ECOSYSTEM SERVICES AND POVERTY ALLEVIATION STUDY IN SOUTH ASIA (ESPASSA):

A SITUATION ANALYSIS FOR INDIA AND THE HINDU KUSH HIMALAYAN REGION

Regional Analysis

Annexure 3

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Contents

Changing Eco-system Social System Links Affecting Rural Livelihood in Fragile Environments*

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Introduction

Ecosystem services and their contributions to livelihoods of the people exhibit significant diversities. Attention to this aspect, generally ignored by mainstream aggregative discourse on ecological services and associated policy processes call for higher priority and its closer integration with the mainstream thrust of the discourse. Because of the very nature of methods and tools of investigations as well as availability of data (which are more macro-focused), the diversity and micro-dimensions of the debated components generally get low coverage. But once one looks at the role of ecosystem services in enhancing livelihood options and reducing poverty, the above disregard of diversities may discount the very purpose of operationally oriented discourse.

The present paper addresses the above mentioned aspects with particular focus on social dimensions (or community approaches) relating to usage and management of environmental resources and how the same have been affected by largely generalized aggregative policy-programme interventions. This is attempted with reference to the field situations in two fragile ecosystems represented by Himalayan middle mountains (covering parts of India, Nepal, Pakistan) and seven tropical arid and semi-arid states in India. Besides, their relative high degree of fragility (and some other broadly shared features to be mentioned later) exposes them to interlinked environmental and social vulnerabilities (Allan et. al 1988).

Besides describing fragility in terms of vulnerability to irreversible damage by higher use intensity, (DESFIL 1988) one can describe it in terms of: low input absorption capacity of the resource; limited scope for resource manipulation; and required high level of biochemical subsidization of the natural resource to achieve a level of output comparable to that from better land resources. The phenomenon can also be expressed in terms of input-output ratios, where the fragile lands have higher than average input-output ratios. Described this way areas with low potential for crop farming including Himalayan middle mountain land scapes with steep slopes and shallow soils (except in some valleys), tropical dry areas with low productivity soils as well as low and undependable moisture availability, fall under this category of fragile landscapes. Despite apparent differences of the two landscapes, for operational purposes fragility and associated attributes impart a degree of similarity, if not exact homogeneity, to these areas. This paper summarizes the relevant findings from the same. This imparts significant advantage in understanding the role of changing ecosystem services in reducing or enhancing rural poverty. The latter happens because the changing bio-physical and socio-economic processes in these areas tend to disrupt the flow of ecological services (or dependent livelihood options) more rapidly (Chambers 1987). Another factor guiding this choice is the author's close links with the

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above regions through research and advisory work exceeding more than a decade in each of the indicated regions, largely while working with ICAR and ICRISAT for dry areas and ICIMOD for mountain areas. The focus of the above work had been largely on micro-level (community level) situations covering diversified farming systems and natural resource management. This paper largely summarizes understanding and inferences from the above personal involvement. More details including quantified details are scattered in the authors' works cited as references.

After a brief descriptions of livelihood affecting features of mountains and dry tropical areas under discussion, first we look at the traditional arrangements manifesting the ecosystem social system links, which facilitated combined focus on production and conservation of natural resources, specially under the context of low population and local autonomy reflected through locally evolved arrangements to regulate resource use systems. This is followed by discussion on the disruptions of the above arrangements following the enhanced external interventions and links leading to marginalization of local resource management systems and inappropriate resource use intensification, contributing to emergence of indicators of unsustainability. The paper makes use of evidence and observations from the areas mentioned above. Most of the information based on research conducted or red by the author is presented in the form of matrix tables to save the space.

The Fragile Ecosystems: Mountains and Dry Tropics

The above two ecosystems greatly differ from each other, but they do share some common features with significant relevance to the present discussion. Compared to the prime lands (agricultural landscapes or agro-ecosystems) both the above regions are faced with ecological and social vulnerabilities due to: fragility of land resources obstructing resource use intensification; limited accessibility (though more in mountains), marginality (both bio-physical and socio-economic marginality) offering only low pay off opportunities and promoting their neglect by the mainstream policy makers/planners; significant degree of diversity and niche resources (acting as source of diverse ecological services and potentially high pay off production systems, though their harnessing is obstructed by marginality, inaccessibility etc.); and unique human adaptation mechanisms and coping strategies to address the above specificities.

Range of implications and imperatives of the aforementioned specific features of fragile areas under question are elaborated elsewhere (Jodha 1991, 1995). Here we focus on poverty related implication of these features. Accordingly, as summarized under Table 1, one can juxtapose the implications of biophysical and social features of fragile regions with the process and factors universally associated with or contributing to enhanced production and prosperity, as historically observed in the developed regions (see Table 1, columns). We relate these issues to agriculture in fragile areas on which most of the poor directly depend. The key message of Table 1 is that intensification and exchange driven processes in fragile resource zones are obstructed by their bio-physical and social characteristics such as fragility, marginality, inaccessibility etc. (Jodha 1991). Even the high potential opportunities due to different types of niche resources in the two landscapes are not locally harnessed due to the above mentioned constraining resource specificities. The external interventions (while over exploiting the niche) are usually not sensitive to the situations indicated by Table 1, beyond extracting the resources for mainstream benefits with limited local gains. Thus unless the circumstances promoting and sustaining poverty prospects in fragile areas are positively addressed their bio-physical endowments are not conducive to converting poverty into prosperity.

Table 1: The Indicative Factors/Conditions Potentially Ensuring Gainful Production and Exchange Options and their Status in Fragile Areas

(A) Resource/area Specificities (objective circumstances) in fragile areas – mountains & dry tropics	***(B)*** **Indicative conditions/processes promoted by and conducive to gains from production and exchange**					
	Relating to production processes			**Relating to post production processes**		
	High producti-vity involving resource use intensificatio n, high input availability and absorption capacity	Specialis-ation and economie s of scale	Trad-able surplus generati on/invest ment potential	Infrastruc-ture, processin g facilities-access	Equitabl e effective market and external links	Human capacities, response to changes, replicability of external successes
Limited Accessibility: distance, semi-closedness, high cost of mobility and operational logistics, low dependability of external support, or supplies	(-)	(-)	(-)	(-)	(-)	(-)
Fragility: vulnerability to degradation with intensity of use, limited low productivity/ pay-offs, risky options	(-)[a]	(-)	(-)	(-)	(-)	(-)
Marginality: limited, low pay-off options; resource scarcities and uncertainties, cut off from the 'mainstream', social vulnerability	(-)	(-)	(-)	(-)	(-)	(-)
Diversity: high location specificity, potential for temporally and spatially inter-linked diversified products/activities	(+)[a]	(-)	(+)	(-)	(-)	(-)
Niche: potential for numerous, unique products/activities requiring capacities to harness them	(+)	(+)	(+)	(-)	(-)	(-)
Human adaptation mechanisms: traditional resource management practices-folk agronomy, diversification, recycling, demand rationing, etc.	(+)	(+)	(-)	(-)	(-)	(-)

Source: Table adapted from Jodha (2001, chapter 3)
Note: a (-) and (+) respectively indicate "extremely limited" and "relatively higher" degrees of convergence between imperatives of biophysical features and the conditions associated with potential gains from production and exchange systems. The situation may differ between more accessible (commercialised) and poorly accessible areas. Besides, the socio-economic vulnerabilities may further affect the above degrees of convergence. To enhance the gainful/high pay off opportunities as adaptation options against the imepdiments, the degree of convergence between (A) and (B) indicated by (+) has to be increased. This would involve (i) enhanced accessibility, (ii) upgrading and development of fragile/marginal lands or evolve high pay off activities suited to them; (iii) demarginalisation and empowerment of mountain communities; (iv) harnessing of niche and high pay off diversified activities with equitable local gains and (v) build upon indigenous knowledge combined with R&D based scientific measures to evolve resource management/usage systems with high returns. All this needs greater understanding of fragile area situation and act accordingly.

Livelihood Strategies Two-way Adaptation Systems

Despite natural circumstances – determined constraints (including those obstructing harnessing of niche opportunities), the communities in the above fragile regions have not only survived but developed in several social and cultural terms. Over the generations this has happened through communities adapting to the ecological circumstances. Human adaptations in fact manifest the traditional arrangements characterized by a two-way adaptation systems. In here based on local knowledge and local control of resources, people have evolved the arrangements and practices (folk agronomy/engineering, locally evolved and enforced regulatory norms etc.) to adapt their demands to what ever nature has offered; and adapt/amend the resource base wherever possible, to suit the human needs. The latter is illustrated by terracing, community irrigation systems, agro-forestry etc. in mountains and agro-silvi-pastoral practices and water harvesting in dry areas). In fact diversified land use and mixed farming, mix cropping and crop rotations etc. prevailed in both ecosystems under review. The traditional arrangements and practices summarized under Table 2 (col.1) for mountain areas and dry tropical areas illustrate the situation. Accordingly, rather than expanding the supplies through over-extraction of generally fragile, marginal and low productivity land resources, the communities evolved methods to control and regulate pressure of demand on fragile resources. Accordingly, the management of demands on fragile ecological resources, under (i) largely subsistence and low populations contexts, (ii) supported by locally evolved and enforced institutional arrangements externally undisturbed due to relative isolation, (resulting from limited accessibility and external interventions), had been the important features of the traditional systems.

However, the above (sort of a low levels equilibrium) situation represented by traditional systems of resource use, changed with the enhanced (but on unequal terms) administrative and economic integration of these areas with the mainstream, prime land, dominant economic areas in different countries. This not only marginalized or disrupted the traditional systems but added to the pressure on fragile resources through increased external and internal demands resulting from market and population growth. Thus despite several gains from the above integration, the latter also induced inappropriate resource use intensification bypassing the ecological imperatives.

The Change Process and its Drivers

The highlights of externally induced measures, processes and consequences are summarized under Table 2 and 3. Under Table 2 we present measures and practices against constraining features of fragile areas directly affecting agriculture or farming systems, the key source of

livelihood for the communities. The measures evolved and traditionally used by the communities are put along with the ones promoted by public agencies in the recent decades. The Table 2 lists the key features of the traditional measures and public interventions directed to address the problems due to fragility, marginality, increased demand pressure, unequal external linkages and wider market systems. The table also lists the measures (options) directed to harnessing of diversity and niche opportunities of fragile areas. It also indicates the limitations and indicative potential of the above measures for enhancing sustainability of fragile land agriculture and related activities.

The details presented in Table 2 are fairly self explanatory to need elaboration. However, it will be useful to put the inferences from the Table, in a wider context of factors and processes associated with the community approaches and usage of natural resources (or ecosystem services) in fragile zones under (a) the traditional and (b) the present day systems. The relevant aspects in this context are summarized under Table 3.

Table 3 first describes the basic objective circumstances characterizing the above (a) and (b) systems. These circumstances under (a) helped promote high collective concern for the health and productivity of natural resource base (NRB) or ecosystems, as source of community's sustenance. The changed objective circumstance under (b) led to reduced collective concern for local NRB and rise of individual interest-driven resource extractive strategies.

Next, the Table 3 lists the key driving forces shaping the resource management systems under (a) traditional and (b) present day situations. Under (a), these drivers led to evolution of collective stake in ecological systems supported by local autonomy and functional knowledge of resource capacities and limitations. Under (b) the changed or new driving forces (including external interventions, economic and socio-political differentiation within the community), led to loss of collective stake and local control of community resources and "reactive" mode of user-responses to the change (Jodha 1998, 2001).

Table 2: Measures against constraints to sustainable resource use (agriculture) in fragile resource zones under traditional systems/development interventions

Measures Adopted Under	
Traditional Resource Usage Systems	**Conventional Development Interventions**
(A) Enhancement of Use Intensity/Input Absorption Capacity of Land (a) Measures	
Resource amendments by ethno-engineering measures: terracing/trenching/ridging, moisture conservation/drainage management/shelterbelts/ agro-forestry, etc.	Selective resource upgrading through irrigation/ other infrastructure, biophysical changes (e.g. new introduction; R and D activity/pilot projects for range lands, watersheds, etc.)
Attributes of (a) Conducive to Sustainability	
Local resource centred, community oriented and supported, small scale, diverse, adapted to local situation; linked to other activities	Science and technology input, strong logistic/ resource support, advantage of scale
Limitation of (a)	
Reduced feasibility with rising pressure on land and weakening of local level collective arrangements, lack of new high productivity components	Side effects of massive interference with fragile resources (water logging, salinity, landslides); inequities between transformed (e.g. irrigated) and leftover areas; insensitivity of R and D based initiatives to local resource

	diversity and user perspective/knowledge
(B) Usage and Management of Low Use-Capability Lands (b) Measures	
Folk agronomy involving activities with low land intensity and low (local and affordable) input regimes; integration of low intensity-high intensity land uses (based on annual-perennial plants, crop-fallow rotations, indigenous agro-forestry, common property resources; social sanctions, resource use regulation; migration/transhumance	Sectorally separated production programmes; high intensity uses through new technology inputs/ incentives/subsidies; focused conservation oriented initiatives (forests/pastures/watersheds) in largely projects mode.
Attributes of (b) Conducive to Sustainability	
Diversified, interlinked activities with different levels of intensity, community participation, control on local demand	New technological input, resource support and legal sanctions
Limitations	
Reduced feasibility and effectiveness due to population growth, decline of collective arrangements, and side effects of dominant; technological and institutional interventions	General indifference to resource limitations, user perspective; 'Technique' and 'project mode' dominated

Cont'd…

(C) Options to Harness Diversity and Niches Measures	
Folk agronomy – diversified cropping, focus on multiple-use species; complementarity of cropping-livestock—forestry/horticulture; emphasis on biomass in choice of land use and cropping patterns; complementarity of spatially/temporally differentiated land-based activities; stability oriented, location specific choices, harnessing niches for small tradable surplus	Sectorally segregated programmes and their support systems (R and D, input supplies, crop marketing); focus on selected species and selected attributes (e.g. monoculture, high grain-stalk ratio); extension of generalized development experience of other habitats with high subsidy support
Attributes Conducive to Sustainability	
Diversity, linkages as dictated by resource characteristics, locally renewable resource focused	Initiatives with strong technological and logistic components, high potential for generating new options

Traditional Resource Usage Systems	**Conventional Development Interventions**
Limitations	
Low productivity, land extensive measures incompatible with high man land ratio, and changed institutional environment	Indifferent to the totality of farming system and diverse resource potentialities; high subsidisation
(D) Resilience of the System and Mechanisms to Handle High Pressure of Demand Measures	
Diversification and linkages of landbased activities; flexibility in scale, operations input use; locally renewable resource focus, recycling of inputs/products, self provisioning; crisis period -collective sharing arrangements, common property resources, social regulations	Public relief and support during crisis/scarcities; public interventions replacing traditional self-help strategies and informal regulatory measures; highly individual (not community) focused interventions (e.g. privatization of common property resources;

for rationed use and protection of fragile resources; release of periodic/seasonal pressure by migration, transhumance, remittance economy	crisis period cushion promoted by increased private-resource productivity of HYVs, etc.; occasional linking of relief measure with productivity measures
Attributes Conducive to Sustainability	
Range of options to match specific constraints of the habitats; emphasis on community centred and regulated activities; informal rationing of demand on fragile resources.	Resource transfer from better off areas to scarcity prone areas; possibility of linking relief initiatives with resource conservation/production programmes
Limitations	
Infeasibility and reduced efficacy of collective self-help measures and folk agronomic devices, due to changed demographic, institutional, and technological environment	Dependency for sustenance on external resources; encouragement for perpetual growth of pressure on fragile resources; indifference to local self-help initiative
(E) Linkages with Other Systems (including Wider Market Systems)	
Measures	
General state of relative inaccessibility (particularly for mountains) and isolation from mainstream market; limited market linkages through tradable surplus; crisis period external dependence through periodic migration and remittance economy	Improved physical and market linkages; integration of fragile resource economy with other systems; focus on special area development programmes, transformation of limited area and their demonstration effect
Attributes Conducive to Sustainability	
A few positive side effects of isolation, local demand centred, socially controlled extraction of fragile resources, better links between the ecological resources and the resources users	Improved opportunities for relaxing internal constraints through technology, resource transfer, interactions with other systems; inducement for fuller use of niches through external demand; closer integration with mainstream economy
Limitations	
Persistent neglect and marginal status of fragile resource areas; slow pace of transformation of agriculture; unfavourable terms of exchange for marginal areas and products	Unless guarded against; high chances of extending irrelevant external experiences (including technologies); external demand induced heavy extraction of niche; unfavorable terms of exchange; distortion in local demand patterns and resource use patterns

Source: Table adapted from Jodha (1991, 1995b), based on studies of resource use and farming systems carried out by the author while working at ICRISAT and ICIMOD. Also see Jodha (2001) for details on different aspects.

Table 3: Factors and processes associated with the community approaches and usage of natural resources in fragile areas under the traditional and the present day systems

Situation under traditional systems	Situation under the present day systems
A. Basic objective circumstances:	
(i) Poor accessibility, isolation, semi-closeness; low extent and undependable external linkages and support; subsistence oriented small populations; (ii) Almost total or critical dependence on local, fragile, diverse natural resource base (NRB). ***Bottom line***: High collective concern for health and productivity of NRB as a source of sustenance	(i) Enhanced physical, administrative and market integration of traditionally isolated, marginal, areas/ communities with the dominant mainstream systems at the latter's terms; increased population; (ii) Reduced critical dependence on local NRB; diversification of sources of sustenance. ***Bottom line:*** Reduced collective concern for local NRB; rise of individual (extractive) strategies.
B. Key driving forces/factors generated by (A)*:** (i) Sustenance strategies totally focused on local resource; (ii) Sustenance-driven collective stake in protection and regeneration of NRB; (iii) Close proximity and access-based functional knowledge/understanding of limitation and usability of NRB; (iv) Local control of local resources/decisions; little gap between decision makers and resource users. ***Bottom line: Collective stake in NRB supported by local control and functional knowledge of NRB.	(i) External linkage-based diversification of sources of sustenance (welfare, relief, trade, etc.); (ii) Disintegration of collective stake in NRB; (iii) Marginalisation of traditional knowledge, and imposition of generalized solutions from above; (iv) Legal, administrative, fiscal measures displacing local controls/decisions; wider gap between decision makers and local resource users. ***Bottom line:*** Loss of collective stake and local control over NRB; resource users respond in a 'reactive' mode.
C. Social responses to (B): (i) Evolution, adoption of resource use systems and folk technologies promoting diversification, resource protection, regeneration, recycling, etc.; (ii) Resource use/demand rationing measures; (iii) Formal/informal institutional mechanisms/group action to enforce the above. ***Bottom line:*** Effective social adaptation to NRB	(i) Extension of externally evolved, generalized technological/institutional interventions; disregarding local concerns/experiences and traditional arrangements; (ii) Emphasis on supply side issues ignoring management of demand pressure; (iii) Formal, rarely enforced measures. ***Bottom line:*** NR over-extracted as open access resources
D. Consequences:	

(i) Nature-friendly management systems; (ii) Evolved and enforced by local communities; (iii) Facilitated by close functional knowledge and community control over local resources and local affairs ***Bottom line:*** "Resource-protective/regenerative" social system – ecosystem links.	(i) Over-extractive resource use systems, driven by uncontrolled demands; (ii) Externally conceived, ineffective and un-enforceable interventions for protection of NRB; (iii) Limited investment and technology input in NRB. ***Bottom line:*** Rapid degradation of fragile NRB; "nature pleads not quilty".

Source: Table adapted from Jodha (2001, Chapter 10)

All the above factors, finally contributed to effective human adaptation to ecological circumstances under (a); while under (b) they led to over-extraction of NRB as open access resources. As a final inference, the situation under (a) promoted "resource protective/regenerative" social system-ecosystem links; the situation under (b) induced rapid degradation of ecological system and reduced livelihood opportunities for the people, where "nature pleads not quilty" (Jodha 1998, 2001).

Without discounting the positive contributions of a number external interventions in fragile areas, it is not difficult to infer from Tables 2 and 3 that as far as the ecological systems and their services to the communities are concerned, there has been many negative consequences, specially for the poor due to their greater dependence of the former. There has been visible negative trends. We call them the emerging indicators of unsustainability of present patterns of natural resource use. Some of them were captured through field investigations in the two fragile regions focused by this paper.

Emerging Indicators of Unsustainability

Through participatory investigations under different studies covering over thirty villages in each mountain areas and dry tropical areas, involving recall focused discussions with relatively older people, complented by scattered village records, some evidence and observations on the changes over 30 to 40 years were collected. Based on the same, some indicators of decline natural resources and their contributions to livelihoods of the people in the fragile areas were identified (Jodha 1991; 1995a). The details are summarized under Table 3A and 3B separately for mountain and dry tropical areas. Since the thrust of the investigations was on sustainable agriculture, we called them "indicators of emerging unsustainability". Both the interviewed groups of villagers and available revenue and development records suggested close links between emergence of negative trend on the one hand and the public plus market interventions and demographic changes in the areas on the other. Put in the context and the language the ESPASSA Project, above indicators represent the declining ecological services adversely affecting the poor; and they are largely rooted in the external interventions.

Table 4A: Negative changes as indicators of the unsustainability of agriculture (Mountain Areas)

Visibility of Change	Changes Related to a)		
	Resource Base	**Production Flows**	**Resource Use/Management Practices**
Directly visible changes	Increased land slides and other forms of land degradation; abandoned terraces; per capita reduced availability and fragmentation of land; changed botanical composition of pasture/forest (e.g. spread of *Lantana in forest)* . Reduced water-flows for irrigation, domestic uses, and grinding mills.	Prolonged negative trend in yields of crop, livestock, etc. increased input need per unit production; increased time and distance involved in food, fodder, fuel gathering; reduced capacity and period of grinding/saw mills operated on water flow; lower per capita availability of agricultural products; etc.	Reduced extent of: fallowing, crop rotation, intercropping, diversified resource management practices; extension of plough to sub-marginal lands; replacement of social sanctions for resource use by legal measures; unbalanced and high intensity of input use, etc.
Changes concealed by responses to changes b)	Substitutions of: cattle by sheep/goat; deep rooted crops by shallow rooted ones; shift to non-local inputs Substitution of water flow by fossil fuel for grinding mills; manure by chemical fertilizers	Increased seasonal migration; introduction of externally supported public distribution system (food, inputs) intensive cash cropping on limited areas.	Shifts in cropping pattern and composition of livestock; reduced diversity, increased specialization in monocropping; promotion of policies/ programmes with successful record outside, without evaluation
Development initiatives, etc. potentially negative changes c)	New systems without linkages to other diversified activities; generating excessive dependence on outside resource (seed, fertilizer/pesticide based technologies) ignoring traditional adaptation experiences.	Agricultural measures directed to short term quick results; primarily product—(as against resource) centred approaches to agricultural development, etc.	Indifference of programme and policies to mountain specificities, focus on short term gains, high centralisatin, excessive, crucial dependence on external advice ignoring traditional knowledge systems.

Source: Table adapted from Jodha 1991

Note:

a. Most of the changes are interrelated and they could fit into more than one block.
b. Since a number of changes could be for reasons other than unsustainability, a fuller understanding of the underlying circumstances of a change will be necessary.
c. Changes under this category differ from the ones under the above two categories, in the sense that they are yet to take place, and their potential emergence could be understood by examining the involved resource use practices in relation to specific resource characteristics.

Table 4B: Negative changes as indicators of the unsustainability of agriculture (Dry Tropical Areas)

Visibility of Change	Changes Related to a)		
	Resource Base	**Production Flows**	**Resource Use/Management Practices**
Directly visible changes	Various forms of resource degradation: Emergence of salinity, coverage of fertile soil by shifting sands, vanishing top soils due to water/wind erosion; deepening of water tables, ground water salinisation; emerging plantless-ness, reduced perennials, increased inferior annuals and thorny bushes; reduced per capita availability of productive resources.	Reduced total and per capita biomass availability; reduced average productivity of different crops, increased cropping on sub-marginal lands; reduced resource, product recycling; higher dependence on inferior options, (e.g. premature harvesting/ lopping trees), rising severity of successive drought-impacts; increased dependence on public relief, increased migration.	Changes in land use pattern; cropping on sub-marginal lands; decline of common property resources; reduced diversity of agriculture (e.g. number of crops and their inter-linkages); reduced feasibility and effectiveness of traditional adaptation strategies (e.g. rotations, inter-cropping, biomass strategies).
Changes concealed by responses to (negative) changes	Increased emphasis on mechanization of cultivation and water lifting; substitution of draft animals by tractors; reduced fallowing of land; large scale 'reclamation' of wastelands; shift from local to external inputs (e.g. from manure to chemical fertilizers, wooden tyre to rubber tyres for bullock carts).	Higher coverage by public distribution system (food, inputs) and other anti-poverty programmes; reduced reliance on self-provisioning system and greater dependence on external market sources; changes in land use pattern favouring grain over biomass production.	Discarding of minor crops, shift towards monocropping with standardization inputs/practices; increased landuse intensity; shift from two-oxen to one—ox plough; tractorisation; practices; replacement of self-help systems by public support systems.
Development initiatives, etc. potentially negative changes c)	R & D focus on: crop rather than resource; technique rather than user—perspective (e.g. method/species/inputs rather than group action for watershed/range development); resource upgrading ignoring its limitations (e.g. irrigation in impeded drainage areas); inducing high use intensity	Highly subsidized, narrowly focused production programmes; focus on crops ignoring other land based activities; grain yield ignoring biomass; monocropping ignoring	Sectoral focus of R and D and other support systems ignoring flexibility and diversification needs; privatization of common property resources; extension of generalized external approaches to specific areas; disregard of folk knowledge informal interventions;

	of erodable soils, and other resource extractive measures (e.g. tractorisation).	diversification; relief operations focused on people and livestock ignoring resource base, thus promoting high pressure on poor resource base.	replacing local informal arrangements by rigid legal/administrative measures.

Source: Table adapted from Jodha (1991)

Note: a. Most of the changes are interrelated and they could fit into more than one block.

b. Since a number of changes could be for reasons other than unsustainability, a fuller understanding of the underlying circumstances of a change will be necessary.

c. Changes under this category differ from the ones under the above two categories, in the sense that they are yet to take place, and their potential emergence could be understood by examining the involved resource use practices in relation to specific resource characteristics.

The negative changes as indicators of unsustainabiliity of agriculture (covering diversified and interlinked land based activities such as cropping, livestock rearing, agro-forestry etc.) are grouped according to: (a) their visibility, i.e. directly visible changes; negative changes concealed by inappropriate (or appropriate) responses; and development initiatives with potentially negative consequences; and (b) the context of the changes, i.e. negative changes relating to production resource base; production flows; and resource use/management practices.

Thus there are (3 x 3) = 9 groups for each of the two eco-systems, under which indicators of unsustainability of fragile land agriculture are presented under Table 4A and 4B. To illustrate, for mountain areas directly visible change relating to resource base includes cases like abondoned degraded terraces; or reduced water flow inspiring. Relating to production flows examples include prolonged negative trend in yield of crops, increased time and distance required for collection of fodder, fuel etc. by women and illustrations of negative changes relating to management practices include reduced extent of fallow or rotation of crops.

Similarly under “visibility” category represented by the changes concealed by responses to negative changes include substitution of shallow rooted crops for deep rooted crops (due to erosion of top soils) substitution of sheep and goat for cattle (due to reduced forage availability) etc. both in mountains and dry lands.

Also increased seasonal migration and greater dependence on public distribution system for food and inputs in both the areas full in the same ‘visibility’ category but relate to production flows. The same way shift in cropping patterns and composition of livestock (part of management systems) represent the change in response to negative change or specific constraints faced by the farmers.

The visibility category: development initiatives with potentially negative change, considered by the farmer groups, as emerging source of unsustainability included promotion of crops with no links with other farm enterprises; product rather than resource centred agricultural technologies both in mountains and dry areas. The relative inappropriateness of newly promoted agronomic practices fell in to management systems with potential negative impacts.

Table 4A and 4B are fairly detailed and self explanatory to need further elaboration. However, this should be noted that several of the items placed under each of the (9) groups can be easily shifted from one group to another. Secondly, since a number of changes put under different categories of negative change, may have other guiding factors, the farmers’ views reported in the tables may be considered indicative only. This applies strongly to “development initiatives etc.” as a group of indicators. However, despite such qualifications, the details under Table 4A, 4B, do suggest people’s perspectives and concerns of shrinking ecosystem services for them. This may also be added that concerned with the negative, trends in many areas, people through collective or individual efforts have effectively tried to restore the health and productivity of natural resources; as revealed by the revisited villages (Jodha 2008).

Other Components of Eco-systems

To complement the discussion on agricultural resource base of the poor and policy-programme interventions ignoring the socio-ecological perspective at micro-levels, we may comment on a few other inter-linked components of micro-ecosystems (landscapes) which greatly helped in sustaining livelihoods of the poor in fragile areas. They include (a) "waste lands (WL)" (b) Common Property Resources (CPRs).

Wastelands

Waste lands (WL) as a category in the land revenue records in India has its roots in the British systems of land classification, where any land not contributing to government revenue through crop cultivation was designated as waste land (*Shiva 1986*). Governed by their goal of streamlining land revenue collection system, such lands, despite their biophysical supplies as well as the environmental and economic support to croplands and to the farmer's livelihoods, were treated as waste lands, with little government attention to them. An important side effect of the government's indifference to non-cultivated lands amounted to leaving them to the defacto custody of village communities. For the latter, the non-crop contributions of waste lands proved a major source of sustenance. To enhance and stabilise these contributions, the communities evolved their own methods of managing WL as a part of village commons (CPRs). In most areas this helped in the undisturbed continuation, of the traditional management systems for CPRs, except when some CPRs (e.g. forests) being more productive were acquired by the colonial rulers. Thus, the colonial government, by default encouraged the management of WL involving their protection, conservation, development and usage by the communities.

In the post-independence period (specially since early 1950s) the state adopted a relatively pro-active approach to address the problems of WL, primarily by exerting its own authority over WL, and evolving various technical as well as administrative measures for development and management of WL. Though in some sense they did continue the colonial approach to resource conservation, which considered rural people completely 'ignorant' of conservation needs and methods. This perspective was used for justifying the nationalisation of resources, over-reliance on both the public sector and the wisdom of bureaucracy in managing natural resources (*Gadgil and Guha, 1995 Blaikie 1985*). The dominant aspects of state interventions in WL included dismantling of the traditional community management system and replacing them by formal, legal, administrative and fiscal arrangements; top down, largely technology dominated approaches, with little or limited participation of local communities. These measures (listed under Table 5) are identified as: (i) legal categorisation of uncultivated/uncultivable lands as waste land by the colonial government and the latter's indifference to WL; (ii) the post-independence government's proactive but often poorly enforced policies towards waste lands, by pronouncing its authority on these lands and discarding their traditional management systems; (iii) undeclared policy of privatisation of CPRs including WL (since the introduction of land reforms in early 1950s); (iv) technology centred approaches for development and conservation WL (1950s - 1960s); (v) special area/sector/group focussed programmes such as DPAP, social forestry, equity-promoting afforestation programmes including tree patta scheme, rehabilitation of degraded forest land through rural poor (1970s-1980s) etc.; (vi) integrated watershed development programmes; (vii) massive fiscal support based effort in terms of establishment of National Waste land Development Board; and (viii) participatory/NGO supported programmes such as JFM; integrated watershed development project, pasture rehabilitation etc. Table 5, summarises the major WL management initiatives with their key attributes described as motives and myths, (i.e. premises and goals guiding public interventions), mechanism and measures (i.e. approaches and steps to implement the policies); and finally the gaps and consequences associated with the above initiatives. Table 5 is quite simple and explicit to need further elaboration.

Table 5: Management/development of the "wastelands" in India during different phases

Myths & Motives	Models & Mechanisms	Gaps & Consequences
PRE-INDEPENDENCE PERIOD Generating crop-revenue is the only indicator of productivity of land **POST-INDEPENDENCE PHASES KNOWLEDGE** (a) State's authority/power to control land means knowledge/capacity; to protect, conserve, manage WL; at local level control WL (since 1950s) village communities are ignorant of conservation needs (b) Conservation technology is only solution to WL problems and creation of technical research centres is answer to the former. (1950s-1960s) (c) Special area/sectoral/group focused approaches can help development of WL. (1970s-1980s); WL treated as piece of land separated from totality of rural economy (d) A generalised/uniform watershed development approach can enhance and harness contributions of WL in all regions (1980s-1990s) (e) A massive resource allocation can rehabilitate WL (1980s-1990s) (f) Formal legal arrangements and subsidisation can ensure effective community participatory for WL development (1980s-1990s)	• Separation of uncultivated lands as WL (through land revenue classification) and their neglect by the state • Undeclared policy of privatising WL as part of CPRs; dismantling of traditional CPR management systems through formal legal, administrative, fiscal arrangements • Creation of research centres for: Soil Conservation in for ravines; desert areas/acid lands, grass lands, areas with salinity and water logging, forestry etc. supported by public sector resources. • Often externally funded special programmes for the rural poor including the ones with focus on development of waste lands e.g. DPAP, social forestry, pasture development, watershed development (in some areas). • Largely foreign aided initiatives on watershed development in different agro-ecological regions; increased space for NGOs. • Establishment of National Waste Land Development Board, with large financial	• Disregard of economic and ecological contributions WL; management of WL (as CPRs) by communities without state help. • Alienation of local communities from local resources; decline in area, productivity (biomass) and services of WL/CPRs; spread of 'PWD' (civil works) system to WL works. • Top down, technique dominated approach without people's involvement; creation of vast scientific information with limited applicability application. • Top down, subsidy driven activities without local participation as well as concern for local needs and indigenous knowledge in choice of activities, species and methods. • Persistence of sectoral approach with domination of forestry component; disregard of both ecological and social diversity of involved components; limited local participation and domination of official decisions and spending targets. • Operations constrained by multiple concerns; increased financial resource-induced complexities (e.g.. inter-ministry tug of war within GOI); focus on 'spending-targets' etc. • Gradual emergence of clearer direction and approaches in

	resources; • It incorporating various models/methods tried earlier; multiple goals to deal with multiple dimensions of WL (ranging from research, pilot schemes to advocacy and awareness promotion). • Multi agency involvement (e.g. NGO-run initiatives) • Support to user group initiatives especially in community forestry, pasture development etc. • Increased of involvement of NGOs • Joint forest management initiatives; decentralisation through Panchayats etc.	different contexts e.g.. User participation; local ownership of WL development initiatives etc. • Limited and scattered area specific specially NGO-supported success stories. • Continued disregard of understanding of key factors that make successful group action e.g. diversity of communities and WL features and local knowledge.

Table: Adapted from Jodha (2000)

Rural Common Property Resources (CPRs)

Rural common property resources are another source of supplies specially for the poor in the fragile areas). Table 6 based on seasonally, physical verification of situations in study villages indicates the type of supplies and services by individual categories of CPRs. both in mountains and dry areas. In particular, a four year study of CPRs covering over 80 villages in 21 districts of 7 arid and semi-arid states of India, indicated that CPRs contribute 14 to 23% of income of the poor households. For others (specially large and medium farm households the corresponding figure was 2-3%. The per household/employment provided by CPRs to the rural poor ranged between 137 to 196 per year (Jodha 1992). A fairly reduced scale of field work covering lesser number of villages in mountain areas indicated higher dependence of poor compared to others in mountain areas as well. However, despite these gains, CPRs have declined both in area and productivity in all the studied areas.

The decline of CPR area has been largely attributed to governments' policies to distribute these lands in the name of helping the poor, who received very insignificant share of privatized CPRs. Transfer of part of CPRs (waste lands which formed part of CPRs) to protected areas and bio-diversity parks also reduced the CPR area. In dry areas of India CPR area declined by 31 to 55 percent during 1950-52 to 1982-84. Consequently, pressure on CPRs in different districts increased from 14 to 101 per 10 ha. of CPR area in early 1950s to 47 to 286 during early 1980s. Increased population and land hunger accentuated the above pressure. Consequently, physical decline of CPRs in terms of plant species and productivity also declined affecting the rural poor the most. (Jodha 1992, 2007). The main inference of the above account is the loss of community's natural assets affecting the rural poor most.

However, revisits to some of the above areas indicated that group of people in the villages have revived selected CPRs (Jodha 2008).

Table 6: Contributions of Common Property Resources to Village Economy in Dry Regions of India[a)]

Contributions	CPRs Types[b)]					
	A	B	C	D	E	F
Physical Products:						
Food/fibre items (NTFP)	●		●	●		●
Fodder/fuel/timber, etc.	●	●	●		●	●
Water (surface/ground water)			●	●	●	
Manure/silt/space	●	●	●			●
Income/employment Gains						
Off-season activities	●				●	●
Drought period sustenance	●	●				●
Additional crop activities			●	●		●
Additional animals	●	●				●
NTFP based petty trading/handicrafts	●					●
Larger Social, Ecological Gains						
Resource conservation	●	●			●	
Drainage/recharge of groundwater			●	●		●
Sustenance of poor			●	●	●	
Sustainability of farming systems	●	●	●		●	●
Renewable resource supply	●	●	●	●		
Better micro-climate/environment	●	●		●	●	

a) Table adapted from Jodha (1992)
b) CPRs: A – community forest, B – Pasture/waste land, C – Pond/tank, D – River/rivulet, E – Watershed
drainage, F – river/rivulet banks and beds

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