

Soil and water conservation

in ravinous watersheds

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Ravines are a system of gullies created by water from top land to the deep rivers below and running more or less parallel to each other. Gullies or ravines are nature's waterways having a distinct watershed consisting of gently sloping table lands, the steeply sloping peripheral lands and the ravinous land proper at the confluence with the river. Since the formation and development of ravines are due to soil erosion, the remedy lies in adopting comprehensive soil conservation measures on a watershed basis. This would control and stabilize the growth of fast spreading ravines and consequently help in reclaiming the ravine land for gainful utilization.

Key words: Integrated farming system, Ravines, Watersheds

UTTAR Pradesh has taken the lead role in reclamation of ravine lands starting from 1884 but most of the project activities gradually approached towards the requirement of reclamation based on integrated farming system approach on watershed basis. Some projects have resulted in cumulative gain in terms of area reclaimed, people benefited and knowledge gained which can be fruitfully utilized for future ravine reclamation planning. However, not much benefit could be derived from the earlier projects due to failure of stable use of reclaimed land for productive purposes. Still about 75% of the ravine land needs to be effectively reclaimed for productive use of these lands. There is need to identify the gaps and suggest approaches and components for effective reclamation of ravine lands on watershed basis. The reclamation should aim for improvement of socio-economic conditions of ravine areas indicating the scope of providing sustainable livelihood to the people of that area. The region has potential for diversified crops including highly remunerative medicinal and aromatic

crops. Introduction of these crops calls for an integrated bio-industrial approach for locally processing the produce that would provide additional income to farmers and generate employment.

Extent and types of ravines in India

In India about 3.97 million ha area has been estimated to be affected by ravines (Table 1).

Problem of ravines

Ravines are affected by severe soil erosion, and in most of cases 'A' horizon of soil have been lost to such

an extent that the soil fertility has become very poor. The development of water resources – surface and ground water, is inadequate with the result that the rain-fed farming is only practice of cultivation. Bio-diversity is poor due to soil erosion, water scarcity, scrub forests and scanty vegetation. The inaccessibility and remote situations in ravines have created law and order problem to the state. Blue bulls are a menace to crops and vegetation

Approach to ravine reclamation

The main objective of the ravines development is to arrest further growth and reclaim the valuable ravine lands and put them under productive purposes by adopting appropriate farming systems approach depending upon land capability and the practical considerations of social and economic conditions. This will add to the availability of more land for the people. The sustainability of the objective outcomes will depend on the peoples' awareness, participation, owning, operating and maintaining the project from its inception to operation.

Table 1. State-wise ravine land distribution

State	Area (in million ha)
Uttar Pradesh	1.23
Madhya Pradesh	0.683
Rajasthan	0.452
Gujarat	0.400
Maharashtra	0.020
Punjab	0.120
Bihar	0.600
Tamilnadu	0.060
West Bengal	0.104
Odisha	0.113
Himalaya foot hills (including Himachal Pradesh and Assam)	0.193
Total	3.975



Proposed approach and policy options for ravine area reclamation

The 'Integrated Development' approach of the ravine area is proposed to be taken on 'Watershed' basis. These areas are rainfed. Hence it is suggested that one need to follow the 'Common Guidelines' developed by National Rainfed Area Authority (NRAA) in this regard. This also has the approval of Planning Commission and Ministries. The guiding philosophies of this guideline are: equity and gender sensitivity; decentralization; facilitating agencies; centrality of community participation; capacity building and technology transfer; organizational restructuring.

Now these are to be appropriately translated into action frame as the possible structure of the guidelines. The general technical approach to the development and integrated farming system models are discussed in later sections. Also, this approach is in line with the Ravine Reclamation Policy of Ministry of Agriculture, Government of India, 1970. The essential part of the Policy was: *work to be done on a watershed basis; shallow and medium ravines to be reclaimed for cultivation and restored to the villagers; irrigation from tube wells or pumping from the river for the ravine land reclaimed for agriculture was made mandatory; deep ravines to be afforested with fruit, fodder, fuelwood, timber and other species wanted by the villagers.*

General approach for development

Protection of marginal lands

Proper protection and treatment of marginal lands which includes table land of slope $<3\%$ would be taken for enhancement of agricultural production. Following measure would be taken to treat marginal land depending upon the site requirement: (a) contour bunding, (b) peripheral bunding, (c) land smoothening leveling with provision of safe water disposal structure, (d) construction of Farm ponds, (e) crop management demonstration in the treated area, (f) horticulture development, (g) agro-forestry, and (h) pasture development.

Protection of shallow ravines

Through treatment of shallow ravines including peripheral lands i.e. constituting the sloping belt between table land and the actual initiation of ravine lands additional area could be brought under cultivation. Following measures would be taken for reclamation of shallow ravines: (a) leveling/ Terracing, (b) construction of grass waterways for safe disposal of run-off, (c) gully head control structures, (d) loose boulder/earthen structures in upper reaches with vegetative support, (e) gully check dams/ percolation tanks in lower reaches of the gully, (f) earthen check dams/ percolation tanks in lower reach of the gully, (g) water harvesting structures/ farm ponds, (h) Agro-forestry, (i) horticulture, (j) afforestation, (k) pasture development, and (l) crop management demonstration in developed areas.

Stabilization of medium deep ravines

Reclamation of these areas is difficult because deep ravines areas are not accessible for physical treatment and in most of the places, it would require aerial seeding which is very expensive; Most of the deep ravines are having dense vegetation because these areas are less affected by grazing problems; structural measures if proposed would of high dimensions and expensive; with the treatment of upper reaches the erosion problem in deep ravines can be stabilized to a large extent as the silt load and runoff from upstream aggravates the erosion problem in deep ravines.

Apart from the above reclamation work in the area site development activities like construction of link road and livestock development and fodder production demonstration can be carried out on small plots of farmer's land (0.01 ha). In reclaimed area, crop production demonstration would be carried out under which selected farmers would be provided with high yielding seeds, fertilizers and pesticides.

Ravine stabilization

Ravines grow by water-fall erosion and retrogression of the head, erosion

on the sides, and degradation of the bed by high velocity runoff waters from the tributary watershed. Therefore, in order to stabilize the ravines, soil conservation measures like bunding, terracing and waterways, are necessary in the table lands and the peripheral land. Runoff should be diverted off the numerous ravine heads into a particularly chosen waterway ravine which can be protected with head control and bed gradient control structures. Such engineering structures should however, be supplemented with vegetative measures like grass establishment and protective afforestation at all sites with erosion hazard. Irrespective of the use to which the already ravine land may be put in due course, the works of ravine stabilization to stop their further growth into the valuable table land above must constitute the minimum priority programme.

Integrated farming system for sustainable development of ravines

Farming systems refers to deliberate raising of crops, forest and fruit trees, animals including fisheries, piggery and duck farming, sericulture, mushroom, on a given unit of land to increase the productivity and profitability, to upgrade natural resource base and to achieve overall improvement of the environment through conservation of natural resources. These also try to provide livelihood support to the people living in the area.

Integrated farming system refer to farming which introduces a change in farming techniques for maximum economic return through appropriate combinations of agri-horti-agroforestry-animal husbandry mix of activities best suited for the location and people's satisfaction and also conserving the natural resources.

Integrated farming system has the advantages of increasing economic yield per unit area per unit time, profitability, sustainability, and provides balanced nutritious food for the farmers, pollution free environment and provide opportunity for effective recycling of one product as input to other component, money round the year



and solve the energy, fodder fuel and timber crisis, avoids degradation of forest and enhance the employment generation, increase input use efficiency and finally improve the livelihood of the farming community.

In these processes, both top table lands and sloping lands are addressed for stabilization from erosion and put into appropriate production systems. The stabilization process includes all above mentioned appropriate measures. The appropriate conservation measures such as, gully land control, grassed waterways, check dams etc. are needed. These water bodies then form the sources of life saving irrigation and also help in increasing ground water. Thus, whole activities are incorporated as integrated farming system.

Giving all due regards to the past efforts as per official record so far only about 25% of the ravine land has been attempted for reclamation. Hardly any assessment of stabilized reclaimed areas is available. Also, the reasons of the failure of stable use of reclaimed land in productive purposes are not clearly known. These reasons for failures are very important for future work plan to address still left over 75% of the ravine land.

The poor socio-economic conditions of ravine areas call for immediate actions. The scope of providing sustainable livelihood to the people of the area through reclamation of the ravine areas is great under the given agro-ecological conditions and with people's participation. It has potential of giving diversified crop outputs along with medicinal and aromatic crops. This would call for an integrated bio-industrial approach for locally processing the outputs and these are expected to provide farmers more return and also will widen the scope employing more people. Hence, a pragmatic view of the ravine development is very important. In this regard the following suggestions to be considered by the authorities:

- Evaluating the specific and overall effects in terms of outputs and outcome of all previous ravine reclamation projects.
- Based on this, future strategies of reclamation planning be made keeping in view of "Common Guidelines" for Integrated Watershed Management Projects of NRAA.

Based on strategies outline future projects for ravine reclamation are to be developed and implemented.

SUMMARY

Reclamation of ravine lands has started since many decades where most of the activities are based on Integrated Farming System approach on watershed basis. In some of the projects, it resulted in cumulative gain in terms of area reclaimed, people benefited and knowledge gained which can be fruitfully utilized for future ravine reclamation planning. However, still efforts for the reclamation of ravine land needs to be adopted for productive use of these lands. The reclamation should aim for improvement of socio-economic conditions of ravine areas apart from providing sustainable livelihood to the people of the area. The region has potential for diversified crops including highly remunerative medicinal and aromatic crops. Introduction of these crops calls for an integrated bio-industrial approach for locally processing the produce that would provide additional income to farmers and generate employment.

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Integrated watershed development

Under the Tribal Sub Plan, a watershed was developed at Bernia, a tribal village of Dungarpur district, Rajasthan. A detailed bench mark survey was carried out to assess problems and potentials of the watershed. Scarcity of water and low productivity of both crops and livestock were found the major problems in the area. To improve the availability of water in the village, capacity of existing village poun or nadi was increased from 4,000 m³ to about 12,500 m³ by excavation. A conveyance channel 400 m length connecting the pond to farmers field was constructed, which benefited 12 farm families. For drinking water in the watershed area, three rainwater harvesting tankas of 21,000 litres capacity each were constructed.

Further to improve the productivity of *kharif* crops, improved seeds of paddy (Pusa Sugandha-5) and urd bean (IPU-94-1/PU-31) were distributed to farmers with package of practices. Similarly for *rabi* crop improvement, seeds of wheat (Raj 4037/4082) and gram (Pratap-1/RSG-888) along with recommended fertilizers were distributed to selected farmers based on land holdings. In all 22.63, 14.50, 214 and 30.94 q seed of paddy, urd bean, wheat and gram were distributed during 2013-2016 that benefited 175 farm families. Data on *kharif* crop yield showed increase in yield from 5 to 7 q/ha for paddy and 1.5 to 2.5 q/ha for urd bean over the traditional cropping practices of the farmer. For *rabi* crops, yield increase for wheat was 12–15 q/ha and gram 3–4 q/ha. Each household in the watershed was provided with solar lantern; and 70 farmers were given seed storage bins. Under horticulture development, 450 seedlings of pomegranate variety bhagwa, 350 seedlings of lemon or kagzi, 500 seedlings of mango Mallika, and 300 saplings of jackfruit were distributed. The survival of various fruit trees varied from 60 to 80%.

For livestock improvement, three bucks and seven rams of Sirohi breed were given to the farmers of the watershed; and 15 progenies were produced from the bucks. For human resources development, four capacity building programs of 3 days each were conducted on natural resources management, income generation and livelihood security. About 260 farmers including 60 women were benefited.

Source: DARE-ICAR Annual Report 2018-19

