder (90 cm wide) and small door and window openings functioned well in the traditional houses. The composite wall of adobe and sun dried brick (outer face) with inside mud plaster (good insulator and exposed brick acts as a good absorbent), heavy door and window frames (absorbing heat on daytime and emitting at night), thick mud mortar on the roof and wooden and mud floor (providing good insulation) coupled with small windows generally on one side of the room have resulted in minimum loss of energy in traditional houses but with insufficient cross ventilation. Besides these design attributes, the traditional dwellings of 'Malla' period have synthesized both visual art and social settings not only in building layout and architectural features but also in terms of urban design and fulfilling community's needs. First, symmetrical façade with larger and more ornamented central elements, dominating double pitched tiled roof (with about 90 cm overhand to protect the walls from rain and sun), carved wooden doors and windows together with brick exposed façade with decorative cornices marking the floor difference all indicate the 'visual art' part of 'Malla' architecture (Figure 2b). Second, common life style, use of locally available materials (brick, mud, wood, etc.) and similar construction methodology have led to the formation of singular composition on building facades with little variations on building bulk, architectural style, roof-lines, etc. thereby not only forming unifying street scene, enhancing volumetric definition and achieving sense of enclosure for pedestrian, as the street width (4 m - 6 m wide) to building height (6.5 m - 8.5 m) ratio lies within the range between 1:1 and 1:2, mostly within 1:1.5 (Figure 2c) but also strengthening social networking and community bond among the neighbours (Shrestha, 2004). Third, the layout of building around the courtyard - court type² - provides higher density and forms community space enclosed by building units (Figure 2d). Such community space in the form of residential courtyards, street squares or Buddhist monasteries comprising of public amenities such as water tap, well, temple, etc. acts as a transition space (semi public/semi-private) between the public street and the private house. In those streets-fronting houses, the podium (a raised platform of between 30 cm-150 cm) acts as a transition zone between the street and house, public and private.

Implications of Post-modern Buildings of the Kathmandu Valley

Modern buildings constructed between 1951 and 1991 generally comprise of simple rectangular shaped plan and elevation with Reinforced Cement Concrete (RCC) or Reinforced Brick Concrete (RBC) flat roof, 'chattja' or 'vertical louver' projections (to protect sun and rain) over simple door and window openings, whereas dwellings built after 1991 popularly known as 'post-modern architecture' are of irregular shape in plan and elevation with mixing up of many elements such as arches, bay windows, Corinthian columns with pediment base, sloped roof, in some cases with 'pagoda style' roof, etc. in one building and combination of flat and sloped roof. In some cases, the RCC frame structure is clad by 'dachi appa', the tapered bricks historically used in temples and ancient palaces. Such trend of new building construction in the Kathmandu Valley has tremendous impacts on different aspects.

Private Aspect

Unlike the traditional dwellings, post-modern buildings are of detached and low rise structure type of varying size and shape with living - dining- kitchen on the ground floor and bedrooms

² A hypothetical model demonstrated by Le Slie Martin and Lionel March revealed that the 'courtyard type' layout of building can achieve five times more accommodation than the 'pavilion type' and one and two third more accommodation than 'row housing type' layout.

on the upper floors. Except for the few cases of applying 'Vaastu Shastra' in layout of building on the site and furniture arrangement in the rooms, new constructions generally lack symbolic meaning and hierarchical organisation of different spaces. The present life style with sleeping in the bed, eating on the dinning table, sitting on the sofa, using ceiling fan and air-conditioning needs higher floor height and larger rooms. However, these buildings are climatically ineffective not only due to use of thin (23 cm and 11.5 cm thick) plastered brick infill wall with cement mortar and RCC (or RBC) roofs but also because of lack of inclusion of energy efficient concept in planning and design of buildings and their detailing.

Public Realm

Architecture is not limited to layout of interior spaces of buildings but it has also public face and community dimension. The treatment of the 'transition space' between the public street (open space) and the private house, layout design of building on the plot and the architectural characters of dwellings define the building density, help the formation of public space and express the socio-economic status of the inhabitants. However, the new emerging trend of building construction in the valley has neglected all these aspects with numerous consequences. First, the trend of mixing various elements - circle, arch, columns, sloped roof, bay windows, etc. - on a single building façade irrespective of the function (individual house, apartment, office cum shopping centre, etc.), location (core area, peripheral area, inside the courtyard, outside fronting the street side, etc.) and the surrounding building context does not help achieve human scale and proportion (Figure 3). Such task of duplicating anything and use for any purpose indicates the cynical attitude to history and degrades the values of those traditional elements. Moreover, most of these decorative elements such as double height Corinthian columns, arches, etc. and the way they are decorated without any structural or functional meaning other than aesthetic purpose do not constitute the continuation of traditional architectural vocabulary of the valley.



(a) Residential bungalow



(b) Office cum shop



(c) Swimming pool complex

Fig. 3. Mixing up of different elements into one single building irrespective of their locations and uses

Second, post-modern buildings with variations in building size, shape, height, bulk and setback and plinth level from the adjacent buildings together with use of different materials and construction technology are not only difficult to relate with the surrounding existing houses but they have also destroyed the sense of enclosure, the singular composition of continuous street walls, volumetric definition and unity in street scene particularly in the historic core area and have formed the chaotic streetscape and public space in the peripheral new settlements

(Figure 4). Destruction of traditional city fabrics means loss of cultural value and deterioration of sense of place as well as decline of city economy in the long run. Radical shift in building form and style, entry way location and building decoration and detailing in new buildings makes the sense of orientation, infrastructure provision, cultural continuity and harmony in cityscape extremely difficult. Individual buildings how well constructed do not add to a worthwhile whole unless they are linked with the surrounding buildings and local context. Absence of well defined semi private or semi public spaces in the new planned and unplanned residential precincts has reduced the scope of socialisation, individual relaxation and assistance among the neighbours. Moreover, transformation of traditional houses even located inside the courtyards into post-modern buildings with commercial uses thereby increasing building density and vehicular use has caused the conversion of the public squares, residential courtyards and Buddhist monasteries, used for multipurpose activities into parking lot, garbage dumping site and stranger's gathering place.

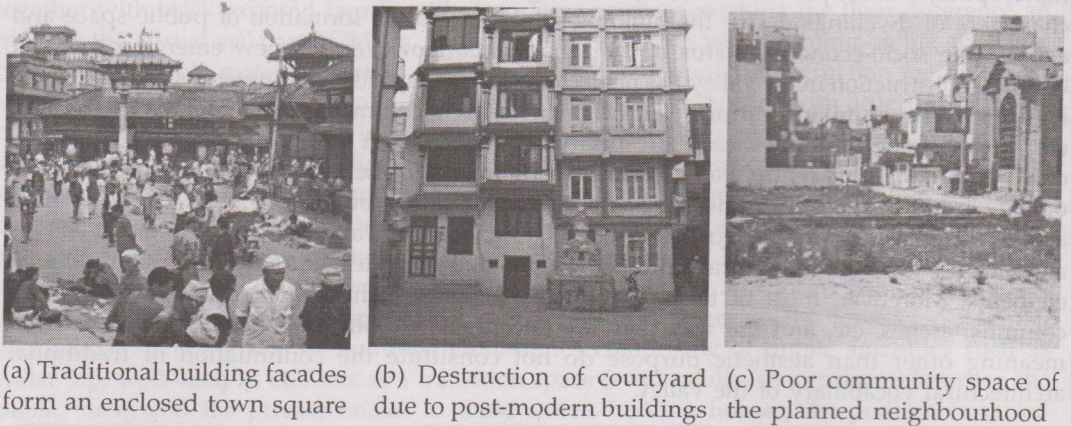


Fig. 4. Comparison of public realm in traditional architecture and post-modern architecture

Third, placement of post-modern buildings on the site with setback from all the sides - pavilion type - results in achievement of lower density and formation of fragmented open spaces between the two buildings, which is hardly useful other than for lighting and ventilating building units (Figure 5). For instance, the planned residential neighbourhoods of 'Kuleswore' housing and 'Gongabu' land pooling projects (both implemented by the government) have gross density of 159 ppha (persons per hectare of land) and 143 ppha respectively compared to the gross density of 1185 ppha of 'Manjushree Tole' (historic core area) of Kathmandu (Shrestha, 2005).

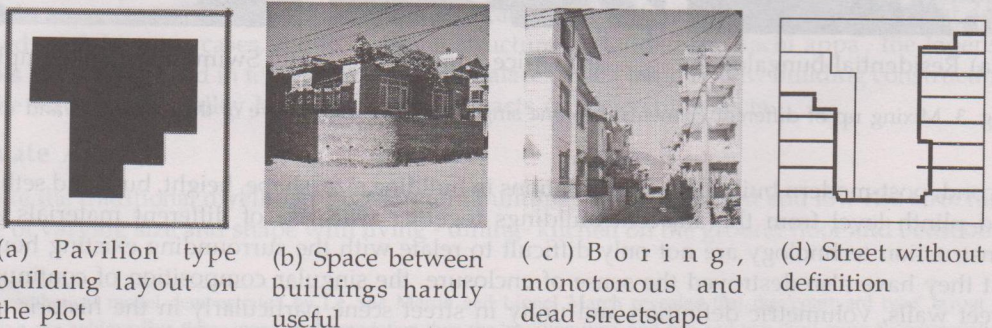


Fig. 5. Consequences of post-modern architecture in the public realm

In terms of earthquake vulnerability, traditional houses made up of bricks and wood, despite simplicity and symmetry in plan and elevation, double timber frames around the door and window openings (kept at least one meter away from the corner) are weak against seismic force due to shallow foundation and absence of damp proof course, poor bonding of mud mortar between the facing and inner brickworks, of different size and lack of ties at corner walls, heavy tiles in mud mortar on the roof and poor strength of building material used. In the process of subdivision of these traditional buildings, new door and window openings and conversion of ground floor into a habitable room (or shop) are carried out either by removing significant parts of the load bearing walls, or adding new floors often of different materials, floor height and construction technique on the top of the existing structure. In this whole process of rebuilding - creation of soft storeys, disturbing the load transferring system, discontinuity in lateral stiffness and strengths resulting in torsional effect - has not only put the structures at higher seismic risk but has also converted the narrow pedestrian lanes, street squares and courtyards into 'death trap.'

Numerous elements added on the outer façade of post-modern buildings for the sake of aesthetic, in most cases are 'non-structural' and are not tied up properly with the main structural system making them more vulnerable to seismic hazard, besides increasing the construction cost. The threat is not only for the building occupants but also for pedestrian and neighbours. Moreover, the way post-modern buildings are constructed has numerous defects - ground floor kept free of shear walls for commercial uses creates a 'soft storey;' window fixed from column to column on upper floors after constructing facade wall upto the sill level forms a 'short column;' and the whole structure is often characterised by 'weak column strong beam.' Lack of quality control on building material and construction work, poor workmanship and absence of site supervision by qualified professionals have further increased the seismic vulnerability of such structures.

Socio-cultural Dimension

Responsive architecture through conserving cultural heritage, continuing traditional architectural vocabulary, building earthquake resistant construction and energy efficient dwellings educates ordinary people, brings community awareness and finally helps develop the habit of taking care of built environment by the community themselves. However, this socio-cultural dimension has hardly been realised in the recent trend of architectural design and built environment formation process. The reasons are numerous. First, numerous responsible institutions - Schools of Architecture, professional bodies and the concerned government bodies including local municipalities - having poor technical, financial and managerial capabilities are little aware about this dimension of architecture. Numerous large scale building and urban development projects are awarded to the engineering firm and the design schemes are judged based on the singular aspect of cost rather than quality of design and its implication on wider socio-cultural dimension. Any engineering profession or even the home owners themselves without architects can build the present styled buildings by hiring the masons and carpenters. Moreover, almost all the architectural schools of the valley are still following the outdated syllabus using old teaching techniques of 'chalk and talk' in the 'factory model' buildings. Second, numerous negative consequences of post-modern architecture in the valley can not be addressed through the existing building bylaws, which is old and outdated. As high as 90% of construction is non-engineered and unmonitored and nearly 30% of construction is illegal (CBS, 1997). The building form with different vertical setbacks allowed by the existing bylaws itself is vulnerable to earthquake. Absence of urban design guidelines and control on architectural design in the new settlement (housing and land development) has

resulted in no differences between haphazard growth areas and the planned development except in the provision of vehicular access to each plot or house in the latter case. Third, as there are hardly any good examples of architecture and urban design (the traditional fabrics are under destruction whereas the new one has also numerous weaknesses) the students in the architectural schools as well as the general public take inspiration from the existing built environment and thus give continuity to wrong practice.

Conclusions and Recommendations

Post-modern architecture has emerged not only to rectify numerous mistakes committed by modern architecture but also to provide a fresh perspective on environmental design as a part of urban design focusing on human component and fulfilling socio-economic needs. However, the present rapid growing trend of building industry in the Kathmandu Valley has failed to acknowledge it. Five decades of modern age are enough to destroy architectural heritage created and preserved over centuries in the Valley. Failure in public dimension of architecture has created new set of problems - discontinuity in traditional architectural vocabulary, destruction of community spaces (squares and streets - earlier used for multiple activities) and intensification of earthquake vulnerability. Academicians, practitioners, and government officials including the existing legal framework, instead of mitigating the negative consequences of post-modern buildings are continuing those activities that not only accelerate the present wrong trend of building design but also hamper educating community and bringing public awareness.

The Kathmandu Valley urgently needs the concept of urban design focusing on environmental quality, natural hazard and cultural heritage, in planning and managing urban growth at macro level and within this framework, design guidelines for public dimension of architecture should be developed by synthesising the 'visual art' based on traditional architectural vocabulary and 'social setting' to suit the present way of life and then these guidelines should be integrated and implemented both in theory and practice.

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CLEANER PRODUCTION IN SRI LANKA: ROLE OF HIGHER EDUCATIONAL INSTITUTIONS

K N H P Liyanage and T S S Jatunarachchi*

ABSTRACT

Cleaner Production (CP) is the continuous process of implementing an integrated preventive environment strategy applied to processes, products and services to increase efficiency, minimize waste and reduce risks to humans and the environment. Developed countries have already gained benefits by practicing this concept. Sri Lanka is yet to introduce this concept to its industries and the seeds of this can be sown in the industry effectively by transferring knowledge to a broader spectrum of the population including students, industrialists and working population in both public and private sector. This paper emphasizes the necessity for promoting a cleaner production concept through education in order to achieve sustainable development of Sri Lankan industries.

1. Introduction

Before the 1980s, energy and pollution were considered as two separate issues. Energy specialists were concerned about the promotion of energy efficient technologies and the development of alternative energy resources and technologies, while environmental engineers were concerned with pollution generation and control. In the past, pollution control was seen as the key to a cleaner environment. Pollution control refers to the measures taken to manage pollution after it has been generated. Over the past few decades, the concept of pollution prevention has become an important issue. Pollution prevention is the use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. It includes practices that reduce the use of hazardous materials, energy, water or other resources and practices that protect natural resources through conservation or more efficient use. Then the concept of Cleaner Production (CP) evolved and this concept was concerned about the proactive approach to environmental pollution instead of the traditional practice of reactive approach of "End of Pipe" treatment

The CP approach includes conservation of raw materials and energy, elimination of toxic materials, and reduction of the quantity and toxicity of all emissions and waste before they leave a process. In the case of products, cleaner production helps reduce impacts along the entire life cycle from raw material extraction to disposal. The cleaner production approaches that can be applied in production processes include recycling, process modification, plant operation improvements, and input substitution. Cleaner products, on the other hand, can be obtained by ways such as redesigning the products, modifying the production processes, and changing the chemicals used to less hazardous ones (Kumar and Visvanathan, 2000).

Implementation of CP activities in the industries started in the early 1980s. In response to increased environmental pollution problems, industry has carried out many CP initiatives. CP helps to reduce level of pollution and environmental risk. More efficient use of materials and process optimization result in waste and emission reduction, which in turn result in lower operating costs. The focus on occupational health and safety also has positive effects on worker productivity and fewer accidents. Wherever an activity involves the use of significant amounts of energy/water or other resources, or results in the generation of wastes and

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emissions, cleaner production can be used to reduce environmental impact, and often to reduce costs. It offers great potential for companies to improve their environmental performance and gain community support, while increasing economic efficiency and productivity.

Cleaner Production concepts are growing in popularity throughout the world. European countries and some of the Asian countries such as Thailand, India have already applied this concept appropriately and reaped benefits, which have greater impact on their economy. However, this concept is still not properly practiced in Sri Lankan industries due to various reasons. Therefore, there is a strong need to introduce cleaner production concept to local industries.

The aim of this paper is to emphasize the necessity for promoting cleaner production concept through education in order to achieve sustainable development of Sri Lankan industries. Furthermore, this paper also presents a study carried out for printing industry in Sri Lanka.

2 Challenges and Barriers in Implementing Cleaner Production in Sri Lanka

Despite the known benefits of Cleaner Production, there are still several barriers to successful development and implementation of Cleaner Production programs. Project SMED [Small and Medium Enterprise Developers - joint collaboration between the Federation of Chambers of Commerce and Industry of Sri Lanka and Friedrich-Naumann-Stiftung of Germany] has carried out several CP assessments for Sri Lankan Industries like Food and Beverages, Steel, Tea and Hospitality industries. During the assessment period, it has identified some barriers that were encountered by the consultants and some of them are (Cooray, 2003);

- **Systematic barriers**

Lack of professional management skills, low quality of record keeping

- **Organizational barriers**

Concentration of decision making powers

Over emphasis on production

Non involvement of workers

- **Technical barriers**

Limited technical capabilities

Limited access to technical information

Limited or lack of skilled man power

Lack of in-house monitoring

Deficiencies in maintenance

- **Economic barriers**

Financial Soundness of the company

High cost and low availability of capital for CP implementation

Apart from these barriers in Sri Lanka most of the people often hesitate to change an already established process or methodologies. Another important factor is the lack of awareness of CP and its benefits. Therefore, it is important to recognize these barriers to implement Cleaner Production projects in Sri Lanka and the following actions can be taken through higher educational institutions to overcome certain barriers.

- Train adequate CP consultants and trainers who can actively participate in CP projects
- Encourage demonstration project whenever possible
- Promotion of CP through higher Educational Institutions

3. Promotion of CP in Sri Lanka Through Higher Educational Institutions

The promotion of CP is greatly important from the national point of view. Sri Lanka is going through a period in which great emphasis is being placed on the development of industries at all levels in order to become a Newly Industrialized Country within the shortest possible time. Many industries, both in the public and private sectors, still use the traditional and outdated end-of-pipe technologies and treatments, which hamper the competitiveness of their products in the local and international markets. As a consequence, given the present market forces and technological advancements, their future survival is uncertain. In the path to achieve a higher level of productivity at the national level, it is important for Sri Lanka to acquire appropriate concepts and tools such as cleaner production, life-cycle assessment and eco-design and train her business community to achieve sustainable industrial development.

In order to promote cleaner production throughout the country, education and training can play a vital role. Availability of such programmes at higher educational institutions will facilitate the transfer of knowledge to a broader spectrum of the working population both in the public and private sectors by observing its mission and achieving its objectives. Many of the CP opportunities do not need major investments yet they are not pursued by factories because of a lack of skills on how to build cleaner production projects, lack of top management commitment, lack of time and lack of allocation of responsibilities for project conception and engineering (Ramjeawan, 2004).

Education and training activities are crucial for the promotion of CP and different strategies can be used to integrate this concept in university programmes. Students and university staff can gain practical experience by assisting industry in CP activities. They must play a strong role in Cleaner Production education, research, policy development, information exchange and community outreach. The role of universities in Cleaner Production promotion is not limited to realigning the formal degree programmes. The Higher Educational institutions should play a primary role in activities such as:

- Organization of short-term training programmes for technical personnel in the industries to disseminate the knowledge and provide necessary skills in Cleaner Production.
- Development of innovative undergraduate and post-graduate training programmes focusing on Cleaner Production.
- Organization of Seminars and workshops for local industries to facilitate the exchange of information and research findings and demonstration of successful projects.
- Development of proper CP materials (self learning, guidance manual, CD-ROM etc.) and if possible make them available in the local language.
- Development of active research and collaborative pilot projects with local industries.
- Compilation and dissemination of up-to-date information on Cleaner Production practices and technologies.
- Organization of panel discussions on specific issues to promote dialogue between industry, government and academia on Cleaner Production.

Department of Mechanical Engineering of the Open University of Sri Lanka has already introduced CP courses for undergraduate and postgraduate degree programmes in Mechanical and Industrial Engineering in collaboration with National Cleaner Production Center, Sri Lanka. Furthermore, the department has already developed CP materials for distance learning. On the other hand, demonstration projects are an important vehicle for education and training

involving participation at all levels within a company and of academics from research and educational institutions. Industry would benefit from better interaction with the academic community through the presentation of results of their successful projects and studies.

4. Case Study - Printing Industry

To demonstrate a successful project, a case study was selected from research undertaken by a postgraduate student as part of the Master of Technology in Industrial Engineering programme at the Open University of Sri Lanka. This project was conducted for the printing industry to increase overall efficiency, profitability and reduce environment impact through CP. For reasons of commercial confidentiality, the name of the company is not used in this paper.

This case study demonstrates the application of cleaner production to the printing industry. In this project, cleaner production audit was conducted by the Keerthi (2003) to find out the possibilities of applying cleaner production solution to achieve resource efficiency, process effectiveness and environment friendliness of processes at the printing press.

The press is catering to a total annual requirement of over 36 million A4 size equivalent pages for textbooks and other documents for more than 20,000 student registration packages. In this process the press has incurred a total material cost of US \$ 190,237 and total cost of printing US\$ 377,485 in the year 2002. It was observed that major cost component (US\$132,847) is associated with the papers. It is nearly 70% of the total material cost as shown in Figure 1.

There were many cleaner production opportunities at the site. It was observed that the total waste of paper is nearly 20% of the total consumption, and the reduction of paper waste at least by 50% will save nearly US\$13,330. The waste of paper occurs at two stages, namely 12% at the cutting stage and nearly 8% at the printing stage. Waste at the cutting stage could be reduced drastically either by selecting papers minimizing off cuts or altering book sizes. Normally it is very difficult to find paper sizes suited to the requirements of the local market. Therefore, altering book sizes, to some extent, will reduce the number of pages of a particular book and subsequently reduce the paper cost. Furthermore, this will help to increase the utilized area of films/tracings and plates.

The printing operations use hazardous chemicals. Though the cost component associated with the chemicals is nearly 1% of the total material cost, the environmental effects are very large, since all used and waste chemicals are discharged into the normal drainage systems, which lead to inland channel. By implementing suggested CP options, environmental effects could

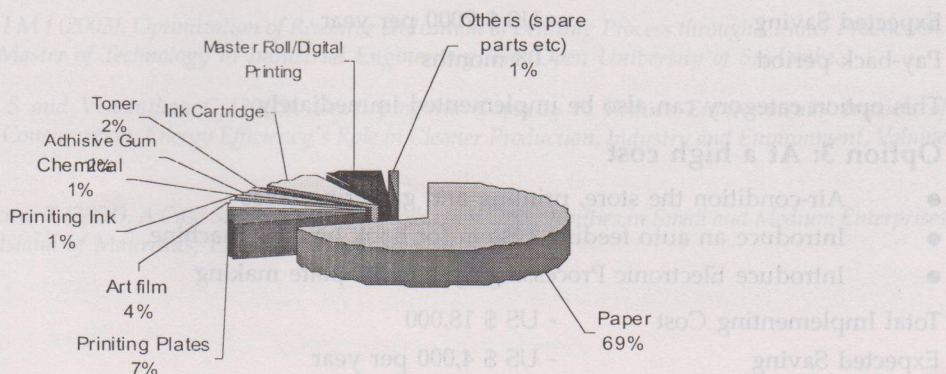


Figure 1. Material Cost Components for year 2002

be significantly reduced, while receiving a financial gain. This study recommended three CP options based on identified root causes for wastes and environmental effects. These options have been prioritized considering technical, environmental and financial feasibility.

Option 1: At a low cost/negligible cost

- Select the paper size minimizing off cuts
- Plan job arrangement system enabling waste minimization, especially chemicals
- Clean machinery and premises regularly
- Implement proper measuring methods specially for chemicals
- Use quality inks/papers
- Implement regular machine inspection system
- Implement planned maintenance system
- Improve storage system
- Introduce First In First Out system especially for stores

Total Implementing cost	- US \$ 700
Expected Saving	- US \$17,750 per year
Pay-back period	- 01 month

This option category can be implemented immediately.

Option 2: At a medium cost

- Use as far as possible tracing papers instead of film making
- Optimize the utilization of paper and films altering the book size
- Recover silver and recycle chemicals
- Conduct experiments and find out the optimum usage of chemicals
- Educate the employees about waste minimization/cleaner production
- Dispose used developer as non-hazardous waste
- Recycle waste inks or dispose as non-hazardous waste
- Rewarding system to motivate the employees who contribute to cleaner production

Total Implementing cost	- US \$ 5000
Expected Saving	- US \$ 7000 per year
Pay-back period	- 08 months

This option category can also be implemented immediately.

Option 3: At a high cost

- Air-condition the store, printing and gathering areas
- Introduce an auto feeding system for book binding machine
- Introduce Electronic Processing System for plate making

Total Implementing Cost	- US \$ 18,000
Expected Saving	- US \$ 4,000 per year
Pay-back Period	- 4.6 years

It can be seen that the financial gains through options 2 and 3 are very less with respect to implementing cost. However, these options will improve environmental performance. Finally, this study suggested option 1 and 2 to be implemented immediately and option 3 during a later stage. This combination is expected to save US\$ 28,500 (7% saving) annually while reducing environmental effects by 70%.

5. Conclusion

Cleaner Production concepts are growing in popularity through out the world. The industrialized nations have already adopted this concept for their sustainable industrial development and this involves planning for constant improvement of productivity, optimize the resource efficiency and reduce risks to humans and environment. However, Sri Lanka along with some other countries in the South Asian region is lagging far behind in this respect. Therefore, there is a strong need to introduce cleaner production concept in local industries. This paper concludes with the recommendation of the necessity for promoting a cleaner production concept through education in order to achieve sustainable development for Sri Lankan industries. The role of universities in Cleaner Production promotion should not be limited to realigning the formal degree programmes. Universities can promote the CP through short term training programmes, seminars and workshops, self-learning materials, pilot projects and demonstration projects. A short-term goal in the promotion of CP is to set up one effective cleaner production demonstration project that will help the industrial sector to understand the concept and benefits of the CP.

On the other hand, 'Educate the educator' activities are important in order to make educational planners and teachers able to incorporate Cleaner Production in the curricula. Academicians themselves need some training in order to be able to spread these concepts. They also need access to relevant resources, demonstration, workshop and research programmes for the application of Cleaner Production concepts into their areas of education.

Acknowledgement

The authors wish to express their thanks to Mr. I M J Keerthi for selecting a CP topic for M.Tech research project and providing necessary information for a case study.

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TRADITIONAL MATERIALS AND SOME TECHNICAL SOLUTIONS TO CONSERVATION OF CULTURAL MONUMENTS

*Ar. Rabin Giri**

Introduction

Monuments are susceptible to many forms of decay. There may be various causes of decay ranging from natural to manmade which is mostly due to the lack of awareness regarding values borne by the monuments implying negligence. Conservation of any monument is multi faceted program based on general theoretical guidance. It is always necessary to answer the question 'Why to conserve?' before solving the problem 'HOW?' However, it is important to assert the right selection of technology and methods through vigorous studies of technical advancement in science and technology and prevailing local and international practices. Since the indigenous technologies are very simple and harmless and sustainable there should be effort to promote these for the protection of monuments.

Scope of the Article

This article is not intended to elaborate the theoretical aspects, which has so far been developed nationally and internationally through Charters, Conventions, and Recommendations. The article is limited to assessments of the technical solutions to conserve the Monuments by preventing further decay, retention of extant materials, and consolidation of structures through technical interventions seen in Kathmandu Valley.

Conditions of Monuments

The condition of monuments of Kathmandu valley are different. It may be categorized as following:

1. Very good condition- restored within 3 years
2. Fair condition - which were restored in 3 to 5 years.
3. Bad condition - which were restored in 5 to 10 years.
4. Dilapidated - Not restored for more than 10 years
5. Collapsing- not restored for more than 50 years

Actors of Damages and Decay to Historical Monuments

It has been the concern of the preservers and restorers to protect the monuments from natural aging, environmental, biological and other microorganism. Besides these factors, in the developing country like Nepal, causes of damages and decay are different from those of the developed countries. Illiteracy, absence of awareness, lack of technical knowledge changing socio-cultural values of society as well as the use values of existing small and big monuments add to the rapid process of damages and decay. Conservators both institutions and individuals in Nepal are facing problems in efforts of minimizing the damages to historical monuments.

Vivid contemporary issues and rising problems in conservation of Nepalese historical buildings are:

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1. Changing ownerships of the old residential buildings

- a. Division of properties among the kin members
- b. Sale of property
- c. Migration of the building owners affecting the due care of the old buildings
- d. Rental practice of the building owners to incompatible small businesses.

2. Partial damages due to misuse of residences and rest houses (Pati, Sattal and Chapat)

- a. Inappropriate division of the buildings.
- b. Removal of building elements and replacement
- c. Incompatible use by community.

3. Ruins due to neglect, vandalism and theft (Both in secular and religious buildings)

4. Modification of the monuments - mainly in traditional residential building

Monuments are modified for various reasons but mainly for the least preferable acts of reconstruction and demolitions of the parts in the process of addition of the floors with incompatible materials, thus destroying the overall feature of the building.

5. Unscientific methods of record keeping during restorations by the agencies.

This happens mostly because of the lack of skilled manpower. It is difficult task to keep record of each items removed during the restoration and it even becomes difficult to replace the items at exact location in case of restoration by anastylosis.

Such technical difficulties destroy not only authenticity of the historical buildings also but brings the unexpected changes in scale and patina.

6. Lack of background research and negligence in case of small monuments by the conservators.

There are substantial instances of malpractice of neglecting small monuments lying next to the important and physically 'big monuments' causing removal, relocation and burying.

7. There are other reasons such as lack of coordination among line agencies, funding agencies, dictation of rules and regulations, recommendations, practiced in the developed countries.

These problems are more dangerous than the malpractice seen in the technical aspects during conservation.

Here are some collection of architectural and structural solutions to the typical damages to the elements and material in traditional construction. However, it is the job of the technical people to judge and practice such technical interventions with complete historical research.

Traditional Materials and Conservation Techniques

Architectural And Structural Solutions To The Typical Damages To The Elements And Material In Traditional Construction

Elements & Materials	Types of Damage	Types of Corrective Measures	Figure
Foundation	Cracks/spreading outward	Installing ring-beam embracing existing foundation	1
Brick Wall	a. Outer leaf bulging/cracks	Reconstitute with the same material and add tie between inner and outer leaf of the traditional wall	2
	b. Weak load bearing wall	1. replace with new wall or 2. consolidate the existing with wooden post and beam.	3
	c. Efflorescence	Apply True Poultrice	4
	d. Dampness in ground floor wall	Install DPC (metal or concrete)	
Floor joist	Absence of wooden keys or rotten ends at supports	Replace the floor joist or Join the new piece of wood to the old joist with fishing joint.	5
Struts	a. Damaged foot	Cut out the damaged piece and add new piece of similar wood to the extant piece	6
	b. Weak	Backing strut with metal strip	7
	c. Missing	Replace with plane strut if carving pattern unknown or search for similar strut pattern and make carvings (architectural conservation)	8
Columns	Damaged foot or carvings	Remove the damaged part and add new with similar wood	9
Purlin/Rafters	Weak at carpenters joints	Strengthen with fishing joint	5
	Displaced due to missing keys		
	Rotten/sagging	Replace or cut the rotten part	
Eaves Tiles	Loose or missing	Nail the eaves tiles	10
Roof	Leaking	2 Layers of tar-felt on boarding	
Roof Tile bed	Weed growing	Spray of herbicide 'karamex'	
Tile	Porous	Dip in dilute silicone for 30 min.	
Stone steps	Worn-out edges	Reverse the stones and replace	
Wall plate	Displaced	Tie inner and outer wall plate making ring beam	11
Roof joists	Displaced	Nail metal sheet to the rafters	12
	Painted wooden component	Cleaning painting	13

Traditional Materials and Conservation Techniques

Architectural And Structural Solutions To The Typical Damages To The Elements And Materials

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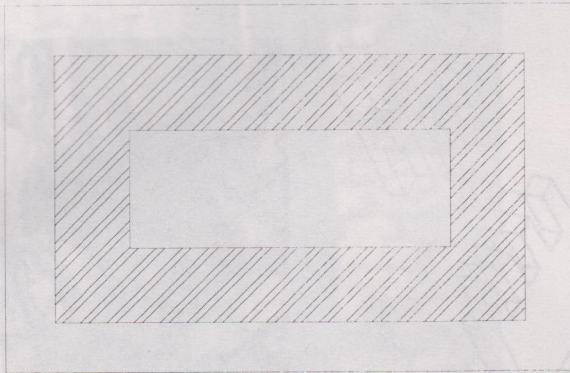


Fig 1

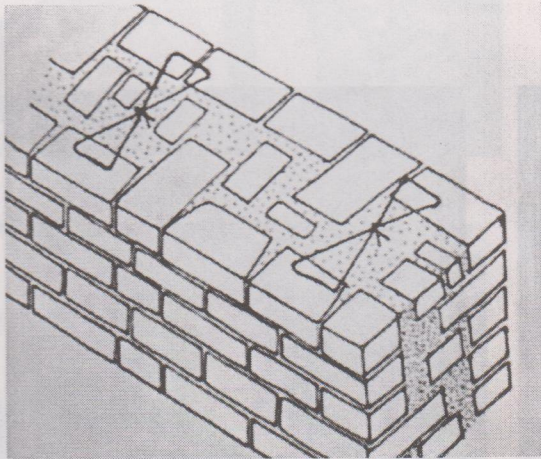


Fig 2

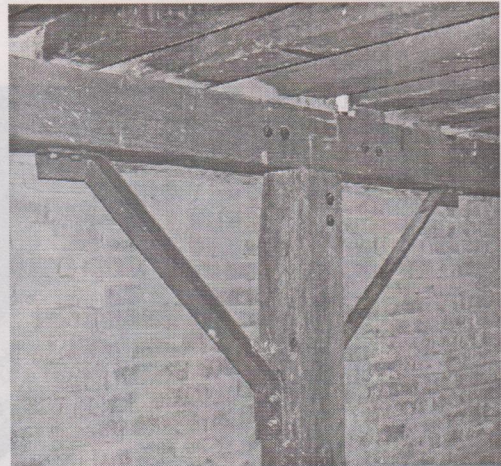


Fig 3



Fig 4

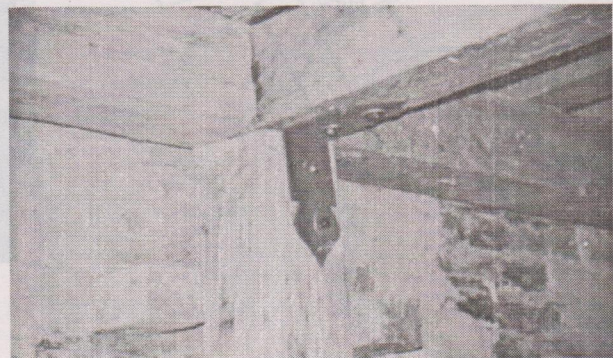


Fig 3

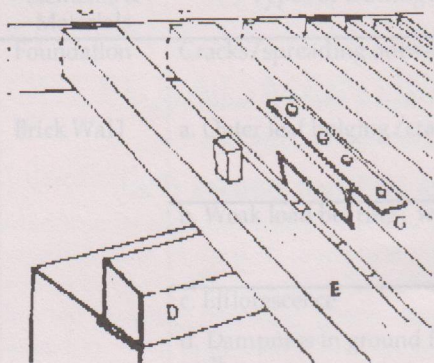


Fig 5

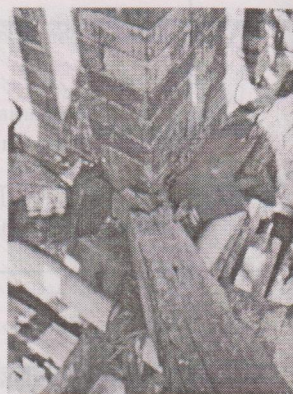
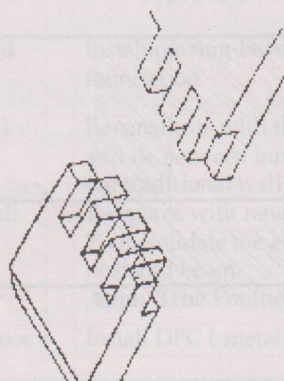


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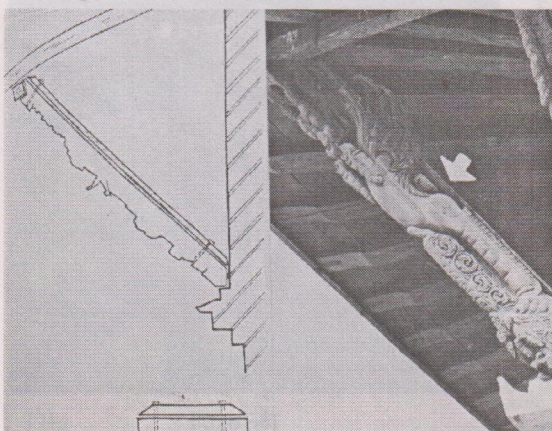


Fig 7



Fig 8

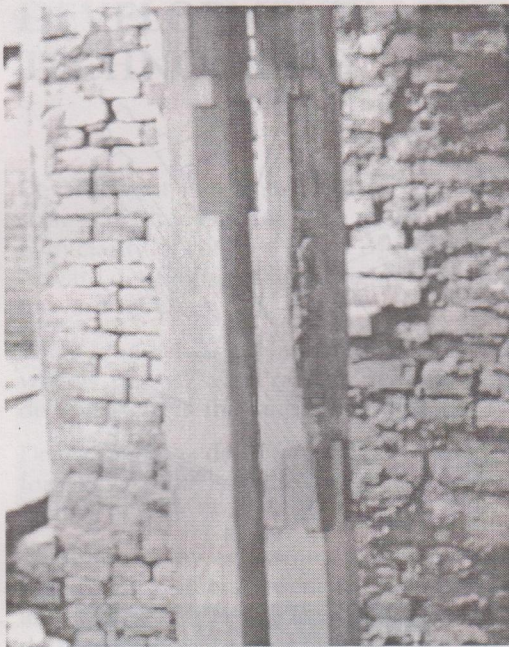


Fig 9

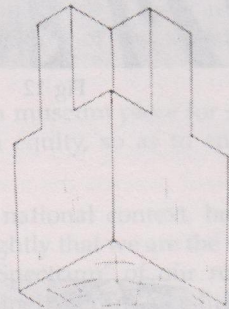
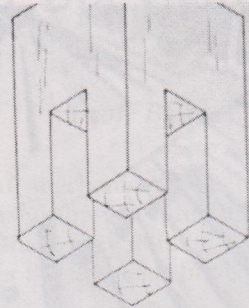
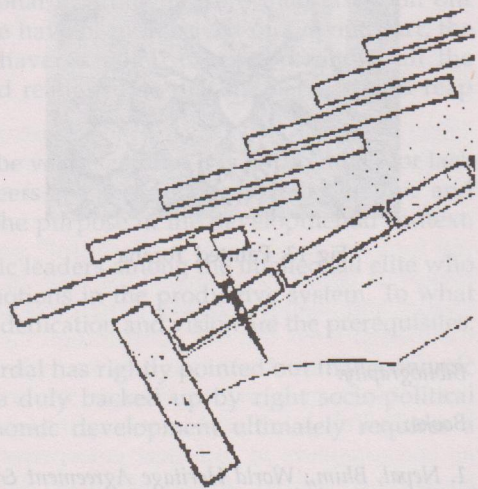


Fig 10



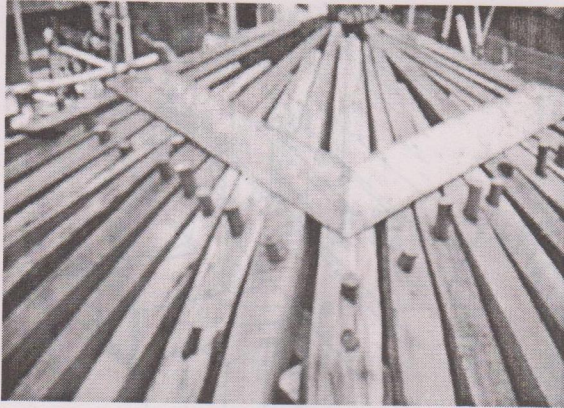


Fig 12

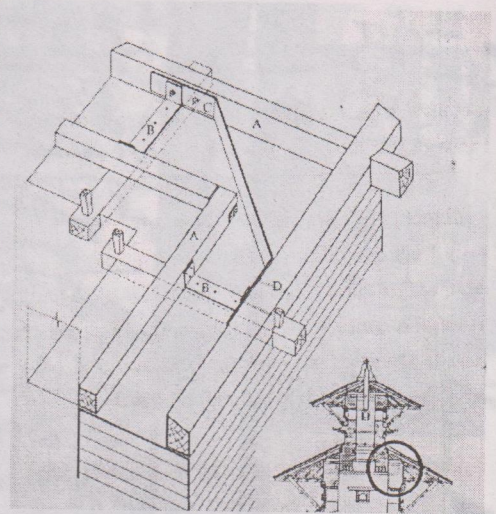


Fig 11



Fig 13: Painted Torana



After Cleaning to original state

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Photo: Courtesy Kathmandu Valley Preservation Trust, Lalitpur & Department of Archaeology, Kathmandu

DEVELOPMENTAL VISION VIS-À-VIS NEPALESE TECHNOCRATS

*Prof. Bharat Sharma**

Development is a systematic process and a well thought out mechanism which ushers in socio-economic enhancement of the status of a nation whereas vision is a futuristic objective with clarity of concept. It is a dynamic quest to achieve something very definite. Vision is an onward developmental paradigm which does not look back over the shoulders but is invariably forward looking.

There is an intrinsic relationship between Development and Vision. Both of them are dynamic wheels of the same cart of national stride towards better future of the society. In fact development is the tangible fruit of our vision.

Development is definitely not a slogan, decorative element or a museum piece for show. It is for delivery of useful goods to the society at large, based on equity, so as to enhance the quality of life.

There are many actors and activators of development in the national context, but without undermining others, we engineers and technocrats could claim rightly that we are the vanguards and carriers of developmental works. But the "Niche" and "Spectrum" of our role play is definitely huge. The coveted National Stride demands greater inertia from Nepali engineers' community, not to imply that our contribution has been below par so far. But definitely our potentiality has not been fully maximized for national upliftment. More than laxity on our part it is very often the right environment which we have been deprived of. On our part, the element of innovation is a key issue which we have to take care of. But above all the developmental paradigms have to be redefined and realigned so that the nation could reap the best benefits of our professional endeavor.

If society is somewhat paralyzed to-day, then let us be very clear that it is not so much for lack of means but rather lack of purpose and we engineers and technocrats have a dynamic and constructive role to play to redefine and highlight the purpose in the developmental context.

In all the South Asian countries there are enthusiastic leaders among the intellectual elite who are conscious of the need to harness nationalist emotions in the productive system. To what extent their efforts will be successful is uncertain but dedication and vision are the prerequisites.

The great economist and social scientist Gunnar Myrdal has rightly pointed out that economic development cannot be comprehended unless it is duly backed up by right socio-political framework. In abstract it could be said that economic development ultimately requires a change in the way people think, feel and act.

Let us ponder over where we Nepalese Engineers are involved. Basically our area of involvement in the developmental context is "infrastructures development". This is a major area which provides the backbone in nation - building. But a word of caution is that simply a dedicated engineering profession with idealistic thinking and ethical norms is not good enough; the National Government has to provide a conducive environment for the profession to play a greater meaningful role in nation-building.

With the advent of globalization and Nepal's entry into the WTO family, our engineering community is facing bigger challenges in the context of "Trade in Services". The service sector's

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commitment and its capacity build-up is the call of the hour. As of now we are engaged in an unequal race so the nation in general and the engineering community in particular have to come out with very innovative, dynamic and pragmatic vision to face the tough global competition. Development should not be taken as a poetic dream whose fruit is to be enjoyed mentally.

Developmental delivery is very much a tangible result to the society and happens by contrivance and not by chance. The Government has to realize this harsh truth and come up with appropriate policies and Acts and other needful so as to create a conducive environment for the technocrats to come out with the right vision of development. Otherwise it will be like asking someone to swim with his hands and legs tied.

E.F. Schumacher has very rightly pointed out in his essay "Conscious Culture of Poverty" that over the last fifty years an implicit doctrine of development has been drummed into our ears that growth of income serves as the very criterion of progress and to live an agreeable life, you have got to be rich, which is extremely ironical.

Let us admit that the paramount prerequisite for development is conducive environment, not exclusively economic but rather socio-political. When a society (nation) is under stress it simply cannot provide the above-mentioned criterion. Let us embrace the fact that a society in perpetual state of anger and distress is not a stable society. As of now this is the situation we are in. Perhaps we technocrats may not have a deciding say over it because it engulfs the society as a whole. So where do we stand in this rather hostile situation? How best can we devise technocratic vision to usher in the dawn of development in the most pragmatic way? The opportunities are less whereas the constraints are more. Even for sectoral vision, it requires lots of efforts on our parts. The least we could do is to adhere to our professional ethics and norms and within our domain come out with the correct vision, mission, planning, design and appropriate technologies. We do not have to appease decision makers but just follow professional norms.

Though the existing facilities and infrastructures are not up to the mark, technocrats could still devise a modest way to get involved in innovations and researches so that they could come out with appropriate technologies and techniques suitable to the country even in difficult economic times. This is a big challenge in all developing countries. As Schumacher has strongly put forward "small could be beautiful", perhaps UN's MDC (Millennium Development Goals) makes us obligatory to fulfill the task. In the area of basic services the role of infrastructure, energy and shelter becomes more pronounced. So far most of us are involved in the above-mentioned areas but our contribution has not been effective enough. It is due to the reason that we have not been visionary enough on our part and the Government's role as facilitator has not been encouraging enough. We do not have control or say over the Government's role but with little bit of soul-searching it becomes obvious that even we have not played our part as entrepreneurs in technical enterprises. Mostly we get bogged down in mere ritualistic stereotyped routine works which do not have an element of vision at all. In all humility perhaps it is essential to state that it is not sermon or preaching on my part to fellow technocrats. I am also party to the limbo and stagnation faced by our profession. In the global context too we have been lethargic though the race is already on for competence and capacity building. Being a member of WTO puts us in a more challenging role for which we are the least prepared. Let us chalk out our visionary - stride in this global unequal race. Our preparedness is the visionary call of the hour; preparedness comes with definite policies, strategies and dedicated execution. Professionally we owe our responsibility to the nation for social delivery. So wherever we are and whatever work we are involved in, we have to come out with innovations and sustaining technologies which can do wonders in our delivery. What it needs is concentrated and judicious efforts on our parts.