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EFFECTS OF DESIGN REVIEW OF SELECTED IRRIGATION PROJECTS FROM DANG VALLEY, NEPAL-ASIA.

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ABSTRACT

Purpose: Design determines what we get after construction. So, Designing is given more attention. This research has attempted to reveal the effects of design review on the performance of the small surface irrigation schemes.

Design/Methodology/Approach: Project-related data sheets and built drawings from District Technical Office Dang were collected as secondary data followed by a questionnaire survey, interviews, and observations as primary data. These data have been analyzed using the method of triangulation. The questionnaire survey, case study and hypothesis testing results were triangulated to conclude the research.

Findings: From the hypothesis testing, with secondary data, it was concluded that crop yield and cropping intensity were significantly increased after the design review strengthening the sustainability and efficiency of the system without a significant increase in time and cost falsifying the respondents' perception. It indicates that if a proper design review system is followed, cost and time is not a barrier to improving the FMIS performance.

Research Limitations: The sample size for the case study was limited to only three in numbers by using the area sampling method.

Practical Implications: The study focused on small scale surface irrigation projects conducted DoLIDAR/ CIP Unit in Dang valley only for the study. As per the Local Government Operation Act 2017, small irrigation schemes shall be conducted by local government so different stakeholders including consultants and contractors probably, will be a guiding norm present in that context. It has been focused to study the effects of design review and its necessity.

Social Implications: This study helps policymakers and local level government to assure construction in compliance with standards. It makes it easier for policy maker to incorporate the development needs without compromising quality through regulatory provision.

Originality / Value: First time effects of design review have been found in the case of small irrigation systems which will enable designers to assure effective construction and operation. It is a guiding document for professional designers.

Keywords: *Crop yield; cropping intensity; FMIS performance; perception; standards*

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INTRODUCTION

Design is the mother of construction and it can provide the complete performance of a project (Mishra, & Aithal,2022: Sharestha, Mishra & Aithal, 2022). It is a crucial part of irrigation projects. The current practice of design and implementation shows a gap among the stakeholders. This has created an impact on the quality and performance of the irrigation system. The site condition and local demand during the survey may change which affects significantly the previous survey and design of the same system. This is more critical in the case of the Farmer Managed Irrigation System (FMIS).

This study is intended to show the present practice of design review, the real and critical causes of design change and its effect on the performance of the small irrigation system. The result of the study would be useful to all the parties (client, consultant, contractor and WUA) to establish an effective design review mechanism.

Effects of Design Change on Construction Projects

Time and cost are the key factors to earning profit for the contractor while constructing an irrigation project. If the project is delayed then there is a slim chance of earning more profit from the contractor and delay in functionality too. However, WUA tends to have an efficient and sustainable irrigation system which is the primary aim of FMIS.

Bhagawat & Patil, (2017) express that irrigation projects in Amravati district is experiencing numerous issues which influence time, cost and quality, these variables are connected with political circumstance, procedures involved and different issues in Amravati locale, these issues are summarized as; Enormous number of labourers in contrast with the number of undertakings, Land procurement issue, Inaccessibility of asset, proceeded with expansion in material costs, Different work endorsement not taken on schedule, Plan of development not prepared on schedule, and Unsteady political circumstance.

These elements above and others added to an enormous extent in making numerous issues in water system projects which typically connected with cost and time invades. Postponement of undertaking and cost invades in India is one of most significant issues at development the board field, additionally exploration and concentrates in this field in India are not many contrasted with commendable anticipated outcomes. Delays in the booked consummation of undertakings can prompt extra disintegration of framework that might have been stayed away from by ideal finishing. They likewise force extra functional expenses expected to deal with the effects of terminations and redirections.

Coordination and communication are important in a multi-participant environment in most construction projects. Detrimental variations, which affect the projects adversely, can be managed

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at the early stage with due diligence incoordination, and frequent communication (Assaf, Al-Khalil & Al-Hazmi, 1995).

According to Soderholm (2008) projects run through different stages on their way to completion. Time is not always the most important defining factor dominated by functional requirements, is still an important factor to distinguish between different project practices.

According to Chitkara (2004), the construction project is a mission, undertaken to create a unique facility, product or service within the specified scope, quality, time, and cost. According to Mulyani (2006) development projects are a series of activities connected with the development field that have a restricted time aspect with the explicit assignment of assets, to understand the thought and a specific reason, after the thought is attainable. To finish development projects, have stuck to the limit three snags are Budget, the development venture ought to be effective, Schedule, the development activities to be powerful, and the quality, execution should meet the expected details and standards.

The primary components that are inside a venture: Cost: money and speculation, Quality: the size of the ideal quality and clear necessities, Quantity: huge or aspects of the venture, and Time: when and how long it takes for the execution of the structure.

Cause and Effect Diagram

A cause and effect diagram is a picture imposed of lines and symbols designed to represent a meaningful relationship between an effect and its causes. It was developed by Dr. Kaoru Ishikawa in 1943 and is sometimes referred to as an Ishikawa diagram or a fishbone diagram because of its shape. C& E diagrams are used to investigate either a bad effect and to take action to correct the causes or a good effect and to learn those causes that are responsible (Besterfield, Besterfield, Basterfield, & Besterfield, 2010). A similar concept has been expressed by Mishra 2022 in his reference book of assessment from the eastern approach.

The rationale of the Study

According to Dahal, Mishra, & Aithal (2022 a and b), design review has been necessitated though it is in the preliminary stage in small irrigation schemes which is needed for cost-effective and sustainable design to irrigate every plot of farmers' field considering socio-cultural and environmental requirements. The major four significant factors to cause design change in small surface irrigation schemes have been found to survey, design, social issues and unforeseen site conditions respectively. However other secondary factors are construction methodology, material use, environmental, social and management issues too. A similar finding was revealed by Mishra & Aithal (2022) for bridge projects. So, to take the study to a new level, it is significant to find the effects of design review.

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METHODOLOGY:

In this research, the concept is only supported by action and research questions which are the most important feature of Pragmatism. This research also integrates the use of multiple research methods such as qualitative, quantitative and action research methods so the philosophy of this research is Pragmatism.

The study is focused on the following system.

Jeetpur Irrigation Sub Project, ParseniTaal Irrigation Sub Project and HanumanpurMulkulo Irrigation Sub Project are lies in Ghorahi sub-metropolitan city -11, Province no. 5 have been selected for the case study. It is a continuous study of Dahal et al. (2022) from which details can be referred.

Table 1 Research Matrix

Objectives	Data required	Data Collection Methodology	Data Analysis
To assess the effects of design review	Primary and secondary data	KII, Questionnaire Survey, Collection of FAR, Variation sheet and work completion report from DTO office	Illustration of data using statistical tools, hypothesis testing(using t-test)

Collection of Data:

a) ***Professional Interview:*** Professional interview was continuously carried out to get insight into the effects of design review.

b) ***Questionnaire Survey:*** After the validity of the questionnaire, the questionnaires were distributed to the respondents of client, consultant, contractor and WUA representative. Ninety percent of the questionnaire was distributed by visiting them on-site while ten percent of the questionnaires were sent by email. Most of the respondents have positive responses to the questionnaire. On average 92% response rate was achieved which was very high and was possible due to continuous field visits to the site..c) Field Observation: The field visit was done carrying a checklist for visual assessment.

c) ***Secondary data:*** Collected from District Technical Office/CIP unit Dang.

Analysis of Data:

After the collection of primary and secondary data, these data were analyzed systematically by the method of triangulation. Triangulation is the process of verification that increases validity by incorporating several viewpoints and methods. In research, it refers to the combination of two or more theories, data sources, and methods in one study of phenomena to converge the results and can be employed in both quantitative and qualitative studies (Blaikie, 2000). It allows researchers to be more confident about the results. It minimizes the inadequacies of single-source research. This may help to uncover the dimension of the deviant phenomenon. The detailed analysis was done including all fifteen ISPs and was further strengthened by taking three irrigation schemes for

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the case study. The qualitative data obtained from the field was analyzed by a cause and effect diagram. The questionnaire survey data were analyzed by using statistical tools and presented on the chart, graphs, tables, diagrams etc. The significant impact of cost, time, cropping intensity and crop yield by design review was analyzed by hypothesis testing. T-test and paired T-test are suitable to check the significance of parameters for small samples (Arora et al., 2007). It can be summarized as:

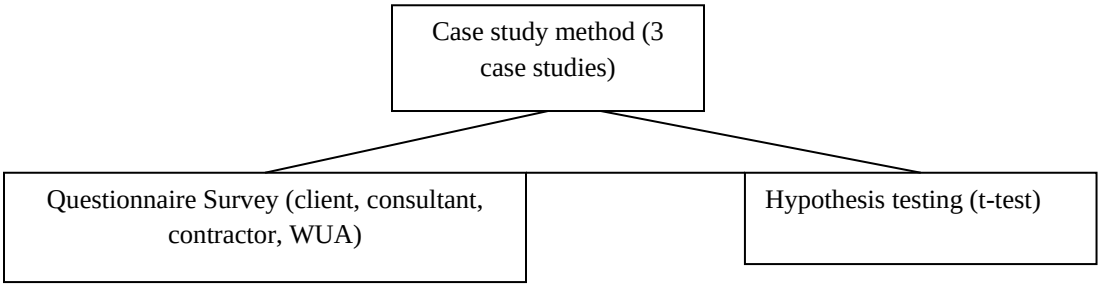

Figure. 1: Method of triangulation for analysis of data *(Creswell, 2016)*

To find the rank of the factors Likert scale has been used to find the result. The five-point scale ranging from one to five was adopted and transformed into relative importance indices (RII) for each factor as follows (Somiah, 2015):

$$RII = \frac{SW}{A \times N}$$

Where,

W is the mentioned scale for rating a factor by the respondents which ranges from 1 to 5
A is the highest weight on the scale
N is the total number of respondents

For conducting t-test and paired t-test secondary data related to before and after design review of cost and time similarly to data related to cropping intensity before and after the project was collected from DTO Dang. Hypothesis testing was done by the use of the following formula (Arora et al., 2007).

$$\text{Mean of sample } \bar{X} = \frac{Sx}{n}$$

$$\text{Estimated Unbiased Variance } s^2 = \frac{Sd^2}{n(n-1)}$$

$$\text{Test statistic: } t = \frac{\bar{X} - m}{s}$$

Population mean (μ)
Degree of freedom =n-1

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For Paired T-test:

Mean difference $\dot{D} = \frac{SD}{n}$

Estimated Variance $s^2 = \frac{Sd^2}{n-1} - \frac{Sd^2}{n(n-1)}$

Degree of freedom =n-1

RESULTS AND DISCUSSION

Effects of design change

Design change affects in various ways in the construction of small irrigation projects. It can create very positive effects on the performance of structures and crop yield while completion time can be influenced negatively.

Delay in construction due to design review process

Delay in construction is a negative impact on construction. However, design review time can't be solely responsible for construction delay. Unavailability of construction material and financial problem of the implementer also plays a vital role.

The clients, contractor and WUA representatives believe that there is no delay in construction due to the design review process while 80% of consultant respondents believe that there is a delay in construction due to the design review process. Overall 50% of respondents believe that there is no delay in construction while the next 50% deny this. It indicates that consultants still suspect the efficiency of the client for design review. So there is a need for proper communication and time table for the review of the design.

Effects of a design change on cost and time in the construction process

Negative effects such as time overrun cost overrun are always undesirable in a construction project however they can occur in some cases due to design review activities. The respondents opined about the negative effects of design change.

Overall 39% of respondents believe that there is both time and cost overrun due to changes in design while 36% believe that there is no time and cost overrun. Only a few percentages say that there is only time overrun and cost overrun. This contradicting result indicates that the present practice of design review is not sufficient. If there is an effective design review mechanism then there is no time and cost overrun.

Positive effects of design change in the construction process

Positive effects of design change in the construction process are always desirable. In FMIS sustainability, efficiency and cost-effective design are always burning issues for the proper

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function of the system.

Overall 53% of respondents believe that the design review process facilitates the sustainability of the system while 39% believe that it supports efficiency, cost reduction and sustainability as well. It indicates that the design review process assures sustainability of the system Similar effect of Design review impacts positively on project performance on road also if it is done for a technical reason rather than political(Mishra & Aithal, 2022).

Negative effects of design change in the construction process

An increase in project cost, the extension of time and disputes between client and contractor/WUA are some of the negative effects of design change that occur in some cases. Design review can be one cause to create such effects.

overall 44% believe that there is an extension of time due to design change while only 14% believe that there is an increase in cost.42% believe that increases in cost, times and disputes between client and contractor arise due to design change. According to Mulyani (2006) construction projects have to be completed with limited time dimensions and resources. If design change occurs there might be the possibility of an extension of time and cost.

Role of design review for sustainability

Sustainability in the context of hill irrigation refers to the ability to mobilize resources to meet expected needs continuingly to keep the system operating within tolerable limits (Yoder, 1994). Sustainability indicates that the system should be operated with the beneficiaries' resources and knowledge so that it can sustain itself for a longer period. So it plays a very important role in Farmer Managed Irrigation systems.

All the clients, consultants, contractors and most of the WUA representatives believe that the design review process supports the sustainability of the system. FMIS seems sustainable because of the correction of some faults that occur during the design by the consultant. Even consultants also fully agree that design can be corrected by the implementer in the field considering the change in local demand and other changing scenarios.

Effect of design review in the relationship between client and contractor/WUA

The design review process has various facets of effects on the relations among stakeholders. A positive relationship is always desirable to complete the construction work on time. Respondents from all the stakeholders opined that there is a positive relationship between the client and implementer after the design review. There is a positive relationship between the client and contractor and WUA after the design review process. Overall 66% of respondents believe that there is a positive relationship while 31% say that it does not affect the relationship. Only 3% think

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that there might be a negative relationship after the design review. The main cause may be clarity in design and drawings which facilitate contractor and WUA for the construction work. Changing local demand can also be addressed with limited resources which prevent beneficiaries to confront clients.

Performance of design review in cropping pattern/cropping intensity

Cropping patterns and cropping intensities are those parameters that indicate the effect of irrigation in the farmers' field. Change in the cropping pattern and enhanced cropping intensity is always desirable. Proper canal system design supports function well to change these parameters. Overall 81% of respondents believed that the design review process helps to increase cropping pattern and cropping intensity because it corrects flaws in design and increases efficiency and sustainability. Only 19% of respondents think that it does not affect cropping patterns and cropping intensity.

Performance of design review in crop yield

Crop yield finally indicates the output of irrigation in the command area. An irrigation canal and provision of sufficient water are needed to increase the crop yield. This is desired output is possible only when the canal works efficiently and effectively without significant loss in canal. To make an effective system, a design review is done. Overall 80% of respondents believed that there is an increase in crop yield after the design review while only 20% think that the crop yield remains the same. This may be an increase in the efficiency and sustainability of the system.

Performance of design review in small irrigation projects

Performance of effective design with proper review changes in some parameters such as sustainability, functionality, crop yield, quality of structure, time, cost etc. The degree of effect as ranked by clients, consultants, contractors and WUA has been presented in Table 2. The very positively affected parameters have been ranked in descending order to less positively affected parameters.

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Table 2: RII and rank of performance-related factors in small irrigation projects

Factors	Overall		Client		Consultant		Contractor		WUA	
	RII	Rank	**RII**	Rank	**RII**	Rank	**RII**	Rank	**RII**	Rank
Sustainability	0.88	1	0.91	1	0.86	1	0.84	2	0.89	2
Functionality	0.87	2	0.91	1	0.82	2	0.84	2	0.89	2
Cropping intensity/pattern	0.86	3	0.89	2	0.8	3	0.8	3	0.91	1
Quality of structure	0.85	4	0.91	1	0.8	3	0.76	4	0.89	2
Efficiency	0.85	4	0.91	1	0.82	2	0.88	1	0.83	4
Crop yield	0.84	5	0.91	1	0.78	4	0.84	2	0.86	3
Operation and maintenance	0.83	6	0.83	3	0.78	4	0.8	3	0.89	2
Project cost	0.61	7	0.71	5	0.56	5	0.6	5	0.6	5
Project duration	0.61	7	0.77	4	0.54	6	0.6	5	0.59	6

Most of the stakeholders think that the design review process supports the sustainability of the system as it is ranked in the first position in the overall ranking. Similarly contractors, clients and consultants also believe that it increases efficiency too. The client also believes that it enhances the quality of structure whereas the contractor suspects this result. . According to Yoder(1994) sustainability refers to the ability to meet expected needs continuingly within tolerable limits. So in FMIS, all the stakeholders believe that the design review process supports the sustainability of the system.

Most of the stakeholders think that project duration and time are negatively affected that's why they have prioritized these parameters in the last ranking. However, from the KII with client and consultant personnel, it was stressed that time and cost are the prime factors to be considered during the planning of a project. Despite the negative impact on cost and time, all the stakeholders agree that it affects positively on sustainability, quality and efficiency of the structure. Most of the parties believed that cropping intensity and pattern will be increased while they believe that crop yield will be slightly positively affected.

Case studies

Case studies have been used to study the changing parameters to change the design along with its effects. Three case studies have been studied to check the result of the questionnaire survey.

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Case study I: Jeetpur Irrigation Subproject

Jeetpur Irrigation subproject of command area 47.8 ha. is a farmer-managed irrigation system constructed by the farmers initially with more than 3 km long main canal, temporary diversion at the head work site and temporary water conveyance structures in the system in which farmers faced operation problems annually could not obtain desired quantity of output from the agricultural field because of an unsecured quantity of water coming into their canal.

Variation in components

Table 3: Major Variation in Components

Major changed items	Unit	Original Qty.	Revised Qty.	Original Amount in NRs.	Revised contract amount in NRs.	% change
Earthwork in excavation	m^3	653.11	816.39	130622.80	163278.50	25
Concreting work(M10)	m^3	225.558	281.948	1804464	2255580	25
Reinforcement work	t	6.6818	4.47271	501135.3	335452.93	-33
Form work	m^2	1543.34	1643.76	463002	493128.3	7
Gabion box fabrication	m^2	4551.6	3805.85	1137900	951462.5	-16
Gabion box filling	m^3	872.025	766.425	1744050	1532850	-12
Geo-textile work (TS-50)	m^2	791.7	624	102921	81120	-21
Total Amount				**7584207**	**8968949.2**	**18.3**

(CIP, 2017)

Table 3, shows a major change in quantity and cost with some components. As from the interview with CIP Engineer Mrs. LaxmiSainju the major changes occurred in head works. Earlier gabion weirs were designed with gabion abutment wall. Later it was observed that the gabion weir may be scoured due to the high current of flow so the gabion weir was additionally concreted with M10 PCC at the top to protect from scouring. From the observation, it was seen that scouring is the major problem due to the high slope of the intake site. Similarly, sidewalls that were planned to be constructed by gabion boxes were changed by a masonry wall.

As per DoI(2014), Badkapath Irrigation project was reviewed and major changes were in headworks and main canal lining works. This shows that major changes in Terai region are in headworks and canal lining works.

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The Ishikawa diagram related to the design review of Jeetpur ISP has been illustrated in figure 2:

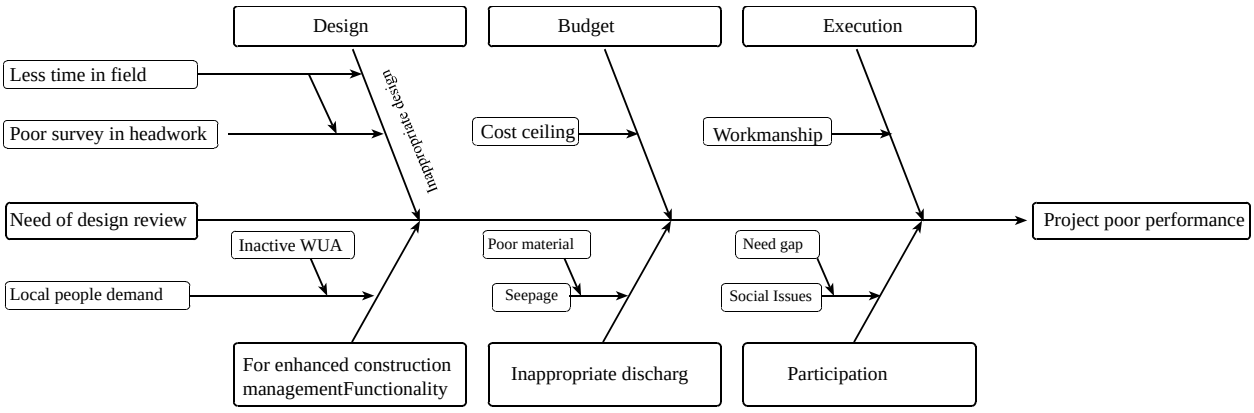

Figure.2: Ishikawa diagram Jeetpur ISP

Causes of variation

Design: Headworks were designed according to Khosla theory of seepage but a proper survey had not been done like river morphology and river bed slope. Gabion weirs were designed without thinking of scouring by river bed slope. It was revised by concreting (M10)over gabion weirs which seems working properly. Similarly, gabion side walls were replaced by masonry walls.

Budget Ceiling: The cost ceiling in CIP projects irrespective of the length of the canal and other structures was the governing factor for the appropriate design of the system. There was a mechanism of $1500 per ha for the new canal and $1000 for the rehabilitation of the canal. This was a very low rate as compared to an allocation by DoI and other clients. These criteria affected every part of the design and enforce a review of the design. There was still room for improvement of guide bunds due to the lack of budget in this ISP.

Farmers' participation: During the survey some leading farmers were absent. They obstructed the construction guide bund. Later on, they were convinced and some protection work upstream of headworks have been constructed by design review.

Functionality: Since headwork design was questionable, proper functionality could not be achieved through that design. Gabion weir was further strengthened by concreting with PCC(M10) to control the seepage.

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Impact of design review: The impacts of design review in this scheme were both positive and negative. However positive impact was seen as more dominant than the negative impact on the sustainability of the system. The positive impacts are:

Functionality: Design discharge can be delivered to the command areas as per the requirements. There is no problem with seepage in the headwork area. Additional discharge in the canal can be prevented from escaping.

Adequacy: Water is adequate in the area. There is no scarcity of required discharge even in the tailrace area.

The negative impacts are:
Increase in cost: The cost of the system has been increased by 18.3% from the previous original estimate.

Increase in time: The design review process took more than 10 days which is not significant for extension of time. For any project, it will be significant as confirmation by the study of bridge projects in Nepal by Mishra & Aithal, (2022).

Case study 2: HanumanpurMulkulo Irrigation Sub Project
Hanumanpur MulKulo Irrigation subproject of command area 74.0 ha. is a farmer-managed irrigation system constructed by the farmers initially with a 1.5 km long main canal, temporary diversion at the head work site and temporary water conveyance structures in the system in which farmers faced some problems annually could not obtain desired quantity of output from the agricultural field because of an unsecured quantity of water coming into their canal it is a perennial river.

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Variation in components

Table 4: Variation in components

Major changed items	Unit	Original Qty.	Revised Qty.	Original Amount in NRs.	Revised contract amount in NRs.	% change
Earthwork excavation	m^3	256.01	334.30	25601.00	33429.60	31
Filling with ordinary soil	m^3	31.46	43.2069	3146	4320.69	37.34
Boulder soling	m^3	1.89	9.945	1890	9945	426
Concreting(M10)	m^3	37.23	35.982	372300	359820	-3
Concreting(M15)	m^3	81.41	90.879	976920	1090548	12
Stone masonry (1:4)	m^3	189.73	136.658	1151661	829514.06	-28
Form work	m^2	630.06	495.42	315030	247710	-21
Reinforcement	T	3.83	2.31399	383000	231399.28	-39.6
Geotextile	m^2	218.68	223.04	43736	44608	1.99
Gabion box filling	m^3	220.5	355.25	330750	532875	61.11
GI wire procurement	m^2	1014	1782	304200	534600	75.74
Total Construction cost				**4264334**	**4274869.6**	**0.25**

Table 4 shows a major change in quantity and cost with a change in some components. As from the interview with Chief District Engineer Mr. Sahadev Bahadur Bhandari the major changes occurred in head works. Earlier there were no sufficient guide bunds to protect nearby cultivable land and canal. Additional sheet piles were added to prevent scouring problems in the downstream site. As per DoI (2006) intake design is site-specific same design may not function properly in other sites. As per Mr. Bhandari copy of the design was one of the causes to review the design. That is one of the causes of this ISP.

The headwork is functioning well after design variation. The problem of seepage and low discharge in the canal was minimized. The Ishikawa diagram related to the design review of Hanumanpur ISP has been illustrated in figure 3:

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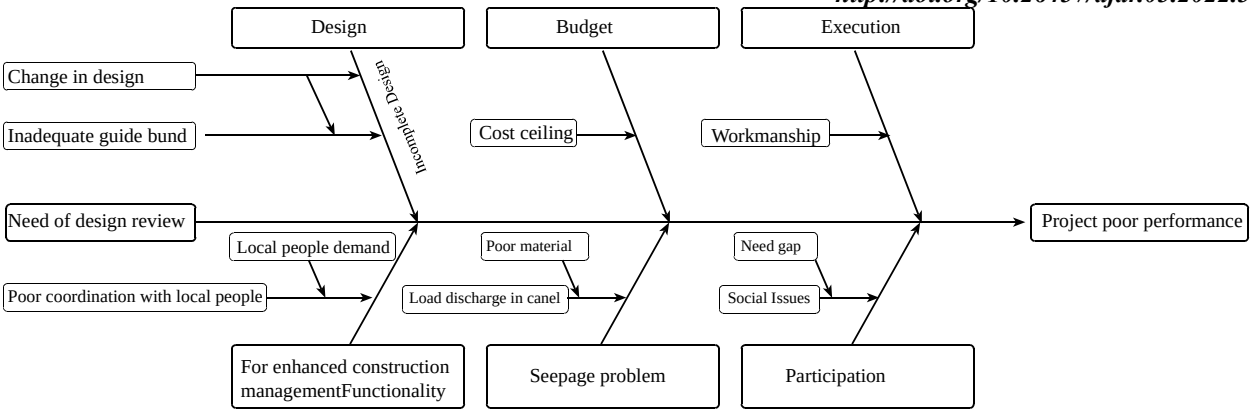

Figure 3: Ishikawa diagram Hanumanpur ISP

Causes of variation

Design: Headworks were designed but enough piles had not been planned. Similarly, scouring problems on the downstream side endangered the intake area. As the bed level raised flash flood damaged cultivated land on the left side. These causes created a review of design and addition of works related to guide bund and downstream protection works.

Budget Ceiling: The cost ceiling in CIP projects irrespective of the length of the canal and other structures was the governing factor for the appropriate design of the system. There was a mechanism of $1500 per ha for the new canal and $1000 for the rehabilitation of the canal. According to CIP Engineer, Laxmi Sainju budget ceiling had affected this canal too. Some upstream side guide bunds were still insufficient to protect from the outflanking of the river.

Farmers' participation: Farmers' participation in this ISP was encouraging but some valuable information was lagging to extract from lead farmers which compelled to review the design to address the effect of flash floods in the intake area.

Social issues: Initially farmers from the right-hand side in the upstream area refused to provide land to construct a guide bund. After one monsoon season, they saw the damage from flash floods and demanded to construct the guide bund. As per information from Er.Sainju was constructed by review of design during the construction phase. She stressed that contract award to WUA for canal excavation and contract award to the contractor for canal lining work in the same area created delayed construction work along with poor performance. It shows that a contract should be awarded to a single party for the same set of works like intake works, canal lining works etc.

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Impacts of design review

The impacts of the design review in this scheme were both positive and negative. However positive impact was seen as more dominant than the negative impact on the sustainability of the system. The positive impacts are:

Functionality: Design discharge can be delivered to the command areas as per the requirements. There is no problem with seepage in the headwork area. Additional discharge in the canal can be prevented from escaping. The provision of a gate in the intake area can control the flow so it is functioning well in recent years.

Adequacy: Water is adequate in the area. There is no scarcity of required discharge even in the tailrace area too.

Construction cost: There is no significant increase in cost but some quantities are decreased and some quantities are increased to optimize the design based on value engineering. Only 0.25% cost is increased which is negligible in nature.

Increase in time: There is no extension of time so the design review process did not take significant time for its revision. As per information provided by DTO Dang, the design review process took 10 days for the client.

Cropping intensity: As per the focus group discussion crop yield has increased significantly by this year which is justified by hypothesis testing of secondary data.

Crop Yield: As per the focus group discussion with farmers crop yield has also increased significantly.

Case study 3:Parseni Taal Irrigation Sub Project

Parseni Taal ISP is a farmer-managed irrigation system local to Ghorahi Sub-Metropolitan City-09 in the Dang district. The water source for this scheme was ParseniTaal. The available flow was proposed to divert to the respective command area for the gravity flow system. Farmers from Ward 9 had attempted to construct a canal to divert water from the Parseni Taal.

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Variation in components

Table 5: Variation in components

Major changed items	Unit	Original Qty.	Revised Qty.	Original Amount in NRs.	Revised contract amount in NRs.	% change
Earthwork excavation	m^3	91.87	129.45	13779.90	19417.35	40.91
Concreting(M10)	m^3	31.92	17.69	351112.92	194640.12	-44.56
Concreting(M15)	m^3	119.16	162.21	1549087.23	2108706.68	36.13
Reinforcement	T	8.61	7.67	861109.79	767433.44	-10.88
Gabion box fabrication	m^2	456.50	69.75	114125	17437.50	-84.72
GI wire procurement	m^3	96.25	16.71	125125	21716.50	-82.64
Rubber seal	rm	23.17	16.17	46346.67	32346.67	-30.21
Total Construction cost				**3393642.45**	**3277811.71**	**-3.41**

(DTO, 2017)

Table 5 shows a major change in quantity and cost and some additional components. As from the interview with the vice-chairperson of that ISP Mr.ChidiyaChaudhary water seepage from the source area as well as the canal section was remarkable which obstructed them to irrigation fully in the irrigable command area. From the observation in the field, the soil was found to be porous in nature. As per information from CIP Engineer at that site Mr.TekanPandit, the major changes occurred in head works. Earthen dam in the Southern part of the source pond was redesigned by the concrete wall because of land availability problem as it was provisioned as the voluntary contribution of land by the farmer which was not possible in Dang Valley. So RCC wall was designed along with backfilling with earthen materials. Some less important lining work was curtailed and added to the intake area economized the design as well decreasing 3.41% of the originally estimated cost which seem the design was optimized as per the requirement in the area. The headwork is functioning well after the design change to address land unavailability conditions.

The Ishikawa diagram related to the design review of Parseni Taal ISP has been illustrated below in figure 4:

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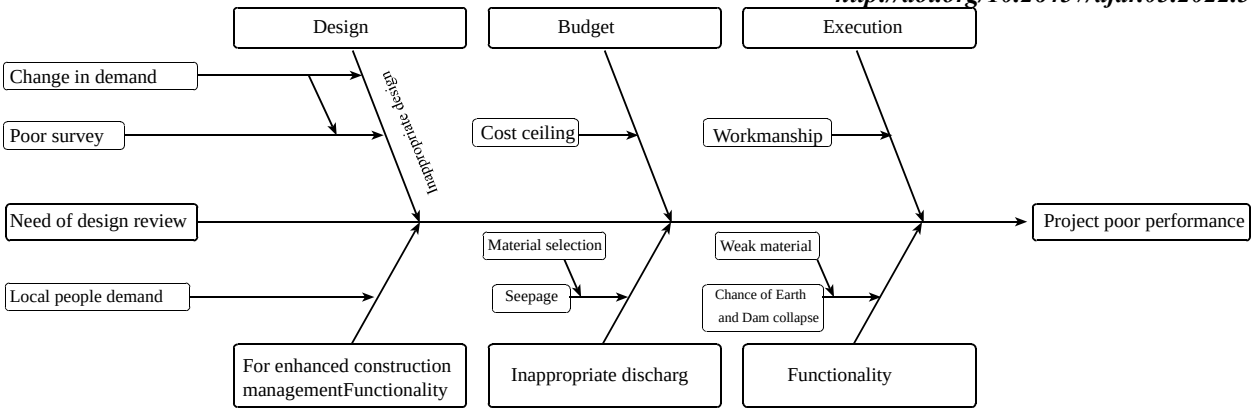

Figure 4: Ishikawa diagram of Parseni Taal ISP

Causes of Variation

Design: Initially earthen dams were planned to be constructed at the headworks site for the creation of a pond. Later on, WUA representatives and client engineers discussed and concluded that strengthening the earthen dam could cover more land which is more precious in Dang Valley and could not be achieved in voluntary contribution as expected by project guidelines. Later on, it was designed to be constructed by RCC concrete wall covering less area and backfilled by earthen materials. Some less important RCC canal lining work was reduced and this quantity was transferred to the headworks side. In this way, a design review was done for the sustainability and efficiency of the system.

Budget Ceiling: The cost ceiling in CIP projects irrespective of the length of the canal and other structures was the governing factor for the appropriate design of the system. There was a mechanism of $1500 per ha for the new canal and $1000 for the rehabilitation of the canal. According to CIP Engineer, Laxmi Sainju budget ceiling had affected this irrigation subproject too. Some canal lining works needed to be done to control total seepage for the sustainability of the system.

Farmers' participation: Farmers' participation in this ISP was encouraging. During construction, they felt that control of seepage at the pond side is far more important than the lining work in the canal so they changed the demand and that was addressed by the client during the design review process.

Social issues: There was no influencing social issue but the demand for fencing around the pond

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is listened to in the community. Small children may be drowned in the pond however client was unable to address the demand due to the budget ceiling.

Unforeseen Site Condition: During the survey period in the summer season it was assumed that the soil in the dam could resist the hydraulic pressures so RCC work was allocated to lining works. As per Engineer Mrs. Sainju, after excavation in the bank, it was felt that due to seepage in the soil dam might collapse so the review was done and RCC (M15) dam was designed.

Impact of design review

The impacts of the design review in this scheme were both positive and negative. However positive impact was seen as more dominant than the negative impact on the sustainability of the system. As per Rezania et al., (2011) design review or value engineering process optimizes design with the reduction in cost and enhancement of functionality.

The positive impacts are:

Functionality: Design discharge can be delivered to the command areas as per the requirements. There is no problem with seepage in the pond area due to RCC concrete wall construction. Additional discharge during the summer season can be easily drained out from the escape. According to vice-chairperson Mr.Chidiya Chaudhary after the construction of the pond structure, WUA can sell water to nearby village farmers who were not participated in the canal, on a time basis and have earned Rs.50,000 during the dry season. This seems a unique approach for the sustainability and optimum utilization of precious water assets.

Adequacy: Water is adequate in the area that's why WUA sells water in the dry season to other nearby farmers who were not included in the system.

Construction cost: The cost was slightly decreased by 3.41% which is not so significant in nature however structural components are had been drastically changed to optimize the system in an effective way which also justified that design review is most essential to address such gap between local demand and approach of design.

Construction time: There was an extension of time by seven months concerning the originally intended completion time however only 12 days had been spent for the design review process so other factors such as delay by the contractor were seen to be dominant for the extension of time.

Cropping intensity: As per the discussion with the farmer it was found that crop yield was increased significantly by this year which is justified by hypothesis testing of secondary data.

Crop Yield: As per the discussion with farmers crop yield was also increased significantly.

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Effects of design review on time, cost, cropping intensity and crop yield of the project

Secondary data from District Technical Office Dang related to change in cost, time, cropping intensity and crop yield of the project has been analyzed using hypothesis testing. Paired t-test and t-test for mean value have been applied.

Testing of hypothesis for cost:

Null hypothesis: Ho**:** $u_x=u_y$ i.e. there is no significant difference between the original cost and revised cost after design review.

Alternative hypothesis: H_1: $u_x<u_y$(one-tailed test) i.e. Revised cost after design review is significantly increased than the original cost.

Table 6: Calculation sheet for original cost compared to the revised cost for the t-test

S.N.	Name of ISP	Type	Original cost per ha(x)	Revised cost per ha(y)	Difference ((D=y-x)	D^2
1	Hanumanpur ISP	NCB	62864.54	**61910.52**	-954.02	910150.72
		WUA	26983.69	26996.31	12.62	159.19
2	Matheuri ISP	NCB	86621.38	86659.24	37.86	1433.44
		WUA	21929.96	21929.96	0.00	0.00
3	Lamitara ISP	NCB	103420.71	93610.17	-9810.54	96246711.12
		WUA	38411.25	36167.26	-2244.00	5035519.97
4	JugkholiTulbigunj ISP	NCB	23573.91	23573.91	0.00	0.00
		WUA	85692.44	87813.23	2120.79	4497751.94
5	Bukakhola ISP	NCB	62335.19	62335.19	0.00	0.00
		WUA	59665.77	59863.19	197.42	38972.99
6	Badahara ISP	NCB	146577.39	143435.44	-3141.95	9871877.40
		WUA	34337.18	34337.18	0.00	0.00
7	Jeetpur ISP	NCB	170256.89	212027.46	41770.57	1744780683.81
		WUA	26599.59	26599.59	0.00	0.00
8	ParseniTaal ISP	NCB	91305.14	88188.74	-3116.40	9711939.49
		WUA	9589.22	9589.22	0.00	0.00
9	Thutetari ISP	NCB	161878.55	155285.75	-6592.80	43465040.35
		WUA	14367.95	14367.95	0.00	0.00
10	Uttar Aamarai ISP	NCB	104011.75	116474.60	12462.85	155322615.10
		WUA	12706.73	12706.73	0.00	0.00
11	BalapurBenguwasota ISP	NCB	96030.48	99670.14	3639.66	13247142.58
		WUA	6001.29	6001.29	0.00	0.00
12	KalimatikuloBalichhopa ISP	NCB	144088.25	153007.51	8919.25	79553075.50
		WUA	23684.47	23684.47	0.00	0.00
13	Ganari ISP	NCB	170217.53	164821.69	-5395.84	29115138.24
		WUA	15657.75	15657.75	0.00	0.00

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14	ChiregadKhadakpur ISP	NCB	123823.48	124023.29	199.82	39926.44
		WUA	16663.37	16663.37	0.00	0.00
15	DaunneKhola ISP	NCB	134736.72	129996.92	-4739.80	22465723.77
		WUA	25380.67	25380.67	0.00	0.00
				Sum	**33365.48**	**2214303862.06**

(DTO, 2017)

We have,
Mean difference $\dot{D} = \sum D/n = 33365.48/30 = 1112.18$
Estimated Variance $S^2 = \sum D^2/(n-1) - (\sum D)^2/(n(n-1)) = (2214303862.06/29 - (33365.48)^2/(30*29)$
$S = \sqrt{75075701.85} = 8664.62$
Standard Error of difference $S.E.(\dot{D}) = S/sq.rt(n) = 8664.62/sq.rt(30) = 1581.936$

Test statistic: $t = \dot{D}/S.E.(\dot{D}) = 1112.18/1581.93 = 0.703$ where Degree of freedom $= n-1 = 30-1 = 29$
Level of significance $(\alpha) = 5\%$

Critical Value: The tabulated value of t at a 5% level of significance for the single-tailed test with the degree of freedom 29 is 1.699.

Decision: Since the calculated value of t is less than the tabulated value of t, the null hypothesis Ho is accepted and the alternative hypothesis is rejected. It indicates that the increase in cost is not significant to the original estimated cost. The result clearly shows that a design review can be done effectively without a significant increase in cost.

Testing of hypothesis for time:
Null hypothesis: Ho**:** $u_x = u_y$ i.e. there is no significant difference between the intended completion time and time after design review.

Alternative hypothesis: H_1: $u_x < u_y$ (one-tailed test) i.e. Revised time increases significantly due to design review time.

Test statistic: $t = (\bar{X} - \mu)/S/\sqrt{n} = 1.304$ where Degree of freedom $= n-1 = 30-1 = 29$ and Level of significance $(\alpha) = 5\%$

Critical Value: The tabulated value of t at a 5% level of significance for the single-tailed test with the degree of freedom 29 is 1.699.

Decision: Since the calculated value of t is less than the tabulated value of t, the null hypothesis Ho is accepted and alternative hypothesis H1 is rejected. It indicates that the increase in time with

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design review is not significant to the originally intended completion time.

Testing of hypothesis for cropping intensity:
Null hypothesis: Ho**:** $u_x=u_y$ i.e. there is no significant difference between cropping intensity before the project and cropping intensity after the project.

Alternative hypothesis: H_1: $u_x<u_y$(one-tailed test) i.e. cropping intensity increases significantly after the project.

The test statistic: t=Ḋ/S.E.(Ḋ)=7.18 where Degree of freedom =n-1=14-1=13 and Level of significance (α)=5%

Critical Value: The tabulated value of t at a 5% level of significance for the single-tailed test with the degree of freedom 13 is 1.771.

Decision: Since the calculated value of t is more than the tabulated value of t, the null hypothesis Ho is rejected and alternative hypothesis H1 is accepted. It indicates that the increase in cropping intensity is significant to cropping intensity before Community Irrigation Project in the area.

Testing of hypothesis for crop yield:
Null hypothesis: Ho**:** $u_x=u_y$ i.e. there is no significant difference between crop yield before project and crop yield after project.

Alternative hypothesis: H_1: $u_x<u_y$(one-tailed test) i.e. crop yield increases significantly after the project.
Test statistic: t=Ḋ/S.E.(Ḋ)=9.69 where Degree of freedom =n-1=36-1=35 and Level of significance (α)=5%

Critical Value: The tabulated value of t at a 5% level of significance for the single-tailed test with the degree of freedom 35 is 1.684.

Decision: Since the calculated value of t is more than the tabulated value of the null hypothesis Ho is rejected and alternative hypothesis H1 is accepted. It indicates that the increase in crop yield is significant to crop yield before Community Irrigation Project in the area.

Professional consultation and Eastern Management understanding (Mishra, 2022), should be focused to identify the client. Innovation is valued highly. Status is secondary to performance and contribution. Leadership is a function of action, not position. Rewards are shared through the work of teams. Development, learning and training are seen as critical paths to sustainability.

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Empowerment to achieve challenging goals supported by continued development and success provide a climate for self-motivation. There are many Stumbling blocks in Nepali organizations such as *Afnomanchhe* syndrome(only our people are good people, not good people are our people), Lack of data collection and analysis system, Lack of vision and mission statements of institutions, Feudal system of management, Weak linkages between bureaucracy, business and academia, Ever-changing systems and procedures, and Problem in the identification of stakeholders/customers.

The following could be possible actions required for implementing Quality in the organization system: Identify the vision and mission of the organization, Identify the customers' design requirements, Establish service standards based on available resources and needs, Follow the cycle: Plan-Commit-Do-Learn, and Synchronize *Mantra+ Yantra+Tantra* that is *Mantra:* Name of an organization expressed through sound and written in words. *Yantra:* Organizational structure, buildings, equipment, facilities etc. It is visible. It is related to efficiency. *Tantra:* Management system which includes process, procedures, guidelines, manuals etc.

CONCLUSION

Effects of design review found to be positive. As the hypothesis testing from secondary data, it revealed that time and cost increment due to design review is not significant in nature. So far assessments carried out for selected subprojects are concerned with the available resources, and the following satisfactory level has been achieved: Change in cropping pattern with increased cropping intensity and crop yield, Successful in addressing socio-cultural factors, and Safeguarding environmental effects.

At last, it can be concluded that an effective design review system is needed to be established to make it more fruitful by reviewing the design just after submission of design by interacting with all concerned stakeholders. It is invisible but can be felt by everybody in an organization. Alignment of *Mantra, Yantra* and *Tantra* is a must for Quality design and construction. Design review is an extended system of quality improvement with decision making based on facts- data collection- not opinion or impression. Design review is a way of managing a construction project, so that every job, every process, is implemented and constructed outright, the first time and every time. It affects everyone. Design review is not something that can be introduced lightly into an organization for political benefits, it demands total culture change from the top to the bottom of the organization for technical benefits.

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