"Inconvenient Truth[1]" behind Engineering Designs of Irrigation Projects Developed during the Last Century

Eng. Mahinda Panapitiya

Managing Director
Davids & M Engineering (Pvt) Ltd.

Introduction

Transformation of the lands located below an irrigation reservoir into agro-landscape is normally referred to as downstream development. When we talk about our ancient irrigation hydraulic systems, normally we highlight only about the glory of big dams and reservoirs built by our ancestors. Wisdom behind the strategies adopted for downstream development is very rarely appreciated. The ancient art of downstream development is a broad sense of knowledge which is entirely different from what has been adopted during the last century. In this article, while illustrating diverse objectives of the ancient approach, an effort was made to analyse modern ideology, which focus only on irrigated mono-culture and human settlement. Main purpose of this analysis is to spark a dialogue among decision makers to refine their approaches adopted during the last century for water resource development into a more holistic and sustainable mode.

Approach Adopted for Downstream Development during the Last Century

After construction phase of head works of irrigation systems (the dam of the reservoir and associated structures, such as, main canal, sluice, spills, etc.), Irrigation Engineers are the very first set of professionals who normally inaugurates downstream development work. Basic data sheet used by them for downstream development is a map of the downstream area indicating the contours and natural features of the landscape. The first activity in this exercise is to identify the areas which can be irrigated by gravity from the reservoir. Then, the layout the canal network below the main canal is decided using contours as the guide with the objective of demarcating a maximum land area which can be commanded by gravity from the water source. In modern designs, water is tapped from the main canal into secondary level canals, when it crosses ridges because then only the water can be spread over a maximum land area. Those secondary canals are normally laid along straight lines. Then the Engineers apply hydraulic equations to decide size of the canal to convey a volume of water that needs to irrigate maximum possible extent. In order to control water flow in the canals, concrete structures are introduced along their routes. Obstructions across the valleys in irrigable areas within the landscape, such as bunds of existing village tanks are then removed and the streams are widened to drain out runoff from irrigated fields. Then other landscape features such as forest patches in irrigable areas are cleared and levelled to make land planed as much as possible to spread water uniformly. Area is then apportioned into about 1 ha farm allotments and handed over to farmers. Their homestead areas are allocated in areas which can not be irrigated by gravity from the water source.

In this approach, the functions derived from other natural assets, such as, forests, wetlands, flora and fauna are secondary, and if more water can be made available, more lands would be developed for irrigation. Amount of dollars earned per unit of water is the main guiding factor of water resource development. Though they are not practising now, this is the same philosophy which was being adopted in the Seventies in large-scale commercial farms, such as, Tennessee Valley in the USA. In this outdated approach, when additional water can be made available as a result of engineering adventures (such as Pologolla Diversions in Sri Lankan case), all the "unproductive" natural features such as forest patches, wetlands, beds of existing village tanks, etc. are removed to convert the land for irrigated agriculture using the additionally available water.

Water Management in Modern Systems

Main objective of water management in those outdated systems, but we still consider as modern, is to spread water uniformly so that each farmer will receive equal volume of water. In this approach, Engineers assume that the social cohesiveness between neighbouring farmers should be purely based on rigid quantitative parameters such as equal volume of water for each farmer. Equal share of water to each farmer would be the binding agreement between farmers even though the equal share is not always the fair share because needs are different from farm to farm. If farmers do not share water equally according to rigid time schedules defined in the design, then another set of professionals (Social Scientists) are introduced to organise farmers to teach the business of sharing equally. Efficiency of the management exercise is evaluated in terms of the uniformity of the water spread over a maximum land area.

Farmer Organisations and Modern Design

The fact that the present day designers did not understand is that their approach adopted for the downstream development was only a carbon copy of the same adopted in large-scale commercial farms such as those found in Tennessee Valley in the USA, which were owned by one farmer or a company. There are no farmers in those projects but only paid labourers called ditch riders. In order to operate Tennessee Valley model on the ground, it is necessary to simulate the same social environment (one farmer or a corporate body) by introducing an appropriate institutional setup. Introduction of canal-based farmer organisations (FOs) in modern systems is the result of this effort. Modern designers expect the farmers to organise around dynamic water bodies such as irrigation canals and also manage water as a profit-motivated corporate body through hired laboures such as ditch riders found in Western Farms. In reality, it is not so. When the utopia was not materialised on the ground, instead of critically analysing the inherent unrealistic social assumptions of the design, innocent farmers become the scapegoat to be blamed for not organising to operate the system as according to the design. However, the truth is that the modern design is ignorant of the maturity of the irrigation systems well laid and operated in relation to the true social ground situation.

Ancient Approach

Philosophy adopted in ancient approach which is entirely a different paradigm, can be illustrated using actual historical monuments in areas under Kalawewa Yoda Ela. Before Kalawewa was built, Yoda Ela was fed by a small diversion across Kala Oya. Latter, when Kalawewa Reservoir was built by King Dhatusena, additional water became available for the areas. Then the Yoda Ela which originally fed small region along Kala Oya, was extended up to Anuradhapura while providing water to areas which were already under Cascade Tank Systems located along its route. With additional water, the cropping intensity within those existing cascade systems was increased, instead of removing the forest covers in the area for more irrigated agriculture. They also built different kind of tanks such as *Kulu Wewas* inside the forests to save local rainfalls to replenish the water table in the total landscapes. As a result, there was little or no drought in forest areas because so much of the rainfall is retained exactly where it is needed. Forest replenished with additional ground water also became an area which provides foods such as different varieties of yams, fruits, etc. Chena Cultivations were practised within the forest adopting sustainable methods. In other words, the additional water harnessed by the new source was used to convert total landscape, into a muli-functional wet zone rather than to a monotonous irrigated agriculture area. Welfare of animals was also another objective of the design. For example, grasses grown in the beds of *Wewas* had been the foods for animals such as wild elephants as well as cattle. Grasses grown in chenas abandoned in the forest after cultivation also had been ideal feeding ground for animals and cattle. As a result, there were no conflicts between elephants and the man as experienced today. Inland fishing in village tanks was also practised with the additionally available water.

One other very interesting feature of the ancient designs is that the need for introducing hard structures to control the water flows along canals was minimum. In ancient designs, water was tapped from the reservoirs for irrigation when the main canal path crosses valleys. At those crossings, water was diverted into natural streams which feed a series of tanks built across the streams in a form of cascades. Water was released to the farms from the Village Tanks while using them for various domestic uses also.

Water Management in Ancient Approach

Another interesting feature of the ancient designs is that designers tried to make water source stationary as much as possible. Stationary water sources facilitate management of water independently for a group of farmers. Around stationary water bodies such as Village Tanks, farmers automatically organise into groups (villages). If the water source is expected to be managed by a group of farmers, the user group also should be able to forecast in advance the quantity of water available in the source for the rest of the cultivation season. Village Cascade Tank systems satisfy those prerequisites for managing a resource as a group and thereby facilitating an automatic formation of farmer organisations, or, in other words, the villages which we witnessed in our traditional environment. Instead of FO Leaders of canal- based organisations formed under modern systems, *Vel Vidanes* at village level was responsible to manage water. Temples found in those villages also played a role in minimising social conflicts in villages through spiritual developments. Tank - Temple - Village combination was the management unit in the ancient designs in contrast to modern designs where the management unit is assumed as a flowing canal with intermittent water flows originating from a centralised tank located far away from the farms.

Respect for Ecology in Ancient Approach

Ecological segments of a landscape are normally not noticed by modern irrigation technocrats as a part of the total system. However, in the ancient design, the total system consisting of hamlet (*gangoda*), *chena* (upland cultivation area), tank bed and also on micro-land

uses of a small tank, such as, *goda wala* (upstream sediment trap), *iswetiya* (upstream conservation bund), *gasgommana* (upstream wind barrier), *perahana* (upstream grass strip to filter the sediment), *kattakaduwa* (downstream wind barrier), *tisbambe* (land strip around the hamlet for protection), *kiul-ela* (common drain of the irrigated lowland), etc. were also treated as essential components of the design in addition to the irrigated agriculture areas (Dharmasena, 2004). In modern approaches, the lands to be allocated for those ecological functions are also converted to irrigated agriculture, because, the main objective is to irrigate maximum possible area available under the command of the water source.

Confession by the Author

When I begun my carrier in 1974 as an Irrigation Engineer attached to Mahaweli Board, I was one of the Engineers who was entrusted to develop Thalawa/Eppawala Region of Kalawewa Right Bank Area for irrigated agriculture. In order to use the additional water received from Polgolla Mahaweli Diversion for irrigation, we started the downstream development under Kalawewa Tank in 1975. The area earmarked for downstream development was located below ancient Yoda Ela flowing from Kalawewa to Anuradhapura. In our approach, the Old Yoda Ela which took a meandering path had to be straightened and converted to a modern canal called Right Bank Main Canal, latter named as Jaya Ganga. At that time, we thought that the Old Yoda Ela was made to take a path of meandering by the ancients, in order to avoid rock excavations encountered along the canal route, because, the ancient people lacked the knowledge of rock excavations. The fact we forgot was that long before our intervention, they were experts in controlled rock blasting and gurus in rock chiselling even to transform a rock, to a delicate statues such as world renowned Awukana Buddha Statue right in front of Kalawewa Tank.

One other interesting feature of Yoda Ela was its very mild slope. In fact, it behaved almost as a Tank having elongated bund. On the other hand, the Modern Jaya Ganga is a sloping canal having dynamic behaviour. As a result, while straightening the ancient Yoda Ela to convert it to a modern express canal with a slope, we had to introduce regulating concrete structures across the new canal for diverting water to the newly-developed downstream areas. However, there was no need for such controlling structures across the ancient Old Yoda Ela because it was behaving as an elongated reservoir with a mild slope. Similar control was also necessary in the modern design for water distribution below the main canal. via a network of distributory canals and field canals. They were equipped with thousands of concrete structures in order to manage and distribute the water over the land. However, need for such artificial controls was minimum in the ancient system, because the water was conveyed along the routes defined by the nature itself. As a result, the final outcome of the ancient design laid on the ground had naturally become a part of the environment itself, thereby minimising the regular maintenance needs.

While we were developing lands under old Yoda Ela in the Seventies, we also had to demolish most of the tanks in the area to suit our design criteria. Some tanks which were of bigger size had to be left mainly due to the pressure exerted from the original settlers of the traditional villages in the area. In fact, H.E. J.R.Jayawardene, President at that time, had been summoned by the public to prevent the tank demolition activity launched by the Mahaveli Authority. We also noticed, there had been numerous small bunds across the small valleys hidden in the forest which were yet to be cleared and converted to farmlands under the project. According to our design criteria, those bunds appeared utterly worthless to us. Therefore, while clearing the forest, we removed those bunds, thereby making the land flat as much as possible to irrigate maximum possible land area. However, those bunds were in fact ecological components such as Kulu Wewas of the ancient design.

After about 30 years, in 2003, I had a chance to involve in rehabilitation of the same area where I worked as a Project Engineer at the initial land development phase. I remember at that time, I used to buy bee honey, curd, lot of cereal such as *kurakkan*, green gram, etc. to take home from this area. Presently, no bee honey is available, because, bees do not colonise in the neighbourhood of chemically-polluted lands. Why is not there locally-grown cereal available as before? What happened to the lands which were being used about 30 years back to cultivate crops other than paddy? Instead of cereals foods which could have been easily cultivated locally, they now depend on imported dhal and wheat. I also remember that most of original settlers had 1 of 2 cows on their home gardens, and they were in fact led a self sufficient livelihood. What happened to those herds which were very common at that time?. Why do the people now depend on imported milk powder for their morning tea? Why do they completely depend on irrigation water diverted from the Central Hills? How come bottled water being a commodity sold in even in a rural boutique at a price higher than a bottle of milk? What happened to serenity of the landscape viewed from the bund top of village tanks? Why don't we hear appealing sound of a flute and folk singing from the landscape? Why people have now begun to quarrel with each other for water? In fact, the area now looks like a desert of paddy, lacking any form of diversity.

Inconvenient Truth

The consequences of the newly-created monotonous landscape are also well reflected in the day-to-day meal plate of the farmer families.

It now consists of nothing else, but, a heap of rice and a curry of fish caught from the nearby tank. Heap of rice stands for the monotony of paddy fields and the fish curry stands for the water that goes to the paddy fields. The plate is lack of curd due to lack space for the cattle to graze and to keep. The plate is lack of cereals, such as, *kurakkan, sesamum, meneri, tanahaal,* etc. It lacks of all types of local pod varieties and hundreds of types of yams and vegetables and fruits as there is no land for them to grow. Day-to-day meal plate of our ancient farmers, on the other hand, would have been at the same status as the typical meal plate of rich countries of the modern world. Rice comprise only very small portion of the meal plate of people from rich countries such as Japan. In fact, this change in the content of meal plate symbolises like a shadow the way the landscape was developed under so called irrigation projects. The whole landscape of modern irrigation projects is nothing else but a desert of paddy! Role of the forest, homesteads, and beds of irrigation tanks as sources producing different varieties of food as the rest of the landscape had completely been forgotten in newly-developed irrigation systems.

The bad repercussions the whole landscape to depend on water that is 'imported' to the region have now begun to emerge in a different forms. The health of people is one aspect. The root cause of the renal failure found in high concentration in the Mahaweli and other paddy-cultivating regions has been proved to be related to fertiliser and other input chemicals in the form of weedicides and pesticides (Bandara, 2008).

One could argue that in newly-settled areas under projects like Mahaweli, the farmers are wealthier than the farmers with lack of guaranteed water for irrigation throughout the year. However at the same time, somebody else could also argue that this is not the level of livelihood anticipated from project with such a guaranteed resource base created by investing a huge capital. After 30 years, the beneficiaries of the project are still living at the expense of the taxpayers of the rest of the country. Recently-implemented fertiliser subsidy can be reckoned as a good indicator of the economic plight of these farmers. Fertiliser subsidy for farmers is in fact identical to the **'doll'** for unemployed people in developed countries who are striving to lay an economic footing. What has led the government to subsidise the paddy-growing farmers in an unsustainable magnitude? For example, government has spent Rs. 65 Billion for fertiliser subsidy between 2008-2009 and every farmer who owns an acre of land has been paid approximately Rs. 1,044,600/- during last 4 year as agriculture subsidies [2] in order to keep them employed in those irrigation projects. This is equivalent to a monthly payment of Rs. 50,000 for farmers who own 1 ha land, which is the average size of a Mahaweli farm. Those projects also need to be rehabilitated after every 25 years in addition to their regular maintenance. For example, Mahaweli System H area which was built in 1975 had to be rehabilitated in 2000-2005 by spending about 500,000 Rs/ha. It is also important to note that the initial capital cost of those projects is estimated to be about 1 million rupees per hectare according to data available from recently-completed Uda Walawa Irrigation Project. Therefore, one could wonder, projects requiring enormous capital investment and also backed by the latest design technologies, how come the farmers living on these projects still lead a subsistence level of life?

The reason behind the government to subsidise the paddy-growing farmers in an unsustainable scale is simply that the farmers' expenditure on the inputs for paddy cannot be met with the output. Recently, the Ministry of Agriculture embarked on production of organic fertiliser in a mass scale as an alternative to chemicals. Will this be a technical alternative for application of chemical fertilisers? Crop diversity of an agricultural environment is an essence for efficient approach for farming. Maintenance of the source of nutrients within the land is one of the prime requirements. In tropical countries, the sources of nutrients exist on the high ground of the landscape. The natural forest, the perennial crops, the seasonal crops, the animals both tamed and wild and small and large including the worms and micro-organisms live on the ground and sub surfaces are the real source of nutrients and nutrient generators which can supplement the crops grown in the deep valley that is paddy in this context. What happens when the whole lands on the down stream are bulldozed off and converted to a one single mass of paddy fields? The whole landscape gets impoverished of generating and holding the nutrients-the essentials for revitalising the productive capacity of soil. As a consequence, the paddy grown on the entire land begins to fail and the farmers in modern irrigation systems are then advised to depend on the chemical fertilisers which are the sole inviters to pesticides and the weedicides.

Are we unintentionally using the landscape to an unsustainable mode of mono-culture in the name of a solution to cater for the population growth? Otherwise, how do the settlers or the colonists of those so called irrigation development programs still lead a life at the sympathy of taxpayers of the rest of the country? Should we borrow money from foreign lenders, any more, to implement this type of bankrupt systems? Irrigation Department/Mahaweli Authority which played a responsible role in implementing those projects should take a serious note on this issue before launching new projects.

May be during last century, we would have completely mishandled a very original and indigenously developed landscape, in the name

of a very narrow objective of irrigating maximum possible area, for the sake of justifying engineering adventures such as Polgolla Dam/Tunnel which diverted additional water into the dry zone. In fact, Kalawewa area would have been a great success even with 1/3 of the present consumption of water diverted from Mahaweli River, if the ancient approaches of downstream landscape development described above was adopted. If so happened, then the water quantity which is now being diverted to North Central Province (NCP) would have been sufficient to replenish whole North and East in addition to the NCP. Even though it provides employment opportunities to current generation through the modern Water and Land Resource Development methods, may be we are unknowingly in the process of transforming our native land to a grave yard of the future generation. Author however has noticed that a deviation from design concepts adopted during the last century, has been tried to a certain extent in recently-completed Japan Bank of International Cooperation funded Uda Walawe Irrigation Upgrading Project, though further improvements are necessary for that design.

Conclusion

In the light of above facts, there is a need to investigate the true situation of already developed areas for irrigated agriculture before applying the same methodologies adopted during the last century for future development programs. There could be alternative ways of synergising water with the landscape to generate optimum benefits to the country in more sustainable ways. For introducing this kind of alternative designs, Irrigation System Designers should be ready to accept that landscape development using water resource is a Science as well as an Art where the diversified benefits, other than pure irrigated agriculture, also need to be taken into consideration. Ultimate objective of the project should be to produce diverse and healthy food varieties in an economically sustainable mode while the beneficiaries are enjoying a livelihood in a pleasing natural environment without depending on heavy and uncertain government subsidies.In this context, though the role of Irrigation Engineers is necessary, but is not sufficient alone. Professionals in other disciplines, such as, Ecologists, Environmental Economists, Landscape Architects, Food Scientist, Nutritionists, Agronomists, Soil Scientists, Production Engineers, and Sociologists, etc. also need to play an equally important role at the initial design phases. Maduru Oya Right Bank area (EP) under Mahaweli Program which has not yet been developed, because of inaccessibility to the region during the past as a result of the ethnic unrests. could be a Pilot Area for testing alternative approaches for synergising landscape with water resource. The past will inform the future - the ways of handling the nature by ancient hydraulic technocrats might also give a big clue to begin this investigation for alternatives for the Pilot Program.

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Contact Details of Author:

Eng. Mahinda Panapitiya, Chartered Civil Engineer, working as a Managing Director of Davids & M Engineering Pvt Ltd (www.dmelk.net) , (a Consultancy Firm specialised in Water Resource Development).

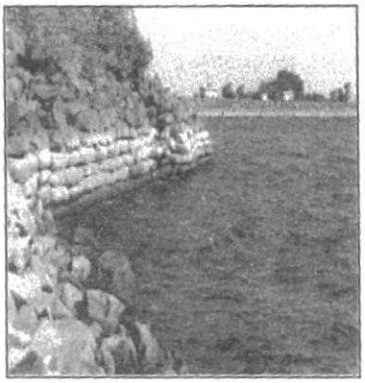
Footnotes:

[1]A phrase borrowed from the Name of a documentary film directed by Davis Guggenheim about former United States Vice President Al Gore's campaign to educate citizens for raising international public awareness of natural environment. (visit www.inconvenient truth.com for details)

[2] Head Line of Ceylon Daily News dated 1stApril 2010.

Exhortation made by King Parakramabahu

Great King Parakramabahu (1153-1186) AD



Parakrama Samudraya

" In the realm that is subject to me there are apart from many strips of country where the harvest flourishes mainly by rain water, but few fields which are dependent on rivers with permanent flow or on great reservoirs. Also by my mountains, by thick jungle, and by widespread swamps, my kingdom is much straightened."

"It is not meet that men like us should live and enjoy what has come into our hands and not care for the people"

" Truly in such a country not even a little water that comes from the rain must flow into the ocean without being made useful to agriculture and man kind"