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Promoting low cost technology and cost sharing for community participation in watershed management

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Abstract

Koraput and Malkangiri districts of Orissa are characterised by rocky terrain, steep slopes and undulating topography. Though rainfall is high in the range of 1200 - 1300 mm. denuded landmass and sloppy surface generate tremendous run off and major portion of the rainfall goes back to sea through networks of natural drainage lines causing serious erosion on the way. Consequently these districts are among worst drought affected districts in India. Water scarcity particularly during post monsoon season limits bio-mass production resulting in poverty, malnutrition and endemic diseases.

Comprehensive Watershed Development Project was conceived to enable poor tribal population to utilise natural resources of land and water through low cost and simple technologies based on indigenous knowledge and wisdom which they can understand and afford to adopt for enhancing and sustaining bio-mass production. Looking to above situation in Danida funded Comprehensive Watershed Development Project (CWDP) Koraput and Malkangiri districts of Orissa, different low cost, appropriate soil conservation methods have been executed from ridge to valley in the watersheds. These have been found successful and visible impacts have accrued within two years by way of arresting large quantities of silt from the eroded lands as well as sustaining a high plant survival percentage on the land.

Low cost simple construction and beneficial effects of the structures have convinced the farmers for replication of them in their own field.

In order to solve serious water scarcity problem during dry spells of monsoon and months after, the project has been successful in creating water bodies with cost sharing by beneficiaries. Dugout recharge ponds have given appropriate solution in storing water coming from the upper reaches of a watershed below the ground enabling the farmers to take up vegetable cultivation, pisciculture, and animal drinking etc..

This paper also deals with increased community participation in watershed management when Integrated Farming System has been taken on the farmers' field following the approach from conservation to production. An attempt on Integrated Farming System model has given scope for continuous involvement of the farmers providing short term as well as long term benefits to each of the farmer in a sustainable manner.

THE CONTEXT

Koraput and Malkangiri districts of Orissa are the most backward districts of the state, Orissa with 90% of households below the official poverty line and literacy is just above 10%. Poverty, ignorance and illiteracy are the root causes of backwardness in these areas.

30% households belong to the landless with 75% households belong to the Scheduled Tribes.

Area in these districts are characterised by rocky terrain steep slopes and undulating topography. Though rainfall is high in the range of 1200-1300mm. denuded landmass and sloppy surface generate tremendous run off and major portion of the rainfall goes back to sea through networks of natural drainage lines causing serious erosion on the way. Consequently these districts are among worst drought affected districts in India. Water scarcity particularly during post monsoon season limits bio-mass production resulting in poverty, malnutrition and endemic diseases.

The Comprehensive Watershed Development Project has been operative since the year 1994 in twelve watersheds of Koraput and Malkangiri districts of Orissa covering total geographical area of 44,000 hectare with a population of 50,000. The project keeps an aim to develop the natural resource system in a sustainable manner and increase agricultural production without causing excessive stress on the environment.

LOW COST SOIL AND MOISTURE CONSERVATION METHODS

From the beginning of the project low cost soil conservation structures have been executed on severely eroded land of the watersheds in order to arrest silt and establish vegetation following ridge to valley approach. The impact of these technologies have been very successfully demonstrated in the project exhibiting visible effects within two years. These structures have been successful in arresting large quantity of silt from the eroded land and enable to conserve maximum water in soil profile to promote growth of grasses, shrubs and trees.

Table 1. Area and cost of the land treatment with low cost soil conservation measures (land slope ranges from 2 – 10 %).

Sl. No	Name of the Watershed (Block).	Name of the Village.	Area treated with low cost structures in hectare.	Total Expenses in Indian Rupees.	Cost / hectare in Indian Rupees.
1	2	3	4	5	6
01.	Kanagaon (Boriguma).	Jadaput.	75	1,57,500	2,100
02.	Kanagaon (Boriguma).	Majhiguda.	60	60,500	1,008
03.	Baminijori (Kundura).	Kudmpadar.	62	1,00,000	1,613
04.	Sindhiguda-Manikpur (Kudumuluguma).	Kenduguda.	75	1,35,000	1,800
05.	Phupugaon-Mohantiput. (Kotpad).	Chitra.	40	70,080	1,752

Loose boulder structures with locally available stones fortified with vegetation like local or vetiver grasses have been put across the flow path on a sloppy land ranging 2 – 10 % slope. Data from five severely eroded land were collected where these above measures have stabilised the gullies resulting natural vegetation. The information on area and cost of the land treatment with low cost measures is given in table 1. It is found that an eroded

land with 2 – 10 % slope can be stabilised with low cost structures by investing Rs.1,000/- to Rs.2,100/- per ha.. Slope, undulation of land and availability of the raw materials affect the investment. More investment will be on land treatment if a land is found more sloppy, undulating and lack of availability of stones locally.

The project has been showing the beneficial effects of Catch pit, 'V' ditch, Brush wood checks and loose boulder structures to the farmers from the beginning of the project. The farmers are now able to keep about 90% survival percentage of plantation by adopting catch pits and 70% survival percentage without catch pits. Data on replication of soil conservation measures by the farmers were collected. Replication of low cost measures by the farmers of the watersheds is given in table 2. It is seen that the 18% of the catch pits have been replicated by the farmers. These catch pits were made by the farmers after observing beneficial effects of them in the Government waste land with project cost. Brush wood checks have been replicated by 125% by farmers as they give practical solution for treating the eroded crop land of the farmers.

Table 2. Replication of low cost measures by farmers of the watersheds.

Sl. No.	Item of Work.	Area / No. executed by the project.	Area / No. executed by the farmers with little assistance from project.	Area / No. executed by the farmers without project assistance.	Replication by the farmers.	% of replication.
1	2	3	4	5	6 = 4 + 5	7
01.	Catch pits for plantations.	2039 ha.	230 ha.	136 ha.	366 ha.	18
02.	'V' ditch for vegetative bunding.	3921 ha.	1200 ha.	237 ha.	1437 ha.	37
03.	Brush wood check.	362 Nos.	350 Nos.	100 Nos.	450 Nos.	125
04.	Loose boulder structures.	2595 Nos.	211 Nos.	150 Nos.	361 Nos.	14
05.	Water hole. (Small dugout pond)	576	----	220 Nos.	220 Nos.	38

Table 3. Unit cost structure of different low cost soil conservation measures.

Sl. No.	Name of the Measures.	Unit.	Cost in Indian Rupees.
1	2	3	4
01.	Catch Pits.	Ha.	400
02.	'V' ditches.	Ha.	150
03.	Brush Wood Check.	One.	200
04.	Loose Boulder Check.	One.	250 to 1,000
05.	Contour Vegetative Hedges with 'V' ditch.	One meter.	10
06.	Water Hole. (Small dugout recharge pond)	One.	270

Regarding 'V' ditch and loose boulder structures the farmers have already initiated replication of them on their field. The project has now extended the field activities more on private land. Hence it is hoped that these items will be replicated by the farmers more. Unit cost of these low cost structures is given in table 3. From the unit cost it is seen that a poor farmer can afford to execute these low cost measures for regeneration of degraded natural resources.

INDIGENOUS WATER CONSERVATION TECHNOLOGY

Under rain-fed conditions looking to high moisture stress and poor holding capacity of the soil, the farmers have not been putting any attempt towards vegetable cultivation in their field resulting lack of availability of fresh vegetables for their home consumption putting uncertainty in nutrition security to the family. The project has encouraged **Indigenous Water Conservation Technology** among the farmers by digging a pit of 3m dia with 1.5m deep locally called as **"Chua"** at the corner of the plot so that water gets collected from surface as well as sub-surface soil enabling the farmer to grow vegetables covering about 0.05 hectare. The project has assisted the farmers with vegetable seeds, cost of a pit and K. B. Pump costing Rs.1,100/-.

The farmers have been getting vegetables worth Rs.3,200/- within three months.

So far the project has already constructed 576 Nos water holes from the project share associating the farmers and 220 water holes have been done by the farmers without any assistance from the project.

SMALL POND ON COMMON LAND

A Case Study

Village, Kanagaon in Koraput district, Orissa is a typical village in need of water for human drinking, livestock drinking, domestic consumption etc.. This village is situated in the project area of Danida Assisted Watershed Development Programme. There is a traditional pond located near the habitation of high caste and influential families. However twelve schedule caste landless poor families of the village were in urgent need of water.

Process

In the above context the project staff in collaboration with NGO partner organised whole village assembly. The problem of water scarcity of the landless families was discussed as per Danida policy of enabling the poorer section (landless people) to solve their own problems. It was also emphasised that the landless should make substantial contribution in the form of labour, so that only willing and needy people participate in solving their problem. It was decided by consensus that a pond should be constructed on a common land by the side of the nala in the vicinity of the habitation of landless. Since there is about 10 ha of degraded common land and area of 45.73m X 30.48m was identified for the digging up pond.

In pursuance of this the entire villagers passed a resolution to allow twelve landless families to construct the pond, maintain it and share the benefits among themselves. These families formed a self help group and opened a joint account in the bank with nominal member fee collecting Rs.120/- @ 10 each family.

Moreover the project staff and NGO obtained the written permission from the Revenue Authority for constructing the pond. The Revenue Inspector came to the spot and demarcated the land proposed for the pond.

Construction of Pond

The project staff designed the pond located near a nala with common inlet and outlet with size 30.48m X 18.29m X 4.57m, capacity about 1,790 cubic meter. Twelve families provided labour and were paid for six days per week and wages for the seventh day was calculated and accounted as their own contribution which total about Rs.10,000/- (20%). The landless families suggested a modification in the design to broaden the embankment so that they can cultivate, plant fruit trees and grow vegetables on it. It was accepted and accordingly the pond was constructed.

Utilisation

The group of twelve families were assisted by the project for pisciculture by providing fingerlings costing Rs.250/-. The twelve families divided total parameter in to twelve portions equally and each family has been cultivating vegetable like brinjal, chilli, tomato etc. and also planted seedlings like drumstick and custard apple. Each family has planted two to three teak plants on their own portion. A package of vegetable seed at Rs.100/- per family was provided for raising seedlings by utilising pond water. Each family has contributed farm yard manure for his own share for getting good yield.

Benefits

The wells located in the vicinity of landless households got recharge and drinking water availability increased considerably. In addition other wells located in the high caste areas benefited from the recharge. About 5 ha. of land around the pond are getting seepage water and crop productivity has increased helping the land holders. The twelve landless families are utilising the pond water for domestic purposes of bathing, cleaning and washing. The first catch of the fish produced around 35 kg costing about Rs.1,000/-. Half of the fish was consumed by the twelve families equally and remaining half was sold out for Rs.500/-. The sale proceeds were deposited in the account of the self help groups of twelve families. This money will be utilised for sustaining the pisciculture in subsequent years. By growing vegetables (brinjal, tomato, chilli) on the embankments the twelve families got good nutrition support. Though no marketable surplus was generated, the families got nutritive vegetable which they could hardly afford to purchase from the market. The self help group showed science of innovation and creativity when they utilised the tank silt to make brick and earned some supplemental income. Thus a small initiative of good will of the village community has improved water availability for landless families and also provided a small asset for pisciculture and vegetable cultivation.

This may not be a total transformation and upliftment of landless families but certainly a small step forward on strengthening their livelihood support system. The project staff and NGO are also working towards legal rights on the pond and its embankment. Five small ponds of similar types have been constructed in the project and same are now maintained by the users group.

INTEGRATED FARMING SYSTEM

Process

Since inception of the project large area has been covered under misc. tree plantation, cashew plantation, horticultural plantation mostly on Government waste land. Out of

which limited area has been covered on private land with cashew and back yard horticultural plantation. These activities permit only long-term benefits for the farmers. Active involvement of the farmers was not possible since the plantation activities did not provide any short-term benefits. While developing a village wise prospective plan, focus on improvement of individual household came up in the project. Instead of taking plantation as single activity for an area need for an Integrated Farming System for a household was felt which combines both short-term and long-term benefits. Details of lay-out of Agro-Silvi-Horti-Pastural-System in ten hectare of land is given in Figure 1.

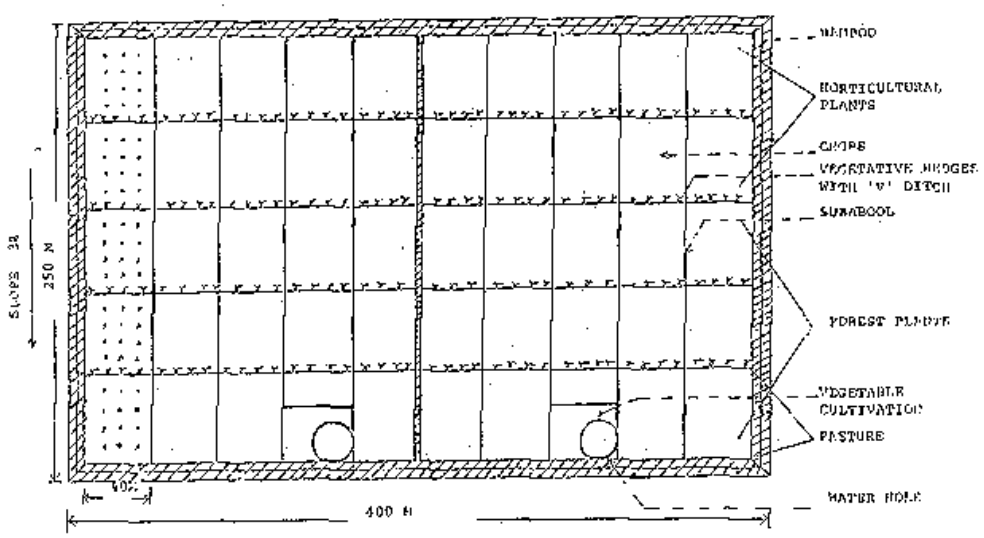

Figure 1. Layout of Agro-Silvi-Horti-Pastural-System in ten hectare of land.

The project developed a model in a village namely Bijapadar, Malkangiri with 10 hectare of land involving 10 farm families from the beginning. The piece of the land is a Government waste land encroached by ten farm families since last twenty years. The land has 3% slope with 50% of the land affected with erosion problem. The farmers have been growing mostly horse gram and they get annual income of Rs.720.00 per hectare in kharif and land lies fallow during Rabi. In the year 1998-99 the project treated this piece of land with low cost measures like vetiver bunding with 'V' ditch across the slope of the land. One hectare of land was demarcated to one farm family. Bamboo strip of 2m width was provided as a border so that 130m can be owned by an individual. 24 fruit trees like mango, guava, lemon etc., 90 forest species, like acacia, gambhari etc. have been planted in each hectare of the land and mixed cropping with black gram, ragi and sesame were adopted. In the interspaces of the trees the farmers have grown horse gram, cowpea, maize, as fodder crops for feeding cows, buffaloes, goats and sheep.

Benefits

In the village Bijapadar, Malkangiri, Orissa this new model of ten hectare of the land has been established with full of vegetation. This has been possible through low cost soil conservation measures like 'V' ditch and vetiver vegetative hedges. Since the land is

within 3% slope and free from the gullies there was no need to execute any loose boulder structures. Mixed cropping with ragi, black gram, and sesame have given good yield under crop demonstration programme. The project has focussed on low external inputs under this programme. Legumes like cowpea, horse gram and stylo-hamata gave adequate fodder for the animals when they were grown in the interspaces of the plantations. Good fodder are now available for feeding cows, buffaloes, goats and sheep of the individual farmers. Improved cropping practices and good crop management have increased the yield and also helped the farmers to maintain production of the land. The project has incurred Rs.7,000/- per hectare for developing the land. Details of the costing is given in table 4.

Table 4. Model estimate for agro-Silvi-Horti-pastural system for five hectare land.

Sl. No.	Activity.	Indian Rupees.
1	2	3
01.	Survey and demarcation 6 man days @ Rs.30/- + Materials Rs.50/-.	230.00
02.	Brush wood fencing @ Rs.3/- for 1200 meter.	3,600.00
03.	Contour 'V' ditches with vegetative hedges @ Rs.250/- rmt/ha. (Including gully checks and low cost rill control measures).	12,500.00
04.	Cost of seeds.	
	a) Grass 1.5 Kg/ha x 5 = 7.5 Kg. @ Rs.60/-.	450.00
	b) Legumes (Stylo) 2Kg./ha x 5 = 10Kg. @ Rs.60/-	600.00
	c) Legumes (Cowpea) @ 2Kg. x 5/ha. = 10 Kg. @ Rs.50/-.	500.00
05.	a) Ploughing over 5 ha. 2 bullock man days @ Rs.50/- 2 x 50 = Rs.100/- per hectare.	500.00
	b) Peripheral ploughing for 2m width bamboo seed broadcasting 4 bullock man days.	200.00
	c) Cost of bamboo seeds.	1,000.00
	d) Cost of broad casting 5 man days @ Rs.30/-.	150.00
06.	Cost of Planting.	
	a) 450 forest species @ Rs.13.85 x 450.	6,232.50
	b) 120 fruit species @ Rs.40.75 x 120.	4,890.00
07.	Farm yard manure / fertiliser (nitrogen, phosphate, etc.) for grass and legumes Rs.200/- per hectare.	1,000.00
08.	Watch and ward or 1st year only (project) (Each family watches 10 weeks / year).	2,713.00
09.	Misc. Contingency for unforeseen activity.	434.50
	Grand Total.	35,000.00

One hectare cost comes to Rs.7,000.00 (Rupees seven thousand only).

In Agro-Silvi-Horti-Pastural-System the farmers have taken up this water hole and vegetable cultivation in their plots. Annual income of one household from one hectare of land under Integrated Farming System is given in table 5. It is revealed that annual income from one hectare of land has increased 304% with cost benefit ratio 1 : -0.02 after one year. It is estimated that the annual income will increase 873% with cost benefit ratio 1 : 1.5 during 2 to 5 years period and 2,233% increase with cost benefit ratio 1 : 3.4 after five years. The system has shown profitability only after two years and net benefit after five years becomes 3.4 times as compared to the cost incurred. This system may remain stable up to 15 years. The project interventions have not disturbed the farmers for their

farming. Different technical options combining the forces of the farmers and the field staff have been attempted and found successful. Continuous involvement of the farmers have been possible since this system provides short term as well as long term benefits to each of the farmer.

CONCLUSION

These are few field tested techniques which have been evolved after six years' works of the project. These new opportunities have been expanded in the project for benefit of other farmers in the watersheds with minor modifications basing on site conditions. The District Administrations Koraput and Malkangiri districts of Orissa have put efforts to expand these activities in other watersheds of the districts.

Table 5. Annual income of one household from one hectare of land under integrated farming system.

A. Before (1997-1998)

Sl. No.	Activity.	Area in ha.	Yield in quintal.	Unit cost in Rs.	Total Cost in Indian Rupees.
1	2	3	4	5	6
01.	Crops. Horse gram.	 1	 1	 720	 720

Cost Benefit Ratio => 1 : (-0.48).

B. After one year. (1998 – 1999)

Sl. No.	Activity.		Area in ha.	Yield in quintal.	Unit cost in Rs.	Total Cost in Indian Rupees.
1	2		3	4	5	6
01.	Crops.					
	i)	Ragi.	0.60	1.80	800	1,440
	ii)	Black gram.	0.10	0.10	1,500	150
	iii)	Sesame.	0.18	1.00	1,200	1,200
	iv)	Fodder.	0.12	2.00	60	120
	TOTAL.		1.00			2,910

Increase in Income by 304 %.
Cost Benefit Ratio => 1 : (-0.02).

C. The period from 2 – 5 years. (1999 – 2002)

Sl. No	Activity.	Area in Ha.	Yield in quintal.	Unit cost in Rs.	Total Cost in Indian Rupees.
1	2	3	4	5	6
	Crops.				
01.	Ragi + Arhar.	0.25	Ragi-1	800	800
			Arhar-0.50	2,000	1,000
	Black gram + Arhar.	0.25	Black gram-1	1,500	1,500
			Arhar-0.50	2,000	1,000
	Maize + Cowpea.	0.25	Maize-3	250	750
			Cowpea-1.5	400	600
	Sesame.	0.10	Sesame-0.20	1,200	240
	Vegetable.	0.05	Vegetable-	50,000	1,000
	Fodder.	0.10	Fodder-2	60	120
	TOTAL.	1.00			7,010

Increase in income by 873 %.
Cost Benefit Ratio => 1 : 1.5 (After 2 years).

D. After five years. (2003 – Onwards)

Sl. No	Activity.	Area in ha.	Yield in quintal.	Unit Cost in Rupees.	Total Cost in Indian Rupees.
1	2	3	4	5	6
01.	Crops.				
	i) Ragi + Arhar..	0.20	Ragi-0.80 Arhar-0.40	800 2,000	640 800
	ii) Black gram + Arhar.	0.10	Blackgram-0.40 Arhar-0.20	1,500 2,000	600 400
	iii) Maize + Cowpea.	0.20	Maize-2.40 Cowpea-0.60	250 400	1,100 240
	iv) Sesame.	0.10	Sesame-0.20	1,200	240
	v) Vegetable.	0.05	Vegetable-	50,000	1,000
	vi) Fodder.	0.10	Fodder-2.00	60	120
	TOTAL.	0.75			5,140
02.	Fruit Trees (24 Nos.).	0.10			3,620
03.	Bamboo Plantation (Peripheral Planting).	130 m. (390 Bushes).	4 Plants per Bush.	4 per plant.	6,240
04.	Fuel Trees (90 Nos.).	0.15		200 per plant.	1,800
	GRAND TOTAL.	1.00			16,800

Increase in income by 2233 %.
Cost Benefit Ratio => 1 : 3.4

N.B.:- The project assisted one household per one hectare as follows:

i)	Agro-Silvi-Horti-Pastural System.	Rs.7,000/- (1st Year).
ii)	Crop Demonstration.	Rs. 800/- (1st Year).
iii)	Water hole and vegetable seeds.	Rs. 370/- (2nd Year).
	TOTAL.	Rs.8,170/-

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