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Abstract

There are about 13 categories of wastelands identified in India, which constitute about 20.17% of total geographical area. The Govt. of India has identified 146 districts in 19 states for micro-planning of degraded lands. Nearly 83% of wastelands are in Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and UP. This paper analyses the classes of wastelands and different approaches to reclamation of these lands.

Keywords: Watersheds, wasteland, livestock, land degradation, common property resources.

Introduction

The soil erosion, caused primarily by water and wind, is one of the major contributors to the land degradation. Livestock vis-à-vis overgrazing is yet another factor causing degradation of the existing common pool resources (CPRs). The existing CPRs, which include the natural grazing lands have very poor green cover to feed the livestock. Heavy grazing intensity reduces vigor of grazed plants, distort the plant growth pattern and change the biodiversity composition of the grazing land. The land degradation leads to the loss of soil, water, biota as well as nutrients from the topsoil. On the other hand improved practices result in efficient and accelerated nutrient recycling system, improved intake of rainwater and thus stimulate plant growth.

Extent of Degraded Lands

There are various estimates of wastelands ranging from 38.4 m ha to 187 m ha due to different methods employed (Table 1). There are about 13 categories of wastelands identified in India, which constitute about 20.17% of total geographical area (NRSA, 2000) (Table 2). The Govt. of India has identified 146 districts in 19 states for micro-planning of degraded lands. Nearly 83% of wastelands are in Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and UP.

Table 1. Various estimates of wasteland in India (m. ha^{-1}).

Source	Area	% of total Geo. area
National Commission on Agriculture (NCA-1976)	175.0	53
Directorate of Economics & Statistics, Dept. of Agril & Cooperation	38.4	12
Ministry of Agriculture (1982)	175.0	53
Society for Promotion of Wasteland Development (SPWD-1984)	129.6	39
Department of Environment and Forests (BB Vohra, 1980)	95.0	29
National Wasteland Development Board (MoEF-1985)	123.0	37
National Bureau of Soil Survey & Land Use Planning (ICAR-1994)	187.0	57
National Remote Sensing Agency (NRSA-1995)	63.85	20
N.C. Saxena (Sec. RD-WD)	125.0	38

Source: V.B. Eswaran, Chairman SPWD, New Delhi, In Proc. of Seminar on Wasteland Development, March 2001, P-14

Table 2. Area under each category of wasteland in India.

Category	Area (Sq km)	% of total geographic area covered
1. Gullied and/or ravenous land	20553.4	0.65
2. Land with or without scrub	194014.3	6.13
3. Under utilized/degraded notified forest land	140652.3	4.44
4. Mining/industrial wasteland	1252.1	0.04
5. Barren rocky/stony waste/sheet rock area	64584.8	2.04
6. Steep sloping area	7656.3	0.24
7. Snow covered and/or glacial area	55788.5	1.76
8. Degraded pastures/grazing land	25978.9	0.82
9. Degraded land under plantation crop	5828.1	0.18
10. Sands-inland/coastal	50021.6	1.58
11. Water logged and marshy land	16568.5	0.52
12. Land affected by salinity/alkalinity-coastal-inland	20477.4	0.65
13. Shifting cultivation area	35142.2	1.11
Total wasteland area	638518.3	20.2

Note: 1,20,849 sq km in J&K is not mapped and hence not considered for calculating the percentage.
Source: NRSA (2000).

Harmonization of Databases for Decision Makers

Harmonizing databases for land use and land evaluation is essential to address the key issues related to land resources and sustainable development of degraded lands. There is a growing concern that various efforts are producing data sets, which are incompatible and figures do not match. This poses difficulties for decision makers to rely upon data emanating from different scientific organizations. Wastelands information of National Remote Sensing Agency (DOS) and soil degradation of National Bureau of Soil Survey and Land Use Planning (ICAR) form a good example. Therefore, there is a need for convergence of these data sets through harmonization to evolve a viable decision support system at policy maker's level.

The reported area under wastelands and their different categories by different organizations has been significantly varying. As per the Wasteland Atlas of India published recently by MoRD and NRSA, the area under wastelands is 63.85 m ha (NRSA, 2000); based on 1:50,000 scale mapping whereas, NBSS&LUP has reported soil degradation of 146.8 m ha in the country out of soil mapping on 1:250,000 scale.

The methodology adopted for harmonization of data sets consisted of collection of information available with NRSA, NBSSLUP, AISLUS and CAZRI, examining the definitions adopted by them, scope for harmonizing the classes in the legend of the maps and availability of maps (Ramakrishna et al. 2007). The nation-wide data are available only with NRSA and NBSSLUP. The data of AISLUS were covering only part of the country and hence not used in harmonization.

The comparison of legends between wastelands and degraded soil indicates that the common categories between wasteland maps and soil degradation maps are gullied and/ravinous lands, semi-stabilized to stabilized sand dunes, waterlogged & marshy lands and land affected by salinity/alkalinity. However, there are some exclusive categories such as land with/without scrub, shifting cultivation, degraded forest-scrub dominated, degraded pasture/grazing land, agriculture land inside notified forest, degraded land under plantations, steeply sloping area loss of top soil, terrain deformation, over blowing and loss of nutrients in soil degradation map.

After thorough deliberations on the data sets of wastelands and soil degradation, a legend comprising wasteland classes and soil degradation was prepared and the statistics were generated on degraded lands of India. The wasteland classes were compared with soil degradation classes to arrive at common classes and mutually exclusive classes. As per the harmonized efforts, the total degraded lands in the country are 105.96 m ha. The figure for soil degradation by water erosion (loss of top soil) is 20.52 m ha and 3.76 m ha for wind erosion (loss of top soil). The area under gully formation under water erosion is 8.47 m ha and under ravines is 1.9 m ha. Under wind erosion the aerial extent of over blowing is 1.89 m ha and 3.24 m ha under terrain deformation. The chemical degradation consists of salinization/alkalization and acidification (<4.5 pH) where the harmonized statistics are 6.73 m ha and 6.19 m ha, respectively. Under water logging two categories namely surface ponding (0.97 m ha) and sub-surface water logging (5.44 m ha) have been identified. The vegetal degradation with water erosion includes land with/without scrub, degraded forest - scrub dominated, agriculture land inside notified forest, degraded pasture/grazing land, degraded land under plantations and abandoned & current shifting cultivation areas of wasteland map prepared by NRSA. The area has been estimated to be 35.45 m ha. The other category includes mining and industrial waste, barren rocky/stony waste and snow covered/ice caps and their aerial extents are 0.2 m ha, 5.77 m ha and 5.43 m ha, respectively.

Classes of Wastelands and Correctives

Since wastelands are unproductive for different socio-economic and bio-physical reasons, different technical solutions will be needed. Broadly speaking, Venkateswarlu (2003) grouped the wastelands into:

- Uncultivable
- Cultivable
- Social
- Marginal

Some details are discussed below:

Uncultivable Wastelands

The first reason is lack of soil of any kind. This includes those areas of barren rocky outcrops and where the surface consists largely of fractured rock, coarse gravel or loose boulders. The Himalayan peaks, frozen arid valley of Ladakh and the hot arid deserts of north-west again come in this category. They can be improved only by planting sparse forest cover in select micro-sites or soil pockets.

Cultivable Wastelands

These areas have some soil and include large areas where the soil is excessively acidic, alkaline, saline or waterlogged either naturally or through previous mismanagement. Such areas may be turned productive by:

- selecting especially tolerant species and varieties or arable crops or trees,
- special soil treatments like deep ploughing, drainage etc, and
- chemical amendments like liming, gypsum or sulphur application.

Generally, such treatments (ii & iii) are costly and only high value crops are likely to give an economic return. Therefore, selection of tolerant trees may be the only economically viable option.

Social Wastelands

This is another category of wastelands that are cultivable. The soils would largely be good with climate that is not extreme. But various social and economic factors make these lands subject to excessive exploitation pressures that remove the productive capital as well as the interest or harvestable annual production.

Among these are, mainly the lands where ownership is either ambiguous, absent or is common. Evidently nobody has a controlling interest to manage it for long term production. On the other hand everybody has an interest in extracting as much as possible. Returning such lands to productivity will require social and economic adjustments that can come through people's participation.

IRMA, Anand had a detailed study on such 'social wastelands' through six case studies. They conclude that the most desirable answers to be:

- assign property rights on newly developed wastelands to individual poor families; with technical back stop largely from voluntary agencies;
- community involvement in wasteland development reducing the indispensability of powerful local leadership;
- reward individual showing quality efforts;
- encourage group consensus in decision-making and also to avoid any possible conflicts;
- let small groups be made responsible for small units of land;
- provide incentives for the rate of growth of trees maintained by these small groups; and
- see that all the participants have access to the gains;

Yet another aspect under social wastelands is the CPRs. In and around the settlements (villages), the economically disadvantaged group (small and marginal farmers and landless labourers) depend on CPRs for their livelihood and also day to day amenities. They also need similar treatment as above.

Marginal Wastelands

This is another large category where combinations of the foregoing causes are at work. These are areas where the soil is very shallow or is gravelly or where other physical or chemical factors make it infertile and unproductive. Often such lands are neglected, partly because their productivity is low at best. But another important reason is because they often are held by resource-poor farmers who cannot afford the investment required to make them productive. Yet they are forced by their situation to continue to try to scratch a base subsistence of food crops for them. Most of the assigned lands (*Patta* lands) fall under this category. Restoring such lands to better productivity also requires a combination of socio-economic and technical interventions. Government of Andhra Pradesh has come up with novel scheme of Comprehensive Land Development Program (CLDP) and tree-based farming system by Bharatiya Agro-Industries Foundation (BAIF).

Watershed Approach to Reclamation

Reclamation products would be more effective if implemented on a watershed mode. This is particularly the case in respect of addressing land constraints such as soil erosion, water logging, salinity, and wind erosion, which have strong spatial dimension in their manifestation. A watershed approach means a strong central planning, active participation of stakeholders and institutions involved and collective ownership. Farmers' participation should be ensured from the beginning and they need to be appraised of the short-and long-term benefits of the measures. Plans need to be drawn such that farmers can see some short-term benefits and the technologies are remunerative. People participate only when they get tangible benefits. The traditional customs and practices, user rights of common pool resources, sustenance of natural resource base have to be taken into account so that the new approaches to development meet the needs of different sections of the society. Most of the degraded lands in a topo-sequence are located in the ridge part of the watershed. These are the hotspots and source of surplus runoff and soil erosion. The success of greening lies in treating these spots and site improvement.

Microsite Improvement

Rehabilitation of degraded lands is very important to enhance the green cover in India. Trees play positive role in ameliorating ill effects of harsh environments of the dry areas. Though many trees are planted each year through various planting programs and the target is achieved, the survival and growth of planted trees remain very poor in these areas. This may be due to many factors, among which poor site is a major one. Microsite improvement consists of soil profile modification. Size of the pit depends on the type of plant and has to provide a good rooting medium for the plant to establish and grow subsequently.

Microsite improvement is done by digging pits at spacing and of size appropriate to the tree species, back filling it with a pit mixture consisting of original soil, FYM and tank silt (in light soils) or sand (in heavy soils) in 1/3 proportion each (by volume). Phosphorus and insecticide are also added to the pit mixture to improve root growth and control termites. The digging can be done either manually or using tractor operated post-hole diggers. In the areas where labour is in short supply or the soil and climatic conditions are not favorable for manual pitting tractor can be used. The coverage with tractor drawn augers is more and faster. Moreover, the work can be done in unfavorable weather like hot summer when the manual work is not possible. Studies under rain-fed conditions at CRIDA have shown considerable improvement in survival and initial growth of the perennials. In the non-rainy period these trees can be spot irrigated using micro tubes or the drips. The cost of microsite improvement is a prerequisite for tree-based interventions to convert demanded degraded lands to dense greenlands.

Micro-catchments

Micro-catchments are formed around the single plant or along rows of plants depending on the planting geometry and topography of land. These measures are adopted to shape the land surface to concentrate the rainwater around the base of the plant. For this, mini–catchments or half-moon configurations are created around each plant. These mini-catchments around the plant can be created in many ways, triangular, rectangular, fish bone, crescent, V-shaped, catch pits, etc., can be raised with an open end at upper side to concentrate the surface flow for higher infiltration into the root zone. Besides these, trench cum bund, staggered and contour trenches were found useful in improving the survival and growth of seedlings planted.

Participatory Approach to Rehabilitate Common Property Resources (CPRs) with Biodiesel Plantations

Energy security has assumed greater significance than ever as energy consumption, food production; improved livelihoods and environmental quality along with water availability are interrelated. Asian countries with dense population are more prone to energy crises than to their counterparts in the world. A strong nexus between overall development and energy consumption as well as source of energy exists. Developed country use more fossil fuel to meet their energy demand where as developing country use lower energy as well as higher proportion of energy from the renewable sources such as wood, coal, animal power, cow dung cakes, etc., (Karekezi S and Kithyoma W, 2006).

Any increase in food production calls for higher energy use in terms of irrigation and fertilizer, as further expansion of area under agriculture is limited. Countries like India have to maintain a delicate balance between food, fodder, water and energy security. All these are interrelated and need to be considered together. For example India has to produce 250 million tones of food to feed its ever-growing human population. Water demand for food as well as for industries, human needs, and environmental services is increasing. Under water limited situation by 2025 one third of the developing world would be facing physical scarcity of water (Seckler et al. 1998). Similarly, of 852 million poor people in the world, 221 million are in India and more number of poor reside in dry land rural areas. Edible oils as well as productive lands will have to be spared for food. Considering all these points use of degraded common property resources (CPRs) along with low-quality private lands with conservation and efficient use of rainwater strategies open up a new window of opportunities for growing non-edible oil trees for improving livelihoods of rural poor (Wani et al. 2006). The advantages of perennials are many as the greenery will protect the land from further degradation and generate employment in rural areas. The total number of species with oleaginous seed material mentioned from different sources varies from 100 to 300 and of them 63 belonging to 30 plant families holds promise. Two species namely *Jatrohpa curcas* and *Pongamia pinnata* are favored in India because of their contrasting plant characteristics and the species selected should match the site characteristics.

ICRISAT developed novel approach for rehabilitating degraded common property resources (revenue lands) using biodiesel plantation involving local landless communities. CPRs for establishing biodiesel plantations were identified through consortium approach involving officials from government functionaries, non-governmental organizations (NGOs), local governing bodies and community. Institutional arrangement was carved out in the identified locations for involving unorganized agricultural labors as a stakeholder in the model. The village agricultural labors are encouraged to bind themselves to form self help groups (SHGs) and inspired to work in the identified lands for establishing biodiesel plantations (Fig. 1). Thus formed SHGs benefit not only earning from the wages and the groups are fostered to nurture plantations by offering harvesting rights (usufruct rights) (Fig. 2) once the plantation starts yielding economic benefits. The arrangement makes wage earners to inculcate ownership in the model. The successful establishment of model not only rehabilitates the degraded lands into greening lands but also becomes source of livelihood for the landless people. ICRISAT has restored more than 500 ha of degraded lands with biodiesel plantations in Andhra Pradesh through the participatory model.

Fig. 1. Biodiesel plantation through collective action of SHGs in Velchal, Andhra Pradesh.

Fig. 2. Biodiesel user-fruct rights handed over by the District Magistrate, Ranga Reddy, Andhra Pradesh, India, to the SHG leaders

Integrating Indigenous Fodder Grasses with Biodiesel Plantations in Low-Quality Grazing Lands

ICRISAT and BAIF evolved model for restoring grazing lands with biodiesel plantations on CPRs in Rajasthan, India (Dixit et al. 2005). In many parts of semi-arid systems, livestock is the mainstay of livelihoods for the survival, where common grazing lands are used to support fodder requirements of the livestock population. Over time, common grazing lands are degraded and grasses grown are neither palatable nor sufficient to feed the livestock population. The village communities are sensitized for collective action, to contribute the labor for the development of the grazing land. Initially, the lands are restored with biodiesel crops for preventing soil erosion and subsequently sowing of grasses were taken up in between rows of plantations with soil and water conservation structures. Institutional mechanism was designed to safeguard the restored areas and harvest the fodder grasses from the land. The model created a sense of ownership among the community for the protection of natural resources and management. The model is highly suitable for establishing plantations on marginal soils aiming at integration of livestock for generation of sustainable livelihoods.

The Process

BAIF Institute of Rural Development, an NGO that is implementing the project, initially recognized the problem and engaged the community to discuss about what could be done to improve the situation. The people reciprocated positively and agreed to part with half of the common grazing area for rehabilitation. The village stakeholder community consisting of grazers, herders and farmers through *panchayat* (local village governing elected body), resolved to erect stone fence around the 45-ha grazing land and not allow any cattle to graze in that area. Thus the area was fortified with physical and social fencing. The stakeholders agreed to take up rehabilitation of the grazing land in half the area initially so that the other half was accessible to common grazing. Villagers contributed their labor to erect stone fencing, and construct soil and rainwater conservation structures to arrest runoff and increase infiltration. Over 200 staggered trenches, 290 percolation pits and 6 gully plugs were constructed across the grazing land. Once the *in-situ* rainwater harvesting structures were in place villagers planted useful grasses and saplings all over the area. The degradation was so severe that the mortality of the saplings was very high. The idea of putting up stone bench terraces, contour trenches and catch pits for in-situ moisture conservation was considered. This resulted in excellent soil and moisture conservation and aided establishment of vegetation. Despite consecutive droughts from 2000 to 2003, the area turned lush green in stark contrast with gray area across the fence (Fig. 3). The villagers cut the required grass freely from the area to feed their cattle and no free grazing is done. For the benefit of CPR villagers leave half of the quantity of grass cut by them for the society. The society auctions the collected grass to neighboring villagers and earns an income of US$ 1830 per annum.

There was a perceptible improvement in the density of vegetation in the protected grazing land in contrast to the unprotected land (Figure 4). The density of vegetation including grass has attracted many birds and animals to this part of the grazing land. Prominent among these are blue bulls. The effort of the villagers and the *panchayat* for over six years has brought out remarkable changes in the flora and fauna of this piece of land. The whole episode has brought out valuable learning for all those involved in the project and helped enhance the confidence level of the villagers. It was precisely at this juncture that the project staff thought of getting the whole process recorded and evaluated by the very people who were instrumental in the success of the project. Thus came the idea of getting the villagers to assess the biodiversity in the rehabilitated grazing land in contrast with land not rehabilitated.

The Objectives of this Exercise

- Let the community know the worth of the efforts put in by collective action.
- Create awareness in the community about the importance of community action in natural resource management.
- Create a sense of ownership among the community so that the conservation and management of natural resources by the community go beyond the project period.

Fig. 3. A villager showing the difference in vegetation on either side of the fence at Devjika Thana, Rajasthan.

Fig. 4. Rehabilitated CPR and Devjika Thana, Bundi in Rajasthan: The PBA team with a blue bull calf found in the same area.

- The number of species of useful grasses and fodder has increased tremendously. Besides the flora, even the fauna was rehabilitated in this area. This area is a safe haven for nilgai (a species of wild cows (blue bulls), adults and young ones. Rabbits, hares, jackals, foxes, mangooses and a host of bird species are found in this area. A biodiversity assessment was undertaken recently with the community participating actively in enumerating and listing the uses of the various herbs, shrubs and grasses that have been rehabilitated in this area.

**Opportunity and Challenges of Common Land Development-
Seva Mandir`s Experiences**

Seva Mandir, a NGO, involved in community development activities in Rajasthan since 1969. It focuses on enhancement of rural livelihoods through development of private wastelands; soil and water conservation activities and small lift irrigation schemes under the guidance of JFM and National Watershed as about 42% of the land is under forest. From 1986 to 2005, Seva Mandir afforested 13255 ha out of which 2509 ha is CPR land.

The problem of encroachment on commons cannot be dealt with by enacting a law against trespassing. To overcome it, Seva Mandir implemented GTZ supported project "Decolonizing the commons" – the provision of an "Environment Fund" which could be used to disburse incentives to the encroachers to handover the land back to the community.

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Trends in Negotiations and Outcomes

1. Facilitation by an outside agency: Presence of Seva Mandir in all cases has initiated the steps towards development of the commons and removal of encroachments, because of disempowerment of formal institutions such as *panchayats* to take any initiative on restoration of these lands, despite being their legal custodians.
2. Reasons for Encroachments: People are willing to buy even encroached pieces of land where the certainty of tenure is highly dubious. The encroachments in Shyampura, Turgarh, Madla all fall in the category of "bought" encroachments.
3. Extent of encroachments: Scattered encroachments are the major fact as in the cases of villages Turgarh and Shyampura, where the encroachers have encroached pockets of an entire forest block.
4. Implications of Encroachments: Ties between people in a village are not one-way but reciprocal and a dissonance in one sphere might translate into loss of support of the patron in other forums.
5. Eviction of Encroachments: The momentum generated on one issue can be transformed to other spheres of development. Building of informal institutions such as *gram vikas* committee, *samuh,* etc., gains support from this observation. It is easy to dislodge a small number of encroachers as in Gadla and Sankhla, recent encroachers than old ones.
6. Ambiguity in Land records, encroachers who have made the maximum investments on lands is not dissuaded under peer pressure to vacate the encroachments.
7. It is absolutely important to establish group norms for the management and usufruct sharing of the common assets developed, eg, *gram vikas* committee, by Seva Mandir.
8. Ambivalent state policies.

In this process, the poor gained the most. A sample survey conducted in 2005-06 on 16 sites covering poor 691 households (mostly tribals) revealed that each household received a monetary value of Rs.1392 (SISIN implementation report, Seva Mandir 2005-06). Apart from this, there have been enormous social and institutional gains. These relations have encouraged the emergence of stronger village level institutions with greater social cohesion (Bhise S.N. 2004, EERN 2002).

Policy Issues

- Access to treat the forestland falling under the watershed. Moreover, since the location of forests is on uplands, leaving forestland untreated would reduce the longevity of watershed treatment benefits downstream.
- Converting revenue land into village pasture can be made simple so that investments can be made to make revenue lands more productive.
- It would indeed be better if authority over village pastures were delegated to the concerned *gram sabha* rather than the *panchayat*.

Recommendations for Practitioners

- Rehabilitate wastelands or low-quality lands not fit for growing food crops with suitable SWC measures with suitable tree cover to decelerate land degradation.
- Use known source of planting material and promote self help groups for raising nursery.
- Identify nutritional constraints in lands targeted for such cultivations and undertake need-based nutritional amendments
- Adopt collective action mechanisms to ensure that livelihood of vulnerable groups and landless dependent on CPRs is not taken away.
- Provide usufruct rights to SHGs of landless/women to harvest benefits from rehabilitated CPRs to ensure improved livelihoods and sustainable management of CPRs.
- Most CPRs are encroached and it's a challenging task to evacuate the encroachments. Combination of social pressures, enabling policies and financial incentives could help in decolonizing the CPRs.

Investment Needs by Local/National Governments or Other Donors

- CPRs and low-quality lands owned by vulnerable group members in the society need public investment to minimize land degradation and provide livelihoods to the stakeholders.
- Greening wastelands through such initiatives need 700-1500 US$ per ha depending on locations and other factors.

Policy and Financial Incentives

- Policy support to access, develop and maintain CPRs is needed.
- Enabling policies to empower landless and vulnerable groups for collective action and facilitation by GOs and NGOs.

Conclusion

Wastelands can be developed with appropriate land and water management practices involving micro-site improvement and micro-catchments. Appropriate nutrient management options along with other agronomic measures can green the degraded CPRs and other low-quality lands through collective action. By allocating usufruct rights for the SHGs of vulnerable groups along with rehabilitation of degraded CPRs livelihoods can be improved and environment also could be protected. PRIs and the community-based organizations can ensure benefits to vulnerable members of the society. However, suitable mechanisms and policies should be worked out to target marginal areas for planting of need-based tree crops integrating with annuals.

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