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## FARM FORESTRY FOR DESERT DEVELOPMENT : SOME ECONOMIC ASPECTS\*

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### CHARACTERISTICS OF ARID REGION

Forestry in desert, a seemingly contradiction in terms, is the subject matter of this paper. It deals with (i) the potential role the farm forestry can play towards the transformation or development of arid agriculture and (ii) the potential hurdles the forestry development is likely to encounter in the framework of subsistence and security-oriented system of farming prevalent in the arid region of Western Rajasthan, which is the eastern part of the 'Thar Desert,' and is spread over an area of 2,14,039 sq. k.m. The main characteristics of the region are low and erratic rainfall, extremes of temperature, low atmospheric humidity, desiccating winds, generally deficient soils because of salinity, alkalinity, poor fertility and erosion hazards, and sparse vegetation consisting of drought hardy trees, shrubs and grasses well adapted to this region. Though these characteristics reduce the physical production possibilities, the economy is predominantly agricultural.<sup>1</sup> The traditional farmer, however, in the process of managing his survival from the deficient resource base, tends to over-use the same. This has severely disturbed the delicate ecological equilibrium of nature in this region. As a consequence we are faced with the operation of what is described as the law of increasing natural resource scarcity, as reflected by deterioration of soil, water and vegetation resources in this region.<sup>2</sup> If the present trend of resource depletion is continued unabated, the process of desertization may perpetuate itself and the arid region may become a permanent liability for the rest of the economy. Thus the measures which may arrest or reverse the resource depletion trend should constitute the core of the strategy for agricultural development in this region. In other words, the conservation and development of the natural resource base is an inseparable component of any meaningful development programme for arid agriculture. It is mainly in this context that farm forestry assumes an important role. In other words, it is forest influence rather than forest product, which has greater significance for the agricultural development in the region.

The process of desert reclamation (or desert development) may consist of various conservation measures, but our interest is mainly confined to the conservation measures where forestry plays the predominant role. In the context of arid region, the conservation measures where forestry plays an important role would

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1. According to 1961 Census, of the total workers numbering 31,85,135 in this region (excluding district Ganganagar) 82.4 per cent are engaged in agriculture as cultivators, stock raisers and agricultural labourers.

2. N. S. Jodha, "Scarcity-Oriented Growth Pattern of Arid Agriculture," *Indian Journal of Agricultural Economics*, Vol. XXI, No. 4, October-December, 1966.

include<sup>3</sup> (1) stabilization of sand dunes; (2) creation of shelter-belts or wind breaks; and (3) afforestation of fallow lands and pastures.

#### ROLE OF FARM FORESTRY IN DESERT DEVELOPMENT

The role of farm forestry in desert development may be discussed in terms of (1) prevention of further loss of the resource base; (2) increased production potential of the resource base; and (3) modification of micro-climate.

##### *Prevention of Further Loss of the Resource Base*

The most harmful by-product of the agricultural growth in arid region has been the progressive depletion of the natural resource base as reflected through deterioration of soil, vegetation and water resources.<sup>4</sup> This has resulted from the unscientific pattern of land utilization which leads to elimination of plant cover. Forestry development may act as a step towards the restoration of ecological equilibrium of the nature in this region by arresting the trend of resource depletion.

The protective functions of forestry-oriented conservation measures may be explained in concrete terms as well. For instance, the stabilization of sand dunes would save the nearby fertile fields and pastures from being lost to or submerged under the drifting sand. Similarly, the wind breaks and trees in afforested fallow lands, while acting against desiccating winds (and also run-off) would reduce the extent of soil as well as moisture erosion.

##### *Increased Production Potential of the Resource Base*

One of the major functions of forestry-oriented conservation measure would be to increase the production potential of resource base. Besides the development of soil through bio-chemical mechanism activated by the presence of vegetation, the increased production potential of the resource base would take two forms.

Firstly, the shifting sand dunes and other barren waste lands which represent the mass of unproductive lands, would be converted into productive assets after afforestation.<sup>5</sup> If properly managed they may serve as permanent reserves of cut-fodder and fuel, importance of which can hardly be exaggerated in the context of arid region.

Secondly, in a way, low productivity of crop farming in arid agriculture may be attributed to arid land's low absorption capacity for various farm inputs (such as manure, fertilizer, labour, etc.), chiefly due to deficiency of soil moisture. Ac-

3. (i) R. N. Kaul, *et al.*, "Afforestation Studies in Arid Zone of India," Papers and Proceedings of "General Symposium on Problems of Indian Arid Zone," Jodhpur, 1964. (ii) C. P. Bhimaya, *et al.*, "Role of Shelter-belts in Arid Zone Farming," Farm Forestry Symposium, I.C.A.R., New Delhi, 1958.

4. N. S. Jodha, "Scarcity-Oriented Growth Pattern of Arid Agriculture," *op. cit.*

5. In Western Rajasthan, nearly 59 per cent of the geographical area is affected in different degrees by different types of sand dunes. P. C. Raheja and A. K. Sen, "Resources in Perspective" in Recent Developments in Rajasthan—Souvenir Volume on the occasion of "General Symposium on Problems of Indian Arid Zone," Jodhpur, 1964.

According to revenue records, during 1961-62, 13.4 per cent of the total area of arid zone has been categorized as barren unculturable waste lands. (Statistical Abstract of Rajasthan, 1963.)

cordingly then, the moisture availability is the chief limiting factor that lowers the production potential of the arid lands.

But it may be noted that normally the overall availability of the soil moisture is not so alarmingly scarce. The total usable soil moisture is much less than the overall availability of the precipitation. The gap between the two is mainly caused by run-off and wind action. To the extent shelter-belts or wind breaks counter the impact of wind action the overall availability of moisture for plant growth is increased. Accordingly, the production potential of crop lands would also increase. It is a matter of common knowledge for the desert farmer that *Matts* (local name for shelter-belts) positively affect the rate and certainty of crop yields.

#### *Modification of Micro-Climate*

The initial deficiencies of the resource base, (particularly of soil and moisture) reduce the physical production possibilities in arid agriculture. These deficiencies are further aggravated through the combined actions of forces like run-off, direct solar radiation and desiccative winds. This makes the arid environment extremely inhospitable for productive (plant and animal) species. The conservation measures may act as defences against the forces mentioned above. And to this extent the micro-climate (the climate nearer the surface) may be modified or adapted to the productive species so that it may accommodate the latter more favourably. Moreover, according to one view which may be termed as 'Dust Theory of Desertization' as advanced by Bryson of Wisconsin University<sup>6</sup> the desertic conditions in this region has been a gradual consequence of progressive increase in the amount of atmospheric dust content (the present dust content over Rajasthan desert being estimated as 5.5 thousand tons), resulting from indiscriminate use of natural resource base leading to excessive soil erosion. The atmospheric dust content perpetuates the process of desertization through reducing the rate of precipitation, by way of interference with the process of dew formation as well as rainfall.<sup>7</sup>

This process of desertization may be reversed by a comprehensive programme of soil conservation, where plant would play the important role in checking the blowing of dust particles and in encouraging dew formation because of their quite low thermal admittance when compared to bare soil. And in this context farm forestry assumes special significance towards the transformation of arid agriculture.

#### PROBLEMS OF AFFORESTATION IN ARID REGION

Ironically enough, in the arid region, where it is needed most, afforestation is a most difficult task. The lack of sufficient moisture for plant growth is decidedly a limiting factor. However, to some extent this limitation may be overcome through

6. For a short description of this view see, R. N. Kaul, "Trees or Grassland in the Rajasthan Desert: Old Problems and New Approaches," *Indian Forester*, Vol. 93, No. 6, June, 1967, pp. 434-435.

7. *ibid.* It would be surprising for most of us to know that the quantity of total precipitable water over Jodhpur (in arid zone) amounts to 4" (only 1" less than the maximum total precipitable water, recorded over Calcutta), a figure which is also true for such wet tropical areas like Congo, Brazil, Ceylon, as against only  $\frac{1}{2}$ " total precipitable water in true climatic deserts like that of South-Western United States. The apparent paradox of low annual rainfall in Jodhpur in spite of having sufficiently high total precipitable water over the region, according to Bryson, can be explained in terms of presence of heavy dust laden atmosphere.

selecting the drought hardy indigenous and exotic species most suited to the peculiar soil-climate complex of the region.<sup>8</sup> Because of such possibility, this paper proceeds with the presumption that technical feasibility may not stand in the way of adoption of vegetation-oriented conservation measures. Therefore, the problems of afforestation of arid region discussed in here are mainly of economic and institutional character.

These problems originate mainly from two sources, *viz.*, (i) certain attributes of the conservation measures involving afforestation; and (ii) the incompatibility between conservation measures and some features of the traditional system of farming in arid agriculture. The attributes of conservation measures which give rise to certain problems are that: (i) the conservation measures possess the macro-economic character, (ii) they are by nature infra-structure works, and (iii) involve disassociation of cost and benefit.

The features of traditional system of farming which are incompatible with the conservation measures are as follows: (i) the security orientation of traditional farming; and (ii) predominance of social cost in traditional farming. These two issues have been discussed in the rest of this paper.

#### *Security Orientation of Traditional Farming*

The subsistence and security orientation of the traditional system of farming in arid agriculture is reflected through the overall land use pattern, cropping pattern and other farm practices in case of both crop farming and livestock raising. Since in the context of farm forestry, the security orientation of livestock farming is more important, we shall confine ourselves to the same in order to show its incompatibility with forestry-oriented conservation measures.

The security orientation of livestock farming in this region, again, can be seen in different farm practices followed by the stock raisers. The weather variability over space and time is a principal source of uncertainty in case of both crop raising and stock raising in this region. In case of stock raising the farmers try to seek security against uncertainty through some informal institutional arrangements. The latter are partly reflected through the practices of uncontrolled and unrestricted grazing, overstocking, etc., because of which, farmers of different areas can accommodate each other to face the challenge of weather variability as affecting the availability of forage and water. The advantage of mobility which imparts higher degree of adjustability (to weather variability) in case of livestock farming is further facilitated by these informal institutional arrangements.

But the above practices which provide some security against periodical scarcities in arid region will have to be suspended, if the farm forestry is to be adopted and developed. The suspension of these practices in turn would mean depriving farmers from an important defensive measure against the fluctuating weather conditions. To the extent such provision is unacceptable to farmers, the farm forestry may not find sufficient favour from the farm community.

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8. (i) C. P. Bhimaya, *et. al.*, "Species Suitable for Afforestation of Different Arid Habitats of Rajasthan," *Annals of Arid Zone*, Vol. 2, No. 2, March, 1964. (ii) Scientific Progress Report of Central Arid Zone Research Institute, Jodhpur for 1960, Report of Silviculture Section, pp. 65-66.

*Predominance of Social Cost*

The predominance of social cost in the context of livestock farming in this region as reflected through various facets of livestock farming can be explained in the following manner. Firstly, because of unrestricted, uncontrolled and free for all grazing in pastures, fallow lands and even private crop lands (during post-harvest period), there need not be any positive correlation between size of land holding and size of stock holding. Thus one can manage a big herd of animal as one likes, without having a single acre of land of his own. In this respect stock raisers carry on their occupation solely at the cost of others (or society). Secondly, because of an almost complete lack of stall feeding in case of sheep, goat, camel and dry and unproductive bovines, the private cost component of maintaining livestock is insignificant. Thus, here again, because of the almost sole dependence on (uncontrolled and unrestricted) grazing on others' lands, it is social cost which predominates. Thirdly, since the private cost (which is very insignificant) does not act as a deterrent for the rate of stocking, overstocking takes place.<sup>9</sup> The latter through indiscriminate and over-use of grazing resources results in the depletion or degradation of the social asset. Thus according to these three circumstances the stock raisers in the arid region carry on their occupation mainly at the cost of the society. The most important root cause of this state of affairs is provision of unrestricted and uncontrolled grazing. However, the abolition of the latter is a precondition for the adoption of forestry-oriented conservation measures. But the adoption of restricted, controlled and regulated grazing, in turn may lead to an increasing dependence on owned grazing and feeding resources, and thus raising the proportion of private cost in stock raising. This may not be acceptable to the stock raiser who has been accustomed to maintain his livestock at the cost of the society.

Moreover, the introduction of controlled and regulated grazing may make a large number of animal population surplus for available grazing resources (including crop by-products) and this again is a big hurdle for the adoption of farm forestry.

Thus in spite of the very valuable role of farm forestry towards transformation or development of agriculture in arid region, its acceptance on the part of the farmers is very doubtful. Firstly, the very attributes of the forestry-oriented conservation measures make them unsuitable for individual action. In this case, the remedy lies in co-operativization of the conservation projects.<sup>10</sup>

Secondly, to the extent security orientation and predominance of social cost in livestock farming stand in the way of adoption of farm forestry, the remedy lies in a proper and sympathetic understanding of the stock raiser's genuine problems, alternative provision of security against uncertainty and partial subsidization of private costs of stock raising at least during the transition.

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9. See Report on Salawas Pilot Survey, Central Arid Zone Research Institute, Jodhpur, 1967, Chapter on Livestock (mimeo.).

10. N. S. Jodha, "A Case for Co-operative Financing of Desert Reclamation," Paper presented to a Seminar on Co-operative Financing for Agricultural Development, sponsored by the University Grants Commission, Ministry of Food, Agriculture, Community Development and Co-operation, and the Faculty of Commerce, University of Jodhpur, Jodhpur, August, 1967.