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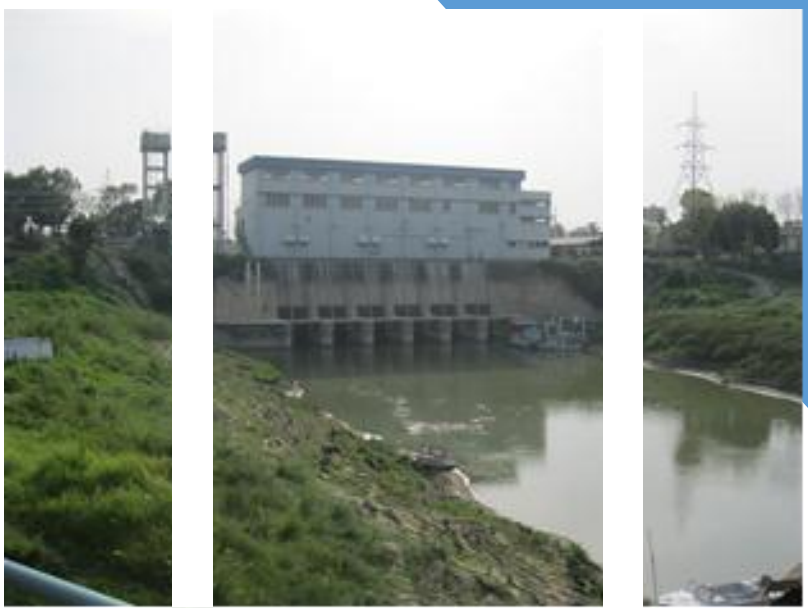

Irrigation Management Improvement of Ganges-Kobadak Irrigation Project

FEASIBILITY STUDY REPORT
Main Report

March 2018

Prepared by Project Management and Design Consultant

Mott MacDonald Ltd (UK) in association with:

- Euroconsult Mott MacDonald (Netherlands)
- Northwest Hydraulic Consultants (Canada)
- SODEV Consultant International Limited (Bangladesh)

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Irrigation Management Improvement Project
(ADB Loan No. 3135-BAN)

Project Management and Design Consultant's Report

Improvement of Irrigation Management of Ganges-Kobadak Irrigation Project
FEASIBILITY STUDY REPORT
Main Report

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
A	12 Feb 2017	NL	SHE	NL	1st draft report
B	1 Apr 2017	NL	NL	NL	Executive summary included
C	24th November 2017	Alan K Clark	Lolu Akindiji	Marieke Nieuwaal	i. Climate change impact included ii. Abstracting large volumes from Ganges during low river flows discussed, and environmental requirements downstream, particularly for Gorai River iii. Predicted depths to water table after 20 years firmed up from modelling iv. Firming up and clearer definition of agriculture support program, components, activities, and costs v. New dredger proposed. vi. Pumping station design and cost amended vii. Option for checks along Kushtia canal to be retained and upgraded to take increased flow presented, as well as new structures viii. Buried pipe systems proposed for whole command area at quaternary level, rather than mix of field channel and buried pipe. Also, hydrant outlets for hose connections proposed. ix. Power requirements adjusted including for pump-buried pipe quaternary systems over whole command. Also operating costs adjusted. x. Results of local stakeholder consultations on quaternary development options (July 2016) mentioned. xi. Advisability of backup supply to ensure supply clarified. Without backup groundwater additional storage is recommended, particularly at tail ends of canal system. xii. Water retention in Kumar River discussed xiii. Improved Legal and Policy Framework included xiv. Social analysis of water management study findings included and implications discussed xv. Implications of modernized engineering works for management structure and staffing requirements included xvi. Staffing requirements and costs for a new management agency included xvii. Discussion of various development scenarios with reduced/ no TWs for backup pumping of groundwater included xviii. Firmed up implementation arrangements including cost for project management and supervision consultancy xix. Updated economic and financial assessment, for both proposed project and alternative scenarios
D	8th March 2018	Alan K Clark	Lolu Akindiji	Marieke Nieuwaal	Report revised in accordance with GoB instruction to adopt development option without TWs, and to maximise use of surface water adopting storage of water in Kumar – Kaliganga river system

Information class: Standard

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Key Data

Name of Project:	**Irrigation Management Improvement Project (IMIP)**
Implementing Parties:	Government of Bangladesh (GoB) *Bangladesh Water Development Board (BWDB)*
Consultant:	***Mott MacDonald Ltd UK*** *in association with:* *Euroconsult Mott MacDonald, Netherlands* *Northwest Hydraulic Consultants, Canada* *SODEV Consultant Int. Ltd, Bangladesh*
Contracting Authority:	PD, IMIP, BWDB, Dhaka
Start/ End Date:	1st March 2015 to 28th February 2020
Beneficiaries:	Farmers of GKIP
Scheme/Location	Ganges-Kobadak Irrigation Project (GKIP) in Kushtia, Jhenaidah, Magura and Chuadanga Districts

Distribution List of this Report

Recipient	**Copies**	**Format**
PD, IMIP, BWDB, Dhaka		Printed Copy Electronic
ADB in Bangladesh		Printed Copy Electronic

EXECUTIVE SUMMARY

Existing Scheme, Constraints and Challenges

1. The Ganges-Kobadak Irrigation Project (GKIP) is one of the 15 large irrigation schemes in Bangladesh. Water is lifted from the Ganges River by a pump station at Bheramara from where it is distributed by canal under gravity. The gross area of the scheme is 197,500 ha of which 142,560 ha is cultivable. The command area of the canal irrigation system which is irrigated by canal and pumped groundwater is 95,600 ha, while the remainder is irrigated just with ground water.

2. The distribution system comprises three main canals, 49 secondary canals and 444 tertiary canals[1], with a combined length of 1,655 km. There are about 5,000 outlets which about 3,500 are authorised. These comprise a simple concrete pipe orifice set in the canal bank. Due to large number of "direct off-takes", only about 52,000 ha (54.6%) of the command area is supplied through the main-secondary-tertiary system hierarchy. None of the canals are lined.

3. The drainage system comprises 91 drains and sub-drains with a combined length of 450 km. These drain into the Kumar-Kaliganga river system.

4. The Project was built in two Phases: 1st Phase from 1955 to 1970, and 2nd Phase from 1960 to 1983, in order to provide supplementary irrigation of rice (Aman and Aus).

5. The irrigation and drainage system was rehabilitated and improved with ADB support in 1984-1994, and efficient new pumps were installed in the Bheramara pumping station with JICA support from 2002-2009. These two efforts addressed deferred maintenance and improved pumping efficiency.

6. Efforts to form sustainable farmer groups, starting with the Chasi clubs in 1962/63 have not had notable success. However, with notification of the Participatory Water Management Rules in 2014, the BWDB started to form new WMOs, and to date 294 of 444 WMGs and 19 of 49 WMAs have been formed. However, social studies[2] have found that these WMGs operate within a complex social structure affected by political elites and notables.

7. About 38% of households only farm their own land, of which the majority are smallholders, while 44% lease-in land from (absentee) landowners to increase the farm size; and about 18% are functionally landless[3].

8. Over the years the pressure for dry (Rabi) season cropping has increased and owing to inadequate canal supply, many farmers invested in diesel shallow tube wells. These were typically 4 inches in diameter and pumped about 11 l/s. By 2014, there were about 64,000 STWs in the project area. Farmers pay from BDT 4,450/ ha to BDT 11,120/ ha to pump owners to irrigate different variety crops.

9. The BWDB increased pumping from the Ganges in the dry season from 2012. Since then the dry season surface water pumping has been in the range of 40-60 m^3/s covering about half of the command area. The majority of farmers continue to rely, at least to an extent, on STW pumped groundwater, due to: (i) canal system capacity constraints[4], and (ii) operational problems to distribute water effectively.

10. With pumping of river water for the dry season, the GoB's annual contribution increased to about BDT 384 million/year[5].

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[1] To date only 373 tertiary canals have been identified, or which 57 offtake from the main canals. However, 208 field channels also offtake directly from the main and/ or secondary canals and a number of these supply large areas and, in effect, are tertiary canals.

[2] Final Report, Project SC106806 BAN, Support to preparation of IMIP – Social analysis of water management in the GKIP and the TBIP, July 2017

[3] The various lease arrangements tend to inhibit investment to modernise on-farm irrigation practices and participation in WMOs.

[4] The canal system was designed for supplementary irrigation, not to meet peak dry season crop water requirements

[5] Current MOM costs are estimated at BDT 453 million indicating a shortfall in funding for proper O&M, particularly as irrigation service charge collection is negligible

11. The irrigation service charge is BDT 600/acre (BDT 1,480/ha) of which BDT 500 is paid to the BWDB and the balance is retained by the collectors. The target collection amount is about BDT 70.0 million (US$ 0.89 million), for 60% of the command area, but less than BDT 1.2 million/year has ever been collected.

12. The GoB has been addressing canal capacity constraints in recent years by increasing canal prism size and doubling up of off-takes[6]. However, irrigation system performance remains poor and unable to meet irrigator demands for flexible and reliable supply of irrigation for a variety of dry season crops. However, addressing the canal capacity constraints and forming WMOs will, in themselves, not result in a paradigm shift in performance due to a host of other technical, operational and social environment constraints.

13. Identified technical and operational challenges include: (i) an intake channel prone to sedimentation, (ii) a large number of direct off-takes making flow control and management difficult, (iii) poor condition of gated regulators, (iv) staff shortages and institutional constraints, (v) absence of effective flow monitoring and communication system, and (vi) lack of accountability and low quality service provided to the farmers. Social and environment challenges are manifest by the difficulty to form and sustain WMOs, and inability to collect significant irrigation service charges.

14. Many of the challenges for improved operations arise from the fact that the system was designed for supplementary irrigation of rice, for which a high standard of service is not required as some over/under supply of irrigation water does not impact much on yields.

15. As the BWDB has made efforts to supply more water for dry season crops, the level of service also needs to be improved, and to become commensurate with that required for dry foot (non-rice) crops, including banana, tobacco, vegetables, maize, wheat, and sugarcane. The current scheme is no longer “fit-for-purpose”, and requires investment to modernise engineering infrastructure, management and operations.

Objectives and Strategic Framework

16. The GKIP modernisation project will support the overall objective of the IMIP to help sustain long term growth in the agricultural sector of Bangladesh at 4.5% per year. Specific objectives comprise:

- Improved service delivery to farmers: i.e. farmers receiving a reliable on-demand supply (within limits) of irrigation water.
- Financial sustainability.
- Improved water efficiency.
- Improved water productivity.

17. The strategic framework will achieve these objectives through the following outputs/results:

- **Output 1: Modernized engineering infrastructure** to enable operators to provide farmers a high level of service, with affordable irrigation more or less on demand, efficient and reliable.
- **Output 2A: Diversified cropping and increased agriculture production** achieved by addressing constraints related to: farmers’ knowledge and skills, seed and planting material, pesticides, and market information and access.
- **Output 2B: Effective farmer institutions** established and providing a platform for a range of agriculture and water management activities including information dissemination and training, and other community actions.
- **Output 3: Efficient client orientated management** through partnership between the BWDB and the farmers with assistance of a service provider[7].

[6] GoB Project for rehabilitation of GKIP, 2012-2017, RDPP 2015, BDT 1,882 million (US$ 23.5 million)
[7] The exact form and arrangement for management of the modernized scheme remains to be approved by GoB

18. Project components associated with each output are: (i) Engineering, (ii) Agriculture Support; and (iii) Management Modernisation.

Component 1: Engineering Works

19. Under the project the irrigation system will be upgraded and modernized, including buried uPVC pipe distribution of water to farmers with pumping from the tertiary canals using low lift pumps (LLPs). Other new works will include an improved and stabilised intake canal, new dredger(s), a supplementary pumping station for 44 m^3/s, balancing storage reservoirs and paved inspection roads along the three main canals and nine secondary canals.

20. To address imbalance between supply of surface water to tertiary canals and farmers' demand two options were considered: (i) provision of TWs to supplement ground water, and (ii) storage tanks at tertiary level. However, the BWDB wishes to avoid use of any groundwater and so tertiary level storage will be provided.

21. When flows in the Ganges River are less than 500 m^3/s and the river levels are below +4.5m PWD, pumping by the main pumps is either low or nil. Considering environmental and technical reasons only about 44 m^3/s will be pumped during these low flow "crisis" periods using the proposed new supplementary pumping station. These low flow periods are expected to occur once in every 4 years on average for about 10-20 days. To mitigate shortage, a rubber dam will be provided to retain water in the Kumar-Kaliganga river system. This stored water will be pumped into the canal system by four small pumping stations with a combined capacity of 12.2 m^3/s. Additional mitigation will be provided by tertiary level storage, and reduction in supply to fields to 80% of design (peak requirement).

22. About one-third of the command, comprising areas in the head-middle of the Alamdanga canal system and the tail of the Kusthtia canal system is potentially "at risk' of an occasional surface supply shortfall for 10-20 days, which will be overcome by the farmers using their STWs. If crop diversification occurs with boro rice replaced by non-rice crops the area "at risk" will reduce. Also, if the low flow in the river occurs outside the peak crop water demand period, which is in February - March, there will not be any crisis.

23. The existing canal system will be rehabilitated. Pre-paid meters will be fitted to the low lift pumps at quaternary level and farmers will be provided with smart cards so that each irrigator pays for the volume of water that he uses. Hydrants rising from the buried pipe system will allow farmer connections using plastic polyethylene pipes[8], or they may dig field channels. A pilot pressurised system will be constructed to demonstrate potential gains in water use efficiency[9].

24. The drainage system will also be rehabilitated, and includes re-sectioning of drainage channels that discharge into the Kumar-Kaliganga river system. While water may be stored in the drainage-river system during the dry season, during the rest of the year it will enable effective drainage. This will also safeguard against any water-logging in the command area due to a slowly rising water table which is expected from increased surface water supply.

25. To enable improved management, a Supervisory Control and Data Acquisition (SCADA) System will be installed, monitoring flows down to the head of each tertiary, as well as pre-paid meter usage. It will also allow remote (off-site) operation of regulators of the main canal systems, with actuators fitted to gates, and the balancing storage reservoir and river pumping station pumps. The main SCADA Control Room will be located at a building in the BWDB's compound in Kushtia.

26. With adoption of the pump and pipe-pipe water distribution system, the command area will increase from 95,600 ha to about 100,400 ha.

[8] Plastic/ polyethylene hose is readily available in the GKIP area, and is commonly used by farmers to convey water from their STWs

[9] The project includes funds for pressure systems such as drip in the Agricultural Support Component

27. The total cost of the engineering works is estimated at about BDT 14,635 million (US$ 182.9 million), including 10% contingency. A summary breakdown is tabulated below.

Engineering Component	BDT million	US$ million	%
PART 1: INTAKE, PUMPING STATION, SUBSTATION & DREDGER	**1,830.5**	**22.88**	13.8%
PART 2: IRRIGATION CANALS	**774.8**	**9.69**	5.8%
PART 3: IRRIGATION REGULATORY/ FLOW CONTROL STRUCTURES	**440.8**	**5.51**	3.3%
PART 4: BALANCING STORAGE RESERVOIRS	**72.6**	**0.91**	0.5%
PART 5. CROSS DRAINAGE STRUCTURES AND BRIDGES	**185.5**	**2.32**	1.4%
PART 6. INSPECTION ROADS	**2,329.0**	**29.11**	17.5%
PART 7. DRAINAGE SYSTEM	**616.9**	**7.71**	4.6%
PART 8.1 TERTIARY AND QUATERNARY SYSTEMS	**5,356.5**	**66.96**	40.3%
PART 8.2 BACKUP SURFACE WATER	**760.0**	**9.50**	5.7%
PART 9. SCADA CONTROL AND METERING SYSTEM	**536.3**	**6.70**	4.0%
PART 10. ELECTRIFICATION	**236.5**	**2.96**	1.8%
PART 11. BUILDINGS	**165.5**	**2.07**	1.2%
TOTAL	**13,304.8**	**166.31**	**100.0%**
TOTAL INCLUDING 10% CONTINGENCY	**14,635.3**	**182.94**	

Component 2: Agriculture Support

28. To address agriculture constraints and achieve production targets[10], an intensive 7-year Agriculture Support Plan is proposed having the following components.

- Training, Extension and Advisory Services for Farmers, including marketing and quality.
- Support for WMO institutions, including construction of office buildings/stores etc.
- Procurement of seeds and planting materials.
- Land improvements and Precision Farming including Mechanisation and efficient On-farm Water Management.
- Innovation support funding.

29. Together these components will boost crop yields and quality, reduce crop losses, support crop diversification and a modest increase in cropping intensity from 247% to 280%, improve water (and energy) use efficiencies as well as more effective and environmentally sustainable use of chemicals, and reduce farmers production costs. They will also support the WMO institutions for water distribution and irrigation charge collection to be facilitated by pre-paid meters and buried pipe system.

30. The total cost of the Agriculture Support Plan is BDT 726.7 million (US$ 9.1 million). The bulk of this cost will be incurred over the first 1-3 years of the 7-year Project.

[10] Production targets, crop yields, are close to potential for field conditions. Details are in SR-03: Land Use and Agriculture

Component 3: Management Modernisation

31. The current BWDB staff and institutional set-up is not sufficient to operate and maintain the modernised engineering system. New skills will be needed, with focus on computer competencies, managing electrical and mechanical systems as well as flow hydraulics, irrigation requirements and application, WMO and agriculture support. To be effective, new vehicles and equipment will also be required.

32. Significant improvement is unlikely to be achieved adopting a '*business as usual*' approach. Real change in irrigation management and staffing skills will be needed for the modernised project.

33. International evidence suggests that adoption of the following key principles, whether under a public or private flag, is most important in the management institution: (i) *Accountability and transparency*, (ii) *Cost recovery for MOM costs*, (iii) *Effectiveness, i.e*. stated level of service is achieved, (iv) *Performance-based, and (v) Clear customer orientation*. Some of these principles are not embedded in the current culture of the BWDB.

34. Three main options for an improved institution are considered. For all of them farmers participation would be through WMOs (WMGs, WMAs and WMF). The options are:

- Option 1: Shared Service Provision Model[11] (BWDB, GK-IMO[12] and WMOs), and variations of this option.
- Option 2: Single Autonomous Management Agency (autonomous GK-IMA and WMOs).
- Option 3: Single Private Sector Party (private GK-IMA[13] and WMOs).

35. Both Options 1 and 2 are considered viable, and should help address many of the key principles, i.e.: (i) cost recovery, (ii) greater efficiencies in providing a high level of service, (iii) performance based operations reliant on revenue from ISC collection, and (iv) a clear customer orientation.

36. A comparative assessment indicates significantly more risk with Option 1 due to the need for cooperation between the public-private parties (BWDB and GK-IMO), the implicit dependency of the GK-IMO on the BWDB, and the difficulties in checking and enforcing bulk water supply at the many hydraulic (canal supply) interfaces between areas of jurisdiction of the two parties. Adoption of Option 2, i.e. a single autonomous agency responsible for the whole scheme may be a better choice. But the BWDB's position, instead, is for appointment of a service provider, essentially a shared service provision.

37. To implement the Project and embed good management practice, a parallel development approach is proposed, i.e.: (i) Rehabilitating and modernising engineering infrastructure, in parallel with (ii) Training of management and operations staff and strengthening the institutional framework for irrigation, WMO and agriculture support services.

38. The proposed vehicle to develop good management is through one or more service type contracts for Irrigation Service Management (ISM). One ISM contract is suggested for the whole scheme, but alternatively several contracts may be awarded, with each contract covering part of the canal system.

[11] This option was proposed by the More Food Less Water Study, 2014 , and is sometimes referred to as the MFLW Option
[12] GK - Irrigation Management Operator
[13] GK – Irrigation Management Authority

Overview of Proposed Contracts

39. An overview of the contracts that will make up the proposed modernisation project is summarised below. An implementation period of seven (7) years is proposed. While the recommended option (after implementation had been completed) is for a single GK-IMA for MOM, a final decision may be deferred to late in the implementation period. In the event that a shared Service Provision Model is chosen, the arrangements adopted for the implementation (construction) period would remain broadly the same[14].

Procurement Contract Type		Scope of Contracts	Contract Duration
1A	DBOT / Procurement of Plant Contracts	Design review, supply of plant and equipment and construction for Intake, Pumping Stations at Bheramara, Dredger and Electric Substation. Also for smaller pumping stations pumping from Kumar-Kaliganga river system. Joint operation and training	7 years after which assets transferred to GK-IMA/ other
1B		Design review, supply of plant and equipment, construction, installation and integration and testing of SCADA System including prepaid metering system. Joint operation and training.	7 years after which assets transferred to GK-IMA/ other
1C		Design review, supply of plant and equipment, construction, installation and testing of all major and High Tension (HT) line electrification works. Excludes for Low Tension (LT) connections to pumps of quaternary buried pipe systems.	3 years. Assets property and MOM remain responsibility of electric company
2	Procurement of Works Contracts	Construction and maintenance for 12 months of civil works for canal system, drainage system, inspection roads, tertiary and buried pump - pipe systems, buildings and rubber dam retention structure. Several contracts envisaged	Several 3 year contracts envisaged. Assets transferred to GK-IMA/ other
3A	Service Contracts	Consultancy Services to support the PMU in Project Implementation including support for implementation of the Agriculture Support Plan – Project Management Supervision Consultants (PMSC)	7 year service contract
3B		Training and Capacity Development services for WMOs and farmers as part of the Agriculture Support Plan, and for BWDB GKIP management and O&M staff	Several short service contracts
3D		Irrigation Systems Management contracts for MOM of canal systems, including water distribution and ISC collection, and for the new maintenance division. Existing BWDB staff on-lien as well as new staff will receive practical experience and training under these contracts.	7 years after which staff will either be incorporated into a single autonomous GK-IMA, or a shared service model will be adopted

Implementing Institutional Arrangements

40. The Project will be implemented by the MoWR. A Project Management Unit (PMU) will be established in Kushtia, in part with staff from the BWDB office at Kushtia, for close supervision and

[14] For example, irrigation systems management contracts would remain the IMO, and not be incorporated back into the GK-IMA.

monitoring of the contracts, and for preparatory work leading to establishment of the GKIP-IMA by the end of the project period (or other approved institution arrangement).

41. The PMU will be supported by the PMSC who will also be based in Kushtia.

42. The Project will require an effective institutional linkage with the MoWR and other concerned ministries of the GoB. These will be done by the Project Steering Committee (PSC), chaired by the Secretary of the MoWR, where all concerned ministries will be represented.

43. An Irrigation Coordination Committee (ICC) headed by the Zonal Chief Engineer of the Western Zone, BWDB, Faridpur will be established to provide oversight and independent monitoring of the Project. It would have representation from all concerned stakeholders, including WMOs, BWDB, GK-IMA (as applicable) and civil society. The ICC should aim to meet every four (4) months.

Capital Investment Cost

44. The capital investment cost for the proposed Project totals BDT 17,262 million (US$ 215.3 million) as summarised below.

Component	BDT million	US$ million	%
ENGINEERING WORKS INCLUDING 10% CONTINGENCY	14,635.3	182.9	84.8%
RESETTLEMENT/ LAND ACQUISITION	269.1	3.36	1.6%
AGRICULTURE SUPPORT	726.7	9.08	4.2%
SUPPORT FOR NEW MANAGEMENT INSTITUTION – VEHICLES, EQUIPMENT AND STUDY TOURS	387.2	4.84	2.2%
PROJECT MANAGEMENT & SUPERVISION CONSULTANTS	1,243.6	15.55	7.2%
GRAND TOTAL FOR PROJECT	**17,261.9**	**215.77**	**100%**

Recurrent (MOM) Costs

45. The current annual MOM cost is about BDT 1,250 million (US$ 15.62 million); about 36% borne by the GoB and 64% by the farmers for privately (mostly diesel) pumped STW water.

46. With the project, the annual MOM cost is expected to be BDT 957 million (US$ 11.96 million); a reduction of about BDT 293 million from the present. Pumping of groundwater will be largely eliminated, but pumping of surface water will increase. Over the command area of 100,400 ha, the full cost of MOM is expected to be BDT 9,530/ha (US$ 119/ha) with-project.

	With-project MOM Costs			**Current MOM Costs**		
Area (ha):		100,400			100,400	
Component	**BDT million**	**US$ million**	**%**	**BDT million**	**US$ million**	**%**
INTAKE DREDGING	40.0	0.50	4.2%	40.0	0.50	3.2%
PUMPING FROM GANGES*1	250.0	3.13	26.1%	148.4	1.86	11.9%
PUMPING FROM LLPS*2	136.9	1.71	14.3%	0.0	0.00	0.0%
PUMPING FROM STWs & TWs*3	22.2	0.28	2.3%	533.3	6.67	42.7%
MAINTENANCE OF ENGINEERING INFRASTRUCTURE	210.2	2.63	22.0%	168.0	2.10	13.4%
MAINTENANCE OF PRIVATE STWS	11.0	0.14	1.1%	263.9	3.30	21.1%
GK-IRRIGATION MANAGEMENT AGENCY/ OTHER APPROVED *4	286.7	3.58	30.0%	96.0	1.20	7.7%
TOTAL MOM COSTS	**957.0**	**11.96**	**100.0%**	**1,249.6**	**15.62**	**100.0%**
Cost/ ha	9,532	119		12,446	156	

1. For tariff of BDT 7.66/ kWh
2. Mostly for LLP pumping at Quaternary Level, but also from Kumar-Kaliganda river system
3. Mostly from private diesel STWs
4. Staffing plus 20% for misc. operating costs

Alternative Development Scenarios

47. The BWDB wishes to maximize use of surface water resources without conjunctive use of groundwater. The proposed project does not therefore include for installation of tubewells.

48. However, during the course of the feasibility study various alternative development scenarios were considered which included for TWs, and for either a 7 or a staged 10 year implementation period. The alternative project scenarios considered in the study are tabulated below.

49. The capital costs (at constant prices) are similar for all the development scenarios, except for Scenario 3 which is only for 44,500 ha. MOM costs vary a little and are adjusted as appropriate, according to area of development, construction period, etc.

Alternative Development Scenarios		Description	Area (ha)	Capital Cost	FIRR %	EIRR %
-	Proposed Project (7 years)	Implementation 2019-2025, level of service good over two thirds of command area (i.e. over 66,900 ha) with occasional reliance for 10-20 days on farmers' STWs in the "at risk" areas totalling about 33,500 ha. No TWs installed but use made of surface water storage within Kumar-Kaliganda river system.	100,400	BDT 17,262 million	12.2%	13.1%
1A	Project with TWs for backup supply (7 years)	Implementation 2019-2025, level of service good over whole area (100,400 ha) with TWs for backup supply for 60% of command area. Some balancing storage.	100,400	BDT 17,408 million	13.7%	14.8%
1B	Project with STWs for backup supply (7 years)	As above but with STWs (instead of TWs) with water pumped using LLPs only. The STWs will be provided to all Quaternary pumping points.	100,400	BDT 17,278 million	13.7%	14.8%
2	Stage 1 only without TWs (5 years)	Implementation 2019-2023. Tertiary level storage tanks/ ponds provided (or TWs in tail end areas over about 10% of command); level of service good over whole Stage 1 area (44,500 ha) due to new supplementary pumping station.	Stage 1: 44,500	BDT 8,454 million	11.4%	13.0%
3	Stage 1+2 with TWs (10 years)	Implementation 2019-2029. TWs over 60% of command in in tails and midsections of command areas: level of service good over whole area (100,400 ha). I.E. as Scenario 1 but a staged development over 10 years.	Stage 1: 44,500 & Stage 2: 55,900 Total 100,400 ha	BDT 17,408 million	11.8%	13.1%
4	Stage 1+2 without TWs and without riverine storage (10 years)	Implementation 2019-2029. Tertiary level storage tanks/ ponds provided (or TWs in tail end areas over about 10% of command). Level of service good over about half of command area, with the remaining area "at risk" with occasional poor supply.		BDT 16,648 million	7.3%	8.1%

Financial and Economic Analysis

50. The indicators derived from the financial and economic Cost Benefit Analysis (CBA) for the proposed project are favourable and suggest that the project is viable. The financial and economic IRRs are 12.2% and 13.1% respectively.

51. Although, Development Scenarios 1A & 1B yield higher IRRs, the BWDB is not inclined to favour either of these options as they entail conjunctive use of surface and groundwater. Scenario 3 is likewise rejected.

52. Scenario 2 only develops a stage 1 area of 44,500 ha and would be a missed opportunity when the larger project could be selected, as well as being likely to result in possible social disturbance from those excluded. Scenario 4 excludes TWs and backup riverine storage and is the least attractive.

53. For all the scenarios, a project life of 30 years was adopted for financial and economic analysis.

Irrigation Service Charge

54. After modernisation, if the full annual MOM cost of BDT 957 million is to be recovered from irrigators through the pre-paid metering system, the irrigation charge to farmers would be about BDT 9,500/ ha, or BDT 0.57/ m^3. If the current Government subsidy of BDT 384 million is maintained, the irrigation charge would be just BDT 5,700/ ha, BDT 0.34/ m^3. Currently farmers are paying about BDT 8,350/ ha, mostly for diesel pumped groundwater using their STWs.

55. Securing full repayment of MOM will be challenging, is part as the GKIP farmers are not used to paying significant amounts for canal water, and will require: (i) that the level of service for canal supply is as good as that provided by private pumping of groundwater, (ii) a paradigm shift in attitudes to service, water charging and payment. Continuation of some government subsidy is likely to be required, at least initially.