DETAILED ECONOMIC AND FINANCIAL ANALYSIS

A. Background

1.   The Karnataka Integrated and Sustainable Water Resources Investment Program (KISWRMIP) will contribute to the improved management and sustainability of increasingly scarce water resources in selected river basins in the State of Karnataka (the State) in India. It will establish and strengthen state and basin level institutions, adopting the principle of integrated water resources management (IWRM) and improve irrigation service delivery by initiating in the Tungabhadra, or K-8 sub-basin (of the Krishna basin).[1]

2.   Overall improved water resources management at the sub-basin level and more holistic planning of irrigation service delivery will provide water savings which can be used for productive gains either on other irrigation systems, as return flows to the environment or for industry and potable supplies. Introduction of river basin planning, volumetric monitoring of water flows in irrigation systems and infrastructure modernization will enable improved water use efficiency and contribute to increased crop productivity within a finite resource. A proportion of benefits will accrue to poor rural households and contribute to national poverty alleviation policies. The project will promote participatory irrigation management (PIM), which will promote operation and maintenance of the infrastructure directly by beneficiaries, and in the long run reduce the budget burden for Government of India (GOI).

3.   The $150.0 million ADB and $70.0 State financed multi tranche financing facility will be implemented over a 7-year duration, with two tranches. The first tranche will be implemented between 2014 and 2018 and will be of 4 years duration. It is expected that tranche-2 will commence in 2015 for a duration of 6 years until 2021 when the MFF will close. Economic and financial analysis has been undertaken based on the sample irrigation subproject to be modernized under tranche-1. This is typical of the subprojects to be improved under tranche-2 though detailed analyses will be undertaken for each subproject during preparation of the second periodic financing request.

4.   The financial analysis for Gondi subproject is undertaken to assess the impact on the farm incomes of intended beneficiaries and their ability to contribute to O&M requirements. The economic analysis is conducted to quantify the economic benefits and costs as a basis for assessing the subproject's economic viability and sustainability in the long-term.

B. Gondi Subproject

5.   The Gondi irrigation system comprises two canals supplied from the Gondi anicut (weir) on the Bhadra river about 14 km downstream of Bhadra dam. The main canals are contour canals. The system is in poor condition, most notably the right main canal where water is reported to be unable to pass from head to tail.

6.   It is proposed to reduce the annual water allocation for the Gondi system from 87.80 Mm³ (3.10 TMC) to 73.8 Mm³ (2.60 TMC) thus making 0.5 TMC available for the Upper Bhadra irrigation system. This is equivalent to a gross annual irrigation application of 1,600 mm over the whole command area.

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[1] The Asian Development Bank (ADB) provided project preparatory technical assistance in 2012.for *Preparing the Karnataka Integrated and Sustainable Water Resources Investment Program*. Manila.

7.   The Gondi irrigation subproject has a gross command area of 5,060 ha and the current culturable command area is 4,600 ha. It has 9 water user cooperative societies (WUCS) which are not currently functional. From satellite interpretation (2011) about 60% of the CCA 3,076 ha is under perennial crops (arecanut 49%, sugar 12%) and most of the remaining area is cropped under Kharif and Rabi paddy rice (38% of the command area). In the subproject, marginal farmers dominate the farmer's distribution 60% to 70%, see Table 1. There are no large farms. Over 90% of land is cultivated by tractors, and combine harvesters are being introduced due to rising labour costs. Cropping is dominated by paddy rice, arecanut orchard and sugar cane.

Table 1: Distribution of Households by Farm Holding

	Marginal under 1 ha	Small 2 to 4 ha	Medium over 4 ha
Household survey, Gondi scheme, 2012 (100 households)	58	22	19
Block level data, Agric. Census 2005	70	20	10

C.   Financial Analysis

1.   Methodology

8.   The financial analysis used late 2012 values.[2] GOI administered prices (crop outputs and fertilisers, in particular), are below world price levels, but output market prices are above the administered price (minimum support price). Project outputs were modelled with and without the project using crop budget models developed in FARMOD 4.02. Labour costs are increasing very rapidly in the scheme area, at 20% to 30% per year, and well above inflation rates. This is the result of increased availability of urban employment and the improved education levels of young entrants to the work force. Wage rates were around Rs 210 per day (Rs 250 for men and Rs 150 for women) in 2012. Gondi scheme is fully developed, with almost 100% cropping in both kharif and rabi seasons (overall cropping intensity is about 138%, due the large area of perennial crops). Use of HYV and high levels of fertilisers and crop chemicals are universal, see detailed crop budgets. There is a potential for increasing by 20% to 30%.

2.   Scheme Background and Cropping

9.   Gondi scheme was developed for paddy rice production however sugarcane became a cash crop. Poor marketing and late payment for sugar led to experiments with and the crop has increased from zero to around 50% of the cropped area in 2012. The area continues to increase, replacing sugar cane and paddy rice. Arecanut is a relatively light user of water. Current prices for wet nut are Rs15/kg on the tree. Processing costs are Rs 20,000 to Rs 30,000 per ha, for harvest, transport, shelling, boiling the nuts and drying, most of the output being red boiled nut in the scheme area. Dry nuts market at about Rs 140 per kg.

Table 2: Cropping Calendar

Crop	Sowing Period	Harvest Period
Paddy - Kharif	Jun-July	Nov-Dec
Paddy- Rabi	Jan	Apr-May
Kharif Field crops	Jun-Jul	Nov-Dec

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[2]   Exchange rate adopted is US Dollar 1 is the equivalent of India Rupees 55.

Arecanut	Jun-Jul	Aug-Dec (40d)
Sugar Cane	Aug-Nov (bienn.)	Aug- Feb
Banana	monsoon	All year
Coconut	monsoon	Aug- Feb

10.   Crop production costs are based on farmer group surveys, crop budget publications[3] and data provided by a local NGO[4] working in the scheme. Crop budgets with the project are based on consultant's assumptions. Scheme construction costs were taken from current engineer's base estimates, and are subject to updating.

D.   Development Costs

11.   Gondi certified command area (CCA) is 4,600 hectare. Gondi subproject operating and maintenance costs are based on engineer's estimates and include: direct and indirect costs, labour, equipment, materials, services, and overheads. Construction costs exclude the taxes paid by contractors, who are paid net of tax, with the tax due paid into State budgets as a paper transaction between WRD and the Revenue Department.

12.   Construction and CAD development works are assumed to start in 2014, and will be completed in 2016. CAD works will be undertaken totalling Rs 190 million. Sub project costs are shown in Table 2. Estimated channel lining costs are 55% of the total for earthworks and lining, or Rs 386 million. Other sub-project costs include project management overheads based on 10% of total project management of Rs 88 million. Institutional strengthening costs are excluded from scheme costs. Physical contingencies of 10% are added to scheme costs. Construction is assumed to take three years. Estimated social support and agriculture costs are included, and are subject to revision.

Table 3: Gondi Base Cost

Item	Cost (Rupees million)
Irrigated Agriculture Management Systems	
WUC Support	18
Irrigation and Associated Infrastructure	
Irrigation Infrastructure	1083
CAD Works	190
Agriculture & livelihoods	26
Institutional Development	
Project Management	9
Physical Contingencies	132
Total Scheme Cost + Physical Contingencies	**1,460**

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[3] Report on Regionwise Cost of Cultivation of Crops 2006-07. Karnataka State Department of Agriculture
[4] JalaSpandana South India Farmers Organisation for Water Management. Personal communication.

3. Subproject O&M Costs

13.   O&M costs were estimated from the CCA at Rs 800 per hectare per year, both with and without the project. If channels are not lined it is assumed that O&M costs for the unlined percentage of the channels increases by 25%. Water charges are paid by farmers according to crop and season currently Rs 250/ha paddy, Rs 1000/ha sugar and Rs 150/ha for garden (tree) crops.

E.   Benefits

1.   Agriculture, Markets and Prices

14.   The Feasibility Studies Supplementary Report, Financial & Economic Analysis Markets and Prices details the prices used in the analysis, and the production and marketing background for the Project, and should be read as an integral part of this report, attached as an Annex **.

2.   Crop Budgets and Production Costs

15.   Crop budgets were prepared for Kharif & Rabi rice, other semi dry crops (maize) sugarcane and arecanut (betel nut). Key inputs, fertilizer and harvest labour were related to yield rates in the model to reflect input costs. A typical physical budget of irrigated paddy is shown as Table 5. Yield rates with the project increase from 5,450 to 7,000 kg per hectare (20%), over three years (not shown) and by-products are directly linked to yield. Inorganic fertilisers and harvest labour are linked to the yield rate.

Table 5: Physical Budget for Kharif Irrigated Paddy Rice

	Unit per ha	Existing Technology	New Technology
Outputs			
Grain	kg	5,450	7,000
Straw and Stalks	kg	8,175	10,500
Inputs			
Paddy Seed	kg	73	66
Nitrogen	kg	130	150
Phosphorous	kg	80	100
Potassium	kg	70	90
Contract transplanting	each	1	1
FYM	kg	3400	5000
Pesticide	kg	14	17
Herbicide	kg	-	0.3
Animal Hire		20	5
Tractor Hire	hour	19.0	30
Combine hire	hour	4	5
Labour	person-day	105	100

Note: Contract planting and harvesting are excluded from labour data

16.   The paddy rice budget shows a very high output and input crop compared to the norm for Karnataka state, with yield rates about twice the average and crop inputs also about twice the average, and high labour inputs. These levels were confirmed in the field, and the scheme is

well developed. Yield rates can be increased, mainly by introduction of SRI, by 20 to 25%. Labour costs are assumed to fall, with increased mechanisation, probably rather more than modelled.

17.   The financial budget of irrigated paddy rice is shown below, for current and new technology for PY 25. The budget shows income before labour costs (which are retained by the farm family) and after. Income after labour costs are quite low, and the budgets are sensitive to the assumed price of rice, which are currently, locally, well above the MSP. If MSP are used the returns, after labour, are frequently negative, as are economic price crop models.

18.   Summary financial budgets by crop are attached as Annex tables. These show that the perennial crops have positive financial, (and usually economic), returns at current prices. However it should be noted that new arecanut plantations are very slow to produce positive cash flow due to the time to reach fruit bearing stage.

Table 6: Financial Budget for Kharif Irrigated Paddy Rice (INR/ha)

	Existing Technology	New Technology
Revenue		
Paddy Rice	76,300	98,000
Straw and Stalks	7,358	9,450
Sub-total Revenue	83,658	107,450
Input costs		
Paddy Seed	2,628	2,340
Nitrogen	2,470	2,850
Phosphorous	3,680	4,600
Potassium	1,820	2,340
FYM	8,500	12,500
Pesticide	1,200	1,500
Fungicide	3,000	3,600
Herbicide	-	75
Animal Hire	6,000	1,500
Contract transplant rice	-	3,250
Tractor Hire	11,400	18,000
Combine Harvester	8,000	10,000
Irrigation Fee Paddy	500	500
Sub-total Input costs	**49,198**	**63,055**
Income (Before Labour Costs)	**34,460**	**44,395**
Labour costs	**22,050**	**21,000**
Income (After Labour Costs)	**12,410**	**23,395**

19.   The main Kharif season crop is Paddy (45% of farm holding); Rabi season crop is Paddy (40%). There are large areas of sugar (15%) and tree crops, mainly arecanut (35%). There are small areas of other semidry crops (under 1%) and other tree crops (banana and coconut (5%) which are not included as separate crops in the analysis. Overall cropping intensity is about 138%, and there is little potential for increasing cropping intensity, due to the large area of perennial crops.

20.   Without project crop yields are typical for the State. Yield rates are assumed to decline by 20% without the project, due to restrictions in the available water supply.

Table 9: Without Project Cropping Pattern Production and Yields

Crop	Area (ha)	Percent of Area	Yield kg/ha
Command Area	**4,600**		
Kharif Season			
Paddy	1,400	30	5,450
Other	350	8	3,500
Rabi Season			
Paddy	1,000	22	5,500
Other Rabi	750	16	3,500
Perennial Crops			
Sugarcane (cane)	550	12	85,000
Arecanut (wet nut on tree)	2,300	50	15,000
Total Area & Cropping Intensity	**6,350**	**138**	

3.   Future Situation (With Project)

21.   The CCA with project remains at 4,600 hectare, though a reduction in area is likely as built up area increases.

22.   Conservative adoption rates were used for the analysis. No benefits were assumed in PY1, and full uptake of the new crop technologies was completed in PY 5. The direct benefits of the sub project are derived by avoiding a decline in yields due to water shortages and improved yields resulting from better irrigation and crop management.

Table 10: Gondi, Area under Existing and New Technology (ha)

Year	Existing Technology	New Technology	Cropping Intensity (%)
1	6,350	0	138
2	5,381	733	133
3	3,175	2,925	133
4	970	5,120	132
5 on		5,850	127

23.   Farmers are expected to continue cultivating paddy as the major crop during Kharif and Rabi seasons, taking up SRI, and expand new arecanut. Yield rates are assumed to increase with new technology by only 20% in a sigmoid pattern over three years from the without project yield levels.

Table 11: With Project Cropping Pattern and Yields

Crops	Area (ha)	Percent of Area	Current Yield (kg/ha)	Yield PY25 (kg/ha)
Command Area	4,600			
Kharif Season				
Paddy	450	10	5,450	7,000

SRI Paddy	450	10	-	8,000
Other	350	8	5,500	6,600
Rabi Season				
Paddy	100	2	5,500	6,600
SRI Paddy	400	9	-	7,000
Other Rabi	750	16	5,500	6,600
Perennial Crops				
Sugarcane	550	12	85,000	100,000
Arecanut	2800	61	15,000	18,000
Total Area & Cropping Intensity	**5,850**	**127**		

4. Production Levels and Output Marketing Constraints

24. There will be an increase in the production of most crops, around 17 to 43%, but paddy rice is replaced with perennial crops, so production declines.

Table 12: Production with and without Project (tonnes)

Crops	Without Project	With Project Full development	Increase (%)	Karnataka State production 2005-06	Sub Project as % of Karnataka
Rice (paddy)	13,130	10,210	(25)	6,000,000	-
Sugarcane	46,750	55,000	17	19,650,000	-
Arecanut (dry nut)	3,500	5,000	43	215,000	2
Other (semi dry crop	3,850	4,620	17	-	-

Source: Report on area, production, productivity and prices of agricultural crops in Karnataka, 2005-2006. Directorate of Economics & Statistics, Bangalore

25. Scheme production is a very small percentage of the total for Karnataka State except for arecanut, which reaches about 2%. No marketing issues are likely to develop as a result of the project. GOI policy is to phase out arecanut consumption, which, if successful, would reduce the market, in which case farmers would replace the crop with an alternative tree crop. Arecanut markets account for a large percentage of production on Gondi, and the scheme will always be subject to market shocks or other threats, such as disease problems. The project can take steps to mitigate this potential problem by exploring and promoting alternative high value products, such as orchard crops or floriculture.

5. Farm Crop Area and Production

26. The following table shows the area of crops for marginal, small and medium farmers with and without the project. These are based on the area assumptions at scheme level, with a minimum of 0.2 ha of rice for subsistence requirements (half the area of a marginal farm). Area of perennial crops is reduced for marginal farms to allow subsistence, and no new arecanut is added. Farm areas are rounded so resemble but do not exactly match scheme area assumptions. Total crop area per season does not exceed farm size. The models are intended to show household income effect of the project.

Table 13: Crop Area by Farmer Category With and Without Project (ha)

	Without Project			With Project		
	Marginal (up to 1 ha)	Small (1 to2 ha)	Medium (over 2ha)	Marginal (up to 1 ha)	Small (1 to2 ha)	Medium (over 2ha)
Arecanut	0.15	0.75	2.05	0.15	0.75	2.05
New Arecanut				0.00	0.15	0.55
Sugarcane	0.01	0.20	0.50	0.01	0.20	0.55
Other Kharif (Maize)	0.04	0.10	0.30	0.04	0.10	0.30
Other Rabi (Maize)	0.09	0.20	0.50	0.11	0.17	0.55
Paddy Kharif	0.20	0.35	1.00	0.09	0.08	0.25
Paddy Rabi	0.10	0.25	0.85	0.00	0.05	0.10
SRI Paddy Kharif				0.10	0.10	0.20
SRI Paddy Rabi				0.12	0.08	0.10
Total	**0.59**	**1.85**	**5.20**	**0.62**	**1.68**	**4.65**
Kharif	0.4	1.4	3.9	0.4	1.4	3.9
Rabi	0.4	1.4	3.9	0.4	1.4	3.9

27.   Cropping patterns for head, middle and tail reach farmers are not known, but household survey data indicates that farm size reduces in the lower reaches of the command, so small and marginal farmers will form a larger proportion of the total.

6.   Farm Financial Income

a.   Marginal Farms

28.   Retained farm income is expected to increase by 53% for marginal farm households, as shown below. This includes the value of family labour retained by the family, the models show that a typical household with 1.6 people available for farm work would not need to hire labour, though in practice some households would do so, either because they have other employment, or less than the assumed labour able to work.

29.   Income levels remain low, at about Rs 30 per person per day, which is well below the poverty threshold, but the return to family labour is attractive, due to low labour requirements resulting from mechanised operations and use of contract harvesting. These increases are adequate to provide incentive to participate in the Subproject, but marginal farmers will need to find alternative employment. A high proportion, about 40%, of the paddy output will be consumed by the household. Cash incomes are likely to be low and mainly used to finance bought crop inputs.

Table 14: Farm Income, with and without Project (Rupees)

Without Project	Marginal	Small	Medium
Output Value	66,624	268,481	742,319
Operating Costs	28,534	115,418	323,846
Family Labour	44	143	371
Hired Labour	0	0	26

	Marginal	Small	Medium
Retained Income	38,090	153,063	418,473
Return per family labour day	866	1,070	1,128
With Project	**Marginal**	**Small**	**Medium**
Output Value	85,570	334,128	925,520
Operating Costs	27,625	119,036	336,929
Family Labour	49	131	296
Hired Labour	0	0	51
Retained Income	57,945	215,092	588,591
Return per family labour day	1,183	1,642	1,988
Annual O&M Cost	320	1,120	3,432
Percent Increase of Output Value	30	25	25
Retained Income	53	41	41

Note: Operating Costs EXCLUDE family labour

b. Small Farms

30. Retained farm income is expected to increase by 41% for small farm households. This includes the value of family labour retained by the family, the models show that a typical household with 1.6 people available for farm work would not need to hire labour with the project. In practice some small farm households do hire some of their labour. The models assume that arecanut and sugar are harvested by contractors, in practice small farmers may prefer to use their own labour, so family labour would be higher than reported.

31. Production of paddy rice averages 1.2 kg per person per day, which allows marketing, and there are substantial marketable arecanut and sugar. Sales should be adequate to finance crop inputs.

32. Income levels with the project are about Rs 133 per person per day, which is above poverty level. The return to family labour is attractive, at Rs 1,642 per day with the project. These increases are adequate to provide incentive to participate in the subproject. Cash incomes are likely to be sufficient to allow small farmers to pay for O&M, which is only 0.5% of their total income.

c. Medium Farms

33. Retained farm income is expected to increase by 41% for medium farm households, as shown in Table 14. This includes the value of family labour retained by the family, the models show that a typical household with 1.6 people available for farm work would need to hire about 51 days of labour per year. In practice most medium farm households hire some or most of their labour. Rice production is well above subsistence requirements.

34. Income levels with the project are about Rs 310 per person per day. These increases are adequate to provide incentive to participate in the subproject. Cash incomes are likely to be sufficient to allow medium farmers to pay for O&M, which is only about 0.6% of their total income.

F.   Economic Analysis

1.   Methodology and Assumptions

35.   The economic viability of the Subproject is assessed by estimating its economic internal rate of return (EIRR) and benefit-cost ratio over an expected scheme life of 25 years. Sensitivity analysis was undertaken for the key perceived risks of increased costs or reduced or delayed benefits. An assessment of the impact of the subproject on poverty reduction is also undertaken. The social discount rate for NPV is assumed at 12%, which is quite high compared to other investment opportunities in the current economic climate, but is the rate normally assumed for development project in India.

36.   Land below kilometre 44 of the Gondi right bank canal is supplied almost entirely by intercepted seepage flows from the Bhadra Canal, and water supply stops completely when the Bhadra canal is closed. There are plans to improve the water management in the Bhadra scheme by introducing water monitoring systems and volumetric water management. When these are implemented the area below km 44, totalling 1,762 ha (38% of the scheme), would cease to have any effective irrigation water (from the surplus/seepage flows of the Bhadra irrigation system).

37.   Farmers might respond to this by increasing pumping activity, but this would be costly, required year round, and possibly exceed current power availability without a substantial investment in new power lines and connections. It is more likely that perennial cropping would largely cease, and farmers would be forced to revert to rainfed cropping. This would be socially and politically unacceptable and measures are required to protect the irrigation supplies for this area, by modernization of the Gondi system. Precise estimates of the reduction of returns if no mitigation was undertaken are not really possible, as the water management implications have not been studied. The analysis assumes that 20% of the total production for Gondi would be lost without the project, and restoring the irrigation supply allows this to be claimed as a direct benefit.

38.   The project will promote the use of water saving crops such as semi dry field crops and SRI paddy, and support limited introduction of new arecanut plantations. Without the project it is assumed that the area of arecanut would increase by around 20% of the cropped area, to about 70%, and rice production would be restricted to subsistence need and areas not suitable for perennial crops (low and wet land).

39.   The detailed project report (DPR) for Gondi, as prepared by Karnataka Neeravari Nigam Limited (KNNL) indicates that the proposed modernization of the canal system will release 0.5 TMC (thousand million cubic feet) or 14 million m^3 of water which will be used to provide new irrigation in the proposed Upper Bhadra schemes. The value of this water has been estimated at Rs 21 per cubic meter, based on crop returns and cropping patterns on Gondi scheme at full development. This value is added to the with scheme benefits, where appropriate, assuming that a proportion of the value of this water is required to pay for water delivery to and distribution on the new scheme, and allow for current crop production value. The net value added is taken as 25%.

Table 15: Valuation of Irrigation Water on Gondi Scheme

Crop	m³/ ha (@80% efficiency)	Gross Margin (with project)	Rs/m³	Percent area	Rupee per m³
Arecanut	9,129	172,390	18.9	50	9.5
Sugarcane	13,362	37,590	2.8	12	0.3
SRI paddy (kharif)	2,408	56,200	23.3	30	7.0
SRI Paddy (rabi)	6,496	58,830	9.1	22	2.0
Semi dry Kharif	2,042	36,610	17.9	8	1.4
Semi dry Rabi	5,813	36,610	6.3	16	1.0
Total				**138**	**21.2**

40.   Based on the DPR summary cost table the cost of lining is estimated as 55% of the total cost of channel rehabilitation with lining. Canal reconstruction earthworks costs (cleaning canal, importing fill, reforming and profiling canal) are 45% of the concrete lining option. Cost of structures (bridges, weirs, outlets, drops, escapes) remains the same in both options. Canal lining costs of Rs 386 million are removed from project costs where appropriate.

41.   The various scenarios used in the economic analysis are as follows:

Scenario	Characteristics
Current	• Current cropping pattern with increasing arecanut area (20%) replacing paddy, based on reported farmer intentions. • No increase in base yield rates assumed during project life. (simplifying assumption) In practice, yield rates increase 2% per year both with or without the project, that is on both sides of the model, so no net effect. • Yield increments due to project (+20%).
Without Project	• Bottom 38% of Gondi loses irrigation supply (tailwater) from Bhadra system • No replacement supply from Gondi as left canal blocked at 'km 44' • Cropping pattern adjusts to this (end of Gondi production falls by 20% overall) • Perennial plantings lost due to lack of Rabi water (half of mature arecanut (400ha) with NPV of about Rs 1.2 million per ha). Rest uses pumped river water.
With Project A1a (lined canal)	• Canal lining 100% • Water supplied along length of canal • 'Limited' irrigation supply (tailwater) from Bhadra • Productivity increases from extension activities (20%) • Reduced arecanut area expansion
With Project A1b (lined canal)	• Selective canal lining • Water supplied along length of canal and 20% production loss at end of system avoided • Productivity increases from extension activities (20%) • Reduced arecanut area expansion
With Project A2	• Add net value of 0.5 TMC (14 Mm³) of water transferred to Upper Bhadra irrigation scheme

a.   Economic Prices, Taxes and Duties

42.   The economic price estimates and Conversion Factors (CF) used for the analysis are detailed in the Feasibility Studies Supplementary Report, Financial & Economic Analysis Markets and Prices. This annex includes details of current levels of duty and local taxes relevant

to the project and should be read as an integral part of this report. A summary of the financial and economic prices and CF are attached as an Annex table.

43. Traded commodities (paddy CF 1, oil crops (CF 1.7, and fertilisers, CF 1.4 to 3) economic prices are based on farm gate values at border parity pricing in 2012 prices. Transfer payments such as taxes and subsidies are excluded. Financial values of non-traded goods and services are adjusted to economic values by the standard conversion factor of 0.9. Individual CF were estimated for crop chemicals (0.8) and mechanised operations (1.2, due to fuel subsidy). Unskilled and agricultural labour are adjusted by a shadow wage rate of 0.9, skilled labour (including project management) was assumed to be correctly valued, (CF 1.0).

44. A Construction Conversion Factor (CCF) (0.8) is applied to subproject construction costs, at 2012 values, based on the weighted CF for materials, fuel and equipment, labour and overheads. Other costs and O&M costs are adjusted by the standard conversion factor (SCF) of 0.9.

45. Remaining items were converted at the SCF.

b. Inflation and Exchange Rates

46. Constant 2012 prices were assumed so US$ and domestic inflation rates were not included in the economic analysis.

47. The exchange rate assumed for the analysis was US$1 = Rs 55. The analysis assumes Constant Purchasing Power Parity for the Rupee, that is the nominal exchange rate will change so that the real value of the Rupee stays constant in US$ terms[5]. This means the assumed 2012 exchange rate can be used throughout the analysis.

c. Excluded Costs

48. There were no excluded costs for the subproject, but only a proportion of the project management costs were attributed to the scheme.

49. A nominal overhead for project management was included, 10% of total costs. The majority of project management costs are for State level institutional development, and are not directly related to the scheme.

d. Project Cost

50. Financial project costs adjusted by the CF above give the assumed costs tabulated below. Pumping costs for conjunctive use of river water are not included in the model. O&M costs are continued. Construction contracts will include provision for continued water supplies for perennial crops, so cropped areas are assumed to be maintained during construction.

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[5] Say the current exchange rate is 55:1, with 20% local inflation and 5% international inflation, then in PY2 the nominal exchange rate would be 55*1.2/1.05= 63:1

Table 16: Gondi Subproject Economic Costs (2012 Rupees million)

Activity	Costs
Irrigated Agriculture Management Systems	
PP & PIM Support	16
Irrigation and Associated Infrastructure	
Irrigation Infrastructure	866
CAD Works	113
Agriculture & livelihoods	21
Sustainable Infrastructure O&M	80
Institutional Development	
Project Management	9
Physical Contingencies	108
Total Project Cost + Physical Contingencies	**1,213**

e.   Project Benefits

51.   Crop production benefits result from increased yields from irrigation and improved agricultural practices, as detailed above, and a small shift to higher value crops, see economic budget Annex table.

52.   Loss of water to the tails of Gondi without project is modelled by reducing the without project outputs and production costs by 20%[6], to represent reduced cropping. Additional pumping costs for remaining perennial crops, if any, are ignored, so the reduction in value is conservative.

53.   Use of water saved by the scheme modernization is modelled assuming a value for water for crops on a new scheme. This is based on crop returns to Gondi (see above), where crops are converted from rainfed to irrigated production. The net value of water saved allows for delivery costs, and net value of current production by assuming a percentage of the gross value, which can be adjusted in the EIRR spreadsheet. More sophisticated modelling of with and without scenarios was precluded by lack of suitable information (though rainfed crop models were prepared as part of the FARMOD file).

54.   The sensitivity of the economics to concrete canal lining is tested by removing the estimated lining costs from the project costs, and increasing the O&M costs by 25% from Rs800 to Rs 1,000 per ha, as earth channels cost more to maintain. Any percentage of lining can be modelled, and the O&M costs are calculated proportional to unlined channel.

55.   Institutional strengthening of WRD, other concerned agencies, and farmers, including PIM, will result in improved water management and security. Expected yield reductions due to declining water availability will be avoided. Agricultural support programs which include farmer training and farm demonstrations are included in the economic model as assumed yield and production increases.

56.   Economic benefits are calculated from the incremental value of crop production generated by the subproject, net of production cost at economic input and output prices. Livestock benefits are included by valuing fodder and crop residues.

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[6] The model allows this percentage to be adjusted within the EIRR spreadsheet, as required.

57.   Project benefits excluded from the analysis include small fishery developments, and health benefits from improved nutrition, better water management and drainage.

2.   Results of the Economic Analysis

58.   The baseline analysis assumes the CCA of 4,600 hectare and a cropping intensity of 138%.

59.   The economic returns are shown in Table 17 the detailed EIRR tables are attached as an Annex table. Gondi scheme, with channel lining, and assuming no downstream crop loss, is not economic, as a stand-alone project, with an EIRR of 9%, base, but is acceptable at 15% with the costs of concrete lining removed. Assuming that there will be loss of production in lower Gondi without the project improves the expected returns to EIRR 17% with lining and 26% with no lining.

60.   Adding the value of water saved and diverted to new irrigated areas, assuming 25% of the water value is retained as net income, improves returns considerably to an EIRR of 22% to 32%. However there are some doubts that the level of savings proposed can be achieved, as they are a considerable proportion of the total current water supply to scheme. The studies to identify the current water supply and potential savings have not been undertaken in detail.

Table 17: Economic Returns to Gondi Scheme

Scenario	Without Yield Reduction (%)	Saved Water Net Return (%)	EIRR (%)	NPV (Rs million)	B:C ratio
With Lining					
A1a: Gondi scheme, 100% lining	0		9	-138	0.8
A1b: Add avoided end of Gondi loss	20		17	274	1.2
A2: Add diverted water value	20	25	22	631	1.4

a.   Sensitivity Analysis

61.   Subproject sensitivity analysis is tested on scenario A2 with a base EIRR of 17%. Including value of saved water tends to "swamp" the returns, and the model becomes insensitive to changes in assumptions on Gondi scheme itself. Parameters tested were: (i) increased investment costs; (ii) delay in achieving full benefits; (iii) shortened Subproject life; (iv) reduced benefits (crop output or price); (v) increased crop production costs; and (vi) shortfall in projected crop yields with project.

Table 18: Sensitivity Analysis (Scenario A1)

Change	EIRR[a] (%)	Switching Value[b] (%)	Sensitivity Indicator[c]
Base (Gondi scheme	**17**	-	-
Construction and CAD Costs Increased by 10%	15	35	1.0
Project Benefits Delayed by 2 Years	11	-	-
Project Life Reduced by 5 Years	17	-	-
Incremental Benefits or Crop yields or Price	14	15	1.9

Reduced by 10%			
Crop Production Costs Increased by10%	16	40	0.8

[a] The EIRR is the discount rate that reduces the NPV of the net annual cash flow to zero during the project lifetime (in this case 25 years).

[b] The Switching Value is the percentage change in the tested parameter that reduces the NPV to zero at the assumed discount rate of 12% (or the EIRR to the assumed discount rate). A high Switching Value indicates that the project is relatively insensitive to the tested parameter.

[c] The Sensitivity Indicator is based on the ratio of the base EIRR and the tested change EIRR, divided by the percentage change in the tested parameter. If the EIRR changes at the same ratio as the change in the tested parameter the SI is 1 (for example if the base EIRR is 20% and the tested parameter is changed 10%, a resulting change in the EIRR of 2% (that is 10% of the EIRR) would give a SI of 1). An SI of less than 1 indicates the EIRR is relatively insensitive to the parameter, the higher the SI the more sensitive the project is to the tested parameter.

62.   Incremental benefits to the subproject were not very sensitive to construction cost increases, but are sensitive to construction delays. Reducing production value (yield rate increases or prices) by 10% reduces EIRR to 14%, and the switching value is a 15% reduction, so the project is sensitive to prices and yield.

G.   Benefit Distribution & Poverty Impact Analysis

63.   The distribution of incremental financial benefits to poor households is shown in Table 19 and 20. Sub project level (undiscounted) annual financial incomes with and without the project, at full development, provide the incremental output to sub project farmers, and similarly for total production costs (before any labour hiring). These benefits and costs are distributed in proportion to the total farm area of large, small and marginal farmers. The value of contract planting and harvesting, including arecanut harvesting (assuming 50 days a ha) are included in hired labour, which does not change greatly due to the project, but would reduce significantly without the project, due to lost crop area. Production, operating costs and labour are assumed to be reduced 20% in the without project scenario, due to loss of supply below km 44 of the right bank canal, as discussed above.

Table 19: Distribution of Incremental Financial Farm Incomes

(Rupees million)	Financial Farm Incomes		
	Without Project	With Project	Incremental Income
Benefits and Costs			
Project Output	(1,003) 802	1,088	286
Production Costs (excluding labour)	(350) 280	327	-47
Total Farm Labour Value	(153) 122	154	-32
Hired Labour (%)			
Hired Labour Cost			
Benefits			207
HH Labour Value			
Proportion of poor (%)			

Notes: Sums rounded and presented in millions.
Without Project figures in brackets are the current levels. The second figure, assuming 20% reduction, is used.
Net benefits INCLUDE the value of household labour, retained by the household.

Table 20: Distribution of Incremental Incomes

(Rupees million)	Distribution of Incremental Income				
	Medium Farmers	**Small Farmers**	**Marginal Farmers**	**Labour**	**Total**
Benefits and Costs					
Share of Benefits (% of area)	50	30	20	0	100
Project Output	143	86	57		
Production Costs (excluding labour)	-24	-14	-9		
Total Farm Labour Value	-16	-10	-6		
Hired Labour (%)	50	20	0		
Hired Labour Cost	-8	-2	0	10	
Benefits	**95**	**60**	**42**	**10**	**207**
HH Labour Value	8	8	6		
Proportion of poor (%)	11	11	60	100	
Net benefits and costs to poor (Rupees mill.)	**11**	**7**	**29**	**10**	**57**
PROPORTION OF BENEFITS TO POOR HOUSEHOLDS					**28%**

64.   Total farm financial labour values (total labour days used, at Rs 210 per day) are shown in the table, but are retained by the farm family, except for the estimated labour hiring. It is assumed that medium farmers hire 50% of the incremental labour requirement. Small farmers are assumed to hire 20% of the incremental labour requirements and marginal farmers do not hire. The costs of net labour hired are removed from the benefits retained by the farmers and added to benefit of labour. The benefits flowing to poor households are based on the proportion of poor in each category, using the percentage of below poverty line (BPL) households found in the household survey. It is assumed all labour is poor.

65.   This model shows 28% of the total farm financial benefits are captured by poor households. It does not show the additional flows to poor households and the government from scheme construction, and from the subsidised O&M costs. It does not show the net taxes and subsidies flowing to GOI, but the benefits and costs to other groups are included in the model as part of the financial price structure, in particular fertilizer subsidies.