# Conception for the regeneration of the upper forest boundary and for the optimisation of hydrological regimes in the Ukrainian Carpathians, 1997

## *Problem outlines*

River Tisa is the longest left-side tributary of River Danube, the second longest river in Hungary. It is of great importance for water transportation, its water is used for the irrigation of agricultural lands in Hungary and Yugoslavia, and as a water source for navigable channels. The total length of River Tisa is 966 km, its length within the boundaries of the region is 223 km. Its total drainage area is 156.400 km2, out of which 12.760 km2 (about 8.1%) are within the region. However, 30.6% of the main drainage volume originates from this area, which is approximately 8 km3, or 625 mm, per year. The formation of one third of the total drainage in only 8% of the drainage area proves that the water conservation function of the river is of great importance. This feature of the drainage area is caused by its hilly relief and the considerable amount of precipitation in the mountains. (If the average amount of precipitation in the piedmont is 600 to 800 mm, in the mountains it is 1000 to 1600 mm per year).

According to data reported by M. A.Golubets (1988), the woodedness of the Carpathian drainage area before human interference started was 95% or even more. This was the main condition for theregularity of the river drainage, and for the balanced water regime of the mountain slopes. At present, woodedness in the Transcarpathian region amounts 51.6%. Careless forest management (both felling and reforestation) has resulted in decreasing biological stability and water regulating functions of the forest drainage area ecosystems, which was displayed in outbreaks of mass pest invasion and fungal diseases, in windfalls, floods and avalanches, and in the alluviation of rivers due to soil erosion. From 1877 to 1933 there were 4 disastrous floods, with the average period between them being 18 years, while from 1933 to 1964 they began to repeat every 3-4 years. At present floods disturb us every other year, if not every year. Human casualties, of course, are a price which can no way be compensated.

The general weakening of forest ecosystems is aggravated by the global industrial atmospheric pollution. In addition to the tangible decrease of woodedness, ecological problems also originate from the age structure shift of woods in the direction towards rejuvenation, from the increase of secondary tree stand ratio, the general decrease of the density of mature and maturing stands, the considerable descent of the upper forest boundary, and the destruction of highland shrub vegetation.

Thus, we suggest that the main cause of the crisis situation is the critical decrease of the level of woodedness, the misbalance of the forest stand age structure, the composition, variety and the extension of forests in relation to the size of the river network and to the Carpathian mountain system as a whole, which all have been caused by careless forest management (intensive fellings and directive forest regeneration, disregarding natural conditions) and the extensification of agricultural production (excessive ploughing on slopes and strip-grazing in areas adjacent to "polonynas") in the recent years.

The problem has a multilateral character; however, it is necessary to begin with the steps that have immediate results.

**Our purposes**

The gradual rising of the upper forest boundary and the regeneration of the shrub cover of "polonynas" are promising. The increase of precipitation in the spruce forest belt is 28% greater than in the beech woods. The increase of precipitation in the highlands is far more calculable than that in the spruce forest belt. By raising the upper forest boundary we first of all form a larger area of condensation surfaces, which causes a considerable increase in condensative precipitation. The same is true with the creeping shrub thickets. According to data by Krecmer (1970), the amount of condensative precipitation beginning from 604 m a.s.l. exceeds the amount of other precipitation captured by the forest cover, and within the upper forest boundary zone it is 84% of the total precipitation amount (O. V. Chubaty, 1968). The air masses, as they ascend along the slope, cool down and condense into moisture. The forest activates this process. As evaporation greatly decreases in the ascent, the main part of horizontal precipitation becomes drainage-forming. Moisture which still evaporates as a result of constant air movement, condenses or falls as vertical precipitation. In the highlands where it is much colder and evaporation is weaker, the infiltration power of the soil is smaller and the drainage modulus is the highest. The woods of the drainage area are the principal regulators of drainage. Consequently, the deforestation of the upper part of drainage area systems where river sources are formed, is of the greatest importance.

The creation of the forest plantation area to access ecological stability would require considerable expenditures, work, and first of all time which will take for these plantations to become able to carry out their protective function.

Thus, the most expedient and effective step in this situation is the creation of forest plantations in the upper forest boundary (around the "polonynas"), where, as a result of sheep breeding activity, the forest boundary has lowered by 100-300 m during this century. Under these conditions with excessive amount of precipitation, low temperatures, slow evaporation and considerable condensation of humidity in the air, forest plantations are able to carry out important water regulating and protecting functions as early as in their young age.

According to our scientists' data, 1 ha forest plantation on its upper boundary equals in water-protecting properties with the drainage formation of 5-6 hectares of plantation in the piedmont zone.

## Grounds for Application

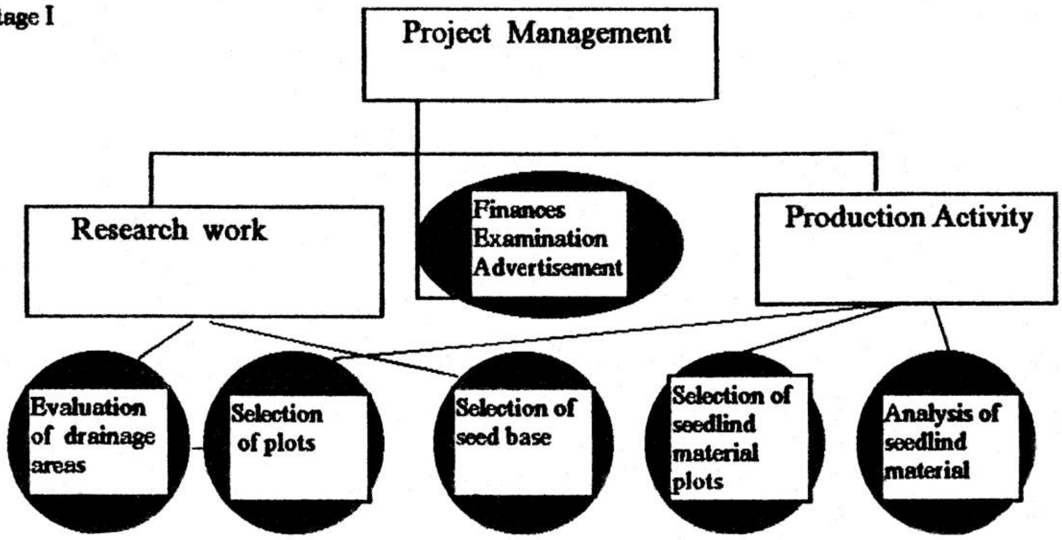
The crisis-ridden ecological situation cannot be resolved by the forest workers of the region because of the lack of budget financing as a result of the ineffectivity of reforming the old planned economy and other negative processes of the political transition. At the same time, there is a great deal of backlog in forest-planting due to the large-scale felling forced by continuing spruce withering (especially in forests of protective significance). The cleared glades should be forested as soon as possible, and the forest enterprises should devote sufficient amounts for it. Additional work related to the fulfilment of the project cannot be financed by them, let alone project research work which is absolutely beyond their plans. They are indebted to their workers even in paying the wages.

We consider that the main duty of the project is to mobilise finances from different sources; a foundation can be created. We hope that this project would find financial support from our Government. This would give us a real opportunity to get assistance from international charity foundations. It is expedient to co-operate with partners from the interested countries in the fulfilment of the joint project. Participation in the project can be registered at any of the three stages in any element of the scheme by simple individual contracts.

An important stimulus in the preparation of the project was the International Seminar of experts on the regeneration of the upper forest boundary (Uzhgorod, 1996). Scientists and specialists from Ukraine, Hungary, Slovakia, Russia, Romania adopted the resolution in which the expediency of these measures was confirmed.

The final result of the project is planned to be the reforestation of the ecologically most critical areas in the zones adjacent to “polonynas”. Forest cultures are suggested to be planted in 5.000 hectares. The supposed expenditures are around 5 million USD. The period of fulfilment is 20 years. The stages of project fulfilment can be illustrated by the following scheme:

Stage I




Stage II

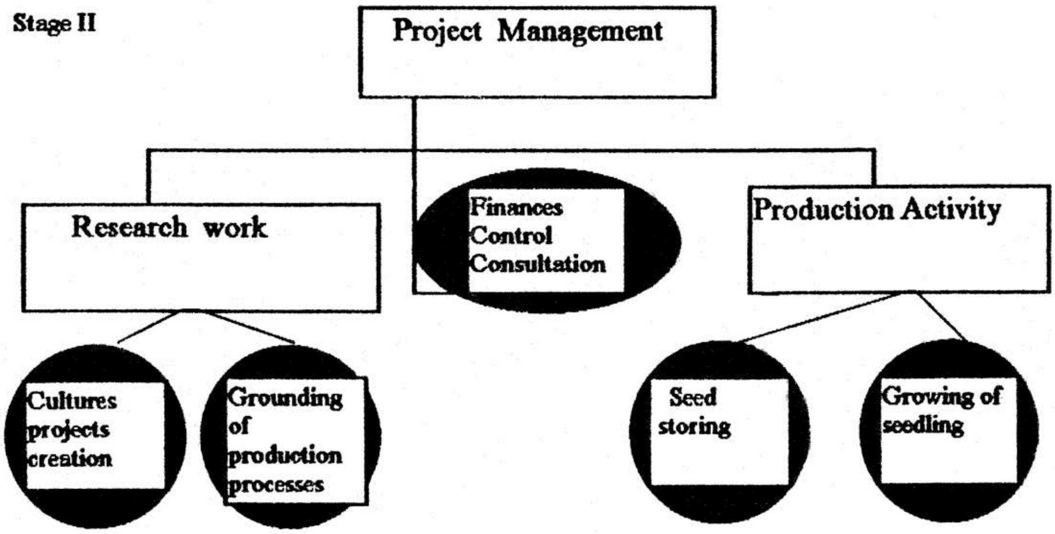
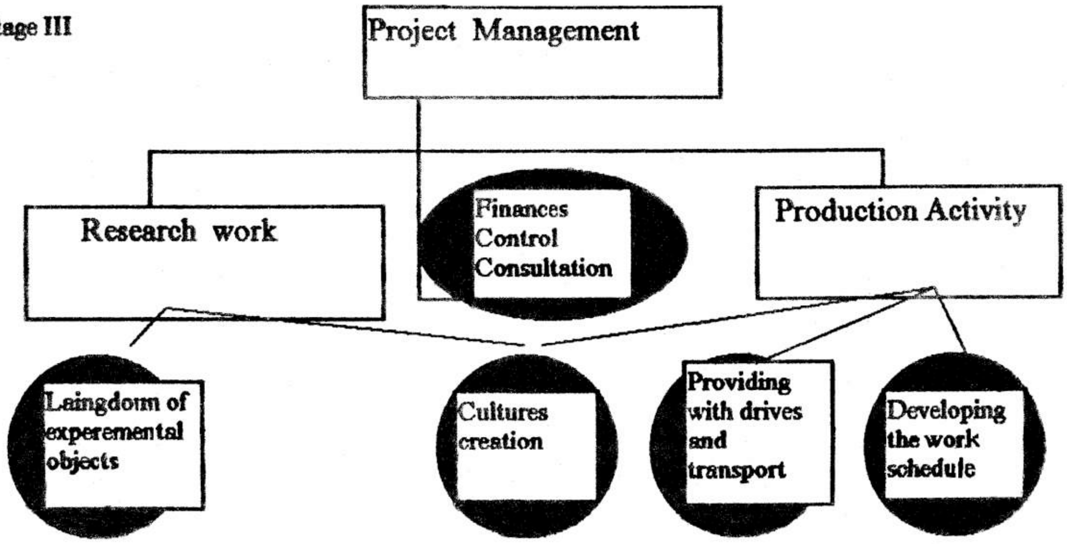



Table 1.

**Stage III**




**Stage IV**

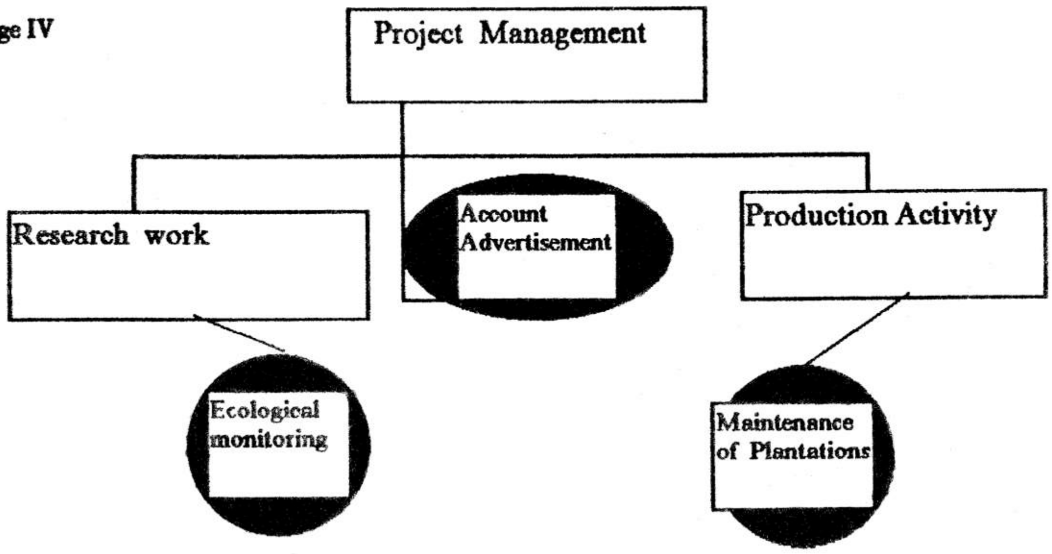



Table 2.

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