

AN INTRODUCTION TO CONSERVATION FARMING.

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Introduction:

FAO statistics show drastic geographical variation in the nutrition pattern of the worlds population. In highly industrialized countries, the daily per capita food consumption is 850 calories more than that in the developing countries. In the developing countries, the per capital nutritional level borders on starvation for the greater mass of the population. FAO estimates show roughly 60% of the families in the third world are chronically undernourished.

In the not too distant future, by the early 21st century, the world population is expected to grow to 6 thousand million. This means that we have to increase food production many fold even to maintain todays state of under nutrition.

The experience of economically developed countries is that the food problem can be solved by intensification. The growth of crop yield in those countries is the direct result of mechanisation and chemicalisation of agriculture, widening irrigation, and introduction of varieties evolved on the basis of the latest achievements in genetics and selection.

We often fail to realize that in the western world high crop yields are obtained at expense of very high inputs. For example, a doubling of corn yields in the US between 1950 to 1970 was achieved by halving inputs such as labour, nitrogen use went up 8 times, phosphate and potash increased threefold, insecticide, and herbicide inputs went up 10 to 20 times respectively.

According to Gerasimov (1975) in the mid sixties the tractor fleet in developing countries was 10.5 times less than in the advanced countries. 12 tractors per 10,000 ha. of cultivated land in the former as against 185 in the latter. The quantity of fertilizer introduced as 22 times less in developing countries. The data demonstrate the wide technological gap between these two groups of countries.

One basic method to increase food production in the developing countries has been the expansion of land under cultivation. This measure alone will not make a real impact to increase food production of a rapid growing population. The world demand for cropland is greater than ever before. Simultaneously a considerable amount of cropland is being abandoned each year due to desertification. The main cause of desertification is not drought as many still believe (drought tends to exacerbate the problem) but human over-exploitation of land through over cultivation, overgrazing, poor irrigation practices and deforestation are some of major contributing factors to desertification. A. Considerable proportion of the estimated annual land degradation rate of 5 to 7 m. ha. occurs in the tropics where 6 to 10 m ha⁶ of new land is annually being brought under cultivation. This is well expressed in an United Nations publication. 'Estimates of present losses of productive land suggest that world is close to one third of its arable land by the end of the century. Such a loss during a period of unprecedented population growth and increased demands for food could be disastrous.'⁷

Most of the soils in the tropics are highly erodible. Although some soils show a low to medium erodibility high rainfall erosivity and undulating slope characteristics render these soils very susceptible to water erosion.⁸ Annual soil loss of 20 to 100 t/ha is not uncommon for soils cultivated to row crops because of low inherent fertility and poor nutrient distribution in the profiles, even a low level of soil loss can result in drastic reduction in soil productivity.

Continuous cultivation results in a rapid decline in soil organic matter content, the effective cation exchange capacity, reduction in water and nutrient holding capacity. As a matter of fact whole ecological environment has been changed dramatically and crop growth is adversely affected. This degradative process set in motion by man's intervention in his quest for producing more is further accentuated by accelerated soil erosion.⁹

Table 1. Declining Yields of Continuous Cropping
of Peanuts, Millets or Sorghum.

5 year cropping period.	Peanuts (kernels) kg/ha	Millets (grain) kg/ha	Sorghum (grain) kg/ha
1931-1935	1015	920	540
1936-1940	785	455	330
1941-1945	700	320	105
1946-1950	320	545	90
1951-1955	510	300	Discontinued

Source: Norman, 1979.

Not only should this degradative process be stopped but immediate steps should also be taken to restore those lands that have been rendered unproductive by mismanagement. These objectives can be achieved through gradual improvement and evolutionary development of suitable technology for sustained productivity rather than through exploitation of the soil and environmental resources in favour of short term gains.

The soil degradative process set in motion by drastic changes in the soil and micro-climatic factors caused by the cultural practices that result in soil exposure and disturbance of the delicate equilibrium that exists between soil-Vegetation-climate continuum. This implies that the protective native vegetation cover should be removed in such a way that this equilibrium is least affected. Furthermore, as the soil is protected when covered by the forest canopy, it should be continuously covered after the forest cover is removed and also during the cultivation phase. This can be achieved by replacing the forest canopy by another low canopy cover or ground cover that will protect the soil against impact of raindrops and also not shade the seasonal crops.

Conservation Farming System:

It is difficult to develop a farming system that is equally applicable for different soils and agro-ecological environments. However, included in the over-all umbrella of the 'conservation farming' system are sub-systems that can be developed and adapted from one place to another. These sub-systems include -

Zero tillage (or no tillage) systems:

The no till technique eliminates the need for tillage by controlling weeds with minute quantities of herbicide. But unlike the plough, it leaves all the dead organic matter as a mulch on the surface of the undisturbed soil. Thus the risk of soil erosion through mechanical soil manipulation can be eliminated.

Crop Residue Mulches.

Crop residue mulch prevents rain drop impact and soil crustation, improves soil temperature and moisture regimes in favour of crop production, and also effectively controls weeds.

Mixed and Relay Cropping.

Traditional farming systems of growing more than one crop simultaneously having a multi-storey canopy of different maturity periods have less soil erosion and weed problems than pure stand crops. The benefits of mix-cropping systems, as measured in terms of 'Land Equivalent Ratio' or yield per unit area per unit time, are greater under adverse conditions with low inputs than with less production constraints and with high inputs.

Live Mulch System

In-situ production of mulch materials can be achieved by planting fallows with legumes such as Centrosema, Pueraria, Macroptelium, Psophocarpus and Mucuna. Live mulch system plays an important part in maintaining fertility levels and minimising erosion

Once desirable cover has been established seasonal crops can be sown through the mulch of cover crops by suppressing them through chemical or mechanical means. Leaving the dead or live (but suppressed) mulch on the soil surface is a better measure to conserve soil and water than ploughing under as green manure.

Avenue Cropping (or Alley Cropping or Agro-Forestry) System.

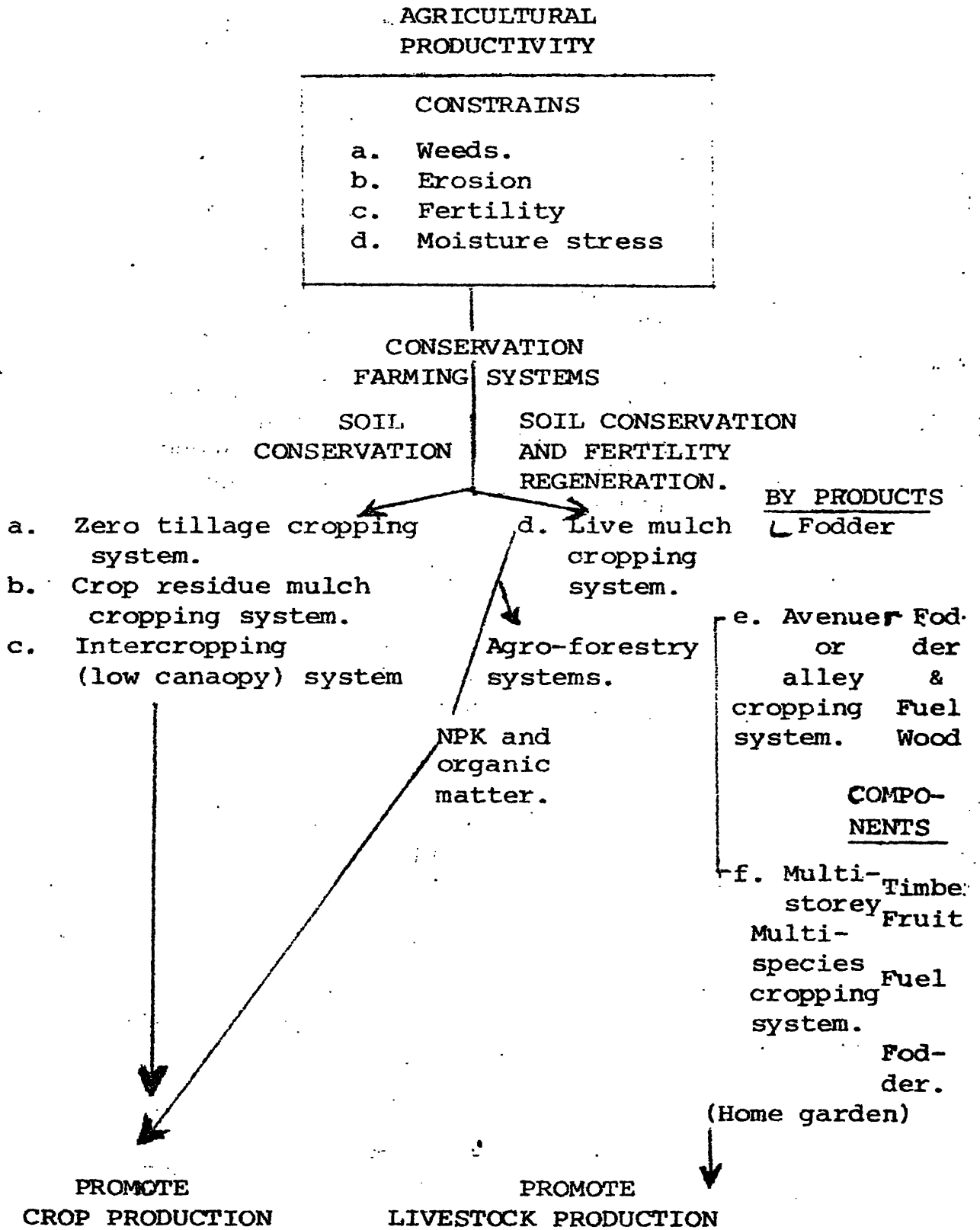
The technique involved growing arable crops in the avenues between hedges or rows of vigorous fast growing and coppicing, perennial leguminous shrubs such as Leucaena, Gliricidia and Caliandra. These leguminous shrubs can be periodically pruned to prevent shading, and to provide additional mulch that can contribute nutrients and protect the soil against rain drop impact. Deep rooted perennials can also provide a nutrient recycling mechanism and minimize nutrient losses through leaching. An added advantage is that about six tons of woody biomass is produced throughout the year.

The research also shows the very considerable (approximately 80 percent) suppression in potential weed growth within the avenues by the dense shade of the over head trees of the hedges which rapidly regrow during the non-arable cropping season.

Multi-storey Cropping:

This is an improvement of 'Avenue Cropping' system. To obtain the final measure of potential productivity from the evolving agro-forestry system it is important to turn to the vertical dimension and superimpose additional layers of middle and upper storey, food, feed and fuel producing trees on part of the land in a manner analogous to 'Javanese Home Garden'¹⁶. For instance high canopies fruit trees, fuel wood and timber trees could be planted with a medium canopied trees like papaw, castor, plantains and cassava and these in turn be intercropped with low canopied arable food crops. In addition livestock is integrated to the system and, thereby it would provide a balanced plant-animal-human relationship.

SCHEMATIC REPRESENTATION
OF
INTEGRATED CONSERVATION FARMING SYSTEMS



REFERENCES

1. Anon, (1977) Society and the Environment
a Soviet View.
Progress Publishers, Moscow.
2. Pimental, D (1973) Food Production and Energy
Crisis. Science 182, 411.
3. Gerasimov, J.P. Abramov, L.S.Kunitsyn, L.F. and
Mints, A.A. (1975) Man. Society and the
Environment.
Progress Publishers, Moscow.
4. Brown, L.K. (1978) The World Wide loss of Cropland.
Worldwatch paper No.24,
Worldwatch Institute, Washington D.C.
5. Tolba, M.K. (1984) Desertification poses a
greater threat now.
Ceylon Daily News of 5th June, 1984.
6. Lal, R. (1982) Soil and Water Conservation and
Management in the Humid Tropics.
Paper presented at the Symposium on
Tropical Agriculture organised
by Sri Lanka Pugwash Group
5-10 July 1982, Sri Lanka.
7. Nagar, B.R. (1981) Energy Crisis, Food crises,
Desertification and Organic
Recycling. Journal of Scientific
and Industrial Research Vol.40,
March 1981 pp.147-153.
8. Weerakoon, W.L. (1982) Conservation Farming Program
in Sri Lanka.
Paper presented at the symposium on
Tropical Agriculture organised by
Sri Lanka Pugwash Group. 5-10 July
1982, Sri Lanka.
9. Weerakoon, W.L. and Seneviratne, A.M. (1982)
Managing a sustainable farming
system in Sri Lanka Proc.1982,
British Crop Protection
Conference, 2, 689-690.

10. Wijewardene, R. and Weerakoon, W.L. (1982) Why Farm Power Paper presented at the Regional Seminar on Farm Power, organised by Agrarian Research and Training Institute 25-29 October 1982. Colombo - Sri Lanka.
11. Weerakoon, W.L. (1983) Conservation Farming Research Program at Maha Illuppallama. Paper presented at the International Training Workshop on Conservation Farming. Jointly organised by the Commonwealth Secretariat and the Department of Agriculture 17, 25 January 1983, 65-77 pp.
12. Weerakoon, W.L. (1982) Organic fertilizer (Recycling of organic matter). Country Report proc. Asian Productivity organisation symp. Tokyo 197-216.
13. Weerakoon, W.L. Kusumawathie, P.H.D. and Seneviratne, A.M. (1984) Mulch based arable crop production in the dry zone of Sri Lanka. Paper Presented at the Annual Conference on Cereals and Grain Legumes. Inservice Training Institute, Gannoruwa, 12-13 March, 1984, Peradeniya, Sri Lanka.
14. Weerakoon, W.L. and Gunasekera, T.G.L.G. (In-Situ application of Leucaena leucocephala (lam) de wit. As a source of green manure in rice. Sri Lanka Journal of Agricultural Science - in press.
15. Weerakoon, W.L. and Keerthisena, R.S.K. Effect of tillage techniques and methods of establishment for rice base cropping system. Sri Lanka Journal of Agricultural Science- in press.
16. Raintree, J.B. (1982) Land Use and Labour Intensity. Prepared for the workshop on Conservation Farming - Colombo, Sri Lanka.