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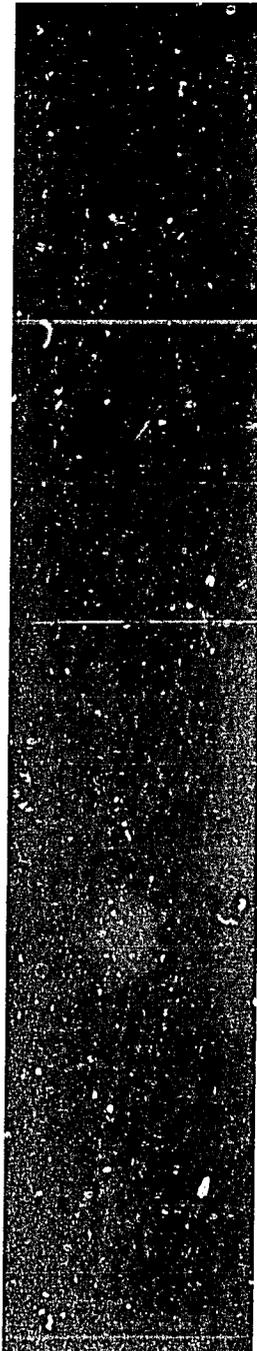
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*Briefing papers on key sustainability
issues in agricultural development*

Glossary of Selected Terms in Sustainable Agriculture

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SUSTAINABLE AGRICULTURE PROGRAMME

This **Gatekeeper Series** is produced by the International Institute for Environment and Development to highlight key topics in the field of sustainable agriculture. This glossary of thirty-five entries covers a variety of terms commonly used in sustainable agriculture literature. Each entry includes a brief description and references for further information on the subject. Cross references to other terms are indicated in bold upper case. References are provided to important sources and background material.

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GLOSSARY OF SELECTED TERMS IN SUSTAINABLE AGRICULTURE

AGROECOLOGICAL ZONING

A multidisciplinary approach for comparing land suitabilities within a given area. Developed by FAO, the zones are defined on the basis of data on the different climatic conditions and growing periods within the area, and the agroclimatic constraints to crop production in these zones are then assessed. A final calculation, of soil limitation ratings according to the soil composition of each zone, arrives at a land suitability classification or land evaluation for crop production at different levels. A Recommendation Domain is the term used for an area, defined by the zoning, where the adoption of a particular innovation would be appropriate. (Higgins and Kassam, 1981)

AGROECOSYSTEM

An ecological system modified by human beings to produce food, fibre and other agricultural products. Defined by some on purely biophysical characteristics (i.e. an agro-ecological-system) (Hart, 1984); others include a socio-economic component (i.e. an agro-ecological socio-economic system) (Conway, 1987)

AGROECOSYSTEM ANALYSIS (AEA)

A systems approach to analysing agroecosystems, and conducted in an interdisciplinary workshop environment. Patterns in space, time, flows and decisions are analysed to determine the important system properties of:

- **productivity:** the output of valued product per unit of resource input
- **stability:** the constancy of productivity in the face of small disturbing forces arising from the normal fluctuations and cycles in the surrounding environment
- **sustainability:** the ability of an agroecosystem to maintain productivity when subject to a major disturbing shock or series of stresses
- **equitability:** the evenness of distribution of the productivity of the agroecosystem among the human beneficiaries.

The outcome of the analyses is a set of agreed key questions for future research or development. Developed by Conway. (Conway, 1985)

AGROECOSYSTEM ZONING

A multidisciplinary approach for mapping an area for development planning. It takes into account any socio-economic differences

within the area, in addition to the soil and climatic factors considered in agroecological zoning. The concept of General Recommendation Domains (each defined as an agroecosystem whose biophysical and socio-economic features are sufficiently common that a menu of diverse innovations and interventions can be appropriately recommended throughout the system) is used to assess the breadth of applicability of development packages. Developed by Conway. (Conway et al., 1987)

AGROFORESTRY

Collective term for land-use systems and technologies where woody perennials are deliberately used on the same land management unit as agricultural crops and/or animals, either in some form of spatial arrangement or temporal sequence. To qualify as agroforestry, a given land use system or practice must permit significant economic and ecological interactions between the woody and non-woody components (As defined by ICRAF, 1987)

ALLEY CROPPING (AVENUE CROPPING, HEDGEROW CROPPING)

Trees or shrubs are established in avenues spaced two to four metres apart. At the beginning of the cropping season, the tree rows are lopped at appropriate heights, and loppings laid in the avenues as mulch. The woody material, removed after leaf fall, constitutes an important source of firewood or stakes. Crops are then planted in the avenues through the leaf mulch. The trees and shrubs commonly used are legumes, and need to have 'pollarding' or 'coppicing' capacity (i.e. the ability to sprout fresh shoots from the stem when lopped repeatedly). Examples: *Leucaena leucocephala*, *Gliricidia maculata*, *Tephrosia candida*, *Cajanus cajan* and *Sesbania* spp. Pioneered at IITA, Ibadan (Wijewardene and Waidyanatha, 1984; Kang, et al., 1985)

APPROPRIATE TECHNOLOGY and INTERMEDIATE TECHNOLOGY

APPROPRIATE TECHNOLOGY (AT) is the generic term for a wide range of technologies characterised by one or several of the following features: low investment cost per work-place, low capital investment per unit of output, organisational simplicity, high adaptability to a particular social or cultural environment, sparing use of natural resources, low cost of final product or high potential for employment. (Carr, 1985). **INTERMEDIATE TECHNOLOGY (IT)** is a technology which stands halfway between traditional and modern technology. But intermediate is a relative notion: in Africa, the ox-drawn plough is an intermediate technology (more sophisticated than the traditional hoe, but less complex than the tractor) but in south-east Asia, it can be considered as a traditional technology (Carr, 1985; Schumacher, 1973)

BIOENERGY (BIOMASS ENERGY)

Bioenergy refers to a wide variety of energy sources which consist of or are derived from vegetation. The collective term 'woodfuels' is normally used for woody fuels which are burned directly, notably firewood ('fuelwood') and charcoal, but may also include shrubs, weeds and grasses, crop and crop-processing residues (e.g. sugarcane stems, cotton stalks, rice straws, and the husks of rice, coffee and coconut) and dried animal wastes.

Many other forms of bioenergy of considerable or potential economic importance are derived from vegetation by seven main types of conversion processes. Vegetable oils (e.g. palm oil) can be purified to make substitutes for diesel fuel. The distillation of wood yields methyl alcohol, or methanol. The fermentation and distillation of sugars (e.g. from sugarcane and cassava) yields ethyl alcohol, or ethanol (potable alcohol), which is increasingly used as a supplement for gasoline (petrol). Liquid hydrocarbon fuels can be extracted and refined from some plants (e.g. some Euphorbia species). The partial combustion of wood or crop residues in a restricted air supply yields a combustible mix of gases, mainly carbon monoxide and hydrogen, commonly known as 'producer gas'. It is typically used to run petrol or diesel engines delivering electrical or motive power. But the most widely used conversion process is probably the fermentation of organic materials such as agricultural residues, manures and industrial effluents in an anaerobic environment to make biogas. Consisting of methane, carbon dioxide and hydrogen sulphide, it is used either for direct combustion in cooking or lighting, or indirectly to fuel combustion engines delivering electrical or motive power. Two added advantages of biogas production are (1) the reduction of the organic matter into a slurry with a high nutrient concentration, which can be used as a fertiliser, and (2) the bacteria harnessed in the production of the biogas and slurry also kill pathogens usually found in high concentrations in manures and which pose a serious health threat to humans (Kristoferson and Bokalders, 1986; United Nations, 1980)

CARRYING CAPACITY

The maximum number of users that can be sustained by a given set of land resources at a particular level of technology. The concept originated in ecological studies where the users were plants; it was later used in connection with livestock production, and then recreational activity (Odum, 1975; Mahar, 1985)

CASH CROPS, FOOD CROPS, EXPORT CROPS

The term **CASH CROP** is often used synonymously with **EXPORT CROP**. Strictly speaking, however, a cash crop may be sold at home or abroad and may be either a food or non-food commodity, whereas an

export crop is a cash crop that is ultimately exported from the country producing it. The major non-food cash crops that are exported are cocoa, coffee, fibre crops, rubber, tea and tobacco. In contrast, the term **FOOD CROP** usually refers to domestic production of basic staples (cereals, pulses, roots and tubers). Although these are the principal subsistence crops, they are also often marketed. For example, in Asia a sizeable proportion of rice and wheat, which are basic food staples, is sold for cash. (Barbier, 1987a; Braun and Kennedy, 1986)

COMMON PROPERTY RESOURCES

Resources collectively owned and managed by a well-defined group of users. Irrigation systems and upland pastures are common examples. Ideally, common property resources are governed by a common property regime (i.e. a system of rights and duties) which prevents overexploitation. Many traditional societies have institutional arrangements to manage common resources in a sustainable manner. In Northern Pakistan, for example, the specific dates that certain upland pastures can be used are set each year, and punishment for violating the rules is severe. In the absence of fear of punishment, sustainable management of common property depends basically on mutual trust among members of the user group. That is, each person will adhere to his/her duties and responsibilities with the expectation that others will do the same. But in the face of rapid population growth and poverty, many common property resource management institutions have broken down. The result may be that common property resources are converted to **OPEN ACCESS RESOURCES**. (National Research Council, 1986)

COMMUNITY FORESTRY (SOCIAL FORESTRY)

The use of public or communal lands for tree growing. Though generally designed to meet community needs, programmes can involve very different levels of community involvement and participation, with the role of the forestry department ranging from being a catalyst for community action to their managing and implementing the planting, harvesting, and disposal of the crop. (Foley and Barnard, 1984)

CONSERVATION FARMING (REGENERATIVE FARMING)

A system of farming which by conserving the natural resources of the soil, its surface and sub-soil fertility, the amount of rainwater it receives, and the natural recycling of nutrients, aims to be input-extensive, productive and self-sustaining (Wijewardene and Waidyanatha, 1984)

DESERTIFICATION

Although no satisfactory definition of desertification exists, the term is often used to describe a process of sustained decline in the biological productivity of arid and semi-arid land. The end result is desert, or skeletal soil that is irrecoverable. Desertification takes two distant forms: desert spread and induced desertification in more humid areas. The former may often be linked to desertisation - the increase in deserts due to natural processes. More recently, however, desertification has been linked to the sustained process of **LAND DEGRADATION**. Common indicators of desertification include a reduction in the amount and diversity of plant and animal species, loss of water retention capacity, lessened soil fertility and increasing wind and water erosion. Eventually, plant and animal communities become so radically simplified that species formerly common in an area can no longer survive under the drastically altered circumstances even if they are deliberately reintroduced. (Kotschi et al., 1986; World Bank, 1985).

FARMER PARTICIPATORY RESEARCH (FPR)

The concept of FPR has emerged from a concern to understand the environments of resource-poor farmers so that developments in technology can be tailored to suit their circumstances, and so that farmers' indigenous technical knowledge (ITK) can be fed into technology development. Informal surveys, with various types of interviewing, as a means of getting farmers directly involved in research, are key components of an FPR approach (Farrington and Martin, 1987)

FARMING SYSTEMS RESEARCH (FSR)

FSR evolved as a response to the need to identify opportunities for appropriate technology change among poor farmers. It is characterised by: (1) an applied 'problem-solving' approach, conducted by multidisciplinary teams, with a degree of farmer participation; (2) assessment of the scope for, and potential impact of, technology change within an holistic farming systems framework; (3) identification of relatively homogeneous groups of (usually resource-poor) farmers within specific agro-climatic zones as the clients of research; (4) a dynamic, iterative approach, in which one year's trials results generate hypotheses for testing in the next; and (5) concern that the results of farm trials should influence on-station research priorities. (Farrington and Martin, 1987; Shaner et al., 1982)

GENETIC PRESERVATION

(Also known as germplasm preservation). The collection and maintenance of wild species, specially-developed breeds (including hybrids produced by the crossing of two different

breeding lines, and genetically engineered lines produced by tissue or cell culture, or some other process of laboratory manipulation), and traditionally-developed breeds (including primitive cultivars produced by generations of informal selection by farmers) of plants or animals. So far the preservation of animal germplasm has been neither as extensive nor as efficient as that of plants. Animal germplasm may be maintained as herds or flocks, but can also be kept as semen or fertilised eggs stored at ultra-low temperatures. (Pino and Strauss, 1987; Holden and Williams, 1984; Wilson, 1988)

INTEGRATED PEST MANAGEMENT (IPM)

The optimisation of pest control in an economically and ecological sound manner, accomplished by the coordinated use of multiple tactics to assure stable crop production and to maintain pest damage below the economic injury level whilst minimising hazards to humans, animals, plants, and the environment. (As defined by the United States Office of Technology Assessment). (Pimentel, 1986)

INTEGRATED RURAL DEVELOPMENT (IRD)

IRD is a project format, commonly ascribed the following characteristics:

- area limitation (e.g to a district)
- multi-sectoral activities (agriculture, health etc.)
- target group orientation in favour of the rural poor
- mobilisation or people's participation.

Generally integration is used to mean the selection and design of activities which together contribute to the solving of a particular problem (for instance: improved breed, veterinary services, fodder production and animal husbandry to improve milk production). Integration thus presupposes a functional relationship between factors/activities, a coordination of activities in time, in space and generally also on beneficiaries. (Birgegard, 1988; Crener et al., 1983)

LAND DEGRADATION

Degradation is defined as a reduction in the capability of land to satisfy a particular use; i.e. the process where formerly productive land is rendered economically unproductive. It is therefore a social problem; environmental processes such as leaching and erosion occur with or without human interference, but for these processes to be described as 'degradation' implies social criteria which relate land to its actual or possible uses.

Degradation is best viewed as a result of both natural and man-made forces:

Net degradation =

$$\begin{aligned} & (\text{natural degrading processes} + \text{human interference}) \\ & \quad \text{minus} \\ & (\text{natural reproduction} + \text{restorative management}) \end{aligned}$$

The impact of natural reproduction on net degradation is illustrated by comparing the soil-loss tolerance in the mountains of Ethiopia and the hills of Northern Thailand. In the former case, cultivation has been going on for 2000 years with a fairly low rate of soil loss. However, the cumulative loss and slow rates of natural soil formation have both served to produce very serious land degradation. In Northern Thailand, however, with higher rates of soil loss, the local land-management system has 'compensated' for this and the capability of the land, in which soil formation is more rapid than in Ethiopia, is maintained. Where extreme processes of land degradation are sustained in fragile environments or where soil formation is severely impaired the end result may be **DESERTIFICATION** (Hurni, 1983; Blaikie, Brookfield et al., 1987)

MINIMUM TILLAGE

Farming with little (or, for no-tillage, zero) disturbance of the soil. Instead of the usual tillage operations (ploughing, harrowing, hand weeding) weeding is done by using herbicides and planting by using 'injection planters'. Mulch and the build-up of soil organic content beneath it are essential for the success of the 'no-till' farming; crops grown on well-drained soils respond best to the no-till techniques. (Lal, 1977)

MULTIPLE CROPPING

The intensification of cropping in time and space dimensions, involving growing two or more crops on the same field in a year. There are two possible types:

1) Sequential Cropping

Growing two or more crops in sequence on the same field per year. The succeeding crop is planted after the preceding crop has been harvested. Can be double, triple, or quadruple cropping (i.e. two, three or four crops a year in sequence) or ratoon cropping (the cultivation of crop regrowth after harvest).

2) Intercropping

Growing two or more crops simultaneously on the same field. Can be mixed intercropping (growing two or more crops simultaneously with no distinct row arrangement), row intercropping (growing two or more crops simultaneously where one or more crops are planted in rows), strip

intercropping (growing two or more crops simultaneously in different strips wide enough to permit independent cultivation but narrow enough for the crops to interact agronomically), or relay intercropping (growing two or more crops simultaneously during part of the life cycle of each. A second crop is planted after the first crop has reached its reproductive stage of growth but before it is ready for harvest). (Andrews and Kassam, 1976; Francis, 1986)

MULTIPURPOSE TREES

Trees used by humans for more than one purpose, for example fuel (wood or charcoal), timber (for construction - fences, housing; for manufacturing - furniture, packing cases, agricultural implements, paper, matches), fodder, food (from e.g. leaves, pods, fruit, nuts, honey, insects, game), medicines, fibre (for making ropes, mats or wall coverings), erosion control, or shade.

OPEN ACCESS RESOURCES

Any natural resource that does not have a barrier or obstacle to its use or exploitation (sometimes also referred to as nonproperty resources). Examples are fisheries, the ocean, certain freshwater sources, and, in the absence of regulation or control, many upland forest resources. Hardin's **TRAGEDY OF THE COMMONS** is one example of an abused open access resource.

Because these resources are available free or at minimal cost, they are frequently overexploited leading to degradation, pollution or exhaustion. (Haebele, 1974)

PASTORALISM

The practice of breeding and rearing certain herbivorous animals so that by these means alone it is possible to satisfy human needs with regard to food, clothing and shelter. Several types of pastoralism have been identified, notably commercial pastoralism - conducted on the large grasslands of the world (e.g. the Argentinian pampas) and regularised for the efficient production of meat for world consumption; and pastoral nomadism (e.g. Bedouins) - a wandering **SUBSISTENCE AGRICULTURE** economy now seen to be declining in favour of more sedentary agricultural forms. (Johnston et al., 1986; Toulmin, 1983). The term Agropastoralism applies to mixed livestock-cropping systems which combine extensive (low man: land ratio) pastoral production with rainfed cropping. Benefits include: (1) mutual contributions of the two systems (traction and dung from the livestock, and fodder from the crops); and (2) reduced vulnerability of the household involved in this joint production system. Agropastoralism is typically associated with **TRANSHUMANCE** and is practiced widely in the West African sahel (Prandstrom et al., 1979)

RANGE MANAGEMENT

The adoption of practices which will preserve a grazing area while allowing the carrying of the economically optimum number of beasts (cf **CARRYING CAPACITY**). Much of the theory and practice of range management has been developed in relation to recently settled grazing areas in the USA, Australia and New Zealand. (Johnston et al., 1986; Sandford, 1983)

RAPID RURAL APPRAISAL (RRA)

RRA may be defined as: a systematic, but semi-structured activity carried out in the field by a multidisciplinary team and designed to acquire quickly new information on, and new hypotheses about, rural life. The core techniques used in an RRA are: secondary data review, semi-structured interviewing, direct observation, drawing diagrammatic models, analytical games, portraits and stories, and workshop analysis sessions. (Khon Kaen University, 1987)

REMOTE SENSING

Obtaining images of features using devices placed on ground, suborbital (aerial) or orbital (satellite) platforms; the devices can be sensitive to, e.g., visible and invisible light spectra, electromagnetism, sound, gravity or radiation. Notable applications have been in resource analysis and flood control (using spectral bands sensitive to vegetation and water), pollution detection (thermal states and visual detection of effluent patterns), regional planning (roads, railways, certain meso-scale urban data), and land-use mapping. (Johnston et al., 1986; Colwell, 1983)

SHARE CROPPING

A tenant farming system in which the landlords' returns are in the form of produce rather than cash. Most commonly the landlord provides all the requisite fixed and movable capital and the sharecropper provides labour. The landlord receives a predetermined proportion of total production which is sometimes laid down by law. Share-cropping tends to discourage long-term land management, and short-term leases are common (Johnston et al., 1986; Barlow, 1978)

SHIFTING CULTIVATION (SWIDDEN)

A form of agriculture particularly characteristic of tropical rain forests, in which soil fertility is maintained by field rather than crop rotation. Normally a patch of ground is cultivated until either the soil shows signs of exhaustion or it

is overrun by weeds, when the land is left to regenerate naturally whilst cultivation is carried on elsewhere. New sites are usually cleared by firing (slash and burn). There are three systems of shifting cultivation: (1) true shifting cultivation by nomadic tribes; (2) a regularised system of bush-fallowing practiced by people living in a permanent central village; and (3) shifting cultivation associated with certain **CASH CROPS** where land is abandoned when yields drop below a certain level. (Johnston et al., 1986; Ter Kuile, 1983)

SUBSISTENCE AGRICULTURE

Farming systems in which a high proportion of final production is consumed by the producers. Pure subsistence displays the total absence of any production for cash or exchange and is not common - most modern subsistence systems involve the production of some cash crop or livestock for sale although the ratio of subsistence to cash production may be highly variable from year to year. Subsistence farming is generally dependent on crop raising; livestock rearing, although usually present, is rarely of greater significance than cropping. (Johnston et al., 1986; Wharton, 1969)

SUSTAINABLE DEVELOPMENT

Two interpretations of sustainable development are now emerging: a wider concept concerned with sustainable economic, ecological and social development and a more narrowly defined concept largely concerned with 'environmentally sustainable development' i.e. with optimal resource and environmental management over time. The former interpretation has been endorsed by the World Commission on Environment and Development (WCED, 1987) who define the concept as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". More specifically, a sustainable development approach "argues that real improvement cannot occur in developing countries unless the strategies which are being formulated and implemented are environmentally sustainable over the long-term, are consistent with social values and institutions, and encourage 'grassroots' participation in the development process... In general terms, the primary objective is reducing the absolute poverty of the world's poor through providing lasting and secure livelihoods that minimise resource depletion, environmental degradation, cultural disruption, and social instability" (Barbier, 1987b).

In contrast, a more narrowly defined concept of environmentally sustainable economic development is:

"Sustainable economic development involves maximising the net benefits of economic development, subject to maintaining the services and quality of natural resources over time". (Pearce et al., 1987).

Where "maintaining the services and quality of the stock of natural resources over time" implies, as far as is practicable:

- a) utilising renewable resources at rates less than or equal to the natural or managed rate at which they can be continuously generated;
- b) emitting wastes at rates less than or equal to the rates at which they can be absorbed by the assimilative capacities of the environment; and
- c) optimising the efficiency with which exhaustible resources are used, subject to substitutability among resources and technological progress.

SUSTAINABLE LIVELIHOOD SECURITY

Sustainable livelihood security integrates population, resources, environment and development in four respects: stabilising population; reducing migration; fending off core exploitation; and supporting long-term sustainable resource management. The Brundtland Commission's Advisory Panel on Food, Agriculture, Forestry and Environment developed sustainable livelihood security as an integrating concept, with these meanings: livelihood is defined as adequate stocks and flows of food and cash to meet basic needs; security refers to secure ownership of, or access to, resources and income-earning activities, including reserves and assets to offset risk, ease shocks and meet contingencies; and sustainable refers to the maintenance or enhancement of resource productivity on a long-term basis. A household may be enabled to gain sustainable livelihood security in many ways - through ownership of land, livestock or trees; rights to grazing, fishing, hunting or gathering; through stable employment with adequate remuneration; or through varied repertoires of activities (Chambers, 1987; Food 2000, 1987)

TRAGEDY OF THE COMMONS

The widespread argument that common ownership of resources is the major 'cause' behind resource degradation because individual and collective interests do not coincide; i.e., "freedom in the commons ruins all" (Hardin, 1968). For example, grazers with herds on common land will add to their herds for so long as the marginal return from the additional animal is positive; in the absence of a binding mutual agreement each herdsman will typically ignore the cost he imposes on the others when introducing another animal into the commons. However correct interpretation of this argument requires distinguishing between **COMMON PROPERTY RESOURCES**, where each of the herdsmen could benefit if they jointly were to exercise some control over the commons, and **OPEN ACCESS RESOURCES**, where the lack of such mutually binding agreements or controls increases the risks of over-use and degradation. (Dasgupta, 1982; Pearce, 1986).

TRANSHUMANCE

The practice amongst pastoral farmers of moving their herds or flocks seasonally or periodically between two regions of differing climatic regimes. The practice is particularly characteristic of mountainous regions where animals are usually transferred from mountain to valley pasture in the winter and back again to the mountains for the summer. Such movements are always accompanied by herders and often by a considerable proportion of the local inhabitants who normally occupy permanent dwellings both in the valleys and in the mountains, which distinguishes them from Nomads. (Johnston et al., 1986; Swift, 1979)

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