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DR. PUNJAB SINGH TAKES OVER AS SECRETARY, DARE AND D.G., ICAR

The ENVIS Centre on Desertification and CAZRI, Jodhpur extend hearty congratulations to Dr. Punjab Singh for taking over charge as Secretary DARE and Director General ICAR, New Delhi. Born on December 10, 1942, Dr. Punjab Singh obtained his M.Sc. (Agronomy) degree from Agra University, Agra in first position in 1964 and Ph.D. from IIT Kharagpur in 1969. Dr. Singh is of unique personality possessing rare combination of excellent academic record and very high-level research contributions. As an eminent teacher and scholar he supervised/guided many Ph.D. students and M.Sc. dissertations. Dr. Punjab Singh has got the experience of working in many research institutes and agricultural universities in responsible position. Dr. Singh served many national and international organisations of repute in various capacities such as researcher, administrator, Director, and Vice-Chancellor. He worked as Assistant Director General (ICAR) of the World Bank Aided National Agricultural Research Project during (1979-86), Director, Indian Grassland and Fodder Research Institute (1986-94) , Indian Agricultural Research Institute, New Delhi (1994-97), Vice-Chancellor, Jawahar Lal Nehru Krishi Vishva Vidhyalaya, Jabalpur (1997-2000) and Director, Indian Agricultural Research Institute, New Delhi (2000-2001). During his stay at various institutions and organisations, he made significant contributions in improving the status of the organisation. As ADG, NARP (ICAR), he contributed a lot in strengthening regional research capabilities of State Agricultural Universities (SAU's). During his regime as VC in JNKVV, Jabalpur, he brought out the University from financial crunches and provided new path for educational programmes and research activities. As president of Indian Society of Agronomy, he made the First International Agronomic congress a grand success. He worked as a consultant in many international organisations such as 'World Bank', FAO, IDRC etc. Dr. Singh is a fellow of many reputed societies including National Academy of Agricultural Sciences and Indian Society of Agronomy. Dr. Singh has got many scientific feathers in his crown and has traveled widely throughout the world. He has been honoured with several awards and fellowships, the important being 'Krishak Bharti Barani Kheti Award','National Productivity Council Award', 'ISA Gold Medal' and ‘Rishabshree Award'. It is believed that the council will march ahead and will achieve new goals under his dynamic leadership.

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SYMPOSIUM ON THAR DESERT ORGANIZED

A symposium on "Impact of Human Activities on Thar Desert Environment" was organized at Central Arid Zone Research Institute, Jodhpur, from Feb. 15 to 17, 2001. A total of 200 participants from ICAR Institutes, State Government Departments and Universities participated in the 3 days deliberations.

Hon'ble Minister for Agriculture, Government of Rajasthan, Shri Tayyab Hussain was the Chief Guest and Dr. J.S. Samra, DDG (NRM) inaugurated the Symposium. Amongst participants the important dignitaries were Dr. Anwar Alam (DDG, Engg.), Dr. A.S. Faroda (VC, Udaipur), Dr. C.P. Yadav (VC, Bikaner), Dr. H.P. Singh (Director, CRIDA), Dr. M.S. Sahni (Director, NRC on Goat), Dr. B.S. Chundawat (Ex-VC, GAU), Dr. J. Venkateswarlu (Ex-Director, CAZRI), Dr. M.M. Bhandari (Retd. Professor of Botany) and Dr. R.P. Dhir.

Dr. Pratap Narain, Chairman, Arid Zone Research Association of India, welcomed the delegates and guests and stressed the need to take a stalk of the impact of research and human activities such as tractorization, tube wells, water logging by canal irrigation, and shifts in land use pattern on the Thar desert. He emphasized that number of viable technologies have been developed, but still more has to be done on war footing and there is no room for compliance in the face of the emerging challenges. Dr. J.S. Samra stressed for a need to increase the productivity of rainfed crops, since irrigation is leading to lowering water table in areas where ground water is being pumped and water logging causing land degradation in the command area. He emphasized that the benefits of green revolution need to be extended to rainfed areas through people's participation in soil and water conservation programme. Likewise, he emphasized the need for sustainable use of resources and maintenance of biodiversity. Mr. Tayyab Hussain complimented scientists for bringing the country from deficient state to the position from where they can export the food grain. He emphasized the need for scientists to increasingly expose

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SOIL BIOTECHNOLOGICAL APPROACHES FOR SUSTAINABLE AGRICULTURAL PRODUCTION IN INDIAN ARID ZONE

A.V. Rao

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The arid ecosystems extend over the earth from the tropical to the sub-alpine zones and below sea level to above 3000m. Arid environments occupy an estimated 20% of the world's surface and semi-arid a further 15% (Grove,1985). Average annual rainfall in Indian arid zone varies from as low as 100 to 400 mm with different drought intensities **(Table).** Out of 100 years, 16 years receive normal rainfall at Jodhpur while only one year with normal rainfall at Jaisalmer. No crop can be cultivated under moderate to severe drought conditions. With the increase in both human and animal populations in Indian arid zone, the demand for grain, fodder and fuel-wood is increasing. But the agricultural production is low owing to the poor soil fertility and occurrence of frequent droughts (Dregne, 1968). So the enhancement of soil fertility thus assumes a great significance for sustained agricultural production in drought prone areas.

Arid soils and crop production:

Camborthids and Solorthids are the major groups among arid soils. These are extremely light, sandy, loamy sand or sandy loam. Calcium carbonate occurs at various depths influencing the effective depth of the soils. Soil depth varies from 70-120 cm. Crusting is a problem in these soils resulting in a significant reduction in per cent germination. Soil erosion by wind is even more serious leading to loss of surface fertile soil. These soils hold very low amount of moisture and nutrients because of sandy nature of the soils. These soils are poor in organic matter and very low in nitrogen. Soil salinity is a common problem because of the extreme aridity and poor quality under ground waters. In view of the above cropping intensity is very low as only one crop is taken during the rainy season. Pearl millet is the main staple food crop of this area. Besides pearl millet arid legumes such as clusterbean, moth bean, green gram and cowpea are also cultivated. Animal husbandry is the mainstay. To sustain the animal population, grasses like *Cenchrus ciliaris, C. setigerus* and *Lasiurus sindicus* are grown extensively.

Production levels of pearl millet and arid legumes vary from 0.93 to 14.3 q ha^{-1} depending on the intensity and distribution of rainfall. In some years it is not uncommon to harvest the straw only because of the terminal drought. The soils do respond to nitrogen if the moisture availability is normal as per the crop requirements. Response of pearl millet to 40 kg N ha^{-1} in terms of grain yield varied from 12 to 49% depending on the pattern of rainfall distribution. So the process of low productivity needs to be reversed by efficient utilisation of available natural resources as well as by adoption of various soil bio-technological approaches for better sustainability of agricultural production.

Soil biotechnological approaches:

Sustainable agriculture encompasses soil and crop productivity and integration of agricultural management technology to maintain soil health at the same time maintaining and enhancing the farm profitability and environmental quality. In this direction soil biological productivity plays an important role. Soil biological productivity is the fertility/productivity of the soil developed/maintained by enhancing the natural soil processes through biological means. It provides balanced nutrition for sustainable plant production through steady turnover of organic matter and to release the nutrients in harmony with the need of the plants. At the same time the nutrients will not be available in excessive amounts. Soil biological productivity can be accomplished/improved by adoption of various soil biotechnological approaches as indicated below.

- Use of bio-inoculants
- Use of organic manures
- Crop rotation
- Adoption of various cropping systems that improve the soil biological productivity
    1. Agro-forestry
    2. Silvi-pasture
    3. Agro-horticulture
    4. Ley farming
    5. Inter/mixed cropping

The systems using animal crop residues, crop rotations involving legumes, agro-forestry, silvi-pasture, ley-faming, alley cropping etc. regulate soil microbiological activities, organic matter turnover and nutrient cycling besides improving the soil physical properties. The recycling of nutrients particularly nitrogen and the proper balance between organic matter and biological activities have been shown to be necessary components of a productive soil in various cropping systems.

(A) Response to bio-inoculants: Bio-inoculants are synonym to biofertilizers. Use of beneficial micro-organisms such as nitrogen fixing bacteria and phosphate solubilizing bacteria, is an integral component of cultivation practices for various crops because of their eco-friendly and cost effective technology. But in arid zone the response of different crops to bio-inoculants varies from year to year depending on the amount and distribution of rainfall. The response of cluster bean, moth bean and green gram to inoculation with efficient strains of Rhizobium varied from 10-18% in normal year while an amount of 13-18 kg N ha^{-1} can be saved by employing *Azospirillum brasilense* as seed inoculant in pearl millet (Joshi and Rao, 1989). Because of the uncertainty of the beneficial effects of bio-inoculants in arid zone, its adaptation is low. However, it is always better to use bio-inoculants as they provide enhanced yields in good rainfall years and they are cheap and eco-friendly besides the microbial build-up which is always important for various microbial transformations. Further, arbuscular mycorrhizal fungi were found to help in the better establishment of seedlings in out plantations and improve the growth and dry matter production.

(B) Response to organic manures: Application of farm yard manure for improving the availability of nutrients and physical properties is an age old practice in Indian agriculture. But with the introduction of chemical fertilisers and slow response of organic manures, its use is reduced. Earlier studies conducted on various crops at different locations indicated that the application of FYM in many crops enhanced the grain yields through the improvement in the availability of nutrients caused by enhanced soil biological productivity. However, with the non-availability of organic manures and to meet the ever increasing demand for food grains, it is suggested that the application of chemical fertilisers may be regulated in conjunction with the use of organic manures and biofertilizers. Pearl millet production was sustainable over the years with the application of FYM (sheep/goat manure) @ 10 t ha^{-1} once in two years compared to 40 kg N ha^{-1} as urea. This is not only due to balanced nutrition but also to the improvement in physico-chemical and microbiological properties of soil.

(C) Crop rotation: It is common to adopt different crop rotations over mono cropping year after year to avoid the risk involved in arid agriculture. A significant reduction in the yields of pearl millet was observed when it is grown year after year (Mann and Singh, 1977). However grain and straw yields of pearl millet was maximum after 3 years of continuous legume followed by 2 year, 1 year and continuous pearl millet. This was due to the improvement in the soil biological productivity as reflected in the enhancement in the activities of various soil enzymes, levels of beneficial micro-organisms, organic matter and the levels of available forms of N, P and K (Rao et al., 1995). Presence of legumes in rotation promoted a strong rhizosphere effect through the changes in the root exudation and increase in below ground inputs of C and N which often enhance the microbial populations and their activities.

(D) Cropping systems: In arid areas it is suggested to grow more than one plant species in different combinations viz. inter/mixed cropping, agro-forestry, silvi-pasture, ley farming, alley cropping etc. for assured supply of either grains, fodder or fuel wood even in bad rainfall years. The benefits of growing more than one species are numerous including more efficient capture and use of sunlight and more efficient utilisation of soil resources from different depths. Invariably one of the components is a legume. The legume component helps in improving soil biological productivity. Legume provides nitrogen to the non-legume either directly by transfer of fixed N or indirectly by non-competing for soil N which is referred as a facilitative production principle. The enhanced availability of various nutrients through higher microbiological activities of the soil under the canopy of *Khejri* (*Prosopis cineraria*) trees resulted in the significantly higher grain yields of pearl millet. Similarly it was observed that the bio-mass production and N-accumulation of *dhaman* (*Cenchrus ciliaris*) growing along with *subabool* (*Leucaena diversifolia*) were enhanced compared to that of mono-cultured grass and was due to the transfer of about 20% of fixed nitrogen from *subabool* to *dhaman* (Rao and Giller, 1993).

Alternate farming systems are sought for higher sustainable crop production at low input levels and to protect the soil from further degradation. Soil physical and biological properties often change when different cropping, tillage or management systems other than conventional cultivation practices are imposed (Follett and Schimel,1989). Soil biological productivity and soil physical properties were significantly improved with different leys resulting in enhanced dry matter production and grain yield of pearl millet compared to that of the conventionally cultivated field (Rao et al. 1997). This was mainly due to significant improvement in the soil biological productivity. Weil et al. (1993) stressed the role of continuous growth of grass roots in improving the total fertility of the soil for sustainable agricultural production and soil conservation.

It is concluded that given the socio-economic conditions of the farmers and the low and erratic distribution of rainfall, the extensive use of chemical fertilisers to augment crop production is a risky proposition. So sustainable crop production can be accomplished through the adoption of such soil biotechnological approaches that enhance the biological productivity of the soils. Further, integrated nutrient practices employing organic manures and biofertilizers with the minimum input of chemical fertilisers can help in improving the soil health for sustainable crop production in Indian arid zone.

Table: Showing Average Annual Rainfall and Probability of Different Droughts

Station	Average Annual rainfall (mm)	%Probability of different droughts			
		No drought	Mild	Moderate	Severe
Jodhpur	368	16	28	16	40
Nagaur	337	7	43	11	39
Barmer	263	7	46	7	40
Jaisalmer	188	1	11	9	79

WASTELAND INFORMATION SYSTEM OF INDIA

Dr. R. Nagraja

Head, LUS, NRSA, Hydrabad

In India, the demand for fodder, fuel, grazing, forestry and arable lands got accentuated with the burgeoning population and depletion of good vegetal cover. Due to non-availability of accurate statistical information and consolidated maps on any scale, showing geographical location and spatial distribution pattern of wastelands in the country, a long felt need to have dependable base line information about wastelands has been realized. This is to enable the planners and decision-makers in preparing various programs for reclamation, management and development of all such lands, mainly for afforestation, pasture development and to meet fuel and fodder demands. Remote sensing technology has a definite edge over conventional techniques both on account of reliability, cost effectiveness and time scale.

Initially, wastelands mapping was conceived as an in-house project of NRSA, to demonstrate the capabilities of various remote sensing techniques for mapping and monitoring of wastelands in the country within the shortest possible time. A standard classification was evolved and state wise maps were prepared on 1:1 M scale for the entire country in 1985. This study had enabled prioritization of around 182 critically affected districts, where the wastelands exceeded more than 15% of total area of the district. Of these, 146 districts were taken up for mapping on 1:50,000 scale (showing village boundaries too) in 1986, as Phase-I & II of the National Wastelands Inventory Project sponsored by the National Wasteland Development Board.

The Phase- III of the project, covering 84 districts, where wastelands cover in between 5% to 15% of their total geographical area, were mapped from 1991 to 1993. The maps generated during this phase have an additional information in the form of all watershed boundaries <5000 ha. Phase- IV involved mapping of 7 districts of Madhya Pradesh State, to facilitate the total coverage of the state.

The last phase i.e., Phase-V of the project (1998 - 2000) involved coverage of all the left-cover districts across the country. Thus, all the phases have ultimately resulted in the total coverage of entire India for wastelands information. At present, NRSA has all the information both in statistical and map forms. About 63.87 M ha, equivalent to 20.17 percent of total geographical area are estimated as wasteland through this exercise. The maps will help to retrieve the information at village/watershed (500 ha) level, for implementation of wastelands/watershed development programmes. The wastelands digital database for the entire country is being generated and will be available by mid 2001. These digital databases will be created in four different layers by using satellite imagery, base layer, village, wasteland and watershed. After the completion of Phase-V, an atlas covering the wasteland statistics of entire country is released for public by Shri A.B. Vajpayee, the Hon'ble Prime Minister of India on 22nd may, 2000 in New Delhi. Subsequently, at the request of Dept. of Land Resources, Ministry of Rural Development, govt. of India, New Delhi, NRSA is organizing data dissemination workshop in different parts of the country to create awareness among the user community like district level Administrators, Planners, decision makers, Rural Development Agency officials, Line Department officials, NGO's etc.

WASTELANDS OF RAJASTHAN - AN OVERVIEW

Regional Remote Sensing Service Centre, ISRO/DOS, CAZRI Campus, Jodhpur

Increasing population has created an excessive demand on food, fodder, fuel & fibre. The biotic and abiotic pressure on land for agriculture and non-agriculture use is extending in less favourable environment. To address this issue more under-utilised areas needs to be brought under agriculture/forest or increase the productivity of land.

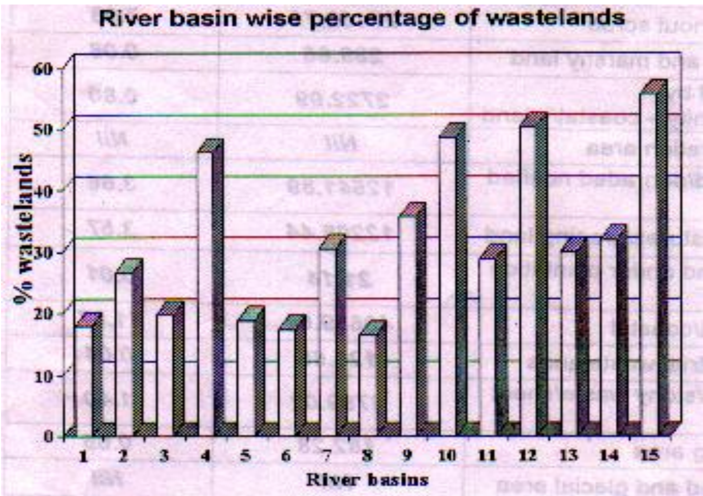
Due to excessive soil erosion by wind & water, salinity/alkalinity, waterlogging, adverse topographic conditions, unscientific practices for agriculture and forest management along with prolonged drought and floods have rendered vast stretches of land as waste.

However, land resource is also finite and information regarding wastelands nature, extent and occurrence is must for reclamation. This has necessitated adoption of scientific methods of management of such lands. Towards this, country wide wasteland mapping was carried out using remote sensing data with ancillary information on 1: 50,000 scale, co-ordinated by NRSA, Hyderabad.

According to wasteland atlas of India, Rajasthan has 30.87% of geographical area under different category of wastelands as compared to all India the figure of 20.17%.

Sl. No.	Wasteland Categories	Area Under Wasteland (Area in Sq. Km.)	% of Geographical Area
1.	Gullied and/or ravinous area	4952.77	1.45
2.	Land with/without scrub	27152.76	7.93
3.	Waterlogged and marshy land	289.66	0.08
4.	Land affected by salinity/alkalinity-coastal/inland	2722.99	0.80
5.	Shifting cultivation area	Nil	Nil
6.	Under utilised/degraded notified forest land	12541.89	3.66
7.	Degraded pastures/grazing land	12208.44	3.57
8.	Degraded land under plantation crop	21.14	0.01
9.	Sands-inland/coastal	40639.51	11.87
10.	Mining/industrial wastelands	128.65	0.04
11.	Barren/rocky/stony waste/sheet rock area	4799.02	1.40
12.	Steep sloping area	182.28	0.05
13.	Snow covered and glacial area	Nil	Nil

Under the project-water resources planning for the state of Rajasthan to address the issue of optimal exploitation and utilisation of limited water resources, basin wise land use/cover statistics was required. In order to get timely availability of reliable information remote sensing and GIS techniques were used. The work was entrusted to an agency, which finaly carried out the image processing at RRSSC, Jodhpur. The spin off of the project generated a database depicting the various categories of wastelands. The river basin wise distribution of wastelands is given below-



River Basin Name

1. Sabi Basin
2. Gambhir Basin
3. Banganga Basin
4. Mahi Basin
5. Chambal Basin
6. Luni Basin
7. Parbati Basin
8. Ruparali Basin
9. Sabarmati Basin
10. Sukli Basin
11. Other nallahas
12. Banas Basin
13. West Banas Basin
14. Shekhawati Basin
15. Out side basin

(*Continued from page 2*)

the farmers to latest technologies for optimising agricultural production. Mr. Hussain cautioned that problems related to ground water are increasing. Publications of CAZRI, Jodhpur, were also released by the Hon'ble Minister and Deputy Director General, ICAR. Dr. D.C. Ojha presented a vote of thanks.

The Symposium was divided in seven technical sessions viz; (a) drought, climate change and desertification, (b) land and water management, (c) crops and cropping systems, (d) biodiversity and alternate land use systems, (e) livestock and range management, (f) management of energy resources, (g) people's participation in development. Each session started with invited lead papers followed by contributory papers.

Introduction of IGNP in the Thar Desert has resulted in considerable changes in the land use, cropping systems and also in the environment. Therefore, a panel discussion on 'Impact of Indira Gandhi Canal on Thar Desert' was also arranged. The symposium was well received by the scientific community working in Thar Desert.

Even if there is only one tree full of flowers and fruits in a village, that place becomes worthy of worship and respect.

DESERTIFICATION, LAND DEGRADATION

Highlights from GEO - 2000

Global Environment Outlook 2000 (GEO - 2000) is a comprehensive and authoritative review and analysis of environmental conditions around the world. It is the flagship publication of the world's leading environmental organization, the United Nations Environment Programme (UNEP) and is based on information provided by more than 30 regional and international collaborating centres.

The book presents a region-by-region analysis of the state of the world's environment, highlighting key global concerns and making recommendations for policy action. The regions covered include Africa, Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, North America, West Asia and the Polar Areas.

Chapter 1. Global perspectives describes the main drivers of environmental change, such as the economy, population growth, political organization and regionalization, as well as potential impacts of recent global developments including the growth of the consumer culture, trade and international debt.

Chapter 2. The State of the Environment provides a global and region-by-region overview of the environment at the end of the second millennium. The chapter covers global issues such as ozone, climate change, ElNino and nitrogen loading and universal issues of land and food, forests, biodiversity, freshwater, marine and coastal areas, atmosphere and urban areas.

Chapter 3. Policy Responses review the broad range of policy instruments and responses being used to address environmental issues, including multilateral environmental agreements, and analyses the difficulties of compliance, implementation and assessment.

Chapter 4. Future Perspectives looks at environmental issues that will require priority attention in the twenty-first century and some alternative policy options that could be used in the regions.

Chapter 5. Outlook and Recommendations makes recommendations for future action based on the environmental legacy left by past and present policy and management systems.

GEO-2000 will be the benchmark reference and guide to the state of the environment. Written in clear, non-technical language and supported throughout by informative graphics and tables, it is essential reading for all those involved in environmental policy making, implementation and assessment and for researchers and students of regional and global environmental issues.

Global

Land degradation is a phenomenon that is global in its scale and debilitating in its impact on communities everywhere. Degradation of land results in not only a loss of productivity but reduces the productive potential of these resources for future generations.

There is a lack of reliable data on land degradation but it is likely that soil degradation has affected some 1,900 million hectares of land worldwide (UNEP/ISRC, 1991). The largest area affected, about 550 mha, is in Asia and the pacific. In China alone, between 1957 and 1990 the area of arable land was reduced by an area equal to all the cropland in Denmark, France, Germany and the Netherlands combined, mainly because of land degradation (ESCAP, 1993).

In Africa, an estimated 500 mha of land have been affected by soil degradation since about 1950 (UNEP/ISRIC, 1991), including 65 percent of the region's agricultural land (Oldeman, 1994). Crop yields in Africa could be halved within 40 years if degradation of cultivated land continue at present rates (Scotney and Dijkhuis, 1989). Land degradation affects about 300 mha of land in Latin America as a result of soil erosion, loss of nutrients, deforestation, overgrazing and poor management of agricultural land (UNEP/ISRIC, 1991). In Europe, some 12 percent of the land area (115 mha) is affected by water erosion and some 4 percent (42 mha) by wind erosion; in North America about 95 mha are affected by degradation, mainly erosion (UNEP/ISRIC, 1991).

Desertification is a significant threat to the arid, semi-arid and dry sub-humid areas of the globe, the 'susceptible drylands', which cover 40 percent of the Earth's land surface. Soil degradation in the drylands affects, or puts at risk, the livelihoods of more than 1,000 million people who are directly dependent on the land for their habitat and source of livelihood.

Some 1,035 mha, or 20 percent of the world's susceptible drylands, are affected by human-induced soil degradation (UNEP/ISRIC, 1991). Of this total, 45 percent is affected by water erosion, 42 percent by wind erosion, 10 percent by chemical deterioration and 3 percent by physical deterioration of soil structure. Water erosion is the dominant form of degradation in semi-arid areas (51 percent of total degradation) and dry sub-humid regions (also 51 percent) and wind erosion is dominant in the arid zone (60 percent).

One major consequence of desertification is the development crisis affecting many dryland countries. Drylands still provide much of the world's grain and livestock, and form the habitat that supports the last remaining big game animals. The human population of the drylands lives in increasing insecurity as productive land per capita diminishes.

Africa

Land degradation is a serious problem throughout Africa, threatening economic and physical survival. Key issues include escalating soil erosion, declining fertility, salinization, soil compaction, agro-chemical pollution and desertification. An estimated 500 mha of land have been affected by soil degradation since 1950 (UNEP/ISRIC, 1991), including as much as 65 percent of agricultural land (Oldeman, 1994). Soil losses in South Africa alone are estimated to be as high as 400 million tonnes annually (SARDC, IUCN and SADC, 1994). Soil erosion affects other economic sectors such as energy and water supply. In a continent where too many people are already malnourished, crop yields could be cut by half within 40 years if the degradation of cultivated lands were to continue at present rates (Scotney and Dijkhuis, 1989).

Recurrent droughts are also a major factor in the degradation of cultivated land and rangelands in many parts of Africa. The two problems are often interlinked. While Drought increases soil degradation problems, soil degradation also magnifies the effect of drought (Ben Mohamed, 1998).

Nearly two-thirds of African land is arid or semi-arid. The continent is the most seriously affected by desertification which threatens more than one-third of Africa's land area, particularly in Mediterranean Africa, the Sudano-Sahelian region and Southern Africa (Darkoh, 1993). In northern Africa alone, more than 432 mha (57 percent of total land) are threatened by desertification (CAMRE/UNEP/ACSAD, 1996). Although overgrazing has long been considered the primary cause of desertification in Africa, it is now thought that rainfall variability and long-term droughts are more important determinants (UNEP, 1997).

As a result of declining food security, the number of undernourished people in Africa nearly doubled from 100 million in the late 1960s to nearly 200 million in 1995. Projections indicate that the region will be able to feed only 40 percent of its population by 2025 (Nana-Sinkam, 1995). Yet the agricultural potential of the continent remains largely untapped. Although there are an estimated 632 mha of arable land in Africa, only 179 mha are actually cultivated (FAOSTAT, 1997). As with other natural resources, the arable land is unevenly distributed. More than 246 mha of the, as yet, uncultivated arable land, representing nearly 40 percent of the remaining total in the region, is found in only three countries (the Democratic Republic of the Congo, Nigeria and the Sudan).

The poverty of Africa's poor is both a cause and a consequence of accelerating soil degradation and declining agricultural productivity. Poverty reduction is thus the major challenge for those responsible for policy and decision making on the protection and sustainable use of land resources in Africa.

Asia and the Pacific

The combination of rapid urban and industrial growth, extensive deforestation and unsustainable agriculture, including inadequate soil conservation, cultivation of steep slopes and overgrazing, has had a devastating impact on land resources. According to GLASOD, of the world's 1,900 mha of land affected by soil degradation during the past 45 years, the largest area (around 550 mha) is in the Asia-Pacific region (UNEP/ISRIC, 1991). For Asia this constitutes about 20 percent of total vegetated land. Dry parts of the region are particularly vulnerable, and it is estimated that 1,320 million people (39 percent of the region's population) live in areas prone to drought and desertification (UNEP, 1997). The more recent Assessment of Soil Degradation in South and South-East Asia (ASSOD, 1997) found that agricultural production is substantially reduced by degradation in dry areas. More than 350 mha, some 53 percent of all land in the ASSOD area, are desertified. Nearly 180 mha in China, including 90 percent of China's extensive grasslands (SEPA, 1998), 110 mha in India and 62 mha in Pakistan are degraded, representing 56, 57 and 86 percent respectively of susceptible drylands (UNEP, 1997).

Soil erosion has reduced agricultural potential in many countries. In India, for instance, as much as 27 percent of the soil has been affected by severe erosion (ADB, 1997), water being one of the principal causes of the removal of nutrient-rich topsoil, particularly in the Himalayas. In the Islamic Republic of Iran, 45 percent of agricultural land is affected by light to moderate water erosion (FAO, UNDP and UNEP, 1994). Wind erosion is also extensive and severe, affecting about 25 mha in India and Pakistan, particularly the dry belt stretching from Central Iran to the Thar desert, and another 75 mha in China (UNEP, 1997). Woods (1983), in assessing the extent and severity of Australia's land degradation in 1977, estimated that about 38 percent of agricultural lands required treatment for wind and/or water erosion. More recent national-scale information on erosion is currently being prepared.

Irrigated agriculture has degraded existing arable lands and resulted in vast expanses of salinized and waterlogged soils. The Asia-Pacific region is responsible for around 75 percent of all human-induced salinization in arid, semi-arid and dry sub-humid areas, the susceptible drylands, of the world (UNEP, 1997). In the mid-1980s, Pakistan, India and China could alone account for about 50 percent (30 mha) of the world's irrigated land damaged by salinization (Postel, 1989). In Pakistan, salt build up in the soil is known to reduce crop yields by 30 percent (Worldwatch Institute, 1997). Estimates of secondary salinity (dryland and irrigated) in Australia vary from three to nine million hectares (SCARM, 1998). This has reduced productivity and sometimes increased erosion in these areas (Commonwealth of Australia, 1996).

Excessive agrochemical inputs in parts of the region are causing further degradation and soil pollution. In Australia, for example, some 30 mha of soils within the higher rainfall, improved pasture and cropping areas have acidified, and have a pH_{water} of less than 5.5 (SCARM, 1998). Acidification can lead to toxic soils, poorer water and nutrient uptake by plants, and thus reduced yields (SCARM, 1998). Japan and the Republic of Korea are now cutting back on the use of agrochemicals. At the same time, maintenance of soil fertility is a crucial issue. In the Mekong Basin, soil productivity is expected to continue its decline with the use of increasingly intensive agricultural practices (MRC/UNEP, 1997).

Urbanization and industrial development, including the construction of dams and mining, have continued to contribute to land degradation in the region. For example, mineral exploitation has already degraded some two million hectares of land in China and continues to affect another 40,000 ha each year. The long-term impacts of nuclear weapons' testing and the hazardous and toxic materials left behind after military activities have been of particular concern for the South Pacific nations. In addition, some of these countries are regularly exposed to tropical cyclones which inflict damage on infrastructure and crops as well as hindering crop growth due to residual salt and the loss of topsoil (SPREP, 1993).

With roughly 60 percent of the world's population depending on only one-third of the world's land area, the region is hard put to provide the basic needs of its expanding population. The major challenge is to optimize land use for competing needs.

Latin America and the Caribbean

Latin America has the world's largest reserves of cultivable land. The agricultural potential of the region is estimated at 576 mha (Gomez and Gallopian, 1995). During 1980 to 1994, the area under cultivation and permanent pasture increased and the forested area decreased (FAO, 1997).

Almost 250 mha of land in South America are affected by land degradation while 63 mha are affected in Meso-America. Soil erosion constitutes the major threat (68 percent and 82 percent of the affected land in south America and Meso-America respectively), while chemical degradation (mainly loss of nutrients) covers an area of 70 mha in South America and 7 mha in Meso-America, some 100 mha of land have been degraded as a result of deforestation and some 70 mha of land have been overgrazed. The major cause of land degradation in Meso-America is poor management of agricultural land. Oldeman (1994) estimates that in South America 45 percent of cropland, 14 percent of permanent pastures and 13 percent of forest and woodlands are affected by land degradation. In Meso-America, 74 percent of cropland, 11 percent of permanent pastures and 38 percent of forested areas are estimated to be affected by land degradation.

In the Caribbean, inappropriate use of land for rapid and unplanned urbanization has led to the irretrievable loss of valuable land which should have been kept for agriculture, watershed protection and biodiversity conservation. Expansion of permanent pastures into previously forested areas is still the main source of deforestation in the Brazilian Amazon (Nepstad and others, 1997) although much of this area is initially used as cropland.

West Asia

Land degradation has been a dominant problem throughout the past decade. Most land is either desertified or vulnerable to desertification. The percentage of desertified land ranges from 10 in Syria to nearly 100 in Bahrain, Kuwait, Qatar and the United Arab Emirates. In Jordan, Iraq, Syria and the countries of the Arabian Peninsula, desertification has affected wide areas of rangelands. In Sebanon degradation is serious on steep mountainous land. Salinity is also a serious problem in Bahrain, Iraq, Jordan, Oman, Syria and the United Arab Emirates (CAMRE/UNEP/ACSAD, 1996).

The following paragraphs summarize the key issues affecting land and food in West Asia:

- Overgrazing and fuelwood gathering have led to deterioration and desertification of more than 36 mha of rangelands in Jordan, Iraq and Syria (AOAD 1995);
- Wind erosion affects 28.1 percent (1.1 million km²) of the total area, mainly in GCC countries, Iraq and Syria. Water erosion affects large areas in all Mashriq countries and Saudi Arabia, including 1,260 ha in Lebanon, more than one million hectares is Syria and up to 21 percent of Iraq. Annual soil loss due to water erosion amounts to 200 tonnes/hectare in the mountainous area of Jordan (CAMRE/UNEP/ACSAD, 1996) and reaches similar values on deforested hill slops in Syria;
- Poor irrigation techniques have resulted in salinization, alkalinization and nutrient depletion in large areas. The percentage of irrigated land that is salinized by irrigation is estimated to be 33.6 in Bahrain, 3.5 in Jordan, 85.5 in Kuwait and .9 in Syria (FAO 1997) ;
- Fertile agricultural land around major cities has been lost to urbanization, industrial establishments and transportation infrastructure. One result is that the food gap in the region increased from US$ 10,700 million in 1993 to US$ 11,800 million in 1994 (FAO/UNESCWA, 1994; UNESCWA, 1997) ;
- Determination of rangeland and farm productivity is forcing farmers to abandon agricultural land and migrate to cities, increasing pressure on services and infrastructure. It is estimated that the cost of soil degrdation in Syria is equivalent to about 12 percent of the value of the country's agricultural output or about 2.5 percenmt of total GNP (Ministry of State for Environmental Affairs, Syria, 1997).

Land degradation is expected to continue unless countries undertake more mitigation measures. Fortunately, most countries have now launched national action plans to combat desertification.

***Source**: Desertification Control Bulletin No. 36, 2000*

RESOURCES

ALLIANCE TO FIGHT HUNGER

The Popular Coalition to Eradicate Hunger & Poverty is global consortium of organisations committed to the empowerment of the rural poor. It brings together intergovernmental bodies, civil society groups, and bilateral agencies. It considers that the poor can best be helped by improving their access to key assets, such as land, water and common property resources. At the same time, ways are needed to give them greater access to decision-making processes at local, national and global levels. Committed to building strategic alliances with others, the coalition has recently produced two publications which outline why access to land is critical to addressing poverty: *The Land poor - Essential Partners for the Sustainable Management of Land Resources and Empowering the Rural Poor - Through Access to Productive Assets and Participation in Decision-making.*

Contact: Popular Coalition, IFAD, via del Serafico 107,00142 Rome, Italy. Fax: +39.065043.463 and coalition@ifad.org

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WEBNETS

Frame and NRM Tracker web sites are two new information sharing networks on environment, natural resource management and sustainable development issues in Africa. FRAME gives you access to tools, technical documents, country specific analyses, and more. It also provides a place to share your information, so that practitioner working on NRM in Africa can exchange ideas and experience with others. NRM Tracker provides a tool for learning about the 'who, what and how?' of local natural resource management initiatives in Africa. Keep an eye on the websites, since they frequently post new material. Of particular interest to French speakers will be the French language version of the NRM Tracker site.

Go and visit them at: www.frameweb.org and www.nrmtracker.org

TRAINING IN AGRICULTURAL RESEARCH

The ICRA courses have provided a very valuable, hands-on opportunity for those involved in agricultural development to sharpen their skills, and learn new approaches. Taking 6 months, half is spent in class and half working in Africa, Asia or Latin America. The courses are run in both English and French language options, and aim to strengthen expertise in working with others, and with policy makers, extensionists and, most of all, with farmers. If you want to take part in the session for January to July 2002, you should apply for details now. A limited number of fellowships are also available.

For English-speaking candidates, contact ICRA, PO Box 88, 6700AB The Netherlands. Fax: +31.317.427046, or icra@iac.agro.nl Those interested in the French language course should contact ICRA Montpellier +33.46704.7526, icra@agropolis.fr

BRIEF YOURSELF FOR JO' BURG

Want to know more about 'sustainable development' and debates leading up to the Johannesburg summit? What are the main issues at stake, and why does it matter? IIED's World Summit on Sustainable Development programme is preparing short briefing notes to help busy people get a handle on what they'll be talking about 10 years after the Rio Summit. First Briefing papers to come out include: *Lessons from the theatre - Should this be the final curtain call for the Convention to combat Desertification?; Climate change negotiations - A view from the South; Striving for good governance - The role of Local Agenda 21s; Striking a balance for trade and sustainable development; biological diversity - More debate than action? And Pro-poor tourism - harnessing the world's largest industry for the world's poor.* Essential reading on the plane going to your next meeting!

Contact Tom Bigg, wssd@iied.org Fax: +44.207.388.2826 and visit the iied website where you can download the paper

PEST CONTROL THE NATURAL WAY

Farmers in South Africa use local plants as pesticides to protect their crops. In Capricorn district (formerly Central Region), Mr. P. Modiba plants garlic (*Allium sativum*) and a root crop called motsi (*Zanthosoma sagittifolium*) in rows at the field border and the centre of the field to prevent moles, rats and snakes from eating his sweet potato crop. The pests are attracted to the motsi as it is more tender than the sweet potatoes, and at the same time are repelled by the smell of garlic. There is no side effects to using these plants next to the sweet potato, and moreover, both these plants are edible!

In one of the pilot villages in Vhembe District (formerly Northern Region), farmers M. Netshithuthumi and M. Livhebe use pests to control pests! Green beans used to be infested with the CMR beetle (*Mylabris oculata*) and most farmers could not afford pesticides. Farmers collect the CMR beetle, roast and grind them into fine powder, and then soak two handfuls of the powder overnight in 5 litres of water. Then they spray onto plants. When the beetle is touched, it excretes a poisonous substance to protect itself against enemies. It seems that it is also toxic to the beetles themselves when applied on the vegetable crop! This pesticide costs nothing, but farmers have found that the powder is only effective when fresh.

In Vhembe District, farmers R. Davhula and M. Tschihombela use "mushongwa wa tshithu", a mixture of aloe (*Aloe swynnertonii rendle*), malongakanuye (*Cissus quadrangularis L.*), mihiri (*combretum imberbe wawra*) and mutangule (*Euclea divinorum hiern*) to control bollworms, stalkborer, cabbage bugs, aphids and cutworms in vegetable crops. Farmers mix equal portions of the plant materials, soak them in water overnight, sieve and then spray on infested plants. After a few days, the pests disappear. This formula is easy to prepare, and cheap. Plants which have been sprayed are safe to eat after 7 days. But beware one disadvantage! High concentration of the mixture burns the leaves. The agricultural Research Council has tested the effectiveness of the farmers' mixture and found that it was as effective as the pesticides normally used. Environmental effects from use of these plants as pesticides are unknown.

In another village in Vhembe District, farmer J. Vhengane uses a solution of 'Sunlight' soap and tobacco to control locusts, bollworms and aphids in cabbages. First, he boils 100g of tobacco leaves and 125g of 'Sunlight' soap block in 5 litres of water. After 15-20 minutes, the solution should be sieved and allowed to coo., before being applied. It seems an effective and cheap way of repelling pests, with no apparent side effective and cheap way of repelling pests, with no apparent side effects or environmental hazards.

Information collected and documented from farmers from the BASED pilot villages. For more information, contact J.J. Mkhari, M. Netshivhodza and M.J. Ramaru at BASED, PO Box 4645, Pietersburg, South Africa. Fax: +27 (0) 15 295 7090. Email: base.gtz@pixie.co.za

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