ENGLISH ONLY

UNCTAD/UNDP SEMINAR ON AGRICULTURAL INSURANCE

Colombo, Sri Lanka, 1 - 5 October 1979

Statistical Theory Applied in the Actuarial Computation
of Premium Rates and Coverages (Paddy Insurance) - Sri Lanka

by P. Senarath

and

Miss H.P.K. Weerasinghe

1. Introduction

Agricultural Insurance is not a novel experience to farmers in Sri Lanka.
Outside Japan, Sri Lanka was the first country in Asia to introduce a
crop insurance scheme in 1958, mainly for paddy (rice), covering around
200,000 acres in 16 districts. With the major developments in the
Agriculture sector, the need arose for the expansion in the field of crop
insurance to other crops and covering livestock as well. Hence the new
Agricultural Insurance Law No. 27 of 1973 was formulated and the
Agricultural Insurance Board was established in 1974 for implementing
the new scheme. The objectives of the Board were :

a) to operate a comprehensive agricultural insurance scheme for the
farmers in respect of paddy crop and other specified crops, and live-
stock. The Insurance Board should indemnify them against loss, provide
a stabilising effect on farm income, and promote agricultural production,
and

b) to undertake research necessary for the promotion and development
of Agricultural Insurance.

In view of the above objectives, the new Agricultural Insurance scheme
was programmed to be implemented in three stages, vis.

i)   The compulsory insurance scheme for paddy.

ii)   Voluntary insurance schemes for livestock and other field crops.

iii) Voluntary insurance schemes for non-traditional export crops.

As a first step, the Board considered to launch a scheme for paddy (rice) covering the entire island with the help of available data, personnel, and rural institutions.   The major technical aspects which the new Board carefully considered were:

i)   Actuarial computation of premium and coverage.

ii)   The method of loss adjustment.

A separate division called the "Actuary and Research Division" was formed within the Board which was responsible for computation and revision of premium and coverage and to formulate a scheme for the improvement of loss procedures.

Deviating from the earlier crop insurance scheme, which charged a flat rate of Rs:6:- as premium/acre, the Actuary and Research Division was entrusted with the computation of varying rates of premia and levels of cover according to risk and productivity in different localities, based on the fact that the scheme is self financing.

The limitations confronted in determining the premium rates and levels of cover, which were meant to be actuarially consistent and acceptable to farmers were :

a)   Lack of reliable agricultural statistics at the village level, spread over a sufficiently long period. The data was not available for smaller units which were considered most appropriate for the actuarial computations.   The Department of Census and Statistics could provide us with the data collected at D.R.O. Division level.   Hence it was decided to use the data at Divisional Revenue Officer (D.R.O.) level, for a period of ten years, for the above computations.

b)   The problem of disaggregating the available data for the smaller areas.

c)   The wide variations in risk between areas, agro-climate zones and land classes caused problems in distributing the risk between these areas.

However, the Actuary and Research Division has evolved a method, with certain adjustments to overcome the above limitations in computing the premium rate and levels of cover, for different localities as explained in this paper.

2.. Premium Rate

The premium rate depends on the risk and the level of coverage.   The principal basis of fixing the premium rate is to use the data on past experience such as the ratio between the indemnity and the liability. But since the compulsory insurance scheme in Sri Lanka was launched recently, commencing from 1975, data on crop damage for a sufficiently long period could not be accumulated and hence we had to rely on other sources of data.   In Sri Lanka it is possible to get well developed yield statistics based on crop cutting surveys conducted by the Department of Census and Statistics for a long period.   The damage to paddy crop is assumed to be composed of two parts and the premium rates should be computed in respect of both parts, namely (a) fully damaged area, and (b) yield on harvested area (partially damaged area).

i)   Premium Rate for Fully Damaged Area

Statistics on fully damaged area are available at district level with a certain amount of reliability and these figures seemed to be over-estimated for a smaller area such as Divisional Revenue Officer (D.R.O. division).   Hence it was decided, to scale down the fully damaged rate of the district to 1/3 the value in estimating the fully damaged rate of the D.R.O. division.   The result was considered equivalent to the premium rate percent in respect of the fully damaged area in the D.R.O. division.

ii) <u>Premium Rate for Partially Damaged Area</u>

The distribution of partial losses is determined using the yield per
acre of the parcel, which is assumed to be nearly the same as that of
the sample plots within the parcel.   These data were obtained from the
results of the crop cutting surveys of the Department of Census and
Statistics.   The distribution of partial losses for a particular D.R.O.
division was computed, based on a statistical theory derived from the
normal distribution principle.

The distribution of partial loss was specified by determining the mean
($\bar{y}$) and the standard deviation (σ) of the yield per acre, averaged
over a 10-year period.   Another parameter commonly used to describe the
risk is the coefficient of variation of yield/acre.   The coefficient of
variation is defined as the quotient between the standard deviation (σ) and
the mean ($\bar{y}$).   It could be proved that the expected loss per acre for a
commodity is completely determined by the coefficient of variation.   A
low coefficient of variation means a low risk and high coefficient of
variation, a high risk.   The premium is proportional to the risk and the
coverage.

Table 1 gives the premium rates for partial losses as a percentage of
the coverage, for different levels of coefficient of variation.   To esti-
mate the premium rate for partial losses in the D.R.O. division, one has
to calculate the coefficient of variation of the yield in the D.R.O.
division, and then read off from the following table the corresponding
premium rate for partial loss, as a percent of the coverage.   This
result was disaggregated to the Agricultural Service centre areas and/or
cultivation officer areas, within the D.R.O. division which are considered
as the appropriate units in fixing the premium rates.

Table 1: Premium Rate for Partial Losses as a Percent of Coverage
for Different Coefficients of Variation (Risks)

Coefficient of Variation % (Class Interval)	Premium Rate as a % of Coverage Without Excess	Premium Rate as a Percent of Coverage with 20% Excess
15.1 - 20.0	7.0	1.4
20.1 - 25.0	9.0	2.9
25.1 - 30.0	11.0	4.9
30.1 - 35.0	13.0	6.7
35.1 - 40.0	15.0	8.8
40.1 - 45.0	17.0	11.0
45.1 - 50.0	19.0	13.3
50.1 - 55.0	21.0	15.6
55.1 - 60.0	23.0	17.9
60.1 - 65.0	25.0	20.3
65.1 - 70.0	27.0	22.6
70.1 - 75.0	29.0	25.0
75.1 - 80.0	31.1	27.4

/Details of the actuarial computations are given in appendix 1/

The total premium rate % for) ،e Premium rate % for fully damaged
the D.R.O. division   )   area + premium rate % for
)   partially damaged areas.

3. Coverage

Coverage is defined as the indemnity paid to the insured when there
is a total failure. For partial losses the indemnity is reduced pro-
portionally to the degree of damage. A major principle in insurance
is that the insured should never be overcompensated. That means far-
mers should not be in a better position after being compensated than if
a crop failure had not occurred. Thus the upper limit for compensation
should be the standard yield value.

Standard yield value = (yield in bushels per acre) x (guaranteed price per bushel)
   (averaged over 10 seasons)

One of the main objects of crop insurance should be to keep the farmers credit-worthy even after a crop failure, so that they are able to repay their cultivation loans. Coverage should therefore be fixed in accordance with the scales of finance of the credit scheme.

The most effective method of determining the level of coverage is to decide the coverage is to be a certain percentage of the standard yield value, which means that the coverage will be directly related to the level of production in the area and can be determined when computing the standard yield and the premium rates. But the farmers cannot afford a high premium rate when selecting a high coverage. It is, therefore, recommended to fix the coverage as 50% of the standard yield value. From our experience we know that when the farmers are given the option of selecting coverages, the coverages they select are generally low except in high risk areas. The reason obviously is that the corresponding premium is low.

In the latest revision of premium rates and coverages, the Agricultural Insurance Board has decided upon the following in fixing the coverage level.

1) For those farmers who take cultivation loans, coverage is fixed in relation to the scales of finance, or as 50% of the standard yield value, whichever is higher.

2. For the other farmers who do not take loans, a lower coverage level is offered.

3. The coverage level is fixed for each A.S.C./CO areas, and by land classes.

4. Need to Introduce an Excess or Franchise.
If the yield obtained over a long period of time in growing a particular crop on a particular area, using the same farmers' methods and equipments, is represented by a graph, the distribution approximates to a normal distribution pattern, with the standard yield as the mean.

y

Probability

Density

x
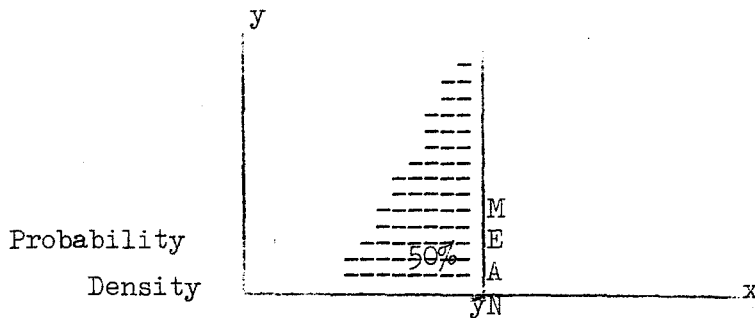
A farmer will be indemnified if the yield/per acre of his parcel is below the standard yield for the parcel.
(Standard yield = Average of the average yields over a long period).

Hence, from the distribution pattern, we find that $\frac{1}{2}$ the number of parcels will have a yield below the mean. This means that 50% of the farmers will be indemnified at present.

In an insurance scheme that is self-financed without any subsidy, (subject to administrative costs met by the Government) the following rule may be accepted in the long run, but not for a single season or for part of the island.

"Premium collected = Total indemnity + commission"

If 50% of the parcels are indemnified the risk is high and hence will result in a high premium rate. Since it is not subsidised, the farmers cannot afford a very high premium rate, and the only way to reduce the premium rate is to introduce an "excess" or a "franchise".

Introducing an excess or franchise means that farmers with minor losses will not be indemnified and/or that the farmer will have to bear a certain percentage of the risk himself.

The % of farmers with a yield below the standard yield that are left out can be seen in the fig. 2A and fig. 2B, for two different levels of co-efficients of variations.

Ex 1: Standard yield = 50 Bu/acre

         Coefficient of variation = 17.5% (low)
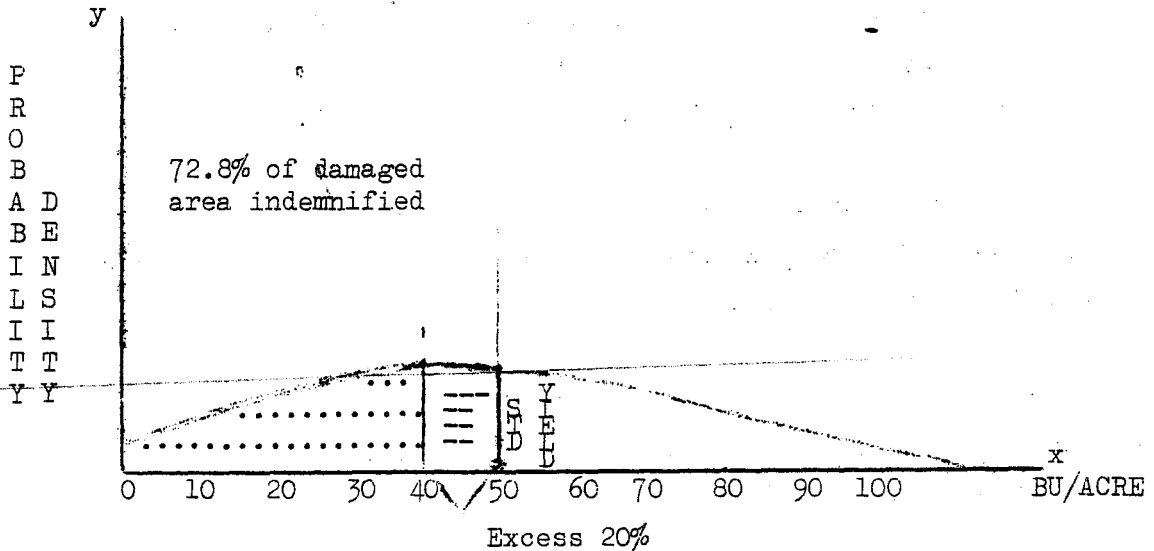
         Level of excess = say 20%

The farmer will be indemnified if he gets a yield below 50 Bu/acre.
But if the excess is 20%, he will be indemnified if the yield he gets is
below 40 Bu/acre.

Fig. 2A Distribution of Yields when the Coefficient of
         Variation is Low
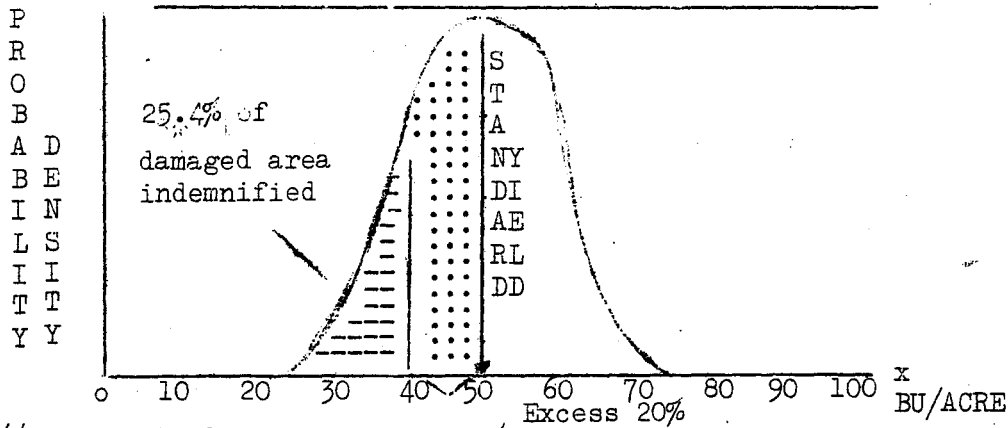
// ex 2: Standard yield = 50 Bu/acre

         Coefficient of variation = 57.5% (high)

         Level of excess = say 20%

Fig. 2B Distribution of Yield when the Coefficient of
         Variation is High

If the excess is fixed at a higher level the percentage of farmers left out in indemnification will be too high, and vice versa. The results of the pilot study led to the recommendation of the level of excess at 20%. The advantages of introducing an excess are :

1) Only farmers who have suffered a real loss will be indemnified.

2) The premium rate will be at a reasonable level.