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Introduction

Agroforestry systems/technologies are long-term in nature because of the tree component present in each system. To compare future net benefits with present-day net benefits, analysts usually assign a lower weight to such future values. This procedure of revaluing future costs and benefits is normally referred to as discounting, while the rate at which future costs and benefits are revalued is referred to as the discount rate.

Three possible rates

In most analyses conducted from the farmer's point of view, analysts assume that additional inputs required to bring about a change in the farming system can be financed with commercial credit. Such an assumption greatly facilitates the determination of the minimum acceptable rate at which future costs and benefits can be discounted since it only requires the analyst to determine the rate at which farmers can borrow money. A simple method of determining such a rate is described in Perrin et al. (1)

However, in many a small farm situation, a farmer will not (be able to) borrow funds, but will either have to use his own (equity) capital or forego some production now so as to be able to reap benefits later.

Gittinger (2) suggests, without further elaboration, that whenever equity capital is used, the analyst should determine the rate (returns) a farmer normally expects from equity capital. Such a rate may, for example, be obtained by determining the return on some existing long-term farm enterprises, e.g. livestock, orchards, timber trees, etc., as well as by determining what interests accrue on savings.

However, on most small farms little equity capital is used. Many crop activities are annual and attract mainly operational expenditures (family labour). For such activities, it is therefore difficult to determine a realistic return to the equity capital. Still, for small farmers, sacrificing part of their present annual production will often be the only way to improve/ensure future production.

To find a rate for such "capital", the analyst should first of all try to determine whether the production foregone would have been used for productive or consumptive purposes. If the purpose, by means of selling, was productive (investment or savings), the discount rate may again be derived from the normally expected returns from equity capital. If, on the other hand, the production foregone now was, in fact, meant for consumptive purposes (directly or indirectly), the question really is: at which rate is a farmer prepared to surrender part of his present consumption for a future one ? In economic analysis (from the point of view of society as a whole), this rate is usually referred to as the social discount or consumption rate of interest.

Consumption rate of interest for society as a whole

The principle behind the consumption rate of interest is that in a developing world with many economic activities taking place, future production is expected to increase so that future per capita consumption is also expected to increase. It is further argued that the higher the per capita consumption level, the lower the value attached to an additional increase in per capita consumption. Therefore, since the future consumption level is assumed to be higher than the present one, the value attached to a unit increase in consumption now is higher than the value attached to the same unit increase in the future.

The value attached to each year's costs and benefits is commonly referred to as the discount factor. The lower the discount factor the lower the present value of future costs and benefits. The annual discount factor, at a given discount rate, declines over time. A visual presentation of this theory is given in Figure 1.

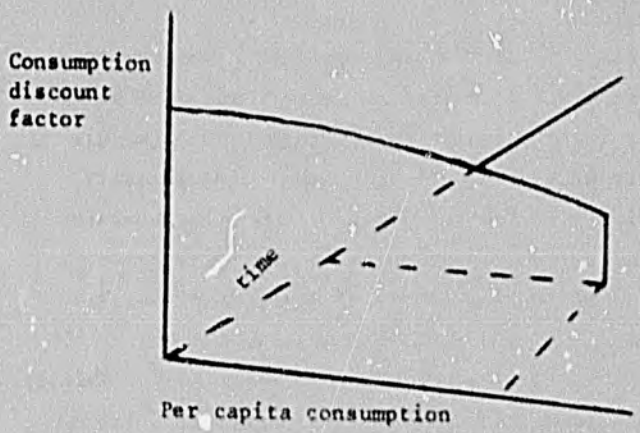

Fig. 1. Consumption discount factor over time (at a positive discount rate)

Although it is possible to give a good theoretical explanation for the consumption rate of interest, most authors admit (3,4) that, in practice, a rate is difficult to determine, not least because the parameters required are morally determined and therefore subject to contention.

Most project analysts therefore ask the government to determine the rate for them, or simply take the rate received on savings and investments by society as a whole.

Consumption rate of interest of a project farmer

The consumption rate of interest should, in principle, be easier to determine in a financial type of analysis conducted from a farmer's point of view since the target group is by definition smaller than society as a whole. However, analysts usually

make very little effort to estimate a proper rate, perhaps because they expect the rate to be roughly the same as the rate of return on equity capital and/or savings.

Let us therefore see whether such an assumption is valid for farmers who are considering the introduction of an agroforestry system/technology on their farms.

While it may be difficult to generalise, there is a particular feature about agroforestry systems/technologies which sets them apart from many other interventions, namely that they often aim for the sustainability of a given ailing system. Agroforestry is therefore particularly suited for farms on which the sustainability of the existing system is seriously in doubt. I hasten to add that there are, of course, plenty of agroforestry systems introduced or practised on farms which do not have sustainability problems. However, let us look at those farms where sustainability is a problem. Is the assumption made about a perceived increase in per capita consumption in the future a realistic one ? Unless technologies already exist which tackle the sustainability problems, the answer may be no, because production from such farms is expected to decline over time.

"May be", since farmers may, in fact, expect a higher per capita consumption because they expect income from non- farm activities to increase over time. "May be", also because although the scientist may have this rather gloomy picture, the farmer may, in fact, be unaware of the bleak future and act as if everything will be fine (in the future).

Although per capita consumption has improved for many members of the rural population over the past decades, this has definitely not been the case for everyone and it is even more doubtful whether it will continue to increase in the future in view of the sustainability problems mentioned above.

There is, therefore, an argument for not discounting future costs and benefits for those farmers for whom no increase in per capita consumption is expected in the foreseeable future because of sustainability problems. In fact, even a negative discount rate may be considered. Such a lower or negative rate would render long-term production systems relatively more attractive to such farmers than they presently are when the average investment or savings discount rate is applied.

The risk discount rate of farmers

Perrin et al. (1) rightly points out, however, that there is another factor which will affect the farmer's valuation of future benefits of a new system, i.e. risk and/or uncertainty. Roumassat (5) defines uncertainty as a state of mind in which the individual perceives no alternative outcome to a particular action. Risk on the other hand, has to do with the degree of uncertainty in a given situation.

The longer a system/technology has been in operation, the more the farmer/analyst knows the risk involved. Many authors (6,7) claim, for example, that agroforestry technologies/systems are less risky (less subject to variation) than monocropping systems. However, whenever a new technology like agroforestry is introduced, the farmer's uncertainty about the outcome of such a system will be higher than the uncertainty about the existing system, simply because the system is unknown to him or her.

Generally speaking, farmers who are better off (i.e. have a relatively high level of per capita consumption) are inclined to accept such uncertainty more easily than farmers who have a low per capita consumption level, mainly because the value attached to the loss of a unit of consumption/income has less serious consequences for the well to do than for the less well off.

Because it is generally accepted that the degree of uncertainty increases the further the benefits are in the future, the risk discount factor for future net benefits is lower than for present-day net benefits. The relationship between the level of the risk discount factor over time and the level of consumption is shown in Figure 2.

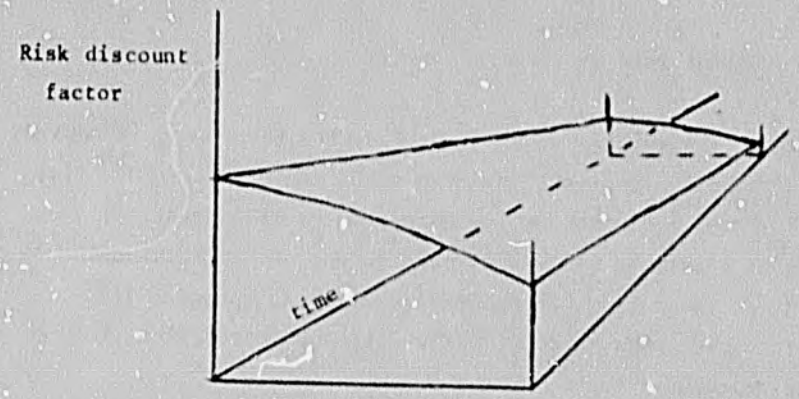

Fig. 2. Risk discount factor over time and in relation to per capita consumption (at a positive discount rate).

The personal discount rate for different categories of farmers

If this risk discount rate is added to the consumption discount rate of the farmers, the level of the resulting personal discount rate will depend on whether the farmer's production is expected to go upwards or downwards and whether the farmer is "rich" or "poor". Taking only the extreme values for each variable to classify farmers, the following combinations are possible:

Group 1. Poor farmers, downward trend in production : these farmers will have a high-risk discount rate, while their consumption discount rate will be low.

Group 2. Poor farmers, upward trend in production : these farmers have a high-risk and consumption discount rate.

Group 3. Rich farmers, downward trend in production : these farmers will have a low-risk and consumption discount rate.

Group 4. Rich farmers, upward trend in production : these farmers will have a low-risk discount rate and a high consumption discount rate.

Farmers who fall in group 3 will therefore have the lowest personal rate, while farmers in Group 2 will have the highest rate.

For these two extreme groups of farmers, it may be worthwhile to examine whether or not their returns on equity capital and savings are different from those obtained, on average, by others. If this is not the case, the analyst is justified in assuming a lower personal discount rate than the average savings and investment rate of farmers in Group 3 and a higher one for farmers in Group 2.

While farmers in Group 3 seem to be easily inclined to adopt a new agroforestry system/technology, Group 1 farmers, who are also potential agroforestry "targets," may not. However, generally speaking, the risk discount rate will change over time because farmers will gradually become more acquainted with the new system/technology which will take away the uncertainty about the system/technology and change it to a known risk. It is, therefore, quite possible for farmers in Group 1 to lower their personal discount rate after they have observed, on some demonstration plots, that the output of the AF system/technology is more dependable than the output from existing non-AF systems.

Discount rate when different sources of capital are being used

Finally, what discount rate should apply if part of the capital required has to be borrowed, part has to be valued at the savings and investment rate and part has to be valued at a personal rate different from the savings and investment rate ?

A weighted discount rate is suggested by Gittinger (1), i.e. (borrowed capital x borrowing rate ÷ total capital) + (equity capital x return needed to attract equity capital ÷ total equity) + (value consumption foregone x personal rate of discount ÷ total capital)*.

Another possible solution is to determine the net benefits of a new technology after financing, thus eliminating the need to include the borrowed capital component in the determination of the weighted discount factor.

Conclusion

In this paper it has been argued that the rate at which future net benefits have to be discounted will differ depending on the "financing" of additional input requirements.

Since there are clearly differences between farmers in this respect, it seems appropriate to differentiate between farmers when evaluating the possible introduction of a new agroforestry system/technology onto a farm. Also, attention should be paid to the actual discount rates used for each different group of farmers. It seems therefore usefull to develop some practical guidelines, which will enable analyst to determine such rates.

*Note: If the rate at which equity capital can be attracted is assumed to be the same as the personal rate of discount, there is no need to differentiate between equity capital and consumption foregone.

References

1. Perrin, R.K., D.L. Winkelmann, E.R. Moscardi and J.R. Anderson. 1976. From agronomic data to farmer recommendations: An economic training manual. Centro Internacional de Majoramiento de Maiz y Trigo, Mexico City.

2. Gittinger, J. Price. 1982. Economic Analysis of Agricultural Projects. The Johns Hopkins University Press, Baltimore, London.

3. Little, I.M.D. and J.A. Mirlees. 1974. Project Appraisal and Planning for Developing Countries. Basic Books, Inc., Publishers, New York.

4. F.A.O. 1979. Economic Analysis of Forestry Projects. F.A.O. Forestry Paper No. 17, Rome.

5. Roumasset, J.A. 1981. Introduction and state of the art. In "Risk, Uncertainty and Agricultural Development". Ed. Roumasset, J.A., J.M. Boussard and I. Singh.

6. Harou, P.A. 1981. Economic principles to appraise agroforestry projects. In "Agricultural Administration".

7. Arnold, J.E.M. 1981. Economic constraints and incentives in agroforestry. In "Proceedings of U.N.U. Workshop on Agroforestry", Freiburg, West Germany (not yet published).