CONCLUSIONS

Poor land management practices, coupled with denudation of forest areas apart from chronic problems of rising population and illiteracy, have led to the degradation of land in our country. As a consequence, the forest cover, which undoubtedly is very important for economic development and environmental stability, has gone too low for our country. In spite of this, unfortunately, the rate of deforestation is too high as compared to reforestation efforts. Piecemeal efforts till now have largely failed to halt the march of degradation, which incidentally is the most severe in the fragile mountainous and hilly ecosystems of the country, especially the fragile Shiwalik range of the lower Himalayas.

Based on the available periodic statistics and the national scenario, especially as regards conservation of soil and water-the two most important life Support Systems-the prevailing conditions have assumed a serious proportion. Since it is relatively a recent problem, especially in view of exponentially increased urge for excessive harvest beyond the carrying capacity, the measures adopted for its conservation appear to be at their trial stage.

Though the technical knowledge and expertise for conserving the soil and water resources on one hand and for stopping the land degradation on the other do exist yet, they only remain confined to official files with the experts rather than being duly applied in field. In order to put these into practice, the involvement / cooperation of local people assumes greater significance. It is also true that the locals of the project areas are the most important factors of influence in the degree of degradation or conservation; not only by being responsible for the works implemented by the government but also by their own agricultural operations and other activities. It appears that the Government alone cannot solve such a complex
gigantic problem without active and meaningful involvement of the people. The accepted failures have been generally at those places where the local skills, knowledge and expertise have been ignored during the setting up of the engineering interventions. Wherever success was achieved, socio-economic parameters were considered as the key indicators, which, being based on various unsustainable inputs, are short-lived.

Basis of sustainability of the life support system is a firm ecological base. In the absence of any evaluation of ecological parameters in the beginning (as base-line data) or during the progress of the engineering interventions, the sustainability of the action cannot be ensured. Undoubtedly, for any long-term environmental decision, ecological stability plays an important role. The sustenance of intervention of any type ultimately depends upon the vegetation density, diversity and richness or vice-versa.

Plants support life on the planet, which in turn is dependent on solar energy, terrestrial base and water. Soil and water help plants to grow and balance the ecological processes. It is in this context that the study remains incomplete without evaluating the plant communities, which serve as a very strong life support system. The present study has been done on the available measures and models of soil and water conservation adopted in Shivaliks with an aim to make better planning and formulate suitable strategy of soil / water conservation specific to a given area.

The outcome of the fieldwork of 3 years and the conclusions drawn and lessons learnt are summarized below: -

- During reconnaissance, it was observed that Sukhomajri area (steep sloppy topography) was characterized by larger engineering interventions consisting primarily of four big earthen dams. On the other hand, Sukhna catchment study area (mildly sloppy) represented a large number of smaller engineering interventions in terms of small earthen dams, stone check dams, Gabion check
dams, Spurs, Grade stabilizers, etc. In contrast, the emphasis in Bhagwasi study area (relatively flat topography) has been on setting up of smaller cost effective engineering interventions involving extensive use of vegetation with engineering structures to reduce the designed dimensions of the structures. This has resulted in considerable cost reduction of engineering interventions. Apart from this, there has been an emphasis on judicious management of land and water resources, adoption of ‘agri-horti’ system and crop improvement programme in Bhagwasi study area. However, being relatively new, as compared to the other two study areas, the sustainability of these cost-effective measures here will only be proved if they stand the test of time.

• For any degraded area requiring engineering interventions, a systematic environmental impact assessment analysis approach, supported by scientific principles, is the optimum solution to ecological stability. The planning, design and construction of engineering interventions is a highly professional job which requires deep knowledge, practical training and experience. An unscientific ‘hit and trial’ approach may lead to ‘ecological backlash’.

• Engineering interventions of mega, medium or minor dimensions—permanent or temporary—depending on the site requirements and objectives, prove very useful in ameliorating soil and water resources, thereby the ecology and environment.

• In Sukhomajri, the ground water table has risen and the fact that tube wells have come up in the area implies that setting up of engineering interventions has improved the health of the most important life support systems—soil and water. As a consequence, the ground water regime has considerably improved here.

• The major reason behind poor performance of earthen dams at Sukhomajri was the silt coming heavily from the catchment and clogging the inlet tank, thereby choking the main outlet pipe. This was the reason for Dam no. III IV
and I being non-functional. But the water in the reservoir of these dams could be used for fish culture and cattle feeding. Wherever the level of stored water was quite high and the villager’s cooperative society was working successfully, engines were purchased for lifting water from the dam to utilize it for irrigation. This fact implies that the people’s sincere participation could derive benefit from even non-functional engineering interventions.

- The area to which the only functional Dam no. II (constructed in the year 1978) provided irrigation has also been constantly decreasing with each passing year. This is because of the reason that now lot of vegetation has come up in the catchment area a) due to the setting up of the engineering interventions and also b) because of protection of the area from grazing, browsing and illicit felling. As a consequence, the water yield as runoff from the catchment has reduced, thereby reducing the water availability for supplemental irrigation.

- In Sukhna catchment, out of a total of 180 silt retention earthen dams, around 41% dams are still having storage capacity to arrest runoff water and sediment. The remaining 59% have, however, silted. The water and silt stored in the reservoir behind these dams have added much to replenish the ground water table and in improvement of existing vegetation in the micro-watershed. Throughout the year, these dams also serve as a source of drinking water for the wildlife of the catchment.

- Due to setting up of engineering interventions in Sukhna catchment, the inflow of silt to the lake has reduced by about 96.5 percent thereby saving the very existence of Sukhna Lake-the lifeline of Chandigarh.

- Since the water table in Sukhna catchment has improved, tube wells have started coming up in the area and people have recovered their land for agricultural purposes.
• Further the permeability has improved and due to recharge, subsurface flow has increased. Similarly, because of development of more water bodies the moisture regime has also improved and the Channel has stabilized in Sukhna catchment. Also, there has been an improvement in the microclimate of the catchment, apart from improvement in the tourism industry.

• In Bhagwasi study area, for achieving the reduction in cost of construction of engineering interventions, erosion control structures here were strengthened with appropriate vegetation like *Sachcharum munja* and *Ipomea spp.*, etc. In these structures, design lengths of headwall extension and apron were reduced by 20 to 30% at the time of construction so as to reduce the cost of construction. It has definitely resulted in the overall economy in the construction of the engineering structures, sometimes even up to the extent of 30-40%. But the sustainability of such structures shall be proved only if it stands the test of time.

• In Bhagwasi study area, the land levelling index (LLI) of the treated areas have gone up from a low of 0.11-0.74 to as high as close to perfect value of one. It is a good indicator of the positive impact of the engineering interventions and farmers' awareness towards improving the health of life support systems—soil and water.

• During the year 2001, areas treated with engineering interventions in Bhagwasi produced 21.5% of rainfall as runoff as compared to 46% average runoff from the untreated area. This clearly indicates the positive impact of the engineering interventions in the treated area here. However, it may be too premature at this stage to comment on the performance of the engineering interventions at this stage, as 5 year is too small a period to judge the efficacy of a system.

• Ecology—the studies of inter and intra-relationships between the biotic and abiotic components—are a dynamic science. Any change in one, few or more
components, is expected to affect the other. Although the interrelationships are so strong and mutually inclusive that evaluating one component of the parameter is not expected to tell the whole setup of the area yet it may serve as a true indicator of the ecology of the area. So, in order to evaluate the effects of engineering interventions on the overall prosperity of area, an assessment of the ecological status of the area, with special reference to the vegetational analysis, assumes great significance. It would help the policy makers to make in stream corrections, repeat/replicate the interventions in other areas and last but not the least, to learn from the past mistakes.

- At location no.1 (control) of Sukhomajri study area, *Achyranthes aspera, Datura stramonium, Zizyphus jujuba* and *Croton variegatum* were present and they are indicative of dry land habitat and relative dryness of the area. Another indication in this direction is imparted by the presence of *Cynodon dactylon* that is expected to grow well in non-arid soil. This indicates aridity of the soil. Perhaps the dry conditions at this location fail to support the green grass here which otherwise is indicated at other locations where interventions existed.

- At location no. 2 (control) of Sukhomajri, presence of *Asphedelus tenuifolius, Datura stramonium, Adhatoda vasica* and *Saccharum munja* is a further indication of dry land system. This indicates relatively poor water regime at this location although the locale of location no. 2 was a bit plateau and a South facing area. Even less no. of plants at this location also support this reason. In short, at all the three control locations, dry conditions prevailed. Lack of change in vegetation structure at all the three control locations at Sukhomajri (Location 1, 2 and 3) suggests that there is not much difference between each of them.

- At the Location no. 4, 5 6 and 7 of Sukhomajri where the engineering interventions were light, average no. of total plants was counted to be more than that at control location nos. 1, 2, and 3 but less than Location no 8, 9, and 10 which had strong engineering interventions. Even minor interventions
at location no 4, 5, 6 and 7 have improved the area in terms of its diversity and
density. Though the type of vegetation has also shown some positive change
in areas with small interventions yet the maximum improvement is observed
to be in location no. 8, 9 and 10, which had stronger engineering
interventions.

• The presence of *Oxalis corniculata*, *Malvastrum coromandelianum* and
  *Euphorbia hirta* at Sukhomajri indicates that the soil conditions have
  improved especially at location no. 8, 9 and 10, where strong engineering
  interventions were set up.

• Presence of *Acacia nilotica* at location no. 8 of Sukhomajri indicates that there
  are semi-arid conditions but whether these trees were existing right from the
  pre-intervention period or were planted during the post-intervention period or
during the period the engineering interventions were being set up, is not
  known.

• In Sukhomajri study area, a major change is linked to the invasion of
  *Parthenium* in this area. Since it requires more humidity for germination of
  seeds and its ecological amplitude being wide meaning thereby that it can
  grow in dry to wet areas, less temperature to more temperature and 0-1500
  metres altitude. It implies that the conditions in this area are conducive for its
  germination. It further indicates that the area is not being properly attended to
  as compared to the last year and the year before when not a single plant was
  noticed in the area. Collection of *Parthenium hysterophorous* this year was a
  matter of surprise and indicates that it is a wasteland. If this trend is not
  checked, it would increase its area of invasion because of its allelopathic
  properties and may even try to replace other species of plants.

• The presence of *Saccharum munja* in locations of small engineering
  interventions (Location no. 4, 5, 6 and 7) is double than those at locations of
  control and a little more than locations with big engineering interventions at
Sukhomajri. However, its presence in this area with more than expected IVI value indicates that water regime in some parts is not adequate.

- At location no. 8, 9 and 10 *Eulaliopsis binata* is present in large numbers (679.04). It is perhaps the best grass for soil conservation, as it possesses fine and intricate fibrous root system, which binds the soil particles. It is useful in soil erosion in steep slopes against beating action of raindrops, splash, erosion and rill formation. Further, it is a plant demanding water, which indicates that water regime has improved here due to the setting up of engineering interventions, thereby resulting in improved ecological conditions in Sukhomajri.

  But much significance cannot be attached to its high value of abundance and density in treated areas and absence in control areas because it is a planted species and has not come up on its own. Had *Eulaliopsis binata* not been planted, some other species would have come up in the area.

- The no. of types of plants in treated areas of Sukhomajri is about 4 times than that of control areas which had no engineering interventions. The species in the treated areas were not only diverse but also exhibited abundance in their number. It is known that the diversity and richness of species with abundance is a true indication of the ecological stability of the area. The relative low values of evenness in treated areas, as compared to control areas, further supports the point, since evenness and diversity are reciprocal of each other.

- In control areas of Sukhomajri, presence of species like *Achyranthes aspera*, *Zizyphus jujuba*, *Calotropis procera* and *Adhatoda vasica* etc. show characteristics of ‘Xeric’ plants indicating thereby relatively less availability of water in these areas.

- Since more no. of plants and species capable of supporting rich and diverse vegetation, is a confirmatory test of improved conditions that are conducive for better vegetation and dependant improved ecological conditions, it can be
concluded that the vegetation and other ecological parameters in Sukhomajri have improved maximum at the locations with strong/big engineering interventions as compared to locations with small engineering interventions, if data of control locations is regarded as the base line data. Although in true sense this is not the baseline, since it does not pertain to pre-intervention period, yet for practical purposes of comparison, this serves our purpose well (being still not treated).

- Sukhna catchment study area is close to Chandigarh and the people working in Chandigarh stay in this area with their families. Therefore the anthropogenic pressures cannot be ignored while understanding the vegetational structure of the area. Close to the village, the overall vegetation in terms of the no. and density had been relatively low as compared to areas away from Sukhna lake. Whether it is on account of pressure of grazers or browsers or on account of picnickers of the city or the villagers collecting the fuel wood illegally, is not known.

- The terrain of the catchment of Sukhna catchment is also such that the rate of flow of run off is not as high as in Sukhomajri (being steeper) or as slow as in Bhagwasi (the locale being relatively plain). The erosion of the topsoil on account of runoff cannot be ruled out although it may not be very quick. The catchment area had been under treatment by the government to save the Sukhna Lake from siltation. Therefore, the vegetation structure shows an influence of anthropogenic liking rather than natural successional vegetation. Horticultural trees like *Acacia catechu, Acacia nilotica, Aegle spp., Bambusa arundinacea, Citrus spp., Dalbergia sissoo, Eucalyptus spp., Eulaliopsis binata, Mangifera indica, Ocimum basilicum, Phoenix spp., Populus deltoides, Psidium guajava* and *Zizyphus jujuba* are planted and are indicators of vegetation manipulated by human beings at Sukhna catchment study area.

- In Sukhna catchment, the vegetational richness has doubled and diversity has improved. In other words, whether the change in vegetation structure and
dynamics is on account of engineering interventions (which lack major engineering structures or major dams) or is on account of manual plantation (vegetational interventions) cannot be ascertained.

- At locations of control in Bhagwasi which supported 24 species, the no. of species in areas treated with engineering interventions has increased to 61 with in a span of about 5 years. Although the engineering interventions in this study area have neither been intensive or extensive (there are only low dimension interventions which are non-intensive) yet the improvement in the vegetation in terms of density and diversity is more than what could be expected. It is perhaps a consequence of the day to day timely interventions (like earthly manipulations and minor earthly treatments by minor levelling and/or by putting little temporary checks to arrest the fast runoff or by making gullies etc) by the local residents of the area. It implies that there has been a sustainable significant improvement in the areas treated with engineering interventions, in terms of the ecological indices. This improvement in the ecological parameters of the area could be attributed to two reasons: a) locale of the area being relatively plain and b) day today timely interventions by the local villagers living in the close vicinity.

- Many of the plant species found in the treated area of Bhagwasi were quite sensitive which generally require better soil conditions for growth. Their very presence in the area indicates the overall improvement in the soil conditions. Not only the diversity but density and abundance has also improved by over 2 times in the areas with engineering interventions as compared to the untreated control area.

- In Bhagwasi study area, the post engineering intervention period of about 5 years is not enough for ‘community’ development in an area through ‘ecological succession’. However, the improvement in the vegetation seems to show success in amelioration of degraded land. At this stage it can only be assumed that the development shall sustain to result into a stable community.
• The total no. of plants that are indicators of dry land system and showing thereby relatively poor water regime, are found to be maximum in the Sukhomajri area as compared to Sukhna catchment and Bhagwasi. But this may be due to the reason that the average no. of plants per location at the control areas is relatively more here.

• *Lantana camara* was another weed counted at Sukhomajri and Sukhna catchment areas only. Its absence at Bhagwasi shows that grazing and browsing is less here and land disturbance is not much. *Agave spp.*, another indicator of dry land system, was seen only at Sukhomajri.

• Based on the species abundance, (N1), the diversity in the Sukhomajri area was calculated to be about one and half times that of Bhagwasi while at Sukhna catchment it was almost same as Bhagwasi. When diversity was compared with very abundant species (N2), the difference between the Sukhna catchment and Bhagwasi areas was brought down drastically to 28.53 and 26.12 respectively while at Sukhomajri area it was much higher than these two study areas with value of 40.5. More diversity at Sukhomajri indicates that vegetational stability is more and community structure is better and their dependent insects and herbivores, in number and diversity, are expected to be more.

• The value of pH was seen to increase with increase in depth in all the three study areas. From the values it is clear that the pH varied from mildly alkaline condition to moderately alkaline at three different depths and at three different study areas. The pH values were found to be highest in case of Bhagwasi followed by Sukhna catchment and way behind was Sukhomajri. All the study areas showed 'basicity' of soil. With the depth, there was hardly much difference except that the top layers were less basic in all the three study areas. Statistically speaking depth wise generally the difference in values was insignificant. This is not a surprise due to lesser vegetation and less leaching of soluble salts due to more evaporation.
• The organic carbon (OC) values at the top layers were found to be higher in case of Sukhomajri followed by Sukhna catchment and Bhagwasi study area. Statistically speaking, the variation in organic carbon with depth was not much significant. It implies that the past organic carbon might have percolated down with the gravitational water. Comparatively, more organic carbon at Sukhomajri and Sukhna catchment study areas indicates that the degradation of organic matter of plant material is more at both these places. It is not unexpected because of the more vegetation cover at both these places.

• Available nitrogen decreased with the increase in depth at all the three study areas. From the values it is clear that the available nitrogen content was highest at Sukhomajri followed by Sukhna catchments and Bhagwasi. Concentration of higher organic matter content at the surface layers, as evident from higher OC values at Sukhomajri, could be the reason for higher organic carbon (OC) values at Sukhomajri.

The highest values of available Nitrogen at Sukhomajri followed by Sukhna catchment and Bhagwasi areas is not a matter of surprise since the plants belonging to the Leguminosae family (which are nitrogen fixing plants) have maximum representation in Sukhomajri followed by Sukhna catchment and Bhagwasi. More rich and diverse vegetation at the Sukhomari study area is another reason for highest available nitrogen at this place.

• Mean available phosphorus and Potassium content was highest at Sukhomajri followed by Sukhna catchments and Bhagwasi study areas. It implies that in Sukhomajri, at the surface layers, concentration of organic matter is more and it was further evident from the higher values of organic carbon there.

• There has been a general improvement in the vegetation cover at all the three study areas because of the proper management of the erosion prone alkaline soils. They were effectively closed and salt tolerant, drought hardy and
nitrogen fixing trees species like *Acacia catechu* and *Acacia nilotica* were planted.

• An overall relative more improvement in the soil properties at Sukhomajri and Sukhna catchment study areas as compared to Bhagwasi area is not unexpected. This is attributed to the fact that engineering interventions and vegetational interventions at both the former areas are more than 27 years old though their quality and quantity has been varying from time to time. In contrast, the interventions at the latter (Bhagwasi study area) are quite recent and are not expected to correct the soil properties so quickly.

• It is interesting to note that the socio-economic parameters are dependant not only on the intrinsic resources alone but many extrinsic inputs like support from the natives of the villagers working outside, location/proximity of the area to the major city and the no. of residents living in the joint families in the area. From the results of the socio-economic evaluation, it is indicated that out of the 3 study areas, Bhagwasi is economically/materialistically not as rich as the other 2 areas. On the other hand, Sukhna Lake catchment is the richest of all the three.

• Sukhomajri dominates in the residency status. That implies that the villagers do not have to go out in search of the livelihood and have ample opportunities in the village itself. Besides their main economic activity concerns agriculture which seems to have overpowered other economic means since the slopes have stabilized, soil has become fertile and water and irrigation facilities improved. In short, here the life support system has become healthier.

• The better socio-economic status at Sukhna catchment seems to be the consequence of its location, being close to Chandigarh, which supports its health, education and gainful service. The relative socio-economic prosperity in this village of Sukhna catchment can be identified either with engineering interventions taken up in the catchment or extrinsic energy inputs. Perhaps,
the latter satisfies the interpretation because of its proximity to Chandigarh. Mostly, the people working in Chandigarh (and who cannot afford the cost of living there) are residing in villages. Here, the agricultural land holdings are small and so insufficient to sustain. In order to supplement their income, many of the residents are serving in Chandigarh. For all practical purposes, the residents are dependent on the city of Chandigarh rather than the resources of the village. So, the prosperity of this village is attributed to the gainful employment from the city rather than through the sale proceeds of the village output.

- As is evident, socio-economic prosperity does not seem to be the sure test of sustainability of the Life support system of a given area. A lot many factors, including the major economic inputs from outside, seem deceptive in such interpretations, if seen alone. Therefore, it is important to impart due credit to the ecological parameters to evaluate the longevity of the impact of any intervention on the soil and water regime of the given area.

- Bhagwasi village is relatively poor in terms of the socio-economic parameters. But the real impact of the engineering interventions on the area will be known only after a few years with the present study data serving as the base line data.

‘Water security’ for Posterity

In the 21st century, water and land will be the two most precious natural resources, which need to be conserved at all costs keeping in view the ever-increasing population, for Asia in general and India in particular. This can be gauged by the disputes over sharing of river water with neighboring countries on one hand and between different states within India on the other. The prediction made by Vice President of the World Bank, Ismail Serageldin, looks preciously close to being realized- ‘Many of the wars of this century were about oil but the wars of next century will be about water’. The World Bank reported that 80 countries had water shortages that threatened agriculture and health. The Egyptians diverted Nile water to the Western desert while Ethiopia tried to
exploit the Blue Nile with small dams for electrical power and irrigation. Another 8 countries, including Sudan, wanted more water from Nile. Egypt once remarked that if any country took more water, it would consider it as an act of war. So, all the countries have to plan their strategies accordingly to avoid water shortages and thereby probability of threat to world peace. India is not far behind and interstate disputes regarding water sharing have already taken magnanimous proportions. More recently, the two states of Karnataka and Tamil Nadu in India were in news because they were at loggerheads over sharing of Cauvery river waters and their fight has reached to the highest corridors of judiciary -The Supreme Court of India. Similar is the situation as far as Narmada-Sabarmati dispute is concerned. Considering India’s bleak water scenario, trouble could also arise over water issues with neighbours like Pakistan and Bangladesh as India controls major watercourses that supply water to these countries.

Apart from water, soil is another crucial life support system since the bulk of food production depends on it. Soil erosion is a natural and continuous process but in undisturbed ecosystem with a protective cover of plants, the soil is usually regenerated at the same rate as it is removed (FAO, 1976). For the forest resource, the identified life support system, other than soil, is water. If the forests are rich and managed, the soil remains conserved and if the soil is protected, it invariably would support good vegetation and ultimately the forest eco-system. Other environment parameters follow suit. Managing the water especially in present scenario assumes greater significance. Though our planet is called a blue planet due to the fact that 70% of earth’s surface is covered with water, but tragically this is a misnomer as the quantity of water that is fit for human consumption is very limited. River water in the coming days is not likely to be a reliable resource for meeting water shortages. An arrogant and powerful country may dry up the reservoirs and rivers of a weak country to meet it’s own water shortages. The only viable solution for a weak country is to conserve its own water resources especially the rainwater which otherwise goes waste as surface runoff causing erosion, floods and siltation downstream. Studies indicate that by 2050, more than 50% of the Indian population shall have shifted to cities making water scarcity an acute problem. The water conflicts between the states in India are likely to intensify on this account.
Acute scarcity of water and growing population have prompted the government of India to initiate major steps to tackle the water scarcity by taking suitable measures such as harvesting of rainwater, spreading awareness, intelligent damming of river waters and encouraging traditional water harvesting techniques. It must be understood that the ecological and environmental problems are no more the problems of future. The calamity is staring right in the face. Even a little delay in the action might just be too late!

LESSONS LEARNT

The following important lessons have been learnt from the present study and these could have far reaching implications in the integrated watershed management policies. These should act as torchbearer for the future projects that are taken up elsewhere, may be in other states as well:

- The degraded lands should be treated with engineering interventions in a ‘holistic’ manner rather than spreading the resources thinly in more than one watershed.

- Integrated conflict management of natural resources like forest produce and water is necessary. Conflicts and the manner in which they are resolved should be examined from a social and historical perspective and at the same time appreciating the viewpoint of the locals.

- All the departments responsible for the amelioration of the degraded land should be integrated under a single implementing agency.

- Local population must be actively involved in planning, implementation, operation and maintenance of engineering / vegetational / social interventions.

- Integrating benefits to resource conservation is necessary. Engineering / vegetational / social interventions must be planned in a such a way so as to find immediate answer to the pressing needs especially of those belonging to the lowest strata of the society. In short, needs like water, fuel wood, fodder and livestock improvement of poor and the downtrodden must be met on priority.
Without such a combined commitment, conservation might constitute a grave offence against the deprived sections of the society.

- Integrated conservation measures must pay adequate attention to the employment/income generating activities like promotion of household and cottage industries, especially for the rural unemployed youth, including women.

- Resource based development policies should take into account the bio-resource conservation, sustainable use, environmental protection and local communities participation right from planning to execution and up to the monitoring levels. During reconnaissance, it was observed that wherever engineering interventions failed, generally it was attributed to the fact that the engineering structures were designed and implemented ignoring indigenous knowledge and skills.

- For elucidating the support of the locals right from the core of their heart, it is extremely essential that every stakeholder must reap, at least, some benefit, however meager it may be. For example, it is suggested that if the site requires construction of an earthen dam, the dam sites should be selected in such a manner that water can be stored to provide irrigation at least to some land of 'each and every' villager. This could act as the major catalyst for bringing people to contribute to the common cause and their participate wholehearted participation in the government programmes.

- Participation is basically a political process concerned with the redistribution of power in a society. This essentially involves transfer of administrative and financial powers from ‘haves’ to ‘have nots’ and sharing of technical information with local people whose participation is sought. The conflicts are likely to take place between the ‘new’ and ‘old’ beneficiaries. In the villages, common resource management society should function in such manner that unsustainable exploitation of natural resources by the wealthiest few at exceedingly high economic and environmental (tangible and intangible) costs to the majority is prevented.
• It was observed that though women carried out most of the agriculture, dairy and fodder collection tasks yet, men controlled the income generated from these activities. So within the new framework of participatory natural resources management, women and other marginalised groups need to be equally empowered to participate in community decision making.

• For resolving the conflicts within the communities, between the forest department and the communities and forest department and other governmental and non-governmental agencies, there is a need to evolve a middle path where every affected party is ready to collaborate by gaining something for itself and in turn surrendering something to the other party. Though some legal authority could be given to the local committees but it must be ensured that it is not institutionalized to such an extent that it transforms into a political body like village panchayats.

The construction of engineering structures at all the 3 study areas has improved the availability of water as well as their moisture regime thereby allowing the nature to spread its green protective cover on eroded and barren hill slopes, especially in Sukhomajri and Sukhna catchment areas. Consequently it has resulted in the rehabilitation of the Sukhomajri village and the sustenance of the Sukhna Lake- the lifeline of Chandigarh!

But it is observed that there is a general feeling of dissatisfaction among all sections of the society, especially in Sukhomajri and Sukhna catchment areas. The younger generation here, who have not seen the hardships to which their fathers and forefathers were subjected to while engineering/vegetational and social interventions were being set up, seem to be ‘disinterested’ in the ecological amelioration. This is, perhaps, because of the pending unemployment issues, for which they have maximum concern, have not yet been addressed to the extent promised. Further, immediate needs like food, clothing and water are still to be met in most cases. On the other hand, the older generation seems to have developed ‘mistrust’ with the government agencies since the tall promises that had been made to them and fulfilled initially, have not been sustained.
Before this 'disinterest' and 'mistrust' reach alarming levels, there is an urgency to understand the issue well. If timely action is not taken to regain the lost confidence of the locals, all that has been achieved after years of hard and sincere efforts with the active involvement of the locals will be lost within no time. Sukhomajri, which is known world over as a ‘success story’, could slowly get transformed into a ‘failure story’. It may amount to doubling of the tragedy. Not only the expenditure on the energy, resource and time spent on setting up engineering interventions here would be lost but also additional expenditure would be required to remake the original engineering structures. In addition, the nature would take its own time in remaking the lost set-up. It might result into ecological backlash or boomerang.

So in order to provide the requisite thrust to the success of the integrated watershed management approach, resource conservation and poverty alleviation should be under sharp focus of the Government of India. Besides introducing uniformity of approach to establish complementarities between various programmes, the institutional and technical coordination within ministries involved should be strengthened further, for effective implementation of integrated watershed management initiatives in our country.