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NEWS UPDATE

New Irrigation Minister Appointed



Honourable Mr Sanjaya Kumar Gautam is appointed as a new minister in the Ministry of Irrigation on July 24th, as New Prime Minister Rt honourable Mr Sher Bahadur Deuba extended the new members in his cabinet with various portfolios. The new Irrigation Minister took oath of the office at the office of the President of Nepal, Shital Niwas on July 25th, he took charge of the office at Ministry of Irrigation on . On that occasion, officials of Ministry of Irrigation, Department of Irrigation including the Director General Mr Ashok Singh. Irrigation Newsletter editorial group expresses hearty congratulation to the new irrigation minister and also extend wishes for his successful tenure in the ministry .

Inauguration of Tunnel Boring Machine (TBM) operation in Bheri-Babai Diversion Multi-Purpose Project

Honorable Minister of Irrigation, Mr Sanjay Kumar Gautam has inaugurated the operation of the first Tunnel Boring Machine

(TBM) at Bheri Babai Diversion Multipurpose Project (BBDMP) on 27th September, 2017,. The project will divert 40 cumecs of water from Bheri river to Babai river to facilitate year round irrigation for about 51,000 hectare of land in Banke and Bardiya district of Western Nepal. The project will also generate 48 MW of electricity. The inauguration function was organized in the presence of high ranking officials from the Ministry of Irrigation and the Department of Irrigation. On the occasion, the Project Director, Mr. Shiva Kumar Basnet welcomed to the honourable Irrigation Minister and all other special guests. During the event, honorable minister expressed his views that the project after its completion will open door for possibilities of new dimension of irrigation development in Nepal, because of its new concept of water diversion from water surplus basin to water deficit basin that will facilitate year round irrigation and hence enhance the agriculture productivity and Minister Gautam further wishes for its successful timely completion. During the occasion the Minister also observed the construction site of BBDMP.



New Director General at Dol

As per the decision made on 16th August, 2017, Mr. Ashok Singh, has been appointed as new Director General of Department of Irrigation. Mr. Singh had been working as the Deputy Director General of Dol. With the decision made on same date, the DG of Dol, Mr. Rajendra Prasad Adhikary has been transferred to Water Resources Research and Development Centre (WRRDC). A function was organized in the department to welcome and farewell of newly appointed Director General and outgoing Director General on the same date. On the function, the newly appointed DG wished cooperation from all officials



of the department during his tenure as a director general which eventually ease to achieve the goal of the department. The outgoing Director General, Mr. Adhikary congratulated Mr. Singh and also wished his successful tenure in the department. Mr Singh presented a Souvenir from Dol to the out-going DG. Editorial group of Irrigation Newsletter expresses congratulation to the newly appointed director general and wish him all the successes during his tenure.

Similarly, some changes has been made in a few arrangements of the department. The Director of Irrigation Management Directorate (CMIASP), Mr. Niaz Warish has been transferred to Department of Water

Highlights of the Issue

News Update

- New irrigation Minister appointed
- Irrigation Minister Started TBM Operation
- New Director General at Dol
- Review meeting of 3rd Trimester and Annual Progress FY 2073/74 held
- ICID 8th Asian Regional Conference in Nepal

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- Inter Basin Water Transfer

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- 16th INPIM Nepal Talk Programme

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- Use of Tunnel Boring Machine (TBM), beginning of a new era in Irrigation Development

Editorial

Inter Basin Water Transfer

As it is mentioned in Water Resource Strategy and National Water Plan for reshaping the mode of better utilization of Nepal's vast and important resources to enhance its productivity, inter basin water transfer projects are being implemented one by one. The basic concept of these efforts is to make water available in the region, where the irrigation canals are being fed with the sources which remain deficit during winter and dry season. Through these efforts, year round irrigation will be achieved for water deficit command area. These efforts obviously will add new dimension in the irrigation history of Nepal

The first of this kind is being implemented in Ramghat of Surkhet district named Bheri Babai Diversion Multipurpose Project with sole investment of Government of Nepal. In this project, from the mentioned location, through a 12.4 Km long tunnel built in between will carry 40 cumecs of water from perennial Bheri river to drop into Babai river and irrigate land via present Babai and Sikta Irrigation System. About 60,000 ha of agriculture land of mid-Western Terai will be benefitted with year round irrigation facility. For such effort, tunnel boring machine (TBM) technology is being used for the first time in Nepal. The machine has already been installed in project site and work is under progress.

Sunkoshi Marin Diversion Multipurpose Project is also being implemented from the current fiscal year. The preparatory work has been initiated. If the project completed in time it will open the possibility to draw water from perennial Sunkoshi river to drop into Marin river a sub branch of Bagmati river and will be able to supply water for dry season to Bagmati Irrigation Project. The year round irrigation facility for command area of about 120,000 ha of eastern terai will be achieved by the completion of this project.

After the successful implementation of these two projects, Dol is planning to implement more than half dozen of inter basin water transfer projects. It is obvious that these type of project will ensure year round irrigation in fertile agriculture land in terai and thereby increasing productivity and overall food production in Nepal. ■

Induced Disaster Management (DWIDM) as a Deputy Director General. Mr. Kaushal Kishor Jha, Deputy Director General, DWIDM has been transferred to Ministry of Irrigation as joint secretary. Director of Water Resources Research and Training Centre Ms. Sarita Dawadi has been transferred to Dol, as DDG of Planning Division. Mr. Saroj Pandit DDG of Planning Division has been transferred as DDG-Surface Irrigation and Machinery Management Division of Dol. Mr. Krishna Nepal has been transferred as DDG of DWIDM from Director of Mid Western Regional Irrigation Directorate, Birendranagar. DDG Mr. Prakash Chandra Pokharel has been transferred to Central Regional Irrigation Directorate as Director. Director of CRID Mr. Maheshwor Narsingh KC has been transferred to the post of project director at Sikta Irrigation Project.

3rd Trimester Cum Annual Progress review meeting

An annual review meeting for the fiscal year 2073/74 Progress has been held in Ministry of Irrigation (Mol) on 28th– 30th, August, 2017. The meeting was chaired by honorable Irrigation Minister, Sanjay Kumar Gautam. The meeting reviewed on annual and trimestral progresses of various projects implemented under Mol, through its departments.

In the meeting, the DG of Dol presented overall trimestral and annual progresses of Dol in its various projects and programmes for the fiscal year 2073/74. According to the progress report, the physical progress and financial progress of the period was recorded 89% and 88% respectively. Most of the projects in Dol achieved above 80% progress of its target during FY 2073/74. Projects under national pride namely Bheri Babai Diversion Multipurpose Project, Sikta Irrigation Project, Rani Jamara Kulariya Irrigation Project and Babai Irrigation Project achieved 96.2, 91.4, 95.7 and 100 percent progress of its annual target respectively. The project directors and managers of various projects under Dol also presented their respective 3rd trimester and annual progresses during the meeting. During concluding remarks, the secretary Mr. Ramanand Prasad Yadav expressed his satisfaction on overall performance of Department of Irrigation. Minister of Irrigation has assured about the full support in future implementation of program if the progress remained encouraging.

ICID 8th Asian Regional Conference in Nepal

8th Asian regional conference of International Commission on Irrigation and Drainage are going to be held in Kathmandu from 2-4th May, 2018, under the banner of "Irrigation in support of evergreen

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revolution". The conference is being primarily hosted by Nepalese National Committee for Irrigation and Drainage (NENCID) and the Government of Nepal. There will be over 500 participants (300 national and 200 international from all the Asian countries), including academicians, students, water experts, scientists, professionals, farmers and other stakeholders working in the various irrigation related institutes. The papers on various themes have already been called for the conference. "Enabling small holders' capacity to obviate farmers' distress"; "Coping with recurring droughts and floods in the context of climate change"; "Modernizing irrigation systems for better services"; Enabling Water Users Institutions (WUIs) for sustainability of Irrigation Systems"; Irrigation, ecosystem services, and aquatic biodiversity"; are five sub themes of the conference.

Nepal is one of the earliest members, joining ICID in 1973 and is active nationally and internationally in the arena of irrigation and drainage. Nepal has long history of irrigated agriculture, mainly through Farmer Managed Irrigation System (FMIS) and are still having 75 per cent of total area being managed by farmers. It is a pride of Nepal to host such a great conference in the country welcoming many international participants.

TRAININGS/WORKSHOPS/SEMINARS

Orientation Training for New Engineers

An orientation and training program for newly appointed Dol Engineers has been organized in Dol from 24th October–3rd November, 2017. On the inaugural session of the program, Irrigation Minister, Honorable Mr. Sanjay Kumar Gautam, congratulated to all the Engineers and expressed his wish as the training program will be helpful to them to understand objective and goal of the Department of Irrigation. During his inaugural speech, Honorable Minister also mentioned about the importance of irrigation infrastructures making the country as agriculture hub, which will ultimately reduce country's dependence on food from foreign lands. The special guest and the secretary of Ministry of Irrigation Mr. Ramananda Prasad Yadav expected that knowledge gained during the training will help participants to cope with the situation in the field with its working modality and its various sub organizations and their respective activities, regulations and policies. DG of DWIDM, Mr. Madhukar Rajbhandary, in this brief speech expressed that the training program will be fruitful to all participants before deployed to the real work stations. The programme director and DDG of Dol Mr. Bashu Dev Lohanee in the beginning, welcomed all the participants to the training program and focused on the content of the training. With the concluding remarks, Chairperson and Director General of Dol, Mr. Ashok Singh has ended the session.

During the training session, Mr. Ashok Singh, Director General, Dol has introduced about ongoing inter-basin water transfer projects

under Dol. Mr. Bashu Dev Lohanee, DDG, Dol has presented historical background of the department, its present organizational structure and overall working modalities.

The chiefs of administrative section, financial administrative section and legal advisory section also introduced the participants with their respective works and activities being carried out. Moreover the chiefs of various ongoing projects/programs under Dol had instructed about brief introduction to their project, activities carried out and the progress made during various phases. In addition to that, instructors from Department of Water Induced Disaster Management, instructed the training participants with their respective divisions/ sub organizations' brief introductions, importance and various activities on river training. Organization and different activities carried out. In addition, various irrigation experts also have delivered ideas on construction management, quality control, sustainable irrigation management, institutional development, and gender equality and social inclusion etc. More than 20 resource person, from different organizations including, MoI, Dol and DWIDM has instructed to the participants during 8 days' program



A field observation tour was also organized to the participants. During the field visit, participants visited Narayani Lift Irrigation System, Khageri Irrigation System and Ground Water Irrigation System in Chitawan district from October 31st to November 1st, 2017. The field visit was assisted by SDE Umesh Sujakhu and Er. Sanchita Kaduwal.

In the closing ceremony of the training program, the chief guest of the closing ceremony and the secretary of MoI, Mr. Ramananda Prasad Yadav congratulated to all the participants for successfully attending the training program and distributed certificate to all the participants. Newly appointed engineers Mr. Manoj Khatiwada and Ms. Sabina Khatri has expressed about the views and general experience during the training program and assured that their gained knowledge will be helpful for their entire career. At the end of closing ceremony, from the chair, DG of Dol, expressed his wishes to the new engineers for their successful career in the department and concluded the program.

Workshops on Cooperative concept in WUAs Organized

The System Management and Training Program (SMTP) organized two WUA level workshop on "Introduction of Cooperative concept in Water Users' Association and its Conceptual Development" in Nawalparasi District. One workshop was organized for the water users' committee members of Piparpati and Parsauni Minor under Nepal Gandak Western Canal System from December 22nd

to 23rd, 2017. In the workshop, 16 participants from each minor participated. Out of total 32 participants 12 were female members. The main discussion in the workshop was collection and utilization of resource for O&M of canal system through expanding the WUA into Cooperative. During the workshop, interaction among the participants and group discussions were also occurred.

Similar another event was organized for Water Users' members of Dharapokhari IS, Ranibel IS, Madanighat IS and Patuadhap IS of Nawalparasi from December 25th to 26th, 2017. In the workshop altogether 37 personnel from the four water users' committees participated including WUA chairman, vice chairman, secretary and treasurer. During the workshop, the participants were introduced with the new concept of transferring the present Water Users' Association into cooperative for the welfare of the members of water users committee in general, which will make their constitutional organization more sustainable in future to carry out various organizational activities. Participants were also encouraged to take part in group discussion and interactions during the workshop



During the both workshops, Division chief Mr. Tikaram Baral of Nepal Gandak Western Canal Irrigation Management Division (NGWCIMD), Engineer Mr. Jitendra Sahani, and Accountant Mr. Ganesh Prasad Ghimire of NGWCIMD, Senior Cooperative Officer Mr. Buddha Prakash Paudel of District Cooperative Office of Nawalparasi attended as resource person. The workshops were coordinated by senior Technician of SMTP, Mr. Rajendra Kumar Thapa.

16th INPIM Nepal Talk Program

The 16th Talk Program of International Network on Participatory Irrigation Management Nepal was organized on the topic of "Redefining Participatory Irrigation Management (PIM) in the Present Context" on 4th August 2017 (20th Shrawon 2074) at the Main Hall of Department of Irrigation, Jawalakhel. The program was organized in the pretext of the twentieth anniversary of INPIM Nepal. At the onset of the program, the President of INPIM Nepal, Mr. Suman Sijapati, provided briefing of INPIM Nepal Activities and its current status. Then he went on to give a general introduction to the topic of need of reviewing and redefining Participatory Irrigation Management (PIM) in the current context so that the roadmap for the future can be laid.

The main presentation in the Talk Program was from Mr. Romain Valadaud, a French scholar doing his PhD in Nepal in the field of PIM. The topic of his presentation was "PIM through the lenses of Hydro-social Cycle and Socio-technical Anthropology: an attempt

to understand the politicization of WUAs in Nepal's Eastern Terai". Mr. Valadaud discussed about the preliminary findings from his research that collected information on how politicization is affecting the WUAs in Sunsari Morang Irrigation Project, in the eastern Terai of Nepal.



After the presentation on main theme, INPIM Nepal President, Mr. Suman Sijapati made a brief presentation on the "The Achievements and Current Challenges of INPIM Nepal". In his presentation Mr. Sijapati discussed about the experiences of INPIM Nepal in the last 20 years and provided some pointers as the needs to be done in the future. Following the presentations, Mr. Ashish Bhadra Khanal, who was appointed as coordinator of the INPIM Nepal Statute Review Committee, was asked to present the conclusions drawn by the committee. He made a presentation on "The Proposed Amendments to the Current Statute of INPIM Nepal".



At the end of the talk program, the participants actively participated in the question/answer session. The discussion continued on the topic of the future of PIM in Nepal and how it can be aligned to the needs of the time.

A Panel discussion was also held with the active participation of Irrigation and Water Users' Experts including Dr. Upendra Gautam, Dr. Prachanda Pradhan, Dr. Khemraj Sharma, Dr. Krishna Chandra Prasad and former secretary of GoN Mr. Maheshman Shrestha. During the Discussion entitled "on present status of INPIM Nepal and its Future Course", all participants put their genuine ideas. As generally understood: "it is the right time to reflect on earlier set vision, mission and update it to address contemporary problems" (As some of participants suggested that INPIM Nepal should "shift from conventional concept of irrigation management and redefine it from the perspective of present day needs of Nepal"). It was stressed in the meeting that its mandate should be more precisely defined as "advocacy, research and training to young generation, professionals and young farmers in participatory approach with improved irrigation technologies and commercial agriculture" and also suggested that the focus should shift to "timely availability of

water for irrigating the crops from our projects including the proper implementation of National Water Plan as well as Water Resources Strategy. During the discussion it was emphasized that INPIM should “follow the mainstream of Irrigation” and have “better collaboration with DOI and that DOI should also be more supportive” and further the network should address contemporary issues of climate change and in advocating and promotion of irrigation practice in high mountain based farming”.

FEATURE ARTICLES

Pressurized Pipe Canal System: An Alternative to Open Canal Surface Irrigation System

✍ *Ravi Kumar Mishra**

✍ *Vijay Shanker Mishra***

Background

As agriculture being the largest water consuming sector, optimal use of the available water is highly desired. This has alarmed the need of change in planning and design of canal system which means time has come to shift from traditional open canal surface flow irrigation system with high seepage, percolation and evaporation loss to pressure conduit (pipe canal) irrigation system with no percolation and evaporation loss. In many places such change has been observed with increasing demand and decreasing availability of water resources.

The water problems in the Asian countries like Nepal are most unpleasant due to a large proportion of water loss in distribution networks, intermittent supply and most of the rivers are dry in winter season. Most of the part of these countries are facing water deficit problem for the irrigation. So as to optimize the use of available scarce water resources, a need of efficient conveyance, distribution and application system is highly realized. Accordingly, a study was carried as the partial fulfillment of academic requirement to evaluate the benefit of pressurized pipe canal system over open surface flow canal system. Such type of attempt is indispensable for planner and decision maker involved in irrigation development sector for increased water and agriculture productivity.

Open Channel and Pipe Flow

An open channel is a duct in which the liquid flows with a free surface. This is in contrast with pipe flow in which the liquid completely fills the pipe and flow under pressure. The flow in a pipe takes place due to difference of pressure (pressure gradient), whereas in open channel it is due to the slope of the channel bed (i.e.; due to gravity). It may be noted that the flow in a closed conduit is not necessarily a pipe flow. It must be classified as open channel flow if the liquid has a free surface.

Basic Differences between Traditional Surface Irrigation and Piped Irrigation Techniques

- The water flow regime: With traditional surface methods the size of the stream should be large, while in pressure piped irrigation systems very small flows, even 1 m³/h, can be utilized.
- The route direction of the flow: With traditional surface methods the irrigation water is conveyed from the source and distributed to the field through open canals and ditches by gravity following the field contours. The piped system conveys and distributes the irrigation water in closed pipes by pressure following the most convenient (shortest) route, regardless of the slope and

topography of the area.

- The area irrigated simultaneously: With traditional surface methods the water is applied in large volumes per unit of area, while piped irrigation systems distribute the water at small rates over a very large area.
- The external energy (pressure) required: Traditional surface gravity methods do not need external energy for operation, while piped irrigation systems require a certain pressure, which is provided from a pumping unit or from a supply tank situated at a high point.
- Irrigation efficiency: In open canal distribution networks, the water losses are estimated at up to 40 percent in unlined ditches and up to 25 percent in lined canals. These losses are due to seepage, phreatophytes and leakage in gates, spillways, etc. In piped systems, no such losses occur. As a result, water losses can be minimized and an irrigation efficiency of 75–95 percent can be achieved. In open canals, the irrigation application efficiency ranges from 45 percent to a maximum of 60 percent.

The Project Features

For the comparative analysis of open surface canal system and pipe canal system, the project selected was Sotikhola Irrigation Project, located at Barahathawa municipality, Ward Nos. 7, 8 and 11 of Sarlahi District. This project is a rehab/ Terai type of project, under construction. The design discharge had been calculated for 1000 lps water carrying capacity for the main canal with a gated head-regulator and weir in source river Soti. However the design water requirement for the present command area 235 ha is 339 lps, but considering further extension of the command area a design discharge of 1000 liter/sec was adopted. The total length of the main canal is 0.525 Km and total length of the branch canal is 3.35 km of which Branch-2 is 1.0 km and Branch-1 is 2.35 km. But there are totally 8nos of outlets has been proposed, so that the farmers manage the water distribution as per their own requirements. The main canal and branch-2 of the project is proposed as a lined canal. For comparative analysis the early designed open surface canal, was replaced with pipe canal system at main and branch canal level keeping the same design discharge. For the main pipe canal, four RCC Hume pipes of 600 mm inner dia. to convey discharge of 0.25 m³/s through each pipe accounting in total 1 m³/sec design discharge is proposed. The pipe is to be laid under Hydraulic Gradient Line i.e. RL 63.2 m at head at storage and 62.75 m at head of branch canals B1 and B2. The invert of pipes at head is at RL 62.5 m and at RL 61.9 m at end. The manual planning and design strengthening manual M8, design manuals prepared for design of irrigation projects in Nepal is followed for design. A check was made on the hydraulics of the pipes to know whether the pipe is submerged because a pipe flows full when the outlet is submerged. The two branches with equal command area after extension in future are designed for 500 lps each. Accordingly, branch-1 with two pipes of 600 mm dia each and branch-2 with two 600 mm dia each is designed to convey a discharge of 500 lps through both secondary pipe canals. The pipe is to be laid under Hydraulic Gradient Line i.e RL 62.35 m at head at bifurcation and 60.72 m and 61.88m at end of branch canals B1 and B2 respectively. The invert of pipes at head is at RL 61.5 m and at RL 59.3 m at end of both branch canals. The pipe canal is designed and laid to flow below hydraulic gradient so the field outlets and pipe laterals can be designed to flow under pressure irrespective of field gradients.

Results Discussion of Comparative Analysis

The results observed from this study is summarized and discussed under different categories such as project cost, water use, land use, social and environment benefit.

Project Cost: The overall project cost of pipe canal system up to distribution system is NRs 55,589,600.00 i.e. NRs 23,6552.00/ha whereas for surface flow open canal system the cost is 57,13,5000.00 i.e. 243,128.00/ha. This result reflect that cost of the pipe canal system is less than open canal system but it will be early to say that the cost of the whole system up-to the field level will also be less until and unless the cost of construction of the canals below distribution level is estimated.

Water Use: The water used in open canal systems is 7,207,115.00 M³ which is 30% more than that of pipe canal system i.e. by 2,162,135.00 M³. The net water used under pipe canal system is 5,044,981.00 M³.

Table 1-Benefit Calculation

Calculation of Benefit for EIRR Computation											
Without Project (A)					With Project (B)						
Crop	Irrig. Status	Area, ha	Yield (t/ha)	Benefit (Rs/ha)	Total Benefit(Rs)	Crop	Irrig. Status	Area, ha	Yield, t/ha	Benefit, Rs/ha	Total Benefit(Rs)
Paddy(mn)	NI	141.00	2.50	6507.8	917593	Paddy(mn)	FI	141.00	4.30	37192	5244037
Wheat	NI	58.75	1.60	8474.8	497892	Paddy(Spr)	FI	0.00	0.00	0	0
Maize (Spr)	NI	0.00	0.00	0.0	0	Wheat 1	FI	94.00	2.50	19802	1861388
Oilseed	NI	23.50	0.70	12603.5	296182	Maize (Sum)	FI	0.00	0.00	0	0
Sugarcane	NI	94.00	30.00	243132.8	22854479	Maize (Wint)	FI	0.00	0.00	0	0
Pulses	NI	23.50	0.90	24306.0	571191	Oilseed	FI	0.00	0.00	0	0
Veg(win)	NI	0.00	0.00	0.0	0	Sugarcane	FI	94.00	40.00	343722	32309840
Veg(sum)	NI	0.00	0.00	0.0	0	Pulses	FI	23.50	1.20	41520	975720
Existing Cropping Intensity	145 %					Veg(win)	FI	23.50	15.00	152975	3594918
Future Cropping Intensity	160 %					Veg(spr)	FI	0.00	0.00	0	0
Grand total (A)					25137336	Grand total (B)					43985903
Net incremental Benefit=(B) - (A) =Rs.					18848567	for open canal & 5,044,981 for pipe canal.					
Net incremental Benefit per year per ha =Rs.					80207						
Water Used in M3					7207115						
Net incremental Benefit/ M3 of Water Used=Rs					2.62	For Open Canal					
Net incremental Benefit/ M3 of Water Used=Rs					3.74	For Pipe Canal					
Net Benefit from Saved Water (2162115 M3)=Rs					8077958						

In the project design report calculation of project benefit was carried out and the incremental benefit assessed was NRs 18848567.00 i.e NRs 80207.00 per ha per year. Considering similar cropping pattern and intensity, the same benefit is used in this study to evaluate water-use productivity and the water use productivity assessed was NRs 3.74/M³ of water under pipe canal, significantly higher than NRs 2.62M³ under open canal system (refer table above). Further the analysis reveals that the total incremental benefit can be accrued from the water saved under pipe canal is NRs 8077958.00.

Land Use: The land under property line of surface canal was assessed considering 19.0 m for main canal of 0.525 km and 9.5 m for branch canals of 3.35 km following the cross-sections of respective canals and the total land to be acquired is 4.18 Ha. Based on the local land value of NRs 3000000.00 per Ha, the amount required for land acquisition is NRs 12540000.00 which in fact can be saved under pipe canal system as land is acquired temporarily during construction. In addition to this, this area can be used for agricultural or other purposes. From the table-I, it can be envisaged that, this area can benefit NRs 782388.00 per annum under irrigation, if not it benefits NRs 447124.00 in rain-fed condition. So it can be assessed minimum benefit from land saved is NRs 12987124.00.

Social and Environmental Benefit: Beside this there are several benefit assumed from the pipe canal system. Since the canal run day and night, there is a chance of falling humans and cattle during night time as well as there is chances of water borne diseases due to stagnant water and water logging in the surroundings. Such social and environmental benefit can be accounted 10 to 15% of total benefit.

Cost Benefit Analysis: Taking in account all the benefit such as agricultural benefit, benefit from water saved and benefit from land

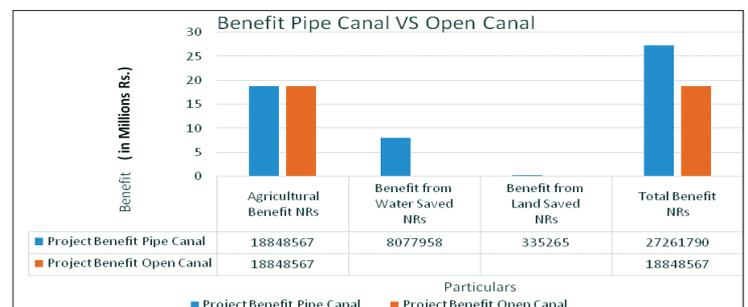
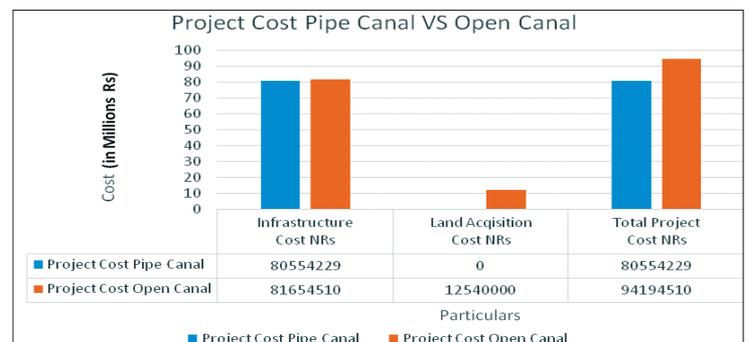
saved except social and environmental benefit were considered in cost benefit analysis of pipe canal system whereas for open canal system agricultural benefit is only considered. On the cost side, though the study is limited to main and branch canal, cost of storage/diversion structures is also considered in both cases for fair evaluation of project's benefit (refer table below). The agricultural benefit is crop budget and productivity mentioned in DDR.

Description	Total Cost of Project in NRs					
	Pipe Canal			Open Canal		
	Financial Cost	Conversion Factor**	Economical Cost	Financial Cost	Conversion Factor	Economical Cost
Storage/Diversion Structure*	41081328	0.95	39027261	41081328	0.95	39027261
Canal System (Main and Branch)	39472901	0.95	37499256	40573182	0.95	38544523
Land Acquisition Cost		0.95	0	12540000	0.95	11913000
Operation and Maintenance Cost	394729	0.9	355256	1217195	0.9	1095476
Total Cost of Projects in NRs	80948958		76881773	95411705		90580260

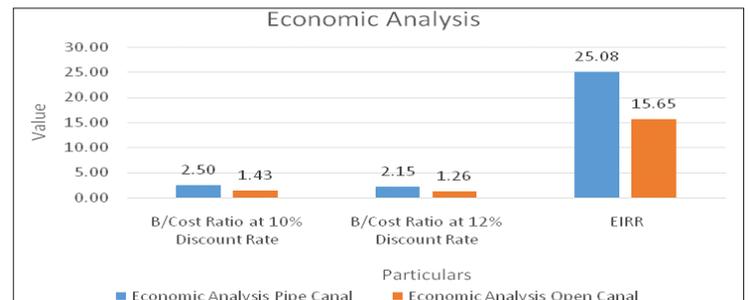
* Cost of storage tank is added from DDR for economic analysis

** Conversion Factor is taken as per PDSP manual M13* to adjust the price in Nepalese context

Operation and Maintenance Cost for surface irrigation system is 3% as per PDSP manual for O&M whereas for pipe canal assumed 1%



The cost benefit analysis reveals that EIRR for pipe canal is 25.08 significantly higher than open canal with 15.65% and cost benefit for pipe canal at 10% discount rate is 2.5 and for open canal is 1.43 (refer chart below).



Conclusion: This study in brief can be concluded as follows;

- This study concludes that cost of pipe system is less than that of open canal system. But the project cost may vary on the project types, sizes, topography etc. So it will be too early to conclude that the pipe canal system is cheaper than open canal system. A detailed study from diversion/storage to farm level for different sizes is to be carried out to generalize the project cost.

- Water is saved significantly in pipe canal system, almost 30%. The water productivity in pipe canal system is higher by 43% than that of open canal system.
- Land under open canal is acquired significantly at higher cost increasing the project cost and diminishing the agricultural land.
- Pipe canal is more social and environmental friendly than open canal.
- Maintenance and operation of open canal is higher than that of pipe canal as number of control and regulating along with crossing structures are required. There are possibility of erosion, weeds proliferation in open canal.
- Benefit Cost ratio and Economic Internal Rate of Return i.e. recovery of investment is quite appreciable in pipe canal system.

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Use of Tunnel Boring Machine (TBM), beginning of a new era in Irrigation Development

 **Rajendra Prasad Adhikary**

In the decades of long course of development we have not experienced the advantage of tunnel in the fullest extent, although tunnelling is considered to be one of the oldest strategic technologies well practiced in achieving safer and shorter distance to overcome difficulties created by the landscape variation. Tunnelling has become a familiar term in Nepal only because of the much hyped Melamachi project. But this article is written about a different experience which is directly related to the new development in tunnel technique.

The viability of transferring water from water abundance snow-fed river to the water deficit river initiated the Bheri-Babai tunnel diversion project, the first national pride irrigation project focused on machine tunnelling. With the arrival of last consignment of tunnel boring machine at the Bheri-Babai project site office in Hathikhal Babai, Banke, Irrigation Department and the technical staff of

the project office are enthusiastically getting set to proceed the tunnel digging work with the use of Tunnel Boring Machine which is scheduled to start soon after Deepawali festival (now work in under progress). Apart from being national pride multipurpose project, to provide irrigation facilities to 51 thousand hectare of land in Banke and Bardiya districts and 48 mega watt of consistent hydroelectricity in the national grid, the project has two remarkable distinctive features. It is a trans basin project that transfers water from water surplus Bheri river from Surkhet to water deficit Babai river in Bardia through 12 km long tunnel dug with the use of Tunnel Boring Machine – first of this kind in the country. The availability of adequate water in Bheri- Ganga and the natural slope in the short tunnel alignment made this project not only technically viable, environmentally friendly and socially responsive, but the expected economic rate of return and the benefit cost ration are also very captivating, 12.89 percentage and 1.66 respectively. The revenue generated by selling electricity thus produced at the present cost can recover the project investment of NRs. 16 Billion within 7 years, with irrigation service being cost free bonus out come.

When we review the history of tunnelling work in the country, we find that there is hardly any tunnel as an infrastructure in the modern planned development. As the matter of fact, Tony Hagen was the first person who visualized the use of tunnel through the mountain to built short and safe highways, but his concept was never realized. Hydropower and Melemchi drinking water project have recently developed the tunnel work, but with the conventional manual technique.

Tunnel boring by machine looks theoretically very simple - the head reach of the 275 meter long machine that runs on railway league is equipped with accessories that probes the type of material to be bored and accordingly adjust the cutting blade as it advances further into the mountain so as to crush and churn the rock material into small pieces which are then brought outside the tunnel automatically loading on the conveyer belt of the machine. As soon as one and half meter of tunnel is dug and brought to the required dimension of 4.2 meter diameter, a set of tunnel shaped high strength precast slabs are fitted by the machine so as to have a finished tunnel surface. Breaking the rock into small pieces, transporting them outside the tunnel, lining and supporting the tunnel hole by readymade concrete segments are the continuous process till the end of the tunnelling work. The exit of machine from the other end implies the tunnel is functionally completed in all respect.

Although tunnel boring machine is considered as the state of art of modern tunnel constructing technique and has been widely accepted despite its high investment cost, we are not in a position to expect its success as easily as it sounds. There are some limitations of this technique of tunnel boring as well. The un-foreseen and less thoroughly studied geological strata to be anticipated while tunnelling may as well trap the machine inside the Chure mountain, making the tunnelling work cumbersome to move ahead. There are cases in many parts of the world including India where a lot of hassles were carried out to make the trapped TBM machine back to work in normal way. In our case the likelihood adversity is estimated in the middle reach of the tunnel alignment where it passes right underneath the Toil khola of Surkhet where the overburden rock mass may consists of water holding geological formation. Despite a few challenges ahead, Department of irrigation is fully prepared to make the use of machine a successful story so as to replicate it in other trans-basin multi purposes water diversion projects that are in pipeline with the department. Once succeeded, it may have wider application including tunnelling through the mountains to built efficient fast track highways.

Modern construction of irrigation infrastructure is said to have begun with the Chandra nahar canal in Saptari by then Rana

prime-minister Chandra Sumsher in B.S 1980 and was typically the extension of British India technology. Irrigation development has strived tremendously since then—ranging from modernizing the local indigenous technologies of farmers managed schemes to the recent world class technique of tunnelling with machine. At present, there are about 14 lakh hectares of land furnished with irrigation infrastructures to cater irrigation water to the agriculture land.

Standing at this juncture, when we review our investment made and output we get, the situation is paradoxical – massive trade deficit in agriculture import, almost every house hold preparing their daily meals by importing edibles with the hard earned remittance, high rate of youth migration and the agriculture land furnished with

expensively invested irrigation infrastructures are being urbanized in fast track. During inception phase, every investment put to develop irrigation infrastructures are justified by the economic benefit it makes when the entire agriculture land area cultivated by the crops intensely. The irrigable flat lands in terai are turned into expensive plot by real estate business entrepreneurs. It is high time that policy has to formulate to keep irrigated agriculture land intact so as to have expected agricultural benefit for years together, failing to do so would be futile investment. To begin with, the regulation can be well incorporated in the four national pride irrigation projects those are under execution.

* Mr. Adhikary is former Director General of DoI

Call for papers of Department of Irrigation (DoI) National Irrigation Seminar on “**Water Resources Development and Management in Federal Nepal; Challenges and Opportunities**”

The Department of Irrigation (DoI) is organizing a National Irrigation Seminar on “**Water Resources Development and Management in Federal Nepal; Challenges and Opportunities**”. Its main objective is to provide a common platform for participants to share experiences, lesson learned and discussion on issues, challenges and opportunities related to water resources development and management. Department of Irrigation calls paper from experts and professionals related to this field. Papers are expected on one of the following sub-themes.

Seminar Sub-themes:

1. Water Resources Development: Socio-Political Challenges and Opportunities in the context of Federal Nepal
2. Inter-Basin Water Transfer Multipurpose Projects for Sustainable Irrigation Development in present Federal Structure of Nation.
3. Sustainability Issues of Irrigation Development and Management in Federal Nepal
4. Socio-Economic and Socio-Political Aspects of Irrigation in Local Level
5. Impact of Climate Change on Overall Irrigation System in Nepal
6. Role of Cooperatives in Irrigation Development and Management in Federal Nepal
7. Human Resource Development and Management in Water Resource Sector in Federal Nepal
8. Scope of Public Private Partnership for Sustainable Development of Water Resources Projects in Nepal
9. Experience, Challenges and Way forward for Promoting Irrigation Management Transfer Program
10. Participatory Irrigation Management: Stakeholders coordination Approach for Improved Efficiency
11. Water, Energy and Food Nexus: An Integrated Approach for Sustainable Development
12. Small Scale Irrigation: Experience, Challenges, Opportunities and Pathways
13. Sustainable Ground Water Irrigation in Terai and Hills of Nepal
14. Water Management and Modern Irrigation Technologies

Schedule for paper submissions:

- Abstract Submission: 6th Falgun, 2074 (18th February, 2018)
- Notification of Abstract Selection: 13th Falgun, 2074 (25th February, 2018)
- Submission of full text paper: 30th Falgun, 2074 (14th March, 2018)
- Date of Seminar: 7-8 Chaitra, 2074 (21st -22nd March, 2018)

The abstract should not be more than 250 words and should contain all the features of the main paper in the brief. All abstract submission will be peer reviewed and evaluated based on originality, technical content and relevance. The accepted full paper will be published in the Seminar Proceeding of DoI.

For technical guidelines and other information, please contact

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