Department for International Development

Climate Resilient Infrastructure Design Document

ODISHA

January 2019 – March 2019

Infrastructure for Climate Resilient Growth in India (ICRG) Programme

Submitted By:

IPE GLOBAL
Expanding Horizons. Enriching Lives.

IPE GLOBAL LIMITED
IPE Global House,
B - 84, Defence Colony,
New Delhi - 110 024, India
www.ipeglobal.com

In association with

Ricardo Energy & Environment

pwc

MANCHESTER 1824
The University of Manchester

Renovation of WHS at Sukunabhata village, Titlagarh Block of Balangir district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development & dug wells	Sukunabhata village GP: Kursud Block: Titlagarh Dist : Balangir 20°11'18''N 82°55'56''E	A, B	WHS, and Soil and water conservation and & irrigation	NA	Renovation of WHS (6982 cum), construction of one outlet. Land development in 16 ha area, & dug well -5 nos.	NA

2. Rationale for selection of Works

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The topography of the Titlagarh block is undulated. Uplands are barren and existences of small barren hillock covered with rocks are high. Uplands have lateritic morrum soil hence runoff intensity is high and ground water recharge is less. Low land patches are covered with paddy crops and some extent of medium lands are also covered with paddy and other crop such as arhar, maize and cotton. There are many small and large water harvesting structures in medium and low land. A river called Sinder passes through the Titlagarh block and joins with Tel River. Most of the cultivable lands are in the valley of the river and its distributaries. Most of the suitable places there are existing WHS and many of them are functional and any either semi functional or non functional. Thus except renovation of WHS, the block has no opportunity go for any new WHS.

The mean rainfall of Titlaghar block between the months of June to September over a period of 30 years (1984-2014) is 1229 mm and its coefficient variation is 32.57. According to the 30 years historical data, the highest rainfall (mm) received in a day is 166 mm and the number of years with normal sowing rain pattern is 4-years whereas 26 years it received abrupt and erratic pattern of rainfall. Titlaghar block has suffered drought condition in last 30 years out of which 5 years was severe drought condition whereas 2-3 years was moderate drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 7.3 % and the projected coefficient of variation of the rainfall will be 33.2 for 2021-2050 years.

According to the vulnerability assessment, (The parameters used were; net irrigated area, groundwater, irrigation intensity, cropping intensity, forest area, crop yield, soil erosion, house hold with income <5000, women headed, disables, and primitive tribal households) the district level aggregated vulnerability of Balangir is high. At the block level, Titlaghar was seen to have low adaptive capacity and climate sensitivity was high. The overall aggregated vulnerability of Titlaghar is very high.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought & Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Dug wells	• To utilize the ground water recharge due to above activities • To enhance irrigation potential and increase income

4. Site Details

The core activity of the CRW is an embankment type WHS situated in the conjunction of Upland and low land, means situated in the medium land to harvest surface runoff from the upland catchment. The catchment is undulated and also catchment cover is not uniform. There are some upland plots without any covers, some plots are planted with tress and some are cultivated with upland crops like

upland paddy, cotton and arhar. A small very low height hillock is also fall in the catchment. Thus the overall catchment characteristics moderate runoff created catchment with moderate top soil erosion. Thus land development activities are proposed in the barren non cover plots, so that topsoil erosion can be restricted and thus no siltation to the WHS. The WHS is located adjacent to the village habitat area and there approach road to access the WHS. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Embankment type
3. Shape of the pond : irregular
4. Slope of the catchment : Av 2.7%, <5%.
5. Type of Soil : clay/silty loam, lateritic
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.5 m
8. Proposed Extra depth of Pond : 1. 0 m Total depth=2.5
9. Existing area of the pond : 1.20 ha (200mx60m)
9. Proposed area to be excavated {LXB) : 7200 sqm (Av. L=180m Av. W=40m)
11. Catchments area of the pond : 52 ha,
12. Command area of the pond /well : 8 ha in Khraif and 1.5+3 (dug well)=4.5 ha in Rabi
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C= Runoff Coefficient of both the catchment =0.5

R= Max one day Rainfall with CV (historical/projected) whichever is higher =(166+166*.332)/1000 = 0.221 m /day (as per CCVA study done by IISc, Bangalore)

A= total catchments area= 52 ha

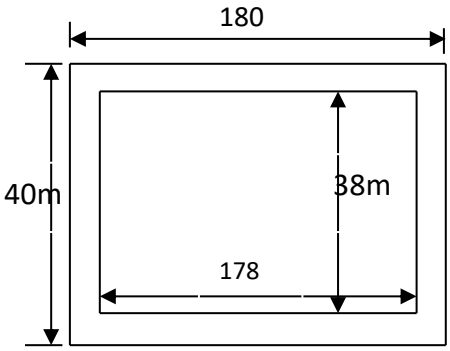
Peak Run off (Qp) =(520000x0.50)x.221= 57460 cum/day or say 0.67 cum/sec,

14. The total surface runoff for the monsoon period, Q= 520000x0.5x1.229=319540 cum (Where, 1.229m is the average mean rainfall of monsoon period for Titlagarh block.). The total surface runoff is 10.31 times greater than the pond capacity of 30982 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

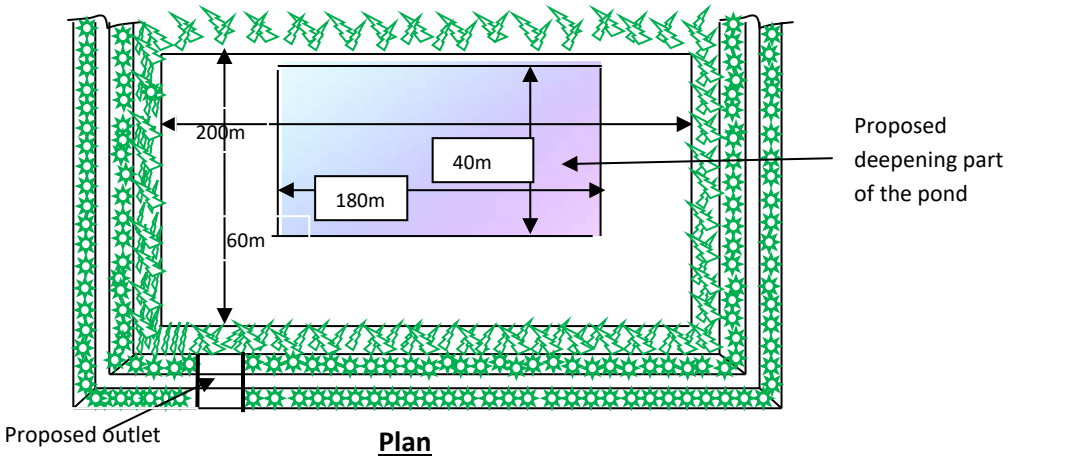
Shape of Pond : Rectangular	
Av. Length of Pond = 180 m	Av. Width of Pond : 40 m
Proposed depth : 1.0m	Proposed berm in layer cutting=2.0m
Soil Type : clay/silty loam	Depth of layer= 0.5 m



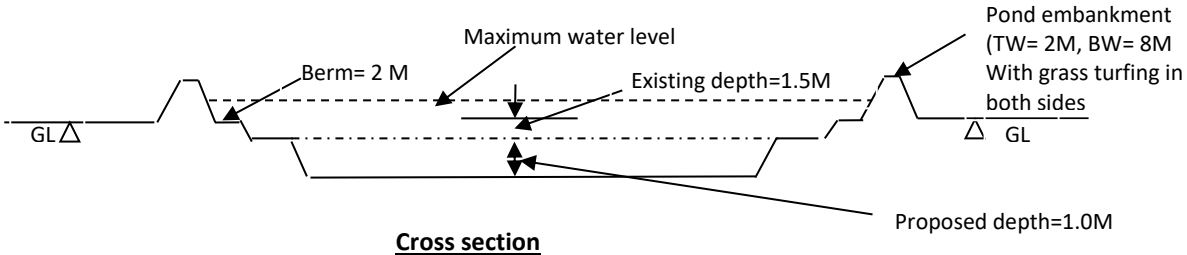
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



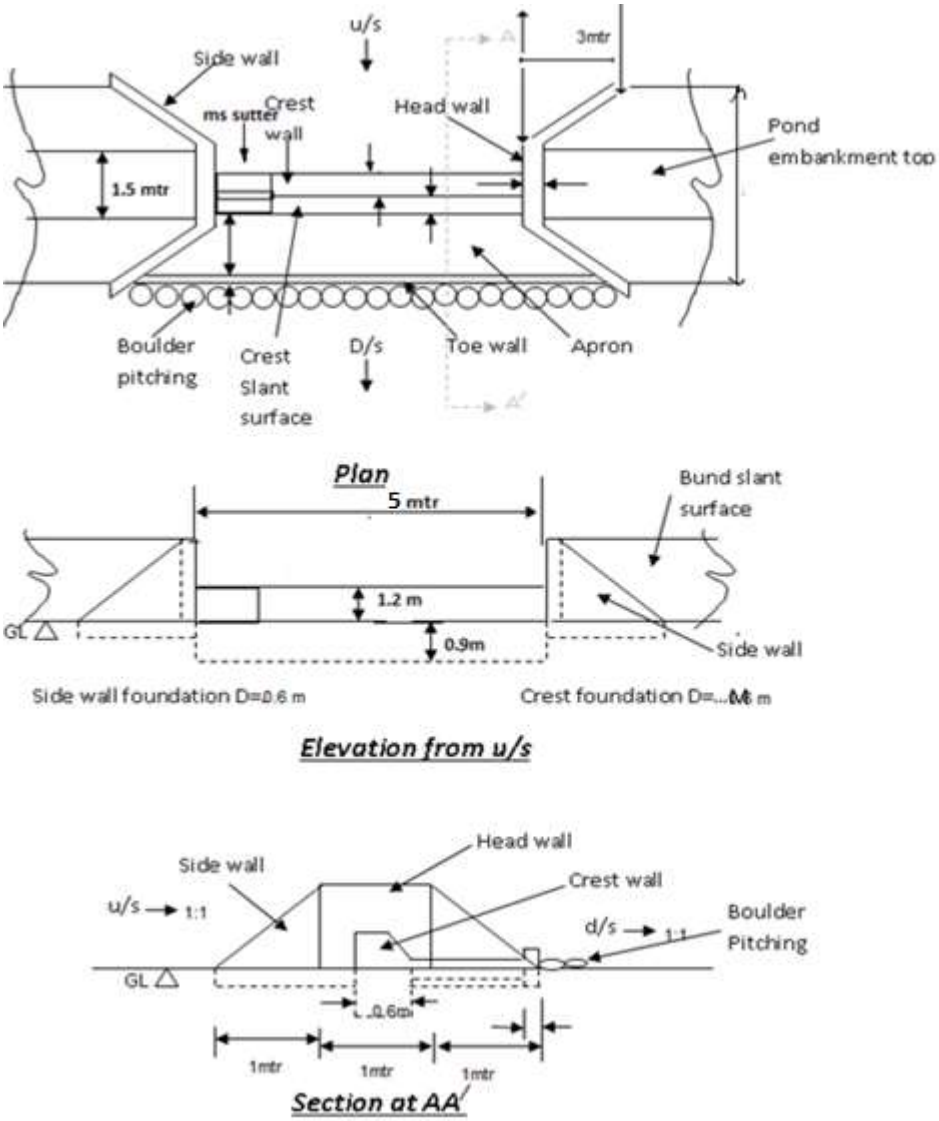
Plan



Cross section

5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.67 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec, that is greater than the Qp of 0.67 cum/sec. Hence the outlet will be capable to discharge the peak runoff safe; however, as the WHS is he and for further cushion of pond embankment during initial years, a 5 m crest length of outlet is proposed. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would require in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The design dimensions and estimate of the outlet is given below.



5.3: Design and drawing of earthen bunds for land development: 16 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 11200RM	Volume of soil excavated : 8064 cum
Plot Size: 50m * 50m	Total no of Plots: 65 nos. (approximately)

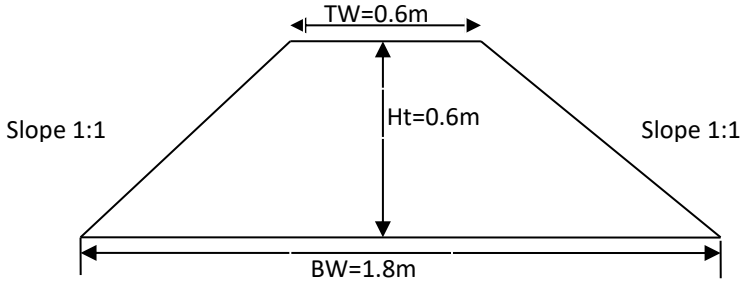


Figure 1: Cross section of the Bund

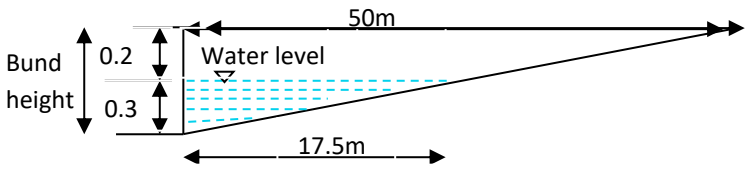
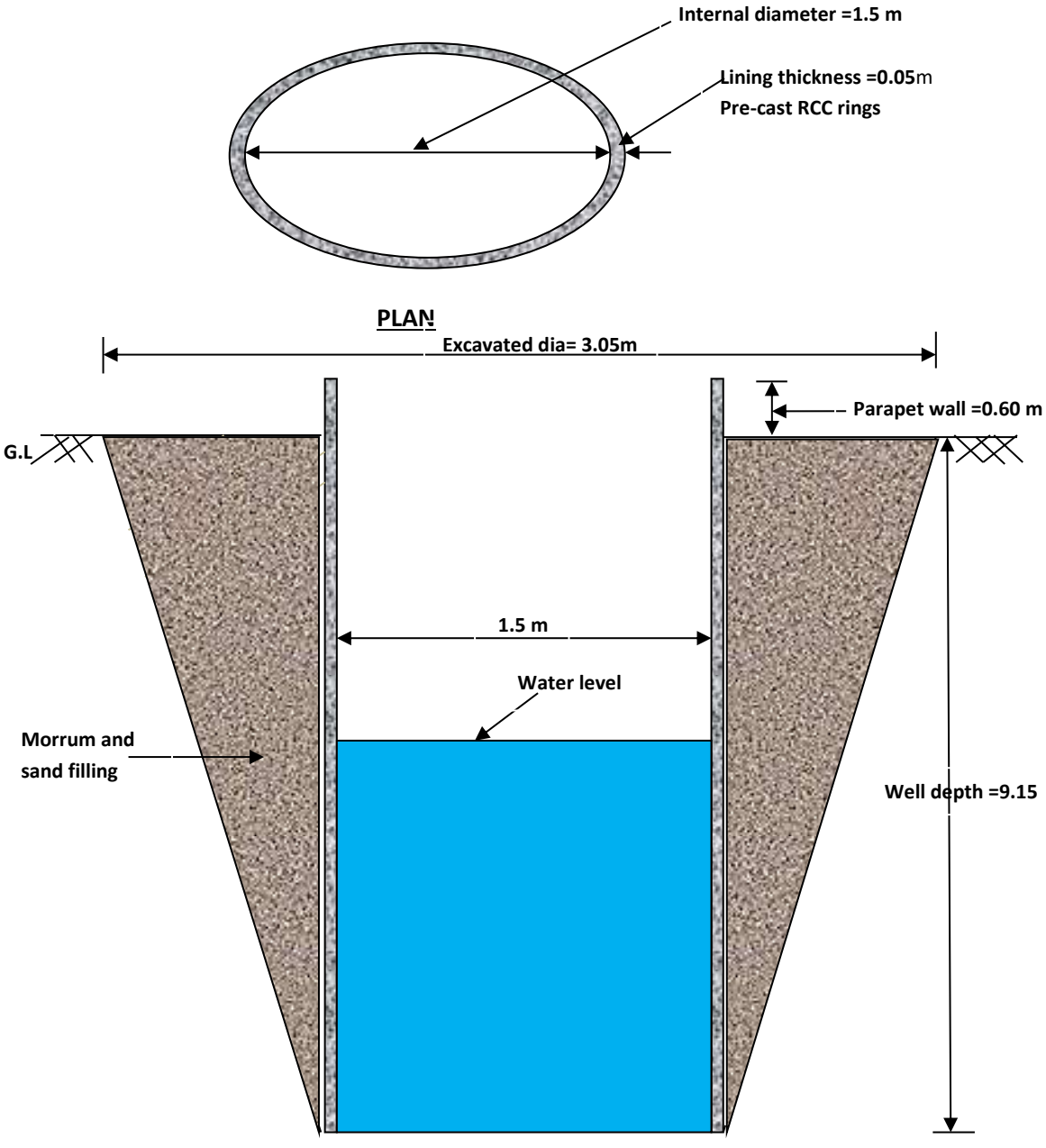


Figure: Section of Water to be stored in front of bunds.

5.4: Dug well ring type: 5 nos.

Five no, ring type dug well would be constructed in the command and nearby the command in downstream side of the pond to harvest subsurface water and ground water to irrigate kharif and rabi crops. The typical design and drawing of ring type well is given below.



6. How is the Work Climate Resilient?

Durability	• The WHS (6982 cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 319540 cum and predicted maximum one day peak surface runoff (Qp)= 57460 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 10.31 times greater than the WHS capacity (30982cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 24000 cum against WHS capacity of 30982 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 16 ha area designed to conserve 75% of total monsoon surface runoff and a total of 7.3 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 25 direct beneficiaries HHs for the CRW. Out of 25 HHs, 9 HHs are from ST community, 7 are from SC and 9 are from OBC community. There are 2 women headed HHs also direct beneficiary and among the total 25 HHs.
Integration	• A proper sized outlet (5 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water to increase the life of the embankments and the pond and also to create additional water storage height of 0.5m in the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 16 ha area in the catchment and command area is proposed. • Five dug wells are also integrated to further enhance the irrigation potential in the CRW area and promote rabi crops.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses.

	• ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

a. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-2	Deepening of WHS	6467	cum	9,89,682	MGNREGA		25
2	CRW-2	Construction of outlet	1	No.	5,13,229	MGNREGA		
3	CRW-2	Land development	16	Ha	12,72,000	MGNREGA		
4	CRW-2	Construction of dug well	5	Nos.	3,35,000	MGNREGA		
		Total CR model Cost (Rs).			**31,09,911**			**25**

b. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (25 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	2 Ha.	50 KG/Ha for 2 Ha.@30/kg	3000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	25 Small and marginal farmers	1000	25000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (25 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (25 farmers covering 5 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2500	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**41200**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 2 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Hirlimal village, Deogaon Block of Balangir district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, LBCDs, Land Development & dug wells	Hirlimal village GP: Makundpur Block: Deogaon Dist : Balangir 20°36'22''N 83°34'06''E	A, B	WHS, and Soil and water conservation and & irrigation	NA	Renovation of WHS (6467 cum), construction of one outlet. LBCDs-10 nos. Land development in 8.5 ha area, & dug well -3 nos.	NA

2. Rationale for selection of Works

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

Deogaon block having undulating topography with some small hillock with trees and shrubs. The soil is mostly silty loam. During field visit it if found that soil erosion is prominent in the block even in the forest areas, hence most of the drainage lines and WHS are traces with silt. Thus old tanks, capacity is decreasing day by day and irrigated area is reducing. The block having fair amount of forest with low altitude and all these catchments are drained water to the tributaries of Tel River.

The mean rainfall of Deogan block between the months of June to September over a period of 30 years (1984-2014) is 1213 mm and its coefficient variation is 21.28. According to the 30 years historical data, the highest rainfall (mm) received in a day is 220 mm and the number of years with normal sowing rain pattern is 13-years whereas 17 years it received abrupt and erratic pattern of rainfall. Deogan block has suffered drought condition in last 30 years out of which 2-3 years was severe

drought condition whereas 15 years was mild drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 6.1 % and the projected coefficient of variation of the rainfall will be 29.4 for 2021-2050 years.

According to the vulnerability assessment, (The parameters used were; net irrigated area, groundwater, irrigation intensity, cropping intensity, forest area, crop yield, soil erosion, house hold with income <5000, women headed, disables, and primitive tribal households) the district level aggregated vulnerability of Balangir is high. At the block level, Deogan was seen to have low adaptive capacity and climate sensitivity was high. The overall aggregated vulnerability of Deogan is very high.

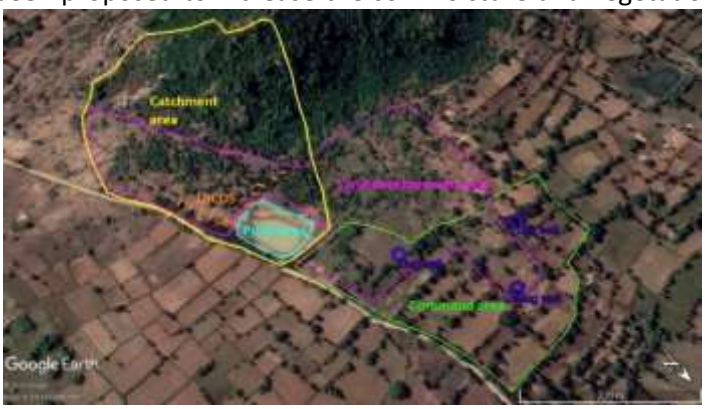
3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought & Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	LBCDs	• To check the runoff intensity and arrest silt. • To harvest soil and water and increase vegetative covers, • To reduce soil erosion and enhance ground water recharge.
	Dug wells	• To utilize the ground water recharge due to above activities • To enhance irrigation potential and increase income

4. Site Details

The selected pond as core activity of CRW is located in the foot hill of a small hillock. The pond is dugout type pond and the entire catchment area is hilly with maximum slope of 24.8%. The catchment is fairly covered with forest trees and shrubs. In the lower catchment the density of the trees is less

and thus land development works has been proposed to increase the soil moisture and vegetation. The land development area would extend up to the command area too. There are two small drainage line those drain hills slant surface runoff to the pond where numbers of small size loose boulders structures are required and also proposed to arrest silt and enhance vegetation. Three dug wells are also proposed in the downstream and in the command area to further ensure water availability and to promote rabi crops and vegetable. The image of area is shown above and details features of the site are given below.



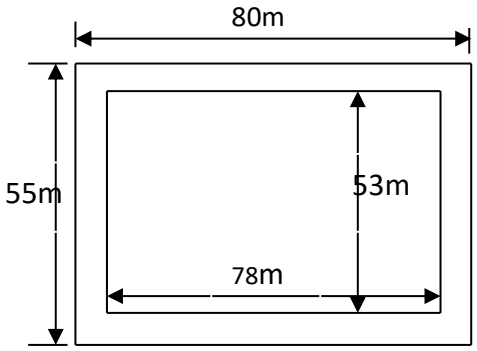
1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Dugout type
3. Shape of the pond : Rectangular
4. Slope of the catchment : 24.8%
5. Type of Soil : clay/silty loam
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.0 m
8. Proposed Extra depth of Pond : 1. 5 m Total depth=2.5
9. Existing area of the pond : 0.50 ha (85mx60m)
9. Proposed area to be excavated {LXB) : 4400 sqm (Av. L=80m Av. W=55m)
11. Catchments area of the pond : 11.5ha,
12. Command area of the pond /well : 5.0 ha in Khraif and 1.8 ha in Rabi
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C= Runoff Coefficient of the catchment =0.5 (clay/Silty loam, slope >10%, forest)
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(259+259*.294)/1000 = 0.335 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 11.5 ha
Peak Run off (Qp) =(115000x0.50)x.335= 19262.5 cum/day or say 0.22 cum/sec,
14. The total surface runoff for the monsoon period, Q= 115000x0.5x1.213=69747.5 cum (Where, 1.213m is the average mean rainfall of monsoon period for Deogaon block.). The total surface runoff is 4.23 times greater than the pond capacity of 16467 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

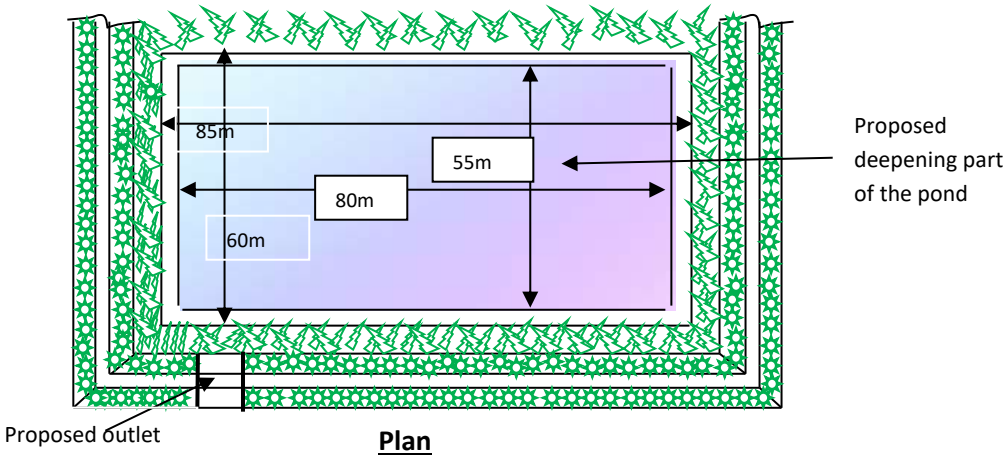
Shape of Pond : Rectangular	
Av. Length of Pond = 80 m	Av. Width of Pond : 55 m
Proposed depth : 1.5m	Proposed berm in layer cutting=2.0m
Soil Type : clay/silty loam	Depth of layer=1.0m and 0.5 m



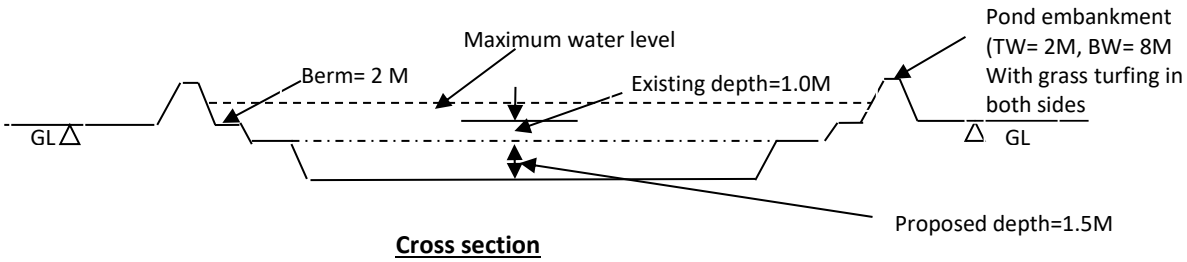
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



Plan

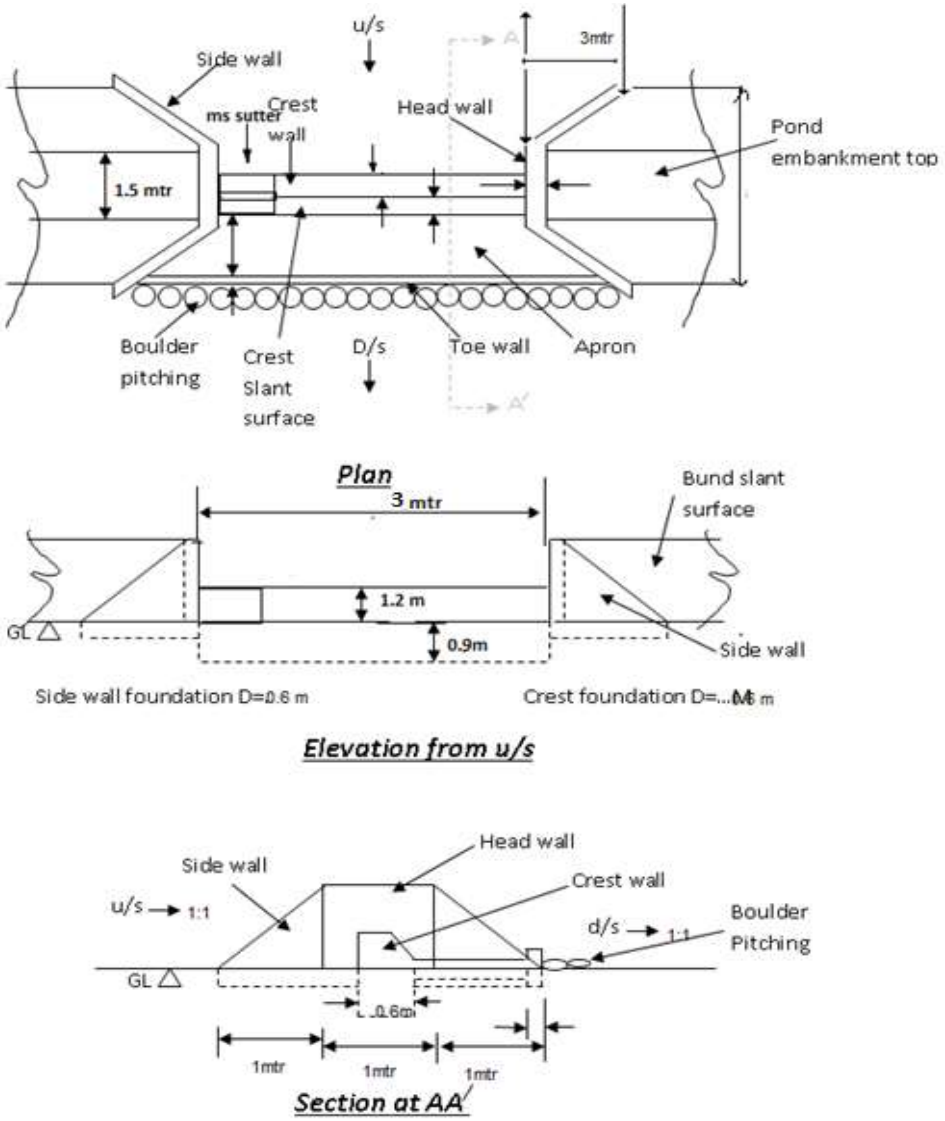


Cross section

5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.22 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec, that is greater than the Qp of 0.22cum/sec. Hence the outlet will be capable to discharge the peak runoff safe; however for further cushion of pond embankment during initial years, a 3m crest length of outlet is proposed. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would require in command area to irrigate then the shutter would be lifted to

allow water to the command area for irrigation purposes. The design dimensions and estimate of the outlet is given below.



5.3: Design and drawing of earthen bunds for land development: 8.5 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 5950RM	Volume of soil excavated : 4284 cum
Plot Size: 50m * 50m	Total no of Plots: 34 nos. (approximately)

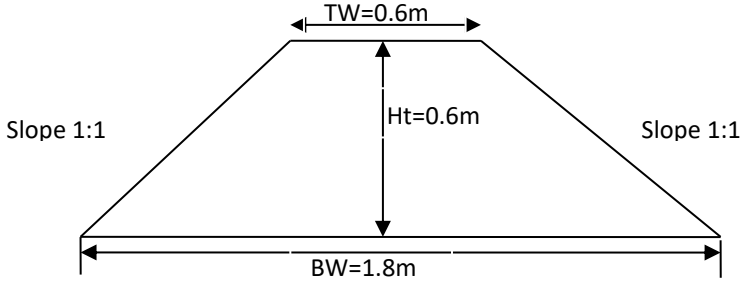


Figure 1: Cross section of the Bund

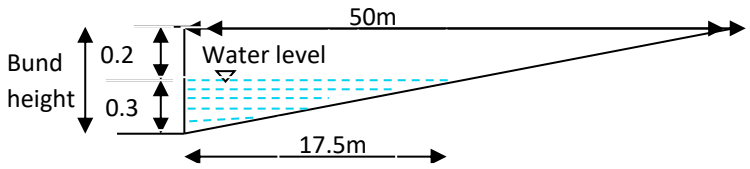
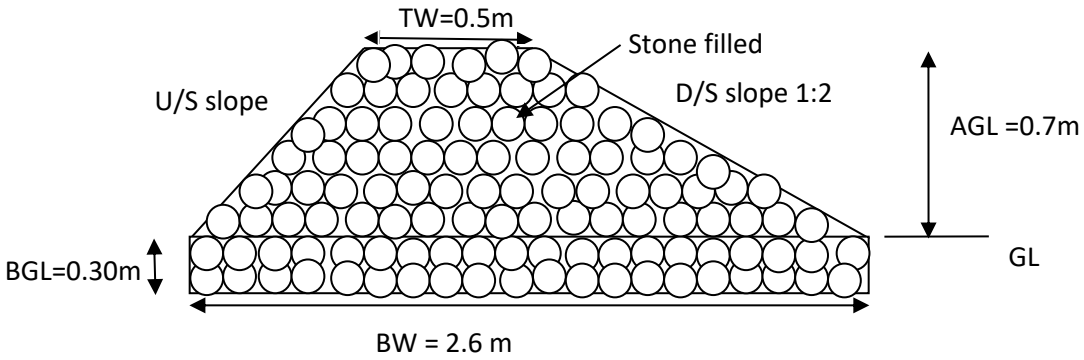


Figure: Section of Water to be stored in front of bunds.

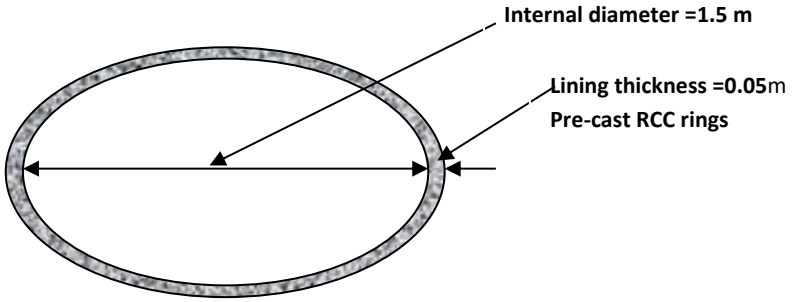
5.4: Construction of loose boulder check dams (LBCDs): 10 nos.

As mentioned in section 4, there are small nala/gullies exist in one placed in the catchment area of the proposed site. After measuring the gully width and depth, 8 numbers of LBCDs with below dimensions are proposed as gully control measures.

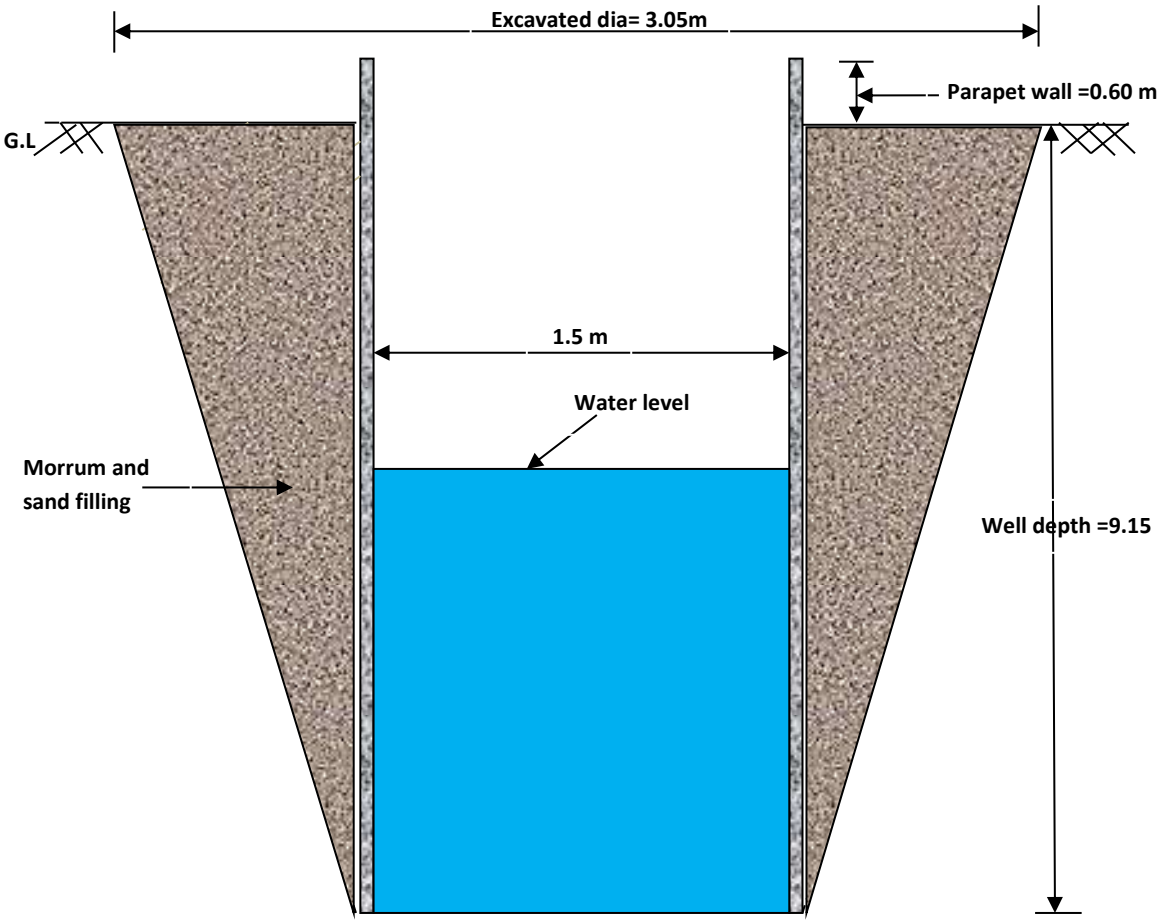


5.5: Dug well ring type: 3 nos.

Three, ring type dug well would be constructed in the command and nearby the command in downstream side of the pond to harvest subsurface water and ground water to irrigate kharif and rabi crops. The typical design and drawing of ring type well is given below.



PLAN



CROSS SECTION

6. How is the Work Climate Resilient?

Durability	• The WHS (6467cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 69747.5 cum and predicted maximum one day peak surface runoff (Qp)= 19262.5 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 4.23 times greater than the WHS capacity (16467cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 15,000 cum against WHS capacity of 16467 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 8.5 ha area designed to conserve 75% of total monsoon surface runoff and a total of 3.8 crore litre in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc.

	• The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 21 direct beneficiaries HHs for the CRW. Out of 21HHs, 8 HHs are from ST community, 5are from SC and 8 are from OBC community. There is one woman headed HHs also direct beneficiary.
Integration	• A proper sized outlet (3 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water to increase the life of the embankments and the pond and also to create additional water storage height of 1.0m in the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 8.5 ha area in the catchment and command area is proposed along with 10 LBCDs to arrest silt and conserve water to enhance ground water recharge and vegetation. • Three dug wells are also integrated to further enhance the irrigation potential in the CRW area and promote rabi crops.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

c. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Deepening of WHS	6467	cum	9,08,423	MGNREGA		21
2	CRW-1	Construction of outlet	1	No.	3,13,229	MGNREGA		

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
3	CRW-1	Land development	8.5	Ha	6,76,750	MGNREGA		
4	CRW-1	LBCDs	10	Nos.	65,000	MGNREGA	Technical support by Hort. department	
5	CRW-1	Construction of dug well	3	Nos.	2,01,000	MGNREGA		
		Total CR model Cost (Rs).			**21,64,402**			**21**

d. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (21 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	21 Small and marginal farmers	1000	21000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on	July,19 to Aug,19	2 trainings (21 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
		Climate resilient livelihood planning.							
F		Coverage of farmers under Crop insurance schemes (21 farmers covering 5 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2500	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**40200**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Rugudipali village, Deogaon Block of Balangir district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development & dug wells	Rugudipali village GP: Makundpur Block: Deogaon Dist : Balangir 20°35'40''N 83°31'10''E	A, B	WHS, and Soil and water conservation and & irrigation	NA	Renovation of WHS (8529 cum), construction of one outlet. Land development in 10 ha area, & dug well -3 nos.	NA

2. Rationale for selection of Works

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

Deogaon block having undulating topography with some small hillock with trees and shrubs. The soil is mostly silty loam. During field visit it if found that soil erosion is prominent in the block even in the forest areas, hence most of the drainage lines and WHS are traces with silt. Thus old tanks, capacity is decreasing day by day and irrigated area is reducing. The block having fair amount of forest with low altitude and all these catchments are drained water to the tributaries of Tel River.

The mean rainfall of Deogan block between the months of June to September over a period of 30 years (1984-2014) is 1213 mm and its coefficient variation is 21.28. According to the 30 years historical data, the highest rainfall (mm) received in a day is 220 mm and the number of years with normal sowing rain pattern is 13-years whereas 17 years it received abrupt and erratic pattern of rainfall. Deogan block has suffered drought condition in last 30 years out of which 2-3 years was severe

drought condition whereas 15 years was mild drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 6.1 % and the projected coefficient of variation of the rainfall will be 29.4 for 2021-2050 years.

According to the vulnerability assessment, (The parameters used were; net irrigated area, groundwater, irrigation intensity, cropping intensity, forest area, crop yield, soil erosion, house hold with income <5000, women headed, disables, and primitive tribal households) the district level aggregated vulnerability of Balangir is high. At the block level, Deogan was seen to have low adaptive capacity and climate sensitivity was high. The overall aggregated vulnerability of Deogan is very high.

3. Description of CRW

Components \ CRW		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought & Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Dug wells	• To utilize the ground water recharge due to above activities • To enhance irrigation potential and increase income

4. Site Details

The selected pond as core activity of CRW is an embankment type pond with large pondage area of almost 2.25 ha. However the water found up to an area of 1.6 ha. In the downstream of the pond there are cultivated paddy plots and pond water can be easily carried to those plots by gravity flow. The catchment area of the pond is 78.6 ha, and of two types. One is cultivated upland with some forest tress and slope below 5% and other one is hilly with dense forest cover and slope is 15.38% i.e. above 10%. Though the pond has large area to store water but the upper part is very

shallow in depth and need excavation along with construction of a waste weir. The cultivated catchment area just above the pond also required land development activities to reduce soil erosion and check runoff velocity. The WHS is located almost 600m away from the village habitat; however there is a kuchha approach road to reach the WHS site. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Embankment type
3. Shape of the pond : irregular
4. Slope of the catchment : Hilly- 15.38%, upland plain -2%.
5. Type of Soil : clay/silty loam
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.5 m
8. Proposed Extra depth of Pond : 1. 0 m Total depth=2.5
9. Existing area of the pond : 2.25 ha (250mx90m)
9. Proposed area to be excavated {LXB) : 8745 sqm (Av. L=165m Av. W=53m)
11. Catchments area of the pond : 78.6 ha,
12. Command area of the pond /well : 14.5 ha in Khraif and 3+1.8 (dug well)=4.8 ha in Rabi
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C= Runoff Coefficient of both the catchment =0.5

R= Max one day Rainfall with CV (historical/projected) whichever is higher =(259+259*.294)/1000 = 0.335 m /day (as per CCVA study done by IISc, Bangalore)

A= total catchments area= 78.6 ha

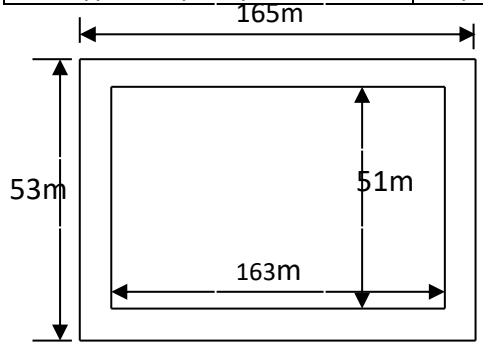
Peak Run off (Qp) =(786000x0.50)x.335= 131655 cum/day or say 1.52 cum/sec,

14. The total surface runoff for the monsoon period, Q= 786000x0.5x1.213=476709 cum (Where, 1.213m is the average mean rainfall of monsoon period for Deogaon block.). The total surface runoff is 8.90 times greater than the pond capacity of 53529 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

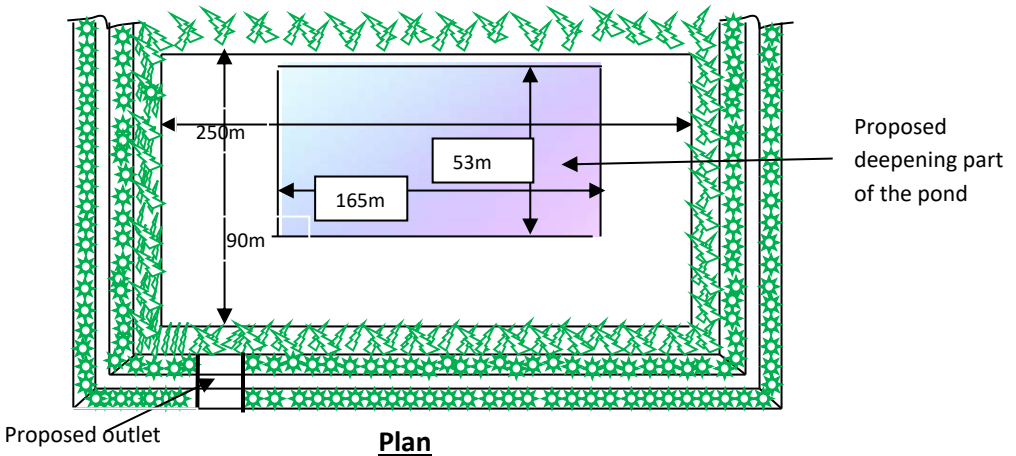
Shape of Pond : Rectangular	
Av. Length of Pond = 165 m	Av. Width of Pond : 53 m
Proposed depth : 1.0m	Proposed berm in layer cutting=2.0m
Soil Type : clay/silty loam	Depth of layer= 0.5 m



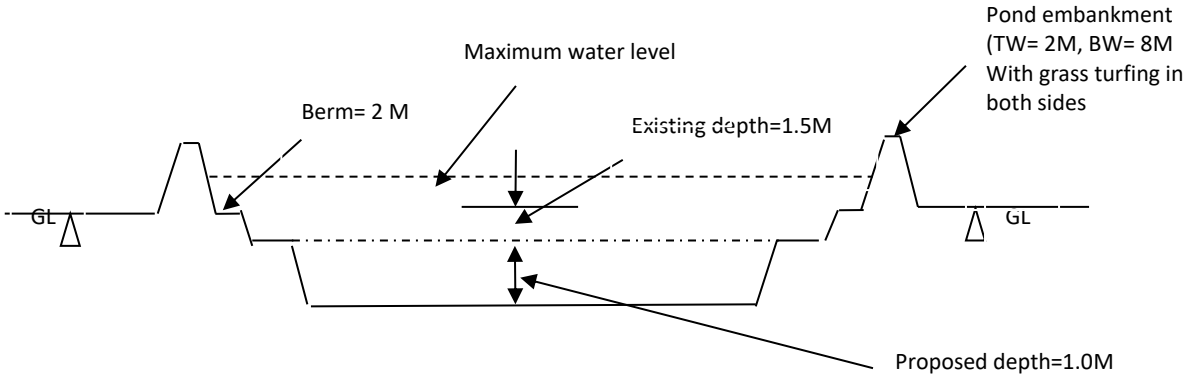
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



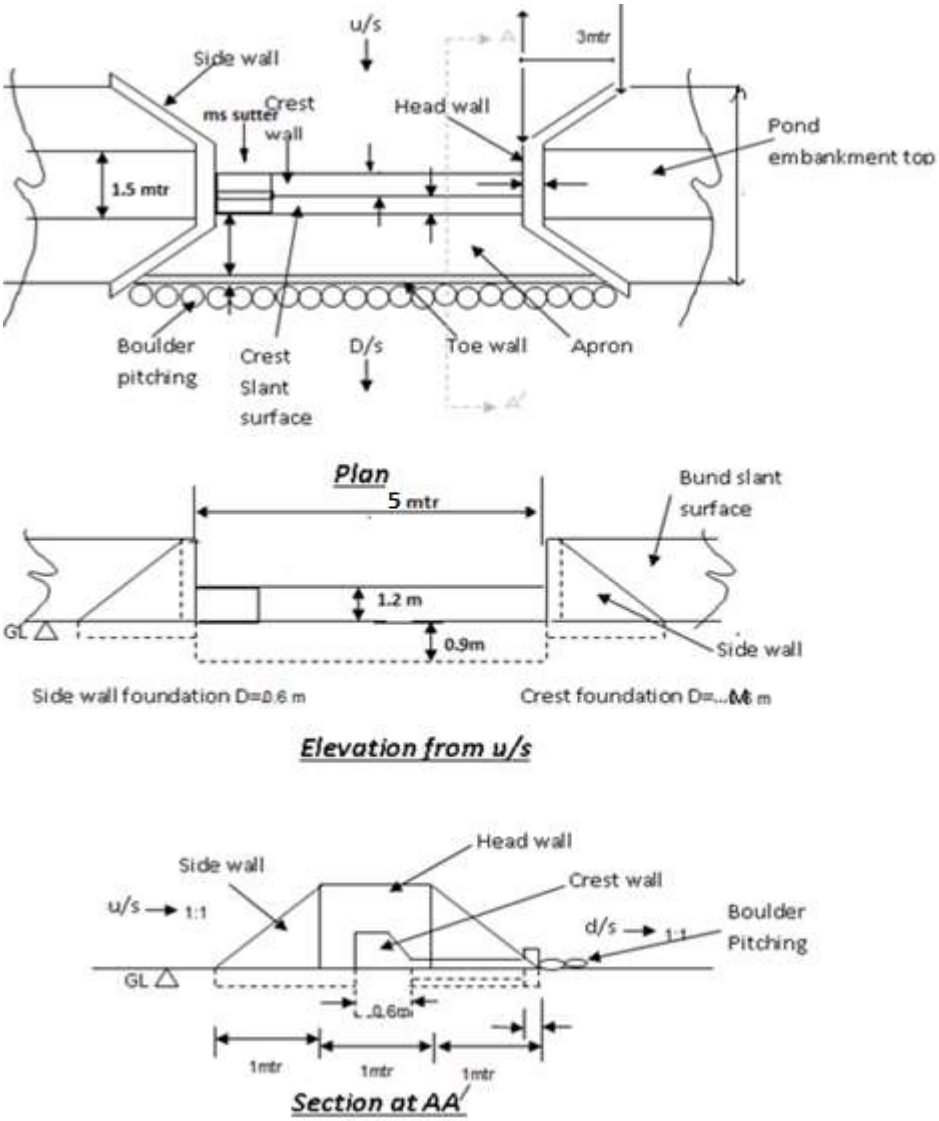
Plan



Cross section

5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 1.52 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 5m and flow height of 0.3 m, we have Q=1.2x2x0.3=1.8 cum per sec, that is greater than the Qp of 1.52 cum/sec. Hence the outlet will be capable to discharge the peak runoff safe; however for further cushion of pond embankment during initial years, a more than 5m crest length of outlet can be constructed. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would require in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The design dimensions and estimate of the outlet is given below.



5.3: Design and drawing of earthen bunds for land development: 10 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 7000RM	Volume of soil excavated : 5040 cum
Plot Size: 50m * 50m	Total no of Plots: 42 nos. (approximately)

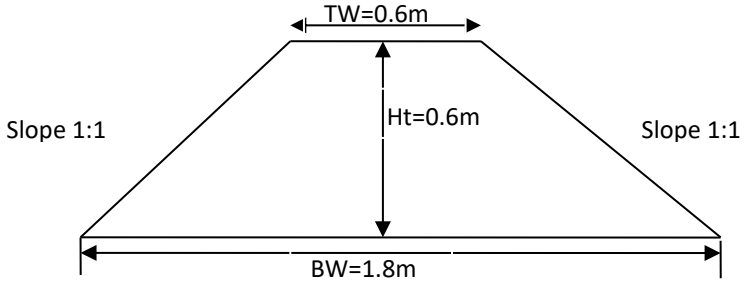


Figure 1: Cross section of the Bund

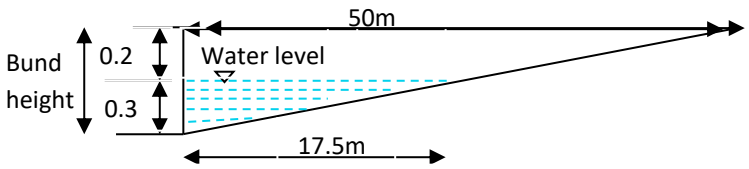
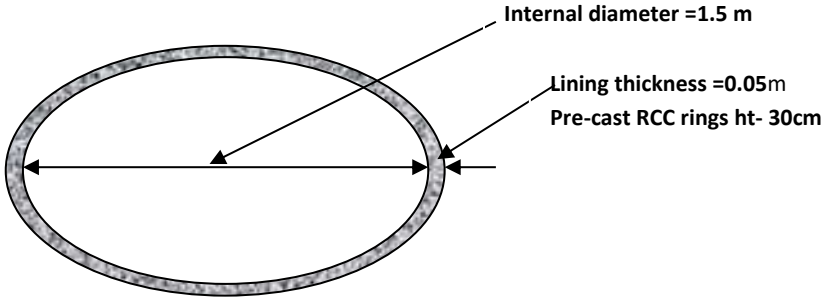


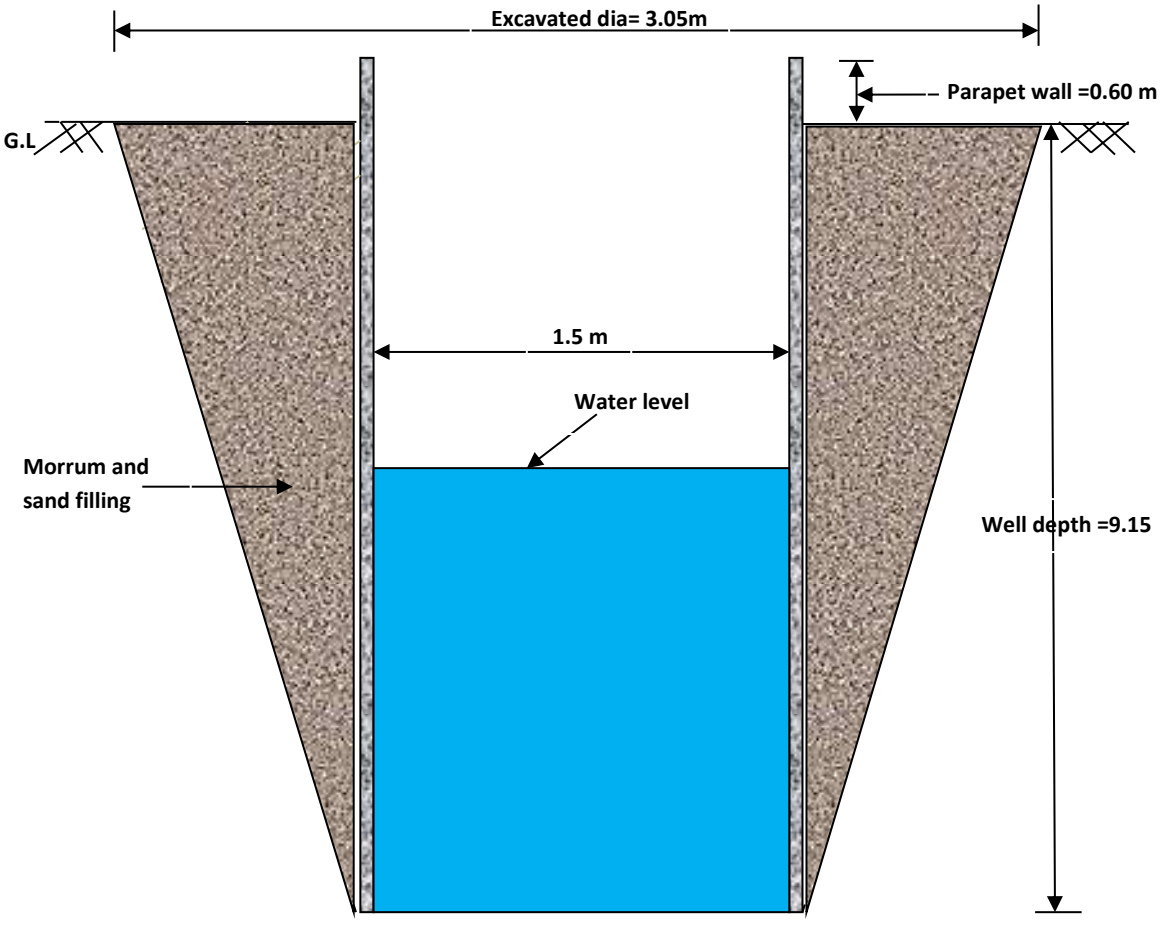
Figure: Section of Water to be stored in front of bunds.

5.4: Dug well ring type: 3 nos.

Three ring type dug well would be constructed in the command and nearby the command in downstream side of the pond to harvest subsurface water and ground water to irrigate kharif and rabi crops. The typical design and drawing of ring type well is given below.



PLAN



CROSS SECTION

6. How is the Work Climate Resilient?

Durability	• The WHS (8529cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 476709 cum and predicted maximum one day peak surface runoff (Qp)= 131655 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 8.90 times greater than the WHS capacity (53529cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 43,500 cum against WHS capacity of 53529 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 10 ha area designed to conserve 75% of total monsoon surface runoff and a total of 4.5 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 21 direct beneficiaries HHs for the CRW. Out of 21 HHs, 3 HHs are from ST community, 7 are from SC and 11 are from OBC community. There are 2 women headed HHs also direct beneficiary and among the total 21 HHs.
Integration	• A proper sized outlet (5 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water to increase the life of the embankments and the pond and also to create additional water storage height of 0.5m in the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 10 ha area in the catchment and command area is proposed. • Three dug wells are also integrated to further enhance the irrigation potential in the CRW area and promote rabi crops.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are

	sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

e. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-2	Deepening of WHS	6467	cum	11,88,652	MGNREGA		21
2	CRW-2	Construction of outlet	1	No.	5,13,229	MGNREGA		
3	CRW-2	Land development	8.5	Ha	7,95,000	MGNREGA		
5	CRW-2	Construction of dug well	3	Nos.	2,01,000	MGNREGA		
		Total CR model Cost (Rs).			**26,97,881**			**21**

f. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (21 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
									cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	21 Small and marginal farmers	1000	21000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (21 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (21farmers covering 5 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2500	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**40200**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Construction of Check Dam at Bandaduma village, Jamda Block of Mayurbhanj district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Construction of Check Dam, dug wells and compost pits	Bandaduma village GP: Pasana Block: Jamda Dist : Mayurbhanj 22°19'37.39"N 86°03'38.70"E	A, B	WHS, irrigation and soil health	NA	Construction of CD(L-8.4m), construction of dug wells-3nos and compost pits-10 nos.	NA

2. Rationale for selection of Works

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The block Jamda is situated in the West end of the Simlipal tiger reserve. Hence GPs can be divided in two categories. GPs those are adjacent to tiger reserve and in the foothills of Simlipal and GPs those are though undulated topography but in lower altitude and have good cultivated land. As per our selection criteria of GPs and discussion with blocks officials including BDO, it was found and observed during our field visit GPs situated in the foot hills are more venerable. Hence after many site visits, those GPs are selected for demonstrating CRWs where there is scope of construction of check dams, renovation WHS, canal construction, land development, earthen embankment to store stream water, construction of proper outlets etc are possible to create irrigation facilities, bring more land under cultivation and reduce the moisture stresses in kharif. Though there are many drainage lines pass through this foot hills land, but there are less irrigation facilities. However, it is observed that WHS are available and required little investment such as deepening, outlet construction, and embankment strengthening to make those functioning.

The mean rainfall of Jamda block between the month of June to September over a period of 30 years (1984-2014) is 1242 mm and its coefficient variation is 25.05. According to the 30 years historical data, the highest rainfall (mm) received in a day is 332 mm and the number of years with normal sowing rain pattern is 10 years whereas 20 years it received abrupt and erratic pattern of rainfall. Jamda block has suffered high drought condition in last 30 years out of which 8 years was moderate drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 17.5 % and the projected coefficient of variation of the rainfall will be 21.8 for 2021-2050 years.

According to the vulnerability assessment, (The parameters used were; net irrigated area, groundwater, irrigation intensity, cropping intensity, forest area, crop yield, soil erosion, house hold with income <5000, women headed, disables, and primitive tribal households) the district level aggregated vulnerability of Mayurbhanj is low. At the block level, Jamda was seen to have low adaptive capacity and climate sensitivity was low. The overall aggregated vulnerability of Jamda is very low.

3. Description of CRW

Components / CRW		Objectives
Core Structure	Construction of check dam	• To harvest water and the harvested water will be utilized for irrigation • To increase productivity • To accelerate ground water recharge • To increase vegetative covers
Supplementary activities	Construction of dug wells	• To increase the irrigated area • To increase the rabi crop area. • To explore the ground water that harvested due to construction of check dam.
	Construction of compost pits	• Use waste materials to convert into organic manure and create clean environment in the village. • To increase soil organic matter and nutrient and thus productivity.

4. Site Details

The proposed check dam site is in a seasonal stream that passes though plain topography with medium and low land paddy plots. The stream basically originated from a low height hill situated in the west south of the bock bordering to CG state. Though the stream is seasonal and but in low land places, due to soft soil and more depth, water found even in summer. But there is no flow in the summer in the stream. Hence construction of check dam can further increase the volume of water in such places and also duration of water storage. This lead to recharge of dug wells in the periphery and

also other WHS and thus water of these infrastructures could use in kharif during dry spells as well as also to promote some rabi crops and vegetable. The check dam is adjacent to the village habitat area easily accessible by the villagers. The image of area is shown above and details features of the site are given below.

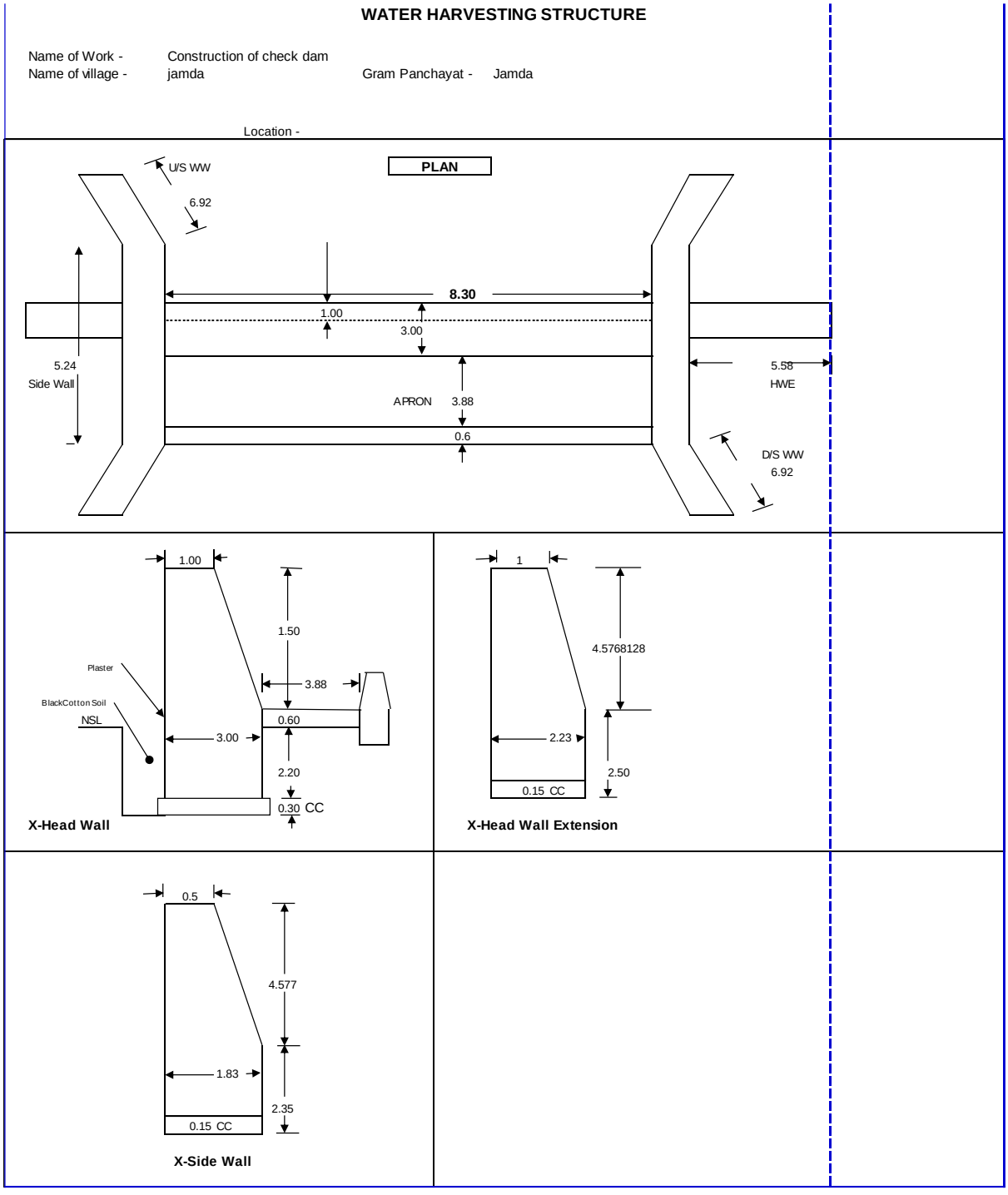
1. Climate Resilient Work : Construction of Check dam
2. Bed Rock : Seems not appear inside of Nalla
3. Depth of the Nalla (Present) : 2.0 m
4. Catchment area of the Check Dam : 73 ha
5. Command area of the pond : 14.9 ha in kharif, water demand for 2 irrigation=44700cum
6. Using By Rational Formulae : Q=CRA
7. Where C= Runoff Coefficient catchment area (cultivated, slope <5%, clay/silty loam =0.5
   R= Max one day Rainfall with CV (historical/projected) whichever is higher =(332+332*.25)/1000 = 0.415m /day (as per CCVA study done by IISc, Bangalore)
   A= total catchments area= 73 ha
   Peak Run off (Qp) =(730000x0.50)x.415= **151475** cum/day or say **1.75** cum/sec,
8. The total surface runoff for the monsoon period, Q= 730000x0.5x1.242=**453330** cum (Where, 1.242m is the average mean rainfall of monsoon period for Jamda block.). That would be sufficient runoff to fill the storage capacity of designed check dam.

5. Engineering Drawing of the work

5.1 Design and Estimate of Check Dam (CD)

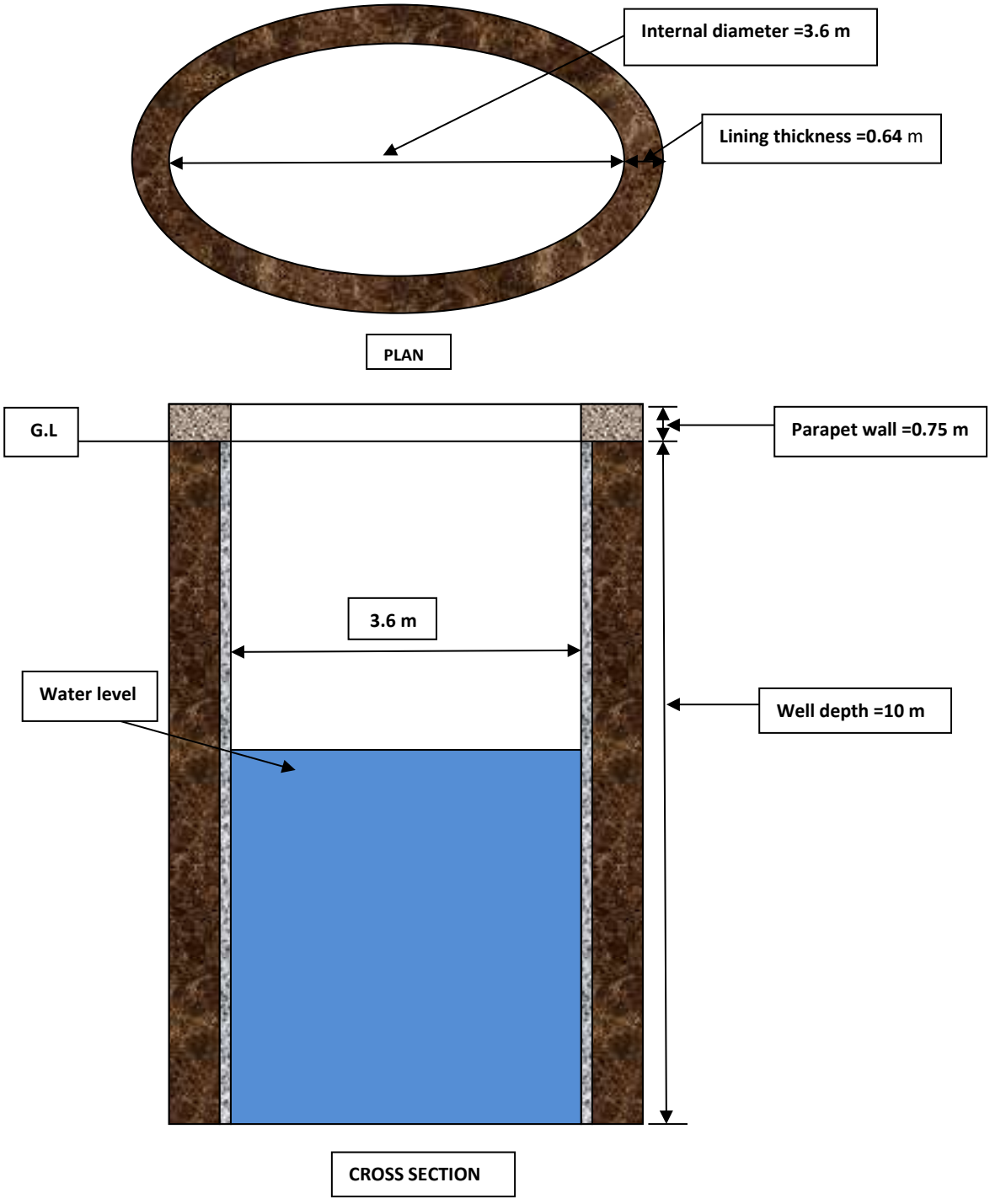
In the design of the check dam it is important that whether the check dam can have capacity to discharge the peak flow of the nala in highest rainfall (storm) condition. From the above calculation of the peak surface runoff of the catchment of nala at the point of check dam, it is found that the Qp is 1.75 cum/sec.

Nala depth is 2.0 m and nala width is 9m. Similar as an outlet design, in Check dam also we need to find out the discharge of the flow through the crest of the CD that is Q=AV, where A area of flow (length of crest x flow height) and V= velocity in m/sec. Considering the velocity of 1.2m/sec and a flow height of 0.3 we need a crest length of 4.86 to discharge the peak runoff of 1.75 cum/sec in the full tank level scenario. As the nala width is 9m, even after leaving 1 m in each side for side walls ,we have 7 m available as crest length. Hence the CD will have capacity of discharging the peak flow even in the full tank level condition, i.e. if the CD is already full and suddenly a height rainfall event occur <=415 mm per day then also the design CD will have capacity to pass the flow to the downstream through its crest. As sufficient foundation depth, sized of side wall and apron are taken in such a way that the weight of the dam is higher than the horizontal force + upward force (due to buoyancy), hence there is no chances of overturning and sliding of the CD. If there is more than 0.3 m flow height then there is free board of 0.48 m and that is sufficient to work as a cushion if there is sudden maximum rainfall occur higher than the considered maximum rainfall. Hence there would be no side topping and side damage of the CD.



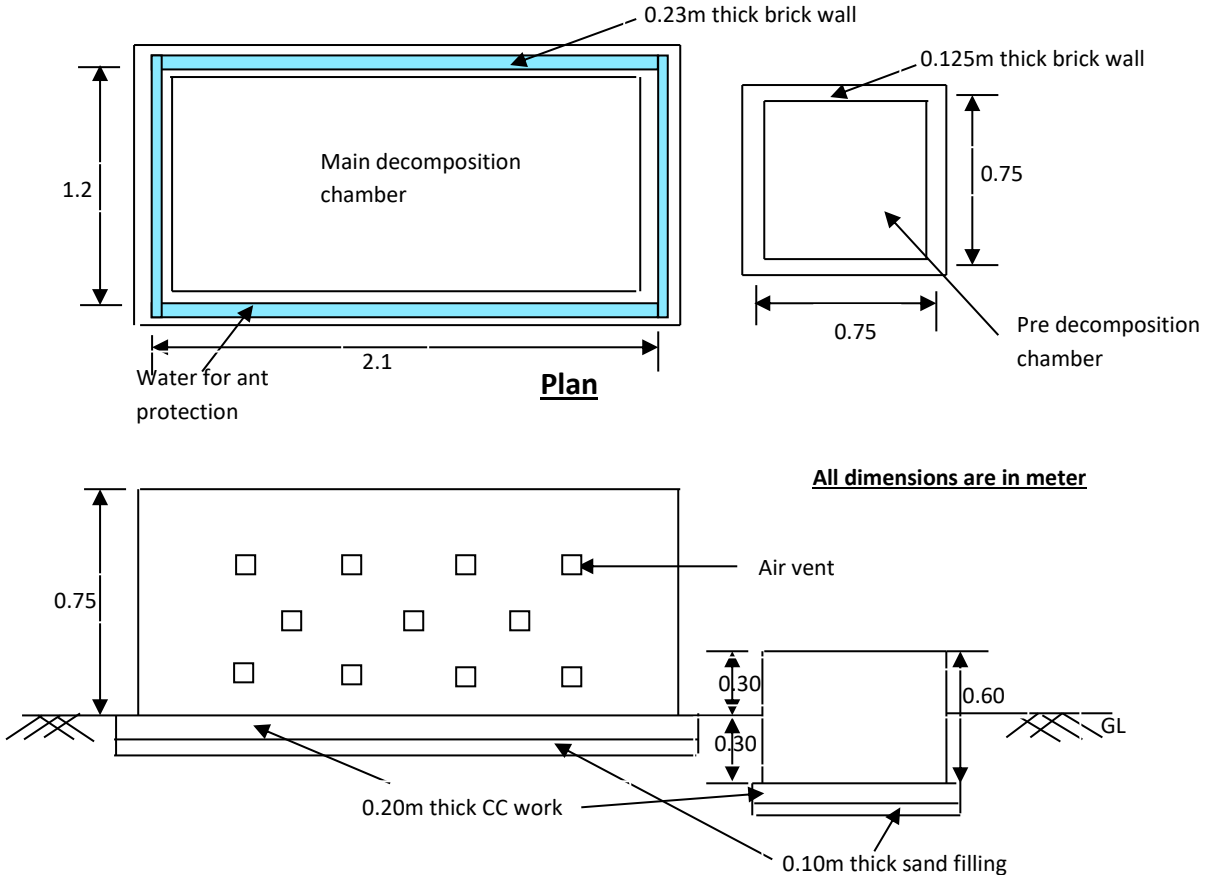
5.2: Design and drawing dug wells: 3 nos.

Three dug wells would be constructed in the periphery of the check dam in the command area to further ensure availability of water and to promote vegetable. These dug well would explore the ground water that would be harvested due to recharge from check dam storage area. The design dimensions and drawing of the dug well is given below.



5.3: Design and drawing of compost pit:

Looking the livestock availability and scope of construction of compost pits along with the demand of the beneficiaries, 10 such compost pits are proposed for some beneficiaries. The model design and estimate has been provided below.



6. How is the Work Climate Resilient?

Durability	• The 12 m long check dam is design on the basis of total predicted monsoon period surface runoff (Q)= **793800**cum and predicted maximum one day peak surface runoff (Qp)= **201622.5** cum/day • Using above data it was calculated and checked the availability of water to meet the irrigation demand (two life saving irrigation of paddy in kharif period) 44700 cum against the peak and total flow to the check dam from the catchment area and also the total check dam storage area 2.5 ha-m. • To keep the design free board of the CD as cushion to discharge safely the excess runoff in case of more than design peak rainfall, side wall of the check dam would be elevated up to 0.4m, so the required height of CD crest can be get to meet the demand of irrigation water and to increase storage area. • Three dug wells are also proposed to further ensure the water availability to irrigate crop for life saving irrigation during dry spells. And promote rabi crops. • Compost pits are proposed to promote organic farming in the command area and also to increase soil organic matter and reduce use for chemical fertilizer.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as paddy, maize and pulses are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as ITDA, Agriculture etc.

	• From dug wells, during rabi season, organic vegetables such as tomato, egg plants, okra, long beans, and potato would be promoted with the inputs convergence from ITDA.
Inclusion	• The CD site has been selected to provide benefits to mostly ST HHs. The total direct beneficiary HHs of the CRW is 24 and out of these there 22 HHs from ST community 2 HHs from OBC community.
Integration	• 3 dug wells are integrated with the CD to further ensure water during dry spells for life saving irrigation and to promote rabi crops in the CD command area. • 10 compost pits are also proposed to increase soil health and to promote organic cultivation and organic vegetable production.
Flexibility	• The CDs are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

g. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-2	Check dam.	1	Nos	8,00,000	MGNREGA		24
2	CRW-2	Construction dug wells	3	nos	6,13,512	MGNREGA		
3	CRW-2	Construction compost pits	10	Nos.	1,40,000	MGNREGA		
		Total CR model Cost (Rs).			**15,53,512**			**24**

h. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Agriculture .	Training to farmers on improved PoPs of	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
		Vegetable Cultivation (24 HHs)							
B		Promotion of Vegetable Cultivation.	July and Oct,2019	2 Ha.	2000/Ha for 2 Ha.	8000	Facilitation by ICRG	ITDA	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Dept	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	24 Small and marginal farmers	1000	24000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production.	July,19 to Aug,19	2 trainings (18 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
Sub-Total:						**42700**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with ITDA will help mobilization of Vegetable Seeds from ITDA. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Promotion of Vegetable Cultivation 2 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Construction of Check Dam at Heselpata village, Jamda Block of Mayurbhanj district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Construction of Check Dam, Farm ponds and Compost pits	Heselpata village GP: Pasana Block: Jamda Dist : Mayurbhanj 22°16'.53.54"N 86°02'.36.20"E	A, B	WHS, and soil health	NA	Construction of CD(L-7.3m), Construction of farm ponds(3 nos) and compost pits-10 nos.	NA

2. Rationale for selection of Works

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The block Jamda is situated in the West end of the Simlipal tiger reserve. Hence GPs can be divided in two categories. GPs those are adjacent to tiger reserve and in the foothills of Simlipal and GPs those are though undulated topography but in lower altitude and have good cultivated land. As per our selection criteria of GPs and discussion with blocks officials including BDO, it was found and observed during our field visit GPs situated in the foot hills are more venerable. Hence after many site visits, those GPs are selected for demonstrating CRWs where there is scope of construction of check dams, renovation WHS, canal construction, land development, earthen embankment to store stream water, construction of proper outlets etc are possible to create irrigation facilities, bring more land under cultivation and reduce the moisture stresses in kharif. Though there are many drainage lines pass through this foot hills land, but there are less irrigation facilities. However, it is observed that WHS are available and required little investment such as deepening, outlet construction, and embankment strengthening to make those functioning.

The mean rainfall of Jamada block between the month of June to September over a period of 30 years (1984-2014) is 1242 mm and its coefficient variation is 25.05. According to the 30 years historical data, the highest rainfall (mm) received in a day is 332 mm and the number of years with normal sowing rain pattern is 10 years whereas 20 years it received abrupt and erratic pattern of rainfall. Jamada block has suffered high drought condition in last 30 years out of which 8 years was moderate drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 17.5 % and the projected coefficient of variation of the rainfall will be 21.8 for 2021-2050 years.

According to the vulnerability assessment, (The parameters used were; net irrigated area, groundwater, irrigation intensity, cropping intensity, forest area, crop yield, soil erosion, house hold with income <5000, women headed, disables, and primitive tribal households) the district level aggregated vulnerability of Mayurbhanj is low. At the block level, Jamada was seen to have low adaptive capacity and climate sensitivity was low. The overall aggregated vulnerability of Jamada is very low.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Construction of check dam	• To harvest water and the harvested water will be utilized for irrigation • To increase productivity • To accelerate ground water recharge • To increase vegetative covers
Supplementary activities	Construction of farm ponds	• To harvest runoff water of a farm plot • To use harvested runoff water for irrigation during drought period or dry spells • To enhance ground water recharge.
	Construction of compost pits	• Use waste materials to convert into organic manure and create clean environment in the village. • To increase soil organic matter and nutrient and thus productivity.

4. Site Details

The proposed check dam site is in the plan paddy grown area. The stream passes through this plain area and originated from a hill in the south west side of the block bordering to CG. It is a large hill with almost 200m high and share runoff water to both Odisha and CG. The streams those flow towards east side north side are fall in to Mayurbhanj district of Odisha. Though the natures of these streams are seasonal, however in low land due to high depth of these streams, some places water found even in summer also. As most of the runoff water flow to the bay of Bengal through

these stream to large rivers, construction of check dams are very useful to harvest water in the upper part of these stream to increase ground water recharge and also to increase vegetation. These CDs are also useful to supply water to the main crop paddy during dry spells. As paddy is the main food crop in the area, these water harvesting structures are in high demand from the community side. The check dam site is near to the village habitat area and there is large cultivable land as command area too. The image of area is shown above and details features of the site are given below.

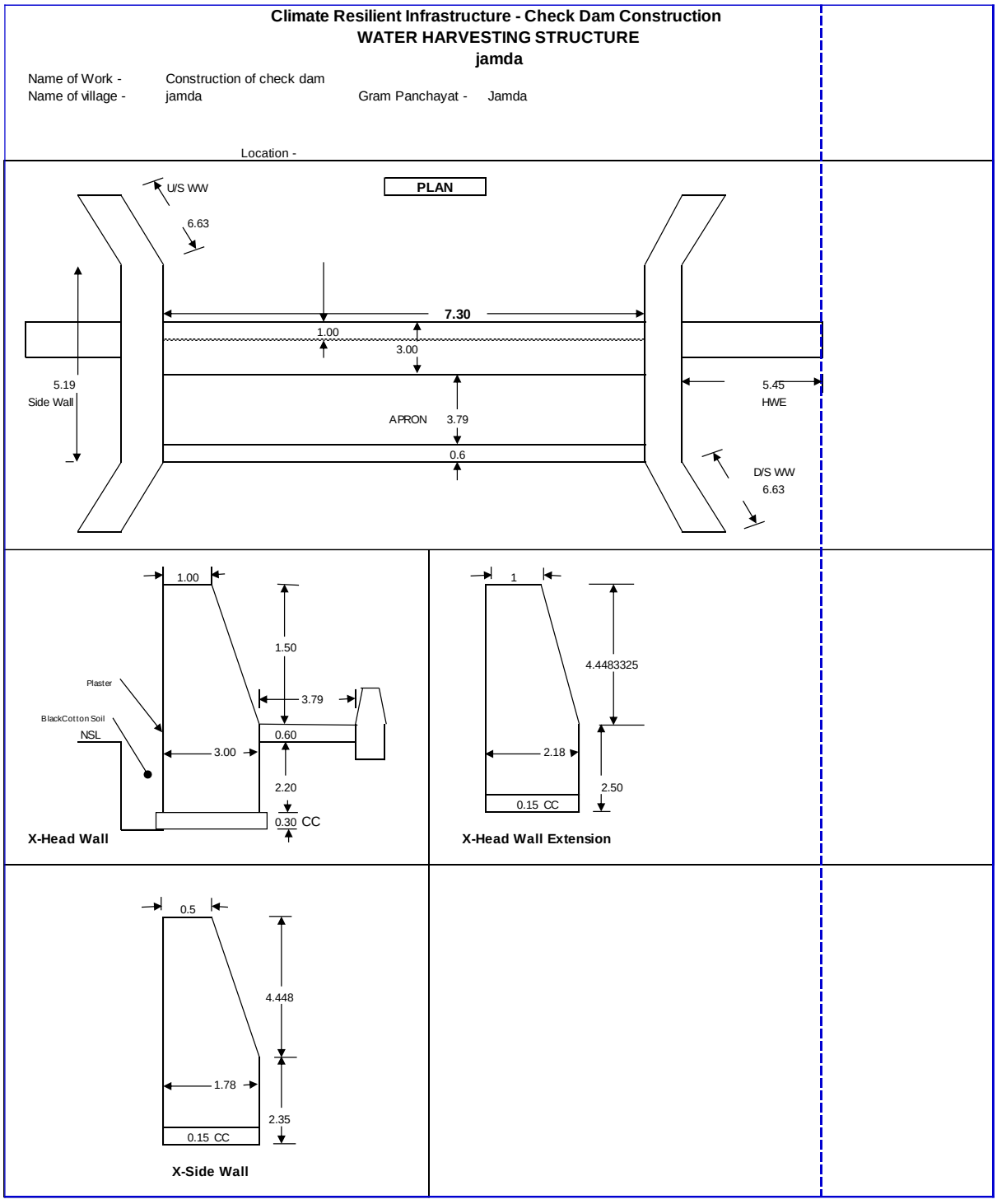
9. Climate Resilient Work : Construction of Check dam
10. Bed Rock : Seems not appear inside of Nalla
11. Depth of the Nalla (Present) : 2.0 m
12. Catchment area of the Check Dam : 63.7 ha
13. Command area of the CD : 14.9 ha in kharif, water demand for 2 irrigation=44700cum
14. Using By Rational Formulae : Q=CRA
15. Where C= Runoff Coefficient forest slope of cultivated land slope <5% for clay/silty loam =0.5
    R= Max one day Rainfall with CV (historical/projected) whichever is higher =(332+332*.25)/1000 = 0.415 m /day (as per CCVA study done by IISc, Bangalore)
    A= total catchments area= 63.7 ha
    Peak Run off (Qp) =(637000x0.50)x.415= **132177.5** cum/day or say **1.52** cum/sec,
16. The total surface runoff for the monsoon period, Q= 335000x0.5x1.242=**395577**cum (Where, 1.242m is the average mean rainfall of monsoon period for Jamda block.). That would be sufficient runoff to fill the storage capacity of designed check dam.

5. Engineering Drawing of the work

5.1 Design and Estimate of Check Dam (CD)

In the design of the check dam it is important that whether the check dam can have capacity to discharge the peak flow of the nala in highest rainfall (storm) condition. From the above calculation of the peak surface runoff of the catchment of nala at the point of check dam, it is found that the Qp is 1.52 cum/sec.

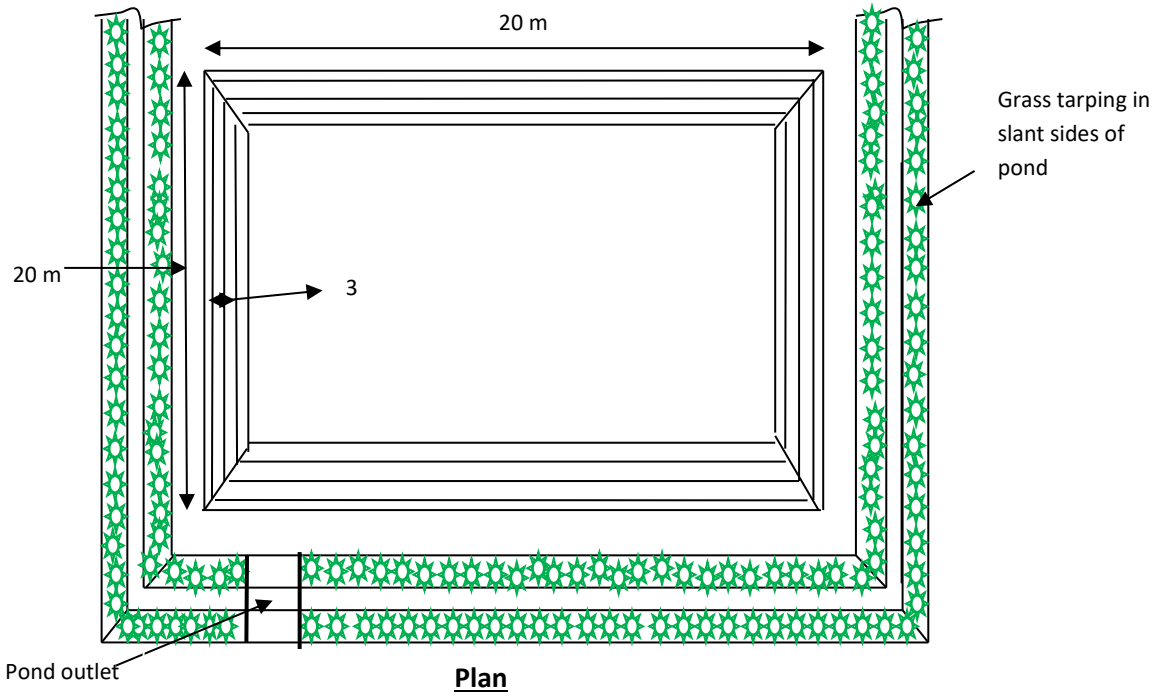
Nala depth is 2.0 m and nala width is 8m. Similar as an outlet design, in Check dam also we need to find out the discharge of the flow through the crest of the CD that is Q=AV, where A area of flow (length of crest x flow height) and V= velocity in m/sec. Considering the velocity of 1.2m/sec and a flow height of 0.3 we need a crest length of 4.22 m to discharge the peak runoff of 2.16 cum/sec in the full tank level scenario. As the nala width is 8m, even after leaving 1 m in each side for side walls, we have 6 m available as crest length. Hence the CD will have capacity of discharging the peak flow even in the full tank level condition, i.e. if the CD is already full and suddenly a height rainfall event occur <=415 mm per day then also the design CD will have capacity to pass the flow to the downstream through its crest. As sufficient foundation depth, sized of side wall and apron are taken in such a way that the weight of the dam is higher than the horizontal force + upward force (due to buoyancy), hence there is no chances of overturning and sliding of the CD. If there is more than 0.3 m flow height then there is free board of 0.48 m and that is sufficient to work as a cushion if there is sudden maximum rainfall occur higher than the considered maximum rainfall. Hence there would be no side topping and side damage of the CD.



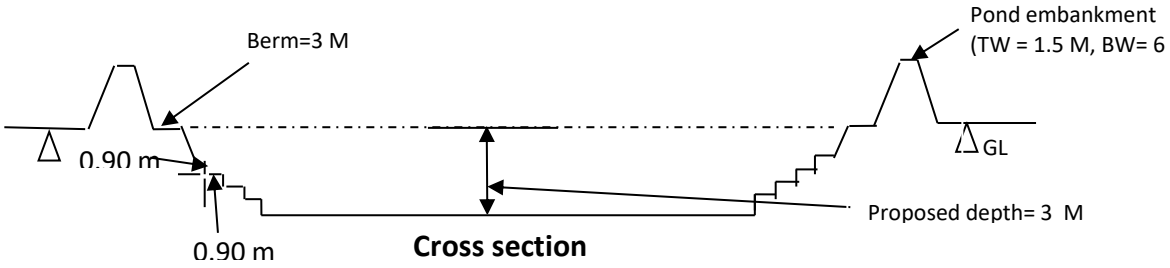
5.2: Design and drawing of canal Farm Ponds: 3 nos.

Three farm ponds would be constructed in individual framers plots near the check dams so that when check dam would harvest water, sub surface flow along with surface water flow of the farm pond plots can be harvested and use the water for irrigation when required. The design dimensions are same for all three ponds and provided below in the table along with the engineering drawing.

Shape of Pond : square	Side Slope of EM : 1:2
Length Of Pond = 20m	Width of Pond : 20 m
Berm during layer Cutting : 2m	Base width of Embankment : 10 m
Top Width : 1.53 m	Vegetative coverage : Napier, lemon and stylo grass:5.8m
Proposed depth : 3 m	Stone Patching: 2 m
Height of embankment : 2.2 m	Length of Sides slope: 2.2m
Soil Type : loamy	Present Cropping : Paddy and Maize – Mono-cropped



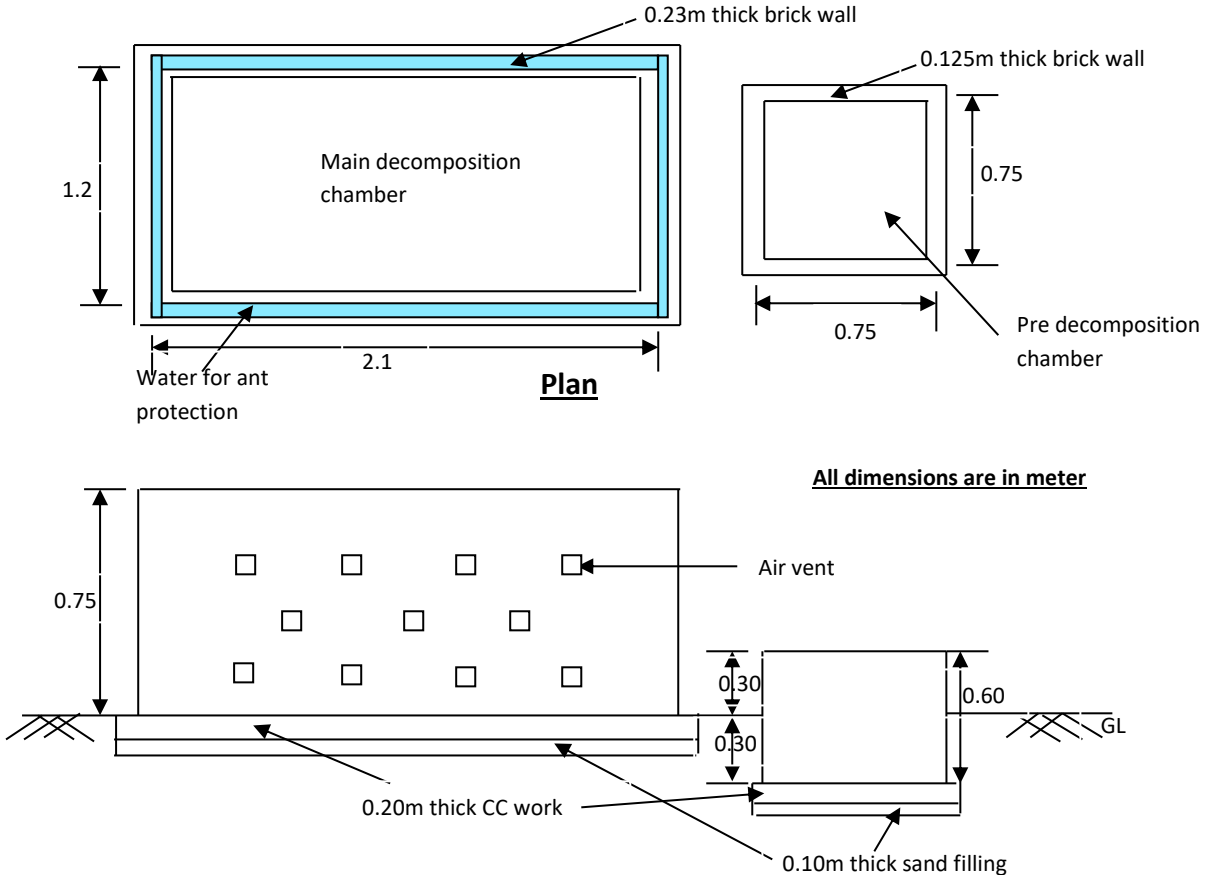
Plan



Cross section

5.3: Design and drawing of compost pits: 10 nos.

Looking the livestock availability and scope of construction of compost pits along with the demand of the beneficiaries, 10 such compost pits are proposed for some beneficiaries. The model design and estimate has been provided below.



6. How is the Work Climate Resilient?

Durability	• The 7.3 m (crest length) long check dam is design on the basis of total predicted monsoon period surface runoff (Q)= **793800**cum and predicted maximum one day peak surface runoff (Qp)= **201622.5** cum/day • Using above data it was calculated and checked the availability of water to meet the irrigation demand (two life saving irrigation of paddy in kharif period) 44700 cum against the peak and total flow to the check dam from the catchment area and also the total check dam storage area 2.5 ha-m. • To keep the design free board of the CD as cushion to discharge safely the excess runoff in case of more than design peak rainfall, side wall of the check dam would be elevated up to 0.4m, so th required height of CD crest can be get to meet the demand of irrigation water and to increase storage area. • Three farm ponds are also proposed to further ensure the water availability to irrigate crop for life saving irrigation during dry spells.. • Compost pits are proposed to promote organic farming in the command area and also to increase soil organic matter and reduce use for chemical fertilizer.

Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as paddy, maize and pulses are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as ITDA, Agriculture etc. • If water available during rabi season, organic vegetables such as tomato, egg plants, okhra, long beans, and potato would be promoted with the inputs convergence from ITDA.
Inclusion	• The CD site has been selected to covered mostly ST HHs. The total direct beneficiary HHs of the CRW is 18 and all are from ST community. There are 3 women headed HHs are also the direct beneficiaries of the CRW.
Integration	• 3 farm ponds are integrated with the CD to further ensure water during dry spells for life saving irrigation. • 10 compost pits are also proposed to increase soil health and to promote organic cultivation and organic vegetable production. • In future after the check dam construction, if there is water whole the year then as per Odisha Agro Industries Corporation (OAIC) norms lift irrigation system would be integrated with the CD. However at present farmers with use portable pump sets available in the village to lift water from irrigation from CD.
Flexibility	• The CDs are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

i. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Check dam.	1	No.	7,00,000	MGNREGA		18
2	CRW-1	Construction farm ponds	3	Nos.	4,66,512	MGNREGA		
3	CRW-1	Construction compost pits	10	Nos.	1,40,000	MGNREGA		

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
		Total CR model Cost (Rs).			**13,06,512**			**18**

j. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Agriculture .	Training to farmers on improved PoPs of Vegetable Cultivation (18 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of Vegetable Cultivation.	July and Oct,2019	2 Ha.	2000/Ha for 2 Ha.	8000	Facilitation by ICRG	ITDA	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	18 Small and marginal farmers	1000	18000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (18 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
Sub-Total:						**36700**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence

with ITDA will help mobilization of Vegetable Seeds from ITDA. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Promotion of Vegetable Cultivation 2 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Sapulgacha village, Lanjigarh Block of Kalahandi district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, and Land Development	Sapulgacha village GP: Champadeipur Block: Lanjigarh Dist : Kalahandi 20°0'59.13"N 83°26'16.85"E	A, B	WHS, and Soil and water conservation	NA	Renovation of WHS (2302 cum), construction of one outlet. Land development in 10.25 ha area	NA

2. Rationale for selection of Works

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

Lanjigarh block is one of the hilliest blocks in Kalahandi district. The block is bordering (south side) to Rayagada and kandhamala district an dbothe districts are hilly district. The topography of the block is fully undulating and elevation ranges from 360 m (in plan cultivated area) to almost 1220m from msl in the hilltop. The block has approximately one third plain area and rest is hilly area. No such major river flows through the block area, however as block is surrounded by large and small hills in east, west and south sides, there are streams/nalas found in the block and mostly those flows from south to north direction and finally these stream discharge runoff water to the Udanti River. Due to undulating topography the block had huge scope of constructing WHS in foothills to harvest hill surface runoff. There are many small to medium WHS are found in almost every corner of these foothills, however many of them are not functioning and thus left with options of renovating those either by desilting, repairing a dilapidated outlet or repairing embankment and canal. Thus the small investment to these structures could bring large impact to harvest huge surface runoff, reduces risk

of flood and drought and also would enhance ground water recharge. Other opportunities are land development through earthen bund and land levelling along with LBCDs in small eroded streams etc. The block is mostly grows rainfed crops as net irrigated area in the block is very low i.e. 3.2% (source: SECC, 2011). Thus most of the low lands in the block are covered with single kharif crop and that is paddy and uplands are mostly covered with paddy, cotton, maize and other leguminous crops.

The mean rainfall of Lanjighar block between the month of June to September over a period of 30 years (1984-2014) is 1189 mm and its coefficient variation is 28.4%. According to the 30 years historical data, the highest rainfall (mm) received in a day is 210 mm and the number of years with normal sowing rain pattern is 7-year whereas 23 year it received abrupt and erratic pattern of rainfall. Lanjighar block has suffered high drought condition in last 30 years out of which 6 years was severe drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be increasing up to 46.7% and the projected coefficient of variation of the rainfall will be 25.3 for 2021-2050 years.

According to the vulnerability assessment, (The parameters used were; net irrigated area, groundwater, irrigation intensity, cropping intensity, forest area, crop yield, soil erosion, house hold with income <5000, women headed, disables, and primitive tribal households) the district level aggregated vulnerability of Kalahandi is medium. At the block level, Lanjighar was seen to have low adaptive capacity and climate sensitivity was moderate. The overall aggregated vulnerability of Lanjighar is very high.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought • Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.

4. Site Details

The selected CRW site is located in the extreme north of the block. The topography of this part of the block is highly undulating due to existence of large numbers of medium and small size hillocks. The proposed WHS is an embankment type pond located just below the foot hills and thus there is huge catchment of WHS. Except few plots in the upstream of the WHS, most of the catchment area is hilly and thus covered with forest trees. The average slope of the catchment area is 18%. In the downstream of the WHS there is a huge patch of medium and low land surrounded by hill in two sides east and west. This patch of medium and low land would work as command area of the WHS and the water of WHS can be easily used through gravitational force to irrigate the paddy plots. The village habitat area is also located in the command area and just 250m away from the WHS and there is a kuchha road to reach the WHS. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Embankment type
3. Shape of the pond : Irregular
4. Slope of the catchment : 18%
5. Type of Soil : Soft morrum
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.5 m
8. Proposed Extra depth of Pond : 1. 0 m Total depth=2.5
9. Total area of the pond : 3.75 ha (Av L=275m, Av W=136.5m)
10. Proposed area to be excavated {LXB) : 2400 sqm (Av. L=60m Av. W=40m)
11. Catchments area of the pond : 183.37 ha,
12. Command area of the pond : 21.46 ha in kharif 5 ha in rabi.
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C= Runoff Coefficient for both types catchment =0.5

R= Max one day Rainfall with CV (historical/projected) whichever is higher =(210+210*.2843)/1000 = 0.2697 m /day (as per CCVA study done by IISc, Bangalore)

A= total catchments area= 183.37 ha

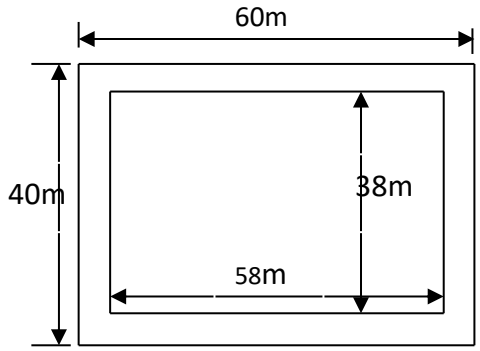
Peak Run off (Qp)=0 .50x0.26943x1833700 = 247026.9cum/day or say 2.859 cum/sec,

14. The total surface runoff water in monsoon period Q=0.50x1833700x1.18=1081883cum (where 1.18m is the mean monsoon rainfall of Lanjighar block as per CCVA study done by IISc Bangalore). The total surface runoff is 14 times greater than the pond capacity of 77302 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

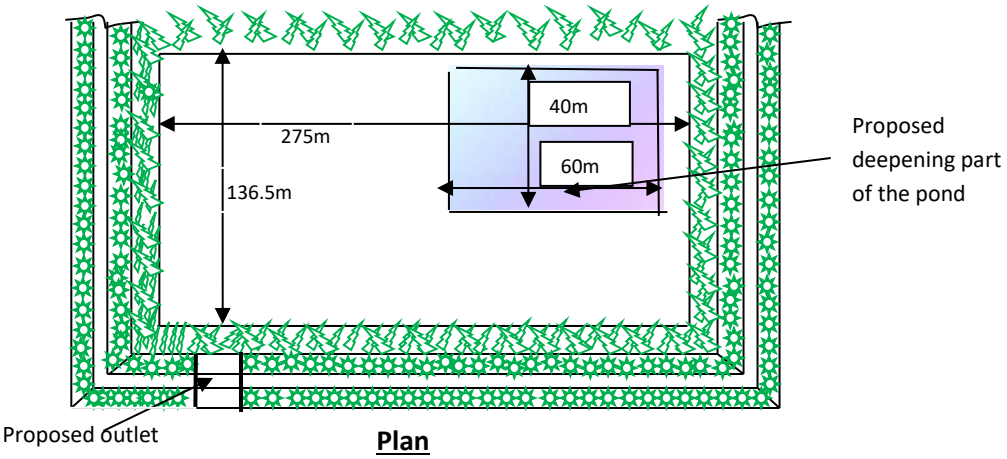
Shape of Pond : Square	
Av. Length of Pond = 60 m	Av. Width of Pond : 40 m
Proposed depth : 1.0m	Proposed berm in layer cutting=2.0m
Soil Type : silty loam and clay	Depth of layer=0.5 m



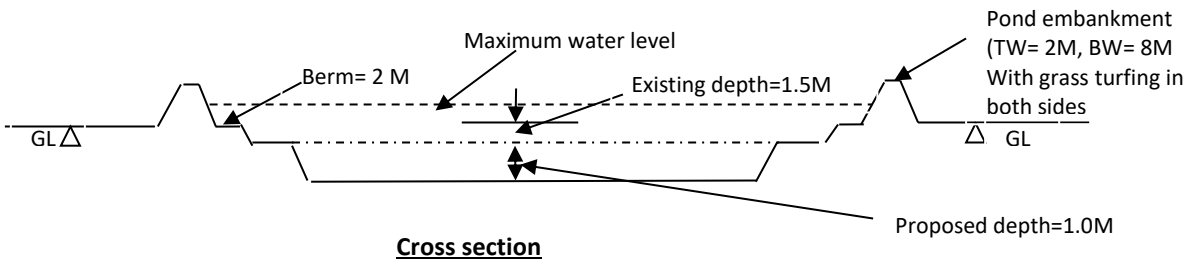
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



Plan

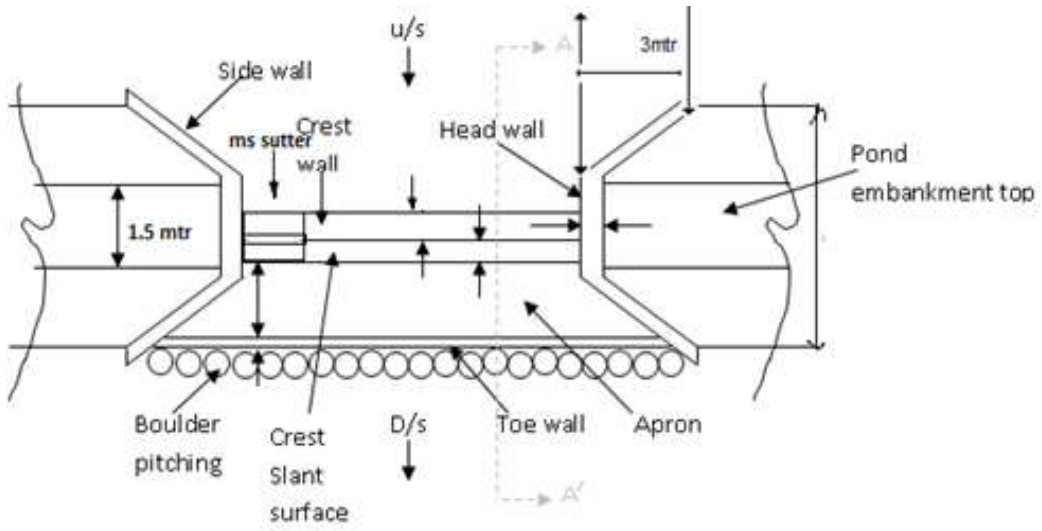


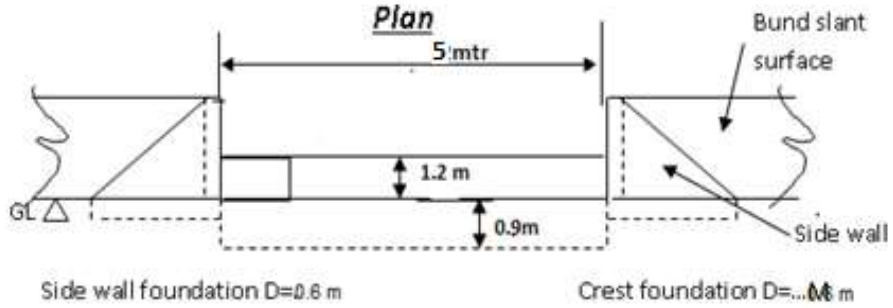
Cross section

5.2: Design and drawing of outlet with MS shutter:

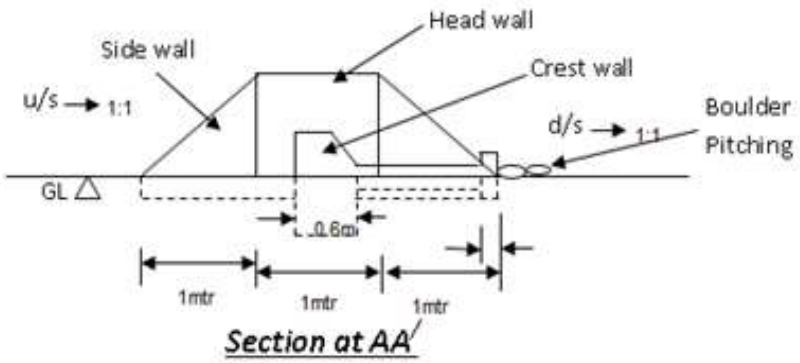
An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 2.859 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and

V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 5m and flow height of 0.6 m, we have Q=1.2x2x0.6=3.6 cum per sec , that is greater than the Qp of 2.859 cum/sec. Hence the outlet will be capable to discharge the peak runoff safe. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would required in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The design dimensions and estimate is given below.





Elevation from u/s



Section at AA'

5.3: Design and drawing of earthen bunds for land development: 10.25 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 7175RM	Volume of soil excavated : 5166 cum
Plot Size: 50m * 50m	Total no of Plots: 42 nos. (approximately)

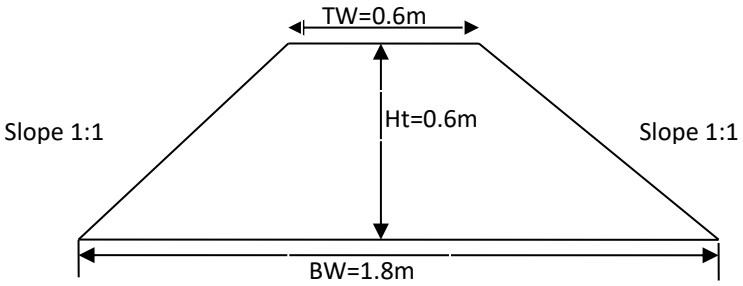


Figure 1: Cross section of the Bund

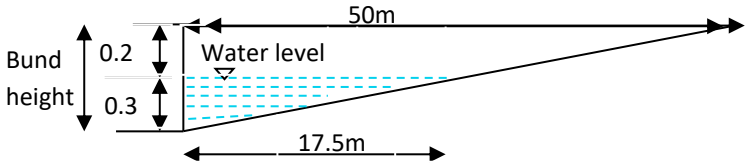


Figure: Section of Water to be stored in front of bunds.

6. How is the Work Climate Resilient?

Durability	• The WHS (2302 cum volume of excavation+737500 sq.m of pond area) is design on the basis of total predicted monsoon period surface runoff (Q)= 10,81,883 cum and predicted maximum one day peak surface runoff (Qp)= 2,47,026.9 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 14 times greater than the WHS capacity (77302cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 64,380cum against WHS capacity of 77,302 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 10.25 ha area designed to conserve 63% of total monsoon surface runoff and a total of 3.8 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc.

	• The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as ITDA, Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area arhar/mung on bund also would be taking as another source of livelihoods.
Inclusion	• The CRW site is selected by considering the patch where land ownership of ST and SC families are high. Thus the direct beneficiaries of the CRW is 10 ST and 9 SC HHs and total is 19 HHs.
Integration	• A proper sized outlet (5 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 10.25 ha area in the catchment and command area is proposed to conserve more water and to increase irrigation efficiency. • Arhar and other leguminous crops are also suggested to integrate on the top and sides of the earthen bunds to protect from splash erosion and also to enhance income of farmers.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

k. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-3	Deepening of WHS	2302	cum	3,28,647	MGNREGA		19
2	CRW-3	Construction of outlet	1	Nos.	5,18,128	MGNREGA		

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
3	CRW-3	Land development	10.25	Ha	7,86,138	MGNREGA		
		Total CR model Cost (Rs).			**16,32,913**			**19**

I. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (19 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	19 Small and marginal farmers	1000	19000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (19 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (19 farmers covering 5 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2500	Facilitation by ICRG	Agriculture	As per actual cost norm

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
Sub-Total:						**38200**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Pengsur village, Lanjigarh Block of Kalahandi district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, canal and Land Development	Pengsur village GP: Pengsur Block: Lanjigarh Dist : Kalahandi 19°42'54.29"N 83°17'9.46"E	A, B	WHS, and Soil and water conservation & Irrigation	NA	Renovation of WHS (5774 cum), construction of one outlet. Canal 250RN) and Land development in 10.00 ha area	NA

2. Rationale for selection of Works

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

Lanjigarh block is one of the hilliest blocks in Kalahandi district. The block is bordering (south side) to Rayagada and kandhamala districts. The topography of the block is fully undulating and elevation ranges from 360 m (in plan cultivated area) to almost 1220m from msl in the hilltop. The block has approximately one third plain area and rest is hilly area. No such major river flows through the block area, however as block is surrounded by large and small hills in east, west and south sides, there are streams/nalas found in the block and mostly those flows from south to north direction and finally these stream discharge runoff water to the Udanti River. Due to undulating topography the block had huge scope of constructing WHS in foothills to harvest hill surface runoff. There are many small to medium WHS are found in almost every corner of these foothills, however many of them are not functioning and thus left with options of renovating those either by desilting, repairing a dilapidated outlet or repairing embankment and canal. Thus the small investment to these structures could bring

large impact to harvest huge surface runoff, reduces risk of flood and drought and also would enhance ground water recharge. Other opportunities are land development through earthen bund and land levelling along with LBCDs in small eroded streams etc. The block is mostly grows rainfed crops as net irrigated area in the block is very low i.e. 3.2% (source: SECC, 2011). Thus most of the low lands in the block are covered with single kharif crop and that is paddy and uplands are mostly covered with paddy, cotton, maize and other leguminous crops.

The mean rainfall of Lanjighar block between the month of June to September over a period of 30 years (1984-2014) is 1189 mm and its coefficient variation is 28.4%. According to the 30 years historical data, the highest rainfall (mm) received in a day is 210 mm and the number of years with normal sowing rain pattern is 7-year whereas 23 year it received abrupt and erratic pattern of rainfall. Lanjighar block has suffered high drought condition in last 30 years out of which 6 years was severe drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be increasing up to 46.7% and the projected coefficient of variation of the rainfall will be 25.3 for 2021-2050 years.

According to the vulnerability assessment, (The parameters used were; net irrigated area, groundwater, irrigation intensity, cropping intensity, forest area, crop yield, soil erosion, house hold with income <5000, women headed, disables, and primitive tribal households) the district level aggregated vulnerability of Kalahandi is medium. At the block level, Lanjigarh was seen to have low adaptive capacity and climate sensitivity was moderate. The overall aggregated vulnerability of Lanjigarh is very high.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought • Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Canal construction	• To increase the conveyance efficiency thus increase of command area • To increase the production and income.
	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.

4. Site Details

The selected CRW site is located in a drainage line. However, it is not a confined drain or nala. The drainage line is now converted in to paddy field. The WHS is an embankment type pond and it is constructed in a point where a village approach road passed through. Thus the road worked as the pond embankment and harvest runoff water. The catchment of the WHS is both hilly and cultivable uplands. As the WHS is situated little away from a foothill thus it has huge catchment area, but the pondage area is less due to unavailability of common land. Thus an outlet has proposed along with a canal to divert the excess runoff water to the paddy fields in the command area situated downstream of the pond. Some plots in the catchment area also need land development works to further check siltation to the pond. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Embankment type
3. Shape of the pond : Irregular
4. Slope of the catchment : Hilly >10% and upland <5%
5. Type of Soil : Soft morrum
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.0 m
8. Proposed Extra depth of Pond : 2 m Total depth=3.0
9. Total area of the pond : 0.63 ha (Av L=90m, Av W=70m)
10. Proposed area to be excavated {LXB): 3000 sqm (Av. L=75m Av. W=40m)
11. Catchments area of the pond : 91 ha
12. Command area of the pond : 5.5 ha in kharif 2 ha in rabi.
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C= Runoff Coefficient for both types catchment =0.5

R= Max one day Rainfall with CV (historical/projected) whichever is higher =(210+210*.2843)/1000 = 0.2697 m /day (as per CCVA study done by IISc, Bangalore)

A= total catchments area= 91 ha

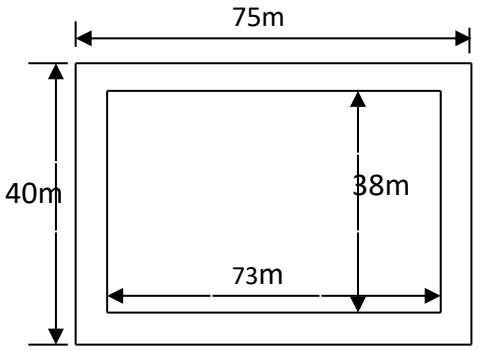
Peak Run off (Qp)=0 .50x0.26943x910000 = 122713.5cum/day or say 1.42 cum/sec,

14. The total surface runoff water in monsoon period Q=0.50x910000x1.18=536900cum (where 1.18m is the mean monsoon rainfall of Lanjighar block as per CCVA study done by IISc Bangalore). The total surface runoff is 29.22 times greater than the pond capacity of18374 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

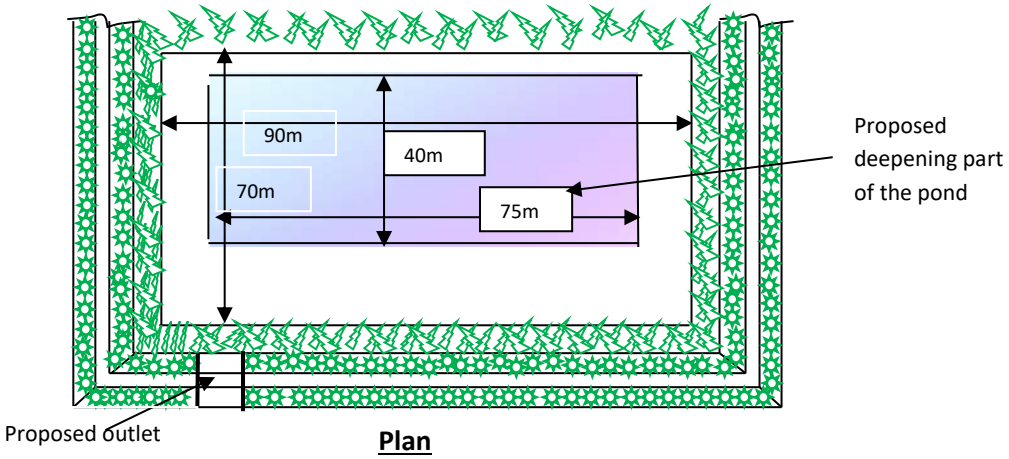
Shape of Pond : Square	
Av. Length of Pond = 75 m	Av. Width of Pond : 40 m
Proposed depth : 2.0m	Proposed berm in layer cutting=2.0m
Soil Type : silty loam and clay	Depth of layer=1.0 m



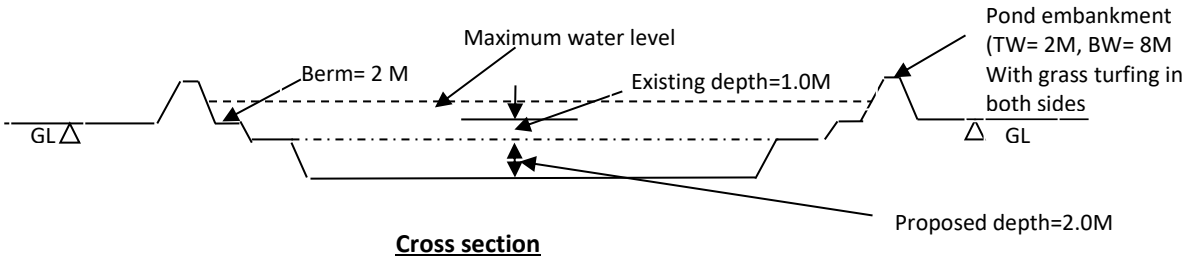
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



Plan

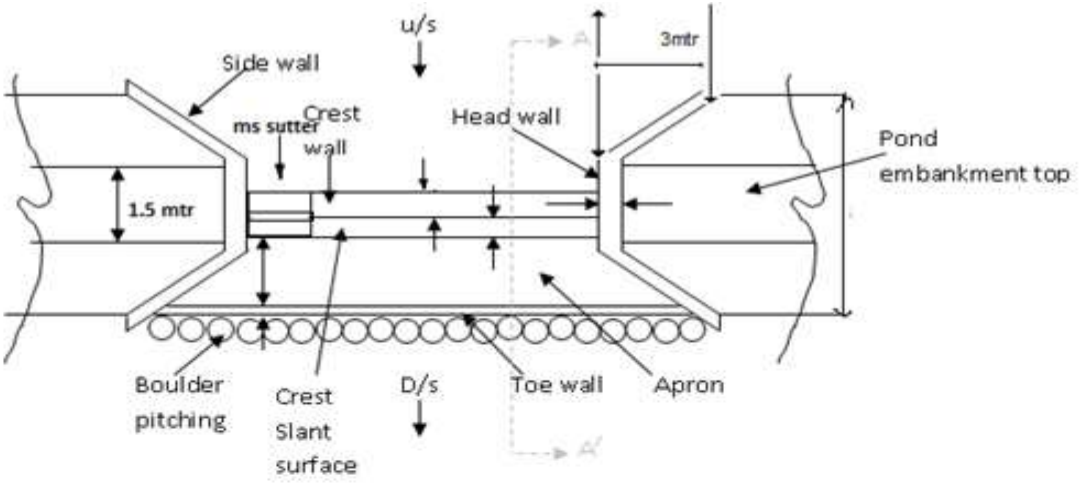


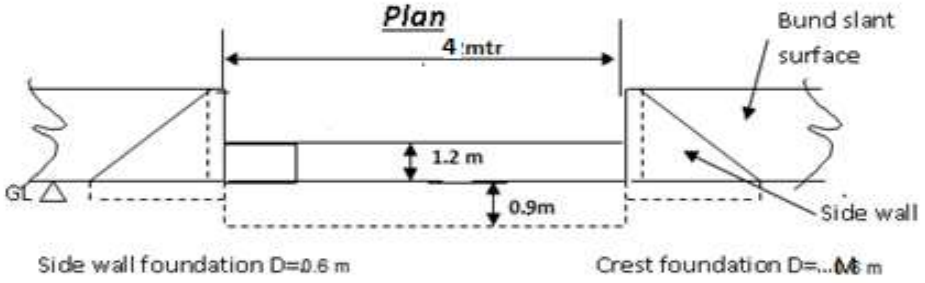
Cross section

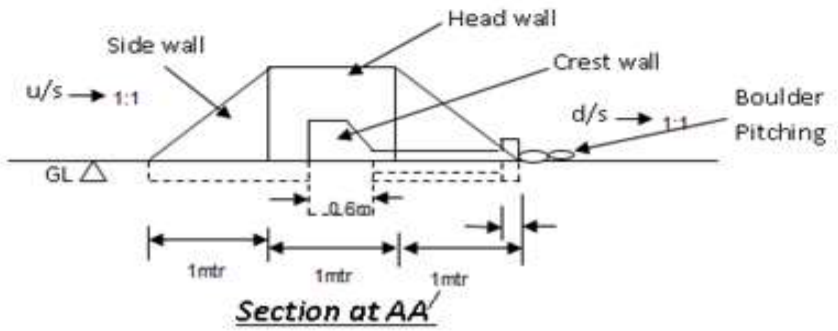
5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 1.42 cum per sec. We know the discharge from the outlet

would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 3m and flow height of 0.6 m, we have Q=1.2x2x0.6=2.16 cum per sec , that is greater than the Qp of 1.42 cum/sec. Hence the outlet will be capable to discharge the peak runoff safe. However as there is huge flow in the pond and large hilly catchment area, a 4m crest length waste weir is proposed. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would require in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The proposed canal would be connected with shutter to carry the water to the command area by opening of the shutter. Flow of the canal can be regulated by maintaining the shutter opening. The design dimensions and estimate is given below.

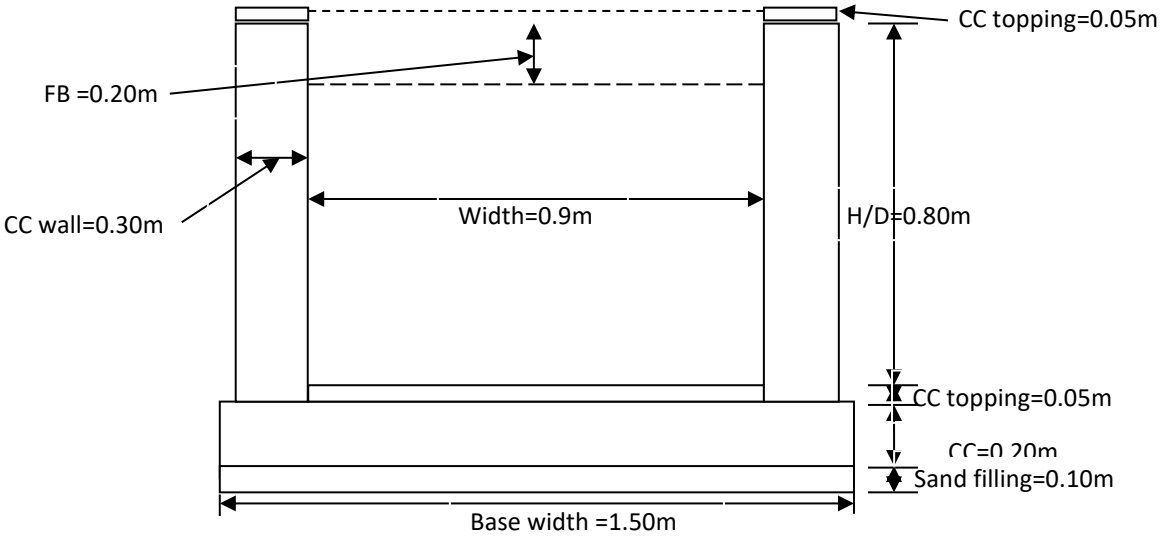






5.3: Design and drawing of Cement concrete canal: 250 RM.

A canal of 250 m long with following design dimensions would be constructed to carry pond water to the command area. The canal would be connected with MS shutter in the outlet so that when shutter will open the water from the pond would flow to the canal and then to the command area plots.



Cross section of CC canal

5.4: Design and drawing of earthen bunds for land development: 10.00 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 7000RM	Volume of soil excavated : 5040 cum
Plot Size: 50m * 50m	Total no of Plots: 40 nos. (approximately)

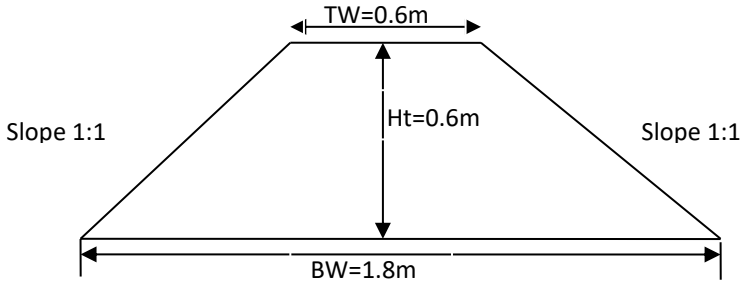


Figure 1: Cross section of the Bund

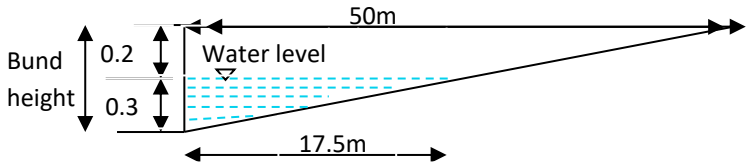


Figure: Section of Water to be stored in front of bunds.

6. How is the Work Climate Resilient?

Durability	• The WHS (5774 cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 536900 cum and predicted maximum one day peak surface runoff (Qp)= 122713.5 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 29.22 times greater than the WHS capacity (18374cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 16500 cum against WHS capacity of 18374cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 10.00 ha area designed to conserve 63% of total monsoon surface runoff and a total of 3.7 crore liter in a year. • A CC canal is proposed to further increase the conveyance efficiency and water use efficiency.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as ITDA, Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area arhar/mung on bund also would be taking as another source of livelihoods.
Inclusion	• The total direct beneficiary HHs for the CRW is 15. There are 7 ST HHs, 2 SC HHs and 6 OBC HHs ot of 15 direct beneficiary HHs. There is one woman headed HH also the direct beneficiary of the CRW.
Integration	• A proper sized outlet (4 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond. • A 250 RM CC canal is also integrated with the CRW core activity to better utilization and enhance the capacity of the core structure. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 10.00 ha area in the catchment and command area is proposed to conserve more water and to increase irrigation efficiency. • Arhar and other leguminous crops are also suggested to integrate on the top and sides of the earthen bunds to protect from splash erosion and also to enhance income of farmers.

Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

m. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-4	Deepening of WHS	5774	cum	7,90,169	MGNREGA		15
2	CRW-4	Construction of outlet	1	Nos.	4,18,128	MGNREGA		
3	CRW-4	CC canal	250	RM	8,62,000	MGNREGA		
4	CRW-4	Land development	10.00	Ha	7,67,320	MGNREGA		
		Total CR model Cost (Rs).			**28,37,617**			**15**

n. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (15 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	2 Ha.	50 KG/Ha for 2 Ha.@30/kg	3000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	15 Small and marginal farmers	1000	15000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (15 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (15 farmers covering 5 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2500	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**31200**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 2 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Adabahal village, Titlagarh Block of Balangir district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development & dug wells	Adabahal village GP: Adabahal Block: Titlagarh Dist : Balangir 20°15'01''N 83°01'54''E	A, B	WHS, and Soil and water conservation and & irrigation	NA	Renovation of WHS (7057 cum), construction of one outlet. Land development in 7.2 ha area, & dug well -3 nos.	NA

2. Rationale for selection of Works

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The topography of the Titlagarh block is undulated. Uplands are barren and existences of small barren hillock covered with rocks are high. Uplands have lateritic morrum soil hence runoff intensity is high and ground water recharge is less. Low land patches are covered with paddy crops and some extent of medium lands are also covered with paddy and other crop such as arhar, maize and cotton. There are many small and large water harvesting structures in medium and low land. A river called Sinder passes through the Titlagarh block and joins with Tel River. Most of the cultivable lands are in the valley of the river and its distributaries. Most of the suitable places there are existing WHS and many of them are functional and any either semi functional or non functional. Thus except renovation of WHS, the block has no opportunity go for any new WHS.

The mean rainfall of Titlaghar block between the months of June to September over a period of 30 years (1984-2014) is 1229 mm and its coefficient variation is 32.57. According to the 30 years historical data, the highest rainfall (mm) received in a day is 166 mm and the number of years with normal sowing rain pattern is 4-years whereas 26 years it received abrupt and erratic pattern of rainfall. Titlaghar block has suffered drought condition in last 30 years out of which 5 years was severe drought condition whereas 2-3 years was moderate drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 7.3 % and the projected coefficient of variation of the rainfall will be 33.2 for 2021-2050 years.

According to the vulnerability assessment, (The parameters used were; net irrigated area, groundwater, irrigation intensity, cropping intensity, forest area, crop yield, soil erosion, house hold with income <5000, women headed, disables, and primitive tribal households) the district level aggregated vulnerability of Balangir is high. At the block level, Titlaghar was seen to have low adaptive capacity and climate sensitivity was high. The overall aggregated vulnerability of Titlaghar is very high.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought & Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Dug wells	• To utilize the ground water recharge due to above activities • To enhance irrigation potential and increase income

4. Site Details

The selected WHS as core activity of CRW is an embankment type pond with large poundage area of almost 3.0 ha. This is an old WHS and thus silt deposition along with aquatic plants are covered almost half of the pondage area decreases the pond capacity. Therefore, de-siltation and cleaning of the pond is required bring the pond in to earlier state. The catchment area is basically upland cultivable

land, non cultivable land and land with forest tree plantation. Though most of the plots are developed and bunded, however there are few plots those are not developed and also not cultivate. Thus top soil erosion traces in those plots and land development activities are proposed. Few dug well are also proposed in the command area, in downstream of the pond to explore ground water and ensure supply of irrigation water during dry spells and rabi season. The WHS is located adjacent to the village habitat area. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Embankment type
3. Shape of the pond : irregular
4. Slope of the catchment : 2.3%, <5%.
5. Type of Soil : clay/silty loam
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.5 m
8. Proposed Extra depth of Pond : 1. 0 m Total depth=2.5
9. Existing area of the pond : 3.0 ha (225mx135m)
9. Proposed area to be excavated {LXB) : 7250 sqm (Av. L=145m Av. W=50m)
11. Catchments area of the pond : 32 ha,
12. Command area of the pond /well : 10.5 ha in Khraif and 2+1.8 (dug well)=3.8 ha in Rabi
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C= Runoff Coefficient of both the catchment =0.5

R= Max one day Rainfall with CV (historical/projected) whichever is higher =(166+166*.332)/1000 = 0.221 m /day (as per CCVA study done by IISc, Bangalore)

A= total catchments area= 32 ha

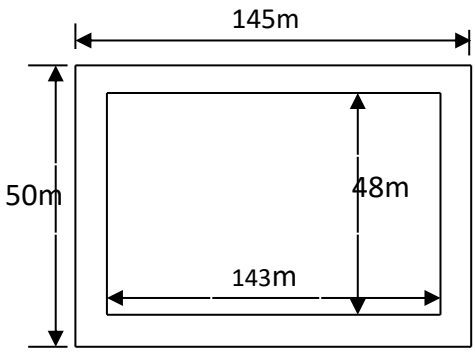
Peak Run off (Qp) =(320000x0.50)x.221= 35360 cum/day or say 0.41 cum/sec,

14. The total surface runoff for the monsoon period, Q= 320000x0.5x1.229=196640 cum (Where, 1.229m is the average mean rainfall of monsoon period for Titlagarh block.). The total surface runoff is 5.30 times greater than the pond capacity of 37057 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

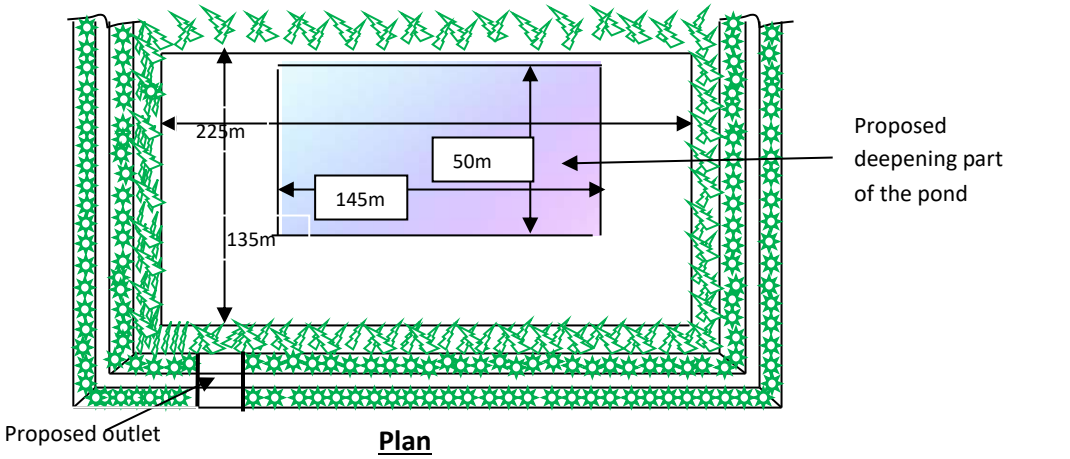
Shape of Pond : Rectangular	
Av. Length of Pond = 145 m	Av. Width of Pond : 50 m
Proposed depth : 1.0m	Proposed berm in layer cutting=2.0m
Soil Type : clay/silty loam	Depth of layer= 0.5 m



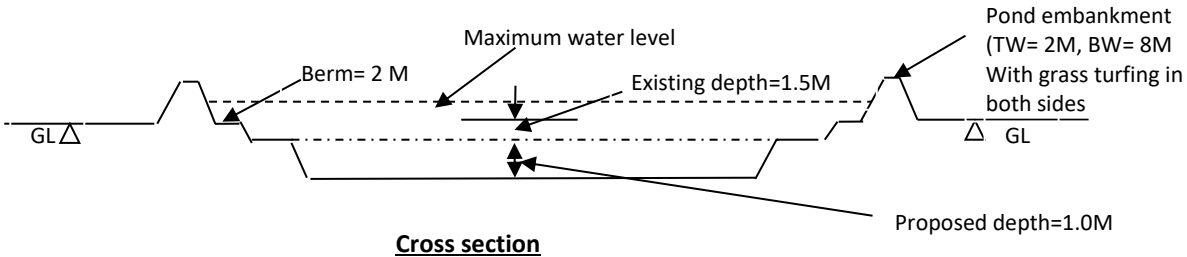
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



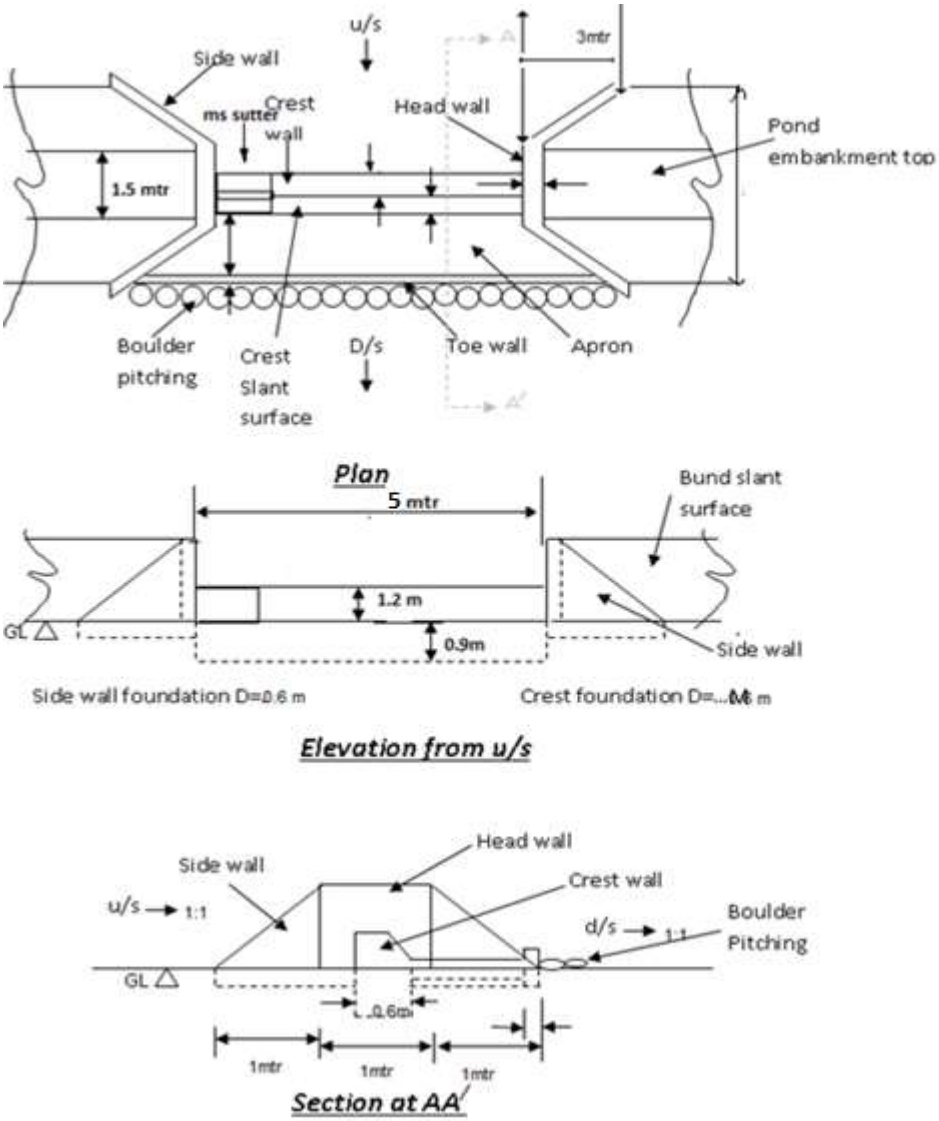
Plan



Cross section

5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.41 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec, that is greater than the Qp of 0.41 cum/sec. Hence the outlet will be capable to discharge the peak runoff safe; however, as the WHS is he and for further cushion of pond embankment during initial years, a 5 m crest length of outlet is proposed. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would required in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The design dimensions and estimate of the outlet is given below.



5.3: Design and drawing of earthen bunds for land development: 7.2 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 5040RM	Volume of soil excavated : 3628.8 cum
Plot Size: 50m * 50m	Total no of Plots: 30 nos. (approximately)

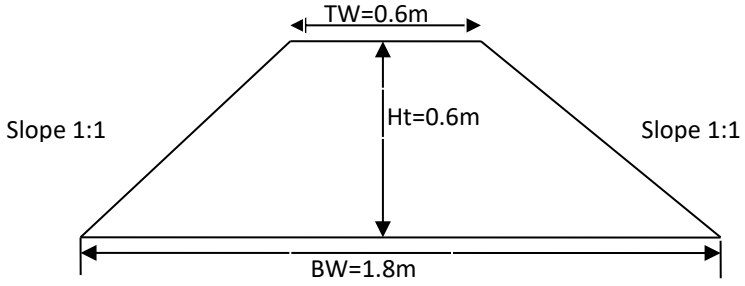


Figure 1: Cross section of the Bund

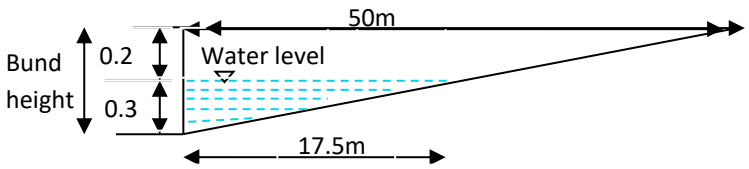
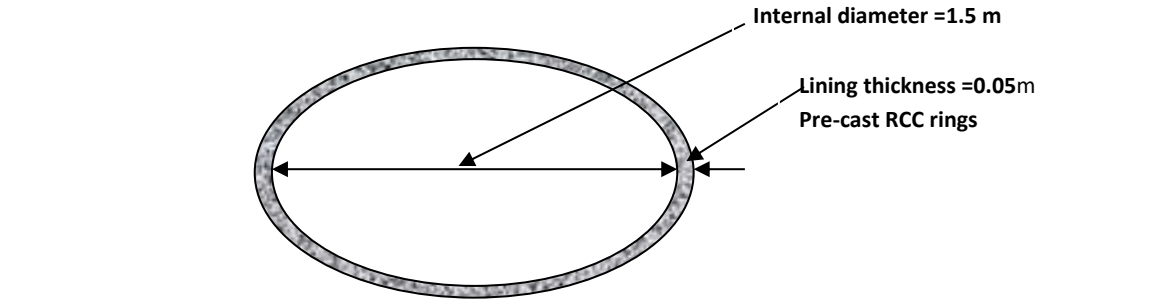


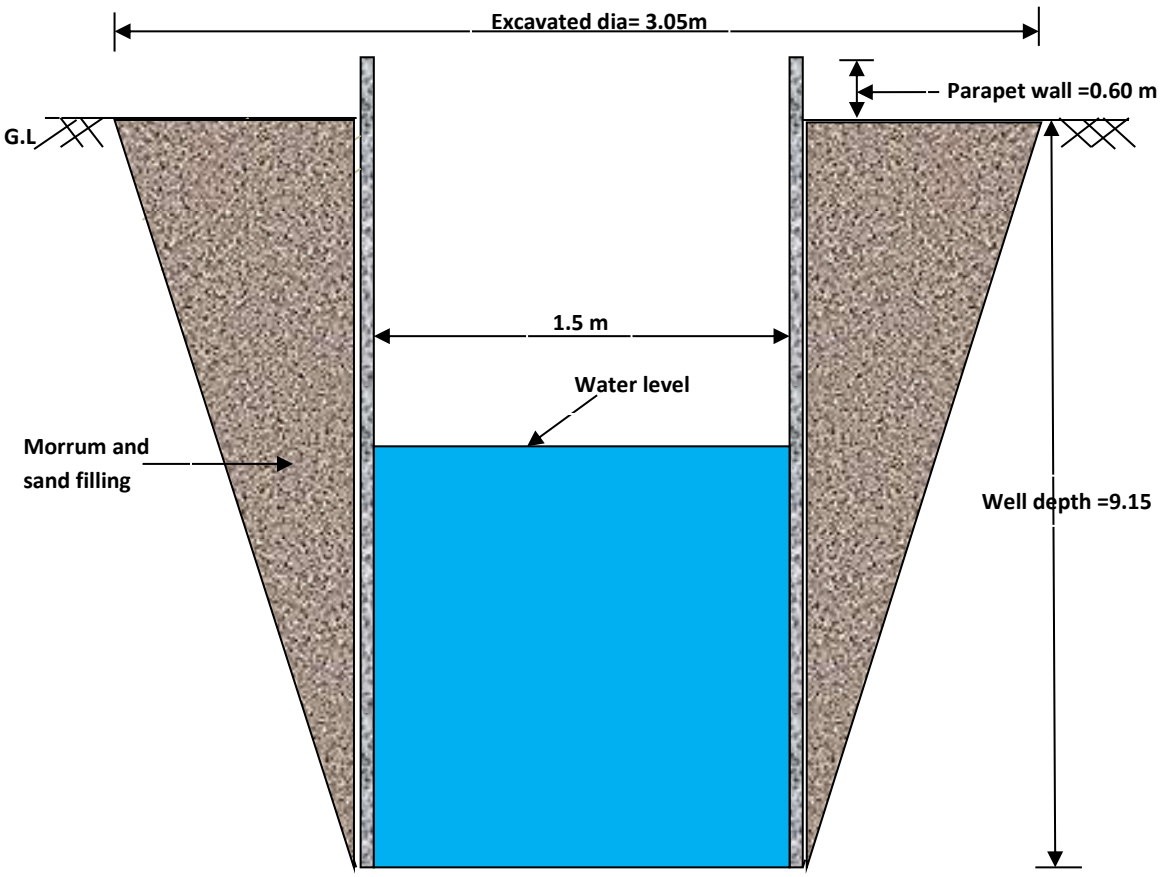
Figure: Section of Water to be stored in front of bunds.

5.4: Dug well ring type: 3 nos.

Three ring type dug well would be constructed in the command and nearby the command in downstream side of the pond to harvest subsurface water and ground water to irrigate kharif and rabi crops. The typical design and drawing of ring type well is given below.



PLAN



CROSS SECTION

6. How is the Work Climate Resilient?

Durability	• The WHS (7057cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 476709 cum and predicted maximum one day peak surface runoff (Qp)= 196640 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 5.3 times greater than the WHS capacity (37057 cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 31500 cum against WHS capacity of 37057 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 7.2 ha area designed to conserve 75% of total monsoon surface runoff and a total of 3.3 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 22 direct beneficiaries HHs for the CRW. Out of 22 HHs, 7 HHs are from ST community, 5 are from SC and 10 are from OBC community. There are 1 women headed and one disable HHs also direct beneficiary and among the total 22 HHs.
Integration	• A proper sized outlet (5 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water to increase the life of the embankments and the pond and also to create additional water storage height of 0.5m in the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 7.2 ha area in the catchment and command area is proposed. • Three dug wells are also integrated to further enhance the irrigation potential in the CRW area and promote rabi crops.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses.

	• ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

o. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Deepening of WHS	6467	cum	9,99,328	MGNREGA		22
2	CRW-1	Construction of outlet	1	No.	5,13,229	MGNREGA		
3	CRW-1	Land development	7.2	Ha	5,72,400	MGNREGA		
4	CRW-1	Construction of dug well	3	Nos.	2,01,000	MGNREGA		
		Total CR model Cost (Rs).			**22,85,857**			**22**

p. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (22 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	2 Ha.	50 KG/Ha for 2 Ha.@30/kg	3000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	22 Small and marginal farmers	1000	22000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (22 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (22 farmers covering 5 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2500	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**38200**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 2 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Ranimunda village, Khariar Block of Nuapada district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, LBCDs and Canal construction	Ranimunda village GP: Ranimunda Block: Khariar Dist : Nuapada 20°11'43''N 82°50'38''E	A, B	WHS, and Soil and water conservation and Irrigation	NA	Renovation of WHS (6812 cum), construction of Inlet & outlet, LBCDs (10 nos.) and Canal 150m long	NA

2. Rationale for selection of Works

As per the Hot spot climate Modelling Report of IISC -Banglore the mean rainfall of Khariar block between the month of June to September over a period of 30 years (1984-2014) is 1197 mm and its coefficient variation is 33. According to the 30 years historical data, the highest rainfall (mm) received in a day is 217mm and the number of years with normal sowing rain pattern is 4 years whereas 26 years it received abrupt and erratic pattern of rainfall. Khariar block has suffered high drought condition in last 30 years out of which 3 years were severe drought and 2-3 years were moderate condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 26.9 % and the projected coefficient of variation of the rainfall will be 29.9 for 2021-2050 years. Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The block Khariar is situated in the south east part of the district and almost 70 km from district head quarter Nuapada. As the block situated toward east side, the block does not share its boarder to CG. Two major sub river of the Udanti River pass through the block. Hence half of the geographical area of block is plain and half is hilly and undulating. The block altitude varies from 210m to 920m from mean sea level (msl). Most of the paddy grown low land are situated near both the rivers. Cotton also one of the second highest grown crop in the block grows in medium and uplands. Due to hilly and undulating topography in half of the geographical area of the block, there are many water harvesting

found in foothills and those are the major source of the in that part of the block. Mostly large WHS are maintained and manage by minor irrigation department however the small sized WHS (pond and embankment type ponds) are constructed by soil and water conservation department, panchayat and through other government programs and handed over to community. Due to lack of proper maintenance these WHS are not functioning well and need some minor renovation works such as deepening, construction of outlet, weirs, and inlets. Some other supporting activities such as land development, LBCDs, and plantation are also required to make these tanks more durable and efficient for future use.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with Inlet & outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought • Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	LBCDs	• To check runoff velocity and cut runoff intensity • To arrest silt and in long run harvest water to stabilize nala/gully. • To increase ground water recharge and enhance vegetative cover.
	Canal construction	• To carry pond water to the command area. • To reduce water application loss and increase command area.

4. Site Details

The proposed CRW activity is located in the foothill of a medium size hill. The hill is covered with trees and vegetation, however as density of vegetative covered decreases over period of time, soil erosion occurs and thus siltation observed in the pond. After the hill catchment there is also a patch of cultivable land of 2.25 ha, however eth patch is well bunded. In the conjunction of hilly and cultivated catchment, there are small stream those contribute runoff to the WHS. It is found that these streams are also contribute silt to the

pond and need to stabilize by checking runoff velocity and arresting silt through series of LBCDs. The slope of the hilly catchment is hill and ranges from 13.1 to 22.9%. The cultivated catchment also have high slope of 14%. To use the pond water t the command area a sluice with canal is demanded by the community to carry water to the medium land below the pond. The CRW site is approachable by a kuccha road and the distance from the village habitat is 780 m, however the radial distance from the village habitat to the CRW site is only 240m. The image of area is shown above and details features of the site are given below.

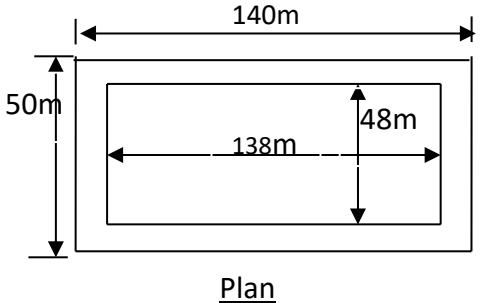
1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Dugout type
3. Shape of the pond : Rectangular
4. Slope of the catchment : hilly-13 to 22.9%, cultivated -14%
5. Type of Soil : Clay/ silty loam
6. Bed Rock : Seems not appear inside of pond
7. Av. depth of the pond (Present) : 1.5m
8. Proposed Extra depth of Pond : 1m Total depth=2.5
9. Existing area of the pond : 0.80 ha (145mx55m)
9. Proposed area to be excavated {LXB) : 7000 sq.m (Av. L=100m Av. W=20m)
11. Catchments area of the pond : 11 ha
12. Command area of the pond : 5 ha in *Kharif* and 2 ha in *Rabi*
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C1= Runoff Coefficient of the hilly catchment =0.5 (clay/silty loam, slope>10%)
C2=runoff coefficient of cultivated catchment=0.72 (slope>10%, Clay/Siltyloam)
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(217+217*.33)/1000 = 0.2886 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 11 ha (hilly=8.75 and cultivated=2.55
Peak Run off (Qp) =(87500x0.5+22500*.72)x0.2886= 17301.57 cum/day or say 0.20 cum/sec,
14. The total surface runoff for the monsoon period, Q= (87500x0.5+22500*.72) x1.197=71760.15 cum (Where, 1.197m is the average mean rainfall of monsoon period for Khariar block.). The total surface runoff is 3.77 times greater than the pond capacity of 19000 cum. Hence, this is sufficient to fill the pond during monsoon period.

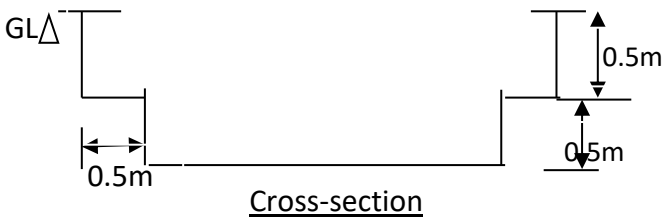
5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

Shape of Pond : Rectangular	
Av. Length of Pond = 140 m	Av. Width of Pond : 50 m
Proposed depth : 1.0m	Proposed berm in layer cutting=2.0m
Soil Type : silty loam/ clay	Depth of layer=0.50 m

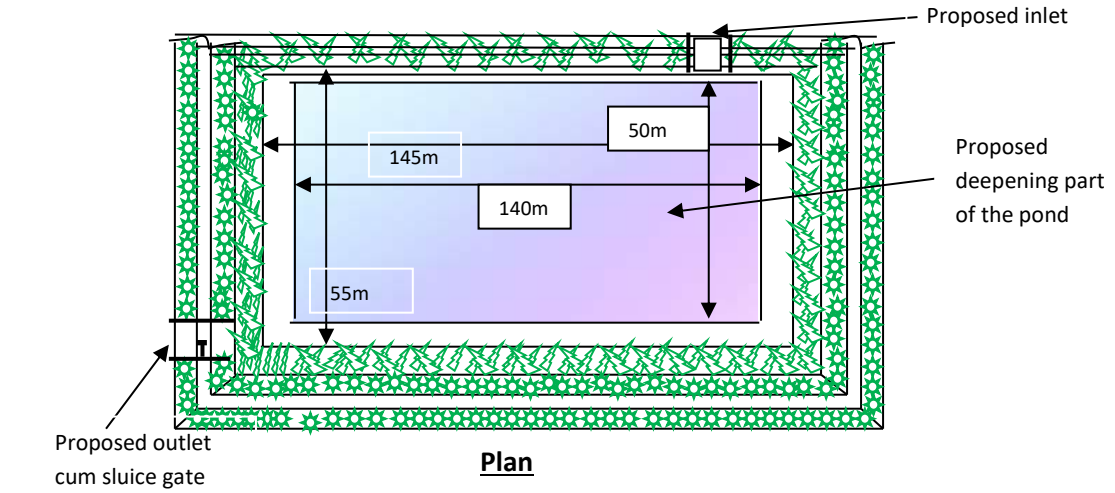


Plan

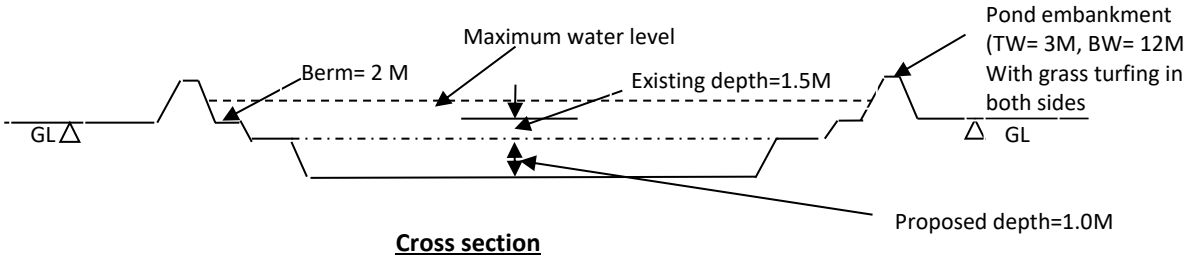


Cross-section

Layout of the whole pond system: (existing and deepening)



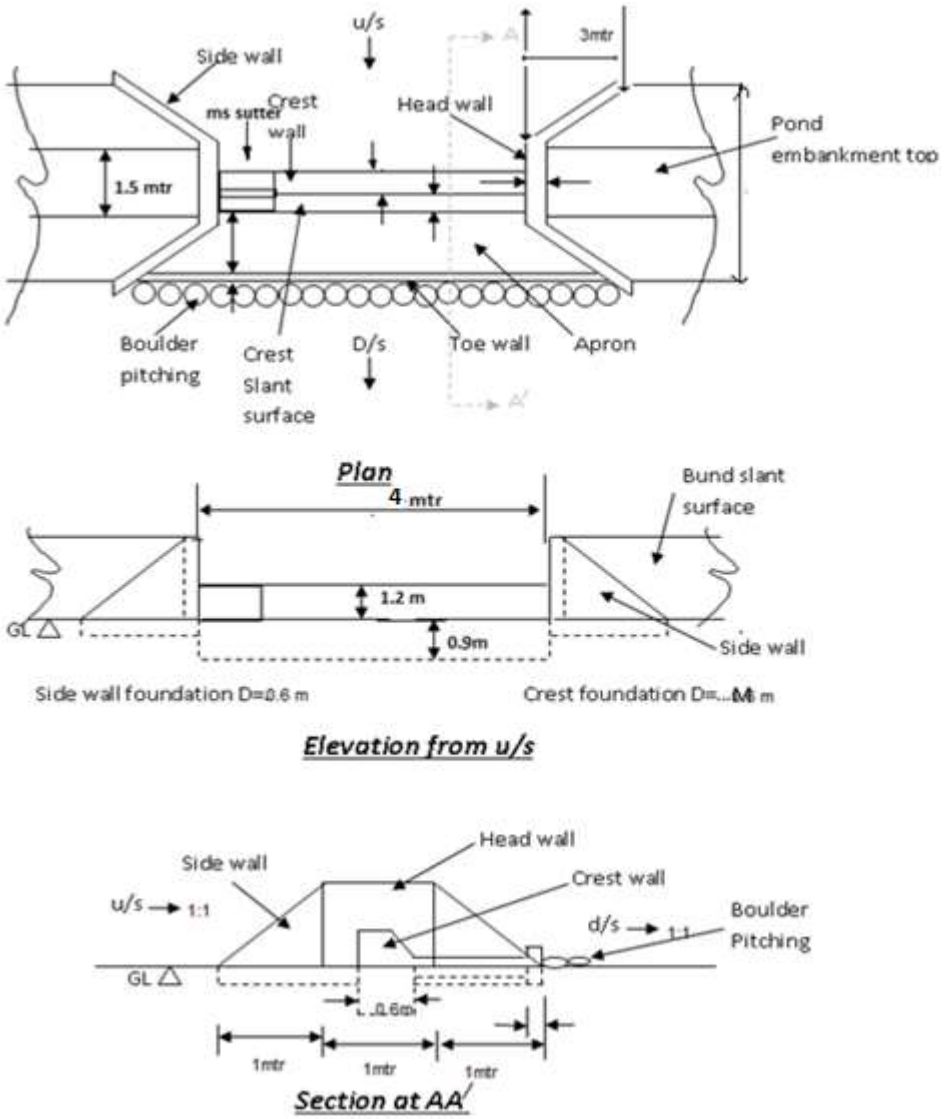
Plan



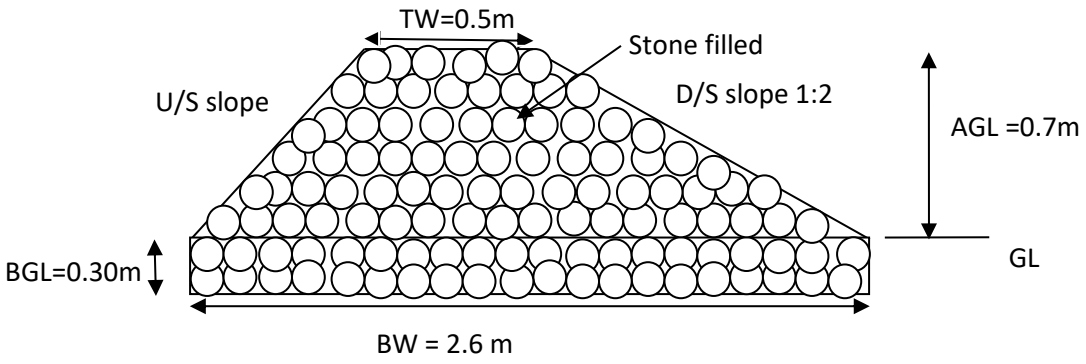
Cross section

5.2: Design and drawing of inlet and outlet cum sluice gate:

An outlet weir will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.20 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec , that is greater than the Qp of 0.64cum/sec. Hence the outlet will be capable to discharge the peak runoff safe. Though the design peak runoff is far more than the required one, but to maintain economy of construction and further to provide a huge cushion in the structure (as the structure is embankment type), and carrying of construction materials in the site etc, the minimum crest length of waste weir would be 4m (3 m as crest and 1m for sluice) and other dimensions of the waste weir would be as per the crest length and pond embankment. An inlet of 3m crest length would be constructed in other corner of upstream side embankment as shown in the pond layout. As the crest length of both inlet and outlet is same the inflow capacity of the inlet is safe and more than the peak runoff. The design of inlet also same as outlet, but outlet will have an additional feature of sluice gate, hence only outlet design drawing is shown below.

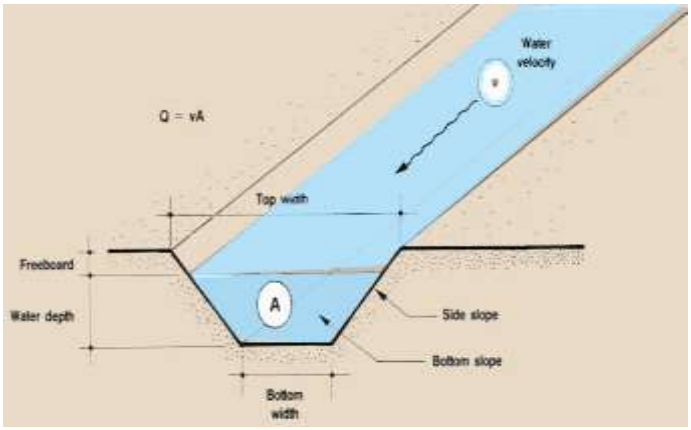


5.3: Design and drawing of Loose Boulder Check Dams(LBCDs): 10 nos. As mentioned in section 4, there are small gullies exist in two placed in the proposed site. After measuring the gully width and depth 10 umbers of LBCDs with below dimensions are proposed as gully control measures.



5.4: Design and drawing of earthen canal: 150m

A 150 RM earthen canal would be constructed and stone pitching to divert pond storage water to the command area and would be connected with sluice gate it the outlet. The design and drawing is shown below.



Calculation:

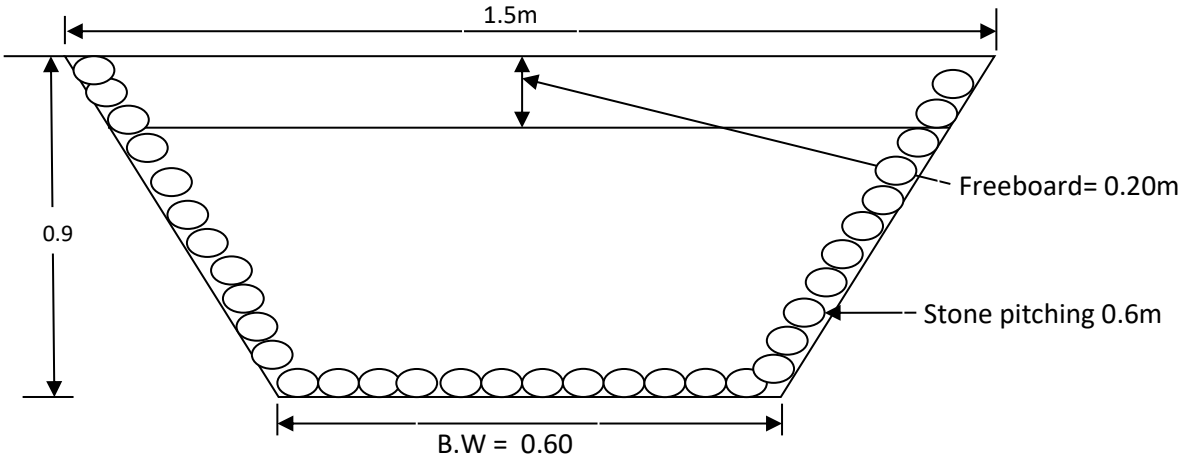
Q = VA

Velocity, V =1.2m/sec,

Flow area, A = ½ * (1.5+0.60) sq.m

Q=1.2x½ * (1.2+0.30)0.7= 0.88 cum/sec

Q= Flow capacity of the canal.



Cross section of the canal

6. How is the Work Climate Resilient?

Durability	• The WHS (6812 cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 71760.15 cum and predicted maximum one day peak surface runoff (Qp)= 17301.57 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 3.77 times greater than the WHS capacity (19000 cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 15000 cum against WHS capacity of 19000 cum), rest volume of water is for dead storage and other losses.

	• Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • 10 LBCDs are proposed to check the siltation and to reduce the runoff velocity.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs.
Inclusion	• There are 30 direct beneficiaries HHs for the CRW out of those 4 are belongs to ST, 8 are from SC and 18 are from OBC category. There is 1 Women headed HHs and 1 disable among the total 30 direct beneficiary HHs.
Integration	• A proper sized outlet cum sluice gate (4m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond. • An inlet to carry peak runoff to the pod with safe velocity and arrest silt is also integrated with WHS. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • 10 LBCDs are proposed in the catchment to arrest silt and increase vegetation. A canal of 150 RM is proposed to carry water from WHS to command area and also to reduce water application loss.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

q. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Deepening of WHS	6812	cum	9,75,813	MGNREGA		30
2	CRW-1	Construction of inlet, outlet & sluice	1 each	Nos.	9,13,229	MGNREGA		
3	CRW-1	LBCDS	10	Nos.	65,000	MGNREGA		
4	CRW-1	Canal with stone pitching	150	RM	1,02,979	MGNREGA		
		Total CR model Cost (Rs).			**20,57,021**			**30**

r. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (30 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	30 Small and marginal farmers	1000	30000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of	July,19 to Aug,19	2 trainings (42	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
		Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.		farmers)					
F		Coverage of farmers under Crop insurance schemes (30 farmers covering 5 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2500	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**49,200**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Nangpada village, Boden Block of Nuapada district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development and Plantation	Nangpada village GP: Khira Block: Boden Dist : Nuapada 20°18'17''N 82°36'33''E	A, B	WHS, and Soil and water conservation and Plantation	NA	Renovation of WHS (7032 cum), construction of one outlet. Land development in 2 ha area and Plantation 1 ha.	NA

2. Rationale for selection of Works

As per Hot spot IISC-Banglore report on climate Modelling the mean rainfall of Boden block between the month of June to September over a period of 30 years (1984-2014) is 1064 mm and its coefficient variation is 26.82. According to the 30 years historical data, the highest rainfall (mm) received in a day is 230 mm and the number of years with normal sowing rain pattern is 6 years whereas 24 yeas it received abrupt and erratic pattern of rainfall. Boden block has suffered high drought condition in last 30 years out of which 3 years was severe drought and 4 years moderate drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be increasing up to 32.8 % and the projected coefficient of variation of the rainfall will be 29.9 for 2021-2050 years.

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The Boden block is located south west side of Nuapada district and almost 80 km away from the district head quarter. The block is shared its entire west side border with the state CG. The entire west side consisting almost 50% of block geography is hilly. The highest altitude of the block is 980m and lowest

is 240 m from mean se level (msl). There is plateau in wet side above the hill and altitude varies from 700m to 800m. Hence the block having cultivated land in two different altitude. The lower plateau situated at 240 to 350 m altitude and another at 700 to 800m altitude. There is no major river passes through the block, however there are many seasonal streams pass through the block flows from west to east side. No such major and large dams found in the block with canal networks. However there are many small WHS found in suitable locations in the foothills and uplands. Many of them are functional and many are defunct due to lack of maintenance. Small interventions such as de-siltation repair of waste weir, etc. along with some integrated activities like land development, LBCDs, trance and plantation. As block is in upper ride, it is drought prone and thus creation of water harvesting structures is the highest priority of the block as well community.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought & Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Mango Plantation	• To increase vegetative covers, • To reduce soil erosion and enhance ground water recharge. • To create another option of livelihoods and carbon sink in long run

4. Site Details

The selected CRW is located in the plain and lower plateau part of the block. The pond is a dugout type and situated in the low land plots i.e. in the drainage line. Thus the pond can be a perennial one after deepening. The pond is almost 2.5 k away from the foot hill situated in west side. The entire catchment area of the pond is cultivated up, medium and low land with slope ranges from 1 to 2% as average and below 5% as maximum. Most of the cultivated plots are having bunds with some trees seen o the bunds except there are few plots those are fallow and not cultivated any crop seasons. There is no community lands fall in the catchment area. The owner of the fallow land interested to take up land development activity with mango plantation in the catchment. There is no such erosion traces in the catchment area. There is no outlet in the pond hence one outlet is also proposed to safe disposal of the excess water from the pond. The pond is adjacent to the village habitat area and easily accessible by the villagers. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Dugout type
3. Shape of the pond : Rectangular
4. Slope of the catchment : <5%
5. Type of Soil : clay/silty loam
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.5 m
8. Proposed Extra depth of Pond : 1. 0 m Total depth=2.0
9. Existing area of the pond : 0.8 ha (95mx85m)
9. Proposed area to be excavated {LXB) : 7200sqm (Av. L=90m Av. W=80m)
11. Catchments area of the pond : 16ha,
12. Command area of the pond : 6 ha in Khraif and 2 ha in Rabi
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

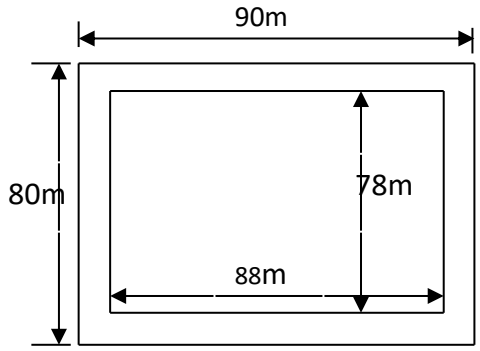
Where C= Runoff Coefficient of the catchment =0.5 (clay/Silty loam, slope >5%, cultivated)
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(230+230*.299)/1000 = 0.2988 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 16 ha
Peak Run off (Qp) =(160000x0.50)x.2988= 23904 cum/day or say 0.30 cum/sec,
14. The total surface runoff for the monsoon period, Q= 160000x0.5x1.064=85120 cum (Where, 1.064m is the average mean rainfall of monsoon period for Boden block.). The total surface runoff is 4 times greater than the pond capacity of 21432 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

Shape of Pond : Rectangular	
Av. Length of Pond = 90 m	Av. Width of Pond : 80 m

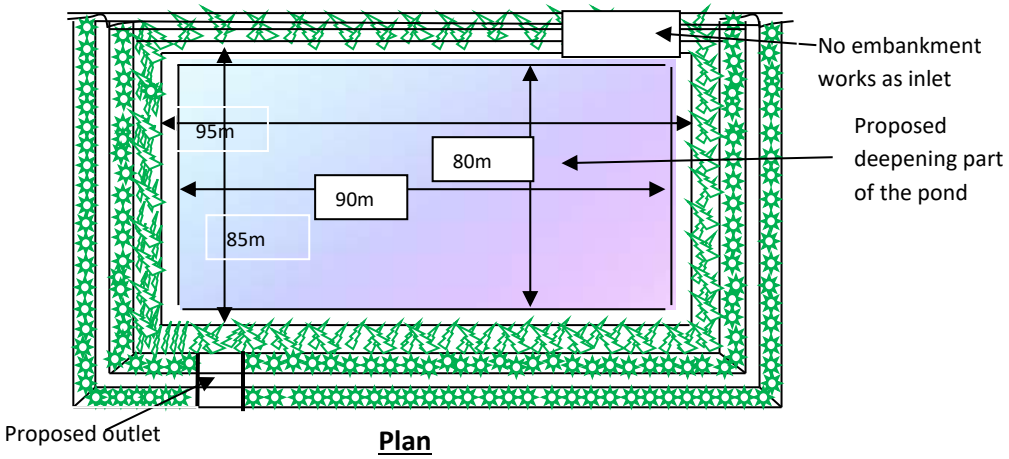
Proposed depth : 1.0m	Proposed berm in layer cutting=2.0m
Soil Type : clay/silty loam	Depth of layer=0.5 m



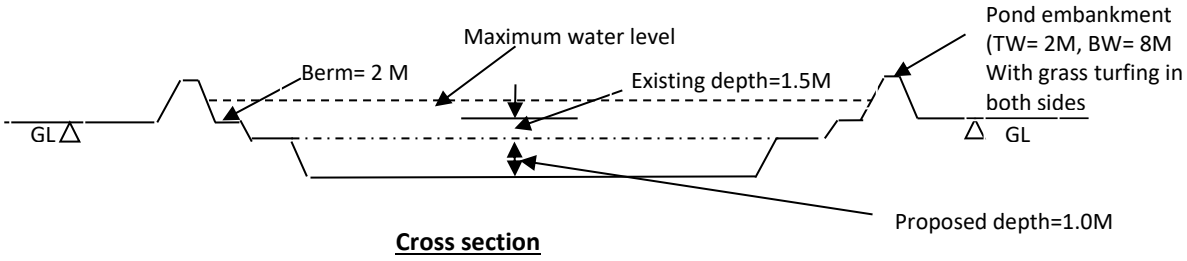
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



Plan

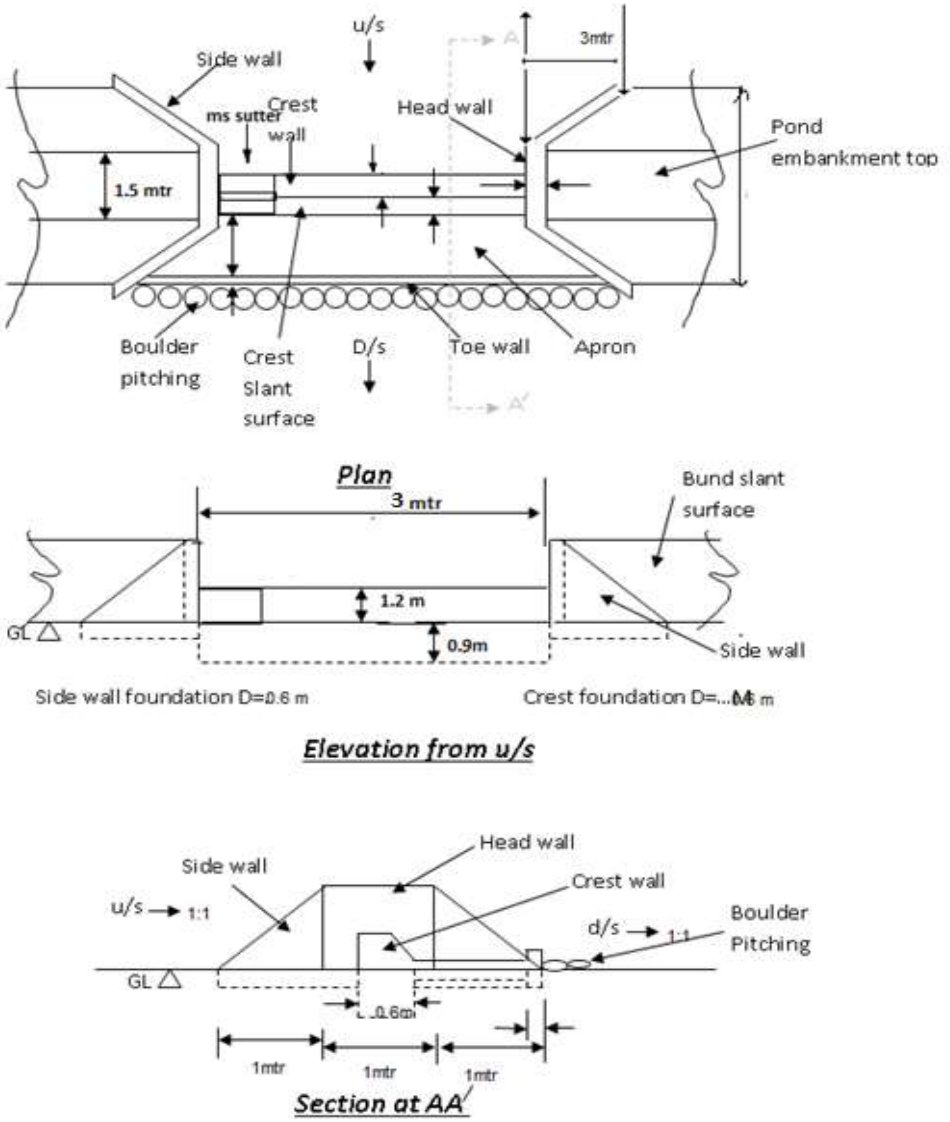


Cross section

5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.30 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec , that is greater than the Qp of 0.30cum/sec. Hence the outlet will be capable to discharge the peak runoff safe, however as the pond

is a huge one thus 3m crest length of outlet is proposed. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would required in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The design dimensions and estimate of the outlet is given below.



5.3: Design and drawing of earthen bunds for land development: 2 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 1400RM	Volume of soil excavated : 1008 cum
Plot Size: 50m * 50m	Total no of Plots: 10 nos. (approximately)

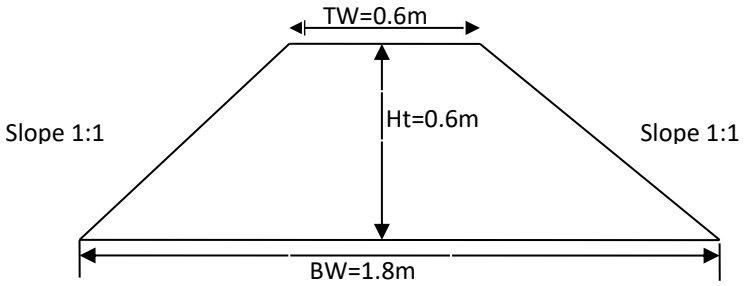


Figure 1: Cross section of the Bund

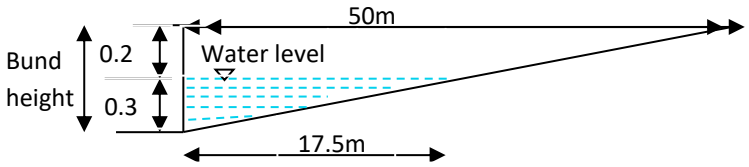
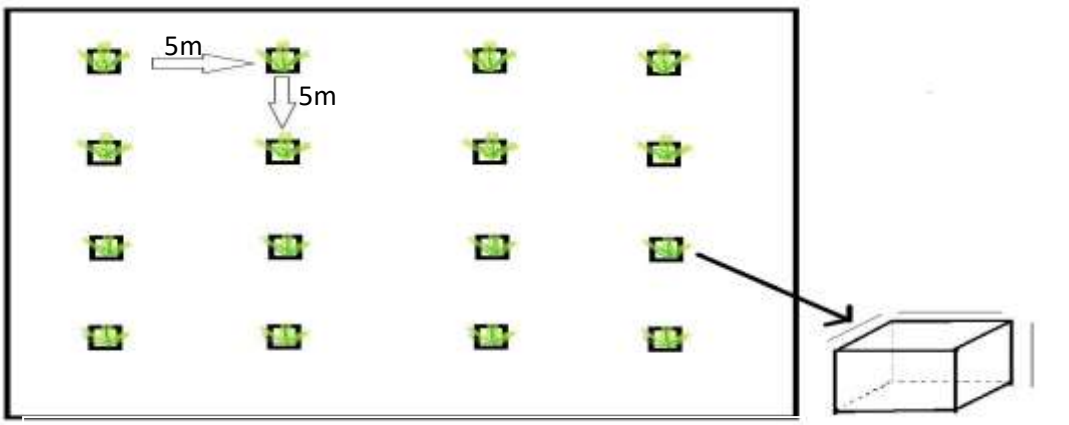


Figure: Section of Water to be stored in front of bunds.

5.4: Mango plantation: in one ha area

Almost the entire catchment area is already planted trees. However a small portion of the catchment area is left out and proposed for mango plantation. That part is also belonging to individual land. The locally available grafted mango planted would be planted with a spacing of 5mx5m with plant density of 400 plant per ha. Total area for plantation is only one ha. A typical layout of the plantation is provided below:



A layout of Mango plantation with specification

Pit (0.6mx0.6mx0.6m)

6. How is the Work Climate Resilient?

Durability	• The WHS (7032cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 85120 cum and predicted maximum one day peak surface runoff (Qp)= 23904 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 4 times greater than the WHS capacity (291432 cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 18000 cum against WHS capacity of 21432 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 2 ha area designed to conserve 80% of total monsoon surface runoff and a total of 0.85 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 25 direct beneficiaries HHs for the CRW and all 25 are from OBC community. There is one Women headed HHs among the total 25 direct beneficiary HHs.
Integration	• A proper sized outlet (3 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water to increase the life of the embankments and the pond and also to create additional water storage height of 0.5m in the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 2 ha area in the catchment and command area is proposed along with one ha mango plantation to enhance vegetation and ground water recharge.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

s. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Deepening of WHS	7032	cum	9,98,973	MGNREGA		25
2	CRW-1	Construction of outlet	1	No.	3,13,229	MGNREGA		
3	CRW-1	Land development	2	Ha	1,78,557	MGNREGA		
4	CRW-1	Mango Plantation	1	Ha	114965	MGNREGA	Technical support by Hort. department	
		Total CR model Cost (Rs).			**16,05,724**			**25**

t. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (25 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	25 Small and mar	1000	25000	Facilitation by ICRG	Nationalized Banks	

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
				ginal farmers					
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (25 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (25 farmers covering 5 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2500	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**44200**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Pharasara village, Boden Block of Nuapada district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development, Plantation & dug wells	Pharasara village GP: Pharasara Block: Boden Dist : Nuapada 20°18'17''N 82°36'33''E	A, B	WHS, and Soil and water conservation and Plantation & irrigation	NA	Renovation of WHS (7062 cum), construction of one outlet. Land development in 4 ha area, Plantation 1 ha & dug well -2 nos.	NA

2. Rationale for selection of Works

As per the Hot spot IISC-Banglore report on climate modelling the mean rainfall of Boden block between the month of June to September over a period of 30 years (1984-2014) is 1064 mm and its coefficient variation is 26.82. According to the 30 years historical data, the highest rainfall (mm) received in a day is 230 mm and the number of years with normal sowing rain pattern is 6 years whereas 24 yeas it received abrupt and erratic pattern of rainfall. Boden block has suffered high drought condition in last 30 years out of which 3 years was severe drought and 4 years moderate drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be increasing up to 32.8 % and the projected coefficient of variation of the rainfall will be 29.9 for 2021-2050 years.

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The Boden block is located south west side of Nuapada district and almost 80 km away from the district head quarter. The block is shared its entire west side border with the state CG. The entire west side consisting almost 50% of block geography is hilly. The highest altitude of the block is 980m and lowest

is 240 m from mean se level (msl). There is plateau in wet side above the hill and altitude varies from 700m to 800m. Hence the block having cultivated land in two different altitude. The lower plateau situated at 240 to 350 m altitude and another at 700 to 800m altitude. There is no major river passes through the block, however there are many seasonal streams pass through the block flows from west to east side. No such major and large dams found in the block with canal networks. However there are many small WHS found in suitable locations in the foothills and uplands. Many of them are functional and many are defunct due to lack of maintenance. Small interventions such as de-siltation repair of waste weir, etc. along with some integrated activities like land development, LBCDs, trance and plantation. As block is in upper ride, it is drought prone and thus creation of water harvesting structures is the highest priority of the block as well community.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought & Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Mango Plantation	• To increase vegetative covers, • To reduce soil erosion and enhance ground water recharge. • To create another option of livelihoods and carbon sink in long run
	Dug wells	• To utilize the ground water recharge due to above activities • To enhance irrigation potential and increase income

4. Site Details

The selected CRW-2 is also located in the plain and in lower plateau part in the extreme south side of the block. The pond is a dugout type and situated in the medium land that connected up and low land plots. Thus the uplands are the catchment area and the low lands are command area of the pond. Average slope of the catchment is 1.5% and the catchment characteristics is degraded village forest with moderate tree density in maximum portion of the catchment. Few cultivable plots are also in the catchment and a part of degraded is with low density trees, thus land development and plantation is proposed in this part as catchment treatment. There is no outlet in the pond hence one outlet is also proposed to safe disposal of the excess water from the pond. The pond is almost 550m away from the village habitat and there is a kuchha approach raod. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Dugout type
3. Shape of the pond : Rectangular
4. Slope of the catchment : <5%, Average 1.5%
5. Type of Soil : clay/silty loam
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.0 m
8. Proposed Extra depth of Pond : 1. 5 m Total depth=2.0
9. Existing area of the pond : 0.55 ha (85mx65m)
9. Proposed area to be excavated {LXB) : 4800 sqm (Av. L=80m Av. W=60m)
11. Catchments area of the pond : 11ha,
12. Command area of the pond : 5 ha in Khraif and 1.5 ha in Rabi
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

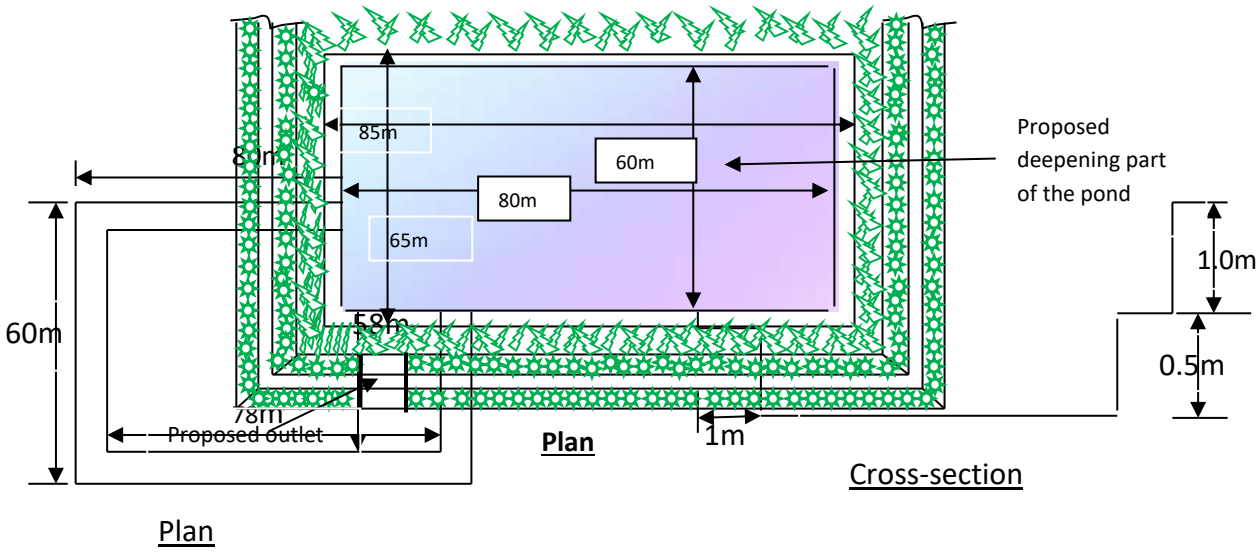
Where C= Runoff Coefficient of the catchment =0.5 (clay/Silty loam, slope >5%, cultivated)
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(230+230*.299)/1000 = 0.2988 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 11 ha
Peak Run off (Qp) =(110000x0.50)x.2988= 16434 cum/day or say 0.20 cum/sec,
14. The total surface runoff for the monsoon period, Q= 110000x0.5x1.064=58520 cum (Where, 1.064m is the average mean rainfall of monsoon period for Boden block.). The total surface runoff is 4.24 times greater than the pond capacity of 13813 cum. Hence, this is sufficient to fill the pond during monsoon period.

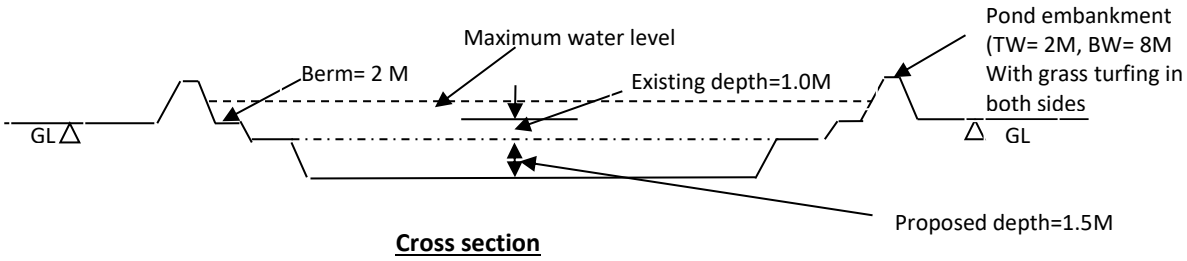
5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

Shape of Pond : Rectangular	
Av. Length of Pond = 80 m	Av. Width of Pond : 60 m
Proposed depth : 1.5m	Proposed berm in layer cutting=2.0m
Soil Type : clay/silty loam	Depth of layer=1.0m and 0.5 m

Layout of the whole pond system: (existing and deepening)

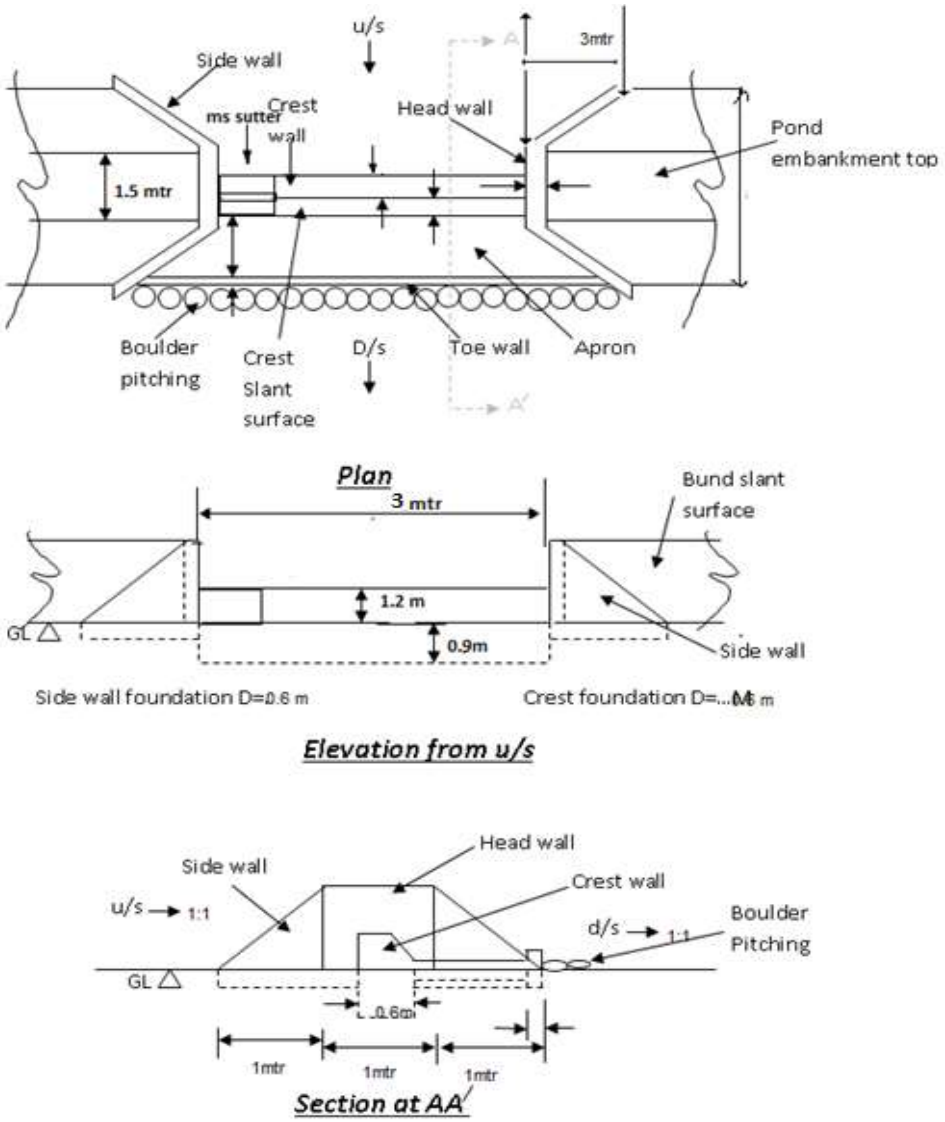




Cross section

5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.20 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec, that is greater than the Qp of 0.20cum/sec. Hence the outlet will be capable to discharge the peak runoff safe; however as the pond is a huge one thus 3m crest length of outlet is proposed. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would required in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The design dimensions and estimate of the outlet is given below.



5.3: Design and drawing of earthen bunds for land development: 4 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 2800RM	Volume of soil excavated : 2016 cum
Plot Size: 50m * 50m	Total no of Plots: 18 nos. (approximately)

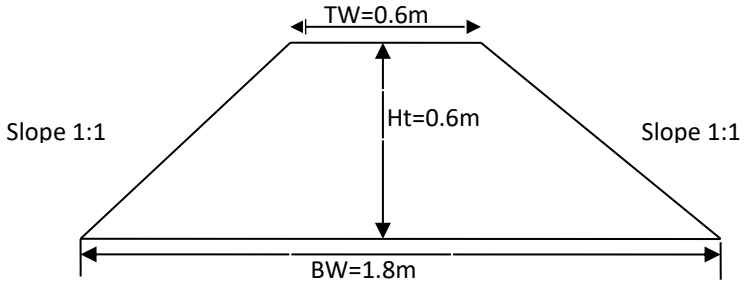


Figure 1: Cross section of the Bund

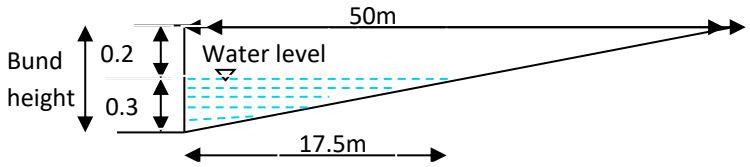
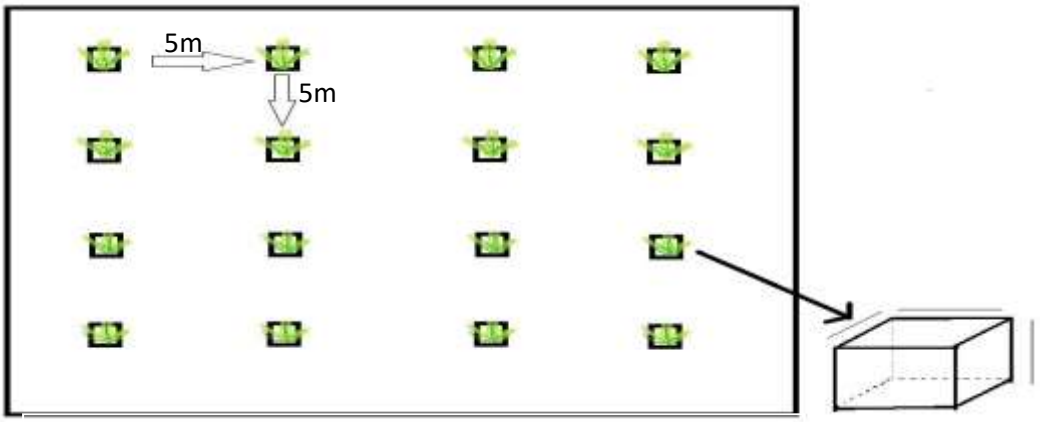


Figure: Section of Water to be stored in front of bunds.

5.4: Mango plantation: in one ha area

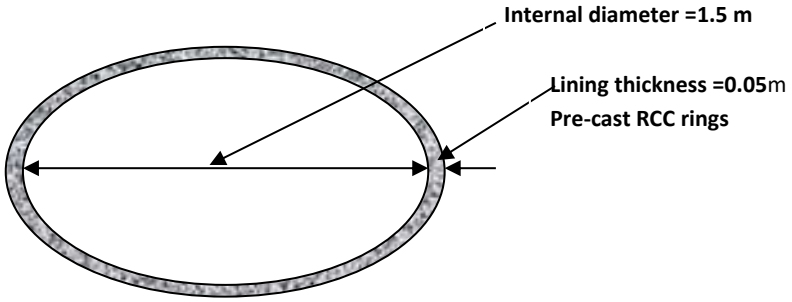
Almost the entire catchment area is already planted trees. However a small portion of the catchment area is left out and proposed for mango plantation. That part is also belonging to individual land. The locally available grafted mango planted would be planted with a spacing of 5mx5m with plant density of 400 plant per ha. Total area for plantation is only one ha. A typical layout of the plantation is provided below:



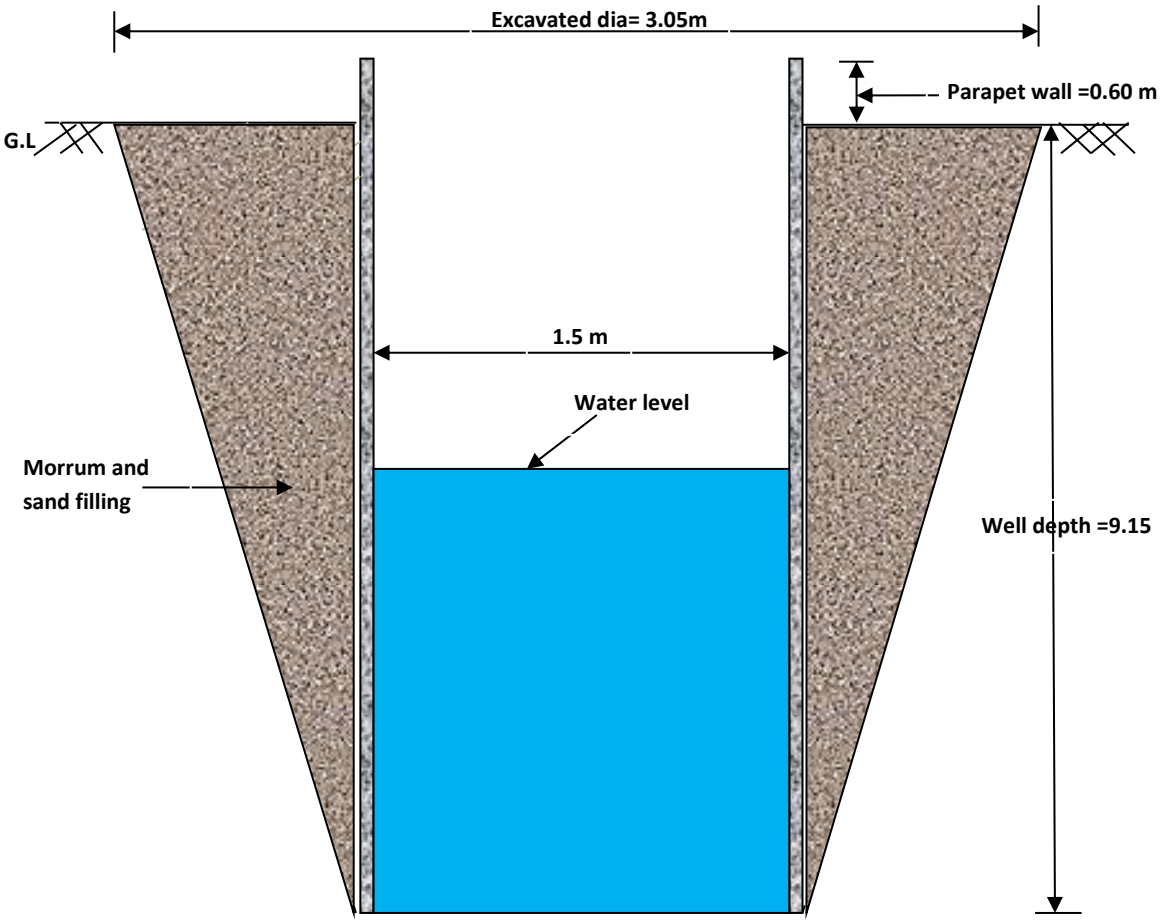
A layout of Mango plantation with specification Pit (0.6mx0.6mx0.6m)

5.5: Dug well ring type: 2 nos.

Two ring type dug well would be constructed in the command and nearby the command in downstream side of the pond to harvest subsurface water and ground water to irrigate kharif and rabi crops. The typical design and drawing of ring type well is given below.



PLAN



CROSS SECTION

6. How is the Work Climate Resilient?

Durability	• The WHS (7062cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 58520 cum and predicted maximum one day peak surface runoff (Qp)= 16434 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 4 times greater than the WHS capacity (13813 cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 10,000 cum against WHS capacity of 13,813 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 4 ha area designed to conserve 75% of total monsoon surface runoff and a total of 1.6 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc.

	• The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 26 direct beneficiaries HHs for the CRW. Out of 26 HHs, 17 HHs are from ST community, 2 are from SC and 7 are from OBC community.
Integration	• A proper sized outlet (3 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water to increase the life of the embankments and the pond and also to create additional water storage height of 0.5m in the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 4 ha area in the catchment and command area is proposed along with one ha mango plantation to enhance vegetation and ground water recharge. • Two dug well also integrated to further enhance the irrigation potential in the CRW area.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

u. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-2	Deepening of WHS	7062	cum	10,02, 813	MGNREGA		26
2	CRW-2	Construction of outlet	1	No.	3,13,229	MGNREGA		

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
3	CRW-2	Land development	4	Ha	3,47,114	MGNREGA		
4	CRW-2	Mango Plantation	1	Ha	114965	MGNREGA	Technical support by Hort. department	
5	CRW-2	Construction of dug well	2	Nos.	1,34,000	MGNREGA		
		Total CR model Cost (Rs).			**19,12,121**			**26**

a. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (26 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	26 Small and marginal farmers	1000	26000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient	July,19 to Aug,19	2 trainings (26 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
		livelihood planning.							
F		Coverage of farmers under Crop insurance schemes (26 farmers covering 5 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2500	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**45,200**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Sardhapur village, Khariar Block of Nuapada district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, LBCDs	Sardhapur village GP: Sardhapur Block: Khariar Dist : Nuapada 20°12'45''N 82°47'03''E	A, B	WHS, and Soil and water conservation	NA	Renovation of WHS (7037 cum), construction of Inlet, outlet & sluice gate, LBCDs (10 nos.)	NA

2. Rationale for selection of Works

As per the Hot spot climate Modelling Report the mean rainfall of Khariar block between the month of June to September over a period of 30 years (1984-2014) is 1197 mm and its coefficient variation is 33. According to the 30 years historical data, the highest rainfall (mm) received in a day is 217mm and the number of years with normal sowing rain pattern is 4 years whereas 26 years it received abrupt and erratic pattern of rainfall. Khariar block has suffered high drought condition in last 30 years out of which 3 years were severe drought and 2-3 years were moderate condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 26.9 % and the projected coefficient of variation of the rainfall will be 29.9 for 2021-2050 years. Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The block Khariar is situated in the south east part of the district and almost 70 km from district head quarter Nuapada. As the block situated toward east side, the block does not share its boarder to CG. Two major sub river of the Udanti River pass through the block. Hence half of the geographical area of block is plain and half is hilly and undulating. The block altitude varies from 210m to 920m from mean sea level (msl). Most of the paddy grown low land are situated near both the rivers. Cotton also one of the second highest grown crop in the block grows in medium and uplands. Due to hilly and undulating topography in half of the geographical area of the block, there are many water harvesting found in foothills and those are the major source of the in that part of the block. Mostly large WHS

are maintained and manage by minor irrigation department however the small sized WHS (pond and embankment type ponds) are constructed by soil and water conservation department, panchayat and through other government programs and handed over to community. Due to lack of proper maintenance these WHS are not functioning well and need some minor renovation works such as deepening, construction of outlet, weirs, and inlets. Some other supporting activities such as land development, LBCDs, and plantation are also required to make these tanks more durable and efficient for future use.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with Inlet & outlet cum sluice.	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought • Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow • Safe outflow of water to the command area through the sluice gate. • Maximum utilization of pod water fro irrigation due to the presence of sluice gate.
Supplementary activities	LBCDs	• To check runoff velocity and cut runoff intensity • To arrest silt and in long run harvest water to stabilize nala/gully. • To increase ground water recharge and enhance vegetative cover.

4. Site Details

The proposed CRW activity is located in the cultivated plain topography with slope less than 5% (average slope is 1.5). Thus, the entire catchment area is moderately plain cultivable land with paddy growing plots. These plots are mostly bunded with low height earthen bund. Few upland plots are also covered with cotton crop during kharif. There are some small and medium height hill in the east and north side of the pond. As the pond is in the low land, the pond will harvest surface runoff water as well as if depth increases it can also catch subsurface flow also. Thus it would be a

perennial pond once the proposed would be completed. There is sufficient command area and command area goes up to the village habitat area and hence there is possibility and opportunity to grow vegetable in kharif using the pond water in the command near the habitat area. There is a small drainage line carry surface water from the catchment area to pond passes through the conjunction of low and medium land and need silt control measures. Thus some LBCDs are proposed. The pond is well connected with village road and is almost 325m away from village habitat area. The image of area is shown above and details features of the site are given below.

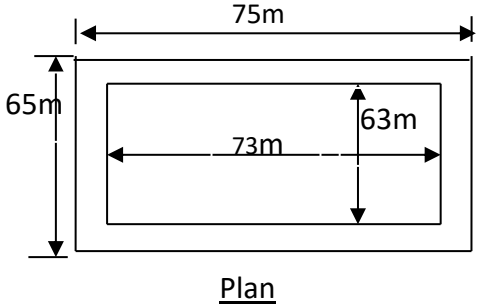
1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Dugout type
3. Shape of the pond : Rectangular
4. Slope of the catchment : 1.5%,
5. Type of Soil : Clay/ silty loam
6. Bed Rock : Seems not appear inside of pond
7. Av. depth of the pond (Present) : 1.5m
8. Proposed Extra depth of Pond : 1.5m Total depth=3.0
9. Existing area of the pond : 0.56 ha (80mx70m)
9. Proposed area to be excavated {LXB) : 70004875 sq.m (Av. L=75m Av. W=65m)
11. Catchments area of the pond : 33.8ha
12. Command area of the pond : 5.59 ha in *Kharif* and 2.5 ha in *Rabi*
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C= Runoff Coefficient of the catchment =0.5 (clay/silty loam, slope<5%, cultivated land)
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(217+217*.33)/1000 = 0.2886 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 33.8
Peak Run off (Qp) =(338000x0.5)x0.2886= 169000 cum/day or say 1.95 cum/sec,
14. The total surface runoff for the monsoon period, Q= (338000x0.5)x1.197=202293 cum (Where, 1.197m is the average mean rainfall of monsoon period for Khariar block.). The total surface runoff is 11.09 times greater than the pond capacity of 18237 cum. Hence, this is sufficient to fill the pond during monsoon period.

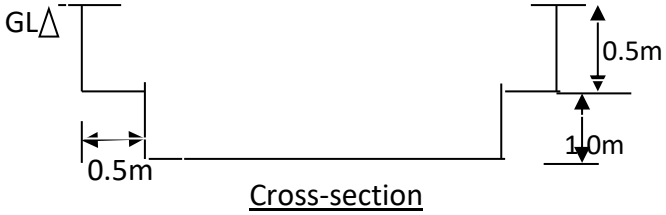
5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

Shape of Pond : Rectangular	
Av. Length of Pond = 75 m	Av. Width of Pond : 65 m
Proposed depth : 1.5m	Proposed berm in layer cutting=2.0m
Soil Type : silty loam/ clay	Depth of layer=0.50 & 1.0m

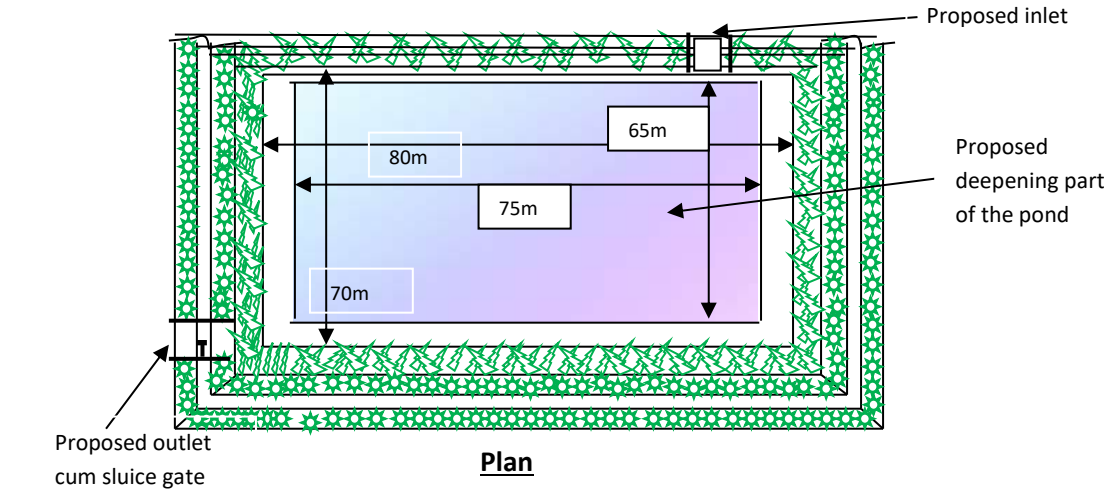


Plan

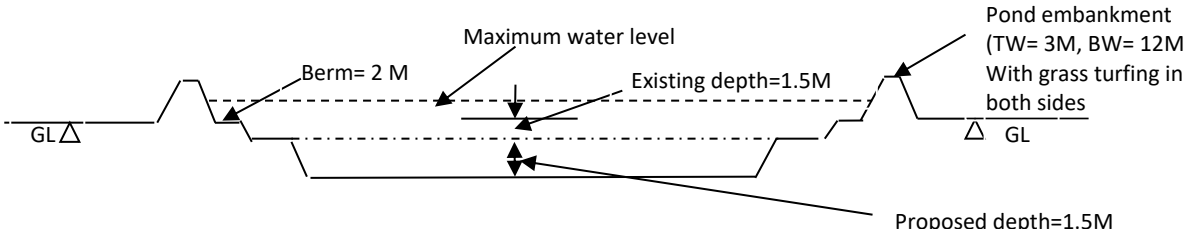


Cross-section

Layout of the whole pond system: (existing and deepening)



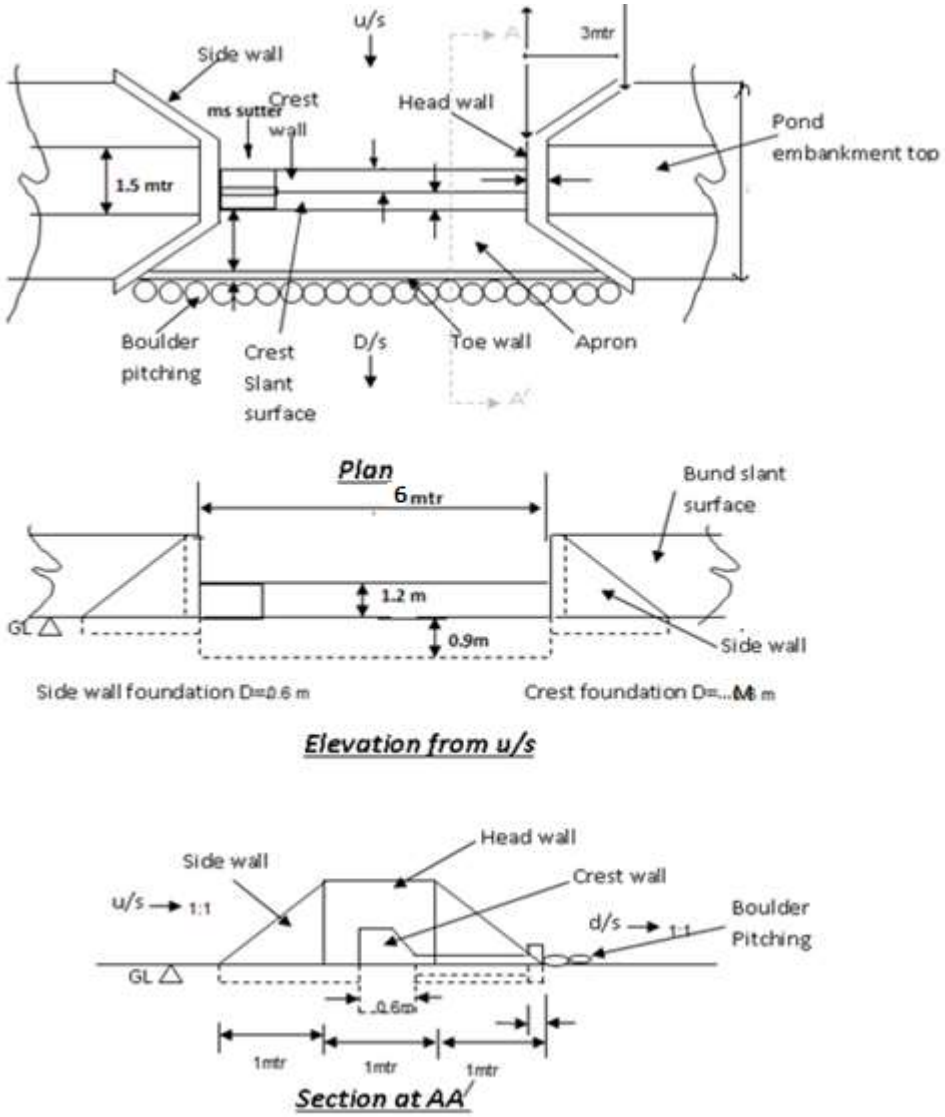
Plan



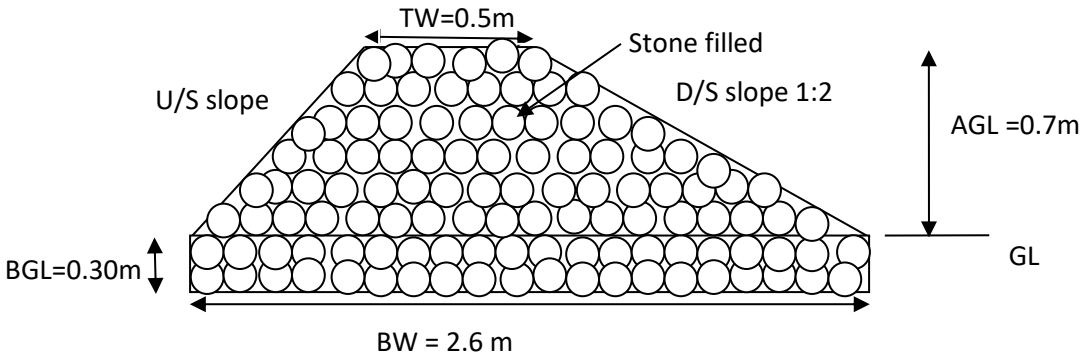
Cross section

5.2: Design and drawing of inlet and outlet cum sluice gate:

An outlet weir will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 1.95 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 5m and flow height of 0.3 m, we have Q=1.2x2x0.4=2.4 cum per sec , that is greater than the Qp of 1.95cum/sec. Hence the outlet will be capable to discharge the peak runoff safe. As a sluice gate would be constructed as integral part of the outlet in one corner (side), hence the total length of the outlet would be 5+1m=6m. An inlet of 5m crest length would be constructed in other corner of upstream side embankment as shown in the pond layout. As the crest length of both inlet and outlet is same the inflow capacity of the inlet is safe and more than the peak runoff. The design of inlet also same as outlet, but outlet will have an additional feature of sluice gate, hence only outlet design drawing is shown below.



5.3: Design and drawing of Loose Boulder Check Dams(LBCDs): 10 nos. As mentioned in section 4, there are small gullies exist in two placed in the proposed site. After measuring the gully width and depth 10 umbers of LBCDs with below dimensions are proposed as gully control measures.



6. How is the Work Climate Resilient?

Durability	• The WHS (7037 cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 202293 cum and predicted maximum one day peak surface runoff (Qp)= 169000 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 11.09 times greater than the WHS capacity (18237 cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 16770 cum against WHS capacity of 18237 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • 10 LBCDs are proposed to check the siltation and to reduce the runoff velocity.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs.
Inclusion	• There are 33 direct beneficiaries HHs for the CRW out of those 8 are belongs to ST, 22 are from SC and 3 are from OBC category. There is 1 Women headed HHs and 1 disable among the total 33 direct beneficiary HHs.
Integration	• A proper sized outlet cum sluice gate (6m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond. • An inlet to carry peak runoff to the pod with safe velocity and arrest silt is also integrated with WHS. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • 10 LBCDs are proposed in the catchment to arrest silt and increase vegetation.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers

	and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

b. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-2	Deepening of WHS	7037	cum	9,99,613	MGNREGA		33
2	CRW-2	Construction of inlet, outlet & sluice	1	Nos.	5,13,229	MGNREGA		
3	CRW-2	Construction of outlet & sluice	1	Nos.	7,33,738	MGNREGA		
4	CRW-2	LBCDS	10	Nos.	65,000	MGNREGA		
		Total CR model Cost (Rs).			**23,11,580**			**33**

c. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (33 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with	May' , June	33 Small and	1000	33000	Facilitation by ICRG	Nationalized Banks	

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
		Banks (Kharif, 2019-20)	and July 19	marginal farmers					
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (33 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (40 farmers covering 4 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2000	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**51700**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Chhata village, Komna Block of Nuapada district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development and plantation	Chhata village GP: Darlamunda Block: Komna Dist : Nuapada 20°29'49''N 82°37'42''E	A, B	WHS, and Soil and water conservation and plantation	NA	Renovation of WHS (9577 cum), construction of one outlet. Land development in 2 ha area and plantation in 2 ha.	NA

2. Rationale for selection of Works

As per the Hot spot Climate Modelling report of IISC- Banglore the mean rainfall of Komana block between the month of June to September over a period of 30 years (1984-2014) is 1076 mm and its coefficient variation is 25.19. According to the 30 years historical data, the highest rainfall (mm) received in a day is 163 mm and the number of years with normal sowing rain pattern is 8 years whereas 22 year it received abrupt and erratic pattern of rainfall. Komana block has suffered high drought condition in last 30 years out of which 3 years was severe drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 42.3 % and the projected coefficient of variation of the rainfall will be 31.1 for 2021-2050 years.

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The block Komna is situated south of the Nuapada block and block Head quarter Nuapada. The west side of the block is bordering to CG. Almost half of the geographical area of block is hilly and undulating. If we draw a line from north to south in the middle of the block, then the south part is

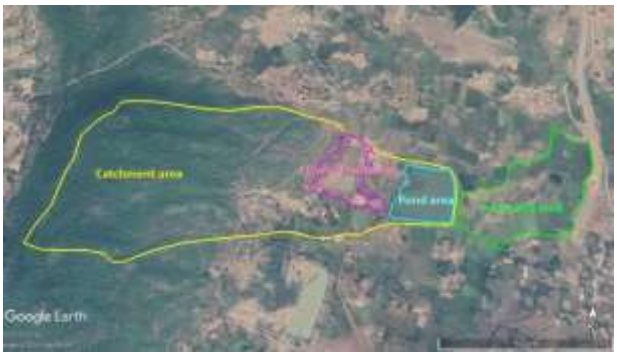
complexly hill area with highest elevation is 830m from the msl. The east part is comparatively plain and paddy grown area with lowest altitude is 255m from msl. Due to this undulation there are three types of lands –upland medium and low land. Most of the low lands do not face moisture stress and some of those are even use for second crops also. There are some Minor Irrigation Projects (MIPs) get water from dams constructed in the hills and foot hills in the block. Due to these MIPs most of plain art get irrigation water and some places second crop (rabi paddy) are also seen. There are many other small tanks in the foot hills low altitude hills and upland, some of those are working and also providing irrigation, however many of them are not functioning properly and need some minor renovation and deepening to make those functional. Some other supporting activities such as land development, LBCDs, and plantation are also required to make these tanks more durable.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought • Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Plantation (Mango trees in individual land)	• To increase vegetative covers, • To reduce soil erosion and enhance ground water recharge. • To create another source of income and carbon sink in long run

4. Site Details

The proposed CRW core activity -WHS is located in a foot hill of a medium altitude hill. The tank is a dugout type tank and thus there are embankments in three sides and upstream side is open to catch the runoff water flows from the hill. There are two types of catchment of the pond. Largest part of the catchment is hilly with think vegetative cover (tall forest trees are there with other vegetations). A small art of approximately 8.5 ha is cultivable fallow and cultivated land. The command area is just below the pond and mostly the low land and situated in the downstream of the pond, thus gravity flow irrigation system would use irrigate the command area either by constructing outlet and or by siphoning system. The lower catchment fallow cultivable land would be treated with land development activity and plantation to check siltation of the tank. The tank is situated almost 500m far from the village habitat area. Thus would mostly use for irrigation and fish cultivation in future. The image of area is shown above and details features of the site are given below.



1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Dugout type
3. Shape of the pond : Rectangular
4. Slope of the catchment : hilly 12.37% and plain 2.8%
5. Type of Soil : Clay/ silty loam
6. Bed Rock : Seems not appear inside of pond
7. Av. depth of the pond (Present) : 1.5m
8. Proposed Extra depth of Pond : 1.0m Total depth=2.5
9. Existing area of the pond : 3.0 ha (190mx160m)
9. Proposed area to be excavated {LXB) : 9775 sq.m (Av. L=115m Av. W=85m)
11. Catchments area of the pond : 51.4 ha, 8.5 ha plain, 42.9 ha hilly
12. Command area of the pond : 16.4 ha in *Kharif* and 6 ha in *Rabi*
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

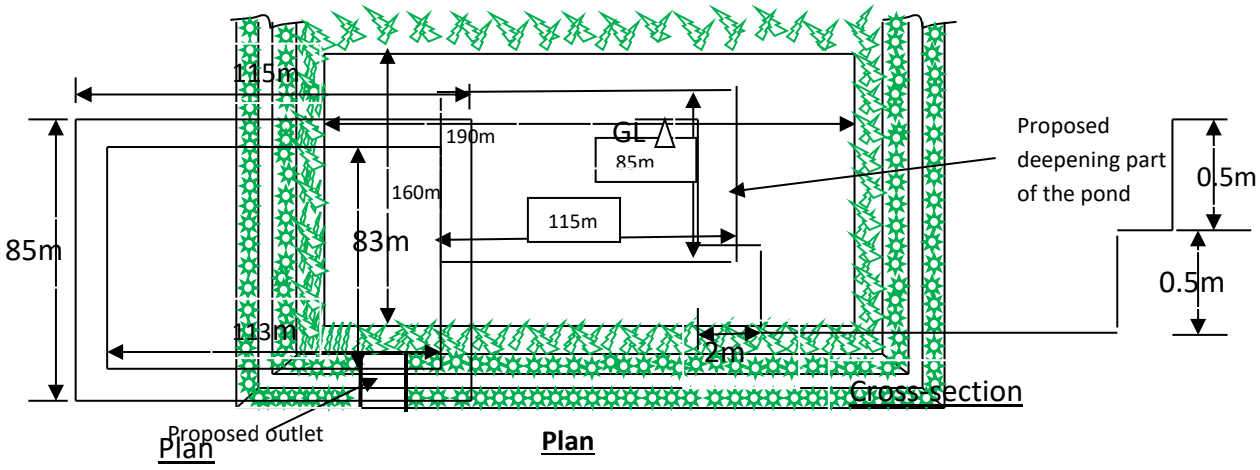
Where C1= Runoff Coefficient of the hilly catchment =0.5 (clay/silty loam, slope>10%)
C2= Runoff coefficient of plain (cultivable land) catchment =0.5 (clay/silty loam, slope 0 to 5%)
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(163+163*.311)/1000 = 0.2137 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 51.4 ha
Peak Run off (Qp) =(514000x0.5)x0.2137= 54919.1 cum/day or say 0.64 cum/sec,
14. The total surface runoff for the monsoon period, Q= 514000x0.5x1.076=276532 cum (Where, 1.076m is the average mean rainfall of monsoon period for Komna block.). The total surface runoff is 3.63 times greater than the pond capacity of 76000 cum. Hence, this is sufficient to fill the pond during monsoon period.

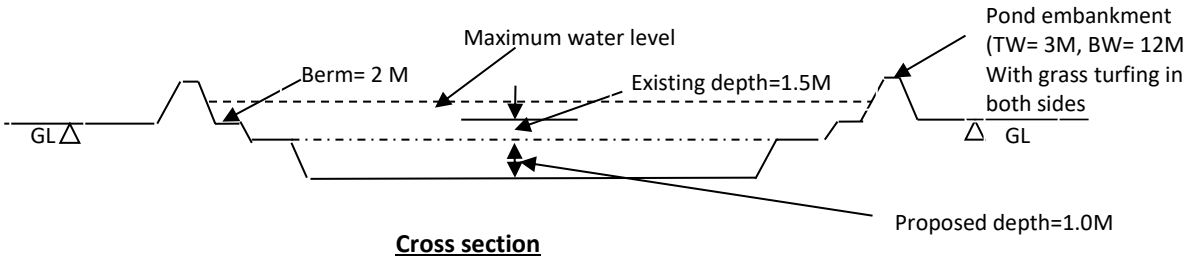
5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

Shape of Pond : Rectangular	
Av. Length of Pond = 115 m	Av. Width of Pond : 85 m
Proposed depth : 1.0m	Proposed berm in layer cutting=2.0m
Soil Type : silty loam/ clay	Depth of layer=0.5 m

Layout of the whole pond system: (existing and deepening)

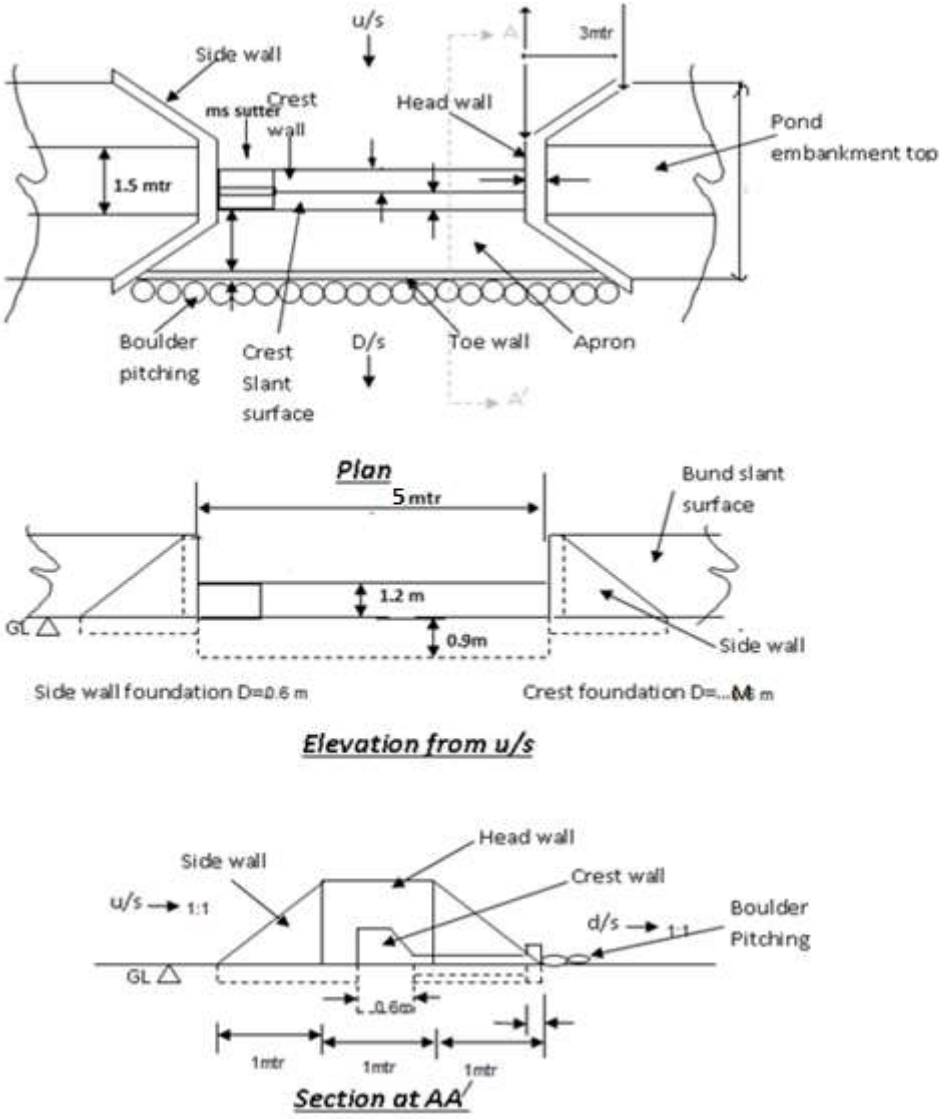




Cross section

5.2: Design and drawing of outlet:

An outlet weir will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.64 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec , that is greater than the Qp of 0.64cum/sec. Hence the outlet will be capable to discharge the peak runoff safe. Though the design peak runoff is far more than the required one, but to maintain economy of construction and further to provide a huge cushion in the structure, then carrying of construction materials in the site etc, the minimum crest length of waste weir would be 5m and other dimensions of the outlet would be as per the crest length and pond embankment. This would provide the structural stability and enhance the durability of the structure as outlet is one of the main components of embankment type of WHS and the stability and durability of the embankment depend on the capacity and stability of outlet. The design dimensions and estimate is given below.



5.3: Design and drawing of earthen bunds for land development: 2.0 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 1400RM	Volume of soil excavated : 1008cum
Plot Size: 50m * 50m	Total no of Plots: 10 nos. (approximately)

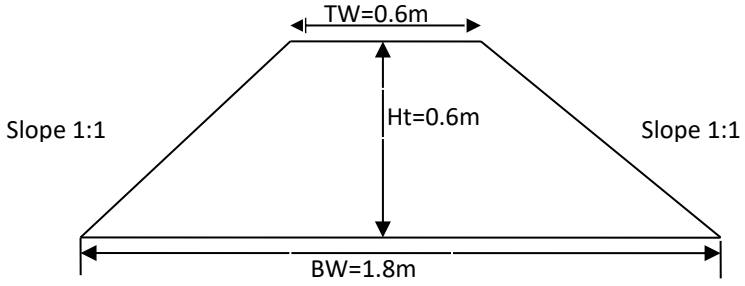


Figure 1: Cross section of the Bund

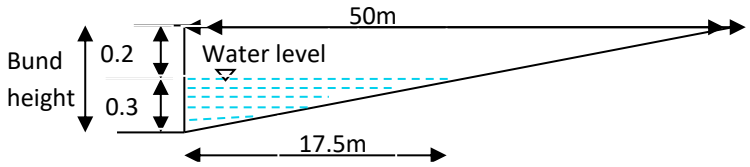
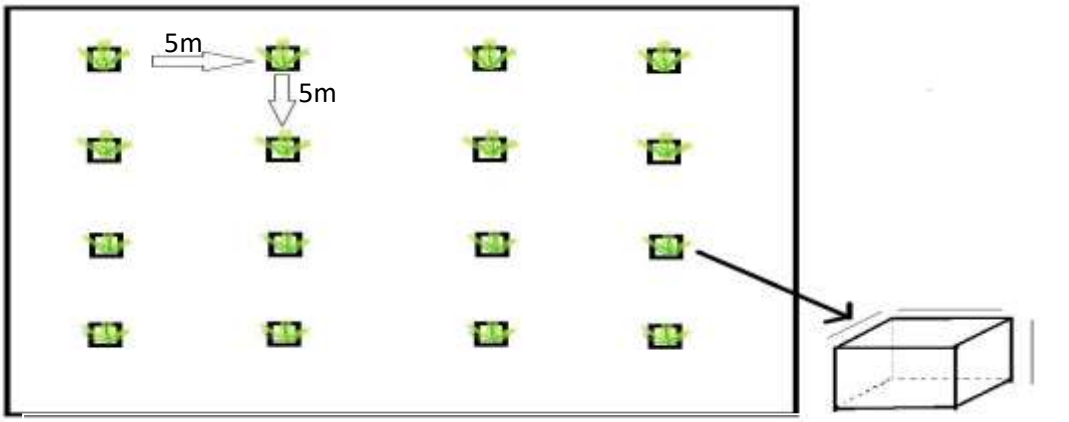


Figure: Section of Water to be stored in front of bunds.

5.4: Mango plantation: in 2 ha area

The land development part in the catchment and command area would be covered with Mango tree plantation as desired by the community. These plots are individual and it will be taken up under MGREGA as individual plantation. The species of mango tree plants would be considered those sapling are locally available. 400 plants per ha would be taken with a spacing of 5m x5m. A Typical layout of the plantation is provided below:



A layout of forest tree plantation with specification

6. How is the Work Climate Resilient?

Durability	• The WHS (9577cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 2,76,532cum and predicted maximum one day peak surface runoff (Qp)= 54919.1 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 3.63 times greater than the WHS capacity (76000 cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 49200cum against WHS capacity of 76000 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block.

	• The land development of 2.0 ha area designed to conserve 63% of total monsoon surface runoff and a total of 0.68 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 27 direct beneficiaries HHs for the CRW out of those 14 are belongs to ST, 9 are from SC and 4 are from OBC category. There is 1 Women headed HHs among the total 27 direct beneficiary HHs.
Integration	• A proper sized waste weir (5m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 2.0 ha area in the catchment and command area is proposed along with Mango plantation to conserve more water and to increase green coverage, reduced soil erosion and enhance ground water recharge.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

d. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Deepening of WHS	9577	cum	13,68,622	MGNREGA		27

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
2	CRW-1	Construction of outlet	1	Nos.	5,13,229	MGNREGA		
3	CRW-1	Land development	2	Ha	1,78,557	MGNREGA		
4	CRW-1	Mango plantation	2	Ha	2,29,930	MGNREGA	Tech support by Horticulture department	
		Total CR model Cost (Rs).			**22,90,338**			**27**

e. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (27 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	27 Small and marginal farmers	1000	27000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient	July,19 to Aug,19	2 trainings (42 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
		livelihood planning.							
F		Coverage of farmers under Crop insurance schemes (27 farmers covering 4 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2000	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**45700**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Bilenjore village, Komna Block of Nuapada district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development and plantation	Bilenjore village GP: Kanabira Block: Komna Dist : Nuapada 20°28'54''N 82°41'23''E	A, B	WHS, and Soil and water conservation and plantation	NA	Renovation of WHS (3764 cum), construction of one outlet. Land development in 2 ha area and plantation in 2 ha.	NA

2. Rationale for selection of Works

As per the Hot spot Climate Modelling report of IISC- Banglore the mean rainfall of Komana block between the month of June to September over a period of 30 years (1984-2014) is 1076 mm and its coefficient variation is 25.19. According to the 30 years historical data, the highest rainfall (mm) received in a day is 163 mm and the number of years with normal sowing rain pattern is 8 years whereas 22 year it received abrupt and erratic pattern of rainfall. Komana block has suffered high drought condition in last 30 years out of which 3 years was severe drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 42.3 % and the projected coefficient of variation of the rainfall will be 31.1 for 2021-2050 years.

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The block Komna is situated south of the Nuapada block and block Head quarter Nuapada. The west side of the block is bordering to CG. Almost half of the geographical area of block is hilly and undulating. If we draw a line from north to south in the middle of the block, then the south part is

complexly hill area with highest elevation is 830m from the msl. The east part is comparatively plain and paddy grown area with lowest altitude is 255m from msl. Due to this undulation there are three types of lands –upland medium and low land. Most of the low lands do not face moisture stress and some of those are even use for second crops also. There are some Minor Irrigation Projects (MIPs) get water from dams constructed in the hills and foot hills in the block. Due to these MIPs most of plain art get irrigation water and some places second crop (rabi paddy) are also seen. There are many other small tanks in the foot hills low altitude hills and upland, some of those are working and also providing irrigation, however many of them are not functioning properly and need some minor renovation and deepening to make those functional. Some other supporting activities such as land development, LBCDs, and plantation are also required to make these tanks more durable.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought • Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Plantation (Forest trees in community land)	• To increase vegetative covers, • To reduce soil erosion and enhance ground water recharge. • To create carbon sink in long run

4. Site Details

The proposed CRW core activity –Water Harvesting Structure is an embankment type structure located just below the foothill. Though there is huge pondage area in front of the embankment, however depth is shallow as during construction earthwork excavation is done only to build the embankment. Hence there is opportunity to increase the capacity of the WHs by earth work excavation in the pondage area and also by construction an outlet. The catchment area of the WHS is hilly with high slope (maximum is 32%) with dense forest tree and shrub cover. Hence no such soil erosion and deposition of silt traces. There are two small barren patches with total area of 2 ha in both side of the WHS in the catchment and command area. Both the patches are proposed to develop by undertaking land development activities such as earthen bunds. These patches are community land thus community proposed forest tree plantation in these patches after land development work has been implemented. The CRW is located little far from the village habitat area and there is no approach road, however, the site is reachable through wide embankment of paddy plots. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Embankment type
3. Shape of the pond : Irregular/Triangular
4. Slope of the catchment : hilly, maximum 32%
5. Type of Soil : Clay/ silty loam
6. Bed Rock : Seems not appear inside of pond
7. Av. depth of the pond (Present) : 1.0m
8. Proposed Extra depth of Pond : 2m Total depth=3.0
9. Existing area of the pond : 0.35 ha (100mx35m)
9. Proposed area to be excavated {LXB) : 2000 sq.m (Av. L=100m Av. W=20m)
11. Catchments area of the pond : 15.81 ha
12. Command area of the pond : 4 ha in *Kharif* and 1.5 ha in *Rabi*
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

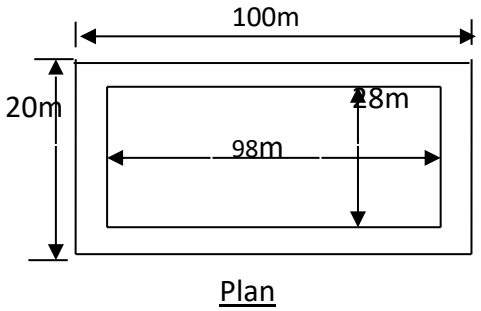
Where C1= Runoff Coefficient of the hilly catchment =0.5 (clay/silty loam, slope>10%)
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(163+163*.311)/1000 = 0.2137 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 15.81 ha
Peak Run off (Qp) =(158100x0.5)x0.2137= 16893 cum/day or say 0.20 cum/sec,
14. The total surface runoff for the monsoon period, Q= 158100x0.5x1.076=85057.8 cum (Where, 1.076m is the average mean rainfall of monsoon period for Komna block.). The total surface runoff is 7.9 times greater than the pond capacity of 10764 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

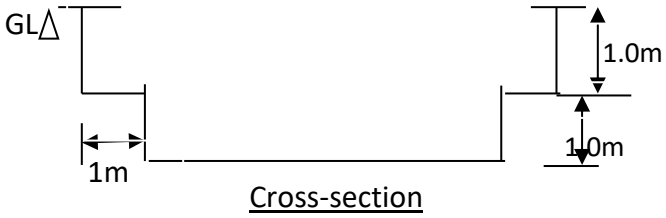
5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

Shape of Pond : Rectangular	
Av. Length of Pond = 100 m	Av. Width of Pond : 20 m

Proposed depth : 2.0m	Proposed berm in layer cutting=2.0m
Soil Type : silty loam/ clay	Depth of layer=1.0 m

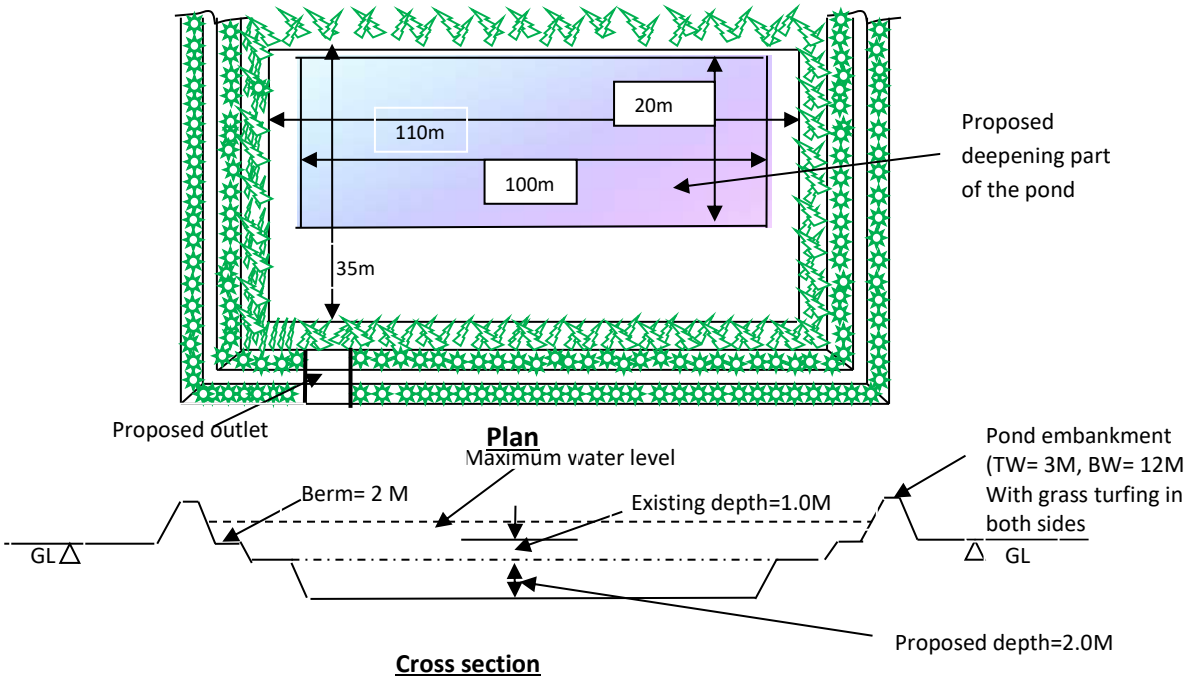


Plan



Cross-section

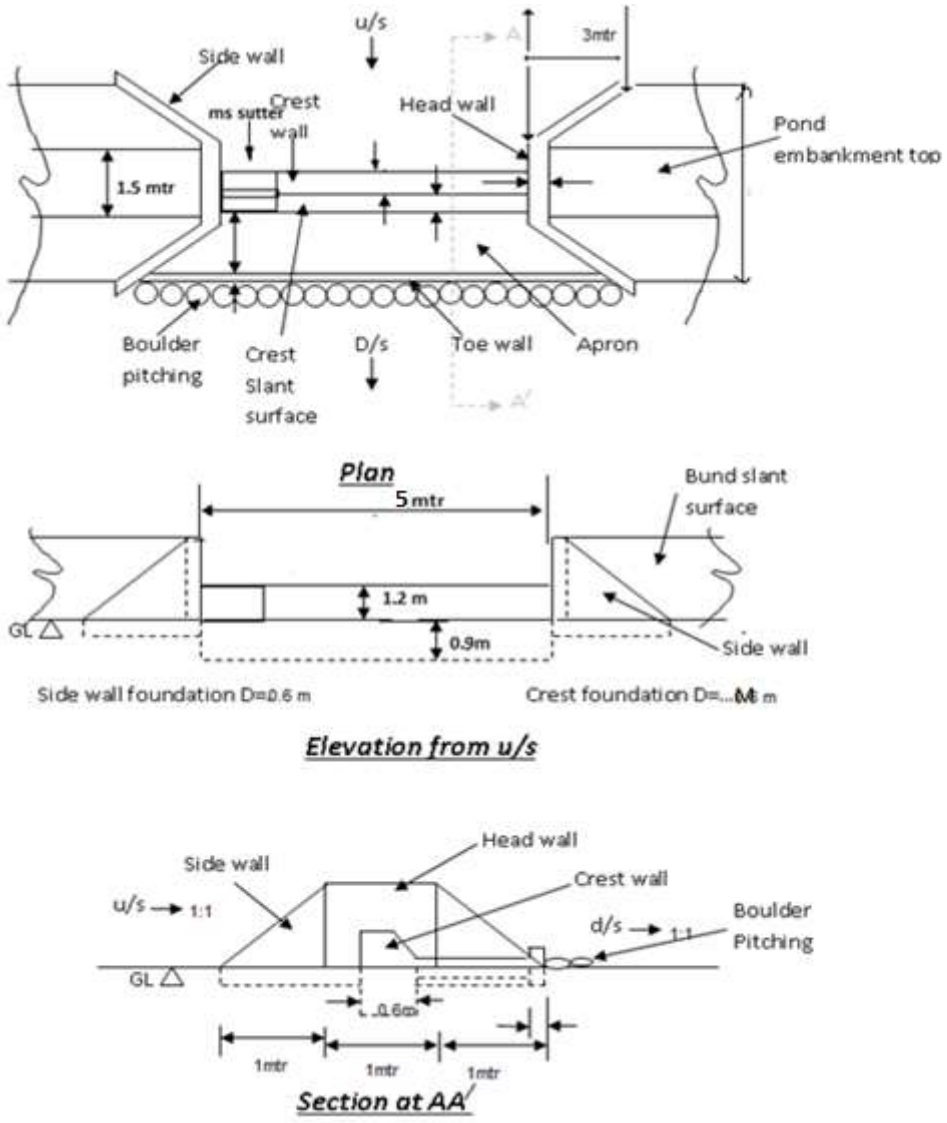
Layout of the whole pond system: (existing and deepening)



5.2: Design and drawing of outlet:

An outlet weir will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.20 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec , that is greater than the Qp of 0.64cum/sec. Hence the outlet will be capable to discharge the peak runoff safe. Though the design peak runoff is far more than the required one, but to maintain economy of construction

and further to provide a huge cushion in the structure (as the structure is embankment type), and carrying of construction materials in the site etc, the minimum crest length of waste weir would be 5m and other dimensions of the waste weir would be as per the crest length and pond embankment. This would provide the structural stability and enhance the durability of the structure as outlet is one of the main components of embankment type of WHS and the stability and durability of the embankment depend on the capacity and stability of outlet. The design dimensions and estimate is given below.



5.3: Design and drawing of earthen bunds for land development: 2.0 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 1400RM	Volume of soil excavated : 1008cum
Plot Size: 50m * 50m	Total no of Plots: 10 nos. (approximately)

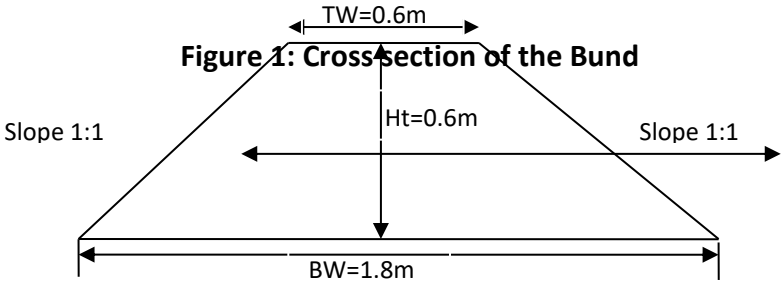
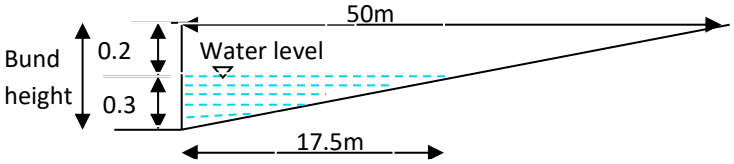


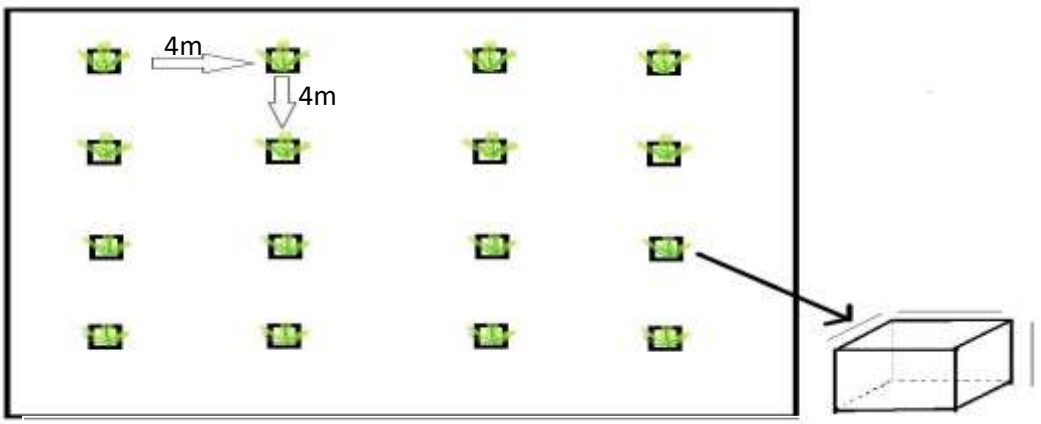
Figure 1: Cross section of the Bund

Figure: Section of Water to be stored in front of bunds.



5.4: Forest tree plantation: in 2 ha area

The land development part in the catchment and command area would be covered with forest tree plantation as desired by the community. These plots are belong to community and it will be taken up under MGREGA as community plantation. The local high growth forest plans would be considered those sapling are locally available. 600 plants per ha would be taken with a spacing of 4m x4m. A Typical layout of the plantation is provided below:



A layout of forest tree plantation with specification

Pit (0.6mx0.6mx0.6m)

6. How is the Work Climate Resilient?

Durability	• The WHS (3764 cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 85057.8 cum and predicted maximum one day peak surface runoff (Qp)= 16893 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 7.9 times greater than the WHS capacity (10764 cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 8000 cum against WHS capacity of 10764 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 2.0 ha area designed to conserve 80% of total monsoon surface runoff and a total of 0.86 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 26 direct beneficiaries HHs for the CRW out of those 3 are belongs to ST, 1 from SC and 22 are from OBC category. There are 2 Women headed HHs and 1 disable among the total 27 direct beneficiary HHs.
Integration	• A proper sized waste weir (5m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 2.0 ha area in the catchment and command area is proposed along with forest tree plantation to conserve more water and to increase green coverage, reduced soil erosion and enhance ground water recharge.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses.

	• ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

f. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-2	Deepening of WHS	9577	cum	6,06,958	MGNREGA		26
2	CRW-2	Construction of outlet	1	Nos.	5,13,229	MGNREGA		
3	CRW-2	Land development	2	Ha	1,78,557	MGNREGA		
4	CRW-2	Forest tree plantation	2	Ha	65,525	MGNREGA	Tech support by Horticulture department	
		Total CR model Cost (Rs).			**13,64,269**			**26**

g. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (26 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
									cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	26 Small and marginal farmers	1000	26000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (26 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (26 farmers covering 4 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	2000	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**44700**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Borpadar village, Lanjigarh Block of Kalahandi district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, and Land Development	Borpadar village GP: Pahadpar Block: Lanjigarh Dist : Kalahandi 19°40'13.85''N 83°10'48.44''E	A, B	WHS, and Soil and water conservation	NA	Renovation of WHS (4564 cum), construction of one outlet. Land development in 6.85 ha area	NA

2. Rationale for selection of Works

As per climate Modelling Report of IISC -Banglore the mean rainfall of Lanjighar block between the month of June to September over a period of 30 years (1984-2014) is 1189 mm and its coefficient variation is 28.4%. According to the 30 years historical data, the highest rainfall (mm) received in a day is 210 mm and the number of years with normal sowing rain pattern is 7-year whereas 23 year it received abrupt and erratic pattern of rainfall. Lanjighar block has suffered high drought condition in last 30 years out of which 6 years was severe drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be increasing up to 46.7% and the projected coefficient of variation of the rainfall will be 25.3 for 2021-2050 years.

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

Lanjigarh block is one of the hilliest blocks in Kalahandi district. The block is bordering (south side) to Rayagada and kandhamala district an dbothe districts are hilly district. The topography of the block is fully undulating and elevation ranges from 360 m (in plan cultivated area) to almost 1220m from msl in the hilltop. The block has approximately one third plain area and rest is hilly area. No such major river flows through the block area, however as block is surrounded by large and small hills in east,

west and south sides, there are streams/nalas found in the block and mostly those flows from south to north direction and finally these stream discharge runoff water to the Udanti River. Due to undulating topography the block had huge scope of constructing WHS in foothills to harvest hill surface runoff. There are many small to medium WHS are found in almost every corner of these foothills, however many of them are not functioning and thus left with options of renovating those either by desilting, repairing a dilapidated outlet or repairing embankment and canal. Thus the small investment to these structures could bring large impact to harvest huge surface runoff, reduces risk of flood and drought and also would enhance ground water recharge. Other opportunities are land development through earthen bund and land levelling along with LBCDs in small eroded streams etc. The block is mostly grows rainfed crops as net irrigated area in the block is very low i.e. 3.2% (source: SECC, 2011). Thus most of the low lands in the block are covered with single kharif crop and that is paddy and uplands are mostly covered with paddy, cotton, maize and other leguminous crops.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought • Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.

4. Site Details

The selected CRW site is located in the extreme east side of the block. The topography of this part of the block is highly undulating due to existence of large numbers of medium and small size hillocks. The CRW site is located in upper plateau in the block at the elevation more than 800m from msl. The core activity a WHS is located just below the foothill with huge catchment area and

the command area is just downstream of the pond. As the pond is located just at the foot hill, during field visit it found that there are no such plots available in the catchment that need any kind of treatment. The vegetation in hill's slant surface is good, thus no such soil erosion or siltation traces. The depth of WHS was shallow and thus required deepening to increase capacity and thus to bring some cultivable plot in the downstream in to irrigation. The command area is adjacent to the village habitat area and the cultivable plots are terrace types due to the hilly topography. Thus irrigation would be easy through gravitational force. Some of the command area plots are found large in size and undulating and without land development irrigation is not possible, thus to treat those plots land development activities are proposed. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : dugout type
3. Shape of the pond : Rectangular
4. Slope of the catchment : 12%
5. Type of Soil : silty/sandy loam/morrum
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.0 m
8. Proposed Extra depth of Pond : 1. 5 m Total depth=2.5
9. Proposed area to be excavated {LXB) : 3200 sqm (Av. L=80m Av. W=40m)
11. Catchments area of the pond : 20.9 ha,
12. Command area of the pond : 4.1 ha in kharif 1 ha in rabi.
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

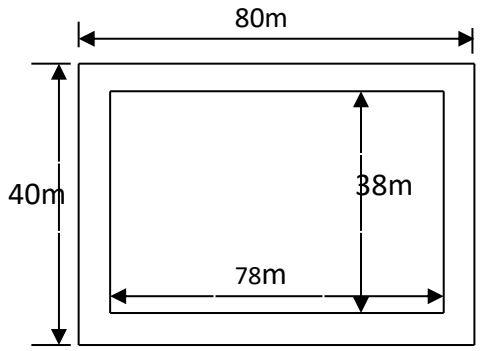
Where C= Runoff Coefficient for both types catchment =0.5
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(210+210*.2843)/1000 = 0.2697 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 20.9 ha
Peak Run off (Qp) =(209000x0.50)x.2697= 28183.96 cum/day or say 0.33 cum/sec,
14. The total surface runoff for the monsoon period, Q= 209000x0.5x1.189=124250.5 cum (Where, 1.189m is the average mean rainfall of monsoon period for Lanjigarh block.). The total surface runoff is 11.09 times greater than the pond capacity of11200 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

Shape of Pond : Square	
Av. Length of Pond = 80 m	Av. Width of Pond : 40 m
Proposed depth : 1.5m	Proposed berm in layer cutting=2.0m

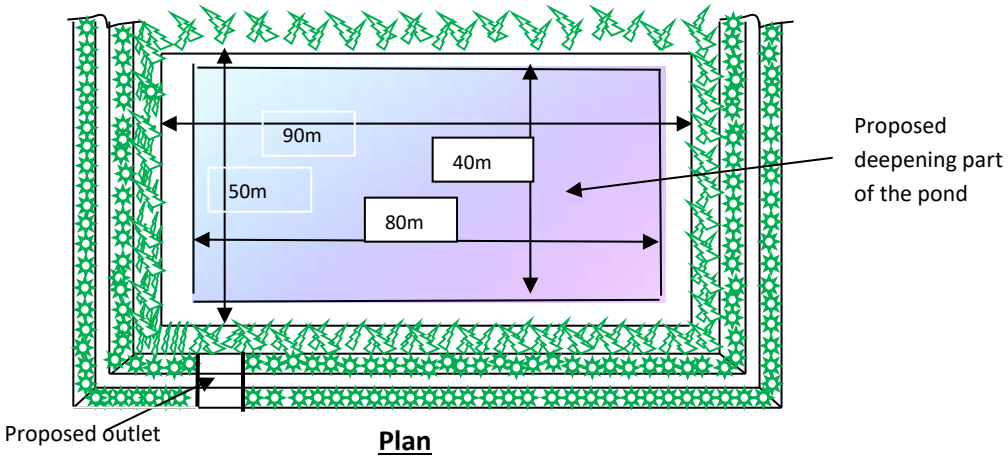
Soil Type : silty loam and clay	Depth of layer=0.5 and 1.0m



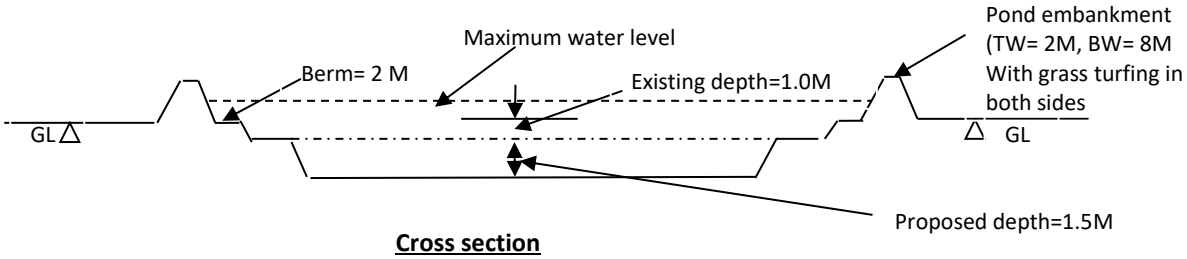
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



Plan

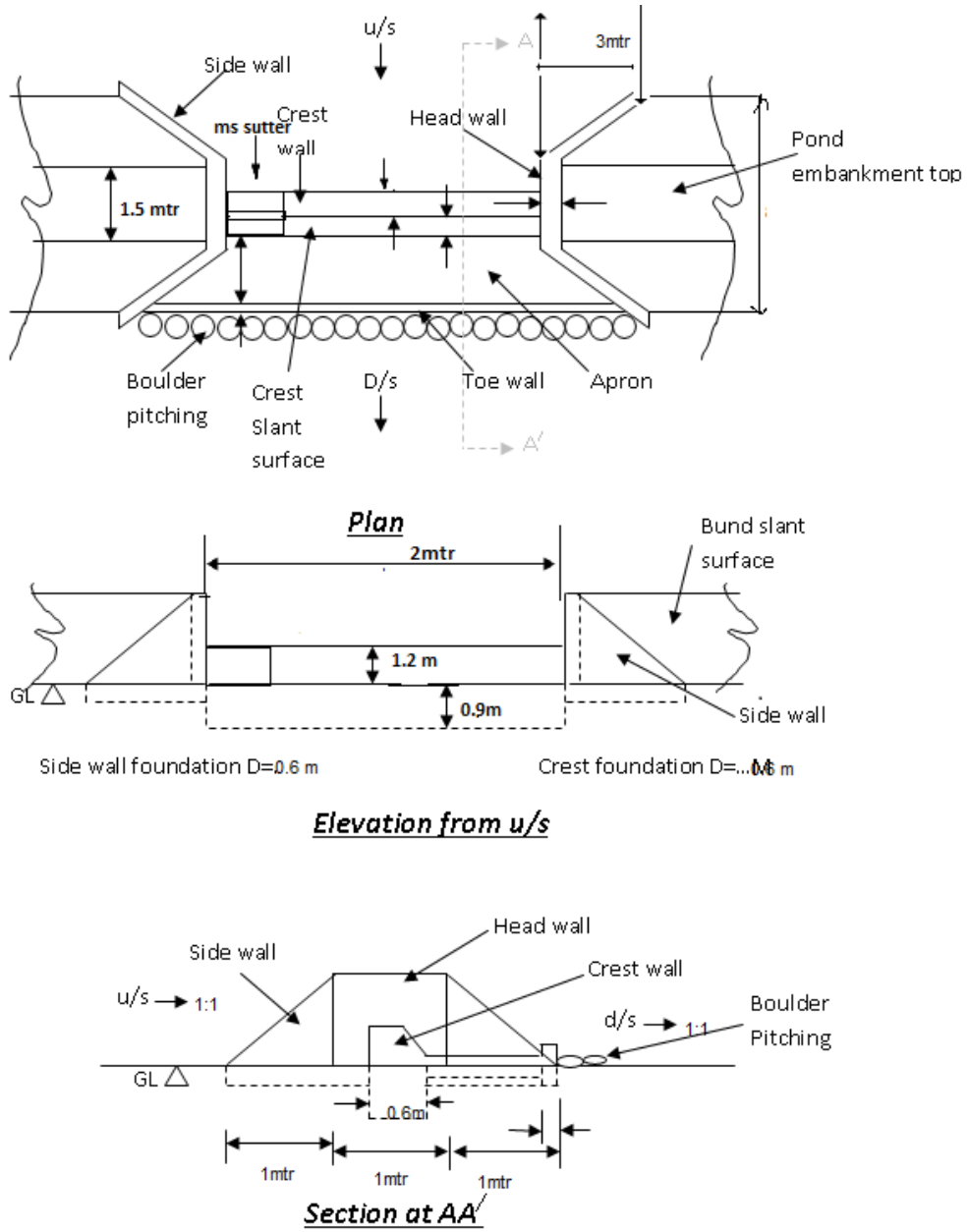


Cross section

5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.33 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.6 m, we have Q=1.2x2x0.6=1.44 cum per sec , that is greater than the Qp of 0.33cum/sec. Hence the outlet will be capable to discharge the peak runoff safe. MS shutter would be

provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would required in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The design dimensions and estimate is given below.



5.3: Design and drawing of earthen bunds for land development: 6.85 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 4795RM	Volume of soil excavated : 3560.73 cum
Plot Size: 50m * 50m	Total no of Plots: 28 nos. (approximately)

Figure 1: Cross section of the Bund

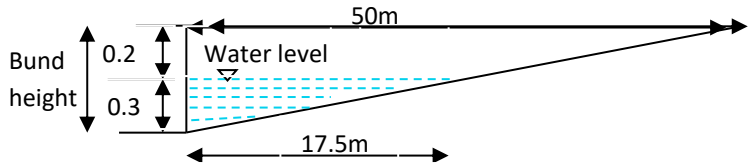
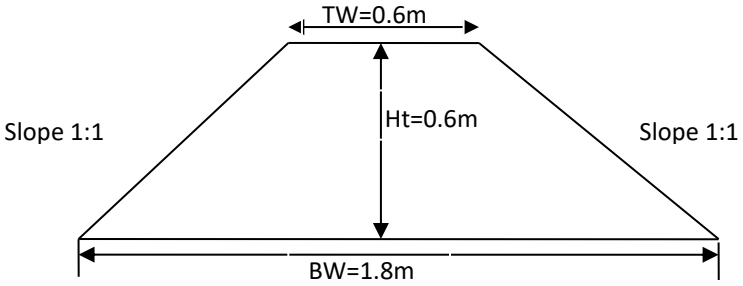


Figure: Section of Water to be stored in front of bunds.



6. How is the Work Climate Resilient?

Durability	• The WHS (4564 cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 124250.5 cum and predicted maximum one day peak surface runoff (Qp)= 28183.96 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 11.09 times greater than the WHS capacity (11,200cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 8200cum against WHS capacity of 11200 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 6.85 ha area designed to conserve 63.2% of total monsoon surface runoff and a total of 2.5 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as ITDA, Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area arhar/mung on bund also would be taking as another source of livelihoods.
Inclusion	• There are 27 direct beneficiaries HHs for the CRW out of those 22 are belongs to ST, 4 are from SC and 1 from OBC community. There are 4

	Women headed HHs are also direct beneficiaries of the CRW among the total 27 direct beneficiaries.
Integration	• A proper sized outlet (2 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 6.85 ha area in the catchment and command area is proposed to conserve more water and to increase irrigation efficiency.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

h. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Deepening of WHS	4564	cum	6,41,298	MGNREGA		27
2	CRW-1	Construction of outlet	1	Nos.	2,93,229	MGNREGA		
3	CRW-1	Land development	6.85	Ha	5,30,909	MGNREGA		
		Total CR model Cost (Rs).			**14,65,436**			**27**

i. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought	Training to farmers on Drought	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
	Resilient Agriculture .	Resilient Agriculture (27 HHs)							cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30 /kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	27 Small and marginal farmers	1000	27000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (42 farmers)	Rs.2500 /- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (27 farmers covering 5 Ha)	July 19 to August, 19	Rs.500 /- per Ha.	500/Ha	2500	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**46200**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Kutingpadar village, Lanjigarh Block of Kalahandi district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, and Land Development	Kutingpadar village GP: Lokabahali Block: Lanjigarh Dist : Kalahandi 19°41'59.52"N 83°15'57.35"E	A, B	WHS, and Soil and water conservation	NA	Renovation of WHS (4092 cum), construction of one outlet. Land development in 6.00 ha area	NA

2. Rationale for selection of Works

As per climate Modelling Report of IISC -Banglore the mean rainfall of Lanjighar block between the month of June to September over a period of 30 years (1984-2014) is 1189 mm and its coefficient variation is 28.4%. According to the 30 years historical data, the highest rainfall (mm) received in a day is 210 mm and the number of years with normal sowing rain pattern is 7-year whereas 23 year it received abrupt and erratic pattern of rainfall. Lanjighar block has suffered high drought condition in last 30 years out of which 6 years was severe drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be increasing up to 46.7% and the projected coefficient of variation of the rainfall will be 25.3 for 2021-2050 years.

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

Lanjigarh block is one of the hilliest blocks in Kalahandi district. The block is bordering (south side) to Rayagada and kandhamala district an dbothe districts are hilly district. The topography of the block is fully undulating and elevation ranges from 360 m (in plan cultivated area) to almost 1220m from msl in the hilltop. The block has approximately one third plain area and rest is hilly area. No such major river flows through the block area, however as block is surrounded by large and small hills in east,

west and south sides, there are streams/nalas found in the block and mostly those flows from south to north direction and finally these stream discharge runoff water to the Udanti River. Due to undulating topography the block had huge scope of constructing WHS in foothills to harvest hill surface runoff. There are many small to medium WHS are found in almost every corner of these foothills, however many of them are not functioning and thus left with options of renovating those either by desilting, repairing a dilapidated outlet or repairing embankment and canal. Thus the small investment to these structures could bring large impact to harvest huge surface runoff, reduces risk of flood and drought and also would enhance ground water recharge. Other opportunities are land development through earthen bund and land levelling along with LBCDs in small eroded streams etc. The block is mostly grows rainfed crops as net irrigated area in the block is very low i.e. 3.2% (source: SECC, 2011). Thus most of the low lands in the block are covered with single kharif crop and that is paddy and uplands are mostly covered with paddy, cotton, maize and other leguminous crops.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought • Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.

4. Site Details

The CRW site is located in the northern part of the block and in the plain cultivated part. The pond selected as core activity of the CRW is located just below a foothill. The downstream part is the beginning of the large plain area of the block. This plain part is the most productive part of the block in term of agricultural production. As the pond is just below the foothill, the entire catchment area falls in the hilly and forest area. Except a small area

of 2 ha that is degraded. Catchment characteristics are hilly high slope with moderate to thick forest cover. The command area is well developed agricultural plots with mono cropped area consisting medium and low land. Paddy, cotton and arhar are the main crops in the command area. Village households are located sparsely and also some HHs are inside the command area. A 300 m long diversion earthen canal is already there to catch the surface ruoff of slant surface of hill and divert the runoff in the pond. Similarly in the downstream another earthen canal is there to discharge excess water from the pond. Though the pond receives huge runoff but as the pond is located in the upland and depth is less, no water found after rainy season. Hence increase of depth and construction of outlet would enable to pond hold water beyond the rainy season. The image of area is shown above and details features of the site are given below.

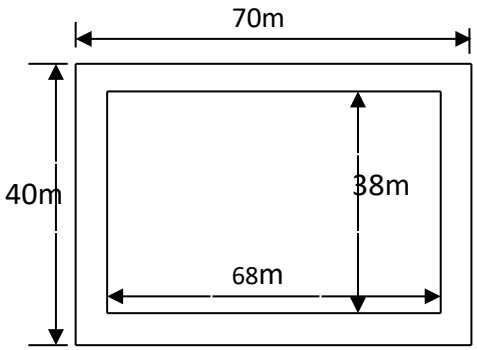
1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : dugout type
3. Shape of the pond : Rectangular
4. Slope of the catchment : 5-8%%
5. Type of Soil : silty/sandy loam/morrum
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.0 m
8. Proposed Extra depth of Pond : 1. 5 m Total depth=2.5
9. Proposed area to be excavated {LXB) : 2800 sqm (Av. L=70m Av. W=40m)
11. Catchments area of the pond : 12.32 ha,
12. Command area of the pond : 3.2 ha in kharif 1 ha in rabi.
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C= Runoff Coefficient for both types catchment =0.5
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(210+210*.2843)/1000 = 0.2697 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 12.32 ha
Peak Run off (Qp) =(123200x0.35)x.2697= 11629.46 cum/day or say 0.13 cum/sec,
14. The total surface runoff for the monsoon period, Q= 123200x0.35x1.189=51269.68 cum (Where, 1.189m is the average mean rainfall of monsoon period for Lanjigarh block.). The total surface runoff is 5.23 times greater than the pond capacity of 9800 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

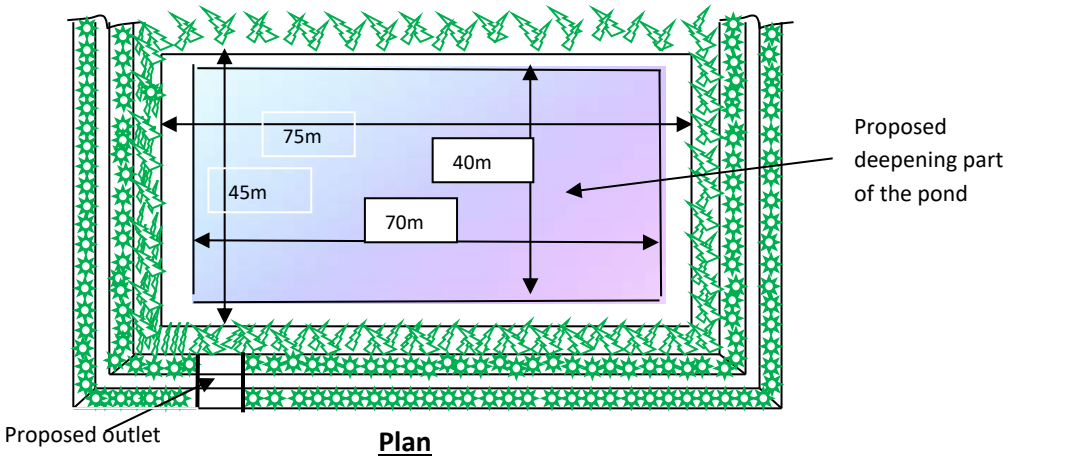
Shape of Pond : Square	
Av. Length of Pond = 70 m	Av. Width of Pond : 40 m
Proposed depth : 1.5m	Proposed berm in layer cutting=2.0m
Soil Type : silty loam and clay	Depth of layer=0.5 and 1.0m



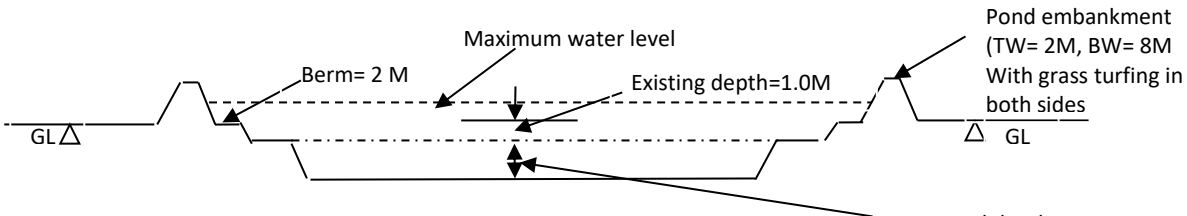
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



Plan

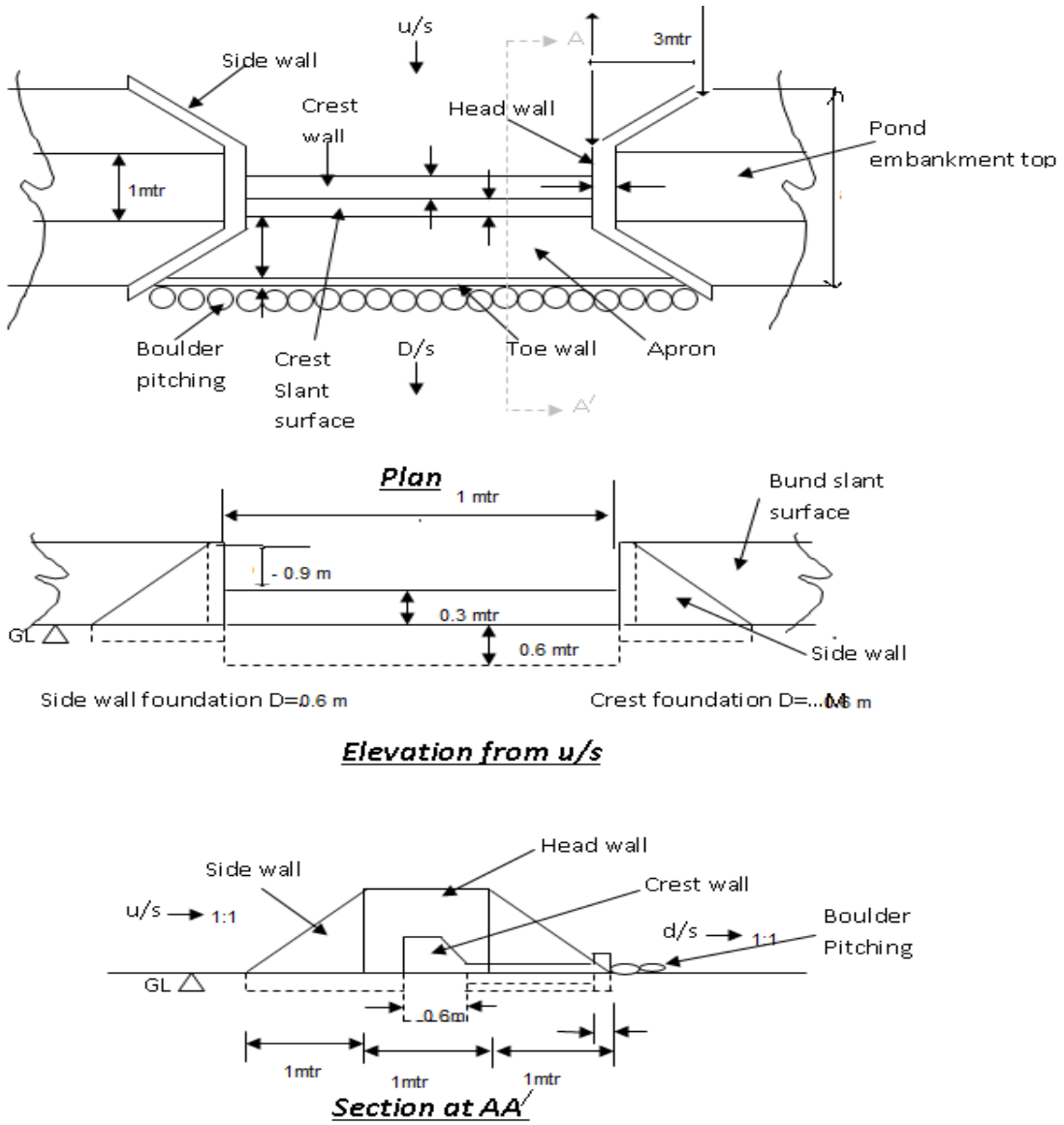


Cross section

5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.13 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 1m and flow height of 0.6 m, we have Q=1.2x1x0.6=0.72 cum per sec , that is greater than the Qp of 0.13cum/sec. Hence the outlet will be capable to discharge the peak runoff safe. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however

when water would required in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The design dimensions and estimate is given below.



5.3: Design and drawing of earthen bunds for land development: 6.85 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 4200RM	Volume of soil excavated : 3118.89 cum
Plot Size: 50m * 50m	Total no of Plots: 24 nos. (approximately)

Figure 1: Cross section of the Bund

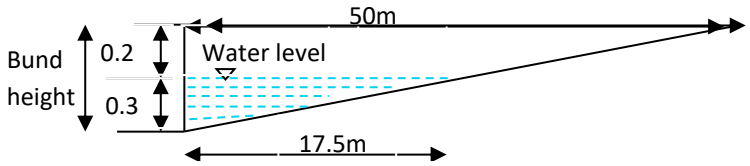


Figure: Section of Water to be stored in front of bunds.

6. How is the Work Climate Resilient?

Durability	• The WHS (4092 cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 51269.68 cum and predicted maximum one day peak surface runoff (Qp)= 11629.46 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 5.23 times greater than the WHS capacity (9800cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 6400cum against WHS capacity of 9800 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 6.00 ha area designed to conserve 65% of total monsoon surface runoff and a total of 1.6 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as ITDA, Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area arhar/mung on bund also would be taking as another source of livelihoods.
Inclusion	• There are 23 direct beneficiaries HHs for the CRW out of those 18 are belongs to ST, 1 from SC and 4 are from OBC community. There are 3 Women headed HHs and 1 disable HH also direct beneficiaries of the CRW among the total 23 direct beneficiaries.
Integration	• A proper sized outlet (1.00 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond.

	• Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 6.00 ha area in the catchment and command area is proposed to conserve more water and to increase irrigation efficiency.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

j. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Deepening of WHS	4564	cum	5,75,870	MGNREGA		23
2	CRW-1	Construction of outlet	1	Nos.	1,93,229	MGNREGA		
3	CRW-1	Land development	6.85	Ha	4,66,807	MGNREGA		
		Total CR model Cost (Rs).			**12,35,906**			**23**

k. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (23 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	23 Small and marginal farmers	1000	23000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (23 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (23 farmers covering 2 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	1000	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**40,700**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Parkod village, Nuapada Block of Nuapada district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development and plantation	Parkod village GP: Parkod Block: Nuapada Dist : Nuapada 20°57'03.39''N 82°36'44.38''E	A, B	WHS, and Soil and water conservation and plantation	NA	Renovation of WHS (7108 cum), construction of one outlet. Land development in 4 ha area and plantation in 4 ha.	NA

2. Rationale for selection of Works

As Per the Hot spot report on climate Modelling prepared by IISC – Banglore the mean rainfall of Naupada block between the month of June to September over a period of 30 years (1984-2014) is 1134 mm and its coefficient variation is 26.98. According to the 30 years historical data, the highest rainfall (mm) received in a day is 148 mm and the number of years with normal sowing rain pattern is 6 year whereas 24 year it received abrupt and erratic pattern of rainfall. Naupada block has suffered high drought condition in last 30 years out of which 6 years was severe drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 45.3 % and the projected coefficient of variation of the rainfall will be 32.8 for 2021-2050 years.

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The block Nuapada having both hilly as well as undulated area. Undulated are having three types of lands –upland medium and low land. Most of the low lands do not face moisture stress and some of those are even use for second crops also. There are some Minor Irrigation Projects (MIPs) get water

from dams constructed in the hills and foot hills in the block. Due to these MIPs some places second crop (rabi paddy) are seen in the Nuapada block. There are many other small tanks in the foot hills and upland, some of those are working and also providing irrigation, however many of them are not functioning properly and need some minor renovation and deepening to make those functional. Some other supporting activities are also required to make these tanks more durable.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought • Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Plantation (forest trees in common land)	• To increase vegetative covers, • To reduce soil erosion and enhance ground water recharge. • To create carbon sink in long run

4. Site Details

The selected CRW site is located in the extreme north and east side of the block. Almost near the CG border. The topography of the CRW site is undulating with three types of lands. In the downstream of the pond there is low land and medium land. In the upstream there is upland with moderate forest cover. Hence the catchment characteristics of pond are upland with thin and moderate forest cover. Through the catchment is upland; however the slope is low 2-3% only. Hence no such severe erosion traces in the catchment. The command area is low and medium

land. The low land part of the command area is paddy grown area. During a good and normal rainfall year due to existence of the pond in the upstream, some farmers take second paddy in the command area The medium land plots in the command area is mostly covered with Arhar, cotton and paddy but need land development work. Some trees also found in this medium land part of the command area. Hence community has proposed land development activities along with plantation in this area. The pond is situated approximately 500m away from the village habitat area, however there is a kuchha approach road that connect village with the pond. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : dugout type
3. Shape of the pond : Rectangular
4. Slope of the catchment : 2-3%
5. Type of Soil : silty clay
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.5 m
8. Proposed Extra depth of Pond : 1. 0 m Total depth=2.5
9. Existing area of the pond : 1.61 ha (230mx70m)
9. Proposed area to be excavated {LXB) : 7500 sqm (Av. L=150m Av. W=50m)
11. Catchments area of the pond : 21.94 ha,
12. Command area of the pond : 8 ha in Khraif and 3 ha in Rabi
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

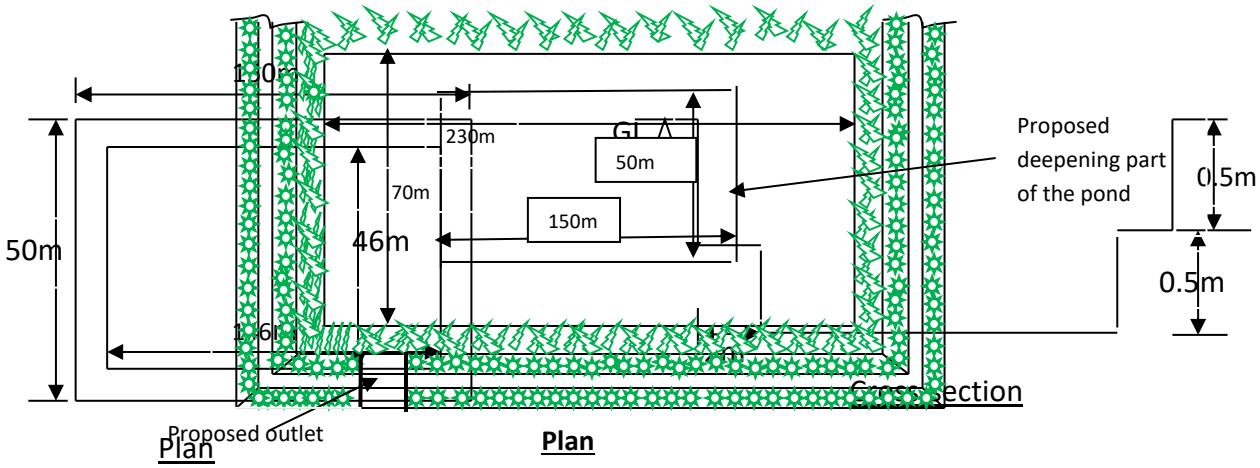
Where C= Runoff Coefficient of the catchment =0.4 (pasture, Silty clay, slope 0-5%)
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(148+148*.328)/1000 = 0.1965 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 21.94 ha
Peak Run off (Qp) =(219400x0.40)x.1965= 17244.84 cum/day or say 0.20 cum/sec,
14. The total surface runoff for the monsoon period, Q= 219400x0.4x1.134=99519.84 cum (Where, 1.134m is the average mean rainfall of monsoon period for Nuapada block.). The total surface runoff is 3.2 times greater than the pond capacity of31258 cum. Hence, this is sufficient to fill the pond during monsoon period.

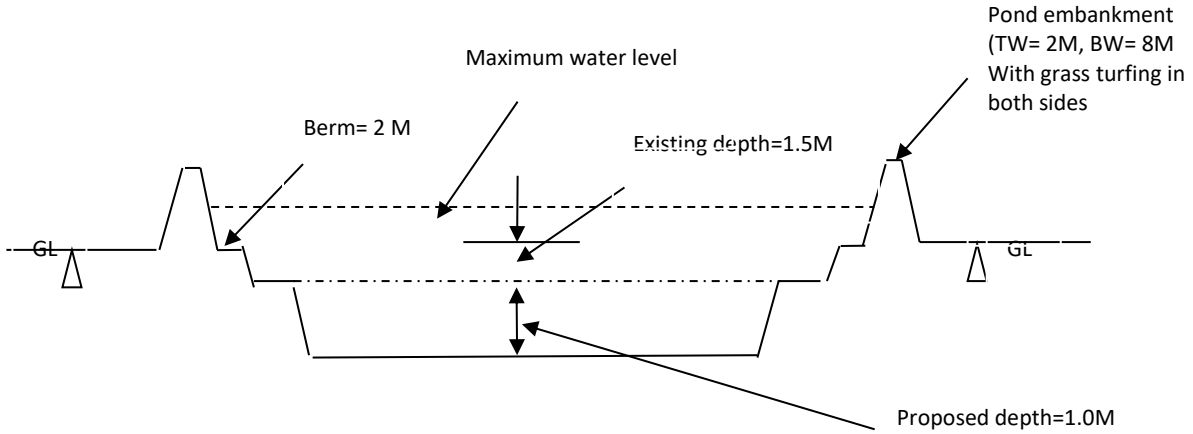
5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

Shape of Pond : Rectangular	
Av. Length of Pond = 150 m	Av. Width of Pond : 50 m
Proposed depth : 1.0m	Proposed berm in layer cutting=2.0m
Soil Type : silty clay	Depth of layer=0.5

Layout of the whole pond system: (existing and deepening)

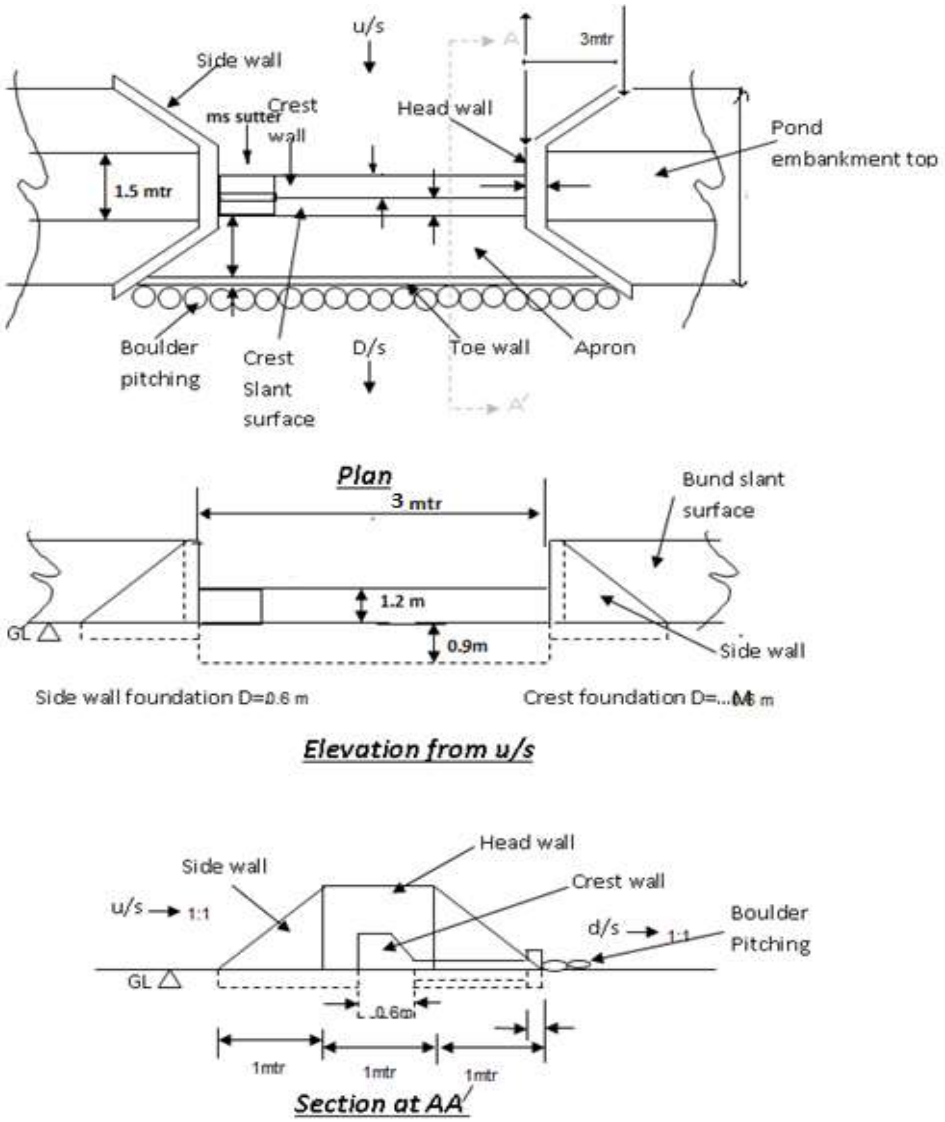




Cross section

5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.20 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec , that is greater than the Qp of 0.20cum/sec. Hence the outlet will be capable to discharge the peak runoff safe, however as the pond is a huge one thus 3m crest length of outlet is proposed. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would required in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The design dimensions and estimate is given below.



5.3: Design and drawing of earthen bunds for land development: 4 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 2800RM	Volume of soil excavated : 2016 cum
Plot Size: 50m * 50m	Total no of Plots: 16 nos. (approximately)

Figure 1: Cross section of the Bund

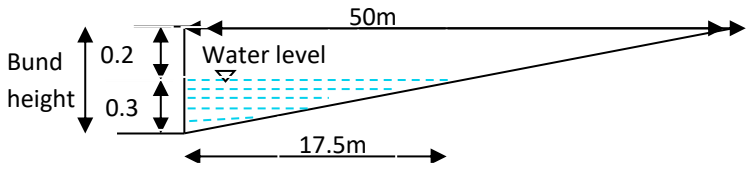
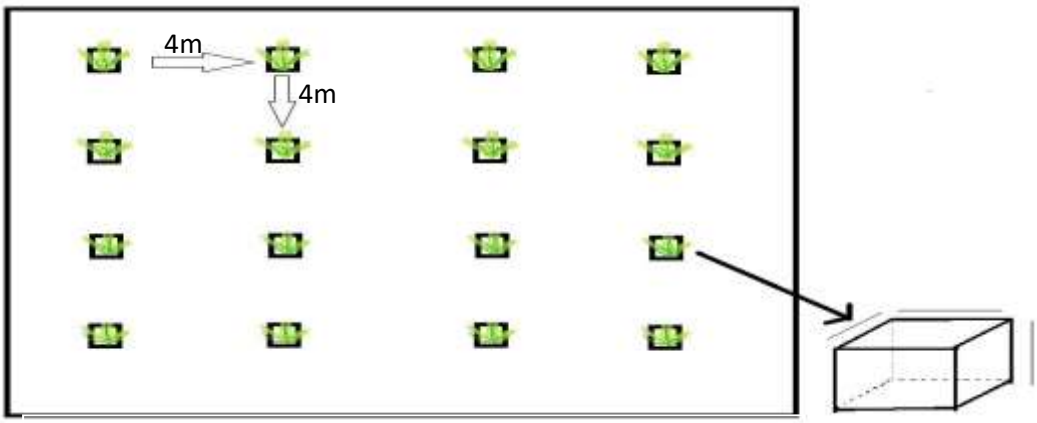


Figure: Section of Water to be stored in front of bunds.

5.4: Forest tree plantation: in 4 ha area

The land development part in the catchment and command area would be covered with forest tree plantation as desired by the community. These plots are belong to community and it will be taken up under MGREGA as community plantation. The local high growth forest plans would be considered those sapling are locally available. 600 plants per ha would be taken with a spacing of 4m x4m. A Typical layout of the plantation is provided below:



A layout of forest tree plantation with specification

Pit (0.3mx0.3mx0.3m)

6. How is the Work Climate Resilient?

Durability	• The WHS (7108cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 99519.84 cum and predicted maximum one day peak surface runoff (Qp)= 17244.84 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 3.2 times greater than the WHS capacity (31258cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 24000cum against WHS capacity of 31258 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface

	runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 4 ha area designed to conserve 80% of total monsoon surface runoff and a total of 1.4 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 28 direct beneficiaries HHs for the CRW out of those 03 are belongs to ST, 07 are from SC and 18 from OBC community. There are 2 Women headed HHs and one disable HHs among the total 28 direct beneficiary HHs.
Integration	• A proper sized outlet (3 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 4.00 ha area in the catchment and command area is proposed along with forest tree plantation to conserve more water and to increase green coverage, reduced soil erosion and enhance ground water recharge.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

l. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Deepening of WHS	4564	cum	9,98,848	MGNREGA		28
2	CRW-1	Construction of outlet	1	Nos.	2,93,229	MGNREGA		
3	CRW-1	Land development	4	Ha	3,71,014	MGNREGA		
4	CRW-1	Forest tree plantation	4	Ha	2,62,100			
		Total CR model Cost (Rs).			**19,25,191**			**28**

m. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (28 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	28 Small and marginal farmers	1000	28000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of	July,19 to Aug,19	2 trainings (28	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
		Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.		farmers)					
F		Coverage of farmers under Crop insurance schemes (28 farmers covering 10 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	5000	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**49700**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Kukrimundi village, Nuapada Block of Nuapada district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development and plantation	Kukrimundi village GP: Parkod Block: Nuapada Dist : Nuapada 20°56'48.29''N 82°37'05.43''E	A, B	WHS, and Soil and water conservation and plantation	NA	Renovation of WHS (4385 cum), construction of one outlet. Land development in 2.4 ha area and plantation in 2 ha.	NA

2. Rationale for selection of Works

As Per the Hot spot report on climate Modelling prepared by IISC – Banglore the mean rainfall of Naupada block between the month of June to September over a period of 30 years (1984-2014) is 1134 mm and its coefficient variation is 26.98. According to the 30 years historical data, the highest rainfall (mm) received in a day is 148 mm and the number of years with normal sowing rain pattern is 6 year whereas 24 year it received abrupt and erratic pattern of rainfall. Naupada block has suffered high drought condition in last 30 years out of which 6 years was severe drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 45.3 % and the projected coefficient of variation of the rainfall will be 32.8 for 2021-2050 years.

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The block Nuapada having both hilly as well as undulated area. Undulated are having three types of lands –upland medium and low land. Most of the low lands do not face moisture stress and some of those are even use for second crops also. There are some Minor Irrigation Projects (MIPs) get water

from dams constructed in the hills and foot hills in the block. Due to these MIPs some places second crop (rabi paddy) are seen in the Nuapada block. There are many other small tanks in the foot hills and upland, some of those are working and also providing irrigation, however many of them are not functioning properly and need some minor renovation and deepening to make those functional. Some other supporting activities are also required to make these tanks more durable.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought • Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Plantation (forest trees in common land)	• To increase vegetative covers, • To reduce soil erosion and enhance ground water recharge. • To create carbon sink in long run

4. Site Details

The proposed CRW core activity - WHS is located in the lower part of a community upland patch. The patch was earlier filled with trees, but over the period of time the density of tree reduces and few years ago (3-4 years) plantation of forest trees has been done almost in the entire patch except a small portion of 2 ha in the east side of the pond left with no plantation. The WHS is earthen embankment, thus earth work excavation was less and silted over the period of time when top cover

was less and soil was degraded. But now as plantation is done, no such severe soil erosion was found and also seen moderate vegetative cover in the catchment area during the field visit. There is no waste weir in existing WHS. Hence along with deepening of pond, an outlet, land development and forest tree plantation has been taken. The command area plots are paddy grown area with well bunded and situated in the downstream of the WHS, so through gravity flow these plots would be irrigated. The site is located little far from the village; however there is a kuchha approach road to reach the WHS site. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Embankment type
3. Shape of the pond : irregular
4. Slope of the catchment : 2-3%
5. Type of Soil : silty clay
6. Bed Rock : Seems not appear inside of pond
7. Av. depth of the pond (Present) : 0.8m
8. Proposed Extra depth of Pond : 2.2 m Total depth=3.0
9. Existing area of the pond : 0.21 ha (70mx30m)
9. Proposed area to be excavated {LXB) : 2100 sqm (Av. L=70m Av. W=30m)
11. Catchments area of the pond : 7.10 ha,
12. Command area of the pond : 2.6 ha in *Kharif* and 1.0 ha in *Rabi*
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

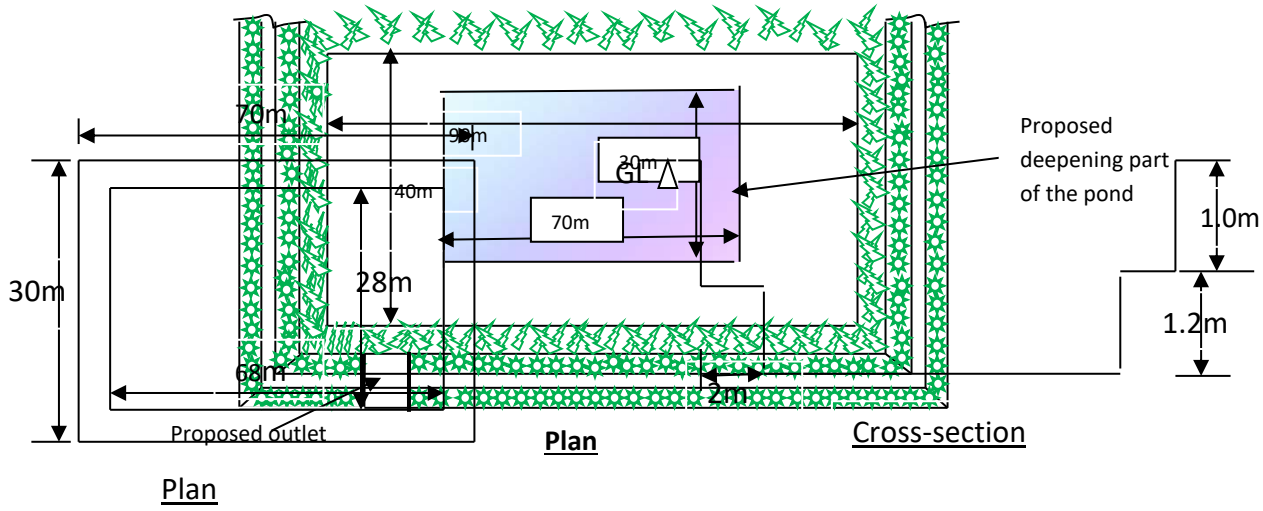
Where C= Runoff Coefficient of the catchment =0.4 (pasture, Silty clay, slope 0-5%)
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(148+148*.328)/1000 = 0.1965 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 7.10 ha
Peak Run off (Qp) =(71000x0.40)x0.1965= 5580.6 cum/day or say 0.065 cum/sec,
14. The total surface runoff for the monsoon period, Q= 71000x0.4x1.134=32205.6 cum (Where, 1.134m is the average mean rainfall of monsoon period for Nuapada block.). The total surface runoff is 4.38 times greater than the pond capacity of 7350 cum. Hence, this is sufficient to fill the pond during monsoon period.

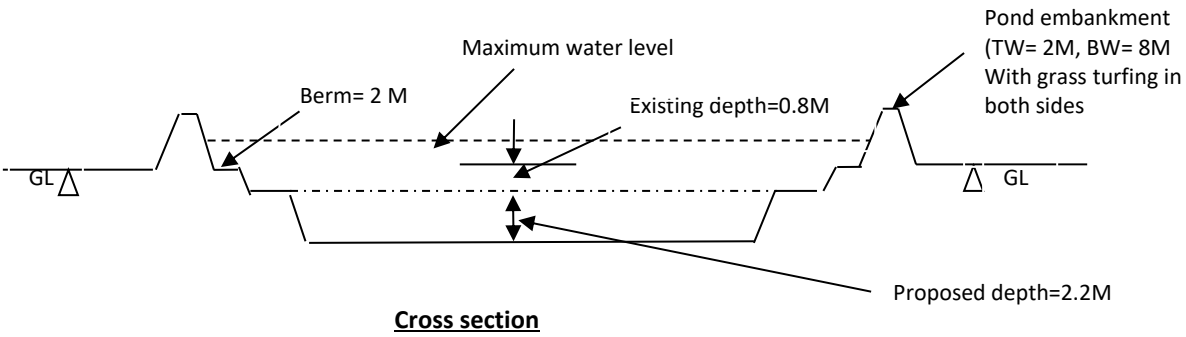
5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

Shape of Pond : Rectangular	
Av. Length of Pond = 70 m	Av. Width of Pond : 30 m
Proposed depth : 1.5m	Proposed berm in layer cutting=2.0m
Soil Type : silty clay	Depth of layer=0.5 and 1.0m

Layout of the whole pond system: (existing and deepening)

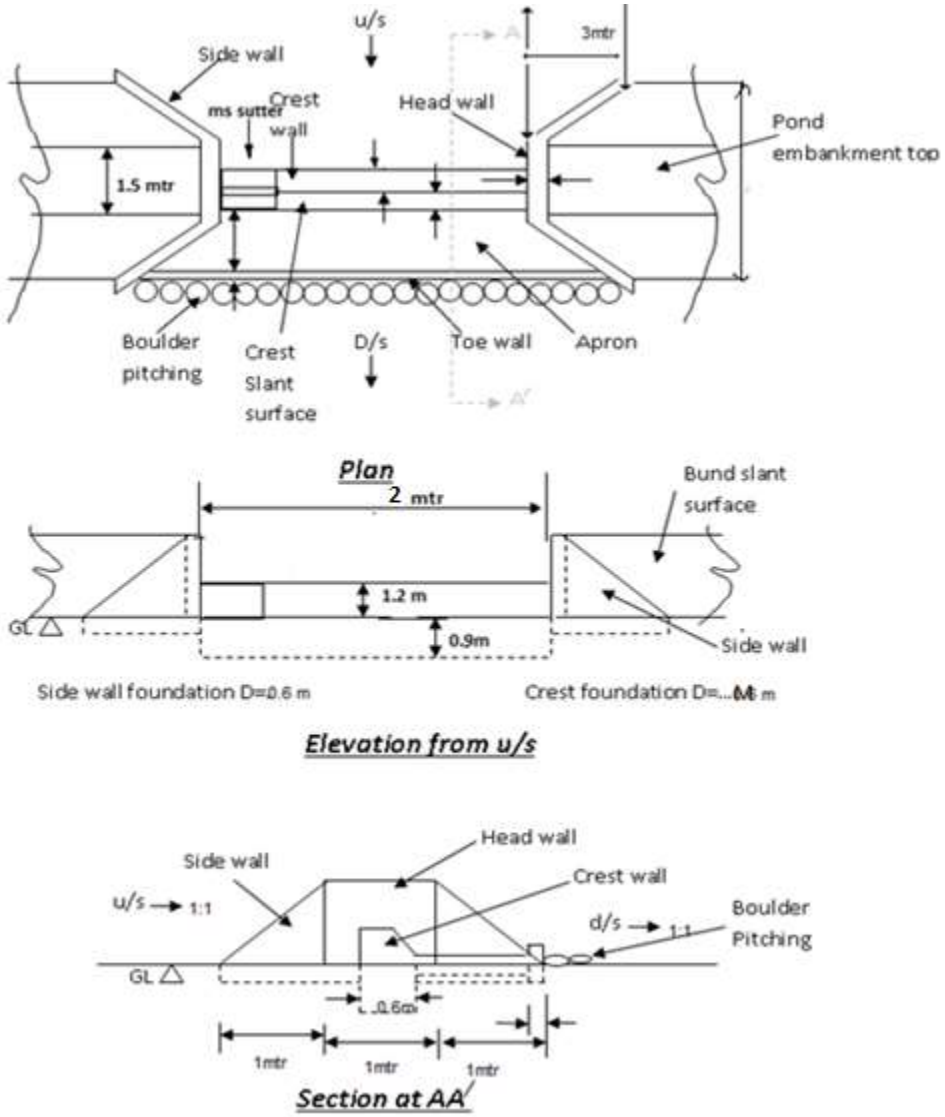




Cross section

5.2: Design and drawing of waste weir:

An waste weir will be constructed to safely discharge the excess water from the WHS. To design the waste weir we have peak runoff from catchment is 0.065 cum per sec. We know the discharge from the waste weir would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec , that is greater than the Qp of 0.065cum/sec. Hence the waste weir will be capable to discharge the peak runoff safe. Though the design peak runoff is far more than the required one, but to maintain economy of construction and further to provide a huge cushion in the structure, then carrying of construction materials in the site etc, the minimum crest length of waste weir would be 2m and other dimensions of the waste weir would be as per the crest length. This would provide the structural stability and enhance the durability of the structure as waste weir is one of the main components of embankment type of WHS and the stability and durability of the embankment depend on the capacity and stability of waste weir. The design dimensions and estimate is given below.



5.3: Design and drawing of earthen bunds for land development: 2.4 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 1680RM	Volume of soil excavated : 1210 cum
Plot Size: 50m * 50m	Total no of Plots: 10 nos. (approximately)

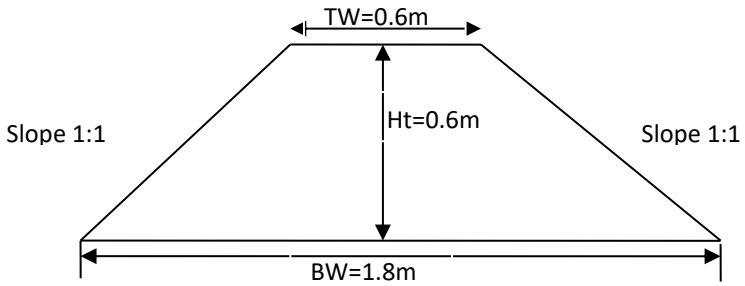


Figure 1: Cross section of the Bund

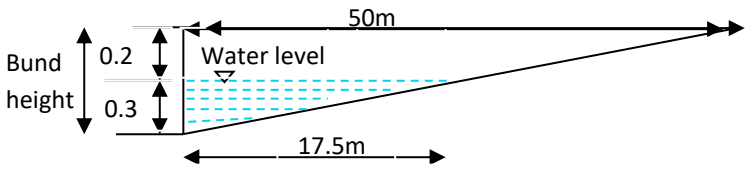
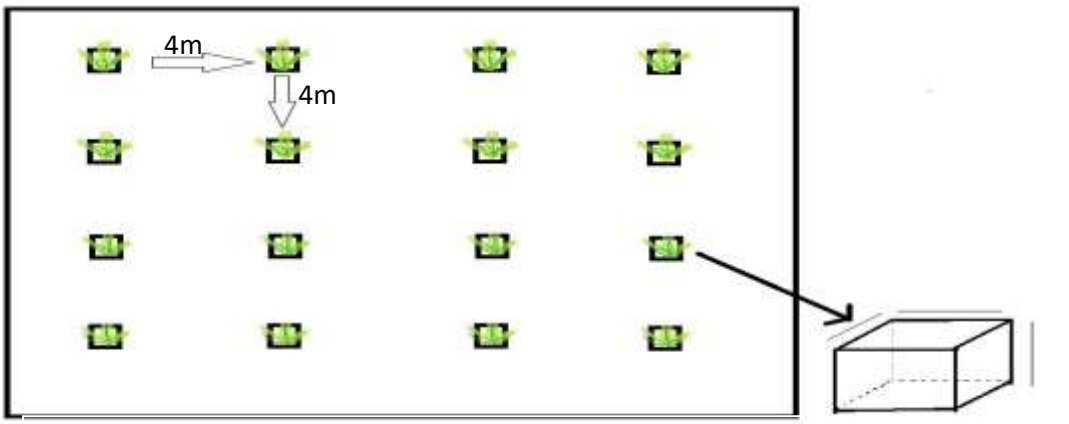


Figure: Section of Water to be stored in front of bunds.

5.4: Forest tree plantation: in 2 ha area

The land development part in the catchment and command area would be covered with forest tree plantation as desired by the community. These plots are belong to community and it will be taken up under MGREGA as community plantation. The local high growth forest plans would be considered those sapling are locally available. 600 plants per ha would be taken with a spacing of 4m x4m. A Typical layout of the plantation is provided below:



A layout of forest tree plantation with specification Pit (0.3mx0.3mx0.3m)

6. How is the Work Climate Resilient?

Durability	• The WHS (4385cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 32205.6 cum and predicted maximum one day peak surface runoff (Qp)= 5580.6 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 4.38 times greater than the WHS capacity (7350 cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 5200cum against WHS capacity of 7350 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block.

	• The land development of 2.4 ha area designed to conserve 80% of total monsoon surface runoff and a total of 0.87 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 29 direct beneficiaries HHs for the CRW out of those 12 are belongs to SC, 16 are from OBC and 1 from other community. There are 1 Women headed HHs among the total 29 direct beneficiary HHs.
Integration	• A proper sized waste weir (2 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 2.4 ha area in the catchment and command area is proposed along with forest tree plantation to conserve more water and to increase green coverage, reduced soil erosion and enhance ground water recharge.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

n. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Deepening of WHS	4564	cum	7,80,416	MGNREGA		29

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
2	CRW-1	Construction of outlet	1	Nos.	2,13,229	MGNREGA		
3	CRW-1	Land development	4	Ha	1,92,083	MGNREGA		
4	CRW-1	Forest tree plantation	4	Ha	1,31,050			
		Total CR model Cost (Rs).			**13,16,778**			**29**

o. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (29 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	29 Small and marginal farmers	1000	29000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (42 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
F		Coverage of farmers under Crop insurance schemes (29 farmers covering 10 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	5000	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**50700**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Tileimal village, Sinapali Block of Nuapada district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development and LBCDs	Tileimal village GP: Jharbandh Block: Sinapali Dist : Nuapada 20°02'32''N 82°34'35''E	A, B	WHS, and Soil and water conservation	NA	Renovation of WHS (6997 cum), construction of one outlet. Land development in 3.6 ha area and LBCDs -8 nos.	NA

2. Rationale for selection of Works

As per Hot spot report on climate modelling prepared by IISC – Banglore the mean rainfall of Sinapali block between the month of June to September over a period of 30 years (1984-2014) is 1089 mm and its coefficient variation is 32.8. According to the 30 years historical data, the highest rainfall (mm) received in a day is 336 mm and the number of years with normal sowing rain pattern is3 years whereas 27 years it received abrupt and erratic pattern of rainfall. Sinapali block has suffered high drought condition in last 30 years out of which 2 years was extreme drought, 3 years severe drought and 2-5 years of moderate drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 24.1 % and the projected coefficient of variation of the rainfall will be for 2021-2050 years.

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The block Sinapali is located extreme south of Nuapada district and almost 100 km away from the district head quarter. The block is shared its one third border with CG. One major tributary of Undanti River that Originate in CG passes through the middle of the block from west to east. Almost 40% area of the block is hilly and most of the hills are situated in the west side of the block bordering to CG.

Though most of the hills are in the west part but the highest altitude hill is located in the east boarder of block with maximum altitude of 890m from mean sea level (msl)and lowest altitude of 215m from msl found also in the east side near the river. Thus the block has both hilly undulating and plain topography. In the undulating part and near the foothills, no minor and major dams and irrigation projects are found in the block. However, there are of small WHS are seen in the block and some of them are functioning and some are not. The defunct WHS are not in use due to minor damages or siltation. Hence activities such as de-siltation, repair or construction of outlets, sluices etc along with some integrated activities such as land development in the catchment, plantation, LBCDs are required to make these structures functional and durable.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought & Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Loose Boulder Check Dams (LBCDs)	• To check runoff velocity and cut runoff intensity • To arrest silt and in long run harvest water to stabilize nala/gully enhance ground water recharge and vegetation.

4. Site Details

The selected CRW is located in the plain topography of the block. The exact location of the pond is in medium land that connected upland cotton growing plots with low land paddy growing plots. The WHS is a embankment type structure that catch runoff water from uplands plots. Low land plots get water in both as subsurface flow or through irrigation. The average slope of the catchment is 3.3%. Both west and east side of the catchment is covered with forest and other trees. West side mostly plantation work has been done. In the east side it is like degraded forest, as some stone blocks hindering tree growth thus density of forest tree is less and plantation work also did not take up while it was done in the west side. Just above the pond, the part of the catchment area is cultivated land and required land development activities. One small narrow nala seen in the catchment and need to be treated with loose boulder structures as it carry runoff water to the pond along with silts. The pond is situated almost 1.2 km away from the village habitat area , however there is a kuccha road that connected the pond with the villagers. The image of area is shown above and details features of the site are given below.

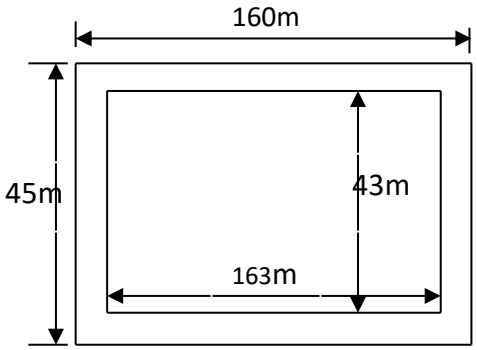
1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Embankment type
3. Shape of the pond : Rectangular
4. Slope of the catchment : 3.3%%
5. Type of Soil : silty/ clay loam
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.5 m
8. Proposed Extra depth of Pond : 1. 0 m Total depth=2.5
9. Existing area of the pond : 1.00 ha (200mx50m)
9. Proposed area to be excavated {LXB) : 7200 sqm (Av. L=160m Av. W=45m)
11. Catchments area of the pond : 14 ha ha,
12. Command area of the pond : 5 ha in Khraif and 1.5 ha in Rabi
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C= Runoff Coefficient of the catchment =0.5 (, Silty/clay loam, slope 0-5%, cultivated)
R= Max one day Rainfall with CV (historical/projected) whichever is higher =(336+336*.328)/1000 = 0.4462 m /day (as per CCVA study done by IISc, Bangalore)
A= total catchments area= 12 ha
Peak Run off (Qp) =(140000x0.50)x.4462= 31234 cum/day or say 0.36 cum/sec,
14. The total surface runoff for the monsoon period, Q= 140000x0.5x1.089=76230 cum (Where, 1.089m is the average mean rainfall of monsoon period for Sinapali block.). The total surface runoff is 3.46 times greater than the pond capacity of 21997 cum. Hence, this is sufficient to fill the pond during monsoon period.

5. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

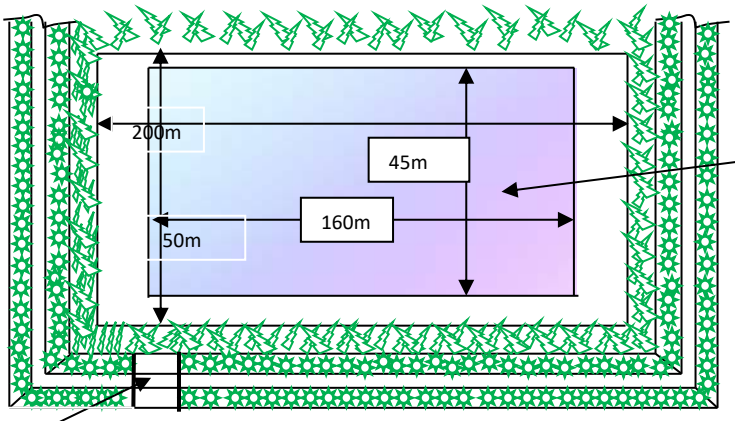
Shape of Pond : Rectangular	
Av. Length of Pond = 160 m	Av. Width of Pond : 45 m
Proposed depth : 1.0m	Proposed berm in layer cutting=2.0m
Soil Type : silty clay	Depth of layer=0.5 m



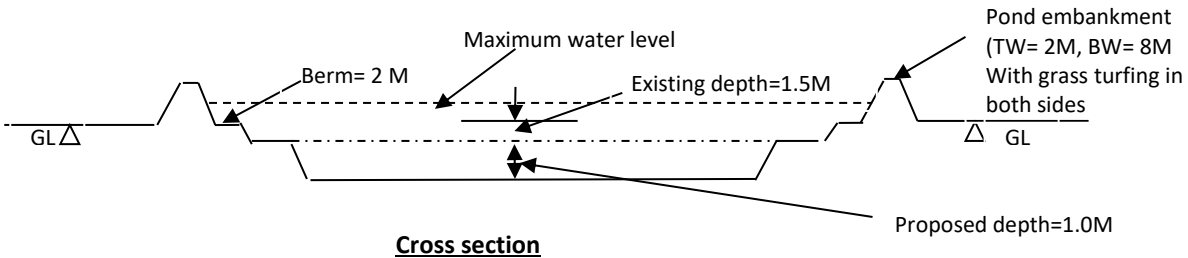
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



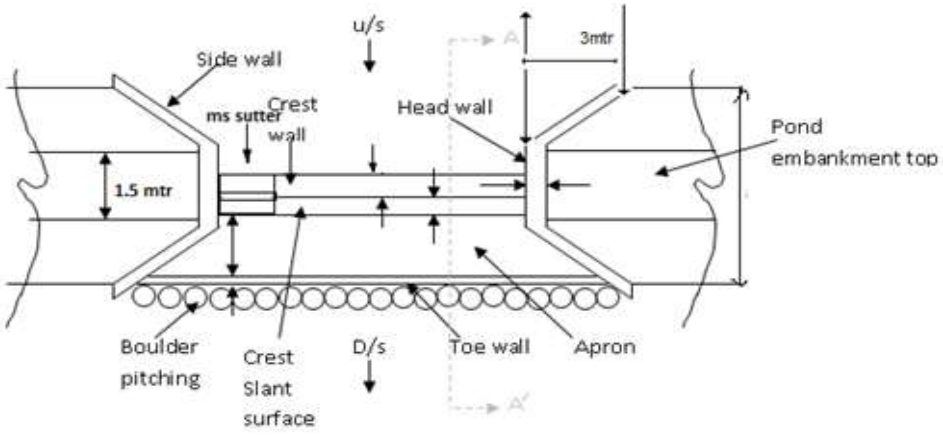
Plan

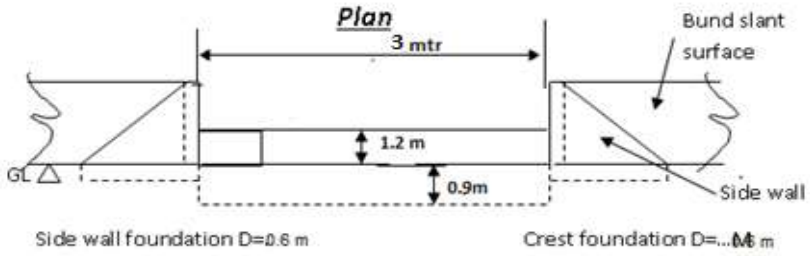


Cross section

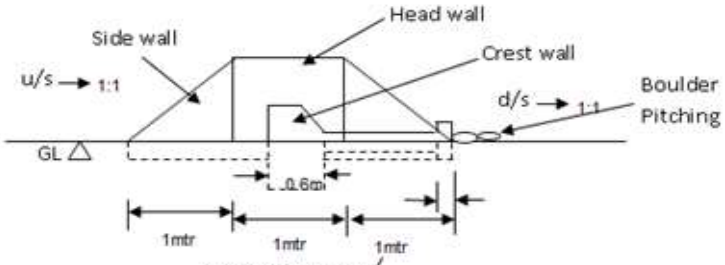
5.2: Design and drawing of outlet with MS shutter:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.36 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec , that is greater than the Qp of 0.36cum/sec. Hence the outlet will be capable to discharge the peak runoff safe, however as the pond is a huge one thus 3m crest length of outlet is proposed. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would required in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. The design dimensions and estimate is given below.





Elevation from u/s



Section at AA

5.3: Design and drawing of earthen bunds for land development: 3.6 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 2520 RM	Volume of soil excavated : 1814.4 cum
Plot Size: 50m * 50m	Total no of Plots: 15 nos. (approximately)

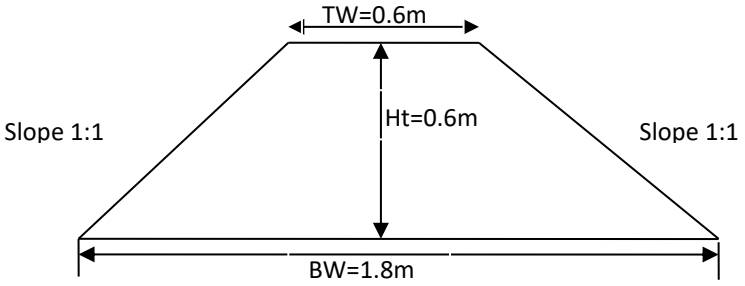


Figure 1: Cross section of the Bund

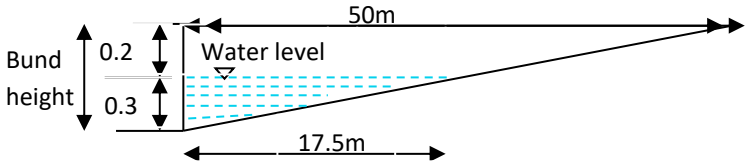
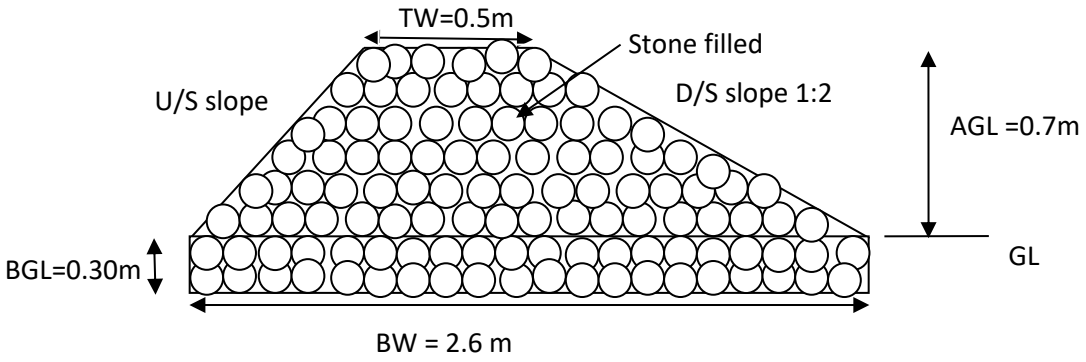


Figure: Section of Water to be stored in front of bunds.

5.4: Design and drawing of Loose Boulder Check Dams(LBCDs): 8 nos. As mentioned in section 4, there issmall nala/gullies exist in one placed in the catchment area of the proposed site. After measuring the gully width and depth, 8 umbers of LBCDs with below dimensions are proposed as gully control measures.



6. How is the Work Climate Resilient?

Durability	• The WHS (6997cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 76230 cum and predicted maximum one day peak surface runoff (Qp)= 31234 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 3.46 times greater than the WHS capacity (21997cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 15000cum against WHS capacity of 21997 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block. • The land development of 3.6 ha area designed to conserve 75% of total monsoon surface runoff and a total of 1.47 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 25 direct beneficiaries HHs for the CRW out of those 06 are belongs to ST, 02 are from SC and 17 from OBC community. There is one Women headed HHs among the total 25 direct beneficiary HHs.
Integration	• A proper sized outlet (3 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to increase the life of the embankments and the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 3.6 ha area in the catchment and command area is proposed along with LBCDs re proposed to check siltation and enhance vegetation and ground water recharge.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site.

	Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

p. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-1	Deepening of WHS	4564	cum	9,94,493	MGNREGA		25
2	CRW-1	Construction of outlet	1	Nos.	2,93,229	MGNREGA		
3	CRW-1	Land development	3.6	Ha	3,33,915	MGNREGA		
4	CRW-1	LBCDs	8	Ha	61,992			
		Total CR model Cost (Rs).			**16,83,629**			**25**

q. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (40 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of drought resilient paddy varieties	July and Oct,2019	4 Ha.	50 KG/Ha for 2 Ha.@30/kg	6000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	40 Small and marginal	1000	40000	Facilitation by ICRG	Nationalized Banks	

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
				farmers					
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (42 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
F		Coverage of farmers under Crop insurance schemes (40 farmers covering 10 Ha)	July 19 to August, 19	Rs.500/- per Ha.	500/Ha	5000	Facilitation by ICRG	Agriculture	As per actual cost norm
Sub-Total:						**61700**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Climate Resilient Paddy varieties in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Convergence works: Fish Farming budget Rs. 63396 (proposed in the main DPR)

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Potential to convert waste land to agriculture based livelihood farming system	Vegetable Production in Waste land during kharif (Pompkin , Long Bin, Bitter Guard, Tomato) for 25 HHs	Apr'19 to Oct'19	2 Ha.	1 kg/Ha	3500	Facilitation by ICRG	ITDA (FADP)	As per actual cost norm.
B		Pulses (Arhar) patch cropping for 8 HHs	July and Oct,2019	2 Ha.	15 KG/Ha for 4 Ha.@60/kg	3600	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	
C		Agriculture Credit Linkage with Banks (Rabi and Kharif, 2018-19)	May' , June and July 19	25 farmers	1000	25000	Facilitation by ICRG	Nationalized Banks	
D		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.	July,19 to Aug,19	2 trainings (25 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
Sub-Total:						**37100**			

9. Convergence Plan

Capacity building of community by Agriculture Department and OLM (Odisha Livelihoods Mission) to ensure implementation of PoP (packages of Practices) of a particular crop in CRW area has been discussed and planned. Convergence with ITDA will help incorporate more improved seed for vegetable crop. Mini kits for vegetable cultivation can be promote through agriculture department in rabi through check dam water and lift irrigation system as the water remain in the stream during rabi season. To increase soil fertility and productivity and organic crops or vegetable compost pits are proposed to prepare organic manure. Some of the key livelihoods interventions proposed are;

- Vegetable Production in Waste land during kharif (Pompkin , Long Bin, Bitter Guard, Tomato) for 25 HHs
- Pulses (Arhar) patch cropping for 8 HHs
- Agriculture Credit Linkage with Banks (Rabi and Kharif, 2018-19)
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.

Renovation of WHS at Kandamunda village, Sinapali Block of Nuapada district

1. Details of the Climate Resilient Work

Name of Work	Location (village, GP, block, district, lat/long)	Category (MGNREGA schedule)	Sub Category (MIS)	Work Code	Dimensions	Current Status (Approved; AS/TS done?)
Renovation of WHS, Land Development and Plantation	Kandamunda village GP: Jharbandh Block: Sinapali Dist : Nuapada 20°02'39''N 82°37'31''E	A, B	WHS, and Soil and water conservation and Plantation	NA	Renovation of WHS (7177 cum), construction of one inlet & outlet. Land development in 8 ha area and Plantation 1 ha.	NA

2. Rationale for selection of Works

As per the Hot spot Report on Climate modelling Prepared by IISC- Banglore the mean rainfall of Sinapali block between the month of June to September over a period of 30 years (1984-2014) is 1089 mm and its coefficient variation is 32.8. According to the 30 years historical data, the highest rainfall (mm) received in a day is 336 mm and the number of years with normal sowing rain pattern is3 years whereas 27 years it received abrupt and erratic pattern of rainfall. Sinapali block has suffered high drought condition in last 30 years out of which 2 years was extreme drought, 3 years severe drought and 2-5 years of moderate drought condition. According to the climate model study it is projected that the percentage of change in number of rainy days (2021-2050 years) will be 24.1 % and the projected coefficient of variation of the rainfall will be for 2021-2050 years.

Given the combination of current vulnerabilities and exposure to long term climate change, the following MGNREGA works have the greatest potential to reduce vulnerabilities and enhance climate resilience of the communities:

- To address net irrigated area: contour bunds, earthen bunding, rehabilitation of minors and sub-minors, community well for irrigation, lining of canals, farm ponds, drainage in water logged areas, diversion weir, link drains, deepening and repair of flood channels etc.
- To address low groundwater availability: recharge pits, contour bunds, artificial recharge of well through sand filter, staggered trench, box trench, diversion drain etc.
- To address low forest cover: grassland development and silvipasture, eco restoration of forest, forest protection, road/canal side plantation, afforestation, plantation in government premises, plantation, bi drainage, diversion weir etc.

The block Sinapali is located extreme south of Nuapada district and almost 100 km away from the district head quarter. The block is shared its one third border with CG. One major tributary of Undanti River that Originate in CG passes through the middle of the block from west to east. Almost 40% area of the block is hilly and most of the hills are situated in the west side of the block bordering to CG.

Though most of the hills are in the west part but the highest altitude hill is located in the east boarder of block with maximum altitude of 890m from mean sea level (msl)and lowest altitude of 215m from msl found also in the east side near the river. Thus the block has both hilly undulating and plain topography. In the undulating part and near the foothills, no minor and major dams and irrigation projects are found in the block. However, there are of small WHS are seen in the block and some of them are functioning and some are not. The defunct WHS are not in use due to minor damages or siltation. Hence activities such as de-siltation, repair or construction of outlets, sluices etc along with some integrated activities such as land development in the catchment, plantation, LBCDs are required to make these structures functional and durable.

3. Description of CRW

CRW / Components		Objectives
Core Structure	Re-excavation of pond (WHS) with outlet	• Enhance capacity of water storage of existing WHS so that its irrigation capacity can be increases • Reduce the risk of damaging crop by flash floods and drought & Increase irrigated area • Increase crop productivity and income of HHs • Safe disposal of surplus water to reduce the risk of damage of WHS and risk of damage of downstream plots to due to surplus water flow
Supplementary activities	Land development	• To resist soil erosion and convert the patch into cultivable land. • To enhance moisture level of the soil and will resist crops during dry spell. • To increase soil nutrition by reducing top soil erosion by rain drop action and surface runoff.
	Mango Plantation	• To increase vegetative covers, • To reduce soil erosion and enhance ground water recharge. • To create another option of livelihoods and carbon sink in long run

3. Site Details

The selected CRW is located in the undulated topography part of the block. The WHS is situated just below small hillock of altitude ranges from 5 to 9 m with length of 650m and width of 160m. The hill is very thinly covered with herbs and shrubs, in summer this is almost a barren hill. The entire hill is almost the catchment area for the WHS. A village approach road is passes through the base of the hillock and thus it separated the hill and the WHS. However the advantage of the road is that it carries water of other part of the hillock in to the WHS as the level of the road is low in front of the pond. Thus, runoff water easily passes over road and enters to WHS. As it enter throughout the total length of the pond in the upstream side, pond embankment erosion seen just below the road. Thus an embankment is needed to build through excavated earth just below the road and in parallel to the road along with a proper inlet. As there is no outlet seen, an outlet with MS shutter is also required. The pond is situated almost 0.5 km away from the village habitat area and connected with a kuccha road. The image of area is shown above and details features of the site are given below.

1. Climate Resilient Work : Deepening of Water harvesting storage structure
2. Type of pond : Dugout type
3. Shape of the pond : Rectangular
4. Slope of the catchment : 7.8%%
5. Type of Soil : silty clay
6. Bed Rock : Seems not appear inside of pond
7. Depth of the pond (Present) : 1.0 m
8. Proposed Extra depth of Pond : 1. 0 m Total depth=2.0
9. Existing area of the pond : 2.21 ha (200mx50m)
9. Proposed area to be excavated {LXB) : 7350 sqm (Av. L=105m Av. W=70m)
11. Catchments area of the pond : 22 ha,
12. Command area of the pond : 8 ha in Khraif and 3 ha in Rabi
13. Using by Rational Formulae : Qp=CRA (As per MGNREGS guidelines 2007)

Where C= Runoff Coefficient of the catchment =0.5 (, Silty clay, slope 5-10%, forest)

R= Max one day Rainfall with CV (historical/projected) whichever is higher =(336+336*.328)/1000 = 0.4462 m /day (as per CCVA study done by IISc, Bangalore)

A= total catchments area= 22 ha

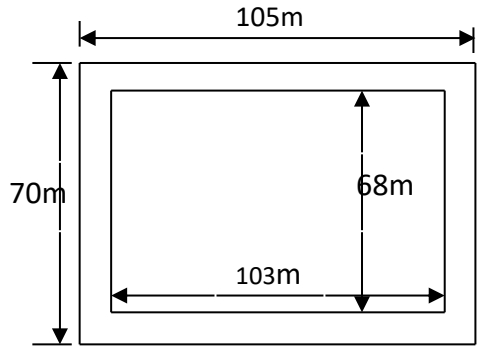
Peak Run off (Qp) =(220000x0.50)x.4462= 49082 cum/day or say 0.586 cum/sec,

14. The total surface runoff for the monsoon period, Q= 220000x0.5x1.089=119790 cum (Where, 1.089m is the average mean rainfall of monsoon period for Sinapali block.). The total surface runoff is 4.09 times greater than the pond capacity of 29277 cum. Hence, this is sufficient to fill the pond during monsoon period.

4. Engineering Drawing of the work

5.1: Design of the WHS (pond) : Design dimensions of deepening part of the pond

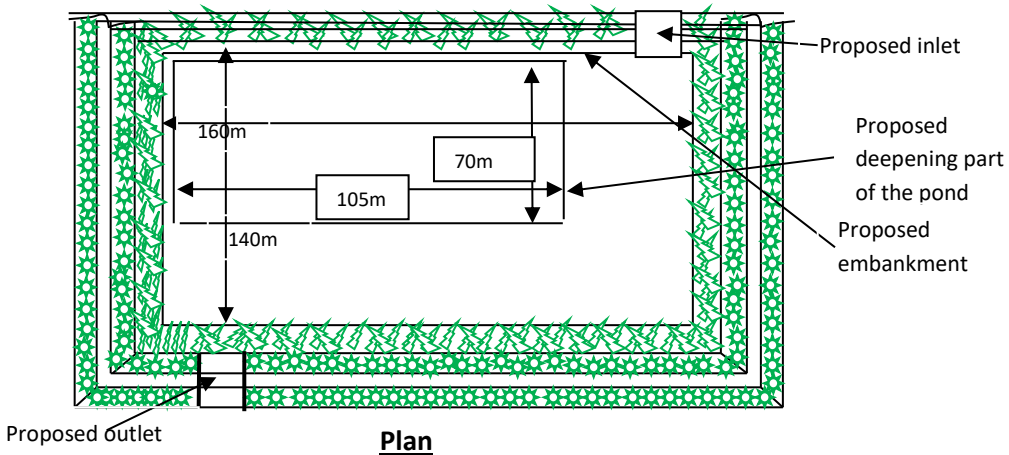
Shape of Pond : Rectangular	
Av. Length of Pond = 105 m	Av. Width of Pond : 70 m
Proposed depth : 1.0m	Proposed berm in layer cutting=2.0m
Soil Type : silty clay	Depth of layer=0.5 m



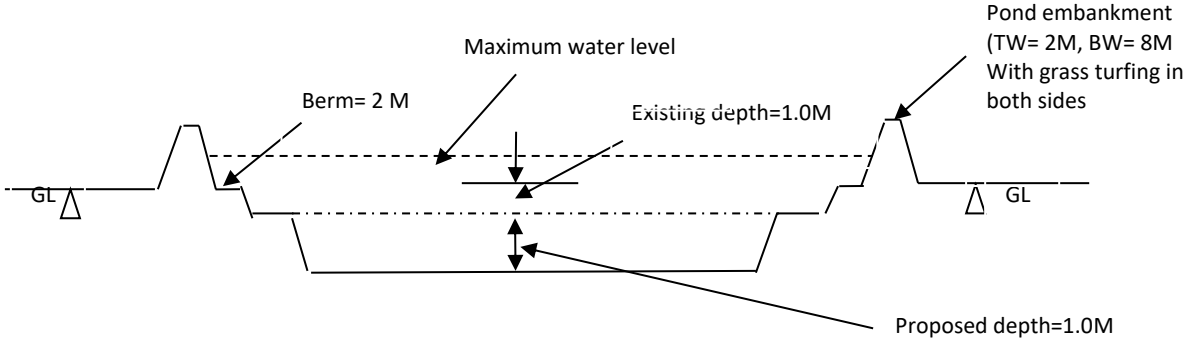
Plan

Cross-section

Layout of the whole pond system: (existing and deepening)



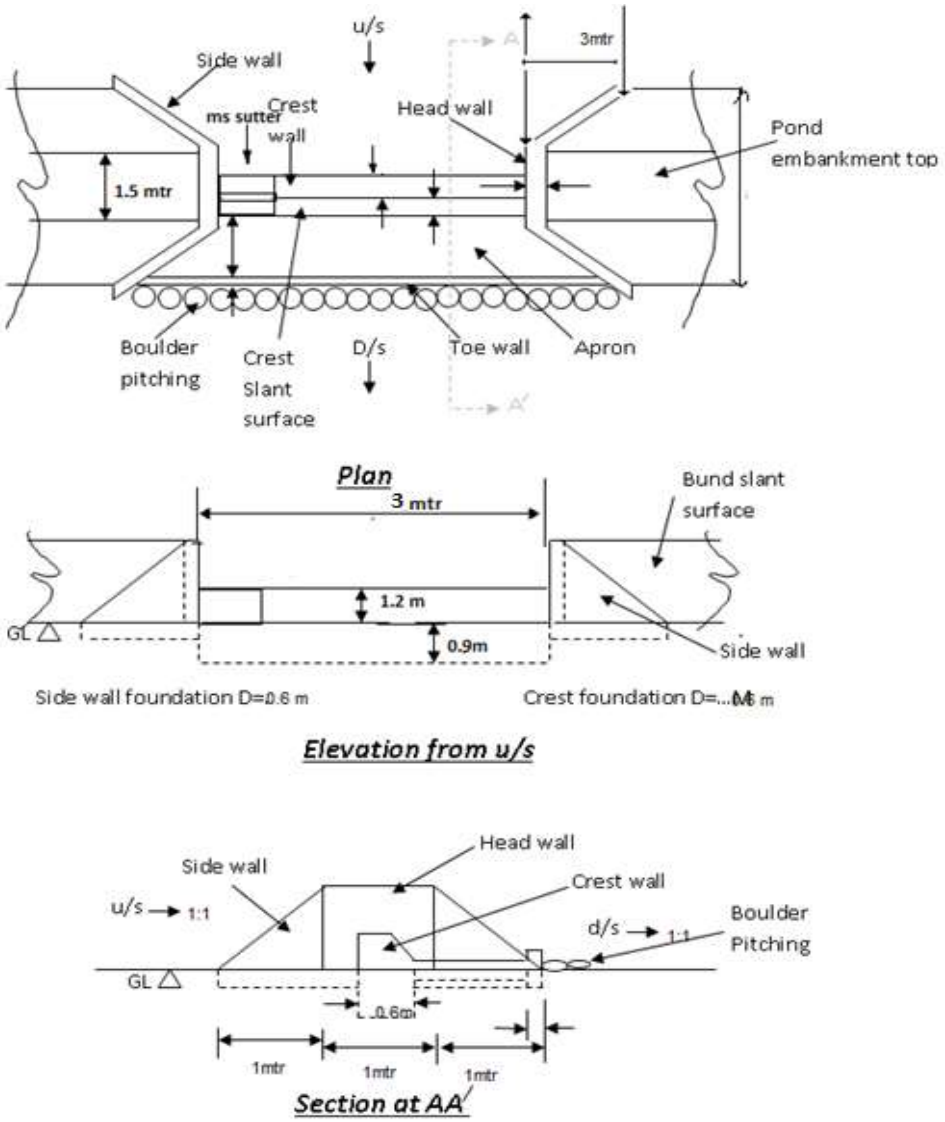
Plan



Cross section

5.2: Design and drawing of outlet with MS shutter & inlet:

An outlet will be constructed to safely discharge the excess water from the WHS. To design the outlet we have peak runoff from catchment is 0.586 cum per sec. We know the discharge from the outlet would be Q=AV, where A is the area of the crest from whether water will flow out from the pond and V is the velocity in m/sec. Considering velocity of 1.2m/sec during peak runoff, and crest length of 2m and flow height of 0.3 m, we have Q=1.2x2x0.3=0.72 cum per sec , that is greater than the Qp of 0.586cum/sec. Hence the outlet will be capable to discharge the peak runoff safe, however as the pond is a huge one thus 3m crest length of outlet is proposed. MS shutter would be provided in one side of the outlet to use outlet as supply of water to the command area. Generally shutter would be close and the crest would work to maintain the water level in the pond, however when water would required in command area to irrigate then the shutter would be lifted to allow water to the command area for irrigation purposes. A same size inlet would also be constructed following same design except the MS shutter to pass peak runoff as inflow in to the pond. As the design calculation and drawing of the structure (inlet) is same as the outlet, hence a separate design of inlet is not provided here. The design dimensions and estimate of the outlet is given below.



5.3: Design and drawing of earthen bunds for land development: 8 ha area

Shape of Pond : Trapezoidal	Side Slope of EM : 1:1
Top width of bund : 0.6m	Bottom width=1.8m
Height of bund : 0.6m	Vegetative coverage : Grass turfng and Arhar
Length of bund : 5600 RM	Volume of soil excavated : 4030 cum
Plot Size: 50m * 50m	Total no of Plots: 35 nos. (approximately)

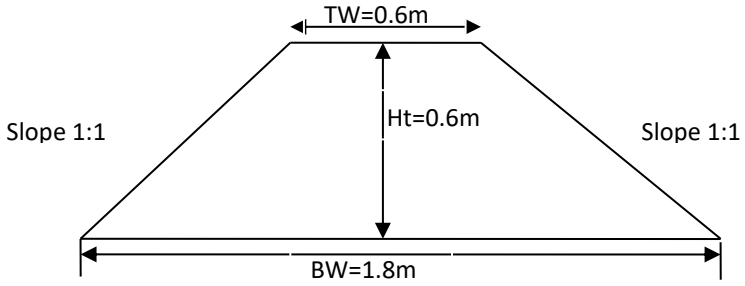


Figure 1: Cross section of the Bund

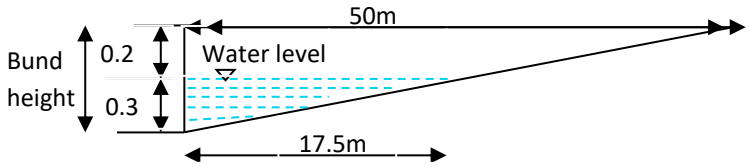
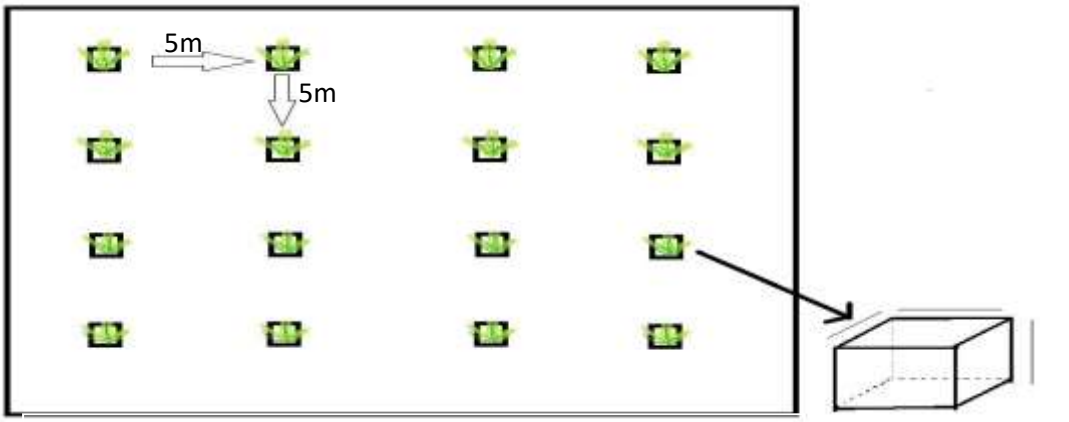


Figure: Section of Water to be stored in front of bunds.

5.4: Mango plantation: in one ha area

Almost the entire catchment area is already planted trees. However a small portion of the catchment area is left out and proposed for mango plantation. That part is also belonging to individual land. The locally available grafted mango planted would be planted with a spacing of 5mx5m with plant density of 400 plant per ha. Total area for plantation is only one ha. A typical layout of the plantation is provided below:



A layout of Mango plantation with specification

Pit (0.6mx0.6mx0.6m)

6. How is the Work Climate Resilient?

Durability	• The WHS (7177cum volume of excavation) is design on the basis of total predicted monsoon period surface runoff (Q)= 119790 cum and predicted maximum one day peak surface runoff (Qp)= 49082 cum/day • Using above data it was calculated and checked the availability of water to fill the WHS and it is found that the surface water yield is 4.09 times greater than the WHS capacity (29277 cum). • Depth of the WHS has been considered taking the demand (crop water requirement) and the underground soil strata so that there will be no seepage (water demand 24000 cum against WHS capacity of 29277 cum), rest volume of water is for dead storage and other losses. • Vegetative covered proposed on the WHS embankment. Required size outlet has already there and checked it size as per peak surface runoff would be generated in predicted maximum one day rainfall of the block.

	• The land development of 8 ha area designed to conserve 75% of total monsoon surface runoff and a total of 3.2 crore liter in a year.
Livelihood Diversification	• Livelihoods plan on the crop grown in the area such as vegetables, paddy, maize and pulses and cotton are prepared considering introducing best variety of seeds, PoPs of the crops etc. • The livelihoods plan would be implemented jointly with OLM and inputs would be mobilized from other line departments such as Agriculture etc. • Cotton with maize as intercrop would be promoted in the cotton cultivated plots following appropriate PoPs. • In land development area forest trees would be planted to regenerate the natural forest in the area and increase the carbon sink
Inclusion	• There are 28 direct beneficiaries HHs for the CRW out of those 08 are belongs to ST, 02 are from SC and 18 from OBC community. There is one Women headed HHs among the total 28 direct beneficiary HHs.
Integration	• A proper sized outlet & inlet (3 m crest length) designed on the basis of peak runoff has been proposed to discharge the excess water and to safe entry of surface runoff water to increase the life of the embankments and the pond. • Vegetative measures such as grass turfing and some climber vegetables are proposed in pond embankment where excavated soil would be disposed. • Land development of 8 ha area in the catchment and command area is proposed along with one ha mango plantation to enhance vegetation and ground water recharge.
Flexibility	• The WHS are very old structures and very common in the region. Though those are constructed in a technically feasible site and thus their ability to harvest maximum water, however those are sometimes do not check with catchment ability to produce sufficient runoff, siltation issues and uses. • ICRG's integration approaches to solve above issues are now mixed with farmer's traditional knowledge of selecting a proper site. Hence, all proposed activities for the CRW are acceptable by farmers and thus possibility to disseminate this package of CRW is more in the nearby area. • Livelihoods around the infrastructures also planned considering local knowledge and practices thus there is scope of replication.

7. Budget

r. MGNREGS works

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
1	CRW-2	Deepening ofWHS	7177	cum	10,17,533	MGNREGA		28

Sl No	CRW design	Name of CR Activities	Quantity	Unit	Amount in Rs	Support by MNREGA	Leverages by line department	No of beneficiaries
2	CRW-2	Construction of outlet	1	No.	3,13,229	MGNREGA		
3	CRW-2	Construction of inlet	1	No.	2,93,229			
4	CRW-2	Land development	8	Ha	7.29.811	MGNREGA		
5	CRW-2	Mango Plantation	1	Ha	114965			
		Total CR model Cost (Rs).			**24,68,767**			**28**

s. Convergence works

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
A	Promotion of Drought Resilient Agriculture .	Training to farmers on Drought Resilient Agriculture (28 HHs)	Apr'19 to Oct'19	2	2500	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.
B		Promotion of Vegetable Production	July and Oct,2019	4 Ha.	2000/Ha	8000	Facilitation by ICRG	Agriculture Deptt (with 50% subsidy).	As per actual cost norm
C		Promotion of bund sowing of Arhar (10 HHs)	July and Aug,2019	1 Ha	10KG/Ha @ Rs.70/Kg	700	Facilitation by ICRG	Agriculture Deptt	As per actual cost norm
D		Agriculture Credit Linkage with Banks (Kharif, 2019-20)	May' , June and July 19	40 Small and marginal farmers	1000	28000	Facilitation by ICRG	Nationalized Banks	
E		Demonstration of Organic practices and training to farmers on Best Practices of Vegetable &	July,19 to Aug,19	2 trainings (28 farmers)	Rs.2500/- per training	5000	Facilitation by ICRG	OLM/Agriculture	As per actual cost norm.

Sl	Climate Issues/Livelihoods Opportunities	Interventions proposed	Time Line	Unit	Unit Cost (Rs.)	Total Cost(rs.)	ICRG Support	Support from Line Deptt	Remarks
		Paddy Production and awareness on Climate resilient livelihood planning.							
Sub-Total:						**46700**			

8. Convergence Plan

Capacity building of communities by ICRG Team with support of Odisha Livelihood Mission (OLM) and Agriculture Department to ensure implementation of Livelihood Plan. Convergence with Agriculture will help mobilization of Climate resilient Seed varieties. Mini kits for vegetable cultivation can be promoted through Horticulture Department To increase soil fertility and productivity, organic vegetable crops have been promoted through compost pits. Some of the key livelihoods interventions proposed are;

- Introduction of Vegetable in 4 Ha.
- Pulses (Arhar) patch cropping for 10 HHs
- Agriculture Credit Linkage with Banks (Kharif 2019-20)
- Training to farmers on Climate Resilient Agriculture
- Demonstration of Organic practices and training to farmers on Best Practices of Vegetable & Paddy Production and awareness on Climate resilient livelihood planning.