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## Plantations in the Sahel

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**In the end, the solution lies in reduction of stands to more human dimensions. Forestry should be brought to the level of the village and of local agriculture.**

**Foresters need to be reminded that the reason for practicing forestry is to satisfy man's needs**

The Sahel is threatened with a medium-term ecological crisis that stems mainly from bad agricultural and pastoral practices. Faced with this crisis - which includes serious shortages of fuelwood for household needs - foresters have reacted by establishing plantations of exotic species of trees for fuelwood needs. These plantations are designed to be set up and maintained with machinery for clearing land and working the soil. Machinery will have to be imported and the machines in turn will require imported fuel, all to be paid for with scarce foreign exchange. The question is, will not Sahelian forestry consume too much energy for the sake of creating energy? It is not a simple question to answer. Its answer, which this article attempts to give, may also be useful beyond the Sahel, anywhere in the world where similar ecological, economic and human factors exist in combination.

To assess these mechanized plantations, certain questions have to be asked.

- Expressed in terms of the biological conditions prevailing in the Sahel and the Sudanian savannahs, do foresters have at their disposal other tested methods for establishing plantations?
- Does the Sahelian rural system, with its strong seasonal characteristics, seasonal biological conditions and human activities, permit foresters to dispense with machines, do good work and realize their programmes? To answer, let us briefly examine the current plantation model, one which guarantees success.

Very widely described in numerous publications on tropical silviculture, this model is based on the following principles:

- Deep-working the soil to make possible absorption of the maximum amount of rain-water, the main factor that determines the growth of trees.
- The utilization of healthy vigorous seedlings, raised in individual pots to avoid any shock when transplanted.

- Finally, careful nursing to eliminate all herbaceous competition for water.

For the first two years, the plantation is more agriculture than forestry.

The main operations during this period are: clearing the land, working the soil, tending the nursery, setting up the plantation, its maintenance and supervision, and, finally, organizational problems.

In the petroleum consumption chart borrowed from Jean Morel, of Mali's Water and Forests Ministry, we find at a glance the work-hours and the fuel-oil consumption of various types of engines for each specific operation. Only mechanized work is shown.

We obtain a figure of about 455 litres of fuel-oil per hectare at the end of the first year of planting. (The cost estimates for maintenance during the second year and for organization and group supervision have not been included.)

Other experts find these estimates too low and give higher ones for consumption per hour for the same engines: thus, Mr Weinstabel, working on the outskirts of Ouagadougou, Upper Volta, notes that consumption varies from 28.4 to 35.6 litres per hour for the D7G, while the project we are examining mentions 28.2 litres per hour for the same engine. Unskilled labour represents 15 percent of the cost and mechanization 85 percent, the fuel-oil coming to about 20 percent at the time the project was planned. Since then, the price of fuel-oil has doubled.

One may criticize this plantation model for its excessive consumption of foreign exchange and energy. But first, could the same technical results in water conservation be obtained by substituting manpower for machines? Or if not for all operations, at least for some? Next, would this manpower be available at the same time that the different operations need to be carried out?

#### **PETROLEUM CONSUMPTION ON A SAHELIAN PLANTATION: Petroleum products used for a 500-ha *Gmelina* plantation at Bamako**

Operations	Material used	Hours of use or km	Volume (litres)
Clearing of land	Crawler tractor 140 hp	400	11288
	Crawler tractor 140 hp	160	4515
• Knocking down	Loader tractor 140	90	1327
• Removal of logs	Tipper truck 12 t	32000 km	12976
• Removal of firewood	2-decker tractors 65 hp	1680	12310
	Tipper truck	200000 km	81100
• Wind-rowing	Crawler tractor 140 hp	1090	30760
• Cleaning up wastes	Tractor tires 65 C hp	544	3985
	Loader tractor 140	50	740
Soil work			
• Deep-digging	Crawler tractor 140 hp	544	15352
• Crushing	Crawler tractor 140 hp	326	9200
• Sub-soiling	Crawler tractor 140 hp	523	14760
Nursery			
• Preparation of materials	Crawler tractor 140 hp	30	847
• Materials delivered	Loader tractor 25		370
	Tipper truck 3000 km	1217	
Mixing of materials			

	Earth crushers	100	550
	Sifter	100	550
	Elevator	200	1100
Watering	Motor pumps	1200	4092
Plantation			
Transportation of seedlings	Tractors (with tires)	800	5862
Maintenance and supervision			
• Opening of service roads	Crawler tractor 140 hp	10	282
• Clearing first year	2-decker tractors 65 hp	2000	14654
• Maintenance of firebreaks	2-decker tractor	44	322
<b>Total</b>			<b>228159</b>

## Technical problems

Which operations could be carried out manually without impeding the rapid installation of the seedlings and the good growth of the plantation? Experience shows that two groups of operations are possible:

- The first group includes work which is done mechanically in the model for reasons of speed: all clearing operations (stump removal, removal of waste material) and nursery maintenance and supervision. The forester prefers to use machines, first, from fear of being unable to get adequate manpower, as well as suitable group supervision, next, from fear of being overwhelmed by all kinds of problems inherent to the mobilization and handling of manpower. It is better to be in charge of machines than of men. Apparently there are fewer risks. But in actual fact, from the purely technical point of view, nothing prevents the use of manpower rather than machines for these operations.
- The second group of operations includes mainly soil work: deep-digging, breaking up, sub-soiling - to get better conservation of water. Most of the foresters in dry and semi-dry regions are convinced that it is difficult to get better penetration of rainy precipitations by methods other than deep-digging and sub-soiling.

The clearing of land calls for some operations which, although carried out by the forester, are not, in fact, chargeable to the plantation. They concern especially the removal of trunks, branches, stumps and other wastes which can be processed into charcoal or used as fuelwood. In the project the cost of transport by dump truck of logs and firewood corresponding to more than 40 percent of the fuel-oil consumed was included in the initial plantation budget. In fact, only knocking down and wind rowing of wastes are really chargeable to the plantation. Wind-rowing waste operations also result in the levelling of the ground by filling the holes left by stump removal. Therefore, by subtracting from the plantation charges all the work of removal and transportation of material, 5 percent in fuel-oil can be saved. But the problem is only displaced, because the question of whether or not to carry out these operations by intensive mechanization still remains. The main issue is that those making plantations need to clear the land in time, and the answer now depends on the availability of manpower. All wastage of wood should be avoided salvage all that can be salvaged, instead of using so much energy in wind-rowing, and burning all this woody production as "waste material."

At the purely technical level, manual stump removal is often criticized; everyone agrees that it can be done better. The real problem is still one of manpower and group supervision.

The growing of seedlings in nurseries does not really require complicated machinery, contrary to a rather common belief, but technical considerations militate in favour of the mechanization of nursery work. In dry countries, for instance, where water points are scarce, one is obliged to opt for fixed nurseries which have to function for years. This necessitates transporting soil not only from the immediate surroundings of the nursery, but also from distant points. Furthermore, the pumping of water cannot be exclusively manual in Sahelian conditions, and a nursery is not a high consumer of imported fuel-oil.

It is difficult to use only manpower for transporting seedlings to the plantation areas and thus save on fuel-oil on the plantation.

Weeding of plantations can be carried out by manpower in the first years and roads and firebreaks that are seldom used by vehicles can also be maintained manually.

Comparing mechanical and manual soil working, Mr Delwaulle, of the Centre technique forestier tropical (CIFT), Niamey, reached the conclusion that good mechanical working of the soil gives better results than good manual working. He observed, however, that results remain good in the case of manual soil preparation and that the choice of one or the other method may be influenced by other factors. It should be noted that these were the results of a test under Sahelian conditions of 625-mm rainfall involving cross sub-soiling with a D-7 crawler and manually dug pits of 60 x 60 cm.

We may conclude, these being purely technical questions, that all operations leading to the success of forestry plantations in the Sahel may be done by manual labour. It is other considerations which have pushed Sahelian plantations toward a technology which consumes too much energy. These are the size of the wood lots, their organization, the availability of manpower, group supervision and economic and social problems.

**The rural world moves forward slowly. Community forestry cannot be thought of as a speed race.**

The energy crisis tends to affect the present model. But to what extent can rural manpower, already much sought after, be substituted for machines?

## Reconciling time-tables

To answer the question, one must first estimate manpower requirements, examine the operation's time-table and compare them with the agricultural calendar and manpower requirements. If these two time-tables are in conflict the decision will have to be to allow the work to evolve toward intensive mechanization. If there is no conflict, Sahelian foresters should return to methods which use more manpower. But perhaps certain compromises are possible.

Assuming that all operations should be manual, the manpower needed and its availability can be estimated.

Clearing trees and stumps can be done only in the wet period when the soil is well soaked, from 20 June to 10 October, or about 110 days, with the strong probability that in some years this period will be reduced to 90 days (1 July to 30 September). This work requires 7.7 working days per square metre of basal area (T.G. Allan and E.C.G. Akwada) and in the savannah containing stock from 7 to 10 m<sup>2</sup> of basal area per hectare, 65 men per hectare are needed. For a timber stand of 500 ha, this represents 32500 man-days, that is, 295 workers to be permanently employed during the 110 days when stump removal is possible.

## Stocking and wind-rowing

Extraction of wood following stump removal as well as wind-rowing and the burning of waste material are operations which can be carried out during almost the entire dry season, up to 31 May at the latest. These operations also call for 65 to 70 working days per hectare, and 32500 to 35000 man-days for 500 ha. Even in the highly mechanized model we are discussing, these operations require 25270 working days. A permanent manpower force of 152 unskilled workers is needed for carrying out these operations in 230 days (10 October-31 May).

Still, on the assumption that a plantation is run entirely by hand, digging is in fact a soil-working operation which calls for making holes 60 x 60 cm before the first rains. According to Delwaule, for a job well done, one should not expect to get more than 10 holes per man-day in tropical ferruginous soil with a sandy texture.

Allowing for soil already slightly loosened by stump removal and in hoping for 30 holes per day per man, this work represents, in a plantation density of 1372 plants/ha, almost 22000 man-days to be mobilized over 80 days, that is, 275 men permanently employed from 10 March to 31 May. Delwaule also points out that this work-force should be organised in groups of 20 men supervised by one team leader. Taking staking out into account, a permanent work-force of more than 300 persons needs to be mobilized.

### **PREPARING LAND FOR A NEW FOREST IN MALI *the cost of using machines vs the need for renewable resources***

Planting done at the intersection of sub-soiling furrows requires 1322 man-days for 500 ha. To that must be added, in the case of manual digging, the filling up of holes, estimated at 25 man-days/ha, that is, 1250 man-days. Thus 2572 man-days of work done in 70 days require 37 permanent workers.

Manual weeding requires 20 man-days per hectare. Two weedings are necessary the first year between 10 July and 10 October, the end of the wet period. For 500 hectares, 20000 man-days are needed within a period of 90 days, meaning 223 unskilled workers permanently employed during this period.

Protection against fire requires: the careful weeding of firebreaks at the end of the wet season between 1 October and 30 November at the latest. The system of protection involves about 675 m<sup>2</sup> firebreaks per planted hectare, at the rate of 500 m<sup>2</sup> per man-day. A force of 675 workers has to be mobilized for 60 days.

## **The agricultural calendar**

Clearing the fields, cutting back the shoots of stumps, gathering and wind-rowing harvest refuse, burning everything must be done in time, so as not to miss sowing. The sowing period is one of frantic activity and great anxiety for the farmer. He has a limited number of days for making a success of his year.

There are still uncertainties. In fact, in the climate of Bamako, there is a 50 percent probability that it will rain enough to permit plants to attain the critical stage of flowering before 30 August, so that the remaining water needs can be satisfied only with rain. The farmer will, however, continue to sow and re-sow up to about 10 July with less and less chance of harvesting anything. Even an early variety of sorghum sown on 10 July, which attains its flowering stage by 20 September, has only a 50 percent chance of satisfying its rainwater needs. In half of the cases, plants have to depend on a reserve in the soil.

The period of sowing is therefore of first importance to Sahelian populations. It is almost

impossible to mobilize workers for activities such as forestry work from the moment the first rains fall, as long as people are not sure that their own sowing has been done successfully.

The same thing happens with the weeding period, which begins before the end of sowing. Three weeks after the first sowing, the young food crops need to be protected from competition with weeds. The rains bring a veritable explosion of graminaceous and other herbaceous plants.

From 20 June to 30 August, the peasant worries constantly about the condition of his fields. No member of the family is permitted to travel without a valid motive. Weeding continues right up to harvest time, but less intensively. In this period young men often leave the family to go out to work elsewhere and earn a little money. Then comes harvest time and once more all the able-bodied assemble for family farm work.

The short pause from weeding is also put to good use to clear new fields. The critical period of this agricultural calendar stretches from the end of May to the end of August - about 100 days. The rural world is conscious of the fact that during this short period its survival is at stake, and it takes exceptional events to distract the farmers from their farming. This calendar, already very tight for wet regions such as Bamako - where it rains about 1100 mm a year - is tighter still in regions with less rainfall. Thus at Segou, about 200 km north of Bamako, where the average rainfall is 750 mm per year, the favourable period for sowing is from 5 to 10 June, and on 20 September, covering date of the early sorghum. The hope of seeing water needs satisfied by rain alone is reduced at Segou to 10 percent instead of the 50 percent expected at Bamako.

The agricultural calendar shows that the two critical periods of the agricultural and forestry time-tables come together from the end of May to the end of August. If all silvicultural operations were to be done manually one would have to employ about 600 labourers, plus their team leaders, permanently for this period. This represents almost 10 percent of the population within a radius of 10 km, supposing a density of 20/km<sup>2</sup>, meaning more than 20 percent of the able-bodied in the area. This is neither realistic nor commendable, if one considers the stability of rural communities. There must, therefore, be a certain amount of mechanization. But it should also be kept in mind that most of the work for a plantation is in clearing and working the ground. This does not have to be done immediately before putting in the seedlings. It may also be done months in advance, avoiding a conflict with the agricultural calendar, during periods when local manpower is available and anxious to find employment.

## **Community forestry, solution for the future**

Sahelian foresters are faced with a difficult problem: on the one hand, there is the absolute necessity to undertake large-scale reforestation work to rehabilitate the ecologically degraded Sahel and to supply the population (above all, the urban centres) with the forest products indispensable to their survival, such as firewood, brushwood and timber. This now seems within reach through some progress made in the choice of species and techniques for establishing plantations. On the other hand, there is the need to keep the energy bill within limits. This pushes toward the use of manpower.

The solution apparently lies in the reduction of stands to more human dimensions, without in any way thwarting the overall objectives of reforestation. The pattern of reduction to apply, then, is to bring the stands to the level of the farm. Forestry should therefore be brought to the level of the village and of local agriculture. That is what the Forestry Programme for the Development of Local Communities (FLCD) seeks to do. Without any doubt the ecological future of the Sahel depends on the success of community forestry. The rational exploitation of the fragile ecosystems of the Sahel necessitates the application, by all economic agents using natural resources, of the principle of sustained yield which is the foundation of forestry.

However, community forestry should be understood as a long-term and exacting activity: the rural world moves forward slowly and community forestry cannot be thought of as a speed race. This, therefore leads foresters back to their immediate responsibilities - the creation of industrial plantations with more immediate effects and results. At this point a compromise is inevitable.

First of all, one must seek to develop timber stands of an optimum size which will make possible the mobilization of numbers of workers easy to group and manage. At the same time, local agricultural time, tables based on rainfall patterns should not be upset or threatened by forestry needs; operations that must be carried out at the busy periods of the agricultural calendar should rely on machinery. Two operations may fall within this framework, stump removal and soil preparation. They represent only a little more than 20 percent of the fuel-oil bill.

It is not correct to say that Sahelian silviculture consumes too much energy. First of all, development of industrial reforestation operations is very limited. On average, there is only one such operation for each of the Sahelian member countries of the Comité permanent inter-Etats de lutte contre la sécheresse dans le Sahel (CILSS).

The exploitation and removal of forest products are often accounted for in plantation charges. However, a new trend is beginning to appear and we must take note hereafter of its advantages and limitations. One of the aims of Sahelian silviculture is indeed the production of energy. It would be paradoxical if it itself consumed too much energy. But, most of all, foresters in the Sahel and elsewhere must be reminded that in all their activities it is man and man's needs that must play the leading role. They constitute the reason why he is practicing forestry.

