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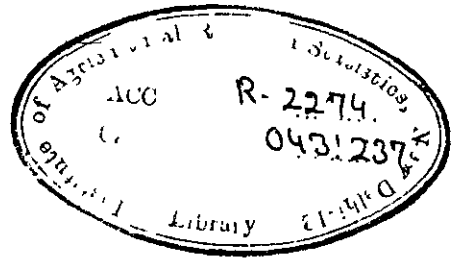
By

D. H. AGARWAL



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1973

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Dissertation submitted in fulfilment of the requirements for the award of Diploma in Agricultural Statistics of the Institute of Agricultural Research Statistics (I.C.A.R.) NEW DELHI - 110012

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ACKNOWLEDGEMENTS

I have great pleasure in expressing my deep sense of gratitude to Shri M. Rajagopalan, Statistician-cum-Associate Professor, Institute of Agricultural Research Statistics (I.C.A.R.) for his valuable guidance, keen interest and constant encouragement throughout the course of the investigation and immense help in writing the thesis.

I am also grateful to Dr. M.N. Das, Director, Institute of Agricultural Research Statistics (I.C.A.R.) for providing necessary facilities to carry out this work.

The work was supported by a Senior Research Fellowship of the Institute of Agricultural Research Statistics (I.C.A.R.). The assistance is gratefully acknowledged.

(D.K. AGARWAL)

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CHAPTER - I

NEED FOR CROP INSURANCE UNDER INDIAN CONDITIONS

No occupation is liable to the risk of heavy losses through sudden calamities beyond man's control as agriculture. Farming has to be carried on in the face of various natural elements such as inclement weather, fire, flood, drought, frost and hail, on the one hand and, on the other, insets, pests and various diseases. Normally the greatest impact of all these factors is on crop production. Although farming is a symbiotic relationship between man and his environment, the yields of farm crops are controlled more by natural factors than man's actions.

Because of the meterological and biological factors yields of crops vary considerably overtime. Farmer cannot fully control the amount he produces. Nature does the business and man is merely the manager.

Uncertainty of crop yield is thus one of the basic risks which every farmer has to face. Farmers in most countries of Asia and the far East region are poor and have extremely limited means and resources, to bear the risks especially when these are of a disastrous nature. A serious crop failure means not only the loss of farmers' income but also the loss of investment for the next season. This leads to their indebtedness. Thereby the entire community is affected by risks, of which the farmers are the direct and primary victims.

Priolkar while stressing the need for crop insurance in India says " The most important part of a scheme of agricultural insurance, however, relates to insurance of crops against unavoidable

production risks. A serious deficiency in the income from the crops means not only loss of family income but inability to pay fixed charges such as rent and taxes. The production risks which cultivator has to face are many and varied, and while his ability to face them is very limited, they are largely beyond his control".

Crop insurance is primarily a technique of protecting farmers against the element of chance in crop production and stabilising farm income. Crop insurance eliminates this chance element by assuring farmers that the loss suffered by them due to any unforeseen changes in nature would be compensated fully or in part. It thus brings security to them and stability in their income.

Rowe says "Many of the troubles of farmers can be traced to failure of crops. Sometimes the effects are moderate, a reduction in income, inability to repay debts, need for additional credit etc. Sometimes the effects are disastrous - complete loss of income, loss of the farm, or sometimes actual starvation. Crop failures probably have their greatest effect upon those whose income is small. These persons have other problems as well as crop failure. It may be too little land, too high rent, inadequate capital, lack of knowledge of good farming methods, or other factors. It is when crop failures occur that they are 'Washed out'. They have no reserves to meet such losses".

In order that productive effort is maintained after a crop failure, it is necessary that farmers should be in a position to repay their loans and also have sufficient funds to carry on the agricultural

operations in a subsequent season. For this purpose, a scheme like "Crop Insurance" becomes a social and economic necessity.

Under crop insurance by paying small amounts as premia, farmers purchase the right to be compensated for loss of crops. Also the liability of the Government of the cost of relief measures to farmers following a crop failure is reduced as through crop insurance they have provided relief on their own.

The working party of F.A.O. on crop and livestock insurance says " The advantages and benefits to be derived from crop insurance will vary according to the nature and extension of protection provided by it". First it prevents the crop loss against various natural hazards.

Second, crop insurance helps to ensure a considerable measure of security in farm income and thus contributes to greater stability in general economic conditions. It spreads the crop losses over space and time, that is, losses suffered by farmers in particular localities are borne by many scattered over wide areas, and reserves accumulated in good years are used to meet losses in bad years. It not only protects their incomes but their investments in the crops as well.

Third, crop insurance will improve the position of farmers in relation to agricultural credit. One of the major causes of indebtedness of farmers in underdeveloped countries in the distress caused by frequent crop failures. Crop insurance by guaranteeing a protection against such failures, would go a long way to free the farmers from increasing debts. Also by improving the economic position of the

farmers it would considerably strengthen the financial position of the agricultural co-operative credit institutions in many underdeveloped countries is that the farmer-borrowers are unable to repay their debts regularly, which often results in considerably accumulation of overdues and, sometimes they are not able to repay, the loans have to be written off either wholly or partially.

Fourth, crop insurance would give farmers greater confidence upon the adoption of new and improved farming practices and in making greater investments in agriculture for improving crop yields and increasing agricultural production.

Fifth, crop insurance by encouraging self help and mutual aid would promote attitude among farmers favourable to co-operative efforts generally.

Finally, crop insurance will help in maintaining the dignity of farmers as they will not have to depend on 'hand out' from the government in case of crop failures, the relief they receive in such eventually is their right. Farmers under crop insurance are assured of maintaining a decent standard of living not by charity but by their own efforts.

Crop insurance is in operation in a number of countries including the United States, Japan and Ceylon. The system of crop insurance, as developed in other countries, cannot be introduced in India as such but has to be modified to suit the special conditions prevalent in the country. Any type of crop insurance should, however,

observe the sound principles of insurance. It should be geared to the needs of the farmers. The amount of premia paid (including the subsidies, if any) over a number of years should balance the claims paid over that period. Therefore, there should be a proper acturial basis for the insurance scheme.

Crop insurance is some what more complicated than some other types of insurance like life insurance. In the latter case, the risks to be insured can be identified at the time of insurance whereas the crop to be insured does not exist at the time of insurance and is still to be produced during the season and the amount of produce to be realized is unknown to both the insured and the insurer. The insured farmer, of course, has some expectation regarding the production which is likely to obtain based on his past experience and thus could determine the amount to be insured. Also when the damage to the crop occurs, it involves the assessment of losses of a large number of farmers within a short period. This assessment is further complicated when the loss of crop is only partial. This is all to be done to the satisfaction of the farmers in the interest of smooth working of the scheme.

CHAPTER - II

CONCEPTS AND DEFINITIONS

1. Risk and Uncertainty :

Since risk is measurable in empirical or quantitative manner the losses or gains can be predicted with certainty, while this is not possible under uncertainty where the knowledge of the future is less than perfect.

Risk can be incorporated into firm's cost structure and is, therefore, insurable, while the uncertainty is not insurable and cannot be reduced in terms of cost.

The term uncertainty can only be used in a very broad sense to include all circumstances in which decisions must be made without perfect knowledge of significant future events.

The uncertainty from the individual's point of view, can be classed as risk, if large number of observations are available and the outcome is predictable. Death, fire losses and similar outcomes are absolutely uncertain for an individual, however, the probability of these outcomes is measurable when the number of cases or observations are sufficiently large and randomly or independently distributed. Insurance companies, therefore can predict the statistical probability of deaths fire losses etc. with a degree of certainty such that phenomena can be called as a risk and hence can be insured. Similarly crop yields on individual farm in a single specified year may be uncertain, but can be predicted on sufficiently large number of farms over a period of years. Therefore, loss in crops due to year-to-year variability in

yields associated with fluctuations in the weather can be classed as risk and hence can be insured.

2. Indemnities:

An important feature of any plan of crop insurance is a definite method of measurement of crop loss for paying indemnities. The procedure adopted is to determine a guaranteed yield for each insured unit which is generally taken as fraction of the normal yield, which is the average of seasonal yields. When the actual yield in any season falls short of the guaranteed yield, a loss is deem to have occurred and the difference between the guaranteed yield and the seasonal yield is taken as measurement of loss. The indemnities is then obtained as the cash equivalent of the loss of fraction of loss. In Japan the guaranteed yield is 70 per cent of the normal yield. In U.S.A. this fraction is 75 per cent. Both in U.S.A. and Japan the maximum indemnity payable is 50 per cent of the normal yield when total crop loss occurs.

3. Premiums:

Under the plan of insurance the premium collected over a long period of years would on an average equal to the indemnities payable during the same period. Thus under the crop insurance premium rates would depend upon

i) Average productivity per acre in the area

ii) The variation in the average yield from year-to-year.

iii) The relationship between guaranteed yield and normal yield.

iv) Relationship between the maximum indemnity and guaranteed yield.

v) Selection of local calamnities.

It is a common practice to quote a premium rate in percentage or a premium per hundren dollars of insurance. The Federal crop insurance instead has throughout most of its history quoted a premium rate per acre. The reason for this was that farmers on land of high productivity were insured for more than farmers on land of low productivity, Despite the higher guarantee or amount of insurance on such land the losses were frequently less than on land of low productivity but with a small gurantee. It did not appear logical to charge a premium proportional to the amount of insurance or the amount of gurantee, since the larger losses were more commonly occuring on the farms with the low gurantees. Therefore, the practice has been followed of quoting the amount of premium per unit of land or per acre in the United States.

According to the Federal Crop Insurance Act, the premium charged shall be such amount as is considered by the Board of Directors to be adequate to meet losses and to establish a reasonable reserve against unforeseen losses. Consequently premium rates have been computed on the basis of the amount necessary to cover only the insurance losses and provide reserves.

4. Crop Insurance - Voluntary or Compulsory :

The question has often been raised whether insurance of crop should be on a voluntary or on a compulsory basis. It is a matter which depends much on the history and the institutions of the people

involved. The system in the United States is voluntary, in Japan it is compulsory.

The voluntary and the compulsory systems have important differences. Probably the greatest difference is that under a compulsory system all, or essentially all, farmers are protected, whereas under a voluntary system only a part have the protection. The percentage of farmers voluntarily buying and paying for crop insurance varies widely by local areas with as high as 80 per cent in some counties of the United States to as low as 5 per cent in others.

Under a voluntary system a large part of the operating activities centres around selling. Farmers do not buy much insurance on their own initiative, they have to be sold. Perhaps this is because insurance is protection for the future and for most people the problems of the present outweigh the problems of the future. The task of selling is avoided under a compulsory system.

In a voluntary system where insurance is sold it is necessary to be constantly on guard against "adverse selection of risks". An example of this would be where more farmers take insurance in those years where soil moisture conditions is normal or above. Another example of adverse selection of risks is found where the less efficient farmers take the insurance on terms planned for the average and the more efficient ones do not. The danger of "adverse selection of risks" is not a problem under compulsory insurance. Whether a country should use a voluntary system or compulsory system is a decision that only the people there can take.

The report of the working party states crop insurance may be voluntary or compulsory as in the United States and Japan respectively. The chief argument advanced by those who favour voluntary insurance is that insurance should not have to be purchased by those who do not feel a real need for it.

On the other hand, the principal defects of voluntary system are first, it may not always ensure the degree of participation necessary for successful program. Second, there is great risk of "adverse selection" that is; farmers will apply for insurance on their high risk crops. Third, voluntary insurance raises additional problems of administration and costs to the extent that the insurance has to be sold.

A compulsory insurance program avoids these difficulties by ensuring adequate participation, preventing adverse selection and reducing cost of operation. Also under compulsory insurance it may not be easily possible to offer different plans of insurance with varying levels of coverage to suit the requirement of different groups of farmers.

The principal point to be kept in view in selecting voluntary or compulsory cover is which promises greater success, considering the special conditions of the country where it is applied.

It is exceedingly doubtful whether in India a sufficiently large number of farmers who are mostly illiterate could be persuaded to participate in a voluntary scheme of crop insurance. Even in the United States where agriculture is carried on a commercial basis, people are much more familiar with the concept of insurance and a efficient sales of organisation exists on an average only 20 per cent of

eligible farmers in the area of operation of scheme are insured. Therefore for successful operation of crop insurance scheme under Indian conditions, compulsory insurance is the only way out.

5. Unit of Insurance:

The unit of crop insurance may be either an individual field or the holding or group of holdings constituting a well defined area. Under the individual insurance, the individual field is the unit of insurance and the farmer will be indemnified, if the average yield of that field falls below the insured level of that field. Under this insurance, the premium rates vary from field to field depending upon their relative productivities. Individual accounts will have to be maintained for each insured field for working out premium and indemnity rates.

Under 'Household Holding Insurance Scheme', all the fields belonging to a single farmer called the 'holding' is the unit of insurance for the purpose of indemnifying losses. For example, if a farmer has insured three farms and if loss occurs in one farm, he will not be compensated for the loss he has sustained from this farm, but he will be compensated only when there is an overall loss from all the three farms. Under this insurance, he will have less indemnity than he would have got under the Individual Insurance Scheme. In addition to the difficulties pointed out in respect of the individual unit scheme, it may not be attractive to the farmer since he is not compensated for the loss he gets from the individual field. Moreover, the overall loss may ~~rather~~ occur infrequently and when it occurs it may not be sizable as the good yields obtained from some fields may compensate the bad yields obtained from some others.

Under Area Insurance, the area in the unit of insurance. Premium rates are worked out taking into account the productivity as a whole. All the farmers in the area will be required to pay premium at a uniform rate, and will be indemnified at uniform rate when the average yield of the area in any year falls below the insured level irrespective of the yields of their individual fields or holdings. In other words, the estimated average yield of the area as a whole and not that of the individual fields or holdings, is adopted for the purpose of loss adjustment. Under the Area Insurance Scheme, it is necessary that the area should be so demarcated as to be contiguous, compact and homogenous so that the productivity is more or less uniform thereby ensuring equality of premium and rates of indemnity. The Area Insurance is simpler, easier and more economical than the Individual Insurance or Household Insurance.

Under Indian conditions where holdings are small and very in large numbers, individual insurance of a field or a holding is almost impossible, area insurance is the only possible method for crop insurance in India.

CHAPTER - III

CROP INSURANCE IN U.S.A. AND JAPAN

United States:

The first initiative in underwriting the insurance of growing crops against multiple risks had been taken in the United States by private insurance companies as early as 1898. Later, from time to time, some of the big fire insurance corporations offered essentially all-risk crop insurance on the major field crops. These attempts failed and the insurance proved almost in every case too costly for the insurance offices. The main reasons for failures were (1) Lack of adequate data for proper actuarial calculations of different risks, (2) too low premiums, (3) limited area of operations with consequent limited spread of different risks, (4) acceptance of application when probabilities of a crop failure existed, and (5) attempt to insure both yield and price.

Partly because of their unhappy experience and partly because of the great depression of the 1930's, the private insurance companies almost completely withdrew from the field of all-risk crop insurance arround the middle of that decade, but the void caused thereby was soon filled by the Federal Government. Having been convinced, in the face of the great slump in the prices of agricultural products, of the importance of crop insurance as a measure of stabilising farm income, the Roosevelt administration passed the Federal Crop-Insurance Act in 1938 and took the initiative in organising crop insurance from the following year.

The original Act provided only for the insurance of wheat. Wheat insurance was started on the 1939 crop and was in operation for three years when cotton insurance was added. Losses in the early years were heavy with losses exceeding premiums on both wheat and cotton in each of the first five years, 1939 - 1943.

As a result of heavy losses in the first four years, the appropriation in the summer of 1943 provided sufficient funds only for liquidation. There was no insurance as 1944 crops nor on the 1945 winter wheat crop planted in the fall of 1944.

By action of new legislation near the end of 1944, the crop insurance programme was revived and flax was added as an insurable crop. This legislation also provided for experimental insurance on other commodities in not more than 20 counties each. The legislation was passed in time to insure spring planted crops for 1945. These covered spring wheat, cotton and flax. In addition, small experiments were started on corn and tobacco. With the revival of insurance in 1945 a number of changes were made that helped to improve the insurance.

As a result of the new legislation and other changes made in the insurance and its operation, the financial experience improved greatly on wheat and the experience on flax, tobacco and corn was quite satisfactory. However, large losses occurred on cotton insurance in 1945 and 1946, primarily as a result of droughts in the Southwest. In the light of the 1945 and 1946 experience the Congress reviewed the operations and decided to reduce the progress to more of an experimental

basis. Insurance was authorised in only limited number of counties. There were 200 wheat counties and 56 cotton counties and a smaller number of counties for the other crops.

This limited and experimental approach went into effect beginning with the 1948 crop with only 375 county programs compared to 2,000 in 1947. Consequently, a new period in the history of the corporation was begun at that time. Insurance operations since that time might be considered as more intensive rather than extensive operations. Other insurance added on an experimental basis has been Florida Citrus -1951, Soyabeans 1955, Barley 1956, Peaches 1957, California oranges 1958 and Oats 1959. Thus, the history of all risk crop insurance in the united states is divided into two periods, first from 1939-46 and second, 1947 onward. The first one is called the nationwide scheme and the second the experimental stage.

Japan :

The history of all-risk crop insurance in Japan can be divided into two periods (1) crop insurance before world war - II i.e. between 1939-46 and (2) crop insurance after world war - II i. e, after 1947.

Crop insurance on scientific basis was first recommended to the Meiji Government by the German specialist, Paul Mayet. He suggested a comprehensive crop insurance scheme as a relief measure to protect the poverty stricken farmers against the ravages of nature. The recommendation made by the Mayet did not, however, materialise

for a long time. Nearly half a century passed before any active consideration was given to crop insurance by the Japanese Government. The first practical step towards the establishment of crop insurance was taken in 1928. The Government appointed a Special Officer in the Ministry of Agriculture and Forestry to work out the details of crop insurance plan. At the same time specialists were deputed to collect and organise data on physical damage of crops and to lay down the basic principles to be followed in loss adjustment. As a result of investigation conducted by the Ministry of Agriculture and Forestry a mature plan of crop insurance was ready by 1931. This was placed before the committee of experts for examination and approval. At the same time a bill on crop insurance was introduced in the Diet but it failed to obtain the sanction of the House owing to some objections put forth by the Ministry of Finance. Following China incident, however, another effort was made by a committee of 16 members headed by Kuniyoshi Murakami to present crop insurance bill before the National Diet (1938). The bill was approved by the House and became crop insurance law.

Crop insurance scheme was greatly revised after the war so as to adjust it to the new agricultural conditions created by the land reform programme. It was also combined with livestock insurance under the compensation against agricultural loss Law of 1947. In addition to stabilising farm income, the immediate objective of this revision was to prevent the reversion of the newly created owner cultivators into the position of tenants due to indebtedness. Crop insurance in post war Japan has been evolved as a vital aspect of agricultural planning and development.

CHAPTER - IV

WORK DONE ON CROP INSURANCE IN INDIA

So far, no serious efforts have been made in India for introducing crop insurance. An attempt was made in 1943 by Dewas Junior State at introducing compulsory scheme of all risks of crop insurance which permitted modest benefits to the farmer. In 1948, an ~~effer~~ officer on special duty, Shri G. S. Priolkar, was appointed by the Ministry of Agriculture to investigate the problems of crop and cattle insurance in India and to prepare a pilot scheme to be operated in selected areas. The recommendations of the special officer were considered at a conference held at Bombay in September, 1949 under the Chairmanship of Secretary, Ministry of Food and Agriculture, Government of India. The conference recommended the acceptance of special officer's report with certain modifications and the I. C. A. R. was requested to prepare a draft pilot scheme on the lines recommended by the conference. The draft pilot scheme as visualised by the I.C.A.R. was to operate for a period of 5 years in the States of Madras, Bombay, Madhya Pradesh and U. P. The crops intended to be covered under the scheme were, rice and cotton in Madras (in 5 centres), Cotton in Bombay (in 3 centres), Cotton, Wheat and Rice in Madhya Pradesh (in 5 centres) and Wheat, Rice and Sugarcane in U. P. (in 5 centres). The Pilot scheme recommended, was a compulsory one or an all-risk insurance pattern. Indemnity was recommended to be paid, when the actual yield of the area in a year fell below 75 per cent of the standard

yield of the area, subject to the maximum of 50 per cent of the standard yield in the event of total crop loss. It was estimated that 2.5 per cent and 4.5 per cent of the standard yield might be sufficient as appropriate premium rates for rice and cotton respectively for Madras, 4.5 per cent of standard yield might be sufficient for cotton for Bombay, 4.5 per cent, 4 per cent and 3 per cent of the standard yield may be sufficient for cotton, wheat and rice respectively for Madhya Pradesh and 3 per cent, 5 per cent and 3 per cent of the standard yield may be sufficient as appropriate premium rates for wheat, rice and sugarcane respectively for Uttar Pradesh.

During the Third Five Year Plan, the Government of Punjab desired to implement an all-risk compulsory crop insurance scheme. The Punjab Government took up the idea of crop insurance in the year 1959 and formulated a draft scheme. It is a compulsory and an all-risk insurance scheme to offer protection to farmers against damages to crops due to floods, drought, hail, pests etc. which are beyond the control of farmers. It is based on Area Insurance. Indemnity will be paid, when the average yield of the area in any year falls below 75 per cent of its standard yield, the maximum amount of indemnity being limited to 50 per cent of its standard yield in the event of total crop loss. The scheme is proposed to be implemented as a pilot scheme covering wheat, gram, sugarcane and cotton crops on an experimental basis in six selected blocks in an area of 3.30 lakh acres. It is recommended that the State Government should finance the administrative expenses of the scheme at least in the initial stages, contribute amounts to set up

an initial Insurance Reserve and subsidise premia in the case of farmers who have not the capacity to pay. The scheme will, therefore, be fully administered by the Government. Premia and indemnity rates should be worked out first in kind and later expressed in cash equivalents by valuing them at the prevailing prices of insured commodities. The basis of calculation of premium shall be such that premia received over a number of years balance the indemnities paid during the bad years. The premium rates depend upon (i) standard yield of the area (ii) seasonal variations over a number of years in the yields of the crop and (iii) administrative expenses of the insurance scheme. The premium rates have been calculated on the above basis, taking into consideration the variations observed in the district yields of crops over the past 5 or 6 years, as such information was not available for smaller areas. The premium rates calculated for wheat varied from Rs. 2.70 to 3.03 per acre. For gram, they varied from Rs. 3.00 to 4.35 per acre. For cotton, they varied from Rs. 7.36 to 9.72 per acre. In respect of sugarcane, the premium rate recommended was Rs. 24.02 per acre. In the year 1962, the Punjab State secured the technical advice of Dr. T. Yamauchi, the F. A. O. expert on crop insurance to finalise the details of the draft scheme:

1) It is necessary that an investigation organisation should be set up urgently from the state level to the village level to collect the necessary data.

2) Following surveys should be carried out urgently for launching the scheme.

a) Standard average yield per acre in the area insured.

b) Planted acreage of insured crops and the number of the insured farmers classified by size of operational and ownership holdings.

c) Collection of damage statistics of the crops insured in the insured area.

d) Investigation concerning the structure of occurrence of agricultural calamity in each block proposed to be insured.

3) Following committees should be set up urgently to define the insurance techniques.

a) Committee of loss adjustment comprising specialists.

b) Committee for each block to advise about standard yield per acre and demarcation of blocks according to risk grade.

4) Provision for the training and education of the field staff of crop insurance should be considered for the success of the scheme.

Even though a few preliminary investigations were carried out for implementing the crop insurance scheme in Punjab in the light of F.A.O. experts recommendations, the scheme could not be implemented due to financial stringency. Recently a committee of experts was appointed in the Ministry of Agriculture to study the feasibility of introducing crop insurance scheme in India. The Government has not

taken any decisions on the recommendation so far. Some attempts are now made for insuring cotton crop in Gujarat by some private companies.

CHAPTER - V

METHODS OF CALCULATING PREMIUM RATES AND INDEMNITIES

1. The U.S.A. Method:

The method for computing premia for crop insurance used in U.S.A. may be described as being essentially based on the idea that the set of yields obtained on a farm during a representative period in the past will be broadly repeated over a similar period in future. Hence the average indemnity that would have been payable in case the farm had been insured during the past representative period is taken as the appropriate premium for insuring the farm.

The method for computing the premium for an individual farm used in the U.S.A. may be described as follows:

During a period of m-seasons considered as representative period for the crop concerned, let X_k denote the yield per acre during the k-th season, so that the average yield during the period is $X' = (\Sigma X_k)/m$. The maximum insurance coverage per acre for the farm payable in the event of a complete crop failure is then $X'/2$. → (The max. risk being limited to 50% of the average yield)
In the event of a partial crop failure indicated by a yield lower than 75 percent of the average; a fraction of this maximum indemnity proportionate to the shortfall of the actual yield of the season from a 75 per cent yield is paid i.e. the indemnity will be equal to

$$\frac{1}{2} X' (0.75X' - X_k)/(0.75X') = \frac{2}{3} (0.75X' - X_k).$$

Thus if the indemnity during the season be denoted by Y_k, Y_k will be equal to '0' if X_k is greater than or equal to $0.75X'$, and equal to

$\frac{1}{3}$ ($0.75X' - X_k$) if X_k is less than $0.75X'$. The average indemnity during the representative period is (ΣY_k)/m and this is taken as the appropriate premium for the farm on the U.S.A. basis.

2. Japanese Method :

Under the Japanese scheme each fragmented field is a separate unit of insurance and each farmer holds one insurance contract for every such field. The Japanese scheme provides 70 per cent coverage of the normal yield of prefecture or village, subject to a maximum of 50 per cent of the normal yield in the event of complete loss of crop. As regards indemnities, farmers are paid mutual relief money only when the decrease in yield is more than 30 per cent subject to a maximum of 50 per cent of the normal yield. Calculation of indemnities is based on a complex formula. First the damage ratio of the field is determined.

$$\text{Damage Ratio} = \frac{\text{Normal yield - Harvested yield}}{\text{Normal yield}} \times 100$$

After determination of the damage ratio, the indemnity payable is arrived at as a percentage of coverage offered on a sliding scale. Having knowing indemnity payable the premium rate is taken as an average of the indemnity. Loss adjustments are carried out by the system which combines pre-harvest eye estimates of the standing crops and sample harvests. Loss appraisal work is entrusted to the Local Mutual Relief Association, whose members are themselves beneficiaries under the programme and as such this feature of the

crop insurance scheme has been a subject matter of controversy.

An important feature of the Japanese system which deserves special mention in the damage prevention work. Further, crop insurance in Japan is integrated with short term agricultural credit. Under this system any farmer who has insured his crop can get credit from the local co-operative institution, on the basis of the crop insurance upto a maximum of the insurance coverage.

3. Alternative Method:

As an alternative, a method which would take into account every variation in the yield which occurs during the period may be expected to provide a stabler estimate of seasonal variability and consequently of the premiums that may be derived from such estimates. It is suggested therefore, that as an alternative to the method used in the U.S.A., the standard deviation or the coefficient of variability may be used as an estimate of seasonal variation and that premiums may be derived by assuming that the deviation from average yield of a farm would be normally distributed. It may be pointed out that this assumption would be no more arbitrary or unreasonable than the one underlying the U.S.A. method of premium computations. A further advantage of the suggested method would be that it will be easier to estimate the effect on the premium rates consequently upon different variations in the average productivity and coefficients of variability.

The suggested method may be described as follows:

It is assumed that the actual yields per acre on a farm are

distributed normally with mean 'm' and variance σ^2 of an observed distribution would provide estimates of the mean and variance of the normal distribution.

Total premium receipts = Total indemnities payable

P = Premium rate = Average of indemnities payable

$$= \frac{\frac{1}{\sigma\sqrt{2\pi}} \int_0^{\frac{3}{4}m} \frac{2}{3}\left(\frac{3}{4}m - y\right) e^{-\frac{1}{2}\left(\frac{y-m}{\sigma}\right)^2} dy}{\frac{1}{\sigma\sqrt{2\pi}} \int_0^{\frac{3}{4}m} e^{-\frac{1}{2}\left(\frac{y-m}{\sigma}\right)^2} dy}$$

This can be simplified to a simple form as follows:

Put $\frac{y-m}{\sigma} = z$

$$P = \frac{-\frac{1}{\sqrt{2\pi}} \int_{-\frac{m}{\sigma}}^{-\frac{m}{4\sigma}} \left(\frac{m}{6} + \frac{2}{3}\sigma z\right) e^{-\frac{z^2}{2}} dz}{\frac{1}{\sqrt{2\pi}} \int_{-\frac{m}{\sigma}}^{-\frac{m}{4\sigma}} e^{-\frac{z^2}{2}} dz}$$

Put $\frac{m}{\sigma} = p$

$$P_e = \frac{\frac{1}{\sqrt{2\pi}} \int_{-V}^{-\frac{V}{4}} \left(\frac{m}{6} + \frac{2}{3}\sigma z\right) e^{-\frac{z^2}{2}}\, dz}{\frac{1}{\sqrt{2\pi}} \int_{-V}^{-\frac{V}{4}} e^{-\frac{z^2}{2}}\, dz}$$

$$= \frac{\frac{1}{\sqrt{2\pi}} \int_{-\frac{V}{4}}^{-V} \left(\frac{m}{6} + \frac{2}{3}\sigma z\right) e^{-\frac{z^2}{2}}\, dz}{K(v)}$$

where $K(v) = \frac{1}{\sqrt{2\pi}} \int_{-V}^{-\frac{V}{4}} e^{-\frac{z^2}{2}}\, dz$

$$= \frac{\frac{1}{\sqrt{2\pi}} \int_{-\frac{V}{4}}^{-V} \left(\frac{V\sigma}{6} + \frac{2}{3}\sigma z\right) e^{-\frac{z^2}{2}}\, dz}{K(v)}$$

where $m = \sigma v$

$$= \frac{\frac{\sigma}{\sqrt{2\pi}} \int_{-\frac{V}{4}}^{-V} \left(\frac{V}{6} + \frac{2}{3} z\right) e^{-\frac{z^2}{2}}\, dz}{K(v)}$$

$$= \frac{\frac{\sigma m}{m\sqrt{2\pi}} \int_{-\frac{v}{4}}^{-v} \left(\frac{v}{6} + \frac{2}{3} z \right) e^{-\frac{z^2}{2}} dz}{K(v)}$$

$$= \frac{\frac{m}{v\sqrt{2\pi}} \int_{-\frac{v}{4}}^{-v} \left(\frac{v}{6} + \frac{2}{3} z \right) e^{-\frac{z^2}{2}} dz}{K(v)}$$

$$\text{Hence } \frac{P}{m} = \frac{\frac{1}{v\sqrt{2\pi}} \int_{-\frac{v}{4}}^{-v} \left(\frac{v}{6} + \frac{2}{3} z \right) e^{-\frac{z^2}{2}} dz}{K(v)}$$

Thus knowing coefficient of variation premium rates can be calculated by multiplying the premium as proportion of normal yield ($\frac{P}{m}$) by normal yield (m). For different coefficient of variations premium as percentage of normal yield per hectare are given in Table - 5.1.

TABLE - 5.1

Premiums as percentage of normal yield per hectare

Percentage C. V.	Premium as percentage of normal yield
5	0.001
10	0.014
15	0.197
20	0.675
25	1.386
30	2.243
35	3.139
40	3.995
45	4.703
50	5.292
55	5.752
60	6.097
65	6.349
70	6.523
75	6.636
80	6.701

CHAPTER - VI

DATA NEEDED FOR FORMULATING A SCHEME OF CROP INSURANCE

From the foregoing chapters it is very clear for a successful implementation of crop insurance scheme, a satisfactory statistical data is a pre-requisite. The statistical data required for the formulation of crop insurance scheme are as follows:

i) Sufficiently detailed information to serve a basis for demarcation of area which would be homogenous with regard of productivity and risks.

ii) Levels of yield rates of different crops in different areas.

iii) Seasonal variation with those yield rates.

An available statistics is neither adequate nor sufficiently precise for this purpose. However it should be possible to make a start on a moderate scale with whatever data available. Thereafter statistical basis of the scheme could be progressively refined by utilising more reliable data as it became available during the operation of the scheme. Currently the data on seasonal yield of important crops are available for the past two decades based upon the objective method of crop cutting experiments. These yield rates are available only for the district. With the introduction of high yielding variety programme such yield rates were available for these varieties from 1967 onwards for a few selected districts. This available information could be made use of in obtaining a broad idea of the financial implication involved in running a crop insurance scheme under Indian conditions.

The financial implication of introducing crop insurance in the districts covering Intensive Agricultural District Programme (IADP) has been illustrated in the next chapter.

CHAPTER - VII

ILLUSTRATION IN IADP DISTRICTS WITH FINANCIAL IMPLICATIONS FOR DIFFERENT CROPS

Towards increasing agricultural production in India, the spread of high yielding varieties of cereal crops is expected to play a key role along with the adoption of associated improved practices such as high rates of fertilizer application, controlled use of water, etc. Though high yielding varieties programme covers five cereals crops, rice, wheat, maize, jowar and bajra, only the first two crops have gained wide acceptance of the farmers in many parts of the country. Of the various areas in which substantial impact has been made by the high yielding varieties of rice and wheat, the districts covered under the Intensive Agricultural District Programme (IADP) form a notable group. This is because of the special facilites created under the intensive project, including strengthened and more experienced extension agencies. Statistical assessment of the progress of the programmes forms its integral part since its inception. Since the introduction of high yielding varieties in these districts in 1966-67, for collecting authentic information on their performance and the extent to which recommended package of practices are actually being adopted by cultivators, special crop cutting experiments based on probability sampling technique are being conducted in those districts.

For illustrating the magnitudes of premium rates and indemnities payable if crop insurance scheme is introduced in these districts covering rice and wheat crops, the data based on the crop cutting experiments ~~conducting~~ covering the 5 year period beginning from 1966-67

have been used. The data pertain to rice crop in 9 IADP districts and wheat crop in 3 districts. These districts covered for rice are West Godavari (Andhra Pradesh), Thanjavur (Tamil Nadu), Alleppey (Kerala), Mandya (Mysore), Sambalpur (Orissa), Raipur (Madhya Pradesh), Surat - Bulsar (Gujarat), Shahabad (Bihar) and Jammu (Jammu and Kashmir). The districts covered under wheat are Ludhiana (Punjab), Aligarh (Uttar Pradesh) and Shahabad (Bihar).

The seasonal yields of rice and wheat both for high yielding varieties and local varieties in these districts are presented in tables 7.1 and 7.2 respectively. In the same table the normal yields (average of seasonal yields) for the different districts are also presented.

The area reported to have been covered under the high yielding varieties and local varieties for these districts during the year 1970-71 are given in table 7.5. These areas figures are utilised for studying the financial implication of the crop insurance scheme at the level of coverage as in 1970-71.

For high yielding and local varieties of rice and wheat in all the IADP districts, the premium rates per hectare in terms of cash equivalent were calculated, obtained by multiplying the premium rates per hectare in terms of yield with harvest prices. The total premium receipts in terms of cash equivalents obtained by multiplying the area (ha.) under each district by corresponding premium rates. These are given in tables 7.3 to 7.5.

As is to be expected the results show that premium rates are

higher for the districts where the coefficient of variation in yields over the years are higher. Similarly they are also dependent upon the normal yields. The premium rate per hectare is around 5 rupees for high yielding varieties of rice in the district of Thanjavur and West Godavari in the kharif season. In the Raipur district where the coefficient of variation in yield is about 13 per cent the premium rate is also and is of the order of 3 rupees per hectare. The premium rate is the highest in Jammu district namely rupees 45 as the coefficient of variation in yield is also the highest in this district. In the rabi season where the data were available for 4 districts for the rice crop, the premium rate per hectare is about 5 rupees in West Godavari and Sambalpur districts. In Thanjavur it is of the order of rupees 8 and the highest premium rate of rupees 32 is for the Alleppey district of Kerala State.

In the wheat growing district of Ludhiana, Aligarh and Shahabad even though the coefficient of variation in Ludhiana and Aligarh is of the same order, the premium rate in Ludhiana is about 6 rupees and in Aligarh about 4 rupees. This is because normal yield in Aligarh for wheat crop is far less than in the Ludhiana district. In Shahabad district both the coefficient of variation and normal yield are very small and therefore premium rate is nominal.

As far as local varieties of rice and wheat the premium rates are far less than for the high yielding varieties because the yield rates are much smaller. The highest premium rate in rice is about 4 rupees

in Sambal-pur district and about 6 rupees in Shahabad district. These above results though illustrative in nature indicate magnitude of the premium rates to be charged from farmers and these should necessarily be different for different agro-climatic regions and seasons. These illustration are based on data of 5 years only. For calculating the coefficient of variation and premium rates it should be necessary to have seasonal yield for a larger number of years. As such data would not be available at present if a beginning should be made in the introduction of crop insurance scheme, these results could be used as indicator of premium rates in different districts. During the working of crop insurance scheme data could be accumulated to revise the premium rates at least at the intervals of 3 years.

The total premium receipt is obtained by product of premium rate and area covered under the crop. For a district it may not be feasible to cover high yielding varieties only, local varieties should also be covered at the same time. If crop insurance scheme is taken up in kharif and rabi rice in all 12 districts the total premium receipts is of the order of 1.15 crores together for high yielding and local varieties.

The total indemnities payable in terms of cash (Rs. in crores) for all the IADP districts of rice and wheat for high yielding and local varieties were available are calculated for various percentages of crop losses. These are presented in tables 7.6 to 7.11.

The total indemnity payable in any district depend upon the

extent of crop loss, the normal yield and area covered under the crop. Since the unit of insurance for this illustration is taken as a district the crop loss is to be determined on the basis of seasonal yield for the district as a whole. The magnitude of indemnity payable when crop loss is of the order of 30 per cent is of the order of 2.8 crores in Thanjavar district of kharif season where area under high yielding variety is maximum as far as rice crop is concerned. In the same district if by chance entire crop is destroyed the amount payable is of the order of 42 crores for high yielding variety alone of rice. Correspondingly the amount for local variety for similar crop loss is of the order of 8.72 crores only.

In a similar way the indemnity payable for farmers in different districts are to be calculated on the basis of actual crop loss incurred in any given season. However the good crop in a few district may balance for crop losses in some of the districts. Thus reducing all over indemnity payable if an All India Crop Insurance Scheme is taken up covering various regions of the country representing different agro-climatic conditions. For such an All India Scheme the re-insurance organisation is a necessity and the financial implications arising out of implimentations of the re-insurance scheme is discussed in the next chapter.

TABLE - 7.1

Seasonal and normal yields (Q/ha) of high yielding kharif rabi rice and rabi wheat districts during the years 1966-67 to 1970-71

District	Seasonal Yield (Q/ha)					Normal Yields (Q/ha)
	1966-67	1967-68	1968-69	1969-70	1970-71	
1	2	3	4	5	6	7
RICE IN KHARIF						
West Godawari	23.2	31.5	34.7	27.9	24.5	28.4
Shahabad	14.4	13.8	16.3	14.3	22.1	16.2
Surat-Bulsar	15.6	18.4	18.8	27.9	22.7	20.7
Jammu	NC	24.2	14.8	16.6	29.7	21.3
Raipur	14.2	16.7	20.1	18.1	20.8	17.9
Mandya	NC	24.5	29.5	35.2	42.8	33.0
Sambalpur	11.4	19.2	18.2	15.6	14.7	15.8
Thanjavar	18.6	19.9	20.3	23.6	28.5	22.2
RICE IN RABI						
West Godavari	22.1	35.9	34.6	27.6	26.4	29.3
Alleppey	NC	34.2	21.8	20.3	20.8	24.3
Sambalpur	21.7	30.5	26.3	19.8	22.4	24.4
Thanjavar	NC	10.0	15.9	15.9	15.5	14.3
WHEAT IN RABI						
Ludhiana	47.3	40.5	35.5	31.4	38.8	38.7
Aligarh	29.6	21.2	19.6	22.3	25.4	23.6
Shahabad	16.7	17.1	18.9	17.1	19.2	17.6

NC : Crop cutting experiments not conducted.

TABLE - 7.2

Seasonal and normal yields (Q/ha) of local varieties kharif and rabi rice and rabi wheat districts during the years 1966-67 to 1970-71

District	Seasonal yields (Q/ha)					Normal Yields (Q/ha)
	1966-67	1967-68	1968-69	1969-70	1970-71	
1	2	3	4	5	6	7
RICE IN KHARIF						
West Godawari	18.9	21.2	21.1	14.5	21.6	19.4
Shahabad	7.9	9.2	11.6	9.9	13.4	10.4
Surat-Bulsar	14.6	13.4	10.2	13.6	14.7	13.2
Jammu	NA	15.7	11.6	14.2	13.8	13.8
Raipur	9.6	13.3	12.8	11.1	16.5	12.7
Mandya	NA	21.5	26.9	28.0	28.6	26.2
Sambalpur	6.1	10.0	9.3	8.5	7.4	8.3
Thanjavar	12.6	14.4	15.8	15.5	17.9	15.2
RICE IN RABI						
West Godavari	16.0	17.8	17.2	14.6	17.8	16.7
Alleppey	NA	16.8	13.7	13.9	12.9	14.3
Sambalpur	12.0	15.3	13.5	11.9	16.5	13.8
Thanjavur	NA	9.3	14.6	12.0	12.8	12.2
WHEAT IN RABI						
Ludhiana	23.6	23.2	18.8	20.1	21.3	21.4
Aligarh	19.4	15.6	15.1	14.0	16.3	16.1
Shahabad	6.8	9.9	11.1	11.2	13.0	10.4

N.A: Not Applicable

TABLE - 7.3

Coefficients of variation, normal yield, harvest prices and premium rates (Rs./ha) of high yielding varieties of rice and wheat in IADP districts

District	Coefficient of variation in percent	Normal yield (m) (Q/ha)	Harvest price (Rs./Q)	Premium rate in (Rs/ha)
1	2	3	4	5
		RICE IN KHARIF		
West Godavari	15.0	28.4	95.43	5.33
Shahabad	19.0	16.2	100.20	10.95
Surat-Bulsar	21.0	20.7	117.13	16.36
Jammu	28.0	21.3	95.00	45.38
Raipur	13.0	17.9	86.04	2.88
Mandya	20.0	23.0	95.36	21.01
Sambalpur	17.0	15.8	95.00	8.63
Thanjavur	16.0	22.2	94.18	4.12
		RICE IN RABI		
West Godavari	18.0	29.3	95.43	5.23
Alleppey	24.0	24.3	94.00	31.66
Sambalpur	16.0	24.1	95.00	4.51
Thanjavur	17.0	14.3	94.18	7.74
		WHEAT IN RABI		
Ludhiana	15.0	38.7	83.38	6.35
Aligarh	15.0	23.6	80.00	3.72
Shahabad	7.3	17.6	81.00	0.15

TABLE - 7.4

Coefficients of variation, normal yields, harvest prices and premium rates (Rs/ha) under local varieties of kharif and rabi rice and wheat in IADP districts

District	Coefficient of variation in percent	Normal yield (m) (Q/ha)	Harvest price (Rs/Q)	Premium rate in (Rs/ha)
1	2	3	4	5
		RICE IN KHARIF		
West Godavari	14.0	19.4	95.43	3.64
Shahabad	18.0	10.4	100.20	1.94
Surat-Bulsar	12.0	13.2	117.13	2.74
Jammu	11.0	13.8	95.00	0.18
Raipur	18.0	12.7	86.04	2.04
Mandya	11.0	26.2	94.36	0.35
Sambalpur	17.0	8.3	95.00	4.53
Thanjavur	11.0	15.2	94.18	0.19
		RICE IN RABI		
West Godavari	7.3	16.7	94.43	0.17
Alleppey	10.0	14.3	94.00	0.19
Sambalpur	13.0	13.8	95.00	2.45
Thanjavur	16.0	12.2	94.18	2.26
		WHEAT IN RABI		
Ludhiana	9.0	21.4	83.38	0.24
Aligarh	11.0	16.1	80.00	0.18
Shahabad	22.0	10.4	81.00	5.67

TABLE - 7.5

Area (ha) under high yielding and local varieties of kharif and rabi rice and wheat in IADP districts during 1970-71 and total premium receipts (Rs.)

Districts	High Yielding Varieties		Local Varieties		Total premium receipts under HYV and LV
	Area (ha)	Total premium receipts Rs.	Area (ha)	Total premium receipts (Rs)	
1	2	3	4	5	6
RICE IN KHARIF					
West Godavari	2,955	15,763	2,71,045	9,88,067	10,03,830
Shahabad	78,509	8,59,814	2,49,991	4,85,957	13,45,771
Surat-Bulsar	32,315	5,28,773	1,12,385	3,08,024	8,36,797
Jammu	14,469	6,56,624	23,431	4,229	6,60,853
Raipur	95,038	2,73,928	63,973	13,04,477	15,78,405
Mandya	2,404	56,517	55,496	19,373	75,890
Sambalpur	16,870	1,45,520	5,22,130	23,66,032	25,11,552
Thanjavur	4,04,092	1063,121	1,22,408	24,212	16,87,333
TOTAL		42,00,060		55,00,371	97,00,431
RICE IN RABI					
West Godavari	60,298	3,15,334	42,102	7,153	3,22,487
Alleppey	26,428	8,36,689	15,172	2,852	8,39,541
Sambalpur	43,070	1,94,353	24,030	58,897	2,53,250
Thanjavur	16,729	1,29,509	1,04,771	2,36,813	3,66,322
TOTAL		14,75,885		3,05,715	17,81,600
WHEAT IN RABI					
Ludhiana	2,19,800	13,96,499	11,200	2,708	13,99,207
Aligarh	1,53,107	5,69,558	16,823	3,095	5,72,653
Shahabad	1,06,432	16,379	75,568	4,29,694	4,46,073
TOTAL		19,82,436		4,35,497	24,17,933

TABLE - 7.6

Total indemnities payable (Rs.in crores) when insurance covers high yielding varieties of kharif rice in IADP districts

Crop losses in per cent	DISTRICTS							
	West Godavari	Shahabad	Surat-Bulsar	Jammu	Raipur	Mandya	Sambalpur	Thanjavur
1	2	3	4	5	6	7	8	9
100	0.39	6.37	3.92	1.46	7.29	0.37	1.26	42.27
95	0.37	5.94	3.65	1.36	6.81	0.35	1.17	39.42
90	0.34	5.52	3.39	1.26	6.32	0.32	1.09	36.61
85	0.32	5.09	3.13	1.17	5.84	0.29	1.00	33.79
80	0.29	4.67	2.87	1.07	5.34	0.27	0.92	30.77
75	0.27	4.24	2.61	0.97	4.86	0.25	0.84	28.16
70	0.24	3.83	2.35	0.88	4.37	0.22	0.76	25.34
65	0.21	3.39	2.09	0.78	3.89	0.19	0.67	22.52
60	0.19	2.97	1.82	0.68	3.40	0.17	0.58	19.71
55	0.16	2.55	1.57	0.58	2.91	0.15	0.50	16.89
50	0.13	2.12	1.30	0.49	2.42	0.12	0.42	14.08
45	0.10	1.69	1.04	0.39	1.94	0.09	0.33	11.26
40	0.08	1.27	0.78	0.29	1.45	0.07	0.25	8.44
35	0.05	0.85	0.52	0.19	0.97	0.05	0.17	5.63
30	0.03	0.42	0.26	0.09	0.48	0.02	0.08	2.81

TABLE - 7.7

Total indeminities payable (Rs.in crores) when insurance covers high yielding varieties of rabi rice in IADP districts

Crop losses in per cent	DISTRICTS			
	West Godavari	Alleppey	Sambalpur	Thanjavur
1	2	3	4	5
100	8.41	3.02	4.94	1.12
95	7.85	2.81	4.61	1.04
90	7.29	2.61	4.28	0.97
85	6.73	2.41	3.95	0.89
80	6.16	2.21	3.62	0.82
75	5.61	2.01	3.29	0.75
70	5.04	1.81	2.96	0.67
65	4.48	1.61	2.63	0.59
60	3.92	1.41	2.30	0.52
55	3.37	1.21	1.97	0.45
50	2.80	1.00	1.64	0.37
45	2.24	0.80	1.31	0.29
40	1.68	0.60	0.98	0.22
35	1.12	0.40	0.66	0.15
30	0.56	0.20	0.33	0.07

TABLE 7.8

Total indemnities payable (Rs. in crores) when insurance covers high yielding varieties of wheat in IADP districts

Crop losses in percent	DISTRICTS		
	Ludhiana	Aligarh	Shahbad
1	2	3	4
100	35.48	14.48	7.60
95	33.09	13.46	7.06
90	30.74	12.49	6.54
85	28.37	11.53	6.05
80	26.00	10.56	5.55
75	23.64	9.61	5.04
70	21.27	8.64	4.53
65	18.91	7.69	4.04
60	16.55	6.72	3.53
55	14.18	5.71	3.03
50	11.82	4.79	2.52
45	9.45	3.84	2.02
40	7.09	2.88	1.50
35	4.73	1.92	1.01
30	2.36	0.96	0.50

TABLE - 7.9

Total indemnities payable (Rs. in crores) when insurance covers local varieties of kharif rice in IADP districts

Crop losses in percent	DISTRICTS							
	West Godavari	Shahabad	Surat-Bulsar	Jammu	Raipur	Mandya	Sambalpur	Thanjavur
1	2	3	4	5	6	7	8	9
100	25.01	12.95	8.68	1.54	34.67	6.83	20.4	8.72
95	23.33	12.09	8.11	1.43	32.36	6.38	19.09	8.15
90	21.67	11.22	7.52	1.33	30.05	5.92	17.71	7.56
85	20.02	10.37	6.95	1.22	27.74	5.46	16.37	6.98
80	18.33	9.49	6.37	1.12	25.42	5.01	14.97	6.39
75	16.68	8.64	5.79	1.02	23.11	4.55	13.64	5.82
70	15.00	7.76	5.21	0.92	20.81	4.10	12.25	5.23
65	13.34	6.91	4.63	0.82	18.49	3.64	10.91	4.65
60	11.66	6.03	4.05	0.72	16.18	3.18	9.52	4.06
55	10.01	5.18	3.47	0.61	13.87	2.73	8.18	3.49
50	8.32	4.31	2.89	0.51	11.55	2.27	6.79	2.90
45	6.67	3.45	2.31	0.41	9.24	1.82	5.45	2.32
40	4.99	2.58	1.74	0.31	6.93	1.36	4.06	1.74
35	3.33	1.72	1.16	0.20	4.62	0.91	2.73	1.16
30	1.65	0.85	0.58	0.10	2.31	0.46	1.33	0.57

TABLE - 7.10

Total indemnities payable (Rs. in crores) when insurance covers local varieties of rabi rice in IADP districts

Crop losses in per cent	DISTRICTS			
	West Godavari	Alleppey	Sambalpur	Thanjavur
1	2	3	4	5
100	3.31	1.01	1.57	5.98
95	3.08	0.95	1.47	5.59
90	2.86	0.88	1.36	5.19
85	2.64	0.81	1.26	4.79
80	2.42	0.74	1.15	4.39
75	2.20	0.68	1.05	3.99
70	1.98	0.61	0.95	3.59
65	1.76	0.54	0.84	3.19
60	1.54	0.47	0.73	2.79
55	1.32	0.41	0.63	2.39
50	1.10	0.34	0.52	1.99
45	0.88	0.27	0.42	1.59
40	0.66	0.20	0.31	1.19
35	0.44	0.13	0.21	0.79
30	0.22	0.07	0.10	0.39

TABLE - 7.11

Total indemnities payable (Rs. in crores) when insurance covers local varieties of wheat in IADP districts

Crop losses in percent	DISTRICTS		
	Ludhiana	Aligarh	Shahabad
1	2	3	4
100	0.98	1.08	3.18
95	0.92	1.00	2.94
90	0.86	0.92	2.74
85	0.80	0.86	2.52
80	0.74	0.80	2.32
75	0.66	0.72	2.11
70	0.58	0.64	1.90
65	0.52	0.58	1.68
60	0.46	0.50	1.46
55	0.40	0.42	1.26
50	0.32	0.34	1.04
45	0.26	0.28	0.84
40	0.20	0.22	0.62
35	0.12	0.14	0.42
30	0.06	0.06	0.20

CHAPTER - VIII

RE-INSURANCE CONTRACTS

The success of crop insurance scheme very much depend upon balancing of losses in bad years with gain in good seasons. If the scheme is operated on a single crop and in limited areas there is a danger of the scheme running into a great loss even in the initial years of the scheme. Therefore there is a necessity to spread the scheme over different crops or to spread over different areas of the country representing different agro-climatic conditions. If such a procedure is followed there will not only be a scope but also a necessity to establish a central organisation which would offer re-insurance to different state governments which operate the scheme.

Normally the re-insurance contract would specify that the re-insurance would operate only if crop loss exceeds certain limit. Since the primary insurance contract between state government and farmers specify that losses would be indemnified only if the seasonal yield goes below 75 per cent of the normal yield. The re-insurance contract would generally came into operation only when the seasonal yield goes below this percentage as it is intended that some risks are to be absorbed by the primary insurance organisation. Therefore re-insurance contract should necessarily specify that re-insurance contract would come in picture only if crop loss exceeds 25 per cent. This proportion should be agreed upon between the re-insurance organisation and the participating state government. Under such a

contract during every season.the state government should have to deposit a part of insurance premium collected from the farmers to the central organisation. The calculation of premium rates and indemnities for two models of re-insurance contracts are discussed below:

Procedure for calculating re-insurance premium rates :

Model - I :

The re-insurance contract may be on the following lines

(1.1) The central government would share the liability of the state government only if the crop loss in any year exceeds 40 percent, and

(1.2) In the event of total crop loss, 50 per cent of such liability would be shared by the central government.

Under such a re-insurance contract the rate of indemnity payable by central government can be calculated as follows:

Let $I_{re} = a\,y + b\,m$ ..... (i)

If $y = 0.6\,m$ then $I_{re} = 0$

and if $y = 0$ then $I_{re} = \frac{m}{4}$

Then we have

$D = 0.6\,ma + b\,m$ ..... (ii)

$\frac{m}{4} = b\,m$ ..... (iii)

From (ii) and (iii)

$a = -\frac{5}{12}$, $b = \frac{1}{4}$

Substituting these values of 'a' and 'b' in (i)

$$I_{re} = -\frac{5}{12} y + \frac{m}{4}$$

i.e. $$I_{re} = \frac{1}{12} (3m - 5y)$$

i.e. $$I_{re} = \frac{m}{4} - \frac{5}{12} y$$

The re-insurance premium rate is calculated with the following formula:

$$P_{re} = \frac{\frac{1}{\sigma\sqrt{2\pi}} \int_0^{0.6m} (\frac{m}{4} - \frac{5}{12} y) e^{-\frac{1}{2}(\frac{y-m}{\sigma})^2} dy}{\frac{1}{\sigma\sqrt{2\pi}} \int_0^{0.6m} e^{-\frac{1}{2}(\frac{y-m}{\sigma})^2} dy}$$

Model - II

Another type of contract may have the following condition.

The central government would share the indemnity with the state government equally.

Under such a re-insurance contract the rate of indemnity payable by central government would be as follows:

$$I_{re} = \frac{1}{2} I$$

where 'I' is the total indemnity and is equal to $\frac{2}{3}(\frac{3}{4}m - y)$.

Substituting the value of 'I'

$$I_{re} = \frac{1}{2} \times \frac{2}{3}(\frac{3}{4} m - y)$$

i.e. $I_{re} = \frac{m}{4} - \frac{y}{3}$

The re-insurance premium rate is calculated with the following formula :

$$P_{re} = \frac{\frac{1}{\sigma\sqrt{2\pi}} \int_{0}^{\frac{3}{4}m} \left(\frac{m}{4} - \frac{y}{3}\right) e^{-\frac{1}{2}\left(\frac{y-m}{\sigma}\right)^2} dy}{\frac{1}{\sigma\sqrt{2\pi}} \int_{0}^{\frac{3}{4}m} e^{-\frac{1}{2}\left(\frac{y-m}{\sigma}\right)^2} dy}$$

$$= \frac{1}{2} P$$

where 'y' : - Seasonal yield

'm' : - Normal yield

'σ' : - Standard deviation

'P' : - Primary insurance rate

Thus knowing σ (or $\frac{\sigma}{m}$ known as coefficient of variation) and m, the premium rates for re-insurance organisation (central government) can be calculated. The premium rates per hectare thus obtained in terms of yield are converted into premium rates into cash equivalents by multiplying the former with assumed harvest prices.

The premium rates for primary insurance organisation (state government) in terms of cash can be easily obtained by subtracting premium rates of re-insurance organisation from total premium rates.

The premium rates in cash (Rs/ha) to primary insurance

organisation (state government) and re-insurance organisation (central government) for models I and II of high yielding and local varieties for three districts namely Ludhiana, Aligarh and Shahabad are given in table 8.1 .

It is seen that share of premium in terms of money of central government is more in model II than I while share of premium of state government is less. Also it is clear that the share of premium in cash of state government is about 3 times that of central government in case of model I of high yielding and local varieties each. While in case of model II central government would share the premium in cash equally with state government.

In Ludhiana district the state government would receive about 5 rupees as premium rate per hectare for high yielding varieties in case of model I while in model II it would be about 3 rupees. In the same district central government would receive about 1.50 rupees as premium rate per hectare for high yielding varieties in case of model I while in case of model II its share of premium is same as that of state government. In case of local varieties share of premium in cash in the same district for both the models are very small because the coefficient of variation is less.

Having knowing premium rates in cash for both organisations of high yielding and local varieties, premium receipts in cash equivalents for state and central governments for all the three districts of wheat can easily be calculated and are given in table 8.2 .

It is found that the premium receipts in cash of central government is more in model II than model I while premium receipts of state government is less. If crop insurance scheme is taken up on wheat in all the 3 districts the total premium receipts to state government is of the order of 0.18 crores and of the order of 0.06 crores for the central government for high yielding and local varieties together in model I while in case of model II premium receipts are equally divided between state and central governments and is of the order of 0.12 crores.

Procedure for calculating indemnities (liabilities) :

Model - I

The liability of the state and central governments under re-insurance contract are worked out using the formulae for rates of indemnities

$$I = \frac{m}{2} - \frac{2}{3} y$$

$$I_{re} = \frac{m}{4} - \frac{5}{12} y$$

If we write $y = (1 - q)m$, where 'q' is the fraction of crop loss, the formula for calculation of rate of indemnities take the following forms:

$$I = \frac{m}{6} (4q - 1)$$

$$I_{re} = \frac{m}{12} (5q - 2)$$

For different percentage crop loss (q) I and I_{re} are first obtained in yield and then converted into money by multiplying

the values of I and I_{re} with the product of area (ha) and harvest prices. The indemnities in terms of money for state government can be obtained by subtracting I_{re} from I for corresponding crop losses.

Model - II

The indemnities in terms of money for state and central governments can be similarly calculated for model II also as described by model I but here

$$I_{re} = \frac{m}{4} - \frac{y}{3}$$

If we write $y = (1 - q) m$, where 'q' is the fraction of crop loss, the formula for calculation of rate of indemnities take the following form

$$I_{re} = \frac{m}{12} (4q - 1)$$

The indemnities payable by central and state governments for high yielding and local varieties in terms of money for model I and II for three districts of wheat namely Ludhiana, Aligarh and Shahabad are given in tables 8.3 to 8.8.

The total indemnity payable in any district depends upon the extent of crop loss, the normal yield and area covered under the crop. Since the unit of insurance for this illustration is taken as a district, the crop loss is to be determined on the basis of seasonal yield for the district as a whole. The magnitude of indemnity payable

by state and central governments when crop loss is of the order of 30 per cent is of the order of 1.18 crores each in model II in Ludhiana district while in model I it is of the order of 2.36 crores to be paid by the state government and in case of central government there is no indemnity payable. In the same district if by chance entire crop is destroyed the amount payable by state and central governments is of the order of 17.7 crores for high yielding varieties alone under each model. Corresponding amount for local varieties for similar crop loss is of the order of 0.49 crores (table 8.6).

Chances of financial liability of the magnitude as given in tables 8.3 to 8.8 both to the state and central governments are indeed very small and re-insurance liability to the centre can be minimised if the scheme is simultaneously operated by several states so that the losses in one area may be compensated by good crops in other area.

The chance of such financial liability depends upon the chance of occurrence of crop loss of such high magnitude. In chapter IX , the probabilities of occurrence of crop losses of given magnitude are discussed.

TABLE - 8.1

Share of premium (Rs/ha) between re-insurance organisation (centre) and primary insurance organisation (state) for high yielding and local varieties of wheat.

District	MODEL - I				MODEL - II			
	High Yielding Varieties		Local Varieties		High Yielding Varieties		Local Varieties	
	Centre	State	Centre	State	Centre	State	Centre	State
Ludhiana	1.55	4.80	0.07	0.17	3.17	3.17	0.12	0.12
Aligarh	0.91	2.81	0.04	0.14	1.86	1.86	0.09	0.09
Shahabad	0.04	0.11	1.67	4.02	0.07	0.07	2.84	2.84

TABLE - 8.2

Share of premium receipts (Rs.) between re-insurance organisation (centre) and primary insurance organisation (state) for high yielding and local varieties of wheat.

District	MODEL - I				MODEL - II			
	High Yielding Varieties		Local Varieties		High Yielding Varieties		Local varieties	
	Centre	State	Centre	State	Centre	State	Centre	State
Ludhiana	3,40,316	10,56,183	803	1,905	6,98,249	6,98,249	1,354	1,354
Aligarh	1,38,776	4,30,782	646	2,449	2,84,779	2,84,779	1,547	1,547
Shahabad	4,565	11,814	1,26,032	3,03,662	8,189	8,189	2,14,847	2,14,847
TOTAL	4,83,657	14,98,779	1,27,481	3,08,016	9,91,217	9,91,217	2,17,748	2,17,748

TABLE - 8.3

Indemnities (Rs.in crores) payable by central and state governments.

Crop insured: High Yielding Variety of wheat District: Ludhiana

Crop losses over the insured area in percent	MODEL - I		MODEL - II		Total (Rs.in crores)
	State's shares (Rs.in crores)	Centre's share (Rs. in crores)	State's share (Rs. in crores)	Centre's share (Rs. in crores)	
1	2	3	4	5	6
100	17.74	17.74	17.74	17.74	35.48
95	16.84	16.24	16.54	16.54	33.08
90	15.96	14.78	15.37	15.37	30.74
85	15.08	13.28	14.18	14.18	28.36
80	14.18	11.82	13.00	13.00	26.00
75	13.30	10.34	11.82	11.82	23.64
70	12.42	8.84	10.63	10.63	21.26
65	11.52	7.38	9.45	9.45	18.90
60	10.64	5.90	8.27	8.27	16.54
55	9.77	4.41	7.09	7.09	14.18
50	8.87	2.95	5.91	5.91	11.82
45	7.97	1.47	4.72	4.72	9.44
40	7.08	NIL	3.54	3.54	7.08
35	4.72	NIL	2.36	2.36	4.72
30	2.36	NIL	1.18	1.18	2.36

TABLE - 8.4

Indemnities (Rs. in crores) payable by central and state governments.

Crop insured: High Yielding Variety of wheat District: Aligarh

Crop losses over the insured area in percent	MODEL - I		MODEL - II		Total (Rs. in crores)
	State's share (Rs. in crores)	Centre's share (Rs. in crores)	State's share (Rs. in crores)	Centre's share (Rs. in crores)	
1	2	3	4	5	6
100	7.24	7.24	7.24	7.24	14.48
95	6.83	6.63	6.73	6.73	13.46
90	6.47	6.01	6.24	6.24	12.48
85	6.11	5.41	5.76	5.76	11.52
80	5.75	4.81	5.28	5.28	10.56
75	5.40	4.20	4.80	4.80	9.60
70	5.03	3.61	4.32	4.32	8.64
65	4.68	3.00	3.84	3.84	7.68
60	4.32	2.40	3.36	3.36	6.72
55	3.96	1.80	2.88	2.88	5.76
50	3.60	1.18	2.39	2.39	4.78
45	3.25	0.59	1.92	1.92	3.84
40	2.88	NIL	1.44	1.44	2.88
35	1.92	NIL	0.96	0.96	1.92
30	0.96	NIL	0.48	0.48	0.96

TABLE - 8.5

Indemnities (Rs. in crores) payable by central and state governments.

Crop insured: High Yielding Variety of wheat District: Shahabad

Crop losses over the insured area in percent	MODEL - I		MODEL - II		Total (Rs. in crores)
	State's shares (Rs. in crores	Centre's share (Rs. in crores)	State's share (Rs. in crores)	Centre's share (Rs. in crores)	
1	2	3	4	5	6
100	3.80	3.80	3.80	3.80	7.60
95	3.59	3.47	3.53	3.53	7.06
90	3.39	3.15	3.27	3.27	6.54
85	3.20	2.84	3.02	3.02	6.04
80	3.01	2.53	2.77	2.77	5.54
75	2.89	2.15	2.52	2.52	5.04
70	2.63	1.89	2.26	2.26	4.52
65	2.46	1.58	2.02	2.02	4.04
60	2.26	1.26	1.76	1.76	3.52
55	2.07	0.95	1.51	1.51	3.02
50	1.89	0.63	1.26	1.26	2.52
45	1.69	0.33	1.01	1.01	2.02
40	1.50	NIL	0.75	0.75	1.50
35	1.00	NIL	0.50	0.50	1.00
30	0.50	NIL	0.25	0.25	0.50

TABLE - 8.6

Indemnities (Rs. in crores) payable by central and state governments.

Crop insured: Local Variety of wheat District: Ludhiana

Crop losses over the insured area in percent	MODEL - I		MODEL - II		Total (Rs. in crores)
	State's shares (Rs. in crores)	Centre's share (Rs. in crores)	State's share (Rs. in crores)	Centre's share (Rs. in crores)	
1	2	3	4	5	6
100	0.49	0.49	0.49	0.49	0.98
95	0.47	0.45	0.46	0.46	0.92
90	0.44	0.42	0.43	0.43	0.86
85	0.43	0.37	0.40	0.40	0.80
80	0.40	0.34	0.37	0.37	0.74
75	0.37	0.29	0.33	0.33	0.66
70	0.34	0.24	0.29	0.29	0.58
65	0.31	0.21	0.26	0.26	0.52
60	0.30	0.16	0.23	0.23	0.46
55	0.27	0.13	0.20	0.20	0.40
50	0.24	0.08	0.16	0.16	0.32
45	0.22	0.04	0.13	0.13	0.26
40	0.20	NIL	0.10	0.10	0.20
35	0.12	NIL	0.06	0.06	0.12
30	0.06	NIL	0.03	0.03	0.06

TABLE - 8.7

Indemnities (Rs. in crores) payable by central and state governments.

Crop insured: Local Variety of wheat District: Aligarh

Crop losses over the insured area in per cent	MODEL - I		MODEL - II		Total (Rs. in crores)
	State's share (Rs. in crores)	Centre's share (Rs. in crores)	State's share (Rs. in crores)	Centre's share (Rs. in crores)	
1	2	3	4	5	6
100	0.54	0.54	0.54	0.54	1.08
95	0.50	0.50	0.50	0.50	1.00
90	0.47	0.45	0.46	0.46	0.92
85	0.45	0.41	0.43	0.43	0.86
80	0.43	0.37	0.40	0.40	0.80
75	0.40	0.32	0.36	0.36	0.72
70	0.37	0.27	0.32	0.32	0.64
65	0.35	0.23	0.29	0.29	0.58
60	0.32	0.18	0.25	0.25	0.50
55	0.30	0.12	0.21	0.21	0.42
50	0.26	0.08	0.17	0.17	0.34
45	0.24	0.04	0.14	0.14	0.28
40	0.22	NIL	0.11	0.11	0.22
35	0.14	NIL	0.07	0.07	0.14
30	0.06	NIL	0.03	0.03	0.06

TABLE - 8.8

Indemnities (Rs. in crores) payable by central and state governments.

Crop insured: Local Variety of wheat. District: Shahabad

Crop losses over the insured area in per cent	MODEL - I		MODEL - II		Total (Rs. in crores)
	State's share (Rs. in crores)	Centre's share (Rs. in crores)	State's share (Rs. in crores)	Centre's share (Rs. in crores)	
1	2	3	4	5	6
100	1.59	1.59	1.59	1.59	3.18
95	1.48	1.46	1.47	1.47	2.94
90	1.41	1.33	1.37	1.37	2.74
85	1.33	1.19	1.26	1.26	2.52
80	1.26	1.06	1.16	1.16	2.32
75	1.18	0.92	1.05	1.05	2.10
70	1.10	0.80	0.95	0.95	1.90
65	1.03	0.65	0.84	0.84	1.68
60	0.94	0.52	0.73	0.73	1.46
55	0.87	0.39	0.63	0.63	1.26
50	0.79	0.25	0.52	0.52	1.04
45	0.70	0.14	0.42	0.42	0.84
40	0.62	NIL	0.31	0.31	0.62
35	0.42	NIL	0.21	0.21	0.42
30	0.20	NIL	0.10	0.10	0.20

CHAPTER - IX

PROBABILITY OF OCCURRENCE OF LOSSES

From the foregoing chapters, it is clear that the financial commitments by the insurance organisation would be quite unmanageable if the crop loss in any season is very heavy. Since the loss in any season depends on natural conditions beyond human control, the loss cannot be predicted in advance. However, information on the fluctuations in the seasonal yields with the past several years could be ascribed to conditions which contribute to such changes. If such representative data are available, the same conditions may considered to be holding good on an average in the future years also. With such an assumption, it would be possible to calculate the probability of obtaining a seasonal yield between two given limits. In other words, the probability of occurrence of crop loss between two given limits can be calculated.

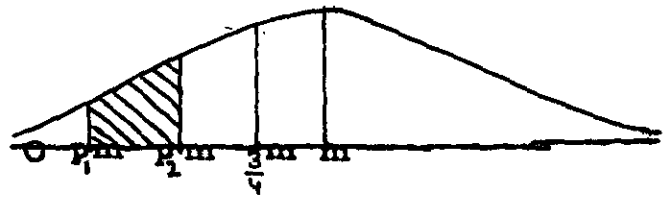
As before, it is assumed that the seasonal yield follows a normal distribution with mean 'm' and standard deviation 's'. Let the seasonal yield lie in the interval y_1 and y_2. These can be written as

$$y_1 = p_1 m$$

and $$y_2 = p_2 m$$

where p_1 and p_2 are the fractions.

The probability to be calculated is shown in the diagram.



This area represents the probability of crop loss and is given by

$$P = \frac{\frac{1}{\sigma\sqrt{2\pi}} \int_{p_1 m}^{p_2 m} e^{-\frac{1}{2}\left(\frac{y-m}{\sigma}\right)^2} dy}{\frac{1}{\sigma\sqrt{2\pi}} \int_{0}^{\infty} e^{-\frac{1}{2}\left(\frac{y-m}{\sigma}\right)^2} dy}$$

The above formula can be simplified as follows:

$$\text{Put} \quad \frac{y-m}{\sigma} = z$$

$$\text{If } y = p_1 m \text{ then } z = \frac{p_1 m - m}{\sigma}$$

$$= \frac{-m q_1}{\sigma}$$

$$= -q_1 v \quad \left[\text{where } v = \frac{m}{\sigma} \text{ and } p+q = 1\right]$$

$$\text{If } y = p_2 m \text{ then } z = \frac{p_2 m - m}{\sigma}$$

$$= \frac{-m q_2}{\sigma}$$

$$= -q_2 v$$

Then

$$P = \frac{\frac{1}{\sqrt{2\pi}} \int_{-q_1 v}^{-q_2 v} e^{-\frac{1}{2} z^2} dz}{\frac{1}{\sqrt{2\pi}} \int_{-v}^{\infty} e^{-\frac{1}{2} z^2} dz}$$

$$\text{i.e. } P = \frac{\frac{1}{\sqrt{2\pi}} \int_{-\infty}^{-q_2 v} e^{-\frac{1}{2}z^2}\, dz - \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{-q_1 v} e^{-\frac{1}{2}z^2}\, dz}{1 - \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{-v} e^{-\frac{1}{2}z^2}\, dz}$$

For different values of q_1 and q_2 and for given coefficients of variation the probability of occurrence of losses are calculated and are given in table 9.1.

The results obtained are discussed for some value of the coefficients of variation for different percentage of crop losses.

It is seen that when the coefficient of variation is 30 per cent, the crop loss between 75 to 100 per cent would occur only once in 200 years, if the past data indicate the future trend also. For the same coefficient of variation the crop loss between 60 per cent to 75 per cent would occur only once in 100 years. When the coefficient of variation is less, the probability of occurrence of crop losses would be much less. If the coefficient of variation is only 20 per cent, the crop loss between 25 to 30 per cent (the lower limit being the one which contains the insurance organisation to pay indemnities) would occur once in 25 years. Thus, there seems to be no danger of the crop insurance scheme being a failure, as the occurrence of heavy crop losses would be a rare phenomenon. No doubt, a sudden unexpected natural calamity may tilt the balance. Towards meeting this contingency it would be advisable to spread the insurance over different crops and areas.

TABLE - 9.1

Probability of occurrence of losses

Loss interval in percentage	Coefficient of variation in percentage						
	20	25	30	35	40	45	50
100 - 75	0.00011	0.00132	0.00573	0.01410	0.02468	0.03572	0.04508
75 - 60	0.00124	0.00684	0.01655	0.02659	0.03629	0.04387	0.04938
60 - 50	0.00486	0.01456	0.03205	0.03371	0.04533	0.04633	0.05074
50 - 40	0.01654	0.03204	0.04202	0.05088	0.05334	0.05664	0.05843
40 - 30	0.04406	0.06028	0.06187	0.06282	0.06384	0.06789	0.06839
30 - 25	0.04826	0.06359	0.06361	0.06421	0.06582	0.06989	0.07039

CHAPTER - X

SUMMARY AND CONCLUSIONS

Crop insurance is one of the effective means of protecting the farmers against crop losses which are caused by factors beyond their control. Their are various plans of crop insurance. The participation of the farmer in a scheme of crop insurance could be either voluntary or compulsory. In U.S.A. it is voluntary whereas in Japan it is compulsory. The nature of participation by the farmers depend upon the socio-economic and political conditions prevailing in the country. A voluntary scheme has several disadvantages where the farms holding are small and numerous. Apart from these disadvantages, those who require insurance protection, most of them may not come forward to participate in such a scheme. Therefore, in a country like India where small farmers dominate, ensuring complete participation of all farmers in the area of insurance is most desirable.

In a country like India where farming is done on a very small scale by vast number of farmers who are mostly illiterate, it could not be feasible to obtain information on the yields rate of each individual holdings. To secure such information for all the holdings is not only very costly but also practically not feasible. Therefore resort has to be taken to have the unit of insurance as a homogenous area comprising a large number of holdings. Practical considerations dictate that a community development block could be taken as a unit of insurance under Indian conditions. For such

unit of insurance it would be far easier to determine the seasonal yields and assessment of losses based upon a crop cutting survey.

Experience in U.S.A. and Japan has shown that crop insurance scheme is successful and pay to itself, has to run for a long period of years and such a scheme should cover large areas representing agro-climatic conditions and various crops. Such a procedure would balance losses and gains between years and between crops.

Further experience in U.S.A. has shown that all-risk crop insurance would become more stable in the long run rather than ensuring individual risk separately. The all-risk insurance has got further advantage of determination of crop losses much more easily.

In this dissertation the methods of calculating premium rates in U.S.A. and Japan have been discussed. A better procedure for determination of premium rates taking into account the variation in seasonal yield over a long period of years has also been discussed.

In India when several states participate in a scheme of crop insurance it may so happen that in a state in a particular year there could be heavy damage when crop insured and the state government would not be able to bear the entire burden. A support to crop insurance scheme is most desirable through the establishment of re-insurance organisation. The central government could appropriately establish a re-insurance organisation and come into agreement with the state government for receiving the part of the premia collected

from the farmers by the state government. The insurance contract may lay down when centre could come to help of the state government when crop loss in any given year exceeds certain limit.

In this dissertation two models for such a re-insurance have been suggested. The share of premium between centre and state and indemnities payable by them are also obtained by utilising the data collected on the yields rate of high yielding varieties and local varieties in a few IADP districts.

The frequencies of crop losses for different coefficients of variation of the seasonal yields have also been obtained.

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