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Research Article

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Investigating the Factors Impacting the Performance of Small and Medium-Scale Irrigation Construction Projects in Eastern Amhara

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Abstract

Recently due to their economic value, there has been a rapid increment of water work construction projects in Ethiopia. However, there is a problems regarding their performance, like cost overrun, time overrun, low productivity & low quality. The same is true for water work projects that are constructed by Amhara Water Works Construction Enterprise. This research work aims to identify and evaluate the main factors affecting the performance of small & medium-scale irrigation construction projects in eastern Amhara region-Ethiopia. To achieve the objectives of this research study, five irrigation construction projects were targeted as the population of the study and both qualitative & quantitative data were collected by desk study, questioner survey, and interviews. Total 75 questionnaires were distributed to the respondents and out of these 75 distributed questionnaires, 70 (93.33%) questionnaires were returned. The data collected were analysed using SPSS version 25 and the significance factors were ranked by using their Relative Importance Index (RII). The results show that the top ten critical factors that affecting performance agreed upon by all parties were an escalation of material prices, unavailability of resources, number of disputes between owner and project parties, quality of equipment or machinery and raw materials, unavailability of competent staff, financial constraints, material and equipment cost, local climate conditions cost of variation orders and leadership skills for project manager.

Keywords: Cost Related Factor, Time, Project Quality, Project Performance, Irrigation Construction Projects, Small and Medium-Scale.

1. Introduction

1.1. Background of the Study

Nowadays, the demand for food is increasing day by day due to the population growth in developing countries like Ethiopia. Therefore, to overcome this problem it is important to focus on small-scale and medium-scale irrigation projects which are the backbone of agriculture. However, it is a complex type of project and consumes a large proportion of water.

The irrigated agricultural project, which is a complicated, non-routine, one-time Work constrained by time, budget, and resource availability as well as performance standards established to satisfy client expectations, is under increased pressure as a result of this situation [1]. The construction industry has complexity in its nature because it involves a large number of parties such as clients, contractors, consultants, and others these parties are not properly managed according to the contract agreement, and monitoring and evaluation systems its poor. A successful construction project involves numerous planned or unplanned events and interactions throughout a facility's life, involving changing participants and processes in a constantly evolving environment. The construction industry provides infrastructural support to the country's economy through various projects, including buildings, roads, railways, irrigation schemes, and water supply schemes. Ethiopia's water work construction sectors are among the most rapidly growing sectors of the country. A large number of irrigation projects have been implemented to improve productivity and allow stable production throughout the whole year, ensuring food security [2].

Most of the project performance in Ethiopia is very poor for different reasons and Irrigation projects are among those which suffer a lot. The Success of construction projects significantly

depends on how the project has been managed and how driving elements can be controlled. Irrigation and construction project success factors and performance indicators frequently change from one project to the next. The main performance factors of irrigation projects are classified depending on participants, the scope of services, the size of the project, the nature of the contract, the implications of technology, and a variety of other factors.

The construction of irrigation systems involves converting the engineering solutions. It provides in the design document a physical reality that enables safe storage or diversion, conveyance, distribution, and application of water. In this regard, it is essential to select qualified consultants and contractors, as well as to use appropriate construction materials and follow standard construction procedures, etc. The primary problems during this implementation phase are among others inadequate capacity of the client, consultants, and contractors that always lead to poor contractual administration, insufficient monitoring and evaluation, frequent design changes that result in excessive cost, and time overruns [3].

The study conducted by, on ten large-scale irrigation projects in Ethiopia showed that 78% of the reasons for project cost overrun were attributed to design, scope, and quality changes. The average time overrun in irrigation project implementation is about 145%, which has direct and indirect cost implications. The authors also assessed ten large-scale irrigation dam projects and found an aggregate average cost overrun and time overrun of 176% and 151%, respectively. For a poor country such as Ethiopia, such inefficiency in project implementation has wide-reaching consequences. Reasons for such wasteful resource use were found to be incomplete design, design change, scope and quality change, poor construction time estimate, constructors' low capacity, client inactions, and shortage of material.

The IAG also conducted an assessment on the effectiveness of contract administration on two large-scale irrigation projects (Megech-Seraba and Zarema May-Day in the Tigray Region in Ethiopia) that are under construction [4]. It was found that the poor performance of these projects was partly attributable to the weak institutional capacities of implementing bodies which were characterized by slow decision-making processes, inadequate monitoring and evaluation, and coordination capacity. Even if such studies have been conducted at the country level, the performance of small and medium-scale irrigation construction projects was not part of the assessment yet. Small and medium-scale projects do have an impact on the livelihood of the farmers and contribute a lot to the economy of the country. Huge capital is allocated both by the government and other donors to construct small and medium-scale irrigation projects but little attention is given to the construction project performance of the projects and most of them are lagging behind their schedule. This research will try to assess the factors affecting the performance of small and medium-scale irrigation construction projects in Eastern Amhara constructed by Amhara Water Works Construction Enterprise.

1.2. Statement of the Problem

The construction industry plays a major role in the development and achievement of the goals of society. Mainly irrigation development is key to the sustainable and reliable agricultural development of nations. Boosting the construction project performance of irrigation schemes will ensure economic sustainability for low-income earners. Smallholder irrigation farming is valuable for improving the welfare of rural communities in Ethiopia.

Even though the Irrigation practice is one of the ancient practices of Ethiopians, they are not developed to their full potential and rank among the lowest in the world [5]. Smaller, medium, and large-scale irrigation infrastructure must be created to ensure food security for Ethiopia's rapidly growing population at the household level. Notwithstanding the construction industry's significant contribution to the economy of developing countries including Ethiopia and the critical role, it plays in those countries' development, the performance of the industry remains generally low.

Besides, the construction projects in Ethiopia are dominantly completed within a period longer than what is agreed upon by the contracting parties and with costs deviating highly from the contract amount [6]. This is attributed to frequent claims, variations, and change orders occurring in those projects. In addition says that the construction performance of irrigation projects in Ethiopia presents a significant challenge, impacting the nation's goal of achieving sustainable agriculture, economic stability, and food security. The previous studies, also emphasize that project performance and performance improvements are critical issues for the construction industry.

Given the crucial role that the irrigation sector plays in Ethiopia and other developing countries, as well as the poor performance of the sector there, raising the sector's performance should be a top priority. Thus, improving the performance of the construction of irrigation projects in the country including in Eastern Amhara needs to be one of the priority considerations for the improvement of the capability of constrictions in developing countries. Therefore increasing performance increases efficiency, so this research aims to analyze the performance parameters on small and medium-scale irrigation construction projects in the case of Eastern Amhara.

1.3. The Objective of the Study

1.3.1. General Objectives

The main objective of this research is to identify and evaluate the critical factors that affect the performance of small, and medium-scale irrigation construction projects of Amhara Water Works Construction Enterprise in Eastern Amhara, Ethiopia.

1.3.2. Specific Objective

• To assess the current performance of small and medium-scale irrigation construction project in the case of East Amhara.
• To identify significant factors that affect the performance of small and medium-scale irrigation construction projects in the case of

East Amhara.

• To evaluate the relationship between project performance and the identified significant factors of small and medium-scale irrigation construction projects in the case of East Amhara.

1.4. Research Questions of the Study

• What is the current construction performance of small and medium-scale irrigation construction projects in Eastern Amhara?

• What are the top driving factors impacting the construction performances of small and medium-scale irrigation construction projects in East Amhara?

• What is the relationship between key factors and project performance of small and medium-scale irrigation construction projects in East Amhara?

2. Research Methodology

2.1. Introduction

The research study's methodology is described in this chapter. It provides information on the target population, sample size, sampling technique, and kind of study design that was used. The reliability of data collection instruments, data analysis techniques, measurement of variables, research instruments, and ethical issues are all included in the description of the tools used in collecting data.

2.2. Description of Study Area

The project area is located in the easternmost part of ANRS extending from Kobo in the north to Minjar Shenkora Woreda in the south and east from Addis Ababa, Woldeya to Mekele asphalt road which lies in the western periphery of the corridor. It consists of 33 rural and 7 urban woredas and 542 rural kebele administrations, which are partly or fully included in the corridor. The corridor occupies a total area estimated at 1,877,278 hectares and is geographically situated between 963873 and 1363639 north and 519535 to 656864 meters east of UTM. It has common boundaries with regions of Tigray in the north, Oromiya in the south and some parts in the west, afar in the east, and Central Amhara and Tekeze Development corridors in the west. Incidentally, the physiographic condition of the study area is categorized into two broad units, namely the highland escarpments and high plateaus of South Wollo, Oromia, North 'Wollo, and North Shewa together with hills to the east of Borkena Valley.

As per the population projection made by BOFED of ANRS, the total population of the Development corridor is estimated to be 3,186,933 in 2008, which is 15.8% of the regional population. The average family size is estimated to be 4.8, and urban and rural dwellers account for 16.3 and 83.7% respectively. The average arable land holding per capita is 1.5ha, where there is a significant variation among woredas within the Development corridor. In this study area, 1 large, 2 medium, and 13 small-scale irrigation projects were under construction from 2008 to 2012 E.C for Amhara Water Works Construction Enterprise. Moreover, there are also huge groundwater resources to be used as an entry for future development. The plenty of surfaces and most importantly groundwater resources, extensive plain areas, suitability to promote commercial agriculture and agro-industry, access to market, etc. are among the good development opportunities. (ADSWE 2008).

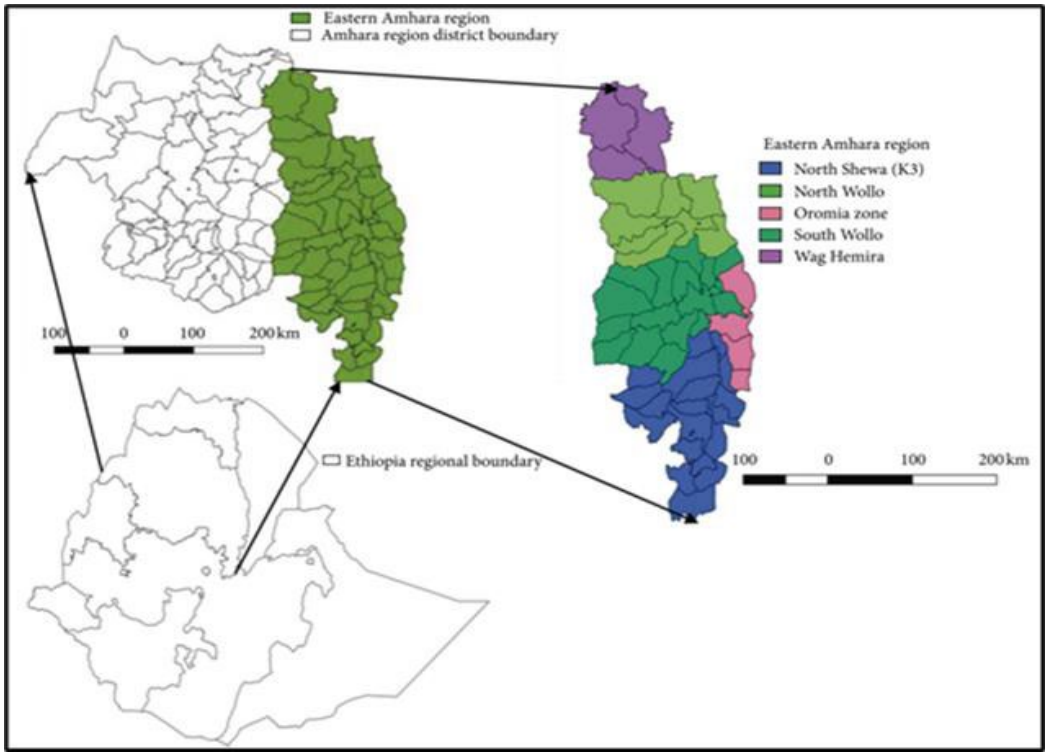

Figure 3. Description of the Study Area

2.3. Research Design

For this research, a descriptive and explanatory research design was used. The major purpose of descriptive research is a description of the state of affairs as it exists at present. This study therefore attempts to describe the effective rate of performance indicators and critically evaluate the variables or factors affecting the implementation of irrigation construction projects under the Irrigation and Water Development Bureau of the ANRS.

2.4. Research Approach

Both quantitative and qualitative research approaches were used for this research. The former involves generating quantitative data for accurate analysis and creating a database to understand characteristics or relationships. The quantitative approach aims to extract "real answers" from "hard data", while the qualitative approach is concerned with the subjective assessment of opinions, behavior's, and attitudes. Quantitative research involves studying (observing or questioning) samples of a population to determine their characteristics. Qualitative methods do not provide direct answers but can develop more questions through the consistent use of "soft data" [7].

2.5. Population and Sampling Design

2.5.1. Target Population

The target population for this research work were irrigation construction projects that are found in east Amhara and constructed by Amhara Water Work Construction Enterprise. There are fifteen (15) irrigation construction projects under the ANRS Water Irrigation & Energy Development Bureau. However, most of the projects are completed and some of them are terminated which makes it difficult to obtain up-to-date data [8,9]. Therefore, the target population for this study were 5 active irrigation construction projects those implemented in the last six years starting from 2008 E.C.

2.5.2. Sampling Design

For this research census sampling technique was adopted. This is by considering that census research is only carried out when it is reasonable to cover the full population or when the population as a whole is small. Thus total 5 active irrigation construction projects were taken as a sample based on a census sampling techniqupe.

Since all participants (workers) in irrigation construction projects are not eligible to respond to the questionnaire, the respondents were purposively selected from workers in these five projects. A total of 75 (20 owners, 29 contractors, and 26 consultants) were selected as respondents [10-12]. The researcher distributed questionnaires to owners, contractors, and consultants of irrigation construction projects as shown in Table 3.1.

Respondant Description	Number	Percentage (%)
Owner side representatives	20	26.67%
Contractors side representatives	29	38.67%
Consultants side representatives	26	34.67%
Grand Total	**75**	**100%**

Table 3.1. Total Questionnaire Distribution of the Study

2.6. Data Sources, Data Collection Instruments, and Procedures

2.6.1. Sources of Data and Data Collection Methods

The researcher collected data from various stakeholders using primary and secondary sources in this study. The owners, contractors, and consultants of the irrigation construction projects listed under the ANRS Water irrigation & Energy Development Bureau completed questionnaires to provide the primary data. The secondary data were acquired from an examination of contract agreements, project reports, correspondence letters, and payment certificates for mostly completed projects. These documents helped the researcher to identify recurring performance issues with the irrigation construction projects.

2.6.2. Data Measurement

Recognizing the level of measurement must be understood to be able to select an appropriate analysis method. The research utilized ordinal scales are used, which are ranking or rating data typically arranged in ascending or descending orders. The numbers assigned to the degree of influence (1, 2, 3, 4, and 5) do not indicate equal intervals between scales or absolute quantities. These are simply numerical labels. These are simply numerical labels. They are merely numerical labels. The researcher too the the following table based on this scale:

Significance Level	Extremely significant	Very significant	Moderately Significant	Moderately Significant	Not Significant
Scale	5	4	3	2	1

Table 3.2. A Rating Scale for a Significance Level of Factors on Project Performance

2.6.3. Data Collection Instruments

To get strong survey findings and a high rate of return, a proper questionnaire design is essential. For this study the questionnaire designed is informed by a comprehensive literature analysis, taking into account the international nature of the construction business and the specific context of the irrigation construction project for the region.

Three sections make up the questionnaires. The purpose of Part A is to established general details of the respondent. Factors affecting the performance of construction projects are listed in Part B, which are broken down into seven categories: factors related to project characteristics, factors related to labour and materials, factors related to contractual relationships, factors related to project procedures, factors related to the external environment, and factors related to clients' and contractors' relationships. Part C contains the respondents' assessment of how well the completed construction projects performed overall [13-15].

In addition, three executives from each department were interviewed. This is done by choosing those whose work is relevant, who have been monitoring the projects for a long time, approving payments, and making decisions on issues that need to be decided. Among three people, one from the Amhara Water Works Construction enterprise, one from the Amhara Design and Supervision Works enterprise, and one from the ANRS Water Irrigation & Energy Development Bureau were interviewed.

2.6.4. Piloting The Research Instruments

The rating scale is a tool used to assess the significance of various factors on project performance. The self-administered questionnaire was pre-tested before distribution to the respondents, taking into account the significance and need to pinpoint and establish any instrument flaws that were present in the research study. A small pilot sample of participants with traits resembling those of the study participants was used to examine the questionnaires and test them. The pilot sample consisted of 5 from the owner side 5 from the consultant side and 5 from the contractors' side who were purposively selected based on their education background (MSc and above) and excluded from the final sample. A proposal for enhancement of the questionnaire has been collected, and adaptations have been made to achieve a more advanced instrument. Piloting helps in revealing questions that could be vague which facilitates their examination until they communicate the same sense to all the subjects [16-20].

2.7. Method of Data Analysis

The data collected by using different data collection tools were analgised by using Microsoft Excel and SPSS version 25. To identify the significant factors out of factors identified from an extensive literature review, their RII were used. To deal with the relationship between dependent and independent variables multi-linear regression analyses were performed. The relative importance index approach (RII) is utilized to ascertain owner, consultant, and contractor perspectives on the relative importance of the key performance indicators. The relative importance index is computed.

3. Results and Discussion

3.1 Introduction

This chapter present the detail of result and their discussion. The result obtained from analysis of data collected were presented then detail discussion were given based on the result or finding. The first section was discussion of respondent demography characteristic. Then the current performance of irrigation construction projects in east Amhara were discussed in detail. Up on this significant factors that affect performance of irrigation construction projects were presented. Then the relation between dependent and independent variable were discussed based on result obtained from multi linear regression analysis [21-25].

3.2 Response Rate

A total of 75 questionnaires distributed to respondents in order to make a survey regarding current performance and factors influencing the performance of irrigation construction projects in east Amhara. Out of the total (75), questionnaires distributed to respondents 70 (93.33%) questionnaires were returned as shown in Table 4.1 below. This response rate is more than enough to proceed next works.

Types of Respondents	Total Questionnaire	Questionnaire Returned	Questionnaire not returned	Response Rate
Owner	20	19	1	95%
Contractor	29	29	0	100%
Consultant	26	22	4	84.6%
Total	75	70	5	93.33%

Table 4.1. Response Rate of Respondents

2.9. Demographic Characteristics of Respondents

2.9.1. The Education Level of the Respondents

The results of the educational level of the respondents of this study are presented in Table 4.2 below.

Level of education of the respondent	Frequency	%
Bachelor's degree	43	61.43
Master's degree	22	31.43
Diploma	5	7.14
Total	70	100

Table 4.2. Education level of Respondent

As it can be noted from the result 43 (61.43%) were Bachelor's degree, 22 (31.43%) were Master's degree and 5 (7.14%) Diploma. The general profile of the respondents suggests that the majority have a level of education that is sufficient for experience in construction firms. This signs that all of the questionnaire's items could be answered by the respondents with the necessary knowledge and educated people.

3.3 Respondents Job Description/Job Title

The results of the respondent job description/job title of the respondents of this study are presented in Table 4.3 below.

Respondents Designation/Job title	Frequency	%
Head of Organization (Deputy managers & Team leaders)	6	8.57
Project Manager	10	14.29
Site engineer	30	42.86
Office engineer	15	21.43
Site Supervisor	9	12.86
Total	**70**	**100**

Table 4.3. Respondents' Description/Job Title

As it can be noted from the result, 6 (8.57%) were heads of the organization, 10 (14.29%) were project managers, 30 (42.86 %) were site engineers, 15 (21.43%) were office engineers, and 9 (12.86%) site supervisor. This indicates that the respondents are individuals who are actively involved in the construction process. Due to this that all respondents can have enough information or knowledge to respond to the questionnaire.

3.4 Experience of Respondents

The results of the work experience of the respondents of this study are presented in Table 4.4 below.

Years of experience of the respondents	Frequency	%
< 4 years	7	10
5 to 8 years	15	21.43
9 to 12 years	21	30
>12 years	27	38.57
Total	**70**	**100**

Table 4.4. Respondents' Years of Experience

As it can be showed from the result, 7 (10%) were less than four years, 15 (21.43%) were five to eight years, 21 (30%) were nine to twelve years, and 27 (38.57%) above twelve Years. As one can note from this result majority of the respondent have more than enough experience to understand the actual situation of the projects and its performance related parameters. This signifies that all of the questionnaire's items could be answered by the respondents with the necessary knowledge.

3.5 Current Performances of Irrigation Construction Projects in East Amhara

The findings from the desk study involved a comparison between the projected and actual time and costs of projects. Time and cost overruns were analysed by assessing the differences between the planned and actual time as well as costs. Furthermore, the project's performance in terms of quality was discussed based on the case study.

3.6 Time Overrun

The percentage of time overrun ranges from a minimum of 233% (28 months) to a maximum of 570% (86 months) of the contract time performance as shown in the table below.

No.	Name of Amhara WIEDB Irrigation Construction Projects	Contractor Name	Contract Time (month)	Actual Completed Time (Months)	Percentage of Time Overrun (%)
1	Mili kotecha medium-scale irrigation project	AWWCC	18	86	476
2	Awash Kesem Small Pump irrigation project	AWWCC	12	68	570
3	Terari -2 irrigation project	AWWCC	10	42	422
4	Zamera Pressurized Irrigation project	AWWCC	12	53	446
5	Tesina irrigation project	AWWCC	12	28	233
			64	278	2146

Table 4.5. Contract Time and Actual Completed Time of Irrigation Construction Projects
Source: ANRS Water Irrigation & Energy Development Bureaus (Projects' Progress and completion report 2022)

As it can be noted from Table 4.5 above, there is a significant difference between the plan and the actual performance of projects in terms time. It can be noticeable that the rate of time overrun was significantly high (233% to 570%) in irrigation construction projects. All projects were completed beyond their planned completion period. Even, the Mile Kotecha medium-Scale project is still an ongoing project that has not yet been completed has taken much time beyond its planned period. As the researcher reviewed above, Project efficiency is measured by its actual performance compared with what was planned in terms of time, it shows very poor performances. Therefore, it is assumed as an inefficient project because it failed to meet its planned time requirement.

3.7 Cost Overrun

To assess the current cost performance of irrigation construction projects in east Amhara the research made extensive review on contract agreement and actual payment made. The result obtained were presented in table 4.6 below.

No.	Name of Amhara WIEDB Irrigation Construction Projects	Contractor Name	Contract Amount (Eth. Birr)	Actual Completed Cost (Eth. Birr)	Percentage of Cost Over Run (%)
1.	Mili kotecha medium-scale irrigation project	AWWCC	71,316,208.27	474,252,785.00	665%
2.	Awash Kesem Small Pump irrigation project	AWWCC	54,565,037.56	148,416,902.16	272%
3.	Terari -2 irrigation project	AWWCC	23,329,126.21	54,356,846.07	233%
4.	Zamera Pressurized Irrigation project	AWWCC	45,495,456.66	84,621,549.39	186%
5.	Tesina irrigation project	AWWCC	33,254,649.75	68,837,124.98	207%
			227,960,478.45	**830,485,225.60**	**1563%**

Table 4.6. Contract and actual completed amount of irrigation construction projects
Source: ANRS Water Irrigation & Energy Development Bureaus (Projects' Progress and completion report 2022)

As can be seen in Table 4.6 above cost overrun is significantly high in ANRS Water irrigation & Energy Development Bureau irrigation construction projects. From the project's completion report, it was found that the cost overruns range from 186% to 665 % which is too much.

It can be also noticeable that all projects were completed beyond their planned cost of completion.

The researcher emphasized that project efficiency is assessed by comparing actual performance with planned time, cost, and quality requirements, using the golden triangles concept. If any project fails to meet its planned requirement in terms of time, cost, and quality that project will be assumed as inefficient. Since the projects were take much cost beyond their planned cost, it is inefficient in terms of cost [26-30].

3.8 Current Quality Performance of the Projects

To assess the current quality performance of irrigation construction projects in east Amhara the researcher made the case study. The detail result obtained from the case study were presented and

discussed below with the support of pictures.

From five projects three projects that can be easily reachable and can show the quality performance were taken for case study.

The Mile Kotcha Medium Scale Irrigation Project is currently facing challenges related to floods, leading to land erosion before the project's completion, as illustrated in Figure 4.1 below. This is a problem caused due to the ground in the places where these foundations will be placed were properly investigated and it is not well treated before construction started and during construction.

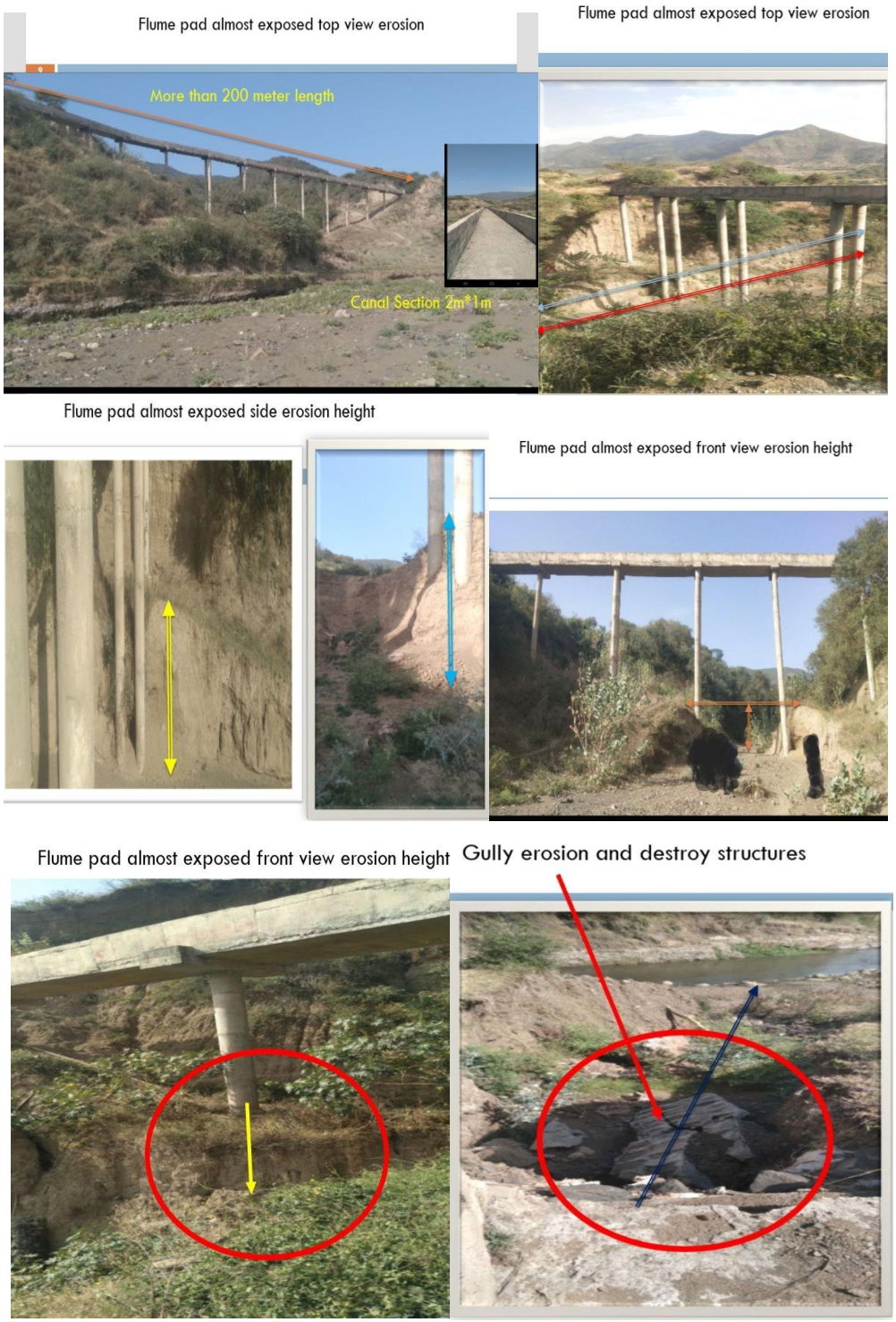

Figure 4.1. Mile Kotech Irrigation Project Flume & Gully Structure Quality Problem

In addition to erosion problems there is also other problems like cracks, alignment, foundation movement or settlement, totally collapse of the structure etc. were observed in Mile Kotcha Medium Scale Irrigation projects.

The next observation or case study was done on **Zamra small scale irrigation projects**. Similar to **Mile Kotcha Medium Scale Irrigation Project,** erosion problem was also observed in Zamra small scale irrigation projects. This is due to the construction of a gate and flood protection wall that did not take into account the risk of flooding when the design was made. Furthermore, the flow of water in the river and the supplementary works were not properly considered during the design phase of the project.

There is also problem like: the water entrance gate (Off take gate) is placed in a low place and the design is a direct gate (Direct Intake), the winter flood comes with sediment because of the sudden flood; The other structure in the river is only a bed bar, so it is not possible to control the flow of water as it is not possible to reverse the incoming water to the off take gate. This in turn causes damage to the farmer and the user as it frequently destroys the pump. At the same time, the water tite foundation between Gate and the sliding Brest wall causes sediment to enter the Approach Canal due to water pressure during high floods. In addition, when there is a heavy flood, the door is easily filled with silt, then the door is because it sticks it doesn't open. These and similar problems were the quality problems that were observed during the case study.

Figure 4.2. Zamera Small Scale Irrigation Project Design Quality Problem

The next observation or case study to check the current quality performance of the project was done on **Terari small scale irrigation projects.** In this project, as we can see in Figure 4.3 below, it can be noted that the structure is collapse and there are cracks in the canal. This problem may have occurred due to the fact that the soil sample and flooding report were not taken correctly during the study and the design was not done, lack of supervision during construction, use poor quality of materials and maintenance problems.

Figure 4.3. Terari Small Scale Irrigation Project Design Quality Problem

Generally, as it can be noted from above assessment and case study the east Amhara water work construction projects are not efficient in terms of time, cost and quality performance. These inefficiency is due to different cause like cost overrun is due to least bidder approach, by poor planning, Poor project management, Poor workmanship, Inflation cost. The same as in time overrun is due to Lack of material supply, late commencement of projects, underestimated contract period, frequent design modification, variation works and Inflation cost. In addition Quality problem is due to poor workmanship, poor project supervision, poor quality control mechanisms, Poor laboratory, and workers negligence, negligence of experts from the preliminary study and data collection for design work, skipping items that should be included in the design or price list, failure to use quality materials when preparing the price list and design.

3.9 Factors Affecting the Performance of Irrigation Construction Projects

In this part of the research, the significant factors affect the performance of irrigation construction projects in the east Amhara region were identified and ranked by using their relative importance index (RII).

About fifty-five (55) factors that have impacts on irrigation construction projects were identified. Further, these fifty-five factors were grouped into five sub-groups as cost-related factors, time-related factors, quality-related factors, productivity-related factors, and client satisfaction related- factors [31-35].

3.10 Cost-Related Factors in Irrigation Construction Projects

From extensive reviews of the literature, it was found twelve factors that affect the cost performance of irrigation construction projects were identified. The primary elements for specific irrigation construction projects are examined based on the combined relative importance index (RII) and rank. To investigate the perspective of stakeholders (i.e. owner, contractors, and consultant) toward factors affecting the cost performance of irrigation projects in East Amhara, the RII was determined within each stakeholders.

Factors affecting the cost of irrigation construction	Owner		Contractor		Consultant		Weighted Average	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Cash flow of project	0.633	7	0.629	9	0.776	2	0.679	7
Material and equipment cost	0.800	3	0.788	2	0.775	3	0.787	2
Project labour cost	0.733	5	0.787	3	0.650	7	0.723	4
Project overtime cost	0.617	8	0.700	7	0.625	8	0.647	8
Cost of rework	0.633	7	0.614	10	0.675	6	0.641	9
Cost of variation orders	0.833	2	0.786	4	0.725	4	0.781	3
Waste rate of materials	0.667	6	0.744	5	0.700	5	0.703	5
Escalation of material prices	0.883	1	0.943	1	0.825	1	0.884	1
Differentiation of currency prices	0.767	4	0.700	7	0.600	9	0.689	6
Design change	0.667	6	0.743	6	0.475	12	0.628	10
Market share of an organization	0	9	0.686	8	0.550	10	0.412	12
The profit rate of the project	0	9	0.743	6	0.500	11	0.414	11

Table 4.7. Participants' RII and Rank of Cost Factors

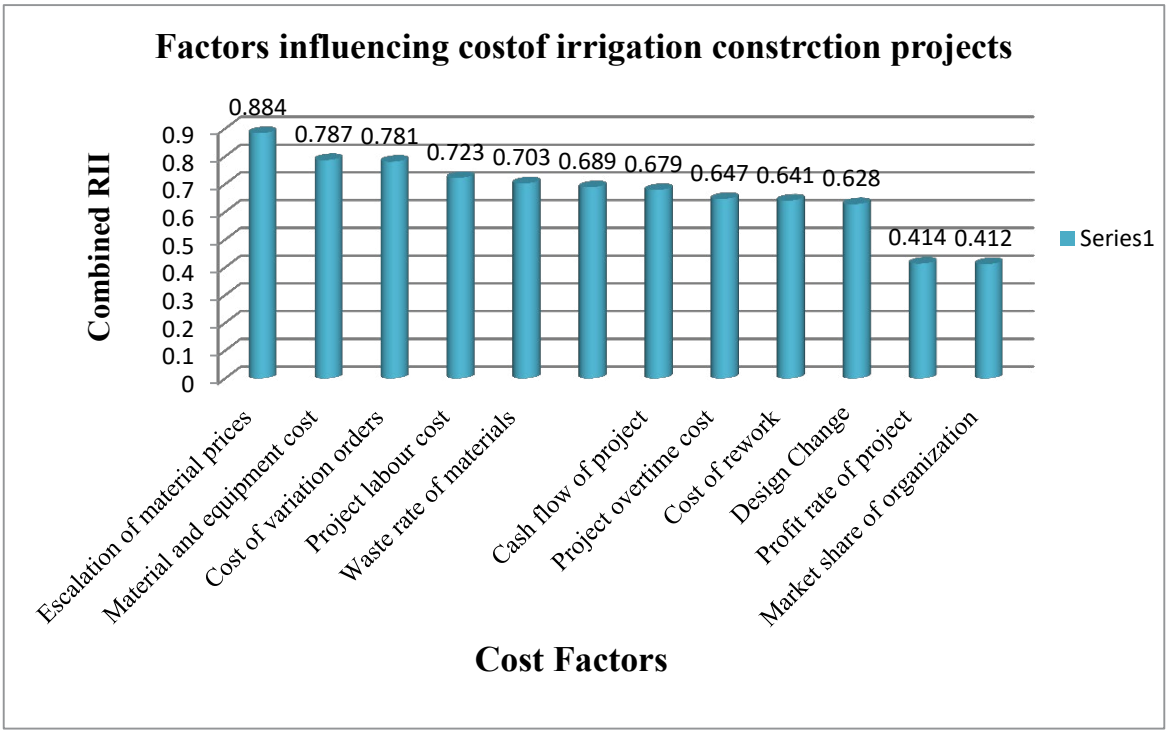

Figure 4.4. Combined RII and Rank of Cost Factors

Based on the result presented in Table 4.7 and Figure 4.1 the primary cost-related factor that affects the performance of irrigation construction project in east Amhara is the Escalation of material prices with RII 0.884. Construction materials' prices fluctuate due to a lack of factories, suppliers, and raw materials as well as the high cost of transportation and an increase in material prices.

The second most significant cost-related factor that affects the performance of irrigation construction projects in east Amhara is Material and equipment cost with RII 0.787. An increase in the cost of materials and equipment has a significant effect on irrigation construction performance. Costs for materials and equipment have an impact on project cost performance and liquidity.

Cost-related factors like the cost of variation orders with RII 0.781 and cost of project labour with RII 0.723 were ranked as 3rd and 4th significant factors respectively. Project expenses increase as a result of variations in owner orders relating to design changes, labour costs, and material and equipment costs. This is because of problems with the assumptions established during the planning stage. Labour expenses affect cost performance because they are one of the main inputs influencing project costs and have all contributed to projects not being completed at the estimated cost.

Materials waste rate with RII 0.703, currency pricing differences with RII 0.689, and project cash flow with RII 0.679 have taken the 5th, 6th, and 7th ranks respectively. If the construction supplies used on site are not adequately managed, there will be a lot of waste, which will increase costs and have an impact on the project's cash flow. The profit rate and cost performance of the project are impacted by currency price differences. Due to the nation's political and economic circumstances, contractors have been harmed by currency price differences.

Cash flow affects both the project budget and the project's cost performance since it can offer a critical assessment of the cost performance at any stage of the project. The escalation of material prices, material, and equipment costs, cost of variation orders, project labour costs, material waste rate, and differentiation of currency prices are the crucial elements of cost performance from the chosen case studies [36-40].

3.11 Time-Related Factors in Irrigation Construction Projects

Thirteen time related-factors that have a significant effect on irrigation construction performance were identified through literature reviews. The weighted RII and RII concerning each stakeholder were determined as shown in Table 4.8 and Figure 4.2 below.

Time factors group	Owner		Contractor		Consultant		Weighted Average	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Too many change orders from the owner	0.783	1	0.815	3	0.600	10	0.732	3
Poor project management assistance on time	0.533	10	0.600	9	0.550	12	0.561	13
Unforeseen ground conditions	0.633	8	0.771	6	0.775	3	0.726	5
Low speed of decision-making	0.685	4	0.714	7	0.650	8	0.682	8
Project complexity	0.633	8	0.671	8	0.575	11	0.626	10
Ineffective communication	0.567	9	0.543	11	0.625	9	0.578	12
Less attention for on time overcome to financial constraints	0.73	3	0.786	5	0.850	2	0.790	2
The average delay in claim approval	0.500	11	0.829	2	0.750	4	0.693	7
The average delay in payments from owners to contractors	0.667	7	0.814	4	0.700	6	0.727	4
Site preparation time	0.567	9	0.714	7	0.525	13	0.602	11
Unavailability of resources	0.767	2	0.857	1	0.900	1	0.841	1
The time needed to rectify defects	0.683	6	0.557	10	0.725	5	0.655	9
The time needed to implement variation orders	0.684	5	0.771	6	0.675	7	0.710	6

Table 4.8. Participants' RII and Rank of Time Factors

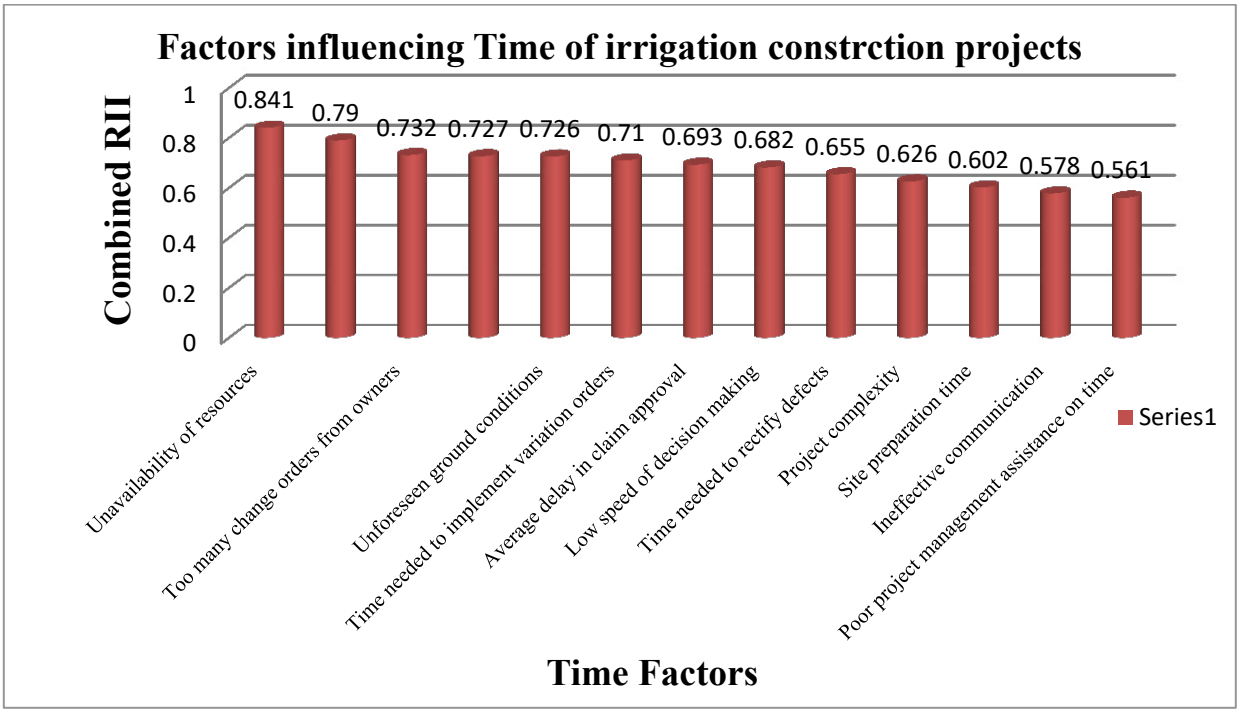

Figure 4.5. Combined RII and Rank of Time Factors

From Table 4.8 and Figure 4.5, the unavailability of resources was first ranked as the critical factor affecting the time performance of irrigation construction project, with a RII of 0.841. This shows that the project will not be able to address the issue of schedule and cost performance if resources are not available as expected throughout the project's length. Additionally, it has an impact on how well initiatives function overall. This is so that both resource availability and the anticipated timeline can improve projects'

capacity to complete on time.

The second crucial time performance component was less attention for on time overcome to financial restriction with RII 0.790. The most important reason is the lack of on time funding provided to the contractors because it is impacted by project cash flow, rising material prices, and currency fluctuations.

Factors like excessive owner change orders with RII 0.732, the typical owner-to-contractor payment delay with RII 0.727, unexpected ground conditions with RII 0.726, and the amount of time required to complete variation orders with RII 0.710 were ranked from 3rd to 6th respectively. This shows they have all played a significant role in project completion times. The volume of owner requests for improvements directly affects timeliness because change orders will disrupt the project's planned operations in sequential order and occasionally result in the project being paused for unfinished design enhancements [41-45].

The time needed to carry out these change orders will impact how quickly the project is completed; some variations call for longer execution times than anticipated. Due to the time required to complete these orders, the project's implementer will face time and cost performance difficulties. Project schedule delays are directly a result of owners paying contractors later than expected. Any payment due to the contractor on time ensures that the project will be completed promptly. Ground conditions are a crucial influence on timing performance due to project completion times are impacted by problematic ground conditions, particularly unanticipated ones like low bearing capacity, black cotton soil, difficult-to-drive hard rock, and water tables near the ground.

In addition to the key elements that have a major impact on irrigation construction performance, from the case studies on-time performance projects have been the owner's excessive demand for variations, design changes, the complexity of the project, disruptions, the time required to fix errors, significant material supply shortages, work suspensions, the need to import materials that are not readily available locally, delays associated with subcontractor work, and owner-to-contractor payment delays.

3.12 Quality-Related Factors in Irrigation Construction Projects

Seven quality-related factors that have a significant effect on irrigation construction performance were identified through literature reviews. The weighted RII and RII with respect to each stakeholder were determined as shown in Table 4.9 and Figure 4.3 below.

Quality factors group	Owner		Contractor		Consultant		Weighted Average	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Conformance to specification	0.733	4	0.757	3	0.750	2	0.747	4
Unavailability of competent staff	0.833	2	0.814	2	0.725	3	0.791	2
Quality of equipment or machinery and raw materials	0.867	1	0.701	5	0.850	1	0.806	1
The quality assessment system in the organization	0.650	5	0.600	7	0.625	5	0.625	5
Quality training or meeting	0.583	6	0.714	4	0.500	7	0.599	7
Incomplete drawing	0.517	7	0.700	6	0.600	6	0.606	6
Incomplete technical specification	0.750	3	0.843	1	0.675	4	0.756	3

Table 4.9. Participants' RII and Rank of Quality Factors

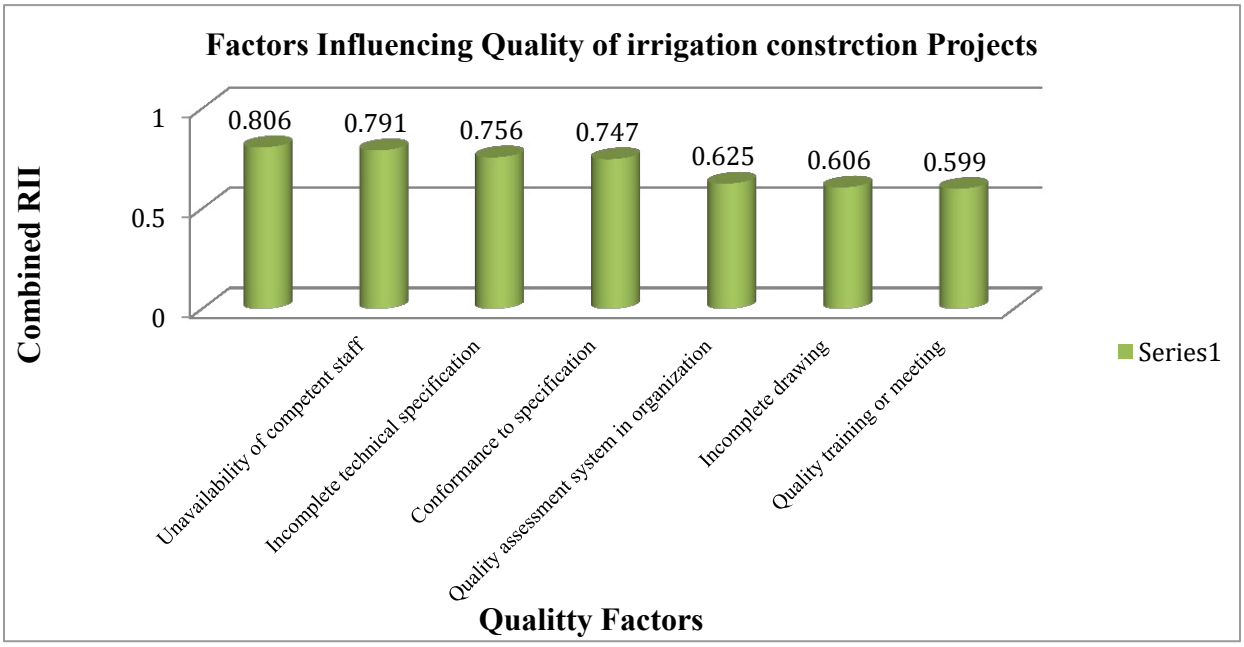

Figure 4.6. Combined RII and Rank of Quality Factors

Table 4.9 and Figure 4.3 shows that the quality of the machinery or equipment and raw materials RII of 0.806, and absence of competent staff RII equals 0.791, have been ranked as first and second most critical factors that affect the quality performance of projects respectively.

The quality of a project's materials, equipment, and machinery is significantly influenced by the limited number of producers in Ethiopia, resulting in minimal variation in quality. There are two types of labourers on the market: unskilled and semi-skilled. The project's quality is mostly impacted by these unskilled employees. When the cost of materials increases above what was originally agreed upon. If there isn't a price adjustment made on the contract, the quality of the materials used in the project will be significantly impacted. The contractor will utilize some low-cost and high-quality products because he wants to avoid bankruptcy.

The third and fourth critical quality performance factors, incomplete technical specifications (0.756) and conformance to specification (0.747), respectively, have been identified. Incomplete technical specifications make it difficult for project leaders to determine what work to do and which equipment, materials, and work schedul to use. The contractor may use low-quality materials, equipment, and workmanship if the contract document does not specify these factors. Among significant factors that have impacted irrigation construction projects' quality performance are Conformance to specifications and unavailability of quality materials.

3.13 Productivity-Related Factors in Irrigation Construction Projects

Eleven productivity-related factors that have a significant effect on irrigation construction performance were identified through literature reviews. The weighted RII and RII with respect to each stakeholder were determined as shown in Table 4.10 and Figure 4.4 below.

Productivity Related Factors	Owner		Contractor		Consultant		Weighted Average	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Project size and complexity	0.600	8	0.629	6	0.475	10	0.568	11
Management-labour relationship	0.633	7	0.514	10	0.626	5	0.591	8
Absenteeism rate throughout the project or late start and early exits	0.783	3	0.815	1	0.650	4	0.749	2
Number of new projects per year	0.683	5	0.557	9	0.525	9	0.588	9
Sequencing of work according to the schedule	0.667	6	0.614	7	0.600	7	0.627	5
Local cultural characteristics	0.567	9	0.643	5	0.625	6	0.612	6

Non-working holidays	0.483	11	0.743	3	0.550	8	0.592	7
Local climate conditions	0.767	4	0.814	2	0.775	1	0.785	1
Wedges amount	0.900	1	0.629	6	0.675	2	0.735	3
Employees motivation	0.517	10	0.686	4	0.550	8	0.584	10
Employees attitudes	0.867	2	0.571	8	0.657	3	0.698	4

Table 4.10. Participants' RII and Rank of Productivity Factors

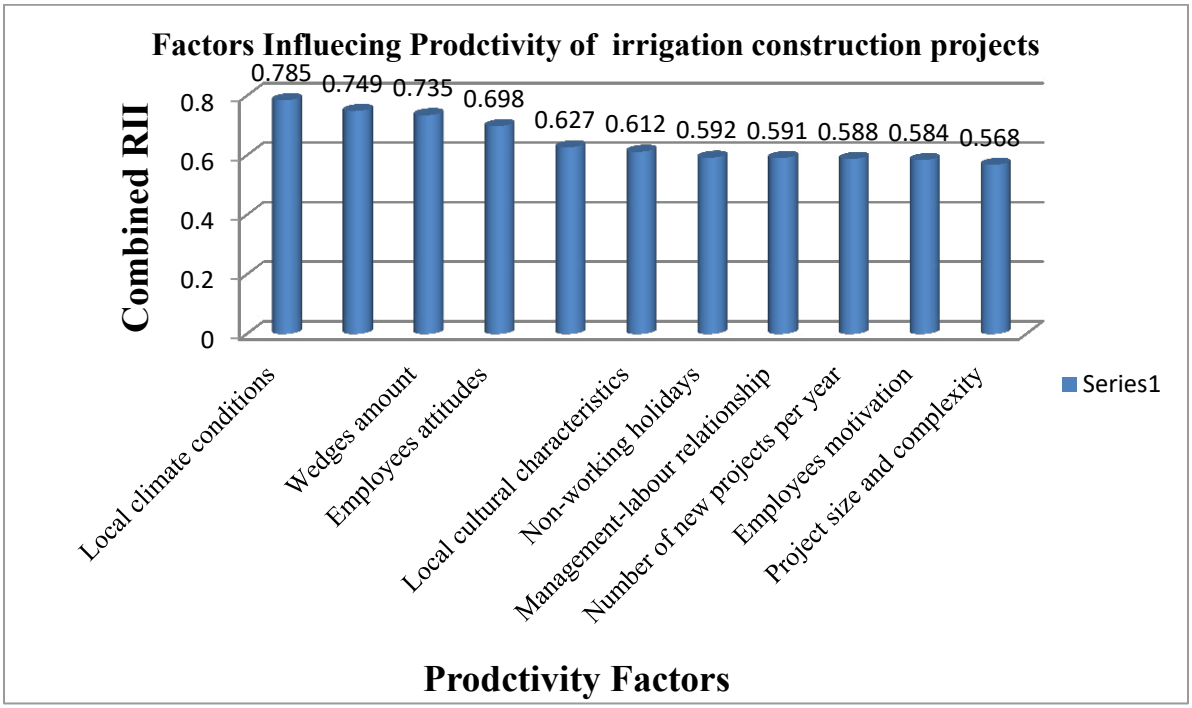

Figure 4.7. Combined RII and Rank of Productivity Factors

The first rank and the primary factors affecting production performance have been the local climate conditions, as shown by Table 4.10 and Figure 4.4, with a RII of 0.785. This shows how the local climate's changes throughout the year have a significant impackt on a project's productivity rate. There is more rain from June to September than there is from November to March. Most construction projects have significant productivity losses during months with heavy rain because the rain causes unsafe conditions for workers and equipment on the project site. In addition, in these times, the inconvenience of the roads makes it impossible to bring materials or move machinery or vehicles, so climate change has a significant impact on the project's productivity performance.

Absenteeism rate through project with a RII of 0.749, and wedges amount with a RII of 0.735 has been the second and the thir factors that affect productivity. The project's productivity performance will be affected by the rate of absenteeism throughout the entire length of the project. As a result of the labourers' early exit and late enterers, the project will experience delays. The wages or compensation that labourers get have significant effects on their output. Higher paid workers are often more motivated than lower paid workers. Then because of this difference in salary, the productivity of projects will be affected.

Factors indicating employees' attitudes with a RII of 0.698, sequencing of work according to schedule with a RII of 0.627, and local cultural characteristics with a RII of 0.612 also have been the critical factors that affect performance productivity. Productivity performance will be affect by the attitudes of project workers. The project manager can completed the project work within the time frame given by organizing the work in a schedule-based manner. Hence, there won't be any delays or cost overruns, nor will the project experience issues with time and cost performance. The local cultures' unique characteristics affect the projects. These is because of the community rules workers followed by in the project area.

Based on the results of a few case study projects, the following factors have a significant impact on productivity: weather, manpower shortages, machine failure, unskilled machine operators, equipment unavailability, and work not being completed on time.

3.14 Client Satisfaction related Factors in Irrigation Construction Projects

Seven client satisfaction-related factors that have a significant effect on irrigation construction performance were identified through literature reviews. The weighted RII and RII with respect to each stakeholder were determined as shown in Table 4.11 and Figure 4.5 below.

Client satisfaction-Related Factors	Owner		Contractor		Consultant		Weighted Average	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Leadership skills for project manager	0.884	1	0.714	4	0.726	3	0.774	2
Number of disputes between owner and project parties	0.883	2	0.771	1	0.825	1	0.826	1
Speed and reliability of service to the owner	0.733	3	0.757	2	0.800	2	0.763	3
Number of rework incidents	0.450	6	0.586	7	0.600	6	0.545	7
Information coordination between owner and project parties	0.717	5	0.657	6	0.500	7	0.625	6
Conflict	0.784	3	0.686	5	0.725	4	0.731	5
Poor workmanship and incompetent workers	0.783	4	0.729	3	0.700	5	0.737	4

Table 4.11. Participants' RII and Rank of Client Satisfaction Factors

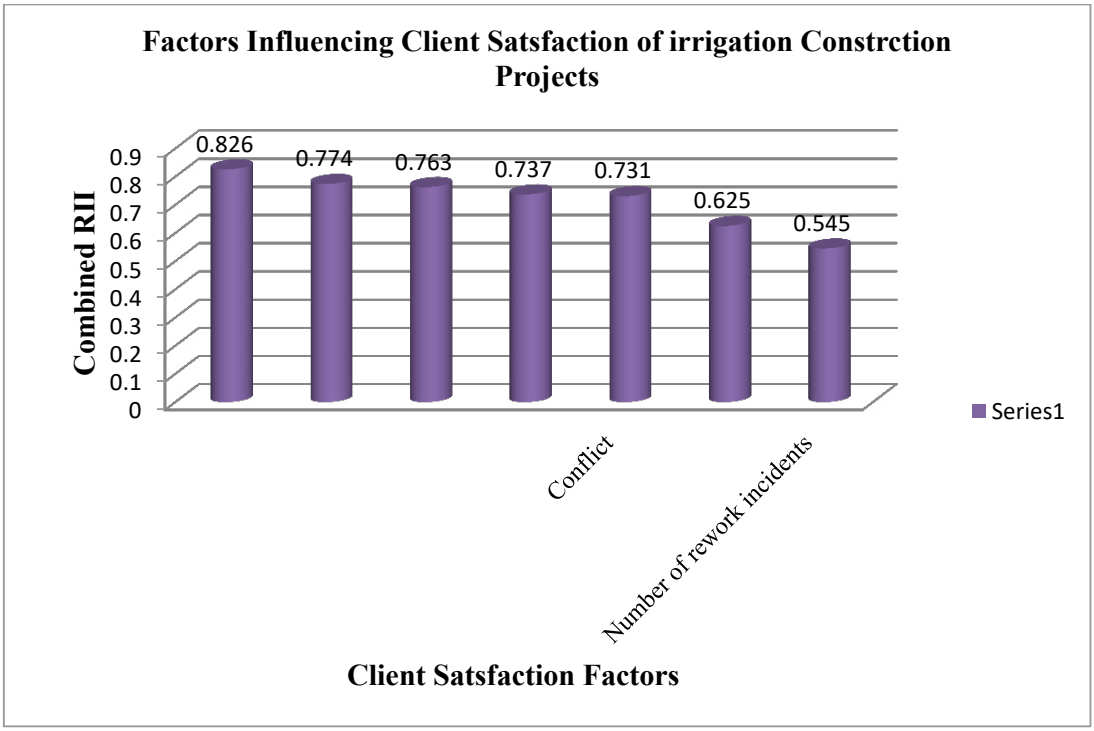

Figure 4.8. Combined RII and Rank of Client Satisfaction Factors

As can be shown in Table 4.11 and Figure 4.5, multiple disputes between the owner and project stakeholders rank as the primary critical factor affecting customer satisfaction performance, with a RII of 0.826. Between owner and contractor and owner and consultant disputes will have an impact on their working relationships and the level of client satisfaction.

The project manager's leadership skills with a RII of 0.774 and the owner's speed and reliability of service with a RII of 0.763 have been the second and third critical factors that affect customer satisfaction. Many disputes between the owner and project parties its affect customer satisfaction and also affect the work it will be done. Project managers' leadership skills are the most important factor for complete the project on time, because it's depending on how well construction projects work and how to success the projects so it's crucial to ensure client satisfaction. Additionally the owner's speed and reliability of service it helps to complete the work on time. For example if the owner paid the contractor

payment on time, the materials will be delivered on time in the project then the work will be done quickly. This factors are crucial to ensure customer satisfaction.

Client satisfaction with a RII of 0.737 will be significantly impacted by the presence of poor workmanship and incompetent staff on the project site. Due to its impact on the project's quality and service life, this is an essential factor of customer satisfaction. Conflicts between workers employed by the contractor and workers on the project site will have a significant impact on how to satisfied clients with a RII of 0.731. This is due to the possibility of fatalities or serious injuries from unnecessary conflicts on the project.

Based on the results of the selected case studies, the contractor's performance, quantity of claims submitted, and speed of delivering the project to the owner have all been identified as key factors affecting client satisfaction.

3.15 Top Ten Critical Factors that Affect Project Performance

Based on their RII the top ten critical factors that affect the performance of irrigation construction projects in east Amhara region were identified and presented in table 4.12 below.

Rank	Factors Affecting Project Performance	Combined RII	Group Factor
1	Escalation of material prices	0.884	Cost
2	Unavailability of resources	0.841	Time
3	Number of disputes between owner and project parties	0.826	Client Satisfaction
4	Quality of equipment or machinery and raw materials	0.806	Quality
5	Unavailability of competent staff	0.791	Quality
6	Less attention for on time overcome to financial constraints	0.790	Time
7	Material and equipment cost	0.787	Cost
8	Local climate conditions	0.785	Productivity
9	Cost of variation orders	0.781	Cost
10	Leadership skills for project manager	0.774	Client Satisfaction

Table 4.12. The Top Ten Critical Factors that Affect Project Performance

As it can be seen in table 4.12 above escalation of material price with RII 0.884 was rack as 1st out of fifty-five factors identified. Also, the Unavailability of resources with an RII of 0.841, the number of disputes between owner and project parties with an RII of 0.826, the Quality of equipment or machinery and raw materials with an RII of 0.806, and the Unavailability of competent staff with RII 0.791 takes the rank from 2 to 5. Factors like financial constraints with RII0.790, Material and equipment cost with RII 0.787, Local climate conditions with RII 0.785, Cost of variation orders with RII 0.781, and Leadership skills for project manager with RII 0.774 were ranked from 6th to 10th rank.

3.16 Stakeholders Perceptions on Critical Factors of Project Performance

In this section of the study, stakeholders' opinions regarding the crucial elements influencing the construction projects' performance of irrigation construction projects in east Amhara were discussed. The top five crucial factors that influence the effectiveness of irrigation development projects in the east Amhara region have been identified based on each stakeholder's perceptions by their RII. The detail discussion were presented in sub section 4.6.1.to 4.6.3 as follows.

3.17 Perception of Project Owners

The top five significance factors that affect performance of irrigation construction projects based on the perception of the owner were identified and ranked base on their RII. Table 4.13 shows top five factors that affect the performance of irrigation construction project with each factor groups (i.e. cost related factors, time related factors, quality related factors, productivity related factors, and client satisfaction related factors).

Critical Factors	List of critical Factors	RII	Rank
Cost Factors	Escalation of material prices	0.883	1
	Cost of variation orders	0.833	2
	Material and equipment cost	0.800	3
	Differentiation of currency prices	0.767	4
	Project labour cost	0.733	5
Time Factor	Too many change orders from owners	0.783	1

	Unavailability of resources	0.767	2
	Less attention for on time overcome to financial constraints	0.733	3
	Low speed of decision-making	0.685	4
	The time needed to implement variation orders	0.684	5
Quality-Related Factors	Quality of equipment or machinery and raw materials	0.867	1
	Unavailability of competent staff	0.833	2
	Incomplete technical specification	0.750	3
	Conformance to specification	0.733	4
	The quality assessment system in the organization	0.650	5
Productivity Related Factors	Wedges amount	0.900	1
	Employees attitudes	0.867	2
	Absenteeism rate throughout the project (late start and early exits)	0.783	3
	Local climate conditions	0.767	4
	Number of new projects per year	0.683	5
Client Satisfaction-Related Factors	Leadership skills for project manager	0.884	1
	Number of disputes between owner and project parties	0.883	2
	Conflict	0.784	3
	Poor workmanship and incompetent workers	0.783	4
	Speed and reliability of service to the owner	0.733	5

Table 4.13. Critical factors RII and Rank of Project Owners' Perception

As shown in table 4.13 above, in the opinion of project owners, the most important cost factor that affect performance of irrigation construction project was the escalation of material prices, which has been ranked first by owners'. It is important to note that owners place a high value on this factor because the rapid shortage of materials for construction drives up the cost of those materials, which in turn impacts the projects' liquidity and cost performance. Subsequently, the owners' ranked the cost of variation orders in second place. This is a crucial factor for owners because fluctuations impact their liquidity, which potentially disrupts project cash flow.

The owners' also ranked the material and equipment costs in third position, which impacts the owner's liquidity and project cost performance. Currency price differentiation, was ranked by the owners' in fourth place. The factor impact the project in several ways, like imported Materials and Equipment, Contractual Agreements, Financing Costs, and Market Conditions. The Project labor cost has been ranked by the owner in fifth position. The factor that affect in cost performance, frequently pushing projects beyond budget and creating obstacles to completion.

Owners find that time is an essential factor as it impacts both cost performance and service speed. According to owners opinion the top significant time factors was too many change orders from owners which is ranked as first while unavailability of resources was ranked as second. This element has a direct and practical impact on project performance, including scheduled for the entire project period. This is due to the fact that the unplanned schedule and lack of resource availability might highly affect project time performance. Based on owners view less attention for on time overcome to financial constraint takes the third place. This aspect has a direct and practical impact on the completion of projects on schedule. The project will experience a time performance issue if the necessary financial resources, particularly from contractors, are not accessible in the required amount of time.

In addition time needed to implement variation orders and low Speed of decision-making takes fourth and fifth place. The basic schedule's performance will be impacted by the amount of time required to implement variation orders. The predicted schedule will be adjusted and updated due to the time required to implement variation orders, and this component has a significant impact on time performance. Poor decision-making extends project durations, resulting in delays and delaying timely project completion. The amount of time needed to correct defects in a construction project can have a negative impact on the project's overall time performance through increased costs, lower quality, delays, and contractual issues.

Based on owners view quality of equipment or machinery and raw materials was ranked as first factor that affect the quality performance of irrigation construction projects in east Amhara. Owners typically desire high-quality, precisely-specified materials utilized in their projects. The majority of materials that are available in study area were produced by a small number of producers and have little variation in quality. As a result, this element influences both the level of owner satisfaction and the quality of project performance. The second most significant quality related factor

was unavailability of competent staff. The owner is satisfied when the project was implemented with qualified personnel with high experience and qualifications in the field.

The owners' placed incomplete technical specification as third ranked significant quality related factor. The entire technical specification found in the contract document has a significant impact on the project's execution quality. Owners should take notice of this since it has an impact on the project's quality performance. In addition, conformance to specification and quality assessment system in an organization takes the fourth and fifth rank. Due of its significance for owner satisfaction, this factor is the most crucial for owners. Usually, the owner wants to carry out the project in accordance with the specification. And also the quality performance of construction projects mainly subject to a systematic framework for assessing and enhancing procedures, materials, and workmanship.

Based on owner's perceptions, wedges amount has been ranked as the first productivity-related factors that highly impact the performance of irrigation construction project in east Amhara. A high wedges number of employee's means that they are more motivated to work, which improves the project's productivity. Because it influences their costs and the project's productivity, it is therefore a crucial element for owners. The second rank was taken by employees' attitudes. Employee attitudes on the project will have an impact on its productivity. Due to its impact on project performance productivity, it is an essential factor for owners. As a result, the owner will experience a project delay.

The absenteeism rate throughout the project (late start and early exists) was placed in third. The project's productivity performance will be impacted by absenteeism during the duration of the project. As a result, the project's delay will negatively impact the owner. Due to its impact on the productivity performance of construction projects, owners find that absenteeism during project implementation is crucial. The local climate condition" is ranked in fourth place. The project's productive performance will be impacted by the various local climate conditions. Certain project activities will be suspended in inclement weather, which will cause delays for the project's owners.

The Number of new projects per year has been ranked in the fifth position. The total productivity and performance of construction projects are negatively impacted by an increase in the number of projects undertaken each year, which also increases the risk of delays as well as impedes quality control.

Client satisfaction-related factors are among the critical factors considered in this study. Based on the relativity importance index, leadership skills for the project manager and several disputes between the owner and project parties have been the first and second ranked critical factors that affect client satisfaction in east Amhara irrigation construction projects. Owners place a great deal of importance on project managers' leadership abilities since they have a direct impact on project success and customer satisfaction. Conflicts between the owner and project participants will damage the relationship and lower the level of customer satisfaction. All of those could have an impact on how well the project works. Due to the significant impact that several disagreements have on project performance and customer satisfaction, this aspect is crucial for owners.

Furthermore, among owners, conflict and poor workmanship and incompetent workers has been rank third position. The quality and productivity of projects will be impacted by the presence of poor and incompetent workers on the project site. Due to its impact on owners' satisfaction and performance, this is a crucial factor. On-the-job disputes will have an impact on employees' health and safety. The site's productivity will decrease as a result of this consequence. It has an impact on project performance in terms of community satisfaction and rules, making it a crucial factor for owners.

On the other hand, the speed and reliability of owner service have been ranked by the owners' respondents in the fourth position. This factor increases the degree of satisfaction concerning the client. This factor is very important for owners because it affects strongly client satisfaction. The speed and reliability of service to the owner was ranked as fifth most significant factor.

3.18 Perception of Project Contractors

Table 4.14 shows the perceptions of project contractors regarding the cost factors, time factors, quality-related factors, productivity-related factors, and client satisfaction-related factors that affect east Amhara irrigation construction project performance based on their relative importance index (RII).

Critical Factor	List of Critical Factors	RII	Rank
Cost Factors	Escalation of material prices	0.943	1
	Material and equipment cost	0.788	2
	Project labour cost	0.787	3
	Cost of variation orders	0.786	4
	Waste rate of materials	0.744	5
Time Factor	Unavailability of resources	0.857	1
	The average delay in claim approval	0.829	2
	Too many change orders from owners	0.815	3
	The average delay in payments from owner to contractors	0.814	4
	Less attention for on time overcome to financial constraints	0.786	5
Quality-Related Factors	Incomplete technical specification	0.843	1
	Unavailability of competent staff	0.814	2
	Conformance to specification	0.757	3
	Quality training or meeting	0.714	4
	Quality of equipment or machinery and raw materials	0.701	5
Productivity Related Factors	Absenteeism rate throughout the project (late start and early exits)	0.815	1
	Local climate conditions	0.814	2
	Non-working holidays	0.743	3
	Employees motivation	0.686	4
	Local cultural characteristics	0.643	5
Client Satisfaction-Related Factors	Number of disputes between owner and project parties	0.771	1
	Speed and reliability of service to the owner	0.757	2
	Poor workmanship and incompetent workers	0.729	3
	Leadership skills for project manager	0.714	4
	Conflict	0.686	5

Table 4.14. Critical Factors RII and Rank of Contractors' Perception

The project contractor's perspective indicates that material price escalation is the top cost factor. The rapid shortage of construction materials leads to increased material prices, impacting the project's profit rate and posing a significant challenge for contractors. Contractors rank material and equipment cost, project labour cost, and cost of variation orders in second, third, and fourth place. Material and equipment cost impacts contractors' profit rate and cost performance. Variation orders affect liquidity and cash flow, while project labour cost impacts project cost performance. Contractors rank waste rate of materials fifth, as it impacts project liquidity, budget, cash flow, and cost performance, affecting contractors' cash flow and cost performance.

Contractors have ranked the unavailability of resources in the first position out of time factors. This factor affects directly and practically on contractors' performance through projects. The availability of resources for contractors during the project duration directly impacts their performance, leading to time performance issues. Claim approval delays was ranked as second most significant time factor. These delays significantly impact time and cost performance, as unapproved claims delay projects. Contractors rank too many change orders from owners and payment delays from the owner to contractor in third and fourth positions. Change orders impact project schedule and estimated time, while delays in payment cause delays, disputes, and claims, ultimately affecting the overall project performance. Contractors rank financial constraints in fifth position. If financial resources are not available at a time, contractors faced difficulty's to supply necessary material to the project and suffer to obtain labour on time.

Contractors have ranked incomplete technical specifications as the top quality-related factor. The technical specification in the contract document significantly impacts the project's quality, as it is crucial for transferring information from owner to contractor. Contractors rank unavailability of competent staff in second position, as high-experienced, qualified staff ensures project implementation with suitable cost, time, and professional quality. Contractors ranked

conformance to specification in the third position, as it gives insight (give direction) about the activity cost and material to contractor.

Contractors have ranked absenteeism rates throughout the project (late start and early exists) and local climate conditions as the first and second productivity-related factors in the project. These factors significantly impact project productivity, leading to cost overruns. The project's productivity may decrease due to the termination of certain activities in challenging climate conditions. Therefore, absenteeism during project implementation is crucial for contractors to maintain project performance. Contractors rank wedges amount in third position, as high wedges increase worker motivation and project productivity, impacting cash flow, cost, and productivity performance.

Contractors have ranked several disputes between owner and project parties in terms of client satisfaction as the top factor. Disputes between owners and contractors impact relationships, client satisfaction, and contractor performance, making it crucial for contractors to address these issues effectively. Contractors have ranked speed and reliability of owner service in the second position. The speed and reliability of service from contractor to client representative significantly impact client satisfaction. The project performance is significantly influenced by this factor as it directly impacts the degree of client satisfaction.

The third-ranked position among contractors is characterized by poor workmanship and incompetent workers. Poor and incompetent workers on project sites significantly impact project quality and productivity, thereby affecting owners' satisfaction. Then, contractors have been ranked leadership skills for project managers in the fourth position. Effective leadership skills in project managers significantly impact the performance of construction contractors, making it a crucial factor for their overall project effectiveness.

3.19 Perception of Project Consultants

Table 4.15 reveals project consultants' perceptions of cost, time, quality, productivity, and client satisfaction factors affecting irrigation construction project performance, based on their relative importance index (RII).

Critical Factors	List of Critical Factors	RII	Rank
Cost Factors	Escalation of material prices	0.825	1
	Material and equipment cost	0.776	2
	Cash flow of project	0.775	3
	Cost of variation orders	0.725	4
	Waste rate of materials	0.700	5
Time Factor.	Unavailability of resources	0.900	1
	Less attention for on time overcome to financial constraints	0.850	2
	Unforeseen ground conditions	0.775	3
	The average delay in claim approval	0.750	4
	The time needed to rectify defects	0.725	5
Quality-Related Factors	Quality of equipment or machinery and raw materials	0.850	1
	Conformance to specification	0.750	2
	Unavailability of competent staff	0.725	3
	Incomplete technical specification	0.675	4
	The quality assessment system in the organization	0.625	5
Productivity Related Factors	Local climate conditions	0.775	1
	Wedges amount	0.675	2
	Employees attitudes	0.657	3
	Absenteeism rate throughout the project (late start and early exits)	0.650	4
	Management-labour relationship	0.626	5
Client Satisfaction-Related Factors	Number of disputes between owner and project parties	0.825	1
	Speed and reliability of service to the owner	0.800	2
	Leadership skills for project manager	0.726	3
	Conflict	0.725	4

	Poor workmanship and incompetent workers	0.700	5

Table 4.15. Critical factors RII and Rank of Consultants' Perception

According to the consultants' perception, the first critical factor affecting the irrigation construction project was the escalation of material prices. The shortage of construction materials leads to an increase in the price of construction materials. This increase in material prices impacts the profitability of projects. The costs for materials and equipment also come in second in the consultant ranking. This is an important factor affecting owner cost performance, project cost flow, and consultant performance because consultants are representatives of the client. Additionally, the cost of variation orders was ranked third by consultants. The cost of varation orders it impact the project cost and may reduce or add the contract price, its affect the quality of works. Project expenses increase as a result of variations in owner orders relating to design changes, labour costs, and material and equipment costs. This is because of problems with the assumptions established during the planning stage.

Consultants prioritize resource unavailability as the top time factor, directly impacting project performance and process. Unplanned resources can negatively affect time performance, making it crucial for construction project success with respect to planned time. Financial constraints ranked in the second places, directly affecting project time performance. Insufficient financial resources can lead to project delays. Then, consultants have ranked the unforeseen ground condition in the third position. Unexpected ground conditions on the project site significantly impacted the consultants' design, affecting project time performance and work execution. Consultants rank average delay in claim approval in fourth position, affecting time performance. Delays in claims approval lead to project delays and negatively impact time performance.

Among the critical factors related to quality, the consultants ranked in the first position is the quality of equipment, machinery, and raw materials in the project's. Consultants generally want the materials used in the projects they oversee to be of good quality and meet specifications. This factor affects the implementation of the project and the level of owner satisfaction, which is one of the main tasks of consultants. Additionally, consultants have ranked the conformance to specification in the second position. This factor is crucial for client representative satisfaction as it is primarily linked to owner satisfaction. Third in the consultants' ranking is the lack of competent staff. This factor is very important for consultants, as the availability of personnel with extensive experience and qualifications helps consultants manage the project with the necessary professionalism and satisfy the owner with the successful implementation of the project.

Among productivity-related factor consultants have ranked local climate condition as the first position. Local climate conditions significantly impact project productivity, with difficult conditions causing project activities to termination, causing delays for project owners. Furthermore, wedges amount has been ranked in the second position, high worker motivation boosts project productivity. The wages or compensation that labourers get have significant effects on their output. Higher paid workers are often more motivated than lower paid workers. Then because of this difference in salary, the productivity of projects will be affected.

Moreover, consultant have ranked employees' attitudes in the third position. Employee attitudes significantly impact project productivity performance, making it crucial for consultants to consider this factor in their project management. And also, consultants have ranked the project's absenteeism rate in the fourth position. Absenteeism in construction projects significantly impacts productivity, time performance, and owner satisfaction, affecting both the overall performance and satisfaction of the project.

From client satisfaction-related factors, several disputes between owner and project parties have been ranked by the consultants' in the first position. Disputes between the owner and the consultant affect the relationship between them and the level of customer satisfaction. All of these can impact project performance. Then, consultants have been ranked speed and reliability of owner service the second- position. The speed and reliability of service from consultant to owner significantly impact client satisfaction.

Furthermore, project managers leadership skills from were ranked third by consultants. The leadership skills of project managers are very important for consultants because the leadership skills of project managers help the consultants to monitor the project with good and proper efficiency. This is convenient and will satisfy the client of the project. Conflict have been ranked in the fourth position by consultant. Conflicts between workers on construction sites impact their health and safety. This effect leads to a reduction in productivity on the construction site. Poor quality of work and incompetent employees ranked fifth on the list of consultants. The presence of poor and incompetent workers on the construction site affects the efficiency, quality, and productivity of projects.

3.20 The Key Performance Indicators in Irrigation Construction Projects

In this section, the results are presented in terms of the study's combined relative importance index (RII) and the order in which each participant ranked the major performance indicators for the irrigation construction projects.

From the literature assessments, five key performance indicators for irrigation construction projects were determined. Table 4.16

shows the total RII of the participants. Then below the table and figure, it explain the five key performance indicators.

No	Key Performance Indicators	Combined Weighted Average	
		RII	Rank
1	Cost	0.854	1
2	Time	0.803	2
3	Quality	0.709	3
4	Productivity	0.692	4
5	Client Satisfaction	0.638	5

Table 4.16. Participants' RII and Ranks of Key Performance Indicators

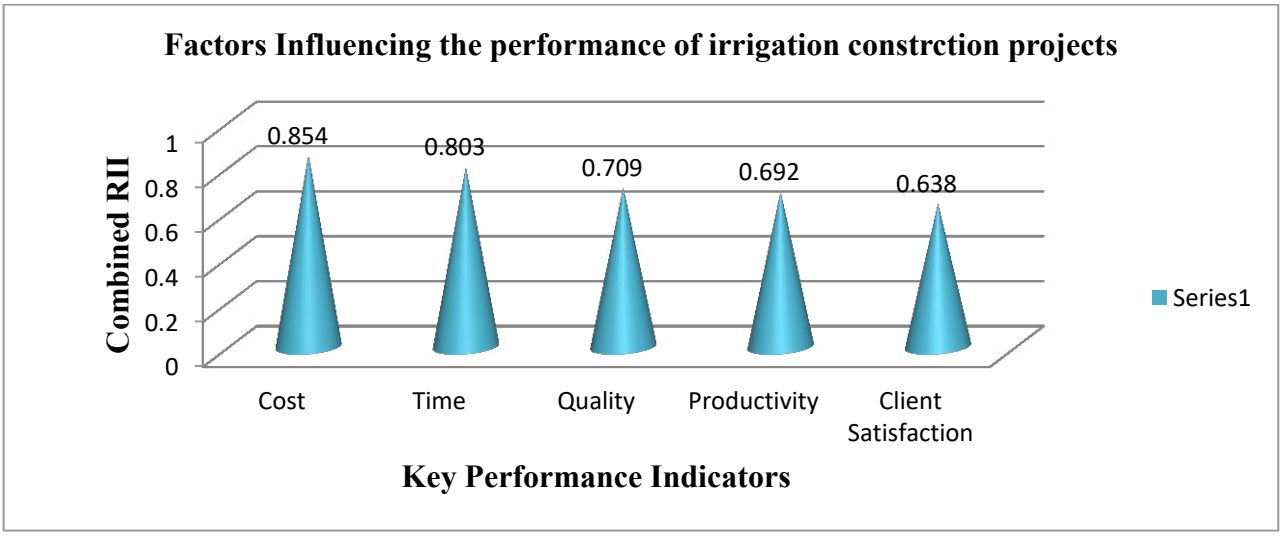

Figure 4.9. Combined RII and Rank of Key Performance Indicators

The cost has been ranked as the first key performance indicator with a RII of 0.854, based on the combined RII and rankings result shown in Figure 4.6. This is a result of the significant effect that cost has on project performance, which makes it the most significant problem for construction projects. The second primary key performance measure, time, has a RII of 0.803. The total success of construction projects is significantly impacted by time.

As shown in Figure 4.6, quality is the third the main key performance indicator, with a RII of 0.709. There will be a major impact on the project's overall performance. The fourth most important key performance indicator is productivity, which has a RII of 0.692. The total performance of construction projects is greatly affected by the project's productivity. Client satisfaction has been ranked fifth with a RII of 0.638 based on the combined Table 4.17. It affects the project's performance as a whole. This factor ranked in this position due to that its effect on the overall project performance has been moderate.

4. Conclusions

Introduction

In this section of the research, the conclusion drawn based on the result obtained and discussion for each results. All conclusion are presented in line with the specific objective of the study. And also the researcher try to recommend the finding of this study.

Conclusion

Based on the result and discussion made previously the following conclusion are made in order of specific objectives.

• As the results of the desk study and case study indicates, the actual time increase about 233% to 570% of planned time, the actual contracted expenditures increases by 186% to 665% of planned contract amount [46-51]. And also as the case study result indicates the projects have several quality problems. Therefore, it can be noted that the current performance of irrigation construction projects is very poor.

• The major factors that affect the performance of irrigation construction project in east Amhara were identified. From the results it can be noted that, escalation of material prices, material and equipment costs, cost of variation orders, and project labour cost have been identified as top critical factor that leads to project cost overrun and affects the cost performance of the project. The top critical factors that affect the time performance of the projects have been identified as, unavailability of resource, less attention

for on time overcome to financial constraints, too many change order from owner, and also average delay in regular payments from owners to contractors. Furthermore, critical factors that affects quality performance of the project were quality of equipment or machineries and raw materials, unavailability of competent staff, incomplete technical specification and conformance to specification. The critical factors that lead the projects to failure in productivity performance have been local climate conditions, absenteeism rate throughout the project (late start and early exits), Wedges amount, and employs attitudes. The most significant factors that affect client satisfaction were also identified as several disputes between owner and project parties, leadership skill for project managers and speed and reliability of service to owner.

• The top ten most significant factors that affect performance of irrigation construction project based on stakeholders response weighted RII were escalation of material price, unavailability of resources, number of disputes between owner and project parties, quality of equipment or machinery and raw materials, unavailability of competent staff, less attention for on time overcome to financial constraints, material and equipment cost, local climate conditions, cost of variation orders, and leadership skills for project manager.

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