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Problems and Prospects of Crop Insurance:

Reviewing Agricultural Risk and NAIS in India

Nilabja Ghosh
S.S. Yadav

सत्यमेव परमो धर्मः

INSTITUTE OF ECONOMIC GROWTH
UNIVERSITY OF DELHI ENCLAVE
NORTH CAMPUS, DELHI – 110 007
Fax: + 91-11-27667410
Gram: GROWTH – Delhi – 110 007
Phones: +91-11-27667101, 27667288, 27667365,
WEBSITE: http://iegindia.org

Preface

Planning for agricultural development in India has been important not simply for agriculture's contribution to the growth of the larger economy but because agriculture provides the basic sustenance of a large section of farmers who operate on small holdings and because they still experience considerable uncertainty in respect of the farm output. Risk in agriculture stands in the way of progressiveness and inhibits financial inclusiveness. Worst, risk makes the small farmers vulnerable to impoverishment, debt-traps and destitution. Among all the instruments for agricultural development, crop insurance has been one that possibly aroused the most skepticism. India's National Agricultural Insurance Scheme (NAIS) has been much criticized but it is one programme that can yield much learning and experience about risk and insurance in agriculture. This report is an attempt to review the question of risk in Indian agriculture and to examine the status and implications of the NAIS as evident from the recent experience.

At the outset we must thank our Director, Professor Kanchan Chopra not only for the institutional help she extended for carrying out the work but also for the academic support that she gave on the subject. Undoubtedly, her encouragement was the necessary inspiration that sustained this effort. I recall that Prof. Indira Rajaraman introduced me to the subject. The Ministry of Agriculture's approval of the project also made it possible to take up this study which drew on my own proposal and interest. Comments from colleagues in IEG and Dr. J. George at an in-house seminar proved extremely useful. Mrs. Shashi Kad typed much of the manuscripts of the report. Mr. Shridharan happily helped with the usual computer related problems and Ms Jasvinder Kaur of the Library was extremely supportive in procuring all the books and reports whose contents went as a background to this work Young Mr. Shailesh Kumar and Mr.Yogesh Bhatt helped in the tabulation and Mr. Bhatt also collaborated in the work at some points. My family enthusiastically helped me and as usual bore with the pre-occupations.

Nilabja Ghosh
Institute of Economic Growth
Delhi 110007
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1. Problems and Prospects of Crop insurance: Scepticisms and Imperatives

Crop insurance presents a bundle of unresolved issues. Is crop insurance at all needed or do other methods suffice? Can crop insurance be left to the market? Are government subsidies to crop insurance justified? Should crop insurance be compulsory and what perils need to be covered for best results? How should premium rates be decided ideally? These are some of the many questions that never cease to baffle the minds of the academics and the policy makers in the field. India's first nation-wide programme called the National Agricultural Insurance Scheme (NAIS) will be completing nine years of operation by the end of the year. Among the number of countries of the world that have had a crop insurance scheme, India's case holds a special place in terms of the size of the agriculture for which it works and for the innovativeness of its design. India's experience with the NAIS can offer important lessons for India's own insurance strategy and for other countries that are planning to initiate or develop an insurance scheme. India's experiment with NAIS as an instrument for agricultural development is important not only because the sector still supports nearly half of the country's large population but also because the sector is facing severe challenges from its own internal dynamics, the urgency of the national food security concern and from the worldwide trade liberalisation process. Above all, a large section of the agriculture-dependent populace is poor and often operates on small sizes of farms. In fact crop insurance can be integrated within a wider strategy for poverty alleviation.

Doubts and Scepticisms

In 1970 an Expert Committee headed by Dharm Narain, an economist of eminence, submitted to the Government of the India, a report which, at least for the time being, sealed the fate of an idea that was nurtured in India through a few decades. Earlier, in a newly formed nation, beset with a vast and stagnating agriculture, the Priolker Committee had made a painstaking analysis of a potential scheme of crop insurance for the Indian soils and succeeded in producing an extremely instructive report (Priolker, 1949, 1950). The Committee had in fact managed to come out with a proposal that was to be forwarded by the central government in India with little success. While Dharm Narain's testimonies managed to provide the idea 'an expert burial', the approach taken by the Report as well as the model scheme under its consideration were intensely criticised by another expert V.M. Dandekar in 1976 (Dandekar, 1976). It was the Dandekar model of a 'homogeneous area based crop insurance' scheme (Dandekar, 1976, 1985) that resurrected the idea and till today largely shapes the contours of the agricultural insurance scheme in India. The wisdom of having a crop insurance programme (CIP) has again come up for reckoning today when globalisation is sweeping the Indian economy.

A widely quoted collection of studies produced by three scholars of repute jointly with the International Food Policy research Institute (Hazell et al, 1985) cast serious doubt on the relevance of crop insurance as an instrument that was proving to be expensive to most of the countries in which it was employed as a policy. The argument for a policy of providing insurance is based on the inadequacy of existing and private risk sharing arrangements among farmers and the public measures that indirectly help risk management. Crop diversification is a dominant strategy in risk prevention, that substitutes less risky though possibly less remunerative crops for the ones that would normally be sown in the absence of risk. Scholars measured the income foregone due to crop diversification and this cost of risk was related to the premium that farmers would be willing to pay for the insurance. Studies undertaken in Mexico and Panama found that farmers would not be willing to pay the full cost of the premium and subsidies amounting to two-thirds of the cost could be required for maize and beans in Mexico to attract farmers in rain-fed regions.

The initiation of the National Agricultural Insurance Scheme (NAIS) in 1999, Rabi season following long years of experimentation, could be described as a bold one. Asymmetries of information and co-variation of risk, the usual problems of insurance are much more acute in the case of agriculture and the administrative burden of monitoring could be immense in view of the vastness and the unorganised nature of India's farming sector. The principal misgiving about a CIP was about its financial viability. The Dandekar formula has several appealing feature that provided the required confidence to move ahead. In its initial phase, as any other endeavour of social importance, the crop insurance scheme does deserve some teething allowance to display the full splendours of the area-based formula. Further, experience is a key strength to any insurance programme and the relatively young crop insurance programme has a long journey on its learning curve.

A more important question that begs answer at this point is that whether the miraculous area-based insurance scheme is offering what India's agriculture is asking for. Today India's agricultural economy is battling the throes of globalisation to support about half the nation's one billion plus population. Even while the economy as a whole has been showing unprecedented performance, agriculture has proved to be a challenge as well as a check on the economy's movement ahead. Livelihood, environment, inclusiveness, food security and comparative advantages are some of the areas of serious concern. The acceptance of the scheme by Indian farmers and its beneficial implications from the social and national points of view would reflect how well the scheme is designed and to what extent it proves useful to the farmers. Even if insurance is accepted, a comparison between the cost and benefits would be important for assessing the economic viability which in turn is determined by the various parameters of the scheme. Since insurance is about reducing risk, the usefulness to the farmers would depend on how adequately the scheme addresses the risk concerns of the farmers even while being economically feasible. Assessment of the insurance scheme on a regular basis would be important for necessary introspection and in seeking suitable directions. Moreover, such reporting would also add to the knowledge bank at a broader scale and possibly prove useful for policy planning in other developing countries.

The imperatives of a globalising economy

The usefulness of a crop insurance scheme needs to be viewed in context of the current contingencies. Unlike the three decades since the 1960s when State intervention was a central feature in India's development policy, the subsequent period was characterised by the State's retreating act. Agriculture was not an exception. Though agriculture is known to incorporate vastly different dimensions than other sectors of the economy and any policy relating to agriculture has more political significance than others nearly in all countries, agriculture did not remain insulated from the far reaching changes going on in the Indian and the global economies. A crop insurance scheme could be relatively more important now to facilitate agriculture to adjust to the changes.

Agricultural insurance is re-emerging as a topic on interest to the farmer, the insurance company and the policy maker all over the world. In a recent survey conducted in 16 Latin American countries, 35.3% of the insurance companies stated that the development of crop insurance was important and 43% believed that its growth potential was high. The renewed interest comes from the need for competitiveness in agriculture in the wake of structural reforms and trade liberalisation as also from the experiences of the several natural disasters that were economically costly. While information was the biggest hurdle in the way of crop insurance in the past, developments occurring in the fields of information technology, satellite imagery and in mathematical modelling of risk could open up a new vista for the operation of insurance in future.

For India, the importance of crop insurance has increased in recent times. Since the 1960s, the Indian economy seems to have come around a full circle. The state-supported agrarian revolution had provided a degree of protection to the farmers. The nationalisation of banks and creation of a large credit network had nearly eliminated the usurious moneylenders and the rural inter-lock of market. Despite policy shortfalls, marginal and small holders comprising the majority of Indian farmers had gained access to affordable credit. Moreover they also benefited from the subsidy regime (Chopra, 2006) although other sections could not be excluded. Ecological insensitivity was the key failure of the green revolution that undermined agro-resource quality in subsequent years and sounds an alarm bell for future strategies. The 1990s changed many of these arrangements possibly in an irreversible way that the farming community will live with. The experience in the early 1990s showed that banking without prudence could only be at the cost of the banker's health and the unsustainable system would not benefit any one. Banker's caution can however go against the interest of the farming sector in the short run. Not surprisingly, the change in policy was accompanied by the return of the money lenders (Ramkumar et. al., 2008) who charge high interest rates. Understandably, India's agriculture has not become significantly less risky than it was about three decades earlier. Withdrawal of government subsidies also exposed farmers to a high cost production system and to commercial input suppliers, raising the magnitude of risk.

Even, while advanced technologies and market orientation increase cost of production, with opening up of international trade, competitiveness has become a key element for success. Farmers, like other sections in the populace, learn of new consumer goods and useful utility items that flow in with regularity, bombarded as they are by commercial advertisements in mass media. In the new world, the way to a more filling life is through consumption, hard work, competition, ventures and risk taking. Commercial orientation not only helps individual farmers to reap pecuniary gains from a world market but, at a broader level, it opens up additional opportunities for value addition and employment generation. Manufacturing industries too look forward to elevated demand for consumer goods coming from a more prosperous rural sector.

Agriculture is probably more risky than most other economic enterprises. Its dependence on weather, the so-called 'rain gods', especially in areas with little or no irrigation is recognised. Its specificity to resources makes adjustments to market signals risky. Growing new or specific crops that demonstrate market prospects is not enough. An incorrect decision can either cause a current disaster or commencement of a crisis. What makes adjustment doubly difficult is the Indian farmers' poor risk taking ability due to their poor asset holding and historically low incomes. Besides, product prices are uncertain, more so in commercial agriculture and crop production is generally neither made to order nor is an instant process. When trade is about specialisation and comparative advantages, trade liberalisation would often require having to move from known and multiple crops to less known specific crops and to undertake trials with new inputs and technology when the results are uncertain.

Farmers have been known to be risk averse (Binswanger, 1978, 1980) Moreover, for a poor farmer, the penalty for a failure is too high (Mellor, 1969) and one drought year can have long-term consequences by bringing down both consumption and investment expenditures in subsequent years (Jodha,1978**).** Besides, the traditional ex-post methods of risk management such as migration, borrowing and support from extended families are either not desirable from a welfare angle or are simply not socially relevant in today's circumstances. Preventive measures like plant-protection, weeding and seed treatment, while advantageous are not adequate. Diversification, the most common risk management method involves growing otherwise avoidable crops that have little market value just for limiting risk. As a consequence, the state's role continues to gain importance. Disaster expenditure, controversial loan waivers and distress income from self-targeted public works acting as safety nets are now more important than ever before in a free trade world notwithstanding their burden on the strained budget. Literature also shows that under risk, a rational and risk averse individual would invest less on inputs than in a risk free situation (Ahsan, Ali and Kurien, 1982) so that risk can only strengthen the stagnation in crop productivities. Risk in agriculture is extremely costly for the country that means to move ahead in globalising times.

Objectives of the project

The performance of a crop insurance scheme can be assessed directly and at a superficial level by its progress and acceptance in the country. Further, assessment will have to take into consideration its commercial viability, its effectiveness in addressing agricultural risk as it occurs in practice, its success in improving credit flow to agriculture and ameliorating rural distress and most important its overall impact on agriculture in the light of current needs. Thus it is important to examine whether the evident implications for the choice of crops, crop productivities, benefits to the small and marginal farmers and for credit and indebtedness are consistent with what is desired and what is expected in the light of theory. To the extent that there is a gap between actual development and the expected, it is critical to ask why this is happening, what remedial steps can be suggested and whether the scheme itself is desirable. This project takes a look at the progress of the National Agricultural Insurance Scheme in India using data on insurance for six years and other agricultural information for a period 1975 onwards. The objectives are as follows:

1. To trace the development of Indian crop insurance in context of international experiences.
2. To examine the financial performance of NAIS.
3. To examine if the NAIS is proving useful to Indian agriculture and Indian farmers in context of the current exigencies.
4. To examine the nature and extent of the risk in agriculture.
5. To critically consider the parameters of the insurance scheme and the farmers' responses.

Based only on secondary data, the studies in this report call for information on various aspects of Indian agriculture, particularly crop yield rates. Such information is also required at disaggregate levels. We have used state level and time series data on acreages and yield rates under different crops collected from various Ministry of Agriculture, Government of India sources. Besides, prices of crops and fertilizer have also been used as necessary sourced from similar official publications. Rainfall data used in the analysis are obtained from Indian Meteorological Department (IMD).

Information on crop insurance is of crucial significance for obvious reasons. In this regard, both the Ministry of Agriculture and the Agricultural insurance Company (AIC), which is a non-government autonomous body have cooperated by providing the basic information of the operation of the scheme. While data at the homogeneous area level would have been of immense value for us, for various constraints the AIC could provide us data only at the state level. The information covers a wide range of aspects like sum insured, area insured, premium collected, claims paid and subsidies paid by government. Details about the participation of small farmers are also given.

The study also takes a disaggregate view based on the endowments in irrigation as irrigation is a prominent classifier of the risk profiles of agriculture. Three separate groups of states are aggregated and categorised as Highly irrigated (HI), Medium irrigated (MI) and Low irrigated (LI) and for all India.

Plan of the Report

The report is organised as follows. The first three chapters and chapter 8 are either theoretical or descriptive in nature. In Chapter 2 we provide a background to the theory behind risk and crop insurance along with the usual problems faced by crop insurance programmes. Chapter 3 outlines the historical sketch of crop insurance in India. As a backdrop the international experiences with crop insurance are also presented in Appendix I. The National Agricultural Insurance scheme in India is also described in Appendix II. Chapter 4 traces the progress of the NAIS in the first six years of its existence, studying its penetration and attainments. Chapter 5 assesses the financial performance of NAIS with and looks for the role of adverse selection. Chapters 6 and 7 provide studies of the contributions of India's NAIS to agriculture keeping in view the perceived needs of the current times as well as the expectations from crop insurance. Chapters 8 and 9 take up the subject of measuring risk in agriculture, first by discussing the subject theoretically and then operationalizing with India's data on crop yield rates. Finally in Chapter 10 we review the outcomes of NAIS and consider the design and its implications and contemplate on the innovative designs under experimentation.

2. An Introduction to Agricultural risk Management and Insurance: Benefits, Costs and Alternatives

The farm sector is so important to any government that it has not been 'proved possible to reach a political equilibrium without government intervention in aid of farmers' (Hueth, 1994). The two most commonly perceived problems of the agricultural sector that have directed public policy are (a) too low incomes and (b) too unstable incomes. Crop insurance implemented as a public policy seeks to address both these concerns.

Insurance as Risk pooling

Crop insurance as any other insurance is an arrangement of pooling risk The possibility of insurance arises for agricultural production as for any other insured events such as death, disease, fire and accident, due to the randomness involved in the outcomes.

At the level of abstraction and possibly as an example of an actual practice, such a risk pooling arrangement even at individual level can be beneficial. A simple two person risk sharing model can be presented as follows. Farmer A and B each invests Rs 2500 on cotton but each faces a risk of crop loss amounting to the entire amount with a probability of 0.2. In the absence of pooling, the expected loss would be Rs 500 and that standard deviation Rs 1000 for each. If A and B decide to share the risk equally, the probability distribution changes. Now the probability of incurring the loss of Rs 2500 is reduced to 0.04 from 0.2 for each member. The expected loss is still Rs 500 but given that that the incidents are independent, the probability that both individuals will make losses is lower than either of them will have a loss only. The standard deviation is less at Rs 707 from Rs 1000. Loss is now more predictable.

Table 2.1: An example-Probability distribution of Losses under risk pooling- 2 individuals			
Event	Total loss	Individual loss	Probability
Only A has a loss	Rs2500	Rs1250	0.2 X 0.8=0.16
Only B has a loss	Rs2500	Rs1250	0.2 X 0.8=0.16
None has a loss	Rs0	Rs0	0.8 X 0.8=0.64
Both have losses	Rs5000	Rs2500	0.2 X 0.2= 0.04
Expected loss= Rs1250 X 0.16+Rs 1250 X 0.16 + 0+ Rs2500 X 0.64=Rs 500			

The underlying condition for this advantage of course is that A's risk is independent of Bs, a condition that may not be easy to meet in real life agriculture. As more individuals join the pooling scheme, the probability of the extreme loss outcome for each participant in reduced.

Risk averse individuals have a strong incentive to participate in risk pooling arrangements if they could be organized at no cost. Unfortunately this is not so and this creates the motivation for insurance companies to exist. The pooling arrangement is organized by the insurance company by selling insurance contracts. In reality, the insurer also agrees to share the risk. In its operation the insurance company faces several costs some of them being (Harrington and Niehaus,2003) underwriting or identifying individual participant's expected loss (participants face different distributions in reality), loss adjustment (by monitoring the claims made and verifying the correctness), distribution or selling the contracts and collection of participants' share of the loss. The last job is done regularly by billing the participants in order to collect advanced premiums prior to any claim payments. A typical insurance contract would require the insurer to provide for the funds to pay for specified losses in exchange for receiving a premium from the purchaser at the inception of the contract. The insurance contract transfers some of the risk of loss from the buyer to the insurer while the insurer company can reduce its risk by diversification (for example they sell large numbers of contracts that provide coverages for a variety of different losses or reinsure from a larger market).

Agricultural risk: Perils and catastrophes

Agriculture is known to be more susceptible to uncertainty than most other sectors. Indisputably, the risk is agriculture has been curtailed over time by the use of improved technology. The high yielding variety of crops were at one time much debated for their impact on yield variability and therefore risk but inputs such as controlled irrigation and pesticides reduced the risk by protecting the crops against failure of rainfall and onslaught of pests. Use of genetically modified seeds are also said to confer resistance against pests but this subject is not resolved till now. The farmer can, to some extent, select the best seeds for planting, match plant agronomic requirements with soil characteristics, take preventive actions to minimize the risk of insect infestation and fertilizer according to schedules based on soil testing reports. A clear and scientific understanding of the sources of crop risks, intensive exploration of methods used in wider world and the promotion of best practices have a potential to significantly reduce risk. Various scientific, logical and technological methods also help to make in-season predictions of the progress of crops in various regions to enable the government to take early action and reduce the loss. Thus, it needs to be acknowledged that a good extension and scientific crop forecasting can go a long way in controlling agricultural risk. Education and information dissemination are important but subtle influences on agricultural risk. Irrigation is also a means to limit exposure to weather vagaries, but at a broader level effective irrigation again depends on the rainfall performance as levels in the reservoir and the water table are crucial parameters for irrigation. However, though risk in agriculture in not invariant to technology and intervention, the scientific methods are in a development stage yet and are often implemented inadequately. Despite the developments and possibilities agriculture probably is a relatively risky operation and calls for insurance cover more than other sectors. Some of the perils to which crop production falls victim have been enumerated in insurance policies as following.

1. Droughts, floods, untimely rainfall or dry spells.
2. Hail-storms, winds, thunder storms, frosts.
3. Pests, diseases, insects, earth-quakes, tidal waves or tsunamis.
4. Apart from these natural risks the farmers also face the risk of accidents, deaths, thefts, machine break-downs, civil strife and wars. In real life there are serious disruptions to inputs supplies such as blockage of roads and failure of power that may no less serious than the natural hazards. New technology often fails to provide expected results in the practical conditions on ground.

Besides the above, the farmer also faces uncertainty of prices that also reflects on their income risk but the price risk in generally managed by public protection (minimum support prices) and through the financial markets. Income shortfalls are often caused by lower than expected crop yield rates and a large part of the variation in yield rates is usually accounted for by weather vagaries. Among the natural risks a categorisation is possible based on the frequency, scale and intensity of occurrence. The first is the catastrophic risk that causes large scale damage over extended area such as an earth-quake, a hurricane, a volcanic eruption and a tsunami. Second is a localized event that causes less damage. Biological risks such as diseases are usually localized in nature but some do turn into an 'out-break' as was the mad cow disease or the bird-flu that devastated certain agro-based enterprises. In general the distinction is not usually sharp and most agricultural risk is systemic in nature and affects large number of individuals similarly. Droughts are common in Africa and in parts of India and are largely systemic. Hurricanes are common in America and windstorms in the Caribbean islands. The Pacific islands are prone to volcanoes and earth-quakes. Many developing countries are more vulnerable to natural calamities than developed countries and such countries tend to be in Sub-Saharan Africa and in East Asia. If global warming is not reversed, the frequency of extreme events and variabilities will go up making agriculture more risky.

Insurance may not be powerful enough to address a catastrophic risk as the latter is covariate in nature, covering large spatial dimensions. Insurance and reinsurance companies have gone bankrupt from indemnising against catastrophes such as the Hurricane Andrew in USA. Usually an insurance contracts in agriculture covers against natural hazards of moderate dimensions relevant for the geography in consideration. There are many other types of insurances for other perils sometime even provided by the same insurers in different contracts (such as life, health and fire insurances). Disaster management programmes are in place for catastrophic perils like earthquakes and tsunamis in some countries. Contracts offered differ among countries depending on the propensity of the perils. Many island countries have insurances against strong winds and tidal waves, hail-storm is a common peril in most countries while in large countries, especially in the monsoon dependent parts of the world, droughts and floods are considered as common perils. Earth-quakes and volcanic eruptions are also included under crop insurance in certain Asian island countries.

Risk management in agriculture

Formal crop insurance is not the only answer to risk in crop production. Risk has been managed in agriculture since ancient times. Some of the methods used by the farmers are ex-ante and related to productions decisions such as

(a) Use of low yield or diversified varieties of seeds
(b) Staggering of planting time
(c) Fragmentation and scattering of plots to diversify the growing conditions
(d) Intercropping
(e) Crop diversification
(f) Conservation of soil moisture, drainage, integrated pest management
(g) Irrigation technologies
(h) Share cropping
(i) Decreased proportion of purchased inputs

A few of these risk mitigating practices (like (f) and (g)) are also favourable for agriculture and its sustainability. Others such as those in (a), (b), (c), (h) and (i) can be costly in terms of productivity of crop and efficiency of farming operations. Diversification, the most popular method embodies a trade-off between income variation and profitability. Foregoing the advantages of specialization the farmer compromises on his future earnings. Negative effect of the risk management methods can contribute to a stagnant agriculture. The farmer is thereby restrained by the probability of failure and the magnitude of loss in taking optimal decisions.

The ex-post methods that are taken after the occurrence of the unfavourable event are costly in terms of welfare effects. These measures are not only distressful for the farmer himself but they can also mean difficulties for other individuals. The visible effects of risk management are as follows:

(1) Savings are reduced and dissavings and debts are incurred.

(2) Loans are taken under distress from informal sources at high interest rates.

(3) Farmers resort to liquidation of assets and mortgage to raise funds in difficult times. In extreme cases, they even sell their lands and exits from agriculture

(4) There is a search for off-farm employment.

(5) They migrate to cities.

(6) Farmers depend on mutual insurance and networking created in better times.

(7) They deduce expenses on consumption, withdraw children from schools, spend less on health and nutrition and alienate themselves from local networks when they migrate.

Most of these risk management methods are signs of human distress and often have far reaching effects. They cause debt-traps that spill into future, urban congestions, less demand for consumer goods and undermine human capital. When risk is correlated (in the case of agriculture this is usually so), methods in (4), (6) and even (5) can bring little relief. Many of the methods have log term effects. Method (3) can push farmers to landlessness and destitution and with method in (7) human capital (education and health) is impaired. In the absence of a risk transfer mechanism, the poor and also those above but near the poverty line are thrown into a vicious cycle of vulnerability due to the transitory shock imposed by a crop failure.

The risk management method is undertaken not just at the micro level. At the macro level, there is a demand for debt forgiveness, and emergency relief. The government has to detract from its usual planned expenditures for productive projects to bail out the farmers. The political compulsion of the government can further create a moral hazard that can affect productive efforts of farmers in the future and when farmers' organizations lobby for relief even less deserving cases get access to public dole-outs.

Financing the Crop insurance Scheme

Insurance is a mechanism for trading in risk. The essence of insurance lies in the possibility of pooling risk from a large number of similarly exposed individuals, the cost of organizing the process being charged on the beneficiary. A commercial insurance company that buys part of the farmers' risk is an institution that can determine and charge the price of risk while pivotal to the sharing arrangement. The company collects premiums from all participants and indemnifies the loss makers. In the event of a large loss the insurance company's own capability to indemnify losses through premium collection becomes insufficient. In fact in most crop insurance schemes the government contributes to the creation of a corpus fund and the insurer supplements it by investing the resources gainfully so that the interest income adds to its financial strength. In cases of very large losses, even these incomes are not enough. The company finds support from the global reinsurance market in which the reinsurance company also agrees to share the risk. But such reinsurance companies are few in number and themselves demand co-payment and high premium rates. They themselves are victims of the same problems of insurance and are hit by the claim burden arising in cases of large catastrophic disasters. They are reluctant to participate in crop insurance because political interferences are common in agriculture. A more ominous problem arises from the fact that even if the insurer is capable of managing the risk, the premiums required to be raised are not 'affordable' to the farmers and there is a demand supply mismatch for insurance products resulting in poor 'willingness to pay' on part of the farmers. In practice the government comes forward to support the insurer by subsidizing the premiums of purchasers. It is also not unusual for the government to finance the excess of claims over the premiums in loss years and it is also a common case when the government bears the administrative (organizational) cost incurred by the scheme.

The Case for a Crop insurance scheme

A case for crop insurance can be built on beneficial factors related to welfare, efficiency and equity. Three positive implications of crop insurance are mentioned below.

Stabilization of income

The sensitivity of agriculture to the weather and other natural factors make farmers highly vulnerable. Any bad year in terms of crop production can throw many into destitution or poverty as well as reduce farm employment for the rural labour drastically. Traditional risk management methods have been shown to be inadequate (Jodha, 1978 Mellor, 1969 Binswanger, 1978, 1980) and the effects of a crop failure often spill over in subsequent years. The coping mechanism in such years adversely impacts on the consumption and investment of following years even if they are normal as the farmers have incurred debts or have lost their assets in emergency.

Efficiency

The appeal of crop insurance also comes from its efficiency inducing possibility since individuals are often risk averse (Binswanger, 1978, 1980) and their resource use decisions are affected adversely by the possibility of unfavourable events. The farmers try to reduce their risk exposures by avoiding crops that present uncertainty even if they are lucrative or desirable on other grounds. Similarly, they diversify crops including less risky and less profitable crops in the basket thereby losing the advantages that may come from specialization. Their resource use is subject to their risk perception and diverges from the one that is dictated by optimality norms and this in turn will lead to output that is sub-optimal (Ahsan, Ali and Kuren, 1982).

Rural credit

The rural credit market is generally incomplete due to the risk of money lending and the poverty of the borrowers. Many small and marginal farmers have little access to institutional credit and resort to money lenders who charge high interest rates. The reluctance of banks comes from the poor recovery rate and the possibility of defaults. Government regulations require formal lenders to charge according to the payment capacity of farmers and political considerations rather than the risk weightage. A collateral is expected to shift part of the risk back to the borrower but unfortunately the small farmers have a poor ability to provide a collateral. Crop insurance can partially act as collateral, in which the insurer pays the indemnity directly to the lending bank. Apart from reducing the risk of the lender and protecting the health of the institution, the crop insurance helps recovery of the loans and maintains the credit eligibility of the borrower regardless of the short term crop failure.

Problems and paradoxes of crop insurance

Despite the need for an insurance mechanism in the agricultural sector the emergence of a market for crop insurance has been slow in most countries. Private enterprises have not shown interest and farmers' participation is poor. In practice government support has been important where ever an insurance scheme existed. The failure of the market is usually attributed to the problems of asymmetric information problems (Raviv, 1979, Nelson and Loehan, 1987, Goodwin, 1996). This arises because the clients have more knowledge about their own distribution of probable losses than the insurer. For a multi-peril insurance that indemnifies losses due to a number of perils (droughts, floods, hailstorms etc.) assigning probabilities of loss at the farmer level to determine the acturially 'fair' premium rates is a nearly impossible task. Faced with a formidable cost of historic information at the farm level, an insurer is compelled to charge a premium based on an average measure of risk, which would mean that the less risky farmer has to pay a relatively high premium rate while a more risky farmer is charged a low premium. Also a guaranteed income (indemnity if crop fails) can also induce farmers to reduce input use, take less care and change cultivation practices all of which might hurt the production performance. Goodwin (2001) explored the possibility of asymmetric information in US. Using data from Kansas wheat farmers, he showed that the demand for insurance was negatively related to the premium rate but the sensitivity to the rate change was much less for the farms that were more risky with greater coefficients of variation. This is the case of adverse selection. The study also indicated moral hazard as the insured farmers tended to use significantly less fertilizer and agro-chemicals than others do. It may be noted that informational asymmetries are a problem for all financial markets. They have their remedies in terms of compatible designs of contracts that provide disincentive for behaviour undesirable for the insurer, better disclosure laws, better auditing and better information. Rothschild and

Stiglitz (1976) separated market equilibrium with low risk and high risk clients buying different contracts.

Adverse selection

This is the first problem of asymmetric information and occurs when the participants differ in their risk exposures, i.e., in the probability of loss and indemnity payable, and these differences are not reflected in the premium rates charged. As a result more risky members will purchase insurance in greater proportions than persons with less risky profiles generating an imbalance between the premium revenues and the indemnity payments. If the investor reacts by raising the premium rate, the less risky among the participants will drop out and the financial performance of the company will deteriorate further. Adverse selection can be combated by collecting better and farm level information and risk classification.

Moral hazard

In this case of asymmetric information, the participation in insurance changes the optimalilty rule of the members. The insured farmer now adopts less costly and less time intensive practices and is now more likely to incur the insured event than an uninsured farmer. Monitoring the insured agents' practices is an answer but is administratively an unwieldy and expensive task.

Mismatches

Farmers usually have limited willingness to pay premiums. On the other hand they prefer insurance that protects their incomes from multiple threats. The multi-peril insurance schemes are difficult and costly to administer and the firms prefer to cover specific perils. The premiums desired by the insuring firms based on the risk calculation and possibly also their commercial considerations may not be low enough to attract participation of farmers. A study in India for the All India Disaster mitigation Commission showed that farmers only want to pay u p to 2% of insured value for a multi peril policy and would prefer that would prefer a kind of service that would make the programme very expensive. Sometimes there is cognitive failure in which the farmer underestimates the risk he faces ('That can't happen to me') and considers the premiums as 'lost money'.

Systemic risk

Risk is either as systemic (or common) risk or as idiosyncratic (or individual) risk. Systemic risk arises when risk is correlated across individuals or that pooling of risk is not a solution. At the extreme, when the undesirable outcome affects a large number of the insured population, the systemic risk becomes catastrophic. Climatic disasters such as floods are geographically extensive. In fact catastrophes that are relatively infrequent and wide spread have exposed the vulnerability of the insurance and reinsurance markets.

Experiences of the Midwest flood (1995) and Hurricane Andrew (1992) in the US are examples of the weakness. Miranda and Glauber (1997) measured the portfolio risk of an insurer and showed that the American insurer faced indemnities that were 126 times more variable than would be the hypothetical case if indemnities were independent and a portfolio risk that was ten times larger than those faced by conventional insurers. Goodwin (2001) pools county level corn yield data of three major US States to examine the issue. While the degree of systemic risk does not turn out serious under normal conditions, drought years considerable persistence across space suggesting that the correlation is state dependent. Duncan and Myers (2000) brings out the difficulty created by the systemic risk through a competitive market model akin to Rothschild and Stglitz. Under uncertainty, a firm maximizing its expected utility of profits has a reservation utility level for its long run competitive existence. The authors measure the degree of catastrophic risk and show that when the equilibrium exists, any increase in the risk would lead to rise in the premium rate and a decline in participation and the equilibrium condition places an upper bound on this preference level. In fact the equilibrium can cease to exist if the reservation preference level is high enough.

High administrative cost

A nation wide insurance scheme can be very expensive to conduct since it it involves several functions such as marketing of the scheme, collection of applications and the premiums, calculation and assessment of losses and disbursal of claims. This hole business is made more complicated by the reliance on information. Information is vital to insurance agencies. In agricultural insurance especially when the clientele is more dispersed and conditions are heterogeneous, information becomes critical to the functioning of the scheme. Data on climate, production conditions, practices and yields become useful. Data collection, assessment and monitoring can be extremely expensive especially when rural infrastructure is also not developed.

Possible solutions and choices

The obstacles mentioned above make crop insurance in a straight forward manner nearly unviable. Several solutions have however been suggested to overcome to problems but these solutions have their own problems. There are therefore a few crucial choices to be resolved while designing a crop insurance scheme. Some of these solutions and choices are enumerated below.

(a) Compulsion: Making participation in a crop insurance programme compulsory is a way to overcome the over-riding problem of adverse selection. For example farmers who have access to good irrigation facility will not find the need to participate. Compulsion would force every one to participate thus ensuring a balanced pool. Yet, compulsion is a coercive measure and may be resisted and is not defensible conceptually (why only some farmers will pay for others' risk and not their own). It maybe viewed as a form of taxation on better endowed (safer) regions.

(b) Linkage with bank loans: This is a way of imposing selective compulsion where participation becomes compulsory for all those who borrow from the banks. Besides ensuring a larger and more balanced pool, this linkage has two other advantages (a) prevents loan defaults from undermining the banking business and (b) economizes on administrative cost by entrusting banks with the duties of managing premium collection and claim disbursal as a marginally additional burden over the loan business.

(c) Area level assessment: This is an alternative to the usual individual based insurance in which the premium and loss assessment is determined at an aggregate level. This level has to be decided on the basis of homogeneity so that all farmers in an area unit will have similar if not identical risk profiles. This reduces the need for information at the farm level, helps to pool diverse regions and reduces the possibility of moral hazard as indemnities are determined by the aggregate rather than individual performances. The main drawback of this solution is the failure to attend to individual or idiosyncratic risks.

(d) Index based Products: Index based products are easier to handle as indemnities are triggered by an easily observable, measurable and independently verifiable extraneous event such as a particular temperature or rainfall. This approach suffers from basis risk and has a less broad based appeal. Due to microclimatic differences and the quality of information, the individual's risk may not correspond with the index.

Cost of Risk, the Social dimension and the importance of crop insurance

Risk is a constituent of most business decisions and its cost has to be factored in the cost and revenue calculations undertaken by a professional firm. In organized business decisions, the components of the cost of risk after decisions are taken are the following: (1) Expected loss, (2) Cost of loss control, (3) Cost of loss financing, (4) Cost of internal risk reduction and (5) Cost of the residual uncertainty. The expected losses would include cost of lost incomes due to the calamity as well as that of the loss of income inflow that would have resulted from investments that could not be undertaken. Loss control involves mostly the precautions that were taken to reduce the probability and severity of loss. At the farmer's end loss control often means taking limited exposure to new crops and technologies but at a broader level expenses on research and extension are an important constituent. Cost of loss financing involves welfare foregone by holding reserves, in this case generally in the form of grains held away from the market. This results in a contraction of marketed surplus. Insurance is a form of loss financing and the premium is reflected by the cost borne by the producer but at a broader level the administrative cost of proving the insurance is relevant.

Internal risk reduction involves diversification of activities and collection of information to reduce risk. All these methods are not enough to eliminate the uncertainty that arises about the magnitude of loss and a residual cost of uncertainty will exist.

The components of risk also make it amply clear that the loss itself and the measures to mitigate the risk are both costly, that there are important trade-offs and that insurance is not the only way of risk management. Any increase in the loss controlling activity would bring down the expected loss but the net effect will take account of the additional cost entailed or the opportunities foregone by say, adhering to old traditions. Loss control through increased research will reduce risk but the cost and benefit needs to be measured. In general even if it were technologically feasible to eliminate uncertainty completely, in a real world people do choose a balance between caution and risk, based on economic feasibility. Nevertheless, it remains to be recognized that research and more importantly extension are powerful substitutes to methods like insurance in risk minimization. The trade-offs generally require the decision maker to equate marginal costs of the constituent methods and their marginal benefits. Thus crop insurance can potentially be substituted by other methods if the latter are less costly. Moreover, the benefit of crop insurance is also limited by the fact that it cannot address the problem of physical shortage at the macro level that a crop loss creates. Expenses made on research, extension and stocking may be more effective in combating physical shortages.

In this background, crop insurance has been a matter of debate. In the critical review of the schemes given by Hazell et al (1986) it was shown that the beneficial effects on crop loans that are ascribed to crop insurance could alternatively be generated by a small increase in the interest rate by the banks and this would increase the cost of borrowing that is comparable to the premium burden on the farmer. In India, the initial proposal for a crop insurance was not supported by the Committee headed by Dharm Narain that considered other kinds of state support more acceptable and economic for inducting a new technology in India agriculture. Insurance is especially hindered in agriculture by the lack of independence among individual risk profiles, the asymmetries of information, the vastness of the sector and consequent administrative cost involved and the availability of alternative methods.

The desirability of a crop insurance scheme and the need for public subsidisation can be judged only in the context of the social cost imposed by agricultural risk, that may not be observed by the producer nor factored in his calculations when managing the risk. The impact of a production failure on the country's food security, human capital formation, competitive advantages of products in domestic and international markets, poverty and social stability and success of up-stream and down-stream economic activities and thereby on the economy as a whole are not necessarily factored in farmers' personal costs. The implicit social benefits also create a ground for public subsidies on crop insurance.

The Area-Yield insurance

The problems of crop insurance and its viability underscores the significance of an innovative design. The area-yield insurance (AYI) is a design to circumvent many of the difficulties that foil the insurance market (Skees and Reed, 1986, Miranda, 1991). Risk is pooled not from individual farmers but from various groups of farmers or 'areas' and indemnity is assessed uniformly at the area level. The concept of an 'area' is based on the possibility of sufficient homogeneity existing within the unit so that the majority of the farmers in the unit are likely to encounter a loss simultaneously and the risk exposure of a representative farmer will be similar to the average risk of all the farmers in the area. The farmers receive indemnities at the same rate when the area yield falls short of its normal regardless of their own losses. The indemnity is calculated based on the contract size and the yield shortfall and no payment is made when the area level yield is above the normal level. It is to be recognized that homogeneity is a elusive idea and the possibility of basis risk when the individual suffers a loss even as the majority do not, cannot be ruled out. Ideally, the individual's yield shortfall should be attended to, but AYI offers only a second best solution to the individual based scheme.

The AYI was first proposed in 1949 by Halcrow (1949), who noted that the variations from forecasted farm level yields are largely a function of systemic reason. It was reconsidered and resurrected by the US Department of Agriculture initiated a pilot test of AYI for soya beans on a limited scale in 1993 using county yields estimated by the National Agricultural Statistical Service. One of the earliest countries to adopt the AYI was Sweden (1961) and India is a dominant example of the experience with the AYI. The AYI has several appealing advantages. (a) The area approach demands information on the average annual yield of the areas only. The system of collection of such necessary data would in fact contribute to building up a strong statistical base. This also remarkably cuts down administrative cost of assessment, monitoring and information collection at the level of the farmer. (b) Since the decisions are unbiased and based on objective information from extraneous sources, the chances of disputes are significantly reduced. (c) The area approach is less liable to the dangers of moral hazards as individuals do not gain from their underperformance under the AYI. (d) If the areas are homogeneous within themselves and diverse across themselves, the chances of systemic risk are minimised.

The AYI is a scheme that overcomes many of the problems that plague any insurance scheme but it also faces weaknesses that tend to offset the benefits expected from insurance also. The major drawback is exclusion of individual concerns. The specification of the area or the units is also a difficult task since risk exposures can never really be same even between contiguous farms. The level of similarity that qualifies for homogeneity can only be arbitrary. Reducing the size of the area helps enlarging the inclusion and coverage but also adds to the cost of administration and of data management and would tend towards an individual based insurance at the limit. The problem of adverse selection needs to be still tacked by other means. Compulsion, the design of the contracts and its parameters are other ways to improve the scheme but keeping in mind the political significance of the issues.

3. Crop Insurance in India: A historical view

Agricultural insurance as was provided by the State in India albeit in different forms, since ancient times. Some of the measures that are comparable to modern day crop insurance are as follows:

1. The Mughal emperor Akbar introduced an in-kind tax called the Dahsuri tax in the sixteenth century intending to tax in kind and store grains during good harvests for use in bad times.

2. Disaster relief was provided to farmers during years of crop loss since times immemorial. Today such payments are often described as insurance without premium.

3. Publicly provided irrigation also acted as an insurance against the failure of rainfall.

4. On occasions when the loss of a crop failure rose above a level prescribed in the famine code, there was a provision of suspension or remission of land revenue in the Nineteenth century**.** This was shown as one of the closest analogies to crop insurance found in early pre-independence history of India.

A direct example of crop insurance in colonial times is undoubtedly illustrated in a book written by one J.S. Chakravarti on agricultural insurance as cited by Mishra (Mishra, 1996). This book written in 1920 came out with a practical scheme suited to Indian conditions, proposing a rain insurance scheme for the Mysore state. Another example that proved valuable for the development of the insurance scheme in India subsequently was a compulsory insurance scheme that actually operated in Dewas, a small state in Madhya Pradesh in 1943.

Besides these instances, there are also evidences that insurance policies were sold by private agencies to tea gardens (Priolkar, 1949). In 1946 on the eve of India's independence, Narainswami Naidu recommended a crop insurance scheme in the lines of U.S.A. (Nigam, 1971) in the context of the indebtedness in Madras.

With such a long history of consideration, it is not surprising that the subject received ample attention soon after independence in 1947 and was discussed in the Central legislature. The then Minister of Food and Agriculture Dr. Rajendra Prasad gave an assurance that the feasibility of introducing crop insurance would be considered by the government. The conference of Cooperative societies in 1947 also recommended state initiative in the matter The resolve was reinforced by the view taken by the Asian Regional Conference in New Delhi. The government appointed an officer on special duty to investigate and work out a detailed scheme. Mr. Priolkar, the officer drew up a pilot scheme for certain crops and came out with his report "Problems of crop insurance under Indian conditions" in 1950. Drawing from the experiences of Dewas in India and the Federal crop insurance scheme (FCIS) in USA, Priolkar considered the pros and cons of various alternatives and produced two schemes that were circulated among the states. Due to financial constraints however, the states were reluctant to adopt the schemes at that time.

The endeavour however continued. The FAO's working party on crop insurance in Bangkok in 1956 also suggested the possibility for India to launch a crop insurance programme and the subject received a reconsideration during the discussions of Third Five Year plan. In 1961, the Punjab government asked for Central assistance to start a compulsory crop insurance programme. The initiation of a crop insurance programmes was also troubled by the fact that agriculture is a state subject in India while insurance falls in the union list. This meant that a compulsory scheme required a central legislation but the draft bill needed the approval of the state governments. When the bill was ready, the reconstituted Punjab state was no longer inclined towards crop insurance and many other states were reluctant and concerned about the finance necessary for implementation. The subject was reopened in the seventies in context of the green revolution when a promising technology was available for India's stagnating agriculture.Inducing the farmers to take up the new technology presented a challenge. The idea at the time gained ground that if the farmer is assured of compensation for possible losses he will not hesitate to adopt the modern method**.**

In July 1970 the Government of India referred the draft bill and the model scheme to the Expert committee on Crop insurance with Dr. Dharm Narain as the chairman. The Expert committee agreed with Priolkar's approaches but recommended that the crop insurance scheme should not be introduced in the near future even on a pilot basis. The Committee noted that hardly in any country was an all-risk crop insurance scheme operating without subsidy. Given the paucity of resources for planned development in India, available funds could be utilised better in ways that directly improve productivity than for crop insurance. While crop insurance was also seen as a way to improve farmer's access to credit, the Committee opined that the newly emerging credit institutions and the Reserve Bank's appropriate guidelines were powerful enough as instruments to improve the availability of credit to farmers and to restore their eligibility even in the event of crop failure. The approach taken by the Report as well as the model scheme under its consideration were intensely criticised by another expert V.M. Dandekar in 1976 (Dandekar, 1976).

The Government did not really accept the Expert Committee's suggestion. More importantly, amd perhaps more interestingly, crop insurance was evolving quite spontaneously in response to its own demand at the grass-root level. In particular the Gujarat State fertilizer Company (GSFC) initiated a '4-P-Plan' of practices and plant protection on potato in 1970-71 and later extended to Hybrid –cotton in 1971-72. Because of the risk of natural hazards even the progressive farmers were reluctant to adopt the package. The GSFC tied up with the Life Insurance Corporation (LIC) of India and the Bank of Baroda to provide loan and insurance coverage for supporting the input intensive cultivation practice. The scheme was taken over new and nationalised General Insurance Corporation of India (GIC) for implementation. The Plan was not a memorable success (Chaudhary, 1977) but was an important step in the history of crop insurance in India. Similar initiatives were also taken by other organisations. Between 1973 and 1976, a number of schemes operated on an experimental basis in different states covering crops like cotton, wheat, groundnut and potato. They were implemented by the GIC. Insurance for cotton was also provided experimentally in 1978-79 in Gujarat, Madhya Pradesh and Maharashtra. These experimental schemes essentially made participation voluntary and assessed losses at the individual level but their financial performances were not satisfactory at all.

The GIC contacted Professor Dandekar of the Indian School of Political Economy of Pune to suggest an alternative scheme. Following his suggestions of an 'Area-Yield insurance', the GIC drew up a scheme based on the area approach and put it into operation from 1979-80 initially as a Pilot scheme in three states and later extended it to twelve states by 1984-85. Participation in the Pilot scheme was voluntary . The premium rate was between 5 to 10 per cent and the financial performance turned out to be reasonably good.

The Comprehensive Crop Insurance Scheme in India

With the success achieved in the Pilot scheme a more ambitious scheme was launched in the financial year 1985-86. Starting from a coverage of over half a million contracts (farmers), 1.2 million hectares and nearly Rs 2000 million in sum insured in the kharif season of 1985-86, the Comprehensive Crop Insurance Scheme (CCIS) was probably one of the largest operating programmes in the developing world. The scheme came into being at a time when crop insurance was already a subject of disillusionment in the wider world. At this point the CCIS drawing optimism from Prof Dandekar's advocation and the success of the earlier experiment was a significant step both by itself and as a precursor to a more developed and larger crop insurance programme, the NAIS that was to follow subsequently.

The CCIS has been studied extensively (Mishra, 1996, Tripathi and Dinesh, 1987). The scheme benefited a wide ranging crops in the groups cereals, oilseeds and pulses. GIC was the implementing agency. Participation of the state was voluntary but crop insurance was linked to institutional credit. Farmers who availed of institutional loans were eligible for coverage and the insurance built in as part of the loan. The banks would remit part of the loan treated as the premium to GIC. In fact participation of farmers who took short term loans from cooperative agencies and regional rural and commercial banks was compulsory. The premium rates were low. They were based on what would be reasonably acceptable to farmers and on Prof Dandekar's calculation of fair premium rates. A premium of 2% of the sum insured was charged on rice, wheat and millets and 1% on oilseeds and pulses. The scheme operated on the 'homogeneous area' basis in which the defined area was a District, Tehsil or Taluka, block, or any other small contiguous area defined on the basis of crop-cutting experiments. A guaranteed yield known as the threshold yield was determined for the area, calculated as a percentage of the moving average of yield rate per hectare in the area. In the case of millets, oilseeds and pulses the preceding 5 years period was considered and the percentage was 80% and for what and paddy crops the period was three years and the percentages were 85% and 90% respectively in low risk and high risk areas. Whenever the area yield fell below the threshold yield the farmers were eligible for indemnity. Small and marginal farmers were given a 50% subsidy on their premiums.

The participation in the CCIS started from a total of 13 states and union territories. Within the states the number of farmers and the area covered also expanded. However, there remained certain grey areas that obscure the scheme's success. First there is a question on the CCIS's role as a credit insurance rather than a crop insurance. Insurance policies were issued in favour of institutional credit agencies and insurance was built in as part of the crop loan where it operated. Since the loan amount is usually too small to cover a significant part of the cost involved in cultivation, the insurance is more a protection for banks than the farmer. On the other hand, the insured amount being 150% of the loan, and the threshold yield being disassociated with the loan, the argument of CCIS being a loan insurance may be an over-assessment. Second, the definition of the area in terms of the CCEs also leaves out the talukas or regions technically without the assessed yield. Such talukas are usually combined with contiguous areas in which the yield rate is available. Third the adverse selection said to be too strong to allow risk pooling. Irrigated states were unwilling to participate. Punjab, Haryana and many of the north eastern states never participated. The reason for reluctance are many, ranging from low risk (Punjab and Haryana), high risk (Rajasthan), unsuitable crops (north-east) and technical deficiency for conducting CCE (Sikkim). The adverse selection proposition was however rejected (Mishra, 1996) because the insurance coverage and irrigation endowment failed to show a significant correlation. Fourth, and this was important, the loss ratio was high, above 6.9% in the period up to 1990-91 and invariably above unity . The performance was particularly unfavourable in the first three years and especially in 1987-88 because of consecutive droughts but overall the financial viability was poor. Fifth, participation was made difficult due the government's own indecisions and contradictory actions relating to the continuance of the scheme and to other measures like loan waiver and drought relief. Despite the poor financial performance crop insurance was shown to be desirable on account of its beneficial effects. Farm level study in three states Gujarat, Tamil Nadu and Orissa. Mishra showed that the insured farm households earned more and invested more on inputs than the uninsured. They spent less on pesticides. Credit delivery improved especially towards the small farmers.

Towards NAIS

NAIS started in 1999-00 rabi season following the patterns of CCIS. It is a scheme that is offered to all the states and union territories and has a wider coverage in terms of crops and beneficiaries. Although linked to credit as in the case of CCIS, NAIS goes beyond the credit linkage. The insurance is open for non-loanees and is voluntary to that extent. The scheme has moved but only marginally towards the acturial regime. The formula for threshold yield has seen some modification. On the whole the differences are not very significant while many of the problems persist. The details of the NAIS is provided in Appendix II.

Crop insurance in Indian economic planning: Motivation and considerations

In the years after independence in 1947, the Five Year Plans directed India's economic development. The importance of crop insurance for the Indian economy was recognized in view of the fact that agriculture had a significant share in the nation's income and employment. In the route to agricultural development a number of instruments have played a considerable role. Public measures that have been intended to help agriculture include investment on infrastructure, especially irrigation, concessional and directed credit and subsidies on inputs. Crop insurance is another instrument that has been in consideration and the motivation for a scheme needs to be viewed in the light of India' development history and contemporary reality.

The initial motivation for having a crop insurance programme (CIP) after independence can logically be associated with the significance that India has attached to agricultural development. After independence, agriculture was given the top priority in the First Five Year Plan in 1951 during which time the Priolkar report was circulated. The Second Plan shifted the attention towards industrialisation of the nation, but it was gradually realised that without substantial increases in food production, it would not be possible to achieve high rates of investment in industries. The Third Plan emphasised increasing agricultural production and crop insurance remained in public consideration though with little progress. This was a period when India faced severe food problem and resorted to dependencies and compromise. A technological transformation in agriculture was urgently required at that time. The poor state of agriculture sustained widespread rural poverty. Risk in agricultural production had a role of considerable significance in scheme of things. It was argued that a crop failure would mean that the small and marginal farmers would lose their resources and would not be able to invest in the following year leading to an adverse effect on the national economy. A CIP would help in maintaining the farmers' purchasing powers and keep the agriculture moving. In the 1960s more initiative were taken both at the Centre and the states with no concrete results. In the early 1970s the fertilizer cooperatives introduced the CIP for a limited number of crops in a few states Gujarat, Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, and West Bengal generating valuable experience and data. A Pilot scheme operated for five years and led to the CCIS programme in 1985 which operated for over a decade. In the eve of the liberalisation and structural reforms India launched the NAIS and subsequently a company was floated on commercial lines as the role of the government in the economic affairs of the country contracted.

Motivations

In the early literature the importance of crop insurance can be traced to the following objectives:

(1) Assure stability of farmers' incomes. This not only prevents misery and economic hardship and keep farmers in business but by cushioning the bad years insurance prevents debts traps and maintains the credit eligibility of farmers.

(2) Strengthen the financial positions of the lending institutions: By preventing defaults, crop insurance helps banks to continue their important lending activity.

(3) Helps government budget: Crop insurance, by indemnising the loss incurring farmers through premiums collected in good years, replaces the financial burdens on the government imposed by measures like relief payments, remission of land revenues and loan waivers.

(4) Benefit to small farmers: Small holding farmers who have meagre resources numerically dominate India's agriculture. Any policy that target them as beneficiaries have made economic and political sense. Crop insurance could be a powerful tool to provide them with the much needed guarantee for their efforts, reward their activities and prevent paucity of resource from deterring them. The government also has an option of subsidising the small farmers in particular and CIP could be made more targeted than many other agricultural support programmes. In this sense crop insurance is also a welfare programme.

(5) Promote agricultural development: Crop insurance by encouraging the use of new and promising technology could pave the way to much needed agricultural development.

Complexities

At the same time, there was an awareness of the range of complexity that might afflict the operation of crop insurance in India. This is amply clear in the pioneering works of Priolkar. While many of these issues are universal and are discussed also in Chapter 2 of this report, some of the barriers to a successful insurance scheme that have been mentioned in Indian context are noted below. Some of these issues are relevant even today while experience has alleviated the significance of others.

(a) Land tenancy: Planning Commission had estimated that 23 to 56% of all cultivators were tenants or lessess of land and 82% of all such tenants did not enjoy security of tenure. In the absence of proper ownership or tenancy contract, it would be difficult to fix the liability of a loan. Today tenants are also eligible for coverage but the issues of oral and informal tenancy still needs to be resolved.

(b) Variation: cropping practices, methods and calendar differ from region to region. This heterogeneity necessitates a CIP to be sensitive to the differences. While the area based scheme alleviates the problem, the problem is not eliminated by the homogeneity assumption, which only raises problems of exclusion and eventually disenchantment.

© Fragmentation: the holdings in India are in many cases small, uneconomic and sub-optimal and premium becomes a burden for the farmer. This is one of overriding reasons of keeping the premium rates low relative to what is commercially desirable.

(d) Administrative burden: in a vast country with a large and varied agriculture and small sized farms, administration of a CIP is a costly affair. Risk classification, premium determination, loss assessment and monitoring to prevent adverse selection and moral hazard add to the burden. Today India's crop insurance economises on the administrative cost by resorting to (i) area yield insurance for simpler methods of assessment, (ii) the crop cutting survey for yield estimation and (iii) linkage to credit so that banks can handle much of the transactions without significantly adding to their cost.

(e) Lack of acturial data: An insurance programme always relies on past experience to understand the risk profiles of the subjects. In India the experience of Dewas state and of limited other countries that had an experience helped to start off. Today through years of operation India has built up some information for acturial database. The schemes are designed for simultaneous operation of the CIP and the creation of a strong statistical data base.

(f) Personnel: Paucity of skill has hindered the operation of a CIP in most countries but the agronomic and statistical expertises have helped India's journey from the start. India already had good institutions for insurance in other products and the these organisations, especially the GIC has managed the CIP through the time till recently a more specialised company is created with the required skills.

(g) Contradictory policies: political contingencies, electoral compulsions and catastrophic events create occasions for loan waivers and disaster relief that ironically can reduce farmers' interest in crop insurance. Recent payments in Vidarbha farmers and the loan waiver in the latest budget are example of how this problem continues.

(h) Limitations: A limitation of crop yield insurance is the inability of controlling the risk of price variability. In fact price variability is shown to be of more importance for farm incomes and high prices in bad years could be a source of distress for small farmers who buy food. Moral hazard is yet another caution since the farmer can reduce the normal risk prevention efforts, generating low crop yields. The usual are alternatives to CIP such as disaster payments and public distribution. Many of the support policies involving subsidies are not in sync with the time now but even CIP till today involves subsidy. On the other hand, safety-nets and productive investment for agricultural development are more consistent wit the spirit of the times.

Table 3.1 : Evolving CIS in India- Some landmark schemes				
	Experimental 1973-7	Pilot 1979-85	CCIS 1985-99	NAIS1999-
				(1999-2003 considered for averaging
Years	4	6	15	onwards
No. of States, Uts	6	12	15,2	23,2
Implementing agency	GIC	GIC	GIC	GIC, AICIL
Crops covered	Potato,Cotton,	Major foodcrops	Rice wheat millet	Food crops Oilseeds
	Wheat, Groundnut		Pulses, oilseeds	Annual commercial, horticultural
Rigidity of scheme	Voluntary	Voluntary for borrowe	Madatory for borrower	Compulsory for borrowers,
	Specific states	only. Premium fixed	Premium rate fixed	Voluntary for others
				Optional for states
		Few states		Premium fixed for select crops
				Actuarial for commercial
Approach	Individual	Area	Area	Area approach but
				Individual for select perils
Average of years				
Area	950 hect.	0.115mill. Hect.	8.5 mill hect.	14.9 mill.hect
Farmers	538.5	0.103 mill.	5.1 mill	9.24 mill.
Sum insured	not reported	Rs 1.01 lakh	Rs 1665 Crores	Rs 8055 crores
Loss ratio	10.7	0.79	5.7	3.8
Depth of Insurance	1.76	1.12	1.67	1.61
Source	Mishra (1996)	Tripathy (	Bhende	G.O.I.
Note: For NAIS 1999-2003 considered for averaging				

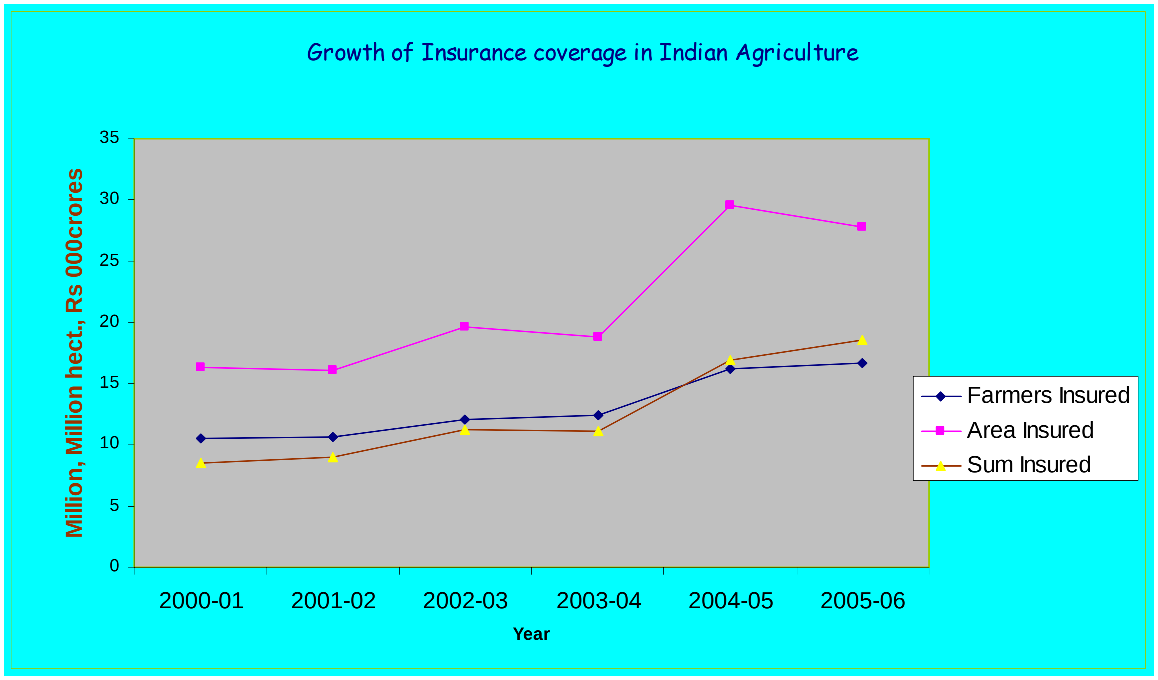
4. The Acceptance of NAIS in Indian Agriculture: Progress and Penetration

The progressive acceptance of the scheme in Indian agriculture is an indicator of the utility it has for the farmers. We will find in following sections that NAIS has indeed made a substantial progress in terms of coverage of farmers, area and sum insured. The willingness of farmers to participate in the programme and the success of NAIS and the partners (Banks, IA, Governments) who convey the necessary information and benefit to the farmers in a large country is itself a sign of success. It is also important to examine the specific dimensions of penetration, across states and regions, across the sections i.e, among the small and marginal farmers, and across the functions i.e., loan motivated and others.

Progress in penetration over time

During the six full years 2000-01 to 2005-06, each covering the kharif and the rabi seasons, insurance coverage expanded in various ways. Figure 4.1 provides a picture of the progress at the all India level. While crop insurance coverage expanded in terms of the area covered, the total sum insured and the number of farmers insured, the growth has not been steady throughout the period. The course taken by the coverage figures can be described by an initial period of slow progress, a perceptible slump in the year 2003-04 (even though this follows a bad year of monsoon) and a quantum jump in 2003-04 to 2004-05. From the details in Appendix Tables in this chapter (Table 4.1A) it is seen that during this time the farmers covered increased from 12.39 millions to 16.22 millions i.e., by about 30% while the area covered expanded by 57% in that one year. In the following year there was stagnation and the area covered contracted. Between the years 2000-01 and 2005-06 there was an annual average (point to point) increase of 12% in participation of farmers, 14% in the area covered and 24% in the nominal sum insured. Every year on the average, 13 million contracts were made, 21 million hectares were insured and Rs 12.6 thousand crores were insured in Indian agriculture.

Figure 4.1



The expansion of coverage needs to be viewed in terms of its seasonal dimension and the broadening of the range of crops that came under the purview of the NAIS. Table 4.2 suggests the dominance of the kharif season over rabi season as is expected. In 2005-06 12.7 million farmers were insured in the kharif season as compared to only 4 million in the rabi season. Over the years the kharif to rabi proportion in insurance coverage is about 3.9 (Table 4.5) but what is interesting is the increasing share of the rabi season. Since kharif crops are usually subject to the unpredictable performances of the monsoon, the rising share of the more irrigated rabi crops may be indicative of better pooling of risk.

Table 4.1: Seasonal dimension of Insurance coverage in India						
	Kharif	Kharif	Kharif	Rabi	Rabi	Rabi
Year	Farmers	Area	Sum insured	Farmers	Area	Sum insured
1999-00				0.58	0.78	356.4
2000-01	8.41	13.22	6903.4	2.09	3.11	1602.7
2001-02	8.7	12.89	7502.5	1.96	3.15	1497.5
2002-03	9.77	15.53	9431.7	2.33	4.04	1837.6
2003-04	7.97	12.36	8114.1	4.42	6.47	3049.5
2004-05	12.69	24.27	13170.5	3.53	5.34	3774.2
2005-06	12.67	20.53	13515.5	4.05	7.22	5069.5
2006-07(P)	6.65	10.11	750			
Notes: Units are Farmers in Million numbers, Area in Million hectares and Sum insured in Rs Crores.						

Crop-wise penetration

In 2000-2001 only 45 crops in total were reported to be covered. This number increased to 74 in 2005-06 and while coverage of the foodgrains-oilseeds group of crops went up modestly from 35 to 43, the commercial crops starting from 10 crops more than trebled during the period. The increase occurred in both seasons. In Appendix tables 4.2A the leading crops in terms of their shares in the sum insured are listed separately for kharif and rabi seasons. The kharif crops relate to the year 2000-01 and 2005-06 but the rabi crop to the starting year 1999-00 and 2005-06 for comparison. The crops in the Foodgrain-oilseeds group and the All crops group each accounts for at least 0.1% of the sum insured in the season while the commercial crops are exhaustive. In both seasons the commercial crops at the beginning of NAIS were Cotton, Sugarcane and Potato and these widened subsequently to include more of spices such as Ginger, Chilli and Onion. This is associated with the NAIS scheme itself widening its coverage of notified crops[1].

Over the whole period in the kharif season Rice (paddy) and Groundnut were found to be the most popular crops to be covered with more than 20% share in each followed by Cotton, Soyabean and Sugarcane each accounting for 8 to 10% shares and Bajra, Redgram, Jowar and Maize each made up at least 2% while the rest of the crops had poor shares in total sum insured. In the rabi season, similarly Wheat is the leading crop and

[1] Onion, chilli, Turmeric and Ginger were added in the second year of NAIS and Jute, tapioca, banana and pineapple in the third.

along with rabi Rice and Potato it accounts for over 70% of the sum insured and each of the three crops accounts for over 10%. A number of other crops including certain Oilseeds and Pulses, Sugarcane and Jowar each contribute more than 2% to the sum insured. Figures4.2-1 and 4.2-2 marks Rice, Groundnut and Cotton as the leading crops in the kharif season and Wheat, Potato and Rice in the rabi season.

Figure 4.2-1

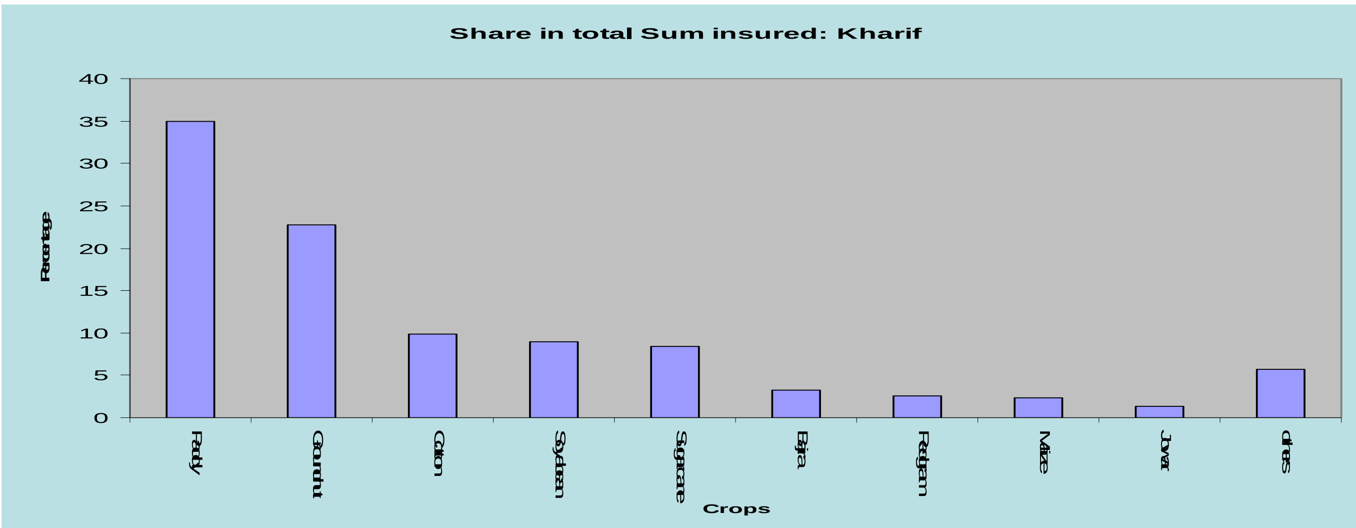
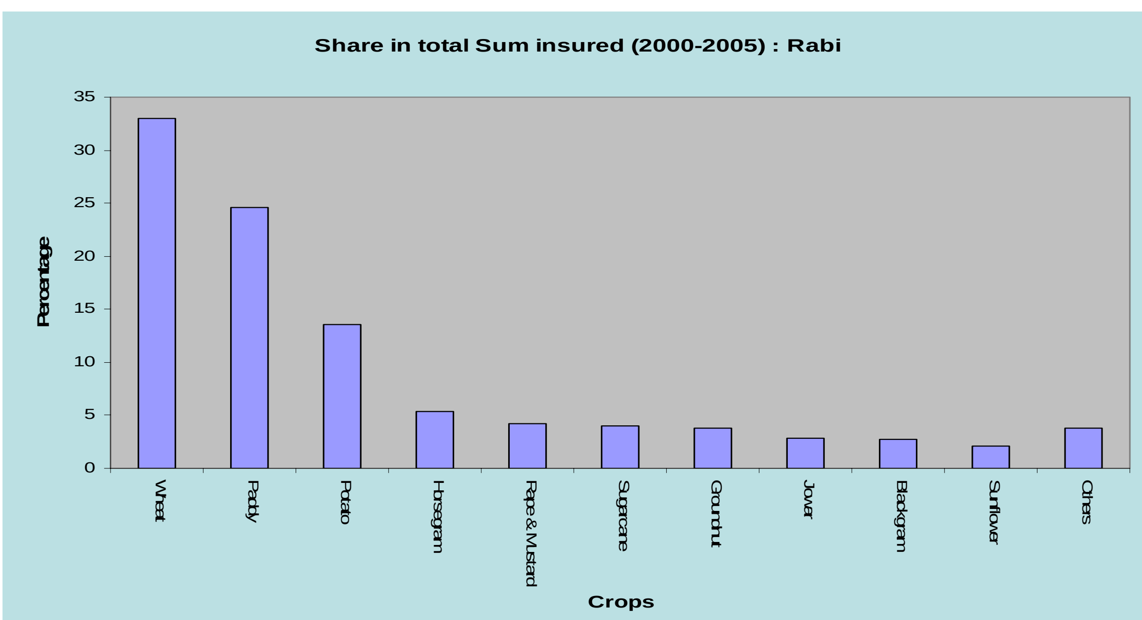


Figure 4.2-2



Haryana were added to the list and in 2005-06 the number rose up to 23. Punjab is an important exclusion in NAIS. Non-participating states and UTs include the following: Arunachal Pradesh, Manipur, Mizoram, Nagaland, Punjab, Chandigarh, Dadra, Nagar and Haveli, Daman and Diu, Delhi, Lakhadweep.

Figure 4.3 Kharif

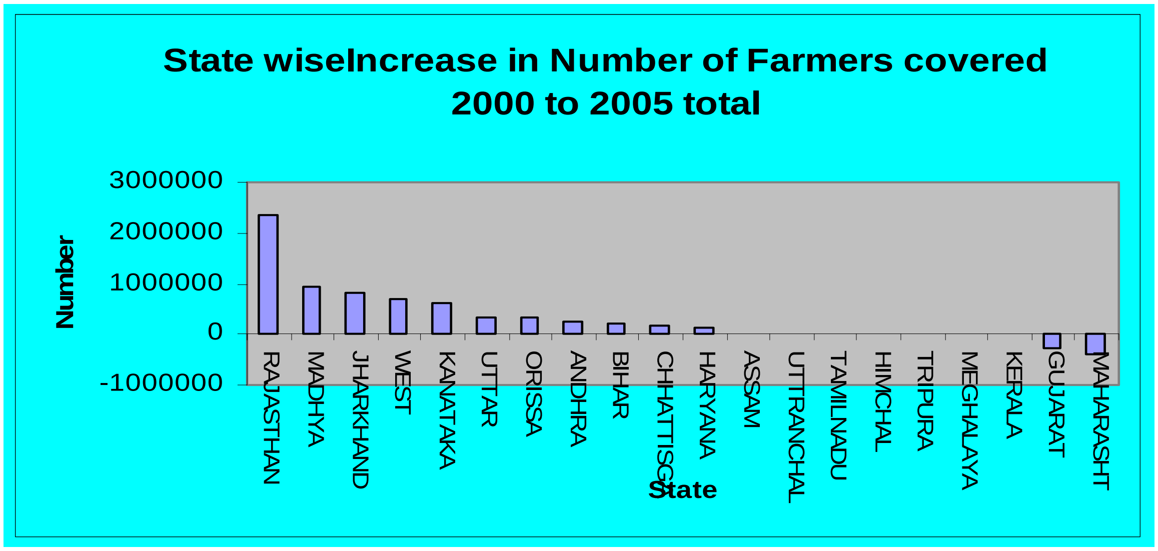


Figure 4.4 Rabi

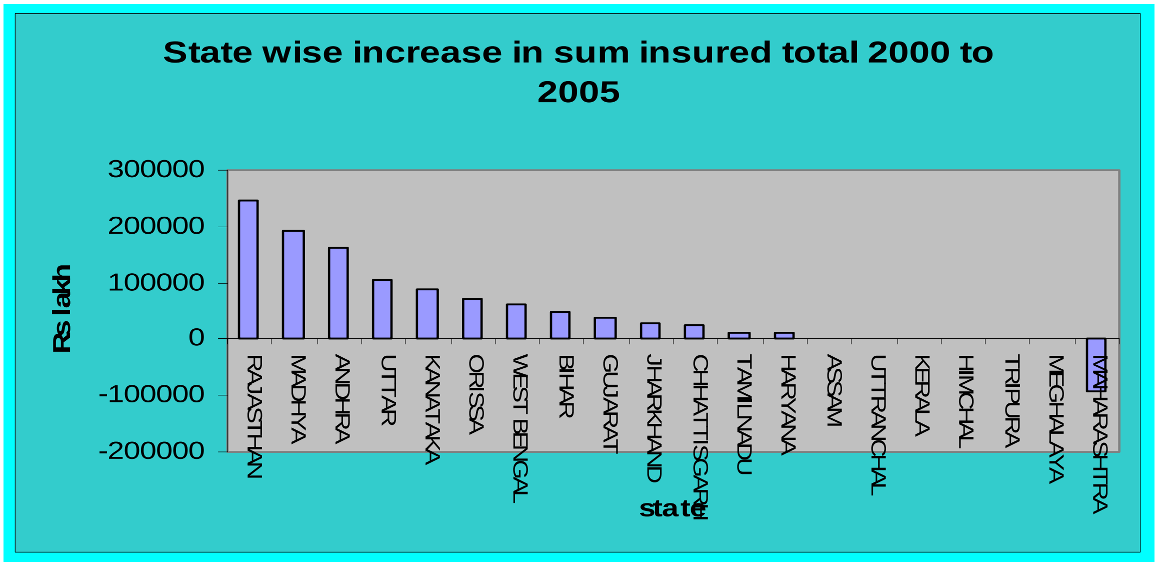
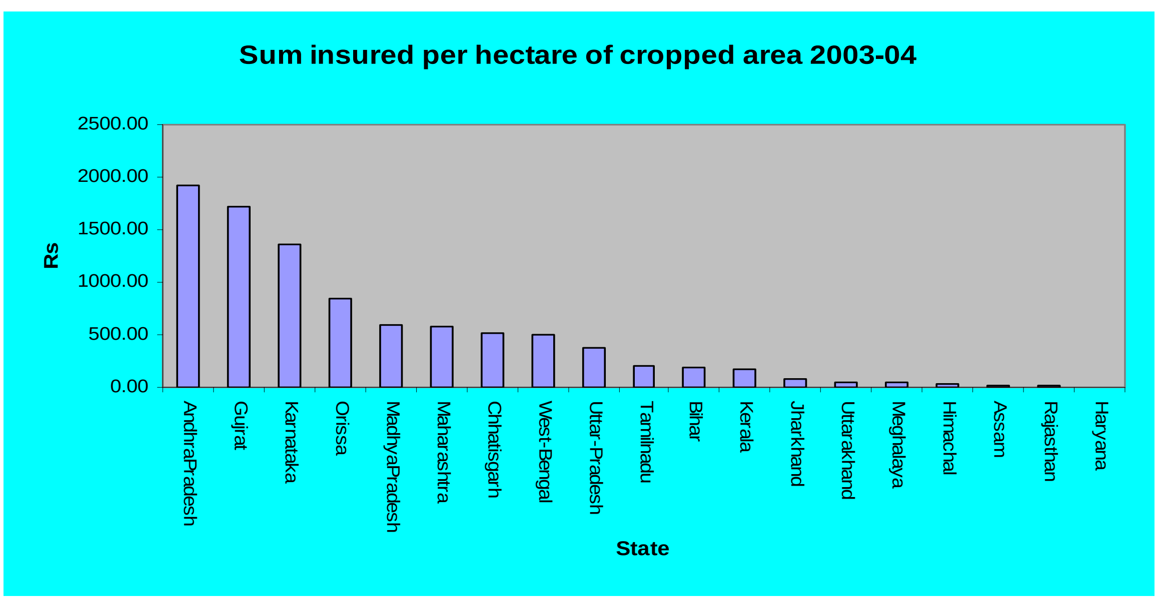


Figure 4.5 shows a view of the state wise participation in crop insurance by plotting the sum insured per hectare of cropped area. Since the sum insured can be expected to increase with the size of the agricultural sector of the state, normalization of the insurance data is required. The total sum insured over all crops is deflated by the total cropped area in the state in the year 2003-04 for which the cropped area is reported in official sources. Andhra Pradesh, Gujarat, Karnataka and Orissa appear as the leading states by this count and Rajasthan and Haryana the least participating states.

The distribution of the states as of 2005-06 is also given in the Appendix Table 4.3A. In the kharif season Andhra Pradesh, Gujarat and Madhya Pradesh are the three largest participators making up nearly 50% of the total sum insured and these states and three other states Rajasthan, Karnataka and Maharashtra make up 80% of the sum insured. The ranking in terms of farmers covered is not quite the same. Andhra and Gujarat have the first two positions when ranked by the sum insured but Maharashtra and Rajasthan, the geographically large states hold those places when the ranking is by the farmers covered and Gujarat takes only the fifth position. In the rabi season Madhya Pradesh, Uttar Pradesh and Rajasthan are the first three states in terms of the sum insured.

Figure 4.5



TO examine the degree of dispersion of coverage across the states an index DISP is computed as follows:

DISP= 1-$\Sigma S_i^{\ 2}$ where S_i is the share of i-state.

Based on the Herfindahl formula and analogous to the index computed in Appendix III, the probability of obtaining a single state twice in two random draws is obtained as the sum of squares of the shares and the spatial dispersion DISP is calculated as the difference of this probability from one. At the lower limit of dispersion, DISP will take a value of zero when all the insured units belong to the same state and $\Sigma S_i^{\ 2}$ =1. The upper limit however depends on the number of states N so that a perfect dispersion would give each state a share of 1/N and $\Sigma S_i^{\ 2}$ is equal to 1/N also. The index is computed for both dispersions in terms of sum insured and the number of farmers covered. Thus in the kharif season two randomly drawn insured farmers would not be likely to belong to the same state in 87.4 out of 100 cases, as compared to the perfect case of 95.6 cases. The dispersion is less even at 85.7% when the sum insured in considered. The dispersion is found to be similar in degree in the rabi season in terms of insured farmers but more even in terms of sum insured.

Table 4.2: Leading participant States in NAIS

	Sum insured/Cropped area	**Share of Farmers insured**		**Share of Sum insured**	
Rank	**Total**	**Kharif**	**Rabi**	**Kharif**	**Rabi**
1	Andhra Pradesh	Maharashtra	Madhya Pradesh	Andhra Pradesh	Madhya Pradesh
2	Gujarat	Andhra Pradesh	Uttar Pradesh	Gujarat	Uttar Pradesh
3	Karnataka	Rajasthan	Rajasthan	Madhya Pradesh	Rajasthan
4	Orissa	Madhya Pradesh	West Bengal	Rajasthan	West Bengal

Comparing the participating states with respect to the expansion of coverage, not all states are found to have shown progress. Considering the number of farmers covered that states that showed significant increases between the years 200-01 to 2005-06 are Rajasthan, Madhya Pradesh, Jharkhand, West Bengal and Karnataka while in Gujarat and Maharashtra the numbers actually went down. The performances are better in terms of the sum insured in which case over 10 states have shown considerable increases, six states show no change and in Maharashtra there is a decline even in the nominal value of the sum insured. Interestingly, in Gujarat the insured sum in nominal value has increased but the number of insured farmers decreased.

Penetration of coverage by Regions

It is well recognized that the irrigation endowment is a crucial determinant of risk in agriculture and can be a parameter for risk classification. It is therefore pertinent to view the acceptance of NAIS in a disaggregated way going by the irrigation regime. We have classified the major states into three categories Highly irrigated (HI), Medium irrigated (MI) and Low irrigated (LI) and explained this in Appendix III of the Report.

Table 4.2 based on 2003-04 data on land use and 1991 agricultural census the HI states constitute 23.9% of cropped area. The corresponding shares are 29.6% and 41% for MI and LI states. The LI states also account for larger shares of area under foodgrains-oilseeds and commercial crops. The HI states have a low share in the total cropped area in the country compared to the others but this group has a relatively high share (43.76%) of small and marginal farmers. The sum insured per cropped hectare is highest at Rs 861.60 in the MI group followed by the LI group and is least in the HI group. The LI group has the lowest share in insured sum and this share is less than half its share in the cropped area. While same shares are relatively more in both MI and LI, the relative share is highest in the MI group of states. IN Appendix III we find that MI has the highest shares in respect of Cotton and Groundnut and the variability of these crops easured by the coefficients of variation around mean of the six years is also considerable. While the participation in the HI group is explained by the relatively low risk faced by the farmers in the irrigated region, this behaviour means also exclusion of a large share of small and marginal farmers. Though farming in the LI region is possibly more risky than in the MI region, the latter attracts a higher share of participation in the NAIS. Similar details for the states within the regions are provided in the Appendix table 4.4A.

Inclusion of Small Farm holders

An important parameter used for assessing the success of a scheme in which there is public financial involvement is the benefits reaching the target groups. In agriculture the small holding farmers are usually the targeted beneficiaries who are important both from political and economic point of view. Table 4.3 shows that for the select major states, the share of small farmers in the total number and area covered are 64% and 40% respectively and that in the sum insured is 49%. Thus the share of farmers head count is greater than that in the area. The share of farmers in coverage is however significantly less than the share of small farmers in the total number of farmers (81%) but the share of insured area under small holding is nearly the same. This suggests moderate degree of inclusion has been achieved. The small farmers' share is high in most of the HI region states but a comparison with share in total indicates a fair degree of inclusion in Bihar only where 94.16% of the insured farmers are small farmers as against their share of 93.4% in the farmer community. In the other two regions too the share in coverage falls short of their actual shares in the farmer community. The claim to premium ratio which is an indicator of the financial benefit for the farmers is favourable to the small farmers on in the HI region and the same ratio is adverse for them in the MI region at 1.69. Appendix Tables 4.6A give further details of the benefits reaching small farmers.

Table4.2: Crop insurance and Shares of State-groups in all India totals 2003-04

State groups	Sum Insured Rs/Hect.	Indicators of Share	Sum Insured	Small/marginal Holdings	Cropped Area	Irrigated Area	FGOLS Area	COM Area
High Irrigated	**266.76**	%share in India	10.84	43.76	23.80	39.47	25.21	19.06
		Relative to GCA	0.46	1.84	1.00	1.66	1.55	0.80
Medium Irrigated	**861.59**	%share in India	43.49	20.98	29.56	27.16	28.18	34.20
		Relative to GCA	1.47	0.71	1.00	0.92	0.95	1.16
Low Irrigated	**651.47**	%share in India	45.60	32.84	40.99	22.32	39.86	44.79
		Relative to GCA	1.11	0.80	1.00	0.54	0.97	1.09

Note: Relative to GCA is obtained as ratio of the share to share in cropped area. FGOLS= Foodgrains-oilseeds, COM=Commercial. The states are mentioned in Table 4.4A.

Source: AIC, Agricultural census 1995, Agricultural Statistics at a Glance

Table 4.3: Small Farmer shares in total and crop insurance (%) and the Claim/premium ratio 2000-01 to2005-06							
	Insurance coverage			All	Small	Insured and uninsured	
NAME	Farmers	Area	Sum insured	Claim/Premium		Farmers	Area
Bihar	94.16	83.58	88.67	11.49	11.51	93.42	62.29
Haryana	47.07	28.04	28.92	0.27	0.49	65.31	20.81
Tamilnadu	68.56	46.00	48.11	6.22	6.29	89.99	55.53
Uttar Pradesh	82.31	58.63	64.92	1.83	1.63	91.13	61.24
HI	**81.91**	**59.56**	**66.00**	**4.10**	**4.48**	**90.61**	**56.24**
Andhra Pradesh	80.85	62.14	67.80	2.67	1.96	82.73	46.32
Gujarat	48.18	24.14	29.30	3.76	1.25	59.59	25.44
Rajasthan	33.41	19.64	21.40	2.90	1.69	52.57	12.41
Uttarakhand	94.22	85.34	81.11	0.91	1.01	88.41	60.96
West Bengal	99.56	98.00	98.31	1.51	1.51	95.30	78.71
MI	**68.17**	**41.35**	**51.42**	**3.11**	**1.69**	**76.53**	**39.61**
Assam	96.58	92.53	94.54	0.82	0.67	81.02	42.54
Chattisgarh	62.40	35.69	38.64	3.33	2.93	75.67	34.35
Himachal	89.27	75.94	86.57	4.21	4.35	86.32	50.77
Jharkhand	59.11	59.41	63.96	12.65	11.28		
Karnataka	41.16	26.65	31.84	4.86	1.19	72.92	34.40
Madhya Pradesh	50.12	23.31	23.23	1.79	1.84	65.07	25.81
Maharashtra	55.98	42.24	41.08	2.32	2.28	75.42	40.00
Meghalaya	94.00	85.19	90.15	0.46	0.18	80.37	52.52
Orissa	89.46	73.24	80.85	2.87	2.63	83.80	53.12
LI	**58.08**	**34.74**	**41.76**	**2.93**	**2.28**	**74.56**	**36.22**
Pooled	**64.33**	**39.72**	**49.17**	**3.11**	**2.23**	**81.27**	**41.79**
Note: Small farmer is defined as farmer holding up to 2 hectares land. Share of small farmers in total is as reported by Agricultural Census 2001.							

The performance of NAIS

At the end of 2005-06 over 9.5% of the cropped area in the country was covered, the sum insured constituted 2.7% of the gross domestic product from agriculture of India, while the sum insured per hectare of gross cropped area in the country rose from Rs 455 in 2001 to Rs 537 in 2005 (Table 4.4). About 10% of the farmers in the country are covered (GOI, 2004). The achievements are modest but indicates a progressive tendency in the following standards: (1) The place of crop insurance has improved in terms of its share in Gross cropped area (8.7 to 9.9) and Gross domestic product of agriculture (1.93 to 2.23), (2) the distribution across the two seasons improved, (3) the sum insured per hectare has increased (Rs 455 to Rs 586) and (4) the claim to premium ratio has progressively come down (5.5 to 3.2) indicating improvement of financial viability (Table 4.5).

Table 4.4 : Growing importance of Crop insurance in Indian Agriculture				
	CI/GDPA	CIA/GCA	CI/GCA	CI/CIA
Year	%	%	Rs/Hect.	Rs/Hect.
2000-01	1.93	8.73	454.85	5208.46
2001-02	2.15	8.42	472.47	5613.20
2002-03	2.34	11.12	640.34	5758.37
2003-04	2.23	9.87	585.57	5930.47
2000-01 to 2003-04				
Average	2.27	9.51	536.72	5644.34

There are a few issues of concern nevertheless. First, of the Rs 12 thousand crores insured nearly 94% are loanee insurance, i.e., insured by virtue of the farmers' institutional borrowing. This suggests that the compulsion element rather free choice still plays a major role in the acceptance of the scheme. Second, the kharif season crop insurance is almost four times the rabi season insurance reflecting poorly on the risk pooling. Third, the commercial result is also poor since the claims are more than thrice the premium receipts in all cases when ideally the two should be about equal. Finally, it may be recalled that According to National Sample Survey findings (NSSO, 2005) in the 59the Round Situation Assessment Survey of Farmers, only 4% of farmer households reported ever having insured their crops and among those who had never insured, 57% were unaware of the practice and 24% said the facility was not available. The crop insurance itself has the 'task of educating the cultivator into appreciation of the value of insurance by actual demonstration of its working and effective publicity' (Priolkar, 1949).

Table 4.5: Performance of crop insurance in India							
YEAR	Claim/ Premiu	Sum Insured			Insurance intensities		
		Total	Non-loanee	Kharif/Rabi	Sum/hect	Sum/farmer	Area/Farmer
Year	(Cum.)	000Cr	%	Ratio	Rs	Rs	Hect.
2000	5.47	8.51	1.95	4.31	5208.5	8100.2	1.56
2001	3.50	9.00	4.02	5.01	5613.2	8449.1	1.51
2002	4.33	11.27	11.88	5.13	5758.4	9316.9	1.62
2003	4.31	11.16	14.40	2.66	5930.5	9008.6	1.52
2004	3.66	16.94	6.98	3.49	5721.4	10448.0	1.83
2005	3.22	18.58	5.56	2.67	6697.8	11116.6	1.66
Avg.e	3.22	12.58	7.47	3.88	5821.6	9406.6	1.61
Note: Claim/premium is cumulated over years.							

Appendix Tables

Table 4.1A: Expansion of Crop Insurance coverage in Indian Agriculture			
Year	**Farmers Insured**	**Area Insured**	**Sum Insured**
(Units)	(Millions number)	(Million hectares)	(Rs Crores)
1999-00	0.58	0.78	356.41
2000-01	10.50	16.33	8506.07
2001-02	10.65	16.03	8999.97
2002-03	12.10	19.57	11269.24
2003-04	12.39	18.82	11163.62
2004-05	16.22	29.62	16944.70
2005-06	16.72	27.75	18584.95
2006-07*	6.65	10.11	750.03
2000-01 to 2005-06			
Total	78.58	128.12	75468.55
Average	15.72	25.62	15093.71
Growth rate (annual)	11.85	13.98	23.70
Note: 2006-07 is provisional as reported in Economic Survey 2007 The growth rate is computed as 2005-06 over 2000-01.			

Table 4.2A-1: List of leading crops insured in India and shares in Sum insured : Kharif season								
Year	2000	2000	2000	2005	2005	2005	2000-05	**2000-05**
Ranks	**Foodgrains Oilseeds**	**Commercial Horti.**	**All Crops**	**Foodgrains Oilseeds**	**Commercial**	**All Crops**	**All Crops**	**Share in Sum Insured %**
1	Paddy	Cotton	Paddy	Paddy	Sugarcane	Paddy	Paddy	**34.9539**
2	Groundnut	Sugarcane	Groundnut	Groundnut	Cotton	Groundnut	Groundnut	**22.7722**
3	Soyabean	Potato	Cotton	Soyabean	Potato	Soyabean	Cotton	**9.8354**
4	Redgram		Sugarcane	Bajra	Onion	Sugarcane	Soyabean	**8.9091**
5	Jowar		Soyabean	Redgram	Chilly	Bajra	Sugarcane	**8.3756**
6	Bajra		Redgram	Maize	Banana	Cotton	Bajra	**3.2016**
7	Maize		Jowar	Greengram	Ginger	Redgram	Redgram	**2.5286**
8	Sunflower		Bajra	Guar	Tapioca	Maize	Maize	**2.3264**
9	Castor		Maize	Jowar	Turmeric	Greengram	Jowar	**1.3767**
10	Greengram		Sunflower	Blackgram		Guar	Greengram	**0.8851**
11	Blackgram		Castor	Castor		Jowar	Blackgram	**0.7810**
12			Greengram	Sunflower		Blackgram	Onion	**0.7128**
13				Moth		Potato	Castor	**0.6097**
14				Sesamum		Castor	Sunflower	**0.5994**
15				Cow Pea		Sunflower	Chilly	**0.5580**
16						Onion	Guar	**0.5370**
17						Chilly	Potato	**0.4663**
18						Moth	Banana	**0.1487**
19						Sesamum	Sesamum	**0.1416**
20						Banana	Moth	**0.1197**
21							Ragi	**0.1066**

Table 4.2A-2: List of leading crops insured in India and shares in Sum insured : Rabi season								
Year	1999	1999	1999	2005	2005	2005	2000-05	**2000-05**
Ranks	**Foodgrains Oilseeds**	**Commercial Horti.**	**All Crops**	**Foodgrains Oilseeds**	**Commercial Horti.**	**All Crops**	**All Crops**	**Share in Sum Insured %**
1	Paddy	Sugarcane	Sugarcane	Wheat	Potato	Wheat	Wheat	**32.99**
2	Wheat	Potato	Paddy	Paddy	Isabgol	Paddy	Paddy	**24.61**
3	Groundnut	Cotton	Wheat	Rape & Mustard	Jeera	Potato	Potato	**13.55**
4	Gram		Groundnut	Bengalgram	Sugarcane	Rape & Mustard	Horsegram	**5.38**
5	Rape & Mustard		Gram	Groundnut	Corriander	Bengalgram	Rape & Mustard	**4.21**
6	Jowar		Potato	Sunflower	Banana	Groundnut	Sugarcane	**4.00**
7			Rape & Mustard	Jowar		Sunflower	Groundnut	**3.78**
8			Jowar	Peas	Chillies	Jowar	Jowar	**2.84**
9			Safflower	Lentil	Tapioca	Peas	Blackgram	**2.74**
10			Sunflower	Maize	Methi	Isabgol	Sunflower	**2.13**
11				Barley	Sonf	Jeera	Peas	**0.57**
12				Safflower	Cotton	Sugarcane	Safflower	**0.54**
13				Blackgram	Ginger	Lentil	Corriander	**0.41**
14					Garlic	Maize	Onion	**0.39**
15						Corriander	Jeera	**0.38**
16						Banana	Banana	**0.34**
17						Onion	Lentil	**0.26**
18						Barley	Isabgol	**0.26**
19						Chillies	Maize	**0.19**
20							Ragi	**0.18**

Table 4.3A-1 : State wise insurance coverage 2005:kharif						
	Farmers covered			Sum insured Rs lakh		
State	**Number**	**%Share**	**%Cu share**	**Rs lakh**	**%Share**	**%Cu share**
Andhra pradesh	1980038	15.63	33.91	319954.8	23.68	23.68
Gujarat	879618	6.94	72.16	199282.5	14.75	38.43
Madhya Pradesh	1398918	11.04	58.11	151298.2	11.20	49.63
Rajasthan	1666628	13.16	47.07	148058.9	10.96	60.59
Maharashtra	2314663	18.27	18.27	121965.1	9.03	69.62
Karnataka	854398	6.75	78.91	117866.1	8.72	78.34
Orissa	900022	7.11	65.22	96259.65	7.13	85.47
Uttar Pradesh	505574	3.99	94.25	57073.69	4.22	89.69
Chhattisgarh	654373	5.17	90.26	43835.66	3.24	92.94
Bihar	221985	1.75	99.28	33911.27	2.51	95.45
Jharkhand	783542	6.19	85.09	27621.24	2.04	97.49
West Bengal	414852	3.28	97.52	25023.09	1.85	99.34
Tamilnadu	12999	0.10	99.83	2911.65	0.22	99.56
Kerala	13986	0.11	99.73	2294.866	0.17	99.73
Haryana	42939	0.34	99.62	1396.98	0.10	99.83
Uttaranchal	7174	0.06	99.96	932.6	0.07	99.90
Assam	8771	0.07	99.90	890.84	0.07	99.97
Himchal	4433	0.03	99.99	312.04	0.02	99.99
Tripura	763	0.01	100.00	80.67	0.01	100.00
Meghalaya	456	0.00	100.00	40.76	0.00	100.00
DISP (Upper Bound=95.6)	87.4			85.7		

Table 4.3A-2 : State wise coverage 2005: Rabi						
	Sum insured			Farmers covered		
State	**Rs lakh**	**%Share**	**%Cu share**	**Number**	**%Share**	**%Cu share**
Madhya Pradesh	97848.25	19.34	19.34	777386	19.24	19.24
Uttar Pradesh	97668.81	19.30	38.64	771009	19.08	38.32
Rajasthan	96980.37	19.16	57.80	670368	16.59	54.91
West Bengal	48471.05	9.58	67.38	482539	11.94	66.86
Andhra Pradesh	45282.12	8.95	76.33	267497	6.62	73.48
Bihar	28439.99	5.62	81.94	187961	4.65	89.74
Orissa	27559.93	5.45	87.39	230039	5.69	85.09
Tamilnadu	22803.37	4.51	91.90	106747	2.64	95.27
Kanataka	10368.88	2.05	93.95	116369	2.88	92.62
Maharashtra	9680.301	1.91	95.86	239266	5.92	79.40
Haryana	9502.81	1.88	97.74	78461	1.94	97.21
Gujarat	2657.871	0.53	98.26	11457	0.28	99.30
Kerala	2586.23	0.51	98.77	17790	0.44	98.68
Jharkhand	1989.629	0.39	99.17	41580	1.03	98.24
Assam	1366.68	0.27	99.44	13764	0.34	99.02
Uttranchal	1062.36	0.21	99.65	8376	0.21	99.79
Chhattisgarh	1057.16	0.21	99.85	11377	0.28	99.58
Himchal	362.26	0.07	99.93	5066	0.13	99.92
Meghalaya	191.99	0.04	99.96	1513	0.04	100.00
Tripura	180.1	0.04	100.00	1888	0.05	99.96
DISP (Upper Bound =95.2)	88.0			87.3		

Table4.4A: State shares in Total insurance and other categories								
	Sum	Small/marginal	Cropped	Irrigated	RW	CCER	PLOLS	COM
	Insured	Holdings	area	area	Area	Area	Area	Area
	%	%	%	%	%	%	%	%
High Irrigated	**10.84**	**43.76**	**23.80**	**39.47**	**36.91**	**15.45**	**14.43**	**19.06**
Bihar	1.28	13.88	4.13	5.95	8.22	2.11	1.76	1.66
Haryana	0.00	1.24	3.35	6.96	4.81	2.50	1.78	3.34
Tamilnadu	0.93	7.75	2.79	3.23	2.03	3.08	2.72	3.87
Uttar-Pradesh	8.63	20.89	13.53	23.34	21.86	7.76	8.17	10.19
Medium Irrigated	**43.49**	**20.98**	**29.56**	**27.16**	**19.12**	**37.88**	**35.13**	**34.20**
AndhraPradesh	21.23	9.23	6.49	6.22	4.31	5.32	10.03	6.92
Gujarat	17.45	2.26	5.93	5.43	2.08	5.74	8.08	9.84
Rajasthan	0.38	2.91	11.36	8.32	3.04	25.64	15.04	10.49
Uttarakhand	0.06	0.00	0.69	0.74	0.58	0.97	0.00	1.39
West-Bengal	4.36	6.58	5.09	6.44	9.11	0.19	1.97	5.56
Low Irrigated	**45.60**	**32.84**	**40.99**	**22.32**	**32.17**	**44.21**	**48.30**	**44.79**
Assam	0.07	2.40	2.08	0.28	3.76	0.00	0.64	2.43
Chhatisgarh	2.61	0.00	2.99	1.53	5.39	1.20	1.87	1.69
Himachal	0.02	0.79	0.50	0.24	0.52	1.10	0.00	0.58
Jharkhand	0.16	0.00	1.17	0.30	2.08	0.81	0.57	0.63
Karnataka	13.92	4.66	6.01	3.52	2.00	11.88	8.74	5.25
Kerala	0.46	6.66	1.55	0.55	0.42	0.00	0.00	6.11
MadhyaPradesh	10.42	6.68	10.38	7.52	8.28	7.59	20.98	4.21
Maharashtra	11.37	8.03	11.64	4.99	3.20	21.06	13.36	16.49
Meghalaya	0.01	0.13	0.14	0.11	0.00	0.00	0.00	0.62
Orissa	6.54	3.51	4.53	3.28	6.51	0.55	2.14	6.78
All India	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 4.5A-1:Insurance benefit for Small farmers (%share):Kharif					
NAME	Farmers covered	Area covered	Sum insured	Farmer benefited	Claim/premium
Andhra Pradesh	81.30	62.59	68.46	73.29	2.04
Assam	97.08	94.12	94.43	83.42	1.56
Bihar	94.54	83.02	89.65	92.75	13.55
Chhattisgarh	62.77	36.06	38.93	58.53	2.92
Gujarat	48.27	24.15	29.32	30.20	1.25
Haryana	43.04	25.39	21.32	67.68	0.82
Himchal	88.44	72.62	86.67	89.27	4.93
Jharkhand	57.56	58.53	62.77	53.77	11.95
Karnataka	48.90	32.21	35.08	40.94	0.76
Kerala	96.43	88.72	92.37	90.08	2.44
Madhya Pradesh	54.37	26.24	25.96	54.78	1.81
Maharashtra	56.06	42.79	41.14	55.96	1.75
Meghalaya	90.86	81.85	82.83	76.05	0.36
Orissa	89.13	71.99	80.00	85.52	3.12
Rajasthan	34.59	21.02	23.63	22.96	2.03
Tamilnadu	60.20	37.51	40.13	63.76	1.64
Uttar	82.04	64.01	61.76	78.38	2.05
Uttranchal	93.25	85.64	77.40	93.66	0.73
West Bengal	99.58	98.40	98.63	99.94	1.64

Table 4.5A-2:Insurance benefit for Small farmers (%share):Rabi					
Name	Farmers covered	Area covered	Sum insured	Farmer benefited	Claim/premium
Andhra Pradesh	77.11	58.54	62.78	75.54	1.02
Assam	96.18	90.94	94.86	97.36	0.25
Bihar	93.44	84.65	88.45	97.28	5.53
Chhattisgarh	37.70	16.65	24.58	39.63	3.16
Gujarat	43.52	23.17	28.58	31.76	2.07
Haryana	57.92	36.57	40.37		0.00
Himchal	93.20	84.81	87.84	82.84	1.64
Jharkhand	81.15	70.98	92.99	92.29	1.50
Kanrataka	22.20	13.40	80.56	19.45	8.31
Kerala	98.22	94.19	94.75	97.64	2.52
Madhya	41.76	18.34	20.34	45.52	2.00
Maharashtra	55.48	38.83	71.86	53.27	9.36
Meghalaya	95.23	87.05	92.18	79.76	0.17
Orissa	90.89	79.80	84.25	95.63	0.19
Rajasthan	30.15	15.08	17.39	29.86	0.23
Tamilnadu	69.71	47.33	50.17	70.47	6.91
Uttar Pradesh	82.52	54.09	67.54	84.21	1.30
Uttranchal	95.11	85.11	84.38	98.37	1.26
West Bengal	99.53	97.56	98.13	99.32	1.45

5. Financial performance of the NAIS

Farmers' participation is only an incomplete indicator of the success of a scheme without taking account of its financial viability. The viability of a crop insurance scheme is its ability to be self-reliant and grow out of government support. The viability can be assessed by the difference between receipts and expenditures. In a temporal perspective, this difference in any one year will not say much. The receipt will in general be expected to exceed the payments in a good years and fall short in poor years when a large number of farmers claim damages. In principle, over a number of years the average receipt will ideally converge with the average expenditure. Similarly, if risk is pooled across insured units in a balanced way, one may expect only some units to be claiming more than their contributions via premiums but not all. In fact the deficit or surplus status of a unit is expected to be random so that no unit can be marked as loss making or gainful in general. Such randomness could ideally be expected to prevail also across areas[1], crops and seasons. When pooling is expected also across the crops, the financial performances of the crops also will vary in a relative sense across areas and across years so that no crop will be expected to bear the cost of another as a rule. In a typically fair multi-crop insurance, no crop, area or season will be expected to make up for shortfalls of others in a consistent way. While the risk exposures can be different across the categories, the pricing of the contracts must be sufficient to even out the expectation of losses so that randomness of financial performances across crops, regions and seasons may result.

In the event that some specific units perform poorly with consistency, the underlying reason may be faulty analysis and pricing. This is distinct from what is known as adverse selection (see Chapter 2) that arises on account of lack of information on the insured units. Such informational inadequacy becomes a serious as the insured unit becomes smaller. Classification of risk

[1] This is the Area concept of the NAIS as described in Appendix II.

profile becomes relatively easier at higher levels of aggregation such as for a state or a crop. Adverse selection is more difficult to detect and correct by pricing mechanism (such as adjusting the premium rate and the threshold yield) because the insurer cannot identify the insured unit as risky with the information available to him. In the presence of adverse selection, the whole pool would become risky (since the less risky or safe ones would not like to participate). On the other hand, a consistent pattern of loss distribution across units would also reflect adverse pooling of risk but that is correctable by adjusting the premium rates and the guaranteed yields appropriately. Another problem that can leave the insurer nearly helpless arises when pooling across units is inhibited by their commonality. Correlated risk can be a factor contributing to high levels of losses on the whole to which a large majority of the insured units contribute.

In this chapter we look at the loss generated by the NAIS from the insurer's point of view. For simplicity and lack of data, we have ignored the administrative cost and also receipts of interest income and defined the insurer's loss as the difference between the claims payable and the premiums received so that

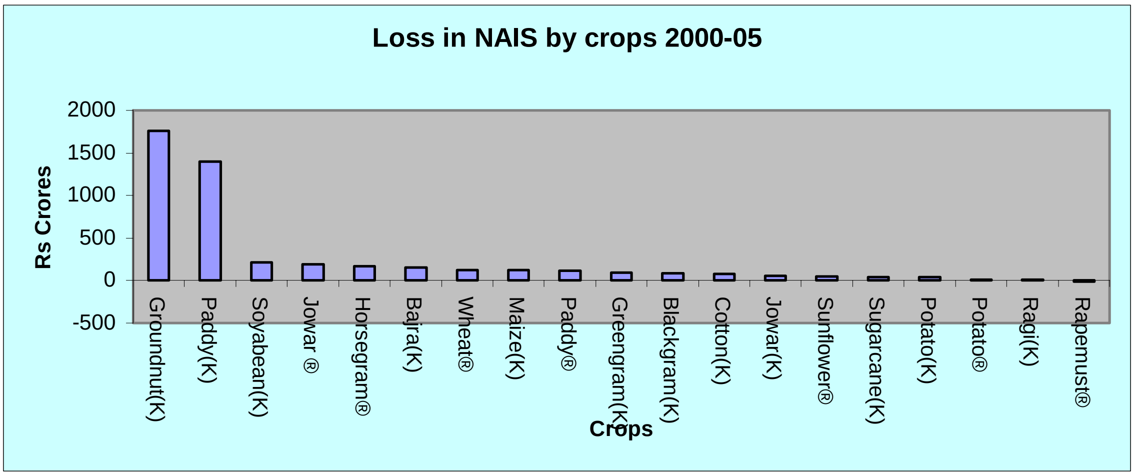
LOSS= Claims - Premiums.

Since claims are the major portion of the outflow and premiums of receipts. Losses being expected to vary across the years, we considered the performance over the six years of study 2000-01 to 2005-06. We have also studied the financial viability of the NAIS by examining the loss with a disaggregate view, based on irrigation endowments of regions.

Table 5.1: Loss in Crop insurance over the years Total					
YEAR	Loss	Sum insured	Area insured	Farmers insured	Small farmers insured
	Rs crores	Rs crores	Mill. Hectares	Mill.	Mill.
2000	1047.44	8506.07	16.33	10.50	6.97
2001	266.43	8999.97	16.03	10.65	7.15
2002	1648.89	11269.24	19.57	12.10	8.19
2003	793.16	11163.62	18.82	12.39	7.68
2004	663.43	16944.70	29.62	16.22	10.37
2005	498.87	18582.97	27.75	16.72	10.28
2000-05					
Total	4918.23	75466.57	128.12	78.58	50.63
Kharif	4249.88	58637.61	98.80	60.20	38.78
Rabi	668.35	16828.96	29.32	18.37	11.84
%Kharif	86.41	77.70	77.11	76.62	76.61

The NAIS has incurred losses in all the years of its existence in 200-01 to 2005-06 showing no sign of a temporal balance. Over the years the total loss has been nearly Rs 5 thousand crores to which the kharif season contributed the lion share of 86%. The total absolute loss was highest in the year 2002-03 in which it rose to Rs 1.6 thousand crores. This was a year when Indian agriculture was severely affected by climatic conditions. There have therefore been year to year variations of loss though around a mean positive figure of Rs 819 crores rather than a figure close to zero as would be expected in a perfect case of temporal pooling. In fact this year was an outlying year for the scheme because all the other years excepting 2000-01 the first year for kharif season insurance, the loss was lower than the mean value so that the mean comes down to Rs 654 crores if the year 2002-03 is excluded. This suggests that a catastrophe caused by one year's climatic conditions could take many years of normal performances to offset. It is also notable that the kharif season contributes as much as 86% in the total loss but only 78% of the sum insured and 76.5% of the farmers insured, which is less than its share in the sum insured.

Figure 5.1



Note: K and R in parentheses stand for kharif and rabi seasons respectively.

Among the crops, Groundnut in kharif season is found to have generated the largest loss to the NAIS followed by kharif Paddy (Figure 5.1). Among the other loss making crops are Soyabean, Bajra and Maize in the kharif season and Jowar, Wheat and Paddy in the rabi season. Since nearly all crops are found to be loss making, the loss may be increasing with the sum insured under the crop. To factor out the effect of scale we have divided the crop share in loss in the season by its share in the sum insured to obtain a coefficient of loss. In the kharif season, three minor crops Black gram, Green gram and Ragi have high coefficient but among the major crops under insurance only Groundnut has a relatively high coefficient of 1.82. For Groundnut, which takes up 23% of the sum insured, 18% of the area insured and 15% of farmers covered, the loss share is much higher at 41%. For all other crops including paddy that has the second largest share of 33% in the loss and the share in sum insured is 35%, the coefficients are less than one. For Paddy the share of loss is only 94% of the share in sum insured. Cotton which claims 10% of the sum insured and 9% of the insured farmers, contributed only 2% to the loss. In the rabi season, Jowar, Sunflower and Horsegram have coefficients more than one. Potato has the lowest coefficient. Except for a handful of commercial crops and Rapeseed-mustard crop, the crops consistently generated losses in all the years considered.

To examine the effectiveness of horizontal pooling, we look at the roles of the states in generating losses in NAIS (Figure 5.2). Gujarat has been the largest contributor to loss in NAIS followed by Andhra Pradesh, Karnataka and Bihar in the kharif season. The ranks are different in the rabi season when Karnataka and Maharashtra are the major loss makers followed by Madhya Pradesh, Bihar, Uttar Pradesh and West Bengal. Six states Bihar, Jharkhand, Gujarat, Karnataka, Himachal and Rajasthan in the kharif season and five states Karnataka, Maharashtra, Tamilnadu, Bihar and Chhattisgarh have generated higher shares in the total loss than their shares in the sum insured. Bihar and Jharkhand have the highest coefficients of loss though their shares in the loss outcome are relatively lower. These states and Gujarat also have high values of loss generated per farmer (Table 5.2A).

Figure 5.2-1

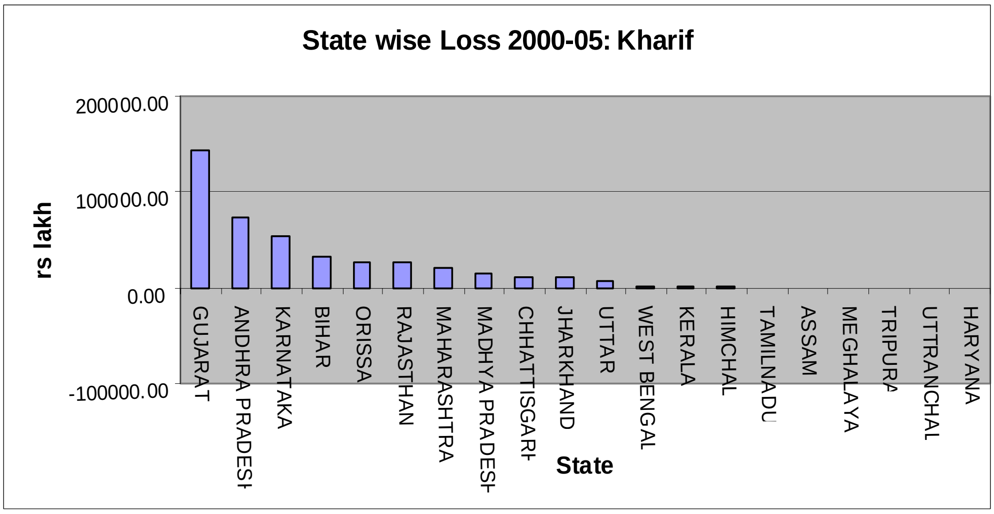
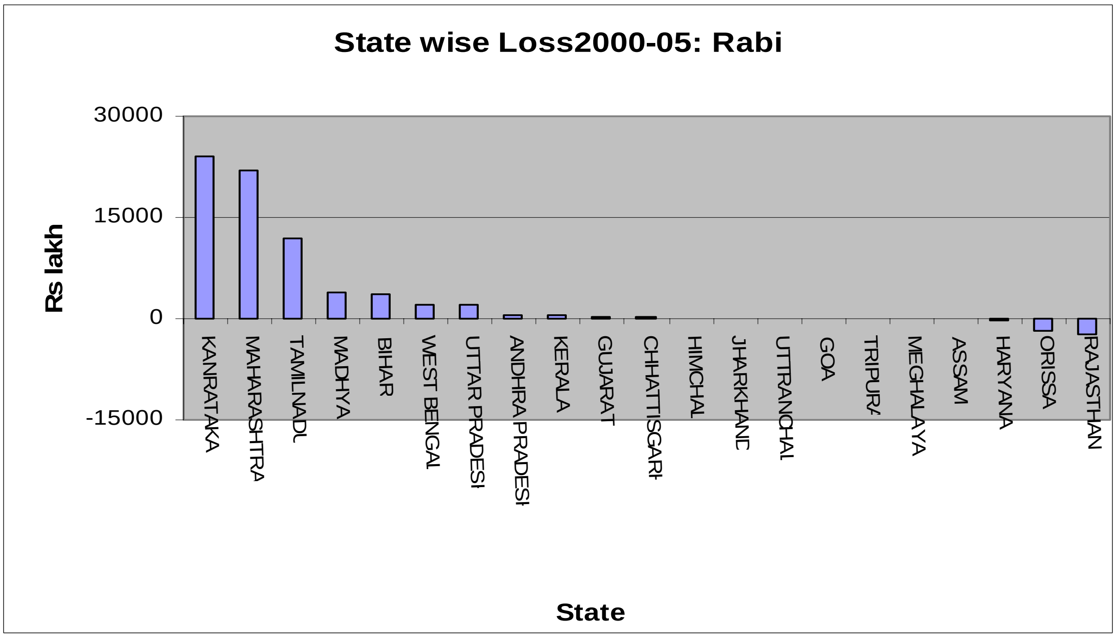


Figure 5.2-2



Aggregating the state level performances we also present the performances by the three broad regions based on irrigation endowment. The criterion for classification is the irrigation endowment (as given in Appendix III.3) based on the understanding that irrigation would be an important discriminator for risk in agriculture. The Medium irrigated (MI) region has been the largest contributor in kharif season and Low irrigated (LI) leads in rabi season losses. It is also interesting and it makes sense for the most vulnerable to participate the 'safe' region High irrigated (HI) leads in loss per every Rs 100 insured and also in the loss per area insured in the kharif season. This may be indicative of a latent tendency of adverse selection within the region which is not surprising as the participation itself is weak in the region. However, there are large variations across the states within any group despite their similarities in irrigation intensities. For example large part of the losses reported in the HI region is accounted by Bihar only. The coefficients of variation of the Loss per Rs 100 of sum insured is high in all cases and particularly so in HI region for kharif crops and MI region for rabi crops suggesting that given the nature of participation, the tendency of losses may not be strongly linked to the irrigation status.

Table 5.2: Loss distribution of NAIS (2000-01 to 2005-06) Region wise					
Region	Loss share %	Loss per farmer (Rs)	Loss per sum insured (%)	Loss per area insured (Rs/Hect.)	CV(Loss per sum insured)
Kharif season					
HI	10.01	1020.05	10.36	705.16	1.67
MI	60.64	1084.93	8.23	585.57	0.57
LI	29.34	405.86	5.23	274.15	0.73
ALL	100.00	724.57	7.17	444.85	0.36
Rabi season					
HI	26.37	365.81	3.57	252.08	1.62
MI	0.65	9.12	0.08	7.53	15.74
LI	72.98	571.18	7.77	298.95	1.45
ALL	100.00	368.86	4.03	229.85	0.95

Note: The states included are reported in Appendix III.3 (extended group of states). The last column in the Table gives the coefficient of variation.

Appendix

Table 5.1A-1 : Crop share (%) in Loss and coverage kharif 2000-05							
Crop	Loss	Sum insured	Area insured	Farmers insured	Small farmer	Loss coeff	No. of deficit years
Paddy	32.99	34.95	33.02	39.45	48.96	0.94	6
Maize	2.92	2.33	2.11	2.91	2.84	1.25	6
Jowar	1.32	1.38	2.60	3.65	2.87	0.96	6
Bajra	3.64	3.20	6.19	4.94	3.22	1.14	6
Ragi	0.24	0.11	0.11	0.17	0.15	2.24	3
Blackgram	2.04	0.78	1.27	1.82	1.43	2.61	6
Greengram	2.14	0.89	1.70	2.08	1.29	2.41	6
Groundnut	41.34	22.77	17.75	14.86	13.19	1.82	6
Soyabean	4.97	8.91	15.38	9.62	7.36	0.56	4
Sugarcane	1.00	8.38	3.43	4.79	5.93	0.12	4
Cotton	1.91	9.84	10.11	8.69	7.68	0.19	3
Others	5.50	6.48	6.34	7.03	5.08	0.85	

Note: Loss coeff is the ratio of loss share to sum insured share. Deficit year is a year in which claim is greater than premium.

Table 5.1A-2 : Crop share (%) in Loss and coverage rabi 2000-05							
Crop	Loss	Sum insured	Area insured	Farmers insured	Small farmer	Loss coeff	No. of deficit years
Paddy	17.07	24.53	13.46	19.96	27.03	0.70	5.00
Wheat	18.69	33.35	48.07	37.19	36.78	0.56	5.00
Jowar	28.59	2.88	7.46	8.02	5.60	9.92	5.00
Rape & Mustard	-1.58	4.28	4.18	3.48	2.04	-0.37	1.00
Horsegram	24.96	5.49	9.61	8.15	4.79	4.55	5.00
Sunflower	7.28	2.17	3.26	2.78	1.15	3.36	3.00
Potato	1.63	13.76	3.88	8.37	12.14	0.12	3.00
Others	3.35	13.54	10.07	12.05	10.46	0.25	
Note: See Table 11.A-2							

Table 5.2A-1States share of coverage and Loss (%): Kharif							
	Farmer	Area	Sum	Loss	Loss coeff	Loss per	Loss per
Name	Covered (%)	Covered (%)	Insured (%)	(%)	%	Farmer (Rs)	Sum (%)
Bihar	1.48	1.01	1.69	7.53	444.83	3582.77	32.25
Jharkhand	1.55	0.52	0.61	2.57	423.60	1174.61	30.71
Gujarat	10.81	16.19	19.63	33.60	171.13	2194.78	12.40
Karnataka	6.91	6.50	8.75	12.55	143.34	1281.92	10.39
Himchal	0.16	0.05	0.07	0.09	126.32	407.10	9.16
Rajasthan	5.29	8.19	4.92	6.08	123.77	811.62	8.97
Orissa	8.18	5.33	7.32	6.43	87.81	554.90	6.37
Chhattisgarh	5.71	7.57	3.31	2.77	83.59	342.04	6.06
Andhra pradesh	18.04	16.66	24.30	17.35	71.41	679.02	5.18
Kerala	0.14	0.08	0.19	0.12	64.57	606.43	4.68
Madhya pradesh	11.24	17.59	8.85	3.68	41.62	231.32	3.02
Uttar	4.93	4.61	4.69	1.89	40.23	270.10	2.92
Maharashtra	21.76	14.08	13.42	5.01	37.36	162.62	2.71
Tamilnadu	0.14	0.16	0.24	0.05	22.09	271.29	1.60
West bengal	3.20	1.13	1.68	0.35	20.96	77.78	1.52
Assam	0.05	0.03	0.04	0.01	13.12	72.56	0.95
Meghalaya	0.00	0.00	0.00	0.00	8.11	41.56	0.59
Uttranchal	0.03	0.02	0.03	0.00	-8.01	-54.13	-0.58
Tripura	0.00	0.00	0.00	0.00	-9.04	-65.88	-0.66
Sikkim	0.00	0.00	0.00	0.00	-13.65	-92.51	-0.99
Goa	0.00	0.00	0.00	0.00	-24.93	-71.25	-1.81
Jammu & kashmir	0.01	0.01	0.00	0.00	-34.51	-132.43	-2.50
Haryana	0.35	0.28	0.24	-0.08	-34.73	-170.15	-2.52
Note: Loss coeff: Loss share as percentage of share in Sum insured							

Table 5.2-2:States share of coverage and Loss (%): Rabi							
	Farmer	Area	Sum	Loss	Loss coeff	Loss per	Loss per
State	Covered (%)	Covered (%)	Insured (%)	(%)	%	Sum (%)	Farmer (Rs)
Karnataka	9.26	9.21	6.33	36.21	571.71	22.72	1422.54
Maharashtra	11.82	7.56	6.42	33.11	515.67	20.50	1018.96
Tamilnadu	3.32	3.51	5.83	17.84	306.05	12.16	1952.95
Bihar	2.56	1.82	3.39	5.44	160.34	6.37	774.25
Chhattisgarh	0.28	0.50	0.18	0.20	110.55	4.39	256.96
Kerala	0.64	0.33	0.77	0.60	77.59	3.08	338.44
Himchal	0.11	0.07	0.08	0.04	44.78	1.78	120.36
Madhya	18.74	35.01	17.68	5.98	33.80	1.34	116.02
Gujarat	0.65	0.71	0.97	0.32	32.81	1.30	179.85
West bengal	11.72	3.46	10.40	3.14	30.23	1.20	97.65
Jharkhand	0.36	0.13	0.19	0.03	17.99	0.71	34.21
Uttar pradesh	20.22	18.39	20.03	2.96	14.79	0.59	53.32
Uttranchal	0.10	0.07	0.11	0.01	5.96	0.24	23.02
Andhra pradesh	7.13	7.08	10.90	0.62	5.70	0.23	31.73
Assam	0.21	0.09	0.21	-0.07	-34.98	-1.39	-130.43
Rajasthan	6.30	8.32	9.45	-3.44	-36.41	-1.45	-198.68
Tripura	0.00	0.00	0.00	0.00	-36.58	-1.45	-106.87
Orissa	6.12	3.41	6.44	-2.64	-40.92	-1.63	-156.69
Goa	0.00	0.00	0.00	0.00	-49.33	-1.96	-37.04
Haryana	0.43	0.29	0.57	-0.28	-50.32	-2.00	-242.22
Meghalaya	0.04	0.03	0.05	-0.05	-112.67	-4.48	-448.39

6. Effects on Indian agriculture:
Reviewing NAIS' performance in the light of expectations

In this chapter we will review the results of NAIS through the six years' of its operation in the light of expectations and today exigencies. As discussed in chapter 1 Indian agriculture can receive important benefits from crop insurance as a risk management measure directly and indirectly that will help particularly in the times of globalisation. The literature on crop insurance suggests that crop insurance may have three important implications for Indian agriculture. These implications relate to the following aspects.

1. Coverage of crops:
India's cropping pattern has been traditionally diversified and included several crops that had limited potential for financial profitability and export market. Crop specialization in areas of advantage could possibly pay rich dividends in terms of greater efficiency, provided that risk can be ably managed[1]. There are reasons to believe that with the availability of a crop insurance scheme, farmers would rationally seek coverage for crops that are lucrative in the present market scenario and has export or domestic commercial possibilities but yet may be avoided under normal circumstances because they are considered as risky (Chapter 2). Hence, the well known dependence on diversified cropping pattern and the inclusion in the crop pattern of less profitable but drought resistant crops may be rendered unnecessary. In sum we would expect farmers to show a preference for crops with commercial and export potency when they choose insurance coverages.

[1] The issue of crop diversification itself is contentious. Crop diversification has been described for its multiple advantages (Anderson, 1996, Saleth, 1999, Ghosh, 2007) but these advantages mostly relate to risk mitigation both on the demand and supply sides. We will avoid the contradictions and dwell objectively on the implications only.

2. Effect on crop productivity

Risk is said to be a deterrent for investment and modernisation in agriculture. Crop insurance, by reducing risk, can appear as an important instrument to improve crop yield rates by motivating optimal resource use in agriculture. This is especially relevant today in India in view of the general concern about a possible slow down in the dynamics of in crop yields (as analysed in Appendix **A**III-4). It is increasingly recognized that an accelerated agricultural growth rate is a critical requirement for achieving inclusive growth in the country (World Bank, 2008). In recent times an uncertainty about the food security in the country, associated also with similar global concerns, has reinforced the significance of achieving higher crop productivities. Crop insurance can expectedly help farmers to behave as risk neutral operators and apply inputs optimally for crop cultivation. Also, both intuition and theory suggests that farmers would feel more equipped to accept new technology that is promising in spite of their unfamiliarity to the same. In sum, crop insurance can help them to step into an area of higher growth rates in yield.

3. Targeting the Small farmer

The small (and marginal) farmers[2] in India have always been a focus of attention in agricultural polices for their meagre risk taking ability. With their high share in the farm economy in India, they constitute a little over 80% of the farm holding population and own only 36% of the area, they can considerably slow down the progress towards new crops, modern technology and higher yield rates. Moreover, because they have very little resources they fall behind in credit worthiness and create a serious shortfall in the financial inclusiveness of development. They are prone to defaults and are vulnerable to debt traps and destitution whenever an adverse circumstance strikes agriculture. Moreover, the subsidies that the government is giving to agriculture are facing a cloud of fiscal restraints, as they are in other activities and the magnitude of the subsidy burden

[2] The marginal farmers are defined to hold up to 1 hectare (2.5 acre) of land and the small farmers hold 1 to 2 hectares.

is an unceasing source of concern for the polity. In such a milieu, it is important to ensure that any subsidy that is given by the government is well targeted towards the most needy. The NAIS being subsidised and managed in an organised way guided by a system of recorded declarations obtained from the farmers, could provide a way to target the smaller farmers even when there are severe restraints on overall subsidies. In India, ideally any good agricultural policy is expected to benefit the small farmers in particular. Whatever subsidies are being doled out in agriculture can be considered most economic if they benefit the small farmers in particular because of their numeric strength, their vulnerability and the overall paucity of public resources.

With this background in mind, in this chapter we examine the following: (1) The preference shown towards specialised exportable and commercial crops for coverage, (2) the possible positive effect of insurance on crop yields and (3) the share of benefits that reach the small farmers.

Choice of crops for coverage

The decision about which crops to insure obviously lies with the farmers but such decisions are inevitably guided by the risk perceived as also the contracts available. Insurance is likely to play a crucial role in shaping the cropping pattern in the country since it potentially replaces the traditional methods of risk management like crop diversification and inclusion of safe crops regardless of their economic potentials. Farmers in India have been known to be risk averse (Binswanger, 1978, 1980). Recent evidences also suggest that, especially in the drought prone states, farmers resort to a number of risk coping mechanisms. These include the maintenance of livestocks at added cost (income diversification), fallowing land (risk avoidance) and mixed cropping with millets in the crop pattern (crop diversification and risk avoidance) as a general rule. Further, they also resort to migration and reduce their consumption in poor years (Rathore, 2004). Crop insurance is expected to encourage farmers to insure and grow crop that he or she would be reluctant to choose in the absence of insurance and help them to reduce their reliance on unproductive coping strategies. We would expect the coverage to be concentrated towards crops that could be considered profitable and the same effect would be more pronounced in regions that suffer from water scarcity.

In India the cropping pattern is highly diversified as shown by the diversity indices computed in AppendixIII-1. Though rice and wheat together constitute nearly 40% of the cropped area, coarse cereals also occupy 16% of the area. Risk reduction was primarily accomplished by growing the coarse cereals, especially Jowar and Bajra alongside with the superior staples Rice and Wheat. With time and increasing access to irrigation, these crops, known to be of poor commercial worth, have been losing share. The government tried to promote oilseeds to replace the millet crops in the 1980s by intervention but these crops, though also suited to water scarce environment and greatly in demand in the market, were unstable in performance but helped in diversifying the exposure to risk. With market liberalization the government's leeway to protect products dwindled. As such, the share of oilseeds varied in phases related the public policy regime. Analysing the data over the years 2000-01 to 2005-06 i.e., in the times of relatively liberalised market, we find no marked tendency for concentration of crop pattern in any direction. (Figure AIII.1-1).

Intuition suggests that insurance would pave the way towards specialisation in areas of national advantage. Such specialisation will improve labour productivity and research (Reddy,2004). Between the years 2000-2005 the Indian exports in Rs Crores have been 30,000 in rice and wheat together (RW) and the imports were 82,000 in pulses oilseeds (PLOLS). For RW, exports were fifteen times the imports and for PLOLS the imports were twenty times the exports. It appears, consistent with expert projections (Gulati et al 1994), that India's comparative advantage is more in the superior cereals than oilseeds-pulses that are importable. Demand and food security concerns have to be factored into such conclusions, but these concerns only increase the importance of the RW group in cropping pattern. Many commercial crops (COM) are exported from India. Specifically for spices, the export to import ratio has been four in the period. Even the critics of crop insurance have agreed that commercial agriculture could be a rationale for crop insurance in the developing countries since large investments are needed for this kind of farming [i] (Roberts,1991). Relatively successful examples can be found in Chile and Mauritius (Appendix I). For India in the be found in post-librealisation era commercial crops have an important place owing to their linkages with the processing and manufacturing industries and their export possibilities. In sum, the impact of agriculture on employment generation, rural incomes and foreign exchange earning could be realised through commercialisation. On the other hand, in current times food prices have shown a rising tendency even at the international level, so that food crops like rice and wheat have again gained importance from the point of view of commercial prospects as domestic prices are increasingly influenced by international movements. They are also important in policy for national food security. It is therefore pertinent to examine if the insurance coverage is in tune with the exigencies of time, keeping in mind the manifold importance of the crops in current times.

For the present paper we have examined the coverage of the four groups RW (Rice and Wheat), CCER (Coarse cereals), PLOLS (Pulses and Oilseeds) and COM (crops classified as Commercial crops[3] or crops other than foodgrains or oilseeds) in NAIS. Diversification is viewed both in terms of the variety in coverage across the four groups and the tendency for commercialisation in agriculture. In Table 6.1 the respective group shares and a more composite indicator of diversity (DIV) based on the Hirschman-Herfindahl index[ii] (see Appendix III-1) are presented. Later in this paper, we will mark that instances of intense acreage diversion towards one or other crop have raised adverse issues in mono-cropping. We have confined the concept of diversification to one of

[3] Crops other than RW, CCER and PLSOLS have been classified as the Commercial crops by AIC reports. It may be noted that all the crops may be grown for commercial purposes though some of them can be grown for home consumption.

balance among crops in coverage and avoided associating diversification with any large scale diversion of land away from foodgrains towards one or more alternatives.

Figure 6.1

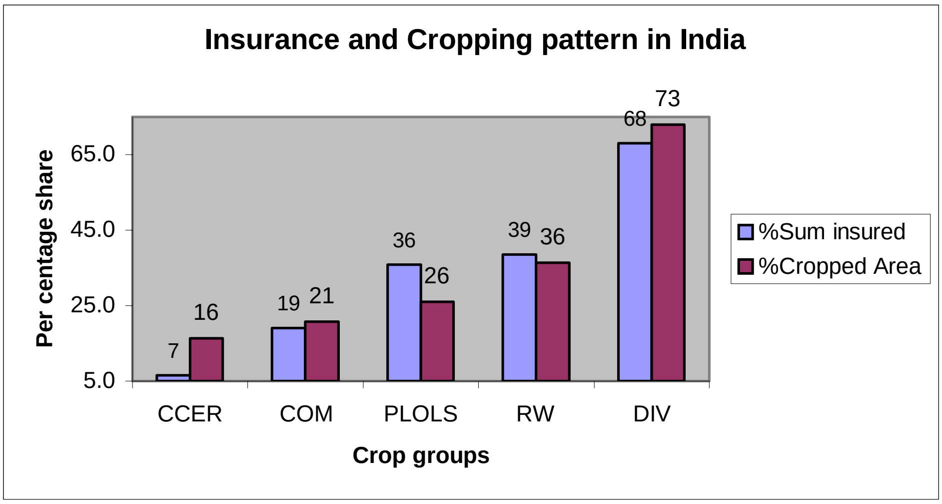


Figure 6.1 compares the crop group shares in sum insured with their respective shares in the total cropped area in India and shows a reasonable degree of agreement between the two. The comparison is however made for only the year 2003-4 based on the latest available data on gross cropped area when the work is conducted. RW representing the major and superior food crops has the dominant place as expected, with similar weights in insurance and cropped area, though slightly more at 39%in the former compared to 36% in the latter. CCER has the least share in each aggregate but the share in insurance is significantly less. This group consists mostly of different millet crops with poor economic value and are grown with little use of water. Noticeably, the share of PLOLS is 36% in the sum insured and only 26% in the cropped area. The shares of COM are comparable and around 20%. Each pattern is fairly diversified with the index DIV exceeding 60% but insurance appears more concentrated than cropped area as expected. Nevertheless, it is noticeable that insurance coverage is sought for different types

of crops, eve the coarse cereals have a share, and the diversity index is considerable.

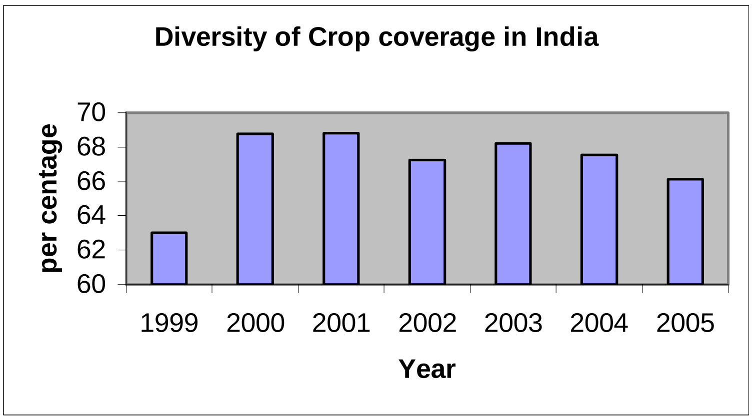
Table6.1 : Share of crops and crop groups in sum insured (%) and Diversity index (%)										
Year	RW	CCER	CER	PLSOLS	FGOLS	COM	GNRM	Cotton	SC	DIV
2000	34.92	3.83	38.75	28.17	66.92	33.08	15.04	12.75	24.44	68.78
2001	37.38	4.38	41.76	30.93	72.69	27.31	21.78	13.00	10.70	68.81
2002	43.38	5.29	48.67	30.60	79.28	20.72	19.45	7.79	8.02	67.24
2003	38.63	6.52	45.15	35.79	80.93	19.07	19.66	7.09	5.49	68.21
2004	40.97	7.61	48.58	35.38	83.96	16.04	18.25	6.59	4.42	67.55
2005	41.83	7.20	49.03	37.47	86.50	13.50	18.67	3.55	4.00	66.12
Growth %	19.79	88.04	26.53	33.00	29.25	-59.18	24.13	-72.13	-83.64	-3.86

Table 6.1 also shows the directional tendency of coverage in the period 2000-01 to 2005-6. Comparison of the two years 2000-01 and 2005-06 finds that all the groups have gained except for COM, i.e., the commercial crop group. This is despite the expansion of range under this group. Of the first three groups RW has gained about 7% points (35% to 42%), CCER about 3% points and PLOLS made the largest gain of nearly 9% points in sum insured. Over the period, the sum insured (level) increased by a little less than 20% in the case of RW but by 26% for cereals as a whole group. The group CCER grew by 88% but the base was relatively small. The Foodgrains-oilseeds group (FGOLS) as a whole grew by almost 30%. The most remarkable increase in marked in the case of pulses and oilseeds (PLSOLS), that are normally import competing rather than exportable but they are also grown with commercial motive. Among the Oilseeds crops the Groundnut-Rapemustard group (GNRM) gained share by 24%. The group specified as Commercial crops COM has shown a negative growth. The bias against the COM crops is further evident in Table 6.2A which finds the different

relevant ratios between FGOLS and COM falling short of one with various measures. Only the sum insured per insured hectare is more for COM than FGOLS by 1.5 and 3.6 times in the two seasons. The share of premium collection from COM insured far exceeds the share of claims which suggests financial returns coming to the insurer from these actuarially priced crops (see Appendix II) .

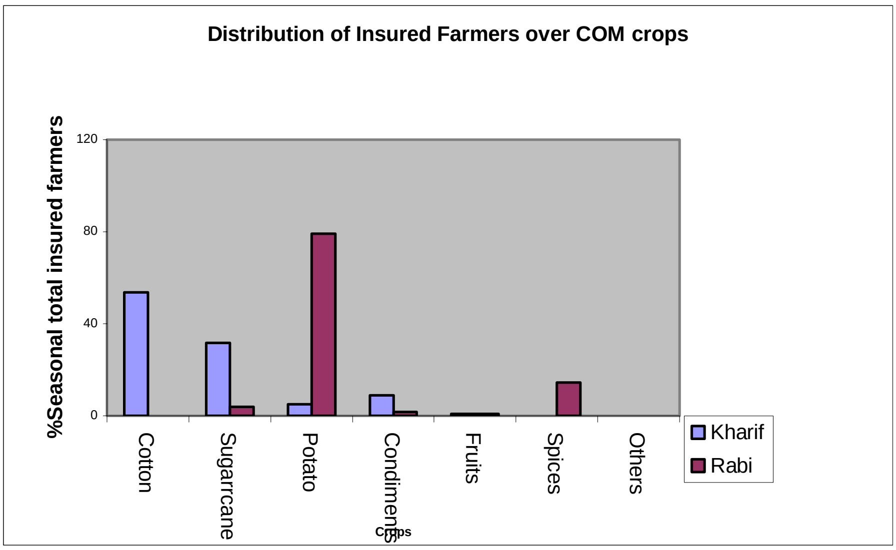
The pattern of coverage has become more concentrated over time (Figure 6.2) due to these movements but there is no visible bias for export crops. Both foodgrains RW and commercial crops COM registered weaker performances than PLSOLS in seeking insurance coverage. Even among the COM group of crops there is a high degree of concentration. The three commercial crops Sugarcane, Cotton and Potato together claim more than 90% of the insured farmers in the kharif season and 83% in the rabi season in 2005-06 despite the continuous expansion of the range of commercial crops under the ambit of NAIS. Figure 6.3 plots the share of farmers insured for the commercial crops in both kharif and rabi seasons. Besides the three important crops, Condiments inclusive of Onion, Chilly, Ginger and Garlic, Spices consisting of crops like Coriander, Turmeric, Jeera and Methi and fruits consisting of Pineapple, Banana and Orange are under coverage.

Figure 6.2



A region wise picture provided in Table 6.1A in the Appendix below suggests a fairly high a concentration in RW group (64%) and a relatively low diversity index in the highly irrigated region. The shares of both PLSOLS (11%) and of CCER (less than 2%) are low in this region but the share of COM is highest (23%) among the three irrigation based regions. The coverage is more diversified in the medium and low irrigated regions where the PLSOLS region gets 43% and 46% shares respectively. The share of COM is least in the low irrigated region. The coverage is highly concentrated (in RW) if the hill states are considered separately. The highly irrigated region presents a picture that is more in tune with our expectations, showing concentration of coverage, high share of exportable (so called) superior crops, preference for commercial crops and aversion for low value and importable crops. In contrast, the medium irrigated region has a relatively diversified coverage, a large share of import competing crops in PLSOLS, nearly 10% share of coarse cereals and a low 15% share of COM group. The pooling across seasons is poor and biased towards the kharif season.

Figure 6.3



A panacea for Yield stagnation and the question of moral hazard

Risk was one factor that explained the persistence of traditions and stagnation in Indian agriculture for a very long time till the new technology was successfully ushered in (Schultz,1964). As a result of risk, farmers are reluctant to try out new technology, invest on costly inputs and aim for higher crop yields. Additionally, this weakness undermines their credit-worthiness and also deprives them of resources necessary for progress   Crop insurance has the potential to facilitate the adjustment to globalisation in which competitive advantage is a key strength. Above all, higher productivities and success in higher valued crops can go a long way in improving farm incomes and in reducing rural urban disparities.

How crop insurance can influence crop yields

We postulate that crop insurance can have a significant and favourable effect on crop yield levels based on the following rationales:

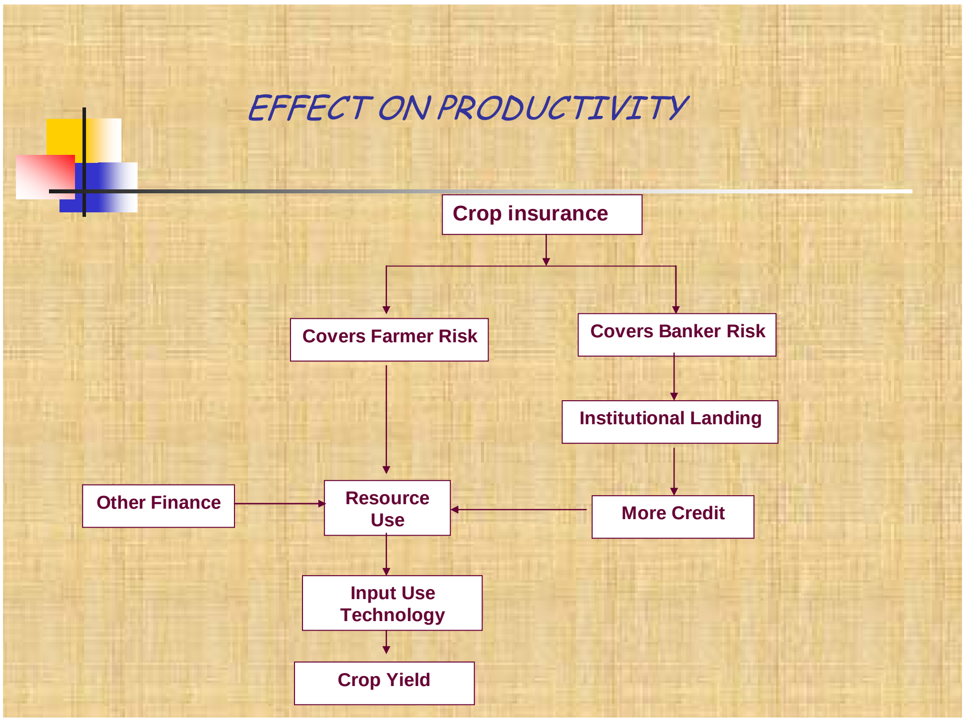
(1) Crop insurance reduces the need for unproductive of risk management methods like fallowing, storage and diversification (Reddy, 2004) and helps to attain optimal resource allocation. Crop specialisation, by reducing unproductive cost, harnesses the benefits of improved labour productivity, research, technology and specialised infrastructure all of which help to increase crop productivity .

(2) By sustaining the flow of credit, crop insurance makes necessary credit available to the farmer on a continuous basis regardless of short run inconsistencies of agricultural performance.

(3) Crop insurance helps the risk-averse farmer to behave as a risk-neutral profit maximising entrepreneur aiming for optimal resource allocation so that his resource use is higher under insurance. This argument is lucidly depicted in a

model provided by Ahsan Ali and Kurien (A,A,K, 1982). This model is also presented in a summary for on the Appendix AIV of this report.

A simple flow diagram helps to demonstrate how crop insurance can be expected to promote crop yields both via coverage of farmer's risk and through uninterrupted resource flow to agriculture.



While a well-functioning insurance scheme is expected to deliver positive returns in the form of higher agricultural productivity, the final outcome depends on the strengths of the caveats noted in the NAIS. In particular a few apprehensions that can possibly offset or even negate the positive expectations need emphasis. They are:

(1) Possibility of moral Hazard: In this case, the existence of insurance itself changes the optimal decisions rules of the farmers who might now take less of preventive measures, less care and apply less labour and inputs than they otherwise would have. In other words, the insurance might negate many of the desirable ex-ante risk mitigation measures and induce a deterioration

(2) Cost effect: Implicit is an assumption of the farmer's dependence on institutional credit. When institutional credit is substitutable with informal credit, less of insurance, say on account of higher cost of borrowing, may also possibly mean greater reliance on non-institutional productive credit.

Yield Dynamics: tendencies in the post-Crop insurance period

We first attempt to pick up any positive signal in yield tendencies during the period in which the NAIS operated in India by comparing the crop yield rates during the crop insurance (CI) period of six years 2000-01 to 2005-06 with the immediately preceding six years period 1994-95 to 1999-00. Since the vagaries of nature are known to cause year to year variations of yield rates, we consider the arithmetic means of the two six year periods. Table 6.2 shows that the average yearly yield rate has recorded positive movements in all cases excepting kharif Rrice, Sugarcane, Soyabean and Tur. Incidentally the standard deviations also increased in majority of the cases but came down for the rabi crops. When the means are tested statistically for equality, the increases were not found significant except in the case of Maize. Sugarcane had a significant decline as is revealed by the t-statistics.

Table 6.2: Testing for change in mean yield over time (pre and post crop insurance)

Crop	1994 to 1999		2000 to 2005			
	Mean	S.D.	Mean	S.D..	Change	T-stat
Cotton	216.3	14.43	228.97	73.7	5.86	0.41
Groundnut	956.2	177.6	967.2	247.2	1.15	0.09
Maize	1675.2	135.7	1914.9	152.2	14.31	2.88*
Potato	18069.3	1678.2	18910.2	1041.6	4.65	1.04
Rice kharif	1712.2	73.3	1679.5	132.1	-1.91	0.53
Rice rabi	2859.9	142.1	2964.2	113.6	3.65	1.40
Tur(arhar)	695.5	96.1	685.3	59.2	-1.47	0.22
Wheat	2222.4	95.2	2265.6	90.71	1.94	0.80
Sugarcane	71047.3	2062.3	65613.9	3504.2	-7.65	3.27**
Soyabean	1029.1	73.9	951.9	166.2	-7.50	1.04

Note: Unit in Kg/hectare. S.D. and Change in %. Two tailed test of eaquality of means is made. *significant at 10% level, ** significant at 1% level.

The results of the above statistical tests are intriguing. Regardless of the existence of the crop insurance we would have expected some rise in the mean yield rates to take place under the influence of positive trends and technological impacts. While a number of factors have been associated with yield stagnation (Economic Survey, 2008**),** the findings in the analysis only suggests strongly that the insurance did very little to counteract the undesirable tendencies. The means of the yield rates and their changes are also presented for the three regions in Table 6.3A. Though varied, the results are far from positive. Maize is the single case that registers positive changes in all three regions. Cotton yield has improved in MI (4.4%) and LI (4.4%) regions, wheat in HI (2.2%) and MI (4.4%) regions and Sugarcane in MI (2%) region. Sugarcane yield declined in HI and by a large amount (13.3%)in LI. Rice yield has declined in HI and LI regions in both seasons, Groundnut in HI and LI regions and Soyabean in all the regions. Potato yield showed good performance in HI region only, fell in LI region and remained largely stagnant in MI region. Similarly, Tur yield showed some improvement in HI region, fell in MI region and stagnated in LI region. In MI region the rice yield rose in both seasons. The HI region stands out in its insipid response of yield in most cases. Only Potato and Wheat seem to have performed well.

Further, to examine the position of the CI period in the long run yield dynamics of the crops we have estimated linear time trends dummy variable for the CI period 2000-01 to 2005-06. The estimates are presented in Appendix of the crop yields over the sample period 1975 –76 to 2005-06. using a slope
III-5.
Table AIII.5.1 finds a positive long run long run trend for all cases barring *Tur* in which case the coefficient of time is insignificant. The coefficients of the Dummy-Time interaction term are nearly uniformly negative. Maize and Groundnut are exceptions in which cases the t-statistics also fall below unity and are not reported. In the trend analysis conducted for the three regions separately, the slow down in trend rate is evident widely. The coefficients (Table AIII-5.2) show

similar results The results of the trend analysis based on long-period time series data are not much different from what the comparison of six year means showed.

Possible impact of Crop insurance on yield rates: An econometric analysis

The analyses of the yield dynamics made in the previous section say little about the specific effect of insurance that could be possible. If anything, such behaviour of crop yields only mirrors an inter-play of a number of forces acting on agriculture. In order to examine if the CI had a favourable effect as expected, other effects on yield need to be corrected for. We have made such an attempt in this section using available information.

The NAIS has been in operation for only six years ruling out the possibility of a typical time series regression. However, the availability of state level information opens up the possibility of a cross-section analysis by pooling the data. Even this approach is constrained by the fact that all the crops have not been covered by all the states in all six years. Some states do not grow certain crops, some do not consider the crops risky enough for coverage and some states joined the programmes later than others. The analysis using any reasonable minimum size of sample could be conducted only for the crops kharif Rice, kharif Groundnut, Maize, Sugarcane, Cotton and Soyabean.

Now, OLS is not the most appropriate method in such a panel data analysis that combines heterogeneous states and different time periods. The most appealing method is the error component method (Wallace and Hussain, 1969).

A general form is presented by the following model

$Y_{it} = \alpha + \Sigma\beta_j X_{ijt} + \varepsilon_{it}$ …………. 6.1(a)

$\varepsilon_{it} = U_i + V_j + W_{ijt}$ ……………..6.1(b)

where Y_{it} is an observation on the dependent variable, for the i-th cross-sectional unit, and t-th time period and X_{ijt} is an observation on j-th nonstochastic regressor for i-th cross-sectional unit and t-th time period while U_i , V_j and W_{ijt} are the components of random error with ε_{it} satisfying the necessary conditions.

The Random effect model follows from this approach, in which the spatial component of the error term is treated as random. Intuitively, this is an acceptable approach to us in this case since our interest lies in understanding the effect of insurance while the states merely provide the sample observations (Baltagi, 2001**).** So long as the different relevant variables are accounted for the spatial effects reflect the random differences such as those in soil and ecological conditions on which our information is limited. A competing method in literature is the Fixed effect (FE) regression, that looks for the specific effect of each state. Since this is not our objective, Random effect (RE) model is analytically preferred. In any case, we also conducted the usual Hausman test. This test accepts the underlying hypothesis of the Random effect model in most cases. Only Maize and Sugarcane presented a question regarding the choice of a model. Since the Test gave a border line case with the Chi-square test at 5% and 1% levels and our intuitive approach favours the Random effect model, we presented the latter in Table 6.3. The OLS and the FE model estimates are also presented in the appendix.

To explain the crop yield in our case, in the simplest form, the model considered is as follows.

$Y_{it} = a+b_{\ i}X_{it} + b_2\ RF_{it} + b_3 D_i + u_i + e_{it}$

The regressions are estimated as crop yield rates (Y) as dependent variables with the independent variables capturing the economic and natural influences along with insurance coverage.

X= exogenous variable

RF =sowing season rainfall

D= Dummy for irrigation endowment

i is cross sectional unit and t is year, u_i is the spatial random effect and the e_{it} is the residual as usual.

Table 6.3: Effect of Crop insurance on Crop yield levels : Regressions using Panel data-Random effect (GLS) Model										
Dependent is Yield										
	---Rice---		---Maize---		--Groundnut---		--Soyabean--		--Sugarcane---	
Variables		t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Insurance	-70.8	-0.09	-5938.6	-2.55	-45.1	-0.07	-954.4	-0.69	5.63	1.02
Price	533.1	2.01	136.1	0.29	353.9	0.71	546.9	1.36	0.67	3.35
Input Price	-3276.4	-2.58	-	-	-	-	-	-	-	-
Rainfall	0.47	2.72	0.37	1.92	0.63	2.48	-0.976	-3.28	0.02	-0.12
Intercepts										
HI	-	-	-	-	-	-	-342.3	-1.04	-	-
MI	-	-	-	-	-	-	-	-	-	-
LO	-713.9	-3.16	-	-	-384	-1.74	-	-	-	-
Constant	2168.4	3.28	1462.1	2.75	395.5	0.83	1475.7	4.48	-	-

The crops we could study cover all the broad groups namely, food grain group (Rice-kharif and Maize), oilseeds (Groundnut and Soyabean) and commercial crops (Sugarcane). As an indicator of risk classification we have also looked at the data disaggregated by the irrigation endowment of the state measured by net irrigated area as a percentage of the net sown area (NIE). The studied states are categorised as (i) High-Irrigation with NIE above 50% (HI), (ii) Medium-Irrigation with the NIE lying between 30 and 50% (MI) and (iii) Low-Irrigation in which the NIE is below 30% (LI). The categorisation is elaborated in Appendix AIII-3.Among the exogenous variables are the following: (1) expected price of product (Rs/100 Kg) or the value of product per hectare (Rs/hect.) specified on the basis on diagnostics, (2) Cost of input (price of fertilizer weighted over nutrients), (3) Substitute price (price of other crops in the same season) and (4) Insurance coverage (Sum insured in Rs per hectare of cropped area). Expected prices can play a role in influencing resource allocation among the crops. Price considered is the wholesale price index but the Minimum support price in the case of Rice. As a proxy for expectations (actual prices are known only after the harvest) the usual lagged price of previous harvest period was considered. Since rising productivity is said to enhance the expect profitability of a crop we have also allowed for a specification with the expected revenue per hectare instead of price. Similarly, price of the major input fertilizer is included to factor in cost that also can influence resource allocation. All the values are deflated by the whole sale price index of all commodities. The input and substitute prices are retained in the specification reported only if the t-statistics of the parameters exceeded one. The substitute price could not be retained in any of the equations. The price , rainfall and most important, the insurance variables are retained in all cases.

Table 6.3 finds that the driving factors for yield rates differ among crops. Price has a significant coefficient in cases of Rice and Sugarcane and rainfall in Rice, Maize, Groundnut and Soyabean (negative effect in the last case). Input (fertilizer) price appears only in case of Rice. Crop insurance has appeared mostly with a negative coefficient, raising questions about the presence of moral hazard. Only for the Sugarcane the impact is found to be positive though not significant. The OLS and the Fixed effect models are also presented in Appendix table 6.4A. In the cases of Maize and sugarcane, where the Random effect model may not be completely justified on statistical grounds one may also look at the Fixed effect models. The insurance variable comes with a significant negative coefficient in Maize but in the case of Sugarcane the positive parameter has a relatively high t-statistics. Thus excepting Sugarcane, a positive impact of crop insurance on crop yield is nowhere borne out by the model.

Small holding farmers as the target of benefit

Considering participation as an indicator of perceived benefit, Table6.4 presents a reasonably positive picture with small farmers constituting about 64% of the participating farmers in both kharif and rabi seasons (See also Chapter 4). Their share is higher for the group COM than the composite group FGOLS (RW, CCER and PLOLS together) especially in the rabi season. This share nevertheless is less than the share of the small farmers in the farmer community. Their share in the total sum insured is more modest but shows a similar pattern.

The break-up of participation rates by loanee and non-loanee farmers is presented in table 6.5. In the kharif season about 66% of the loanee farmers are small farmers on the average compared to 54% in case of non-loanee farmers. In the rabi season this divergence is even wider at 70% and 39%. This might indicate that the need for institutional finance probably draws the small farmer towards insurance. The divergence is observed in each of the insurance years also except for 2000-01, the starting year in kharif season. While the adoption of the scheme is an indication of the small farmers' preference for coverage, especially among the borrowing farmers, a comparison of the financial benefit can throw more light on the relative position of the small farmers in this scheme. Considering the claims to premiums ratio, the small farmer is found to be benefited less than others because the latter's expenditure on coverage (premium) relative to their receipt is less than the same calculated for small farmers in particular (Table 6.5). The claims-to-premiums ratio falls below unity for kharif commercial crops and the pattern is same even if the ratio is corrected for the premium subsidies. Despite the meagre gain in a relative view, the reasonably high participation rate among the small farmers can probably be explained by their need for institutional finance only. There is thus a question on whether crop

insurance a regressively designed tax for borrowing public money rather than a gainful route to progressive farming.

Table6.4 : Share of small farmers in loanee and non-loanee insurance coverage								
	Non-Loanee	Loanee	Non-Loanee	Loanee	Non-Loanee	Loanee	Non-Loanee	Loanee
	----------------Rabi season---------------				----------------Kharif season--------------			
Year	Farmers insured		Sum insured		Farmers insured		Sum insured	
2000	52.20	72.45	56.73	36.99	73.84	65.04	65.35	48.82
2001	37.33	76.42	63.61	27.16	54.85	66.32	43.22	49.15
2002	48.67	72.78	59.96	30.44	65.14	67.73	49.11	49.96
2003	34.81	74.14	61.33	20.98	46.47	68.52	28.67	50.29
2004	37.69	68.29	52.39	34.56	52.64	64.90	41.49	48.41
2005	49.39	63.81	48.54	41.24	48.36	63.66	39.68	48.25
2000-05	38.88	70.20	54.72	26.39	53.73	65.81	41.88	49.01

Subsidies in India as in the rest of the world are viewed as potent welfare augmentation instruments of fiscal policy particularly where income inequalities are extensive. Issues such as the amounts of subsidies, the targeted beneficiaries and their effectiveness complicate the subject. While commercial viability merits attention in a market driven world, it is useful to note that the support provided by the government both in paying for premiums and the claims works out to be Rs 863 crores per year which amounts to a modest 2.7% of the food-fertilizer subsidy budget in India. This itself is not large given that crop insurance can have important social benefits, but the targeting precision needs attention too.

Table6.5 : Claim to premium ratios							
CROP	YEAR	All	Small	All	Small	Small	
		Claims/Premium		Claims/Premium		Claims/Premium (Adjusted for subsidies)	
		Kharif		Rabi		Kharif	Rabi
COM	2000-05	1.34	0.53	1.11	1.25	0.70	1.59
FGOLS	2000-05	3.89	2.91	3.66	2.81	3.75	3.54
GRAND	2000-05	3.14	2.23	2.96	2.24	2.90	2.84

The government supports crop insurance financially, not only by subsidising the premium payments of small farmers but also by deficit financing the AIC in paying indemnities to farmers. It is therefore not enough to consider only the entries that are assigned as subsidies in the data as government support. All premium subsidies reach the small farmers but the deficit financed implicitly reaches all sections. Table 6.6 finds that of the sum total of premiums received and claims paid a large part constituting 54% is provided by the government as a support to the programme. Looking at the two components separately, the primacy of the claim side is clear. Subsidies support only 10.4% of the premium but 68% of the claims. All premium subsidies reach the small farmers. Assuming that the proportion of support reaching the small farmer claimants is same as the proportion of indemnities paid by AIC to small farmers, it is found that only 36% of the total support is targeted towards the small farmers.

Table6.6: Nature of government support and the targeting of subsidies towards small farmers

YEAR	CROPS	Government Subsidy share (%) in			Estimated Share (%) of Small farmers in total Subsidies
		Premiums collected	Claims Paid	Premiums and Claims	
2000-05	COM	11.07	60.83	39.26	33.63
2000-05	FGOLS	10.16	69.12	56.98	36.68
2000-05	GRAND	10.43	68.11	54.08	36.19

Appendix 6

Table 6.1A: Diversity of crops covered by Insurance in different state-groups									
		----------------------------------Share-----------------------------------					4-Group Total	------All crops-----------	
State	Unit	RW	CCER	PLOLS	FGOLS	COM		Kharif	Rabi
High Irrigated							-------------Diversity--------------------		
Share in Sum Insured	%	64.17	1.99	11.22	77.38	22.62	41.43	38.82	41.43
Kharif share	%	40.88	93.09	25.64	40.02	29.47			
Medium irrigated									
Share in Sum Insured	%	32.06	9.87	43.35	85.28	14.72	53.03	59.08	53.03
Kharif share	%	62.07	98.39	87.68	79.29	71.62			
Low irrigated									
Share in Sum Insured	%	34.74	9.99	46.19	90.92	9.08	48.58	44.76	48.58
Kharif share	%	61.17	95.09	85.25	77.13	61.69			
Hill and NE Plains									
Share in Sum Insured	%	85.29	7.95	0.00	93.24	6.76	24.64	6.97	24.64
Kharif share	%	43.87	71.24		46.20	7.88			

Note: . The last group is based on geography and the states overlap with the irrigation based groups. The States in the Groups are as follows: **High Irrigated**- Haryana, Tamilnadu, Uttar Pradesh and Bihar; **Medium irrigated** -Rajasthan, Andhra Pradesh, West Bengal and Gujarat; **Low irrigated** - Meghalaya, Madhya Pradesh, Karnataka, Orissa, Chhattisgarh, Maharashtra, Kerala, Jharkhand, Assam; **Hill and NE Plains**- Assam, Meghalaya, Himachal, Uttranchal.

Table 6.2A : Diversification of Coverage towards Commercial crops 2000-01 to 2005-06							
Measures	Unit	Kharif season			Rabi season		
		FGOLS	COM	Ratio	FGOLS	COM	Ratio
Insured area	%	85.72	14.28	0.17	93.96	6.04	0.06
Sum insured	%	79.89	20.11	0.25	81.01	18.99	0.23
Loanee sum insured	%	78.96	21.04	0.27	79.36	20.64	0.26
Sum insured/insured area	Rs/hect.	5531.53	8357.56	1.51	4948.00	18055.67	3.65
Total claims	%	87.46	12.54	0.14	89.65	10.35	0.12
Total premium	%	70.57	29.43	0.42	72.48	27.52	0.38
Note: Ratio % is (ratio of) COM to FGOLS							

Table 6.3A: Change in mean crop yield rates over time in three regions

Crops	Mean (1994-1999)	Mean (2000-2005)	Change
High-Irrigated (HI)			
Cotton	268.7	251.6	-6.36
Groundnut	1598.3	1246.3	-22.02
Maize	1558.7	1820.7	16.81
Potato	17736	19561.9	10.29
Rice kharif	1934	1819.3	-5.93
Rice rabi	2927	2570.1	-12.19
Tur(arhar)	1060.9	1108.8	4.52
Wheat	2468.6	2523.6	2.23
Sugarcane	65602.8	61588.4	-6.12
Soyabean	755.7	631.2	-16.47
Medium- irrigated (MI)			
Cotton	292	304.8	4.38
Groundnut	883.8	985.6	11.52
Maize	1563.1	1854.1	18.62
Potato	23295.7	23306	0.04
Rice kharif	2033.7	2331	14.62
Rice rabi	3022.3	3274.5	8.34
Tur(arhar)	583.7	559.3	-4.18
Wheat	2470.2	2578.1	4.37
Sugarcane	71153.2	72575.1	2.00
Soyabean	1114.1	1061.4	-4.73
Low-irrigated(LI)			
Cotton	158.2	165.5	4.61
Groundnut	877.4	808.9	-7.81
Maize	1867.6	2029.5	8.67
Potato	10170.4	9143.1	-10.10
Rice kharif	1338.1	1224.1	-8.52
Rice rabi	2324.8	2171.8	-6.58
Tur(arhar)	624.7	637.2	2.00
Wheat	1612.6	1513.7	-6.13
Sugarcane	83770.9	72631.1	-13.30
Soyabean	1021.5	939.7	-8.01

Note: Unit in Kg/hectare, Change in %.

Appendix Table 6.4A-1: Effects of Crop insurance on Rice yield : Regressions using Panel data						
Dependent is Yield rate per hectare						
	OLS		Fixed Effect		Random effect (GLS)	
Variables	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Insurance	599.6	0.85	-307.5	-0.35	-70.8	-0.09
Price	710.7	1.45	468.5	1.71	533.1	2.01
Input Price	-3743.9	-1.54	-3039.5	-2.32	-3276.4	-2.58
Rainfall	0.26	1.63	0.53	2.63	0.47	2.72
Intercepts						
Dummy-LO	-685.3	-6.15			-713.9	-3.16
Constant	1893.1	1.68	1818.6	2.64	2168.4	3.28
R	0.32			0.21		0.21
Hausman test for H0: Difference in coefficients not systematic Chi-Sq=1.32 P>Chi-Sq- 0.86						
Note : Price is Minimum support price deflated. Input is fertilizer nutrients.						

Append Table6.4A-2: Effects of Crop insurance on Maize yield : Regressions using Panel data						
Dependent is Yield rate per hectare						
	OLS		Fixed Effect		Random effect (GLS)	
Variables	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Insurance	1276.3	0.53	-8214.2	-3.27	-5938.6	-2.55
Price	794	0.97	-64.5	-0.14	136.1	0.29
Rainfall	-0.14	1.18	0.51	2.58	0.37	1.92
Constant	1054.4		1652.4	3.2	1462.1	2.75
R	0.02		0.23	0.23		0.23
Hausman test for H0: Difference in coefficients not systematic Chi-Sq=5.86P>Chi-Sq- 0.05						
Note : Price is Value (at Whole sale price) of output per hectare deflated.						

Append Table6.4A-3: Effects of Crop insurance on Groundnut yield : Regressions using Panel data						
Dependent is Yield rate per hectare						
	OLS		Fixed Effect		Random effect (GLS)	
Variables	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Insurance	-71.3	-0.18	-55.9	-0.07	-45.1	-0.07
Price	969.5	1.44	143.6	0.29	353.9	0.71
Rainfall	0.08	0.33	0.85	3.05	0.63	2.48
Intercept						
LO	-169.9	-1.32			-384	-1.74
Constant	103.8	0.17	216	0.48	395.5	0.83
R	0.08		0.22		0.22	
Hausman test for H0: Difference in coefficients not systematic Chi-Sq=4.07P>Chi-Sq- 0.25						
Note : Price is Whole sale price per Quintal deflated						

Append Table6.4A-4: Effects of Crop insurance on Soyabean yield : Regressions using Panel data						
Dependent is Yield rate per hectare						
	OLS		Fixed Effect		Random effect (GLS)	
Variables	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Insurance	694.6	0.57	-1896.1	-1.19	-954.4	-0.69
Price	463.7	0.93	567.1	1.37	546.9	1.36
Rainfall	-0.77	-2.98	-1	-3.06	-0.976	-3.28
Intercept						
HI	-253	-1.92			-342.3	-1.04
Constant	1239.7	3.43	1438.1	4.66	1475.7	4.48
R	0.37		0.32		0.31	
Hausman test for H0: Difference in coefficients not systematic Chi-Sq=1.56P>Chi-Sq- 0.67						
Note : Price is value (at whole sale price) of output per hectare deflated.						

Append Table 6.4A-5:: Effects of Crop insurance on Sugarcane yield : Regressions using Panel data						
Dependent is Yield rate per hectare						
	OLS		Fixed Effect		Random effect (GLS)	
Variables	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Insurance	5.63	1.02	13.87	1.91	5.63	1.02
Price	0.68	3.35	-0.22	-0.66	0.67	3.35
Rainfall	0.16	0.9	0.12	0.8	0.02	0.9
Constant	-3.53	-0.12	70.82	2.06	-3.53	-0.12
R	0.49		0.24		0.01	
Hausman test for H0: Difference in coefficients not systematic Chi-Sq=10.61P>Chi-Sq- 0.01						
Note : Price is value of output (at whole sale price) per hectare deflated.						

[i] Crop insurance schemes primarily for commercial and exportable crops are shown to be financially viable in Chile and Mauritius.

[ii] The Herfindahl index, also known as Herfindahl-Hirschman Index or HHI, is a measure of the amount of competition among firms. It is an economic concept but widely applied in competition law and antitrust. It is defined as the sum of the squares of the market shares of each individual firm. As such, it can range from 0 to 1 moving from a very large amount of very small firms to a single monopolistic producer..

7. Credit flow and the problem of agrarian Distress: Inclusive development with Crop insurance

A major benefit from crop insurance is said to come from of its impact on the flow of credit and especially on the targeted flow of credit towards the needy and poorer sections in agriculture. This chapter, based mostly on reviews of recent studies on agricultural credit and distress and on an appraisal of what official data indicates, addresses the subject of credit.

Indebtedness and credit are two sides of the same coin and have grave significance for the political economy of India. That indebtedness was at the root of the misery of the rural people was known even during colonial times as was evident in the report of the Central Banking Enquiry Committee, 1929. The real response to the malaises of the rural credit system however only came in independent India after the historic surveys of the Reserve Bank of India, namely the All India Rural Credit Survey (AIRCS) and the All India Debt and Investment Survey (AIDIS) were conducted. This was also the threshold of a period in which a new package of technology and practices was injected into an archaic agriculture in India, that too manoeuvred by farmers who barely lived at the subsistence level of life. Credit flow to agriculture was necessary not just for ending their misery but also for switching over to a dynamic agriculture. Higher productivity, larger farm surpluses, increased income generation and national level food security all depended on necessary resource flows to the sector.

The issue of indebtedness and rural distress has again gained relevance. After the first two surveys namely the AIRCS and the AIDIS, the National Sample Survey Organisation (NSSO) has conducted surveys on rural indebtedness with regularity. It reports a statistic named the 'Incidence of Indebtedness' or the IOI which it defines as 'the proportion of rural households having any outstanding cash debt". In this sense however, indebtedness may not necessarily be an indicator of misery as it also signifies the flow of credit to the 'indebted' households. The flow of productive credit can in fact be a positive sign for agriculture. Even unproductive credit towards a better quality of living, as evident in the urban sector, also need not be undermined in its impact on welfare and its worth can only be assessed by the repayment capability of the borrower. The interpretation of IOI therefore needs care.

'Indebted' as used in the context of distress is defined as 'that level of debt burden for the individual, which offsets the process of credit recycling, impedes productivity and forces a person into an intractable vicious debt trap' (Patil, 2008). Credit, even if it is for productive purposes, can turn out to be blight, if expected events fail to emerge, making repayment difficult. The most glaring example could be a case when a loan is taken for buying farm inputs but due to an unforeseen crop failure repayment becomes a burden to the farmer. The borrower falls into a debt trap when she herself has little asset to ease the situation and further borrows to repay the debt at a higher interest rate. Institutionally, defaults also lead to ineligibility of credit in subsequent times and accumulation of over-dues for banks. The borrower is either pushed out of his occupation or he has to resort to money lenders who are willing to lend at higher interest rates. This is a typical case in which crop insurance can potentially play a constructive role in keeping the loans flowing even in the face of unwarranted crop failures. This is because the banks recover the dues from the agency directly and continues to lend to the affected farmers. This process however is relevant only when the default is caused by a general 'area-level' crop failure and a majority of farmers are simultaneously encountering the loss.

Credit flow to agriculture and related issues

Credit to agriculture has played a significant role in India's political economy and in the country's agricultural development in the past years. Today it is a key element in the country's serious concern for financial inclusiveness. The large cooperative credit delivery system in India, possibly the largest financial system in the world, helped to drive forward the green revolution and free the farmers from the clutches of local money power. However all this benefit also came at a cost as the financial system mostly performed under government guidelines and for social objectives rather than for profits. Constrained by a chain of regulations and obligations, the lending institutions eventually eroded their financial base and became burdened with mounting over-dues and non-performing assets. With the economic environment becoming more liberal and market friendly, consistent with the spirit of the time, the Narasimhan Committee in its report of 1991 proposed a 'vibrant and competitive financial system' and the banks inevitably joined the privatisation and competitive processes. While banker's health is valuable for agricultural progress, the short run effects of the RBI directive on 1992-93 on prudential norms of lending were appalling. Concern was widely expressed on how agriculture and the small farmers were being deprived of needed credit. The ensuing slow down in agricultural growth and the deprivation of farmers could not be overlooked even while bank loans flowed freely to real estate, automobiles and even luxury items in urban areas. The credit package of 2004 is claimed to have come as a reversal for farm credit. The validity of this claim is yet to be borne out.

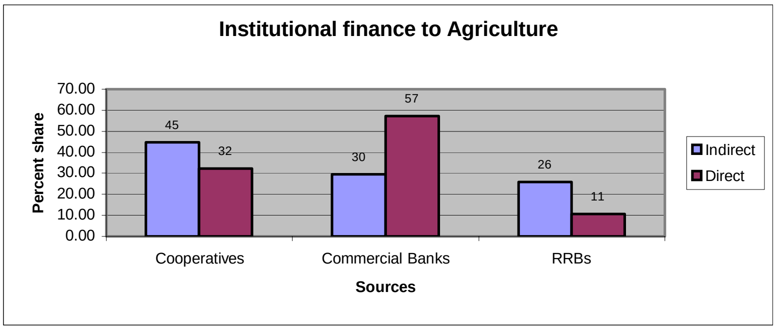
A number of recent studies are questioning the meaningfulness of such claims **also** (Ramakumar and Chavan, 2007, Shah et. al. 2007,Kamath, 2007 and Shatish, 2007). The broad consensus on recent directions can be stylized as follows.

1. Credit flow to agriculture has indeed accelerated since the year 2000.
2. The relation between reported credit flow to agriculture and its production performance has been weak.
3. A substantially rising share flowing via indirect credit routes aids the credit flow.
4. Even the direct credit is canalised towards higher credit limits, large agri-businesses and towards the more landed farmers.
5. Both direct and indirect credit shifted towards higher credit limits.
6. Financial inclusion would involve a redirection of credit to value-addition services. Directed lending and social banking should give way to a more demand driven lending regime.

Agriculture is emerging as a constraint for inclusive growth in India. In the past, the priority sector commitment has been the persuading instrument for banks to discharge their social obligation but while the system continues today in principle, market pressures have encouraged definitional dilutions for the purpose of redirecting the finance. Credit flow to agriculture is increasingly taking an indirect route[i] rather than the conventional one going via the farmers. The rationale for this modified approach can be found in the contradictions that can be noted within the above highlighted inferences and views made by scholars today. Agriculture is increasingly viewed in a holistic manner along with its linkages with processing, research and technology and other industries. Moreover, with the indifferent performance of public research and extension services and the increasing role of the private sector in the economy, the inclusion of private enterprises in the agricultural development process has become an important element of policy. The indirect route is a means to broaden the out reach of credit to an agriculture that includes other players of development beyond farmers.

Although, consistent with the contemporary view of a broad-based agriculture and the public-private partnership in development, the precision of the method in reaching agriculture and the poor can only be borne out by the actual performance of agriculture. As yet, the priority sector obligation remains a policy requirement with little short-term direction. Agricultural credit grew by 20.5% in 2000-06, which is impressive compared to 1.8% rate in 1990s, and 8.7% in the 1980s. The break up is however, 32.9 % growth in indirect credit and 17.4% in direct credit in 2000-06 as compared to 3.5% and 1.5% respectively in the 1990s. Figure2 shows that cooperative institutions, that have been the pillars of agricultural finance, have the highest share in indirect credit flowing to agriculture.

Figure 7.1



Direct finance to agriculture (57%) mostly comes from banks but the importance of smaller loans (taken usually by smaller farms) has diminished. Banks have been lending towards higher credit limits and there has been a continuous fall in the share of loans below Rs 25000 both in direct and indirect credit. Table7 shows that during 2000-04, credit flow has risen sharply both in terms of the number of loans given (5.8 million to 10 million) and the amount lent (14.5 thousand crores to 41 thousand crores) but the share of small and marginal farmers as recipients did not increase significantly. On the average, they constituted 72% of the number but only half the amount loaned. The amount per loan account drawn by the small farmer has as is usual been lower (at Rs23 thousand). The gap has however widened since the Nineties (Ramkumar et al,2008).

Table 7.1: Direct finance to Small farmers from Scheduled Commercial Banks

	Share in Total		Total finance over all		Amount per account	
Year	Number	Amount	Number	Amount	All	Small
	%	%	of A/C'000	Rs crores	Rs000	Rs1000
2000-01	72.63	50.85	5841.3	14516.1	24.85	17.40
2001-02	66.16	53.51	6970.0	16300.1	23.39	18.91
2002-03	69.07	47.64	6411.3	21856.5	34.09	23.51
2003-04	73.93	47.96	8664.7	31885.2	36.80	23.88
2004-05	75.11	52.00	10185.5	41118.8	40.37	27.95
2000-05	71.81	50.28	38072.8	125676.7	33.01	23.11

Source: Reserve Bank of India (2006-07) Handbook of Statistics on the Indian Economy

Crop insurance is more closely associated with the direct loans taken by farmers for the purpose of buying inputs and meeting other day to day cost from cultivating a crop in the current season. Seasonal agricultural operations (SAO) loans are a part of the direct credit, which the crop insurance is expected to sustain. These loans are direct resources to farmers to enable them to carry on operations and to adopt and use modern technology and inputs as the final end users. In this sense the SAO loan flow ensures the effective and final realisation of the other agricultural credit that has gone to develop technology and improve the potential of agriculture.

Since crop insurance compulsorily covers the loans taken from institutional credit sources, the sum insured under the loanee category reported by the AIC also reflects the SAO loans received by the farmers for crop production. Table 7.2 . The total number of farmers benefited by the short term crop loans rose from 101 lakh to 143 lakh and the amount increased from Rs 8.3 thousand crores to Rs Rs 17.5 thousand crores. While the increases are impressive the same bias is notices with the number of marginal and small farmers benefited increasing by 7% per year compared to over 8% increase among all farmers. The gap is even wider for the amount loaned (20% against 22%) and also for the area benefited (8% against 12.5%). The amount of loan increase faster than the number of farmers receiving institutional loans . The growth rate was also faster in the rabi season than the kharif season and the loan amount grew by 44% in the rabi season which was double that in the kharif season.

Table 7.2: Number of Farmers and the Area benefited and Amount of Institutional short term Loans (S.A.O) from crop insurance data in India

Year	Number of farmers		Area under crops		Amount of loan	
	Small/ Marginal	Total	Small/ Marginal	Total	Small/ Marginal	Total
	Lakh no.	Lakh no.	Lakh Ha	Lakh Ha	Rs Crores	Rs Crores
1999-00	4.01	5.60	3.10	7.59	204.83	348.21
2000-01	67.37	101.39	68.39	159.97	4192.68	8339.99
2001-02	67.25	98.54	64.27	152.70	4455.83	8638.03
2002-03	71.33	103.86	72.87	175.64	5129.22	9930.00
2003-04	64.77	92.67	63.36	149.82	5039.56	9555.69
2004-05	94.13	143.31	105.92	278.46	7775.80	15762.74
2005-06	90.95	142.78	96.53	260.09	8481.64	17549.13
Annual average growth rate						
Total	7.00	8.16	8.23	12.52	20.46	22.08
Kharif	5.17	5.71	6.79	9.31	16.74	17.17
Rabi	14.04	18.65	14.51	26.75	34.70	43.92

Rural indebtedness and the role of institutional sources

A comparison of rural indebtedness of a pre-crop-insurance year 1992 with the latest NSSO survey result of 2002 suggests several positive developments. The rural sector's share in the total debt in the country went up from 59% to 63% even while the share of rural households fell marginally from 74% to 73%. The IOI increased from 23.4% to 26.5% but in this, the IOI sourced from institutional sources was lower at 13.4%, than 15.6% in 1991 and IOI sourced from non-institutional sources was 15.5% in 2003, which was higher than 9.8% in 1991.

The positive indications of the changes in statistics (Table 7.3) are (a) a perceptible redirection of loans towards the rural sector and (b) a rise in the share of productive borrowings to 52% from a low of 20% although the share was much higher at 65% reported in the 1981 survey. On the contrary, there are also matters of concern. First, the share of debts with the institutional sources fell from 64% to 57% **du**ring the same period and dependence on non-institutional sources increased[ii]. Secondly there is a small increase in the debt asset ratio, which is a measure of the debt burden, from 1.78 to 2.84. This by itself is not significant enough to raise any alarm (Vaidyanathan, 2006**).** Third and more disquieting is the observation that the dependence of the poor, defined in terms of asset holding, on non-institutional sources is much more while the richer households show relatively greater dependence on institutional sources than the poor. The debt-asset ratio also declines in the same direction implying greater debt burden on the poor. Finally, borrowings for household expenditures rose marginally.

The picture that emerges from the surveys on indebtedness has little to disagree with what we had from RBI's credit flow data analyses. Indeed, the non-inclusiveness of the credit system has become a discredit in these times of high growth, savings and investment rates. Unofficial surveys have showed that 75% of the borrowing of the lowest 60% of the population, drawing less than Rs

50,000 per year, comes from friends and family or money lenders and only 14% from banks, 5.2% from cooperative societies and 1.7% from chit funds and that an interest charge of 36% per annum or more is paid by nearly half of the persons who have borrowed from relation or friends, 60% of those who borrowed from money lenders and 51% of those who borrowed from chit funds (Rajan, 2008). For the average farmer, over a quarter of the debt came from professional moneylender and 14% from traders and friends (2005). Not of any less embarrassment is the fact that, after 15 years of credit targeting towards agriculture, the total debt of farmer households from all institutional sources put together was less than that from the moneylenders in Andhra Pradesh and Rajasthan and in Punjab, Assam and Bihar it was less than that from all non-institutional agencies.

The reluctance of the institutional sources probably comes from the high real cost of lending relative to what banks are allowed to charge (10 to 12% interest rate but 7% for farm loans). Mandating a priority sector target only forces banks to lend to the best credits that qualify and with enlarging net, the target reached would increasingly be big farmers and rich agro-businesses. A large target for agricultural loan imposed on a weak institution can also undermine the quality of loan use and hamper recovery (Radhakrishna, 2008**)**. Worse, considering the time and money demanded by the process, the documentation complexities and the long time taken for processing, the readily available money lender may actually prove more economic to the farmer. It is not surprising that most farmers have running accounts with the 'adtiya' or middleman for meeting credit requirements on a regular and assured basis (Patil, 2008).

Table7.3: Changes in Extent and nature of Rural indebtedness		
Indications	1991	2002
Households %	74	73
Debts	59.0	63
IOI %	23.4	26.5
IOI-Institutional%	15.6	13.7
IOI-Institutional%-Lowest decile	5.3	3.6
IOI-Institutional%-Highest decile	25.5	26.7
IOI-Non-institutional%	9.8	15.5
IOI-Non-institutional%- Lowest decile	7.4	12.9
IOI-Non-institutional%- Highest decile	7.9	10.3
% Borrowing. Productive	20.3	52.1
% Borrowing. – Farm use	12.9	38.0
% Borrowing. – Household.	46.7	47.9
Debt/Asset	1.78	2.84
Debt/Asset - Lowest decile	14.09	20.1
Based on NSSO, 1998 and 2005 48th and 59th Round		

In Table 7.4 we attempted to present a disaggregated picture of credit flow in relation to the irrigation endowment of the states. We have classified the major states into three categories Highly irrigated (HI), Medium irrigated (MI) and Low irrigated (LI) . HI is represented by states with (net) irrigation intensity exceeding 50%, MI by states with irrigation intensity between 30% and 50% and states with irrigation intensity up to 30% are classified as LI.

HI: Uttar Pradesh, Bihar, Tamilnadu

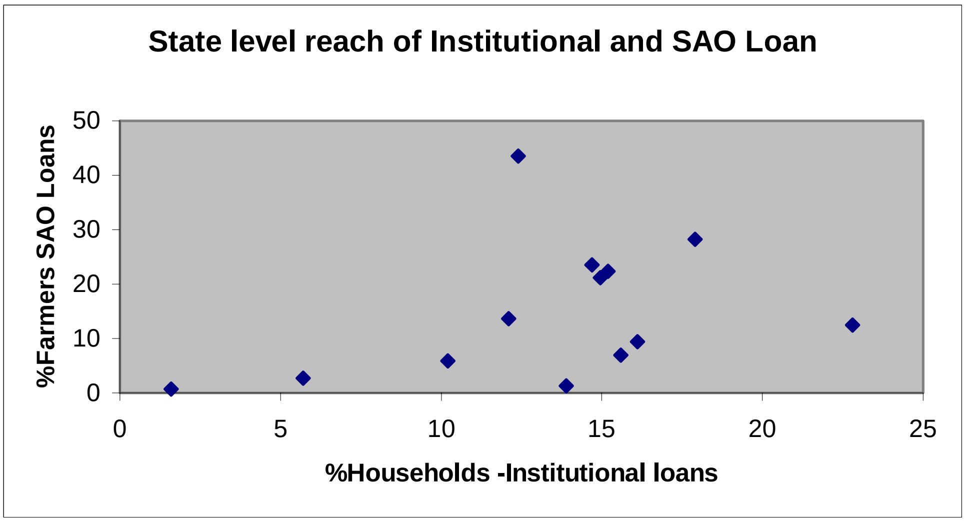
MI: Rajasthan, Andhra Pradesh West Bengal, Gujarat

LI: Madhya Pradesh, Karnataka, Orissa, Himachal Pradesh, Maharashtra, Assam

Table 7.4: Access to Credit in Irrigation based regions					
Region	**MPCE (Rs)**	**%Households In first 30percentile**	**%Household With cash Loan**	**Average Cash loan per Household**	**%Household With institutional cash Loan**
HI					
Mean	**603.70**	**28.00**	**25.95**	**7428.50**	**11.35**
Max	862.89	46	31.3	12359	15.6
Min	417.11	7	21.8	2992	5.7
Range	445.78	39	9.5	9367	9.9
MI					
Mean	**583.65**	**21.75**	**31.50**	**9402.25**	**13.53**
Max	596.09	25	42.3	12031	14.9
Min	562.11	17	21.8	3194	12.1
Range	33.98	8	20.5	8837	2.8
LI					
Mean	**472.54**	**40.57**	**21.51**	**4132.00**	**13.47**
Max	567.76	57.00	31.30	9193.00	22.80
Min	398.89	17.00	7.50	643.00	1.60
Range	168.87	40	23.8	8550	21.2
ALL					
Mean	**537.14**	**32.20**	**25.36**	**6416.47**	**12.92**
Max	862.89	57.00	42.30	12359.00	22.80
Min	398.89	7.00	7.50	643.00	1.60
Range	464	50	34.8	11716	21.2
Source: Computed based on NSSO data, also see Table 9.1A					

It is not surprising that the average monthly per capita consumption expenditure (MPCE) is highest in the HI region followed by MI and lowest in the LI region. Within the region, the range is maximum also in HI and least in MI. Considering ion the distribution among households, 40.6% of the households are in the first three all India percentiles in the LI indicating the extent of deprivation in this poorer region. The same ratio is least in the MI region. The loan distribution shows the MI region as the privileged one with 31.5% of the households holding cash loans compared to 26% households in the HI region and 21.5% in the LI region. The average loan held per household shows the same direction so that the MI household holds Rs 9402, the HI household holds Rs 7428 and the LI household holds only Rs 4132 in cash loans. While these loans are from all different sources, the table also shows the dependence on institutional sources to be marginally higher at 13.53% of the households than the LI households, with the HI households coming last in the ranking. Figure 9.2 which shows the scatter diagram for intensity of reach of institutional loan (per household) as reported by the NSSO against that of the institutional SAO agricultural short term loan (per farmer) as reported in crop insurance data indicates a high degree of correspondence among the states but with a smaller slope at the lower levels.

Figure 7.2



Farmer suicides: Can crop insurance help?

Rural credit and indebtedness have always been associated with agrarian distress. In recent years the issue of farmer suicides has become a subject of concern as well as controversy. Whether the media has overplayed such instances, whether 'all those who have committed suicides are branded as farmers' and if such suicides have any thing to do with agricultural performance are unresolved matters. The estimates of the number of suicides vary with studies and reports (Mitra, 2007). The National Crime Record Bureau (NCRB) places the number at 17,060 in the year 2006 and at 1,66,304 between 1997 and

2007. Hot-spots like Vidarbha in Maharashtra, Warrangal in Andhra, Northern districts of Karnataka, Wayanad in Kerala and Sangrur-Mansa belt in Punjab are noted though suicides are also reported in other, even relatively endowed districts and in other states. The matter has put immense pressure on the government and raised questions on the effects of globalisation on Indian agriculture. Since the issue of farmers' suicide is closely associated with risk and indebtedness, the value of a crop insurance can be considered in the context.

Bias cannot be ruled out in the reports presented by the specific activist groups, institutions and NGOS who have conducted most of the surveys but a few official reports seem to be no more objective. The few independent studies that came out with their reports include the National institute of Rural development (NIRD, 2004), Indira Gandhi Institute of Development Research (Mishra,2007), Tata Institute of Social Sciences (TISS,2005) and a study from ICFAI, Hyderabad (Menon,2006). An official study in Karnataka did not find farmer suicide as a serious problem and found family feud, depression and alcoholism as important reasons. In 1998 a commissioned study by Chandigarh's Institute for Development and Communication (IDC) scaled down media reports of farmer suicides as an 'exaggeration' (Frontline, 1998) though agreeing on the rising rate of suicide mortality in Punjab. The report associated the suicides more with non-economic reasons and unproductive loans than direct agrarian failure.

On the other hand the NIRD, that studied cases in North-Karnataka and neighbouring Warrangal in Andhra Pradesh reflected that 'suicides in such scale cannot be dismissed as personal problem but necessarily be related to agrarian crisis'. NIRD saw sources of problem in the cropping pattern change, monoculture, purchased inputs and lack of other opportunities. In 2005 Maharashtra government admitted before the National Human Rights Commission that farmers committed suicide due to droughts and indebtedness. TISS, in its report[iii] on farmer suicides studied three regions Vidharbha, Marathwada and Khandesh drawing attention to the distressing indebtedness caused by recurrent crop failure, pest attacks, and rising cost. IGIDR (Mishra, 2007) mentioned both price and yield shocks and the breakdown of both the formal credit system and the extension machinery in Maharashtra. The ICFAI study in Warrangal noted the change in cropping pattern and dependence on private input suppliers. In an intense assessment, Vaidyanathan (2007) could not relate the distressingly high incidence of suicides to free trade but use of new technology and the rural urban disparity are noted. Thus though there is a tendency especially in government circles to dissociate the issue of farmer's suicides from that of the agricultural situation, there is no strong case to rule out the effect of agricultural failures with farmers' distress on a broader view.

Going through the literature and reports it is possible to distinguish certain features associated with the suicide affected regions, households or victims.

1. There has been a shift in cropping pattern from a traditional and mixed one to specialisation. The chosen crop is usually new and often commercial such as cotton.
2. New technology sometimes applied such as the Bt. Seed, failed to deliver the expected success.
3. Unexpected water shortage caused failure of the crop.
4. In the absence of extension, advice was taken from local commercial input suppliers. The same advice or the input failed. Faulty pesticide and wrong use of pesticides were a common problem.
5. Price of crop unexpectedly crashed.
6. Money was borrowed from moneylenders who were sometimes also input suppliers.
7. Low agricultural income and the rising demand for consumer goods led to unproductive borrowings and indebtedness.

Table 7.4: Sources of farmer's distress: can NAIS be the answer?		
Factors	NAIS Role	Effective/Supporting Methods
Price volatility	Provide resilience if income improves	Information, efficiency, Derivative Market
Failed inputs	---	Legal Process, inspections
New Crops	Important	Extension, training
New inputs/technology	Important	Extension, training
Untimely Rainfall	Limited role, Rain insurance?	Insurance by stages of crop growth
Droughts/floods	Important	Extension, water management, forecasts
Water shortage	--	Public irrigation investment, ecological intelligence and prudence
Illness, accident etc.	Resilience if income improves	Special Insurance products, social amenities
Unproductive Loans	Important if income improves	Education Medical Insurance, Public Health Facilities
High Cost of Inputs	Important	Regulation of input supplies, market efficiency, information

Many of these observations are hardly surprising in context of globalisation that seems to have brought a sea of change in farmers' approaches to risk taking and credit. They are now more optimistic and commercial than in the 1960s and moved towards lucrative, specific and new commercial crops. They depend more on commercial sources than public agencies. They are open to new technology. They are also aggressive in their demand for consumer and utility goods for which a ground is created incessantly by the promotional activities of the commercial companies in conjunction with the media. In this changed scene, crop insurance could have a powerful role if it helped to increase farm income on a sustained basis. Stabilisation of income by means of insurance can help maintain the incentive to use of untried and promising technology. Higher income will serve to an extent to meet the legitimate desires of the farmers as citizens viewed in current perspectives and the aspirations of good living though possibly even this will leave room for unjustified and inconsistent expenditure demands.

Crop insurance however is hardly enough and both the farmer and the insurer needs a strong support from an extension system that provides correct guidance to the farmers on soil moisture management, an information system that advises of weather, technology and markets and a legal and regulatory system that guards farmers from unethical business. At the same time, continuous research needs to be conducted to predict the future and overcome the foreseeable impediments. All these are methods of reducing avoidable risk (Chapters 2 and 3). Other methods like health, life and accident insurance and public spending on heath and education can add to the process of building up a financially lucrative agricultural sector.

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[i] From 1993 direct and indirect finances together came to be considered when meeting the priority sector targets. Alongside, was a continual broadening of definition of what constitutes indirect lending. Loans to input suppliers, dealers of irrigation and agro-machinery, electricity boards, agri-clinics non-banking financial companies and warehouse construction came to be gradually included (Shah et al.,2007).

ii The NSSO's Situation Assessment Survey 2003 further finds that of the farmerii households that constitute about 60% of rural households, 48% of the households are indebted and 65% of the loans for productive purpose.

[iii] TISS was asked to be a consultant by the High Court of Mumbai in a Public Litigation case on farmer suicides.

Table 7.1A: Access to Credit by states					
Region	**MPCE (Rs)**	**%Households In first 30percentile**	**%Household With cash Loan**	**Average Cash loan per Household**	**%Household With institutional cash Loan**
UP	532.63	33.00	23.40	5059.00	10.20
TN	602.17	26.00	31.30	9304.00	13.90
BH	417.11	46.00	21.80	2992.00	5.70
HRY	862.89	7.00	27.30	12359.00	15.60
AP	585.55	25.00	42.30	10590.00	14.90
GJ	596.09	21.00	28.10	11794.00	14.70
RJ	590.83	17.00	33.80	12031.00	12.40
WB	562.11	24.00	21.80	3194.00	12.10
AM	543.18	17.00	7.50	643.00	1.60
CH	425.10	55.00	19.80	3933.00	14.40
JH	425.30	46.00	12.00	1124.00	6.30
KRN	508.46	32.00	31.30	9193.00	16.10
MP	439.06	47.00	26.10	9031.00	15.20
MH	567.76	30.00	27.50	1391.00	22.80
ORS	398.89	57.00	26.40	3609.00	17.90
Source: NSSO 2002					

8. Risk in Developing Agriculture: Some Conceptual issues

That the farmers in developing countries are rational decision takers was a view that gained acceptance in the 1960s with persuasive support from the leading development economist Schultz (1964**)** and confirmations from rigorous econometric test**s** (Krishna, 1963, Askari and Cummings, 1975). The transformation of traditional agriculture was a mission that evoked much discussion at the time. The apparent reluctance of small farmers to switch to the modern methods that hindered the use of the high yielding seeds was a major enquiry. With farmers' rationality in decision making being fairly established, an alternative explanation was necessary for the slow rate of adoption of a lucrative technology. The conventional profit maximisation hypothesis seemed inadequate to the task. A class of optimising rules that recognized multiple goals of security and profits appeared as a more promising approach. The lower expenditure on cash inputs observed particularly in farms with inadequate control on water (Barker, 1969) indicated that the farmers were concerned about the risk of crop failure. Wharton (1968) described the importance of risk in that context in the following stylised statements

- Attempts at changes, especially those which come into conflict with the fundamental goals of security and survival of the farmer's family, must take into account the degree of risk associated with the change.

- Such farmers are understandably reluctant to experiment with the survival of their families

- Elimination or reduction of risk should prove a major stimulus for technological innovation.

Risk and Uncertainty concepts

Risk refers to situation where alternative outcomes, not all of which are favourable to the decision maker, can come out of any decision and these outcomes have certain probabilities that can be found out empirically. Risk and uncertainty both refer to a situation where alternative outcomes are possible but the distinction between the concepts is usually associated with the measurability of the probabilities, more relevantly related to the objectivity versus subjectivity of probability.

The distinction between risk and uncertainly is therefore not very sharp. Both refer to a situation where alternative outcomes are possible but risk is associated with probabilities that are known and objective while uncertainty is a state of mind (Roumasset et al 1979) in which probabilities are defined as the degree of belief that a person has in the truth of proposition. In the case of risk, the probability of an outcome may be empirically measurable by the percentage of equally likely and mutually exclusive events, which are favourable (Knight, 1921) to the event. Though useful as a hypothetical construct, it is hard to find in real world, where most variables are in a flux, examples of cases where objective frequency is well-defined (Roumasset, 1976). Models based on subjective probability may be applied to situations where the decision maker accumulated substantial experience on the relative frequency of the outcomes or where he or she has no reason to believe that one outcome is more unlikely than the other.

Risk in Agriculture: Measurability and Measurement

Risk is a characteristic of most economic activities. However in industry, the specific techniques and organizations that shape the fulfilment of the planned outcome are known and under control and the outcome can be fairly accurately foreseen (Ray,1974). In agriculture on the other hand, received knowledge hardly enables one to predict results with any precision. Factors that primarily determine productivity in agriculture are thought to be least susceptible to correction through changes in techniques. However, this presumption is not entirely justified. Some of the standard risk management methods do aim at stabilising crop yields across years and avoid crop losses. These include good practices of land and water management, seed treatment and plant protection and vigilance against pests and wild animals. Research and extension relating to high yielding varieties or the genetically modified seeds, more effective pesticides and tillage reduce the chances of loss. Extension of good quality irrigation has always helped to reduce the uncertainties of weather effects. Recent methods of crop forecasting and early warning also help to take preventive steps before the onset of a crisis. However, although agriculture is also amenable to scientific monitoring, dependence of weather, susceptibility to diseases and pests and the unavoidable disruptions in the input market still make agriculture a subject of uncertainty under the current state of technology.

In today's context, the issue of risk is of interest both for positive and normative reasons and for policies to assist farmers in making production decisions that are desirable on social grounds. Subjective and objective probabilities of crop loss are both important for different reasons though several complexities surround the measurement of both possibilities. Risk has been treated differently in literature depending greatly on the purpose of study. In a normative study the analyst's estimates of probabilities are used but subjective probabilities of decision makers are relevant in descriptive studies. However the presumptions are flexible, subject to availability of data. Often, farmer's subjective probabilities are assumed to be same as the analyst's estimates and it is expected that the farmers experience is similar to the analyst's information set. In one approach, the decision maker's subjective probability can be elicited directly through surveys by asking questions about their beliefs. The problem of the survey method is that farmers do no always think in terms of probabilities. In an indirect way, revealed probabilities may be captured as those which make individual's preferences consistent in the ranking of act. In this approach, the decision maker's action is assumed to follow optimality rules which again may not always be realistic. Real life decision makers often act according to rules of thumb, habits or neighbours' and specialist (extension) advice. Empirical estimates from past data can be ascribed for the probability of crop loss as assessed by the farmers who go by their experiences.

The Expected Utility theorem

The expected utility theorem is the most widely used model of behaviour under uncertainty (Pope and Ziemer, 1984) in which the expected utility rather than the profit that is maximised. In this it is possible to assign cardinal utility values to consequences in such a way that the expected utility of any action suffices to rank the actions according to the individual's preferences.

The expected utility approach was first postulated by Bernoulli and a set of axioms that were considered reasonable were shown by Von Neumann and Morgenstern to be sufficient for the validity of the theorem. So long as the individuals are risk-averse, their utility will be a concave function of wealth and the individuals will prefer a sure amount of wealth to an expected value of the same magnitude. The cost of risk can be measured as the maximum premium they will pay willingly to enjoy certainty. This is given by the difference between the expected value of the risky prospect and its certainty equivalent to the persons (Binswanger, 1980).

Mean Variance theorem

This approach usually compares the two moments of the probability distributions across the relevant cases. In a typical mean variance analysis a decision D2 is preferred over decision D1 if a comparison of the expected values and the variances shows that $E_1 >= E_2$ and $V_1 <= V_2$ and one strict inequality holds where E is t he expectation and V is the variance.

A mean preserving spread of a frequency distribution of outcomes (Rothschild and Stiglitz, 1970) is said to be equivalent to an increase in risk. Under the assumptions that (1) the possible returns associated with each alternative are normally distributed and (2) the decision makers preferences are given by a quadratic utility functions the utility of a distribution is a function of the mean and variance of the distribution. For the quadratic utility function it turns out that the expected utility of a distribution can be expressed as function of the mean and variance. The mean variance analysis is consistent with the expected utility theorem under certain conditions. However there are objections associated with this approach such as the possibility of non-normality of returns and the unappealing property of increasing absolute risk aversion (the individual is less willing to accept any given sized increase in returns at higher levels of wealth) which is not convincing in the case of small farmers.

Bounded rationality

Expected utility maximisation is a full optimality model that ignores the role of decision cost. The complexity of real world decision problem and the decision makers' limitations of imagination and computation raise problems of rational choice that can be described by an optimising behaviour. Alternatives of maximisation such as 'satisficing' behaviour are considered. For the farmer who has limited information and limited ability to process the information preventing a complete ranking, decision are characterised by bounded rationality.

Safety First approach and its relevance to Indian agriculture

In common parlance risk is the probability of loss. Consistent with this idea is a definition that specifies risk as the probability that the stochastic variable (income) will take on a value less than some critical minimum disaster level. Safety first is a general heading of rule of thumb models.

(1)

$$\text{Min } \alpha = \text{Prob } (II < d)$$

This model minimises the probability that profit (II) falls below a specified (fixed) disaster level d.

(2)

In this rule probability is exogenous and a constraint to the model. This is a chance constrained programming (Strict Safety First model of Charnes and Cooper, 1958)) to maximise the objective function subject to the constraint

$$\text{Prob } (II < d) \leq \alpha$$

Where d and α are fixed.

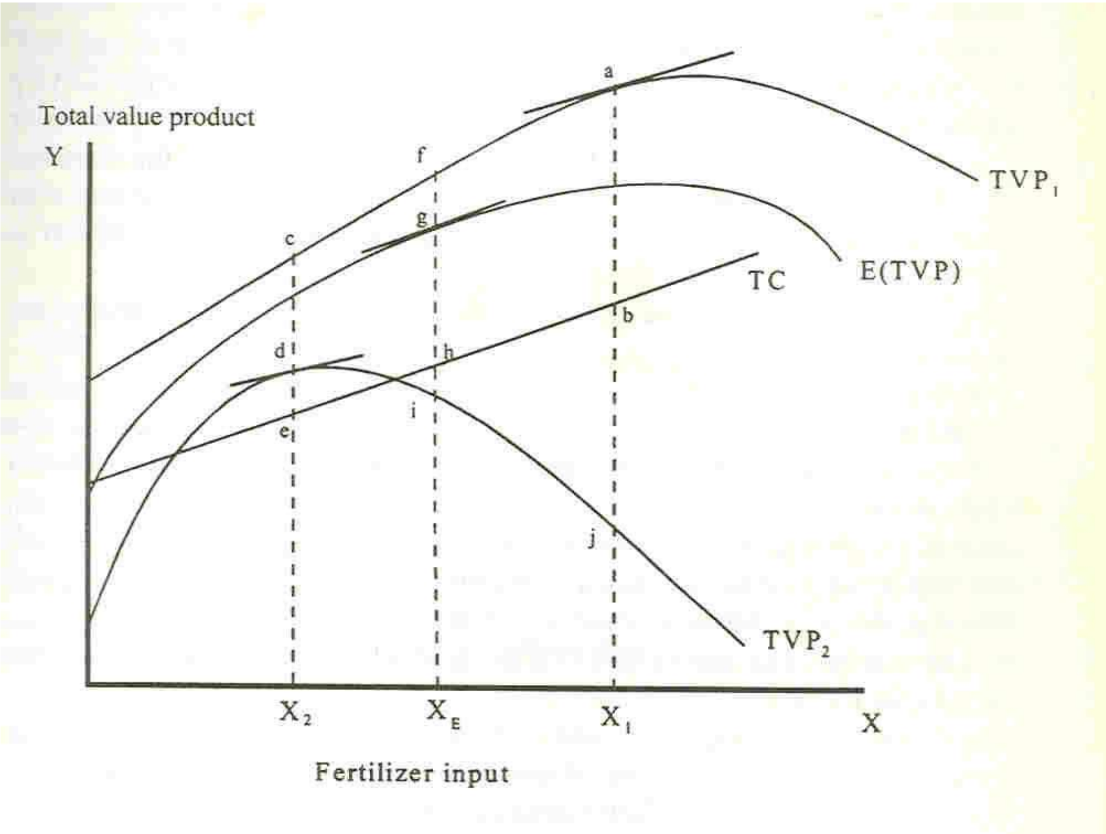
(3)

This is a so called 'safety fixed' model that maximises the minimum return d which can be attained with a fixed confidence level (α is fixed).

$$\text{Prob } (II < d) < \alpha$$

The safety first approach appears relevant compared to expected utility and mean variance approaches in case of small farmers for whom survival is a basic condition. Figure 8 is a demonstration of the significance of the minimum security. This considers a simple case when there can be two possible states, favourable and unfavourable and the only resource is fertilizer. With favourable conditions the production function is given by the curve TVP1 but if adverse circumstances prevail the relevant curve is TVP2. Going by the expected values the relevant function becomes E(TVP) which is optimised at g when X_E resources are invested. However, if the unfavourable state occurs the actual curve becomes TVP2, in which case there is a loss of ih with X_E amount of investment. When the farmer is concerned about protecting his basic security, he might consider the worst case and invest only X_2.

Figure
8.1



In a normative sense too the public policy would seek to promote actions that would ensure the basic security of farmers while maximising production or other desired objective. The political importance attached to farmer suicides in recent times highlights this commitment. Many decisions that are associated with the losses such as incurrence of excessive debt, specialisation in new crops, use of modern untried technology are inspired by volatile market signals, media reports, demonstrations, advice from local experts and dealers and advertisements. They are actions of risk taking given the limitation of information as also inefficient extension. A welfare directed government policy would choose to aim for maximum returns while also protecting the basic needs of the poor farmers.

Normality of crop yield

The issue of normality has been raised in context of the literature on decision making in which the popular expected utility approach is found consistent with the Mean-variance approach (Pope and Ziemer, 1984) if the distribution is normal and higher moments are not considered of importance. Alternative to the parametric approaches is the second-degree stochastic dominance (SSD) approach, that compares the cumulative probability distribution across decisions. This method may or may not assume normality but under normality all the approaches are equivalent. That the methods can yield different rankings became an important issue when it was proposed that crop yields may not generally be normally distributed (Day,1965).

9. Crop yield risk in India:
Normality issues and the Magnitudes of risk

Risk in agriculture is best specified as the risk of yield shortfall[1]. Our focus in this study is the outcome effect of risk rather than the multiple causes of risk, i.e., the hazards that afflict agriculture. This follows the idea behind an all-risk or multi-peril crop insurance in which the end effect of risk rather than different sources of risk are the items for insurance. The nature of yield risk becomes an important factor for farmers' decisions to participate and the desirable properties of a crop-insurance design. In this chapter we will attempt to examine the distributions of yield and the possible measures of risk that the farmer may encounter in the cases of the major crops covered by insurance. We assume that risk, as perceived by the farmers, would be determined by the probability of the occurrence of what may be deemed as yield 'loss' and the magnitude of the loss itself expected.

The statistical analysis we have conducted pertains to the data on yield rates of select crops namely kharif Rice, rabi Rice, Maize, Wheat, Groundnut, Soyabean, Pulse (tur), Sugarcane, Potato and Cotton. These crops cover all majot crop groups i.e., cereals, oil seeds, pulses and commercial crops. The data are taken from the regular publications of Government of India's Department of Economics and Statistics in the Ministry of Agriculture. Time series data over a fairly long period 1973-74 to 2005-06 is used for studying the yield behaviour. The analysis is done at a disaggregate level for three groups of states aggregated and categorised as Highly irrigated (HI), Medium irrigated (MI) and Low irrigated (LI). This categorization is based on the supposition that the irrigation endowment of a state is an important criterion for assessing its risk profile. HI is represented by states with irrigation intensity exceeding 50%, MI by states with irrigation intensity between 30% and 50% and states with irrigation intensity up to 30% are classified as LI. Based on the availability of time series data on yield the following states are considered at their pre-bifurcation(reorganization) states. More details of categorization and the three irrigation based regions are furnished in Appendix III.3.

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[1] Price risk is also an important component of agricultural risk but is not directly addressed by NAIS.

HI: Uttar Pradesh, Bihar, Tamilnadu

MI: Rajasthan, Andhra Pradesh West Bengal, Gujarat

LI: Madhya Pradesh, Karnataka, Orissa, Himachal Pradesh, Maharashtra, Assam

The Measurement of risk

It is common in the literature in agricultural economics to represent risk simply by the variance or the corresponding relative measure coefficient of variation over a number of years in the most immediate past and this measure is often inserted as an explanatory variable in other relevant models such as the area response functions for econometric analysis**.** The concept of the coefficient of variation (CV) as a measure of risk is implicitly accepted by India's insurance scheme the NAIS. The threshold yield which is a crucial input in the calculation of yield loss and indemnity is determined using the Level of Indemnity or LOI which in turn computed on the basis of the CV of yield over the last 10 years. The very appropriateness of the LOI and its underlying assumptions are not beyond question. The issue is more complex than it appears on surface as discussed at length in the literature.

Associated with this understanding of risk as the second moment of a distribution is a tacit assumption that yield rates are normally distributed, more specifically the yield is symmetrically distributed around a certain mean level and the three measures of the central tendency (mean, median and mode) converge. If the yield rate is normalised around its expected value, the first moment of the distribution becomes zero in any case and the second moment measured by the variance is the most common differentiator among the crop cases in terms of their riskiness. Skewness and the kurtosis based on the third and the fourth moments are invariant across all cases under normal distribution.

In general, the presumption of normality has been widely questioned by scholars and it may be important to look at the two higher moments of distribution before rushing into the generalization. When the data contains appreciable contents of extreme values, the distribution is not likely to be normal. In this chapter we refrain from making any assumption of underlying normality and examine the distributions of crop yield rates. In particular the skewness of the distribution is of interest in this study as the significance of the standard deviation in describing the risk involved can only be validated by the affirmed symmetry of the distribution. The justification is outlined below.

The importance of Skewness of yield rate distribution

Normality of yield has been an important supposition when the alternative paradigms of the expected utility, the mean variance and stochastic dominance theorems (Chapter 8) are compared. Indeed, the importance of the normality hypothesis arises time and again in the literature on decision making. Yet, the possibility of non-zero skewness can have serious implications for farmers' decisions as well as their welfare. It is intuitively reasonable to assume that the farmer's risk perception and his or her resultant decision will be influenced powerfully by the probability of a loss and the magnitude of the loss possible that the farmer perceives rather than the variation in either direction. In the case of small farmers in developing countries like India, in which the farmer operates at a near subsistence level with very little resources to fall back on, the probability of loss and the basic requirement of security are key factors in farmers' decision making. The safety first notion of risk aversion (Chapter 8) may be a more appropriate description of behaviour in such a situation. While the standard deviation, treated as a measure of yield variability, can measure the expected deviation from the mean or expected yield rate, this measure obviously has its limitation when a risk-averse producer is concerned about a loss in particular. This is because this consideration treats positive and negative deviations in a similar light, while for the risk-averse farmers the negative deviations and their magnitudes are of more vital concern. If the distribution is skewed, the probabilities of losses may be different from those of gains and the probability of occurrence of extremely large negative values is not appropriately captured by the variance measure. So the analysts' conclusions diverge from what really happens on ground and what perhaps is apparent and relevant to the farmers. Moreover, a welfare motivated policy maker plans out suitable safety-nets would do well to heed this aspect of the distribution.

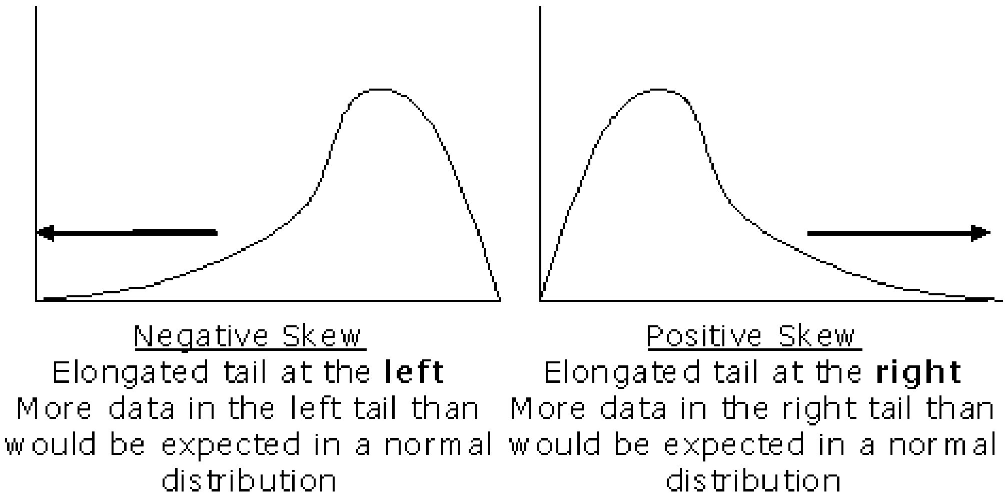
The symmetry of a distribution, measured by the skewness statistic, is based on the third moment of distribution. Skewness is expected to be zero or close to it under normality.

For univariate data Y_1, Y_2, ..., Y_N, the formula for skewness is given by the following equation.

$$skewness = \frac{\sum_{i=1}^{N}(Y_i - \bar{Y})^3}{(N-1)s^3}$$

Where s is the standard deviation of yield.

Figure 9.1



The assumption of normality was questioned by Day (1976) who found a persistent tendency for over-prediction while using a production model. Day hypothesised that the underlying population distribution could be positively skewed which meant that the probability of getting 'below average' yields was greater than that of getting 'above average' yields. His rationale followed this line: For high yields to be obtained excellent weather condition should prevail during all of the growing season consisting of the germination, flowering, heading and harvesting periods. On the other hand, too much or too little rain or heat during any of the critical periods is sufficient to reduce yield drastically though ideal weather prevailed in the other periods. Thus common sense suggested that 'less than average yields' cases are more likely than 'greater than average' yields cases. However, statistical results need not be bound by such reasoning. The lower bound of yield rates (they cannot be negative) is another reason why yield can be positively skewed with some instances of extremely good performance possible. A similar reason also applies in favour of a negative skew since yield rate also has a biological maximum bound. While Day's proposition and his empirical findings have inspired much investigation in literature (Moss and Shonkwiler, 1993, Gallegher, 1987, Nelson and Preckel, 1989), several empirical studies have not been able to reject the normality hypothesis in practice.

The normality test is complicated by the usual nature of agricultural data. A time-series data of yield rates often used for analysis usually incorporates a time trend reflective of the secular progress of technology. Without suitable de-trending, the data would not be stationary and the distribution will also reflect this trend. The data can be described as purely random if only the mean is zero, which is the case in a normal distribution. Day had used the Wald-Wolfwitz run method to test for the randomness of the data. In India, Dandekar used the Chi-square test for normality to establish his idea of homogeneous areas but data has been shown to have a time trend that was ignored (Rustagi, 1988). Just and Weninger (1999**)** emphasised that for a normality test it is critical to deal with the random component only and so elimination of the deterministic component is a prerequisite. In reality the conditional distribution is influenced by a complex set of economic, behavioural and biological factors and actual specification of these processes are usually unknown. Just and Weninger however used a polynomial time function to isolate the random elements and using rigorous statistical tests, they could not rule out normality. Day's own experiments were also said to have been weak in rejecting normality. Evidences of non-normality were strong only for cotton but this may have been due to the presence of only a few years of extreme conditions.

Cross-sectional spatial data on yield rates do not suffer from the non-stationarity problem that time series does but here the distribution would be influenced by the kind of spatial units pooled. Rustagi examined the effect of different types of pooling and found that percentages of cases of normal distribution diminished as the spatial expanse of the geo-political units pooled, increased reducing the homogeneity of conditions. He also noted that when temporal pooling is done over an area, chances of obtaining normality was higher for irrigated crops that were relatively unaffected by droughts than dry crops like sorghum**.**

Experimental data in a region is probably the best item for exploring the distribution of yield rates. However, the practical relevance of such pooling is doubtful, as there is no strong reason to believe that experimental data would follow what actually takes place in real life in which a number of complex natural and human factors influence yield even in the presence of a similar technology. Especially, the weather condition is highly unpredictable and may not repeat itself in any foreseeable period. Data generated by a controlled experiment may miss out on this random occurrence of extreme events.

Kurtosis risk

Kurtosis based on the fourth moment is a measure of peakedness of the distribution curve. In a typical bell-shaped normal curve, the kurtosis takes the value of 3. A kurtosis above this value suggests that a narrow range of data are clustered towards the mean.

Iff $X_1, ..., X_n$ are independent random variables all *having the same variance*, then

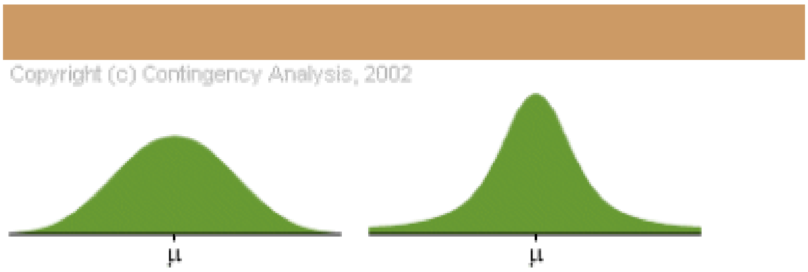
the kurtosis K is measured as

$K = \mu_4 / \sigma^4$

where μ_4 is the fourth moment about the mean and σ is the standard deviation.

Figure 9.2

Kurtosis:



These graphs illustrate the notion of kurtosis. The PDF on the right has higher kurtosis than the PDF on the left. It is more peaked at the center, and it has fatter tails.

Kurtosis risk has also proved to be a serious issue in many present day analyses in financial markets because 'fat tails' add to the probability of higher losses even if the distribution is symmetric. This is the typical case of high kurtosis when more values occur in the tail regions than the normal distribution would suggest, increasing the probability of large losses. The importance of skewness and kurtosis in assessing the risk is important since the probability of loss (rather than deviations in either direction) and the incidences of large losses are of significance to the farmers and any erroneous supposition of a normal distribution will generate a misplaced understanding of the risk involved.

Detrending of yield and the Normality analysis

To study the yield distributions we have detrended the yield rates using linear time trend equations. We have conducted the trend analysis in Appendix III.4 to study the behaviour of yield rates over time. We also noted the presence of structural breaks using Chow tests. Since the trend curves have shifted and such shifts are also known to the operating farmers, the trend equations need to incorporate these structural changes (also obvious to the farmers) in order to obtain the random and unpredictable components around the expected values. As an example we can consider an upwardly moving series that has shifted downwards at a given point of break. If we fail to take account of the shift and measure the deviations around the linear and unbroken trend the distribution, even when normal, would tend to include a high proportion of large negative values typically projecting a positively skewed yield distribution which would be actually misleading. The trend equations at the aggregate level using flexible break points, based on data of crop yields over 1973-74 to 2005-06 are presented in Table 9.1.

Table9.1: All India Time trend of crop yields with a break							
Variable	Con.	time	time*dummy	Adj-R2	DW	F-stat	break
Ricekh	914.3	32.5	-7.4	0.86	2.50	6.1	2000
Ricerb	1820.5	44.6	-5.8	0.91	1.60	10.7	1998
Wheat	987.1	52.0	-7.8	0.96	2.3	18.6	1997
Maize	818.5	35.6		0.86	2.2		
Groundnut	683.3	9.2		0.23	2.7		
Soyabean	308.8	29.4	-8.2	0.61	2.6	5.3	2000
Tur	701.0	0.29	-0.7	-0.61	1.7	1.5	2000
Sugarcane	49909.6	840.3	-329.3	0.71	1.9	9.7	2000
Potato	10626.0	309.8	-39.8	0.82	2.1	3.1	2000
Cotton	104.8	4.34	1.6	0.86	1.7	19.2	2000

A positive time trend is noted for all the crops and a structural slow down detected in all but three cased. The equations are further discussed in the Appendix text. It may be noted that, the t-statistics (not reported in table 9.1) may be ignored when the normality assumption is under question.

Table 9.2 summarises the normality tests in terms of skewness and kurtosis of the detrended series of variables given by Y_{dt} for the select crops for the three irrigation-based regions. The means (not reported) are zero at a reasonable level of precision and the standard deviations, skewness and kurtosis measures are presented along with the **J-B test** of normality in Table9.1A in the Appendix to this chapter.

Table9.2: Number of cases characterised by high risk (out of 30)				
Risk measures	Standard error >0.1*Mean	Skewness <Standard error (Skewness)	Skewness >Standard error (Skewness)	Kurtosis >3
Region-HI	7	1	3	6
Region-MI	5	3	0	4
Region-LI	7	2	1	3
Total	19	6	4	13

Looking at the signs, on the whole the skewness of crop yield distribution was found to be dominantly negative. This suggests that the probability is high for the actual yield rate to exceed the mean yield rate but extreme values on the negative side are also present though infrequent. These values indicate risk and present a case for insurance. Positive skewness is noted in only select regions in the cases of kharif Rice, Maize, Cotton, Groundnut, Sugarcane and Wheat. Only in the case of Groundnut yield the skewness has a positive sign in all the regions showing that yield is likely to be less than the computed mean level. Interestingly, for Maize, Cotton, Groundnut and Sugarcane the positive skewness is found in the HI region, that is considered to be safe. Choice of a crop that shows a positive skewness is hardly a sign of risk aversion and can be explained by a logic that the possibility of less infrequent yet higher gains are drawing the producers. The case for a support through an insurance is doubtful. For Wheat and kharif Rice the MI region shows positive skewness of yield rate. However, the magnitudes of the skewness measure need to be considered along with the sign to arrive at any firm conclusion.

It is also interesting to take a view of the kurtosis. The kurtosis around the mean value, which is more relevant in the case of symmetric distribution, falls within 3 in a majority of cases including all regions for kharif Rice, Maize and Wheat. Greater peakedness or ‘fat tail’ is also noted in a number of cases as for rabi Rice in the LI region, for Soyabean, Tur and Sugarcane in all regions and cotton in HI and MI regions and Potato in HI regions. In these cases probability of extreme values are more that that usually presumed under normality.

To view risk the measures statistically, they may be viewed in relation to those expected in the case of normality. We assessed the magnitude of skewness by comparing it with the standard error of skewness, and Kurtosis with the normality value of 3. We also looked at the standard error and compared it with the mean of (expected) yield (since the deviation is around the trend yield only) as this is the most common measure of risk. Table 9.2 tabulates the numbers of cases identified as risky as measured by the relative measures given by (a) skewness divided by the standard error of skewness, (b) standard deviation of the series divided by the trend value of the series and (c) kurtosis divided by 3. The deviation around the trend value is highest for Sugarcane in the MI region, and is high exceeding 10% in 19 out of the 30 cases, kharif Rice in LI, Tur in MI, Potato in LI, Maize in HI, Cotton and Groundnut in all the regions. All regions are affected by risk in this sense and even the highly irrigated region is no exception. **T**here are only a few cases when skewness is found significant (exceeded its standard error). Of the 10 such cases, rabi Rice in LI region, Potato in HI and LI regions, and Cotton in MI region are found to show negative skewness. Positive skewness is found in respect of Groundnut in LI region and Tur and sugarcane in HI region. Kurtosis appears to have presented a more considerable challenge. The cases that have shown the significant positive kurtosis or the 'fat tail' risk are as follows: rabi Rice in LI, Sugar cane and Soyabean in all three regions, Cotton in Mi region, and Potato in Hi region. The cases of Rabi Rice in LI, Potato in Hi and Cotton in MI regions present risk in terms of both negative skewness and positive kurtosis.

In our exercise, the distributions are in most cases normal so that the non-normality conjecture is not totally substantiated. Hence the standard deviation may not be an inappropriate indicator of risk in most cases. For cases where significant skewness and kurtosis are identified, the occurrence of extreme event needs consideration. However, given the chances of asymmetry and extreme results, the magnitudes of loss and the probability of the incidence of loss are important parameters for an appropriate design. In particular, when the skewness is positive, such as Groundnut (LI) and Tur(HI) and sugarcane (HI), insurance may not be an answer to the problem raised by yield variation. Such crops add to the risk pool by increasing the probability of loss and an appropriate risk management measure would be to have direct policies to increase the mean yield rate. Technology and greater attention towards early warnings and loss prevention could help in addressing kurtosis risk.

Analysis of yield Shortfall

The risk measures commonly considered in literature and those used in the above analysis concentrate on the relative measures of deviations of physical yield. The magnitude of loss due to the risky event is probably important to the decision maker. This is especially so in agriculture in which the farmers are poor and invest from their scarce resources so that the safety-first approach may dominate in their investment decisions. A resource poor farmer may arguably be reluctant to take up a high value crop for cultivation even if necessary credit can be accessed because a crop failure is likely to inflict a much larger financial burden than a lower valued crop. Since losses are occasional, variable and unpredictable, it is not easy to ascertain the level of loss that farmers would consider relevant for their decisions. The farmer could guard against a loss that has prevailed on average or if his level of risk aversion is high, he may even be conscious about the maximum loss that may fall on him. In fact the farmer may be daunted from taking up an activity that has generated a devastating loss in the past, one that had a long lasting impact of his family well-being. The farmer also takes account of the probability of loss in terms of the frequency with which a bad year comes or the probability that the loss would fall below a certain critical value. We assume that farmer will make such judgements based on the experience of past in way that can be done objectively with the data of yield over a number of years. What level of yield shortfall or a loss the farmer would consider as the threshold can only be a subjective phenomenon and will depend among other things on the farmers' specific concern such family commitments, average household income and the cost of cultivation.

Yield shortfall or a yield loss is assumed to have occurred when the yield rate falls below a certain level. This is similar to the way loss assessment is made for insurance as specified by the computed threshold yield level. In our computation in the usual manner we consider the band determined by the standard deviation obtained around the expected or trend yield so that

$Ymin = Y_t^{'} - SE(Y)$ …….E9.1

Where SE(Y) is the standard deviation of yield around the trend and $Y_t^{'}$ is as defined in equation 9.1 and Ymin marks the lower band with this deviation**.** Loss is said to be incurred if actual yield falls short of the lower band yield at that point in time i.e., when

$Y < Ymin$

The loss is then calculated as the difference between the trend yield rate and the realised yield rate for the years in which loss is incurred. Since physical yield rates across crops are not comparable nor of primary significance to the security conscious farmer, we have expressed the shortfall in value terms using the wholesale prices of the crops in the year 2000-01. The value of the loss may be more pertinent in the farmer's calculations than the physical crop loss as it impairs his income, consumption and debt position to that extent. The loss or shortfall denoted as YLOSS is calculated as

$$YLOSS = Price * (Y - Y_t^{'}) \text{ if } Y < Ymin$$

And =0 otherwise.

YLOSS gives a series of values denoting the yield shortfall from its trend level in the years of loss. YLOSS takes a value of 0 in other years that are normal and not of direct relevance in the context of risk. The average of YLOSS over the years in which a loss is incurred gives an impression of the expected level of loss that a risk-averse farmer will guard against. However, under a high degree of risk aversion, the farmer may consider an extreme event drawn from experience (own or informed by the earlier generations) and would hesitate to invest in the risky cases. Simultaneously the farmer would consider the chances that a loss of at least some large specific magnitude will occur. The decisions would depend essentially on the psychological attitude towards risk, the actual economic situation in terms of access to resources, savings and family circumstances and the level of past information available. On a normative front, a policy making government has to decide how much risk is tolerable given the welfare concerns and political compulsions and has to strike a balance between production targets and security.

Table9.3 : Average Yield Loss and the probability of incurring loss of major crops (1975-76 to 2000-05)

Region = Pooled	**Price per Quintal**	**Average Loss Rs/ha.**	**Maximum Loss Rs/ha.**	**Prob(Loss)**	**Prob(Loss> Rs1000)**	**Prob(Loss> Rs2000)**
Rice-kharif	1008	278.21	2188.37	15.15	15.5	6.06
Wheat	602	134.01	1070.72	18.18	3.03	0
Potato	193	630.15	6154.71	15.15	15.15	15.15
Tur	1418	173.00	1605.89	16.13	6.06	0
Maize	432	136.64	1530.71	15.15	3.03	0
Groundnut	1338	489.04	5009.47	15.15	15.15	15.15
Rice-rabi	1008	246.15	2209.33	15.15	18.18	3.03
Sugarcane	980	7136.75	59918.96	15.15	15.15	15.15
Cotton	1765	84.54	827.61	15.15	0	0
Note: Loss in value at Wholesale prices prevailing in 2000.						

Using loss as a criterion, sugarcane appears to be the most risky crop which registers an average loss of Rs 7136 per hectare and a maximum of rs 59,918 in the historical period at recent prices. Potato is another commercial crop that calls for risk management. Groundnut, the main beneficiary of the crop insurance is average and Rice and Cotton can be viewed as relatively safe. Ranked by the maximum possible loss, Sugarcane, Potato, Groundnut, Tur and Mize are first few crops and Cotton and Wheat are the last two. Comparing the regions (table 9.2A) Rice, Wheat and Potato have a larger loss exposure in the HI region while crops like Groundnut, Maize, Tur and Sugarcane can incur higher losses in the MI region. Compared to the monthly per capita Consumption expenditures (MPCE) of rural households in the regions computed in Chapter 7 for sugarcane that maximum loss registered is found to far exceed the MPCE with a ratio of 363 and 221 respectively in the MI and LI regions. The ratio of the maximum loss to the MPCE is highest in the MI region in the cases of Groundnut (10), Maize (4.2) and Cotton (3.5) while for Rice and Sugarcane it is highest in the LI region.

Appendix-9

Table9.1A: Normality test for Crop Yield rates in the Irrigation based regions						
CROP		CV%	Skewness.	Kurtosis.	J.B-test stat.	Probability
RICE KHARIF						
	HI	8.63	-0.34	2.31	1.29	0.52
	MED	5.90	0.07	2.59	0.26	0.88
	LOW	**11.31**	-0.31	2.24	1.34	0.51
RICE RABI						
	HI	**16.22**	-0.071	2.03	1.32	0.52
	MED	3.74	-0.36	2.7	0.84	0.66
	LOW	**10.88**	**-1.82**	**9.54**	76.95	0
SOYABEAN						
	HI	**29.72**	-0.23	**3.6**	0.58	0.75
	MED	**21.53**	-0.45	**3.29**	0.89	0.64
	LOW	**12.68**	-0.02	**3.15**	0.02	0.99
TUR(ARHAR)						
	HI	**15.11**	**0.87**	**3.57**	4.36	0.11
	MED	**18.08**	**-0.49**	**3.89**	2.41	0.3
	LOW	**13.55**	-0.22	2.52	0.56	0.76
POTATO						
	HI	**10.10**	**-0.99**	**4.08**	6.94	0.03
	MED	7.56	0.21	2.37	0.78	0.68
	LOW	**11.66**	**-0.47**	2.9	1.2	0.55
MAIZE						
	HI	**11.97**	0.28	2.59	0.67	0.72
	MED	**19.15**	-0.05	2.82	0.06	0.97
	LOW	9.16	0.29	2.35	1.05	0.59
COTTON						
	HI	**17.25**	**0.53**	**3.72**	2.29	0.32
	MED	**13.96**	**-1.47**	**6.78**	28.65	0
	LOW	**17.53**	-0.2	2.65	0.38	0.82
GROUNDNUT						
	HI	**14.10**	0.13	2.9	0.1	0.94
	MED	**30.00**	0.23	**3.22**	0.35	0.84
	LOW	**12.65**	**0.59**	2.63	1.99	0.37
SUGARCANE						
	HI	8.64	**2.17**	**11.17**	117.6	0
	MED	6.81	**-0.79**	**4.21**	5.45	0.06
	LOW	8.44	-0.11	**4.97**	5.39	0.07
WHEAT						
	HI	4.62	-0.19	**3.13**	0.21	0.9
	MED	5.36	-0.09	2.24	1.83	0.66
	LOW	6.86	-0.03	2.03	1.31	0.52
Figures in bold are significant.						

Table 9.2A : Average Yield Loss and the probability of incurring loss of major crops (1975-76 to 2000-05)						
	Price per Quintal	**Average Loss**	**Maximum Loss**	**Prob(Loss)**	**Prob(Loss>1000)**	**Prob(Loss>2000)**
Region=HI						
Rice-kh	1008	325.89	2565.86	15.50	15.5	9.09
Wheat	602	173.80	1585.43	18.18	6.06	00
Potato	193	711.36	9162.48	12.12	12.12	12.12
Tur	1418	282.32	2179.61	19.35	12.12	0.00
Maize	432	145.76	1173.10	15.15	6.06	0.00
Groundnut	1338	561.42	3324.66	18.18	18.18	18.00
Rice-rb	1008	1051.34	6610.56	21.21	21.21	21.00
Sugarcane	980	5862.07	83408.78	9.09	9.09	9.00
Cotton	1765	186.74	1229.32	18.18	9.09	0.00
Soyabean						
Region=MI						
Rice-kh	1008	235.27	2185.65	15.15	15.15	3.03
Wheat	602	162.00	1283.34	15.15	9.09	0.00
Potato	193	535.34	5960.86	12.12	12.12	12.00
Tur	1418	354.36	3548.97	18.18	18.10	00
Maize	432	254.36	2476.57	15.15	15.15	3.03
Groundnut	1338	729.21	6144.77	15.15	15.15	15.15
Rice-rb	1008	229.42	-1936.97	12.12	12.12	00
Sugarcane	980	12027.64	129248.28	15.15	15.15	15.15
Cotton	1765	116.49	2065.05	9.09	3.03	3.03
Soyabean						
Region=LI						
Rice-kh	1008	297.06	2700.43	15.15	15.15	6.06
Wheat	602	146.29	877.90	21.21	00	0.00
Potato	193	465.50	4936.07	15.00	15.15	12.12
Tur	1418	258.22	2199.60	19.35	12.12	00
Maize	432	195.13	1003.32	24.24	3.03	00
Groundnut	1338	316.30	1662.06	21.21	21.21	00
Rice-rb	1008	457.13	8839.15	9.09	9.09	9.09
Sugarcane	980	10936.41	171271.66	9.09	9.09	9.09
Cotton	1765	100.43	754.01	15.15	00	0.00
Soyabean						
Note: Loss in value at Wholesale prices prevailing in 2000.						

10. Some lessons from the NAIS Experience

Any experience with crop insurance generates useful data on the bahaviour of human beings in relation to agricultural risk and to the possible designs of the insurance scheme. The NAIS, despite its debatable impacts on agriculture, can prove to be important in learning about some finer truths about our agriculture, the potentials of the area-yield crop insurance formula and for planning innovations.

Critics usually focus on two records in the report card of a scheme which are participation and viability. While both are useful in assessing the scheme they are not mutually independent. Greater participation diversifies the risk pool making it more viable and a viable scheme would also encourage participation. On the contrary, when the scheme at the individual level is loss generating on the average, expansion of participation will only multiply the losses. This has largely been the case with India's NAIS. With a number of restraints acting on the power of the insurer to fine-tune the parameters of the contract, the balance between the receipts and revenues from the insurance business has been highly adverse towards the insurer and in a way that only adds to the budgetary load of the government in a rather uncontrolled manner. Yet, the participation of farmers, and especially the small farmers is hardly impressive. It is important at this point to examine the various responses and constraints and weaknesses that stand in the way of the scheme.

This chapter presents some salient finding from the analysis of data on crop insurance and the yield rates at the state level. While this aggregation will tend to average out much of the micro level (area level) intricacies of risk, the results are broadly indicative as also demonstrations that can be conducted at lower levels of analysis once area level data is available. The issues taken up relate to the behavioural responses of demand for insurance, the criticality of asymmetric information, the degree of correlation of risk, and the justification of the threshold yield formula.

The Response of insurance Participation

We present an empirical model aimed at investigating the possible behavioral responses of farmers in insuring against risk to different relevant factors. As discussed in earlier chapter 8 behaviour under risk has been described using various hypotheses. Theoretical and empirical explorations made by Ahasan, Ali and Kurien (1982) and Goodwin (1993) have created models of farmers' behaviour in different ways to bring out their responses in terms of resource use and insurance demand. Under Indian conditions, possibly the approaches based on the 'safety first' theory are more relevant than the mean variance approaches. A typically risk averse farmer maximizes his expected returns subject to a minimum security concern.

We assume that there can be two conditions of production beyond control, Good and the Bad. The farmer invests in anticipation of a good condition prevailing (this may relate to weather or other factors) but also takes care of any contingency by way of insurance though he has to incur a premium cost. He takes insurance such that in the possible case of a bad condition, the indemnity from insurance is able to balance his loss of revenue (from that expected by him in the normal circumstance) leaving him with a minimum security balance of δ. In other words the farmer maximizes his expected returns subject to a minimum assurance.

A simplified model can be postulated as

$$\text{Max } [P_G.R+P_B(R-L+c(X))] - p(X) + \lambda(R-L+c(X) - \delta)$$

Where R is the farmers' notion of what his returns would be under normal (Good) conditions and may be considered as a function of resources used and past experience. L is the notion of the shortfall possible in returns from R in case the conditions do not turn out to be normal. Like R the shortfall L may also be considered to be determined by the resources used and the past experiences of losses. The Return functions under either condition will have the usual properties of concavity. The coefficients P_G and P_B are the probabilities of the prevailing conditions being Good and Bad respectively so that $P_G+P_B=1$. This of course is a simplified representation and can be extended as a probability distribution among a multitude of production conditions. X is the insured amount that interests us, p is the premium function. In the La-Grangian expression the expression, λ is the La-Grangian multiplier and within the parenthesis is the constraint which says that the indemnity c(X) and the returns under the Bad condition must be equal to a minimum required for sustenance given by δ. The coefficient c is the parameter for indemnity that may in reality be derived by various formulae incorporated in the contracts. The minimum security δ is given by the actual social realities and may in practice be positive as well as negative when the farmer is willing to undertake a part of the liabilities (repayment of agricultural loans, consumption expenditure etc.) from his own resources, relief payments or informal loans.

Maximising and solving for X in the above equation we have the following equation that describes the demand for insurance.

$$X = f(p, c, P_G, \delta, R, L)$$

In the empirical model we specify the following:

(a) We aim to explain the sum insured per hectare of cropped area.
(b) The premium (or price of insurance) is collected as a proportion on the sum insured though the proportion may vary over crops, regions or be progressive over the amounts insured. The premium rate is obtained as the weighted average of the subsidized premium rate of the small farmers and the applied rate of the others with the share of small farmers under coverage used as the weight.
(c) The claim parameter is actually a formula that depends on the threshold yield. The farmer compares the threshold with some realistic norm to assess their gain from the insurance scheme.
(d) The response to premium charge may depend on the risk perceived so that a more risk exposed farmer may reduce coverage to a lesser extent than a less exposed farmer if the premium rate goes up. The risk is measured by usual statistics (alternatives are CV, skewness, probability of loss, maximum or average loss etc.).
(e) For simplicity, δ can be assumed to be zero so that the farmer is viewed to cover his expected loss by the indemnity received. However the monthly per capita expenditure of rural people (MPCE) is included as a possible determinant of the unobservable δ.
(f) The threshold yield is calculated by applying the official formula (Appendix 2) to the state level data.
(g) A time variable is tried to capture a possible trend coming from greater information propagation.

We have pooled all the crop-state-year cases of insurance adding up to a number of 209 cases. Each case is considered to be a unit of decision making in financial terms and is treated as an observation. Thus no distinction is made between the crops, states or years since the decisions are essentially considered to be financial. The dependent variable is the sum insured per unit of cropped area in value terms. The explanatory variables include the premium rate (PRMRATE), the Threshold yield (THRY) measured in relation to the previous year's yield. The value of the crop of the previous year (VALUE) may have a negative effect since a fall in the value may lead to more apprehension and coverage. On the contrary, the value also acts as a scale variable since high value crop involves higher resource use and higher expected returns. The past value would be an incentive to invest in this crop with insurance. The expectation of shortfall depends at least in part on the current sowing season rainfall that may be visible to the insurance buyers if the purchase can be made late enough. The risk also depends on the irrigation endowment of the state that would act as a substitute for insurance. We have used the dummy variables for irrigation endowment as defined in Appendix III. An interaction terms has been considered to mark the price response. The variable measuring the proportion of small farmers (SMMF) is included since their demand may differ from others. All values are deflated by the wholesale price index of all commodities. The estimated equation selected on the basis of the parameter signs and significance is as follows:

Table 10.1: Estimated regression equation for Demand for crop insurance				
	Specification without risk		**Specification with risk**	
PRMRATE	-99.9	-1.24	-447.98	-3.06
VALUE	-.0.002	-1.17	0.00	0.13
SMMF	-0.19	-1.4	-0.15	-1.09
THRY	-3.15	-0.69	0.52	0.11
DUMMED	15.98	3.61	14.72	3.37
DUMLOW	8.45	1.95	10.3	2.41
RFJUL	-0.02	-1.90	-0.02	-1.62
MPCE	7.30	3.11	7.49	3.25
PRMRATE*RISK			24.89	2.82
C	10.95	0.65	-1.33	-0.78
R-adj^2	0.19		0.22	
Note: RISK is measured by coefficient of variation (%).				

The estimates based on pooled data have yielded fairly low R-bar squares. The proportion of small farmers in the state is found to decrease insurance demand. The rural MPCE of the state has a positive and significant effect on demand and the sowing season rainfall has a depressing effect though not significant. The irrigation dummies are significant but the impacts are larger for the medium irrigated region. The previous year's value has an insignificant coefficient. The threshold yield is also not found to be influential as a policy parameter for the design. The premium rate has an expected negative coefficient and is significant in the second specification in which the response reduces with greater risk measured by the coefficient of variation.

A relevant objective of a public policy is to reaches the small and marginal farmers. We have measured an indicator of targeting as the number of small farmers insured per unit of acreage under insurance. The dependent variable (SMFIA) is thus the number of insured farmers per hectare of insured area. Essentially, we here look at the composition of the farming class within the insured hectare. The composition is postulated to depend on the following factors:

1. Net premium rate (SMPRATE) charged from the small farmers (corrected for the subsidies).
2. Value per hectare (VALUE) of the crop measured as the yield rate of the previous year.
3. The proportion of farmers under the small and marginal class (SMMF) in the state.
4. The threshold yield divided by the actual yield realized in the previous year (THRY).
5. The irrigation endowment represented by the dummy variables for medium irrigation (DUMMED) and low irrigation (DUMLOW). The irrigation

endowment is categorized in three groups high –above 50%, medium- 30 to 50% and low – up to 30% of net area under irrigation.

6. Rainfall in the sowing season given by the variables for rainfall in June (RFJUN), in July (RFJUL) and in June and July together (RFJJ).

5. Risk measured by coefficient of variation (CV), skewness (SK), kurtosis (KURT), maximum historical loss (MAXLOSS) or probability of loss (PLOSS).

Table 10.2 : Variables explaining the intensity of Small farmers in the Area under insurance

	Spécification 1		Spécification 2		Spécification 3	
Dep.=SMFIA	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
SMPRATE	-2.15	-1.65	-2.78	-2.13	-3.84	-2.95
VALUE	5.88	1.84	8.96	0.25	3.52	1.13
SMMF	0.013	6.27	0.012	5.88	0.012	6.28
THRY	-0.08	-1.12	-0.147	-1.99	-0.086	-1.26
DUMMED	0.19	2.81	0.216	3.22	0.260	3.92
DUMLOW	0.107	1.61	0.070	1.03	0.051	0.79
RFJUL	0.00	7.04	0.00	6.82	0.001	7.13
CV			-0.011	-2.87		
MAXLOSS					-7.64	-4.60
C	-0.78	-3.29	-0.39	-1.48	-0.46	-1.99
$R\text{-adj}^2$	0.40		0.42		0.45	

Table 10.2 shows that a number of variables such as the net premium rate effectively payable, the low value of the crop, the high threshold yield relative to past yield reduce the number of small farmers in any unit insured area while the preponderance of small farmers in the state expectedly has a positive effect. Surprisingly poor rainfall also draws the non-small farmers and even greater risk measured by the CV decreases the density of the small farmers. The dummy for the medium irrigated region seems to have a favourable effect. The result suggests that the small farmer is not relatively more benefited by the coverage as would be expected. However when the probability of loss is considered as risk, the impact is positive on the small farmer density.

Figure 10.1

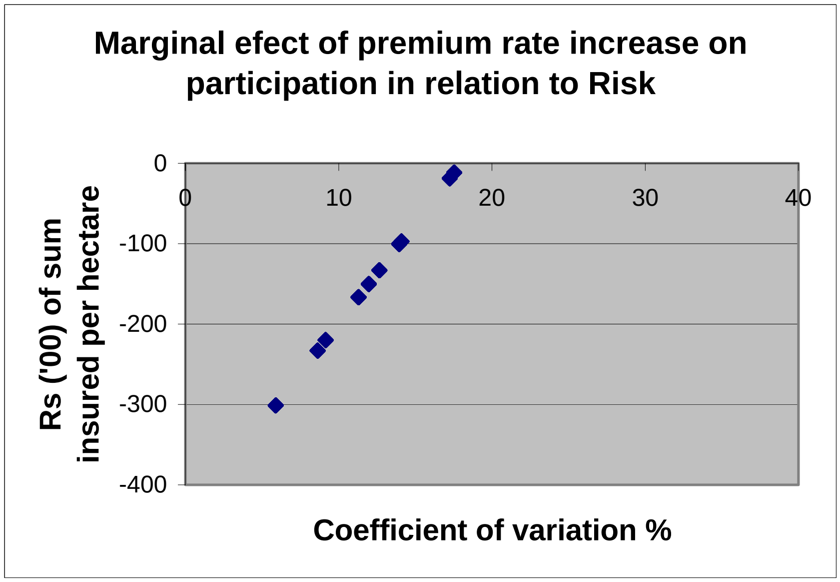
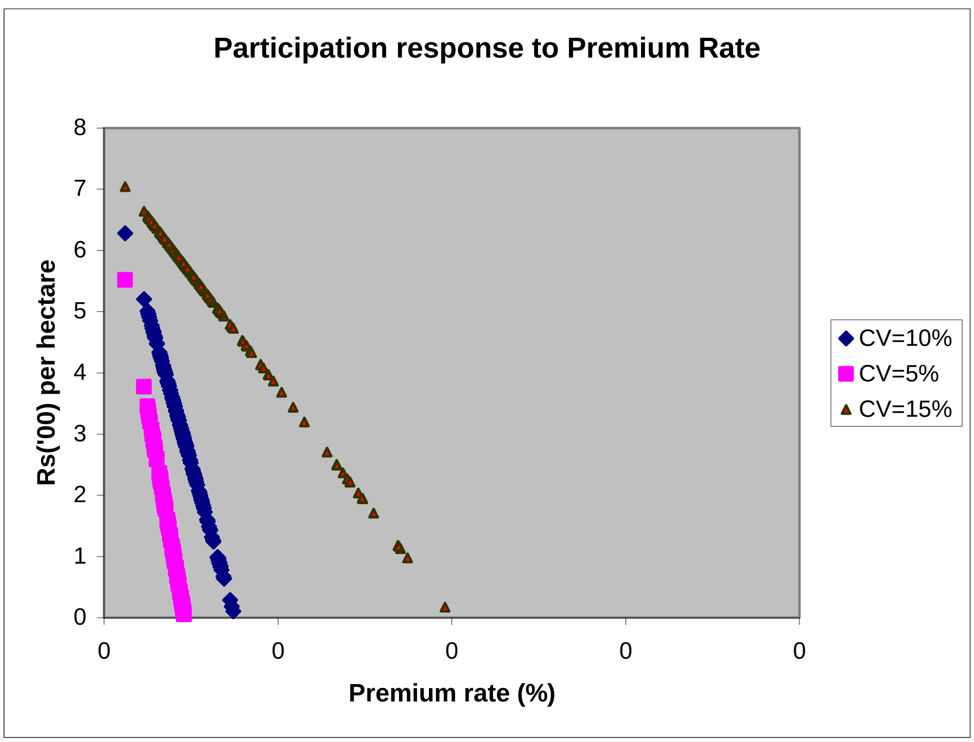


Figure 10.2



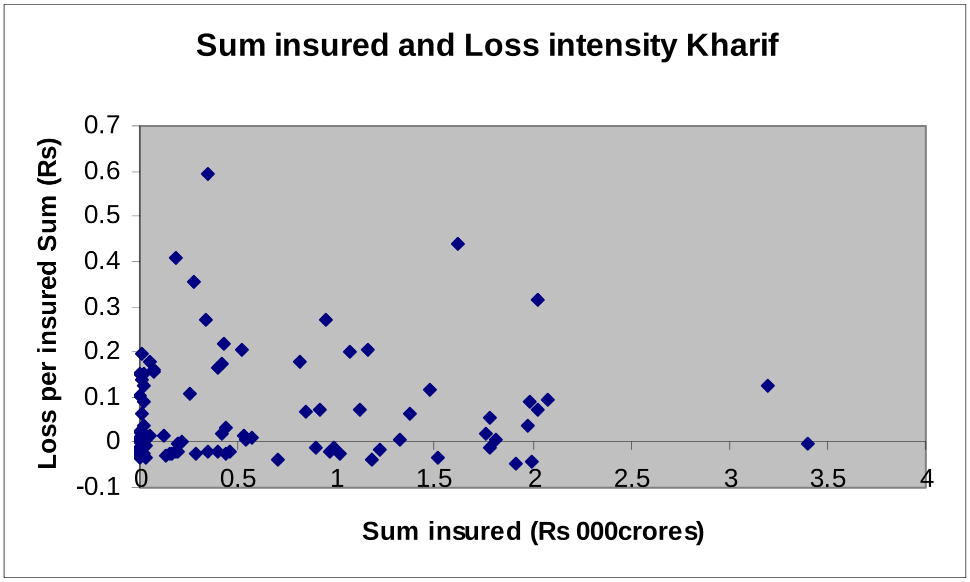
The possibility of Asymmetric information

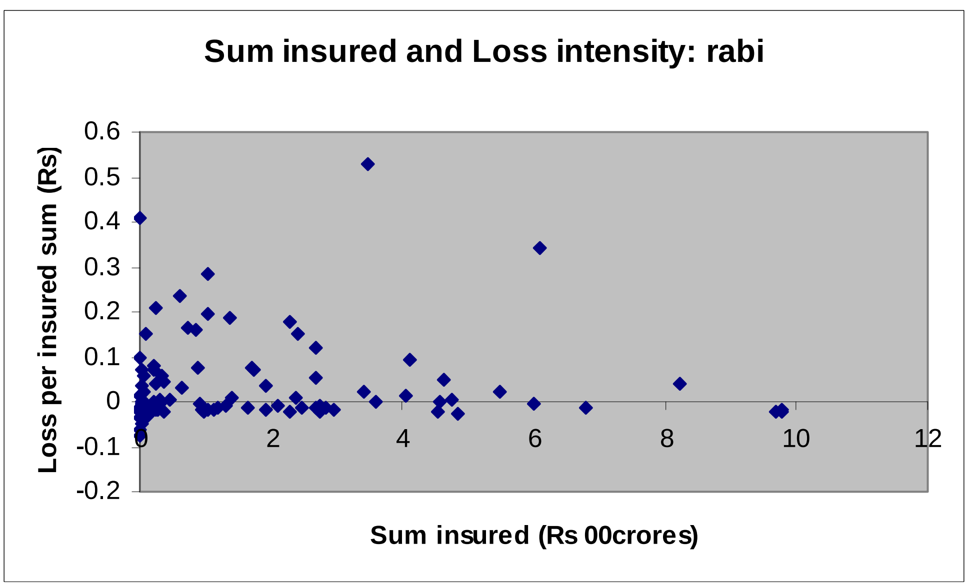
Adverse selection of participants is usually represented as a prime cause of loss in insurance schemes and often its failure, whereby the more risky units tend to participate actively while the less risky units find it unattractive to do so, given the kind of contract. The insurer, ignorant of the true profile of the client is instrumental in creating this network which is adverse to its own viability. Figures 10.1 and 10.2 based on the econometric analysis show how the more risky farmer responds less intensely to an increase in premium rate demonstrating the adverse election problem is present though the profile is implicit. A detailed risk classification of the clientele can be a way to overcome the adverse selection problem, but this itself is not an easy task owing to the lack of information available to the insurer. The risky client has a strong incentive not to reveal his/her true risk profile. Moreover, with the insurance cover, the client has all the incentive to reduce the efforts and cautions that were taken in the absence of insurance so that the event of incurring loss becomes more probable. The insurance coverage and the tendency for loss found ex-post would, under this circumstance, be related.

In the spatial pattern of participation, we found that certain states contributed dominantly to the loss (Chapter 5). Since nearly all the participating states produced losses for the NAIS, the contribution of the states to the total loss could actually be determined by the state shares in the agriculture or the insurance coverage. The loss intensity measured by the loss divided by the sum insurance i.e., Loss in Rs per Rs 100 of sum insured, would therefore be a more suitable index for the tendency for loss or the risk profile of the state. With the state level information we have looked for possible relations between the sum insured on the one hand and the tendency for loss incurrence. Since the tendency for loss is not measurable using extraneous and observable indicators (if it were, the information would be available to the insurer) we have considered the loss intensity that was actually realized (at the close of the insurance coverage), hypothesizing that this was unknown to the insurer but could be assessable to the insured at the time of declaration

Since the insurer's loss is the farmer's gain, we have considered the loss intensity (loss divided by the sum insured) as a measure of the gain (farmer's) from insurance that encourages the farmer to insure. While information at the area level would ideally help in making any assessment, with the data available to us we could only analyse at the state level which is essentially treating the states as insured units. Pooling the data across the states and the six years we plotted the loss intensities against the sum insured for the two seasons. We expect that if the farmer had any prior knowledge of the gain that was to be made or had any power of realizing that, the loss intensity would be positively related with the sum insured by the farmer. We note in Figure 10.3 below that such a positive relation is not totally obvious. The correlation coefficients are only 10.5% and 4.6% respectively in the kharif and rabi seasons. It needs to be noted that this shows the lack of correspondence between the degree of participation and the loss propensity of the participant farmers only and cannot rule out the possibility that the all the relatively safer farmers are out of the net.

Figure 10.3


Sum insured and Loss intensity Kharif
Loss per insured Sum (Rs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
0.5
1
1.5
2
2.5
3
3.5
4
Sum insured (Rs 000crores)


Sum insured and Loss intensity: rabi
Loss per insured sum (Rs)
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
0
2
4
6
8
10
12
Sum insured (Rs 00crores)

The tendency for Covariate risk

As discussed in Chapter 2, insurance for crop yield loss is severely hampered by the possibility of the yield rates being correlated across units making pooling of risk difficult. Most natural events like floods, droughts and tidal waves affect large areas so that farmers operating in these areas are affected similarly on any year and they all claim indemnity from the insurer. India being a large and geographically diverse country, insurance coverage across the geographical expanse from any one insurer would mean pooling diverse risk exposures. Any categorization of area for the purpose of insurance would therefore aim for similar exposures of farmers within the area but diversity among the units. The NAIS has identified insurance units or 'areas' and aim to reduce their sized in order to achieve greater homogeneity within them.

The three irrigation based regions that we have categorized are much larger entities but are expected to be more diverse among themselves owing to their geographical distances and essentially because the distinguishing factor irrigation is said to have powerful role in determining the risk exposure. Thus we expect risk exposure to be even more divergent between any two of the irrigation based regions than between two areas in any one region. To explore the extent of divergence we have calculated the Spearman correlation coefficients with respect to the yield among the three regions. We expect under the hypothesis of effective risk pooling that the yield rates will not move in same directions and the correlation coefficients will be poor.

Table 10.3: Correlation coefficients between Yield rates of irrigation-based regions				
		HI-MI	HI-LI	MI-LI
Rice Kharif	Level	0.88	0.79	0.72
	Detrended	0.24	0.49	0.43
Rice rabi	Level	0.82	0.68	0.61
	Detrended	0.36	0.22	-0.03
Maize	Level	0.74	0.84	0.87
	Detrended	0.03	0.33	0.61
Cotton	Level	0.18	0.22	0.75
	Detrended	0.02	-0.1	0.22
Groundnut	Level	0.32	0.58	0.22
	Detrended	0.54	0.13	0.11
Potato	Level	0.82	0.61	0.71
	Detrended	0.36	-0.06	0.44
Wheat	Level	0.97	0.96	0.94
	Detrended	0.53	0.27	0.35
Sugarcane	Level	0.56	0.56	0.34
	Detrended	0.31	0.29	0.19

At the first stage we computed the correlation coefficients between each pair of the three different regions. The correlations seem to be fairly high except in the case of Cotton for the HI region and the other regions and for Groundnut between MI region and the others. However, the correlation coefficients of yield rates at the level may not necessarily expose the covariate nature of risk because the latter usually refers to the unpredictable component of yield behaviour and the part of the yield movement may be foreseeable to the farmers for example when there are systematic trends over time. We have therefore used the trend corrected yield rates, where the trends incorporate the structural changes observable. These detrended yield values are worked out in Appendix III.-4 and used in Chapter 9. The detrended yield series show fairly low correlation among the regions on the average though the coefficients exceed 50% in the case of Maize between MI and LI regions and Goundnut and Wheat between HI and MI regions. Although the information at such aggregate levels are only indicative and similar analysis the area level would be more informative, the analysis has a positive implication on the prospect of risk pooling for insurance in India.

The threshold and the Lower Band yield under yield dynamics

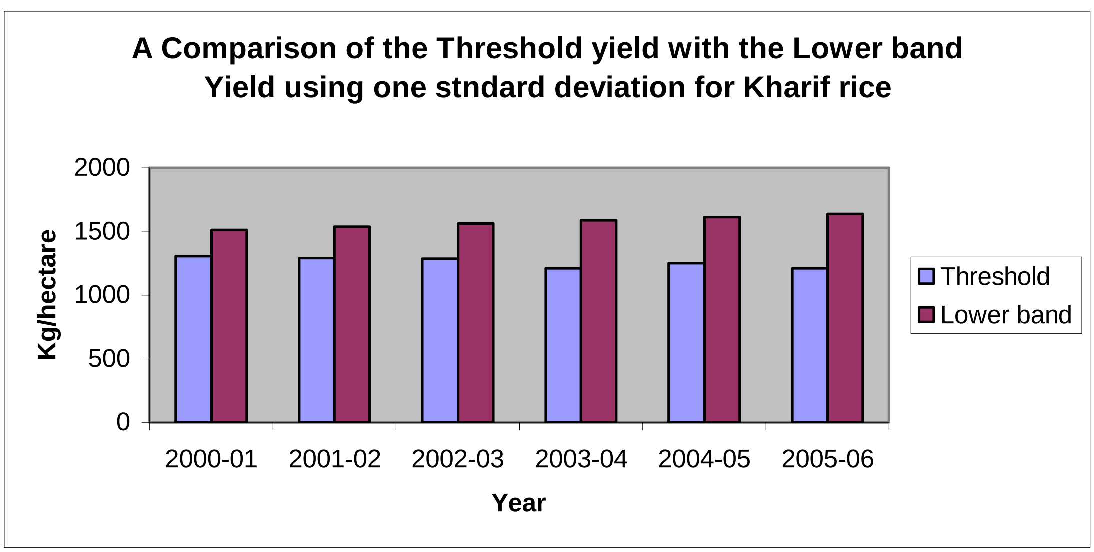
The threshold yield has been a target of criticism from different beneficiary and policy quarters. Indeed, the determination of the threshold yield is critical in the crop insurance design as this value is important for the farmers' motivation and justification of participation and is important both for political and policy perspectives. The threshold yield is usually criticised to be not high enough to mean any advantage for the farmers and it has been recommended even by a review committee to revise the formula in order to arrive at a high enough threshold yield to make participation rewarding. One primary factor that contributes to this perception is probably the near failure to capture the farmer's own notion of what is the normal yield under a situation of non-stationarity. The threshold is built upon a premise that the normal yield can be calculated purely by averaging the past yield rates. In a case of yield dynamics, it is normal to project the yield into the unknown future, especially when the progressive farmer incessantly perseveres to stretch the limits. A moving average of the past yields is inadequate to capture the movement. For example a normal yield of 200 obtained by averaging three consecutive realizations of 100, 200 and 300 would be no different from one obtained from unchanging realizations of 100, 100 and 100. The formula makes no distinct ion between a stagnant and a dynamic situation and in fact can prove to be a disincentive to progress. Even formulas such as the average of a few best yield realizations of the past may be closer to the notional normal in practice and is theoretically inadequate in a dynamic situation.

Table 10.4: Comparison between Estimated Threshold and a Lower band Yield rates (average of 2000-01 to 2005-06)					
Region	Proportion	HI	MI	LI	All
Rice kharif	TY/(Y'-n.σ) (where n =1)	0.94	0.7	0.78	0.8
	N (where TY= Y'-n.σ)	1.78	7.4	2.95	4.11
Rice rabi	TY/(Y'-n.σ) (where n =1)	1.47	0.86	0.93	0.88
	N (where TY= Y'-n.σ)	-1.93	5.2	1.68	4.53
Maize	TY/(Y'-n.σ) (where n =1)	0.79	0.75	0.75	0.74
	N (where TY= Y'-n.σ)	3.25	2.53	4.24	4.39
Groundnut	TY/(Y'-n.σ) (where n =1)	1.1	0.78	0.73	0.74
	N (where TY= Y'-n.σ)	0.56	1.61	2.58	2.11
Cotton	TY/(Y'-n.σ) (where n =1)	0.79	0.74	0.62	0.65
	N (where TY= Y'-n.σ)	2.02	4.33	3.58	5.33
Note: TY= threshold yield, Y'= Trend yield, σ= standard errors of estimate					

To make an assessment we have made an attempt to compare the values of yield rates measured by the threshold formula employed by the NAIS with the values obtained in the lower band in our trend equation. We have obviated from any relaxation of the normality assumption and considered the standard deviation as an adequate measure of dispersion.

When a deviation of one standard error is considered around the estimated trend value in general the threshold is f1ound to be lower than the lower band. The exceptions are in cases of rabi rice and groundnut in HI region. In the case of rice the threshold is more than 80% of the lower band but it is relatively low in the case of maize and groundnut and lowest for cotton. An alternative way of looking at this is to estimate the deviation as a multiple of the standard error that would equate the threshold yield to the lower band. This multiple is over 4 for all the crops barring groundnut and is above 5 in case of cotton. Only for groundnut is the threshold level comparable to a deviation of 2 standard error (a little less than 5% probability of yield rate falling short of this band). Although such judgement is subjective, the threshold level appears to be too low in relation to the probability of occurrence of the event. Although the figures given in Table 10.4 are computed averages over the years 2000-02 to 2005-06, the comparison is largely consistent. Figure 10.4 illustrates that the threshold yield computed for the pooled states using NAIS formula falls short of the lower band obtained using the trend equation incorporating a yield dynamics and a one standard error deviation for all the years in the period.

Figure 10.4



11. The NAIS:
Limitations and New Directions

The NAIS which is based on the formula provided by Professor Dandekar seemed to provide the best possible solution for a crop insurance programme. Nevertheless, the shortcomings of the conceptualisation and the practical difficulties of implementation cannot by any means be underestimated and the scheme needs constant reviews, monitoring and correction. A central concern of a crop insurance scheme is its ability to spread risk. In reality, such a spread may incorporate inter-temporal risk pooling but this is more a measure of forced thrift among the individual farmers (who save in good years for distribution in poor years). A vertical spread of risk over time is important for the viability of NAIS because a farmer who persistently pays more in premiums than he receives as claims, will discover his net loss and will be tempted to opt out. However, horizontal risk spreading is considered more important. It is a basic principle of insurance according to insurance expert Maine. In this chapter, we revisit the shortcomings of the scheme, the innovations under experimentations and the directions that could be explored.

Limitations of the Area Yield insurance

Many of the limitations of the area yield scheme are well known. In the near absence of an idea that provides the benefits of multi-peril insurance without the encumbrance of these shortfalls, the AYI has been accepted or under acceptance in some countries. It is however useful not to lose sight of the limitations as intuitively clear or are evident from the experience in order to search for the next generation schemes.

The impractical concept of a Homogeneous area:- A scheme based on individual assessment was discarded as 'impracticable' in India in favour of the homogeneous areas based formula. The homogeneous 'area' is conceptualised as one in which the 'output of a majority of farmers together move above or below their own normal levels' (Dandekar, 1976) so that premium rates and loss assessments, worked out at the area level also cover the risk of the individuals operating in that area. In the individual based strategy, the assessment of premium rates and losses would require on a regular basis, the measurement of farm level output variability, ascertainment of a normal yield and monitoring of performances. All this would involve nearly an unmanageable burden of expenditure and administration.

But the presupposition of the conformity between the experience of the individual cultivator and that of the area is hardly practical either. In general, it is unlikely that all farmers even within proximity would be similarly exposed to even any specific peril. The varieties of seeds used, the crop calendars followed and the kind of inputs utilised by the different farmers even in a neighbourhood need neither be uniform nor present similar incidences to any risk factor. The preventive actions are generally costly and the better off farmers may be more capable of preventing or reducing a risk than the poorer ones. Individual defaults that are not in tune with losses at the area level will also plague the banks and will infuse a bias against the poor farmers in their lending practices.

Difficult parameters:-If premiums were not charged from farmers, there would be little to distinguish an insurance policy from a disaster relief. Typically, a fair insurance would call for the classification of risk to determine the premium rates. This is not so easy because a risk-exposed individual is not likely to reveal his own profile. The AYI, in practice charges all individual farmers in an area the same rate regardless of their individual risk profiles. This simplification raises the chances of adverse selection making way for a risky pool in the area in which the less risk prone farmers become disinterested.

The premium rates in the NAIS are however differentiated by the risk profiles of the 'areas' accounting for some degree of risk classification across aggregate areas. The adverse selection problem is even then not circumvented, because the farmers in less risky areas (irrigated areas for example) would be unwilling participants unless the premium rates are low enough. In actual practice, specifically for cereals, pulses and oilseeds, certain fixed rates are applied and the acturial rate is applicable only if that is lower (which is rare) than the fixed rate in that area. For commercial crops, acturial rates are the norm and for any other crop, the acturial rate applies on a coverage beyond a certain point. For all purposes the applied premiums do not reflect risk exposure. Any increase in the premium rate is likely to adversely affect participation and make the pool more risky.

In the pooling scheme, the threshold yield probably plays a more relevant role than the premium rates. The threshold yields, in turn are worked out by a formula that takes account of past yield behaviour and the coefficients of variation. Such a formula is again not beyond question. In fact under a reasonable assumption of yield dynamics, a threshold tied to the past would continuously fall short of the farmers' own perceived target that could in reality be a notional but unobserved threshold. The threshold also disregards intra-area differences in the state of technology and the stages of cultivation that are implicit in the cost of cultivation already incurred by the farmer at the time of loss. For the same reason, the alternative formulas suggested also suffer from their arbitrariness, their insensitiveness to trends and their bias against more progressive farmers. The challenge is to work out the threshold yield or the premium rate that would accomplish the multiple expectations of increasing participation, improve viability, widen the risk pool and encourage the small farmers to come forward.

Redistribution and Exclusions- : The crop insurance programme in India seeks to rope in all institutional borrowers by mandating participation. Apart from helping to achieve a more complete pooling, the compulsion also assures banks their dues and minimises cost of operation because banks can handle the operations without significantly adding to their burden. However, the compulsion to pay premiums may be viewed as coercive and resented as a form of taxation. The response to the compulsion can be exclusion of many from insurance and from institutional loans.

Restriction of compulsion only to irrigated regions had been suggested since the inception (Priolkar, 1949, Dandekar, 1976) for better pooling. Intuitively, this does not seem tenable as the redistribution in favour of drier areas can only be viewed in context of the larger national community that benefits from agriculture without burdening particularly the farming community of endowed areas. Alternatively, the compulsion can be viewed as a tax on rent income if bank loan has greater beneficial effects due to natural advantages. The issue can only call for debate.

The compulsion in case of borrowing farmers can be a discouraging factor. As a transitory process, the government has been subsidising the premium payments of small farmers though the rate of subsidisation has come down with time. The loan linked compulsory insurance in India makes institutional borrowing more costly than otherwise and can discourage many potential but poor borrowers, even defeating the purpose. Moreover, given the added non-monetary cost of documentation and the complexity of the scheme, some borrowers may in fact turn to the friendly neighbourhood moneylender. The more irrigated among the participating states have a low relative rate of participation because farmers have less reason to insure and may be turning to non-institutional sources. The highly irrigated state of Punjab has not even joined the NAIS. The farmers do not take insurance but this does not come in the way of institutional borrowing. The indifference of the irrigated states makes exclusion of a large section of small farmers, many of whom are concentrated in them more probable. Priolkar had noted this unavoidable bias for larger farms.

A voluntary component is present in the NAIS, but as a dissuading factor, beyond the threshold yield value (or the loan value if that is higher), the premium rate usually becomes higher. Not surprisingly, over 90% of the insured farmers are also loanees. Voluntary (non-loanee) insurance not only has a minimal presence, the uniformly higher claim to premium ratios recorded for the non-loanees compared to the other group (Ministry of Agriculture,2004) is a sign of the selective bias that is inherent in NAIS. Thus, NAIS as an insurance is acceptable to farmers only in acute cases of riskiness. While many like to describe the NAIS as merely a banker's insurance, it is perhaps reasonable to note that this indirectly helps the farmers by maintaining the continuity of credit.

Risk, Catastrophe and Disaster Relief

With the incomplete association between individual and area interests, at best, the area-based crop insurance is effective enough as a catastrophic insurance to cover against risk that generally affects large areas, an undertaking that is akin to disaster management. In an analogous measure, a disaster management bill has been passed in India's parliament in 2005 providing for prevention and relief against losses due to calamities like 'catastrophe and mishap arising out of natural and man made causes resulting in substantial losses or suffering'. In such a milieu the distinction of crop insurance is not totally obvious. Geographical entities such as districts, agro-climatic regions or states that have suffered from a severe drought or a flood or a natural calamity have been beneficiaries of disaster relief and other such pay-outs and such political and economic compulsions often encroach on the function of a crop insurance scheme and create contradictions.

Pressure on the statistical system:- The crop insurance scheme makes intense use of the statistical system of the country as it requires the crop yield rate estimates for loss assessment. These yield rates are obtained from the crop cutting experiments conducted by the government. These are sample surveys performed scientifically. About 5 lakh such experiments are conducted in the country for the purpose of gathering reliable intelligence on agricultural performance used also as an input for estimating the gross domestic product of the nation. The synergy of this function with crop insurance has been viewed positively as economic and efficient. In practice however, the overlapping use of the results created practical problems for the statistical process. There are two reasons for this. (1) The crop insurance unit is determined by achievement of a specific minimum number of crop cutting experiments being conducted in the area so that an objective information of the yield is gained. The programme also targets reaching smaller levels of units or areas preferably a Gram Panchayat. With the limited man power available with the government and restraints on recruitments and expenditure, the increase in the crop cutting experiments creates excessive load and undermines the quality. (2) Crop insurance also inevitably creates political pressures arising from below say from the panchayat or from farmers' groups who would benefit from a lower estimate of yield. To the extent that such pressures are effective, the linkage with crop insurance would render the statistical system vulnerable to underestimation.

What restrains commercial viability and participation?

The NAIS, as reported for 2006-07, is implemented in 23 states and 2 Union territories and covered 97.1 million farmers, 156 million hectares with a sum insured of Rs 92.6 thousand Crores till that time. Participation in the NAIS is yet considered to be poor. This is despite the administration of the scheme in many ways. Some of the intervention measures that still stand in the way of making the NAIS a market based instrument can be mentioned as follows:

1. Premiums of foodgrains and oilseeds are not acturial. They are usually less than the recorded acturial premium rates and determined by considerations of acceptability from farmers.
2. The small farmers are subsidized and though the subsidies were intended to have been phased out, the 2007-08 Economic Survey reported that premiums payable by small and marginal farmers were subsidized to the extent of 10%. The subsidy burden was shared equally by the Central and state governments.
3. The determination of the threshold or the guaranteed yield takes into account what is acceptable to the political economy.

In spite of the positive measures at the national level NAIS has reached 10.7% of the cropped area and 11.8% of the farmers. Some states like Punjab stayed away, in others the penetration was poor. Assam in the north east has the least penetration where less than 1% of the farmers and area are covered by insurance. The more irrigated states (HI as in Appendix III) Tamilnadu, Bihar and Uttar Pradesh have low penetration of NAIS. Rajasthan also falls in this rank. Among the more successful states in this regard are the drought prone states Karnataka, Gujarat, Orissa and Maharashtra. Of the MI regions, West Bengal and Andhra Pradesh show good penetration. Even the most successful of the states show no more than 30% of the farmers to be insured.

Table 11.1: Penetration of NAIS 2003-04				
State	NAIS Farmers(000)	NAIS farmers as % of state total	NAIS Area (00000)	NAIS Area as % of state total
Assam	12.3	0.46	0.09	0.3
Tamilnadu	66.0	0.80	1.0	1.4
Rajasthan	58.6	1.09	0.7	0.3
Bihar	175.2	1.24	1.8	1.7
Uttar Pradesh	1002.2	4.70	14.5	7.8
West Bengal	748.2	11.40	3.8	6.8
AP	1737.1	16.40	26.2	18.2
Madhya Pradesh	2017.5	21.0	48.8	22.3
Orissa	841	21.2	8.1	15.8
Maharashtra	2761.7	25.9	30.4	15.3
Gujarat	1029.9	27.2	22	22.2
Karnataka	1858.8	29.9	34.4	28.4
India	12359.2	10.7	192.3	11.8
Source Government of India 2004				

Some of the factors that may possibly inhibit the popularity of the scheme may be the following:

1. Risk is not significant given the technology and management practices.
2. The designing of the contract may be a factor that makes the scheme unattractive to the farmers. The farmers own calculation of gain from participation may be negative.
3. There may be a divergence between what the insurer or policy maker measures as risk and the way the farmer assesses his risk. There is a need to explore what constitutes risk in the farmers' perception such that they seek insurance coverage.
4. Farmers may, due to bounded rationality, be unprepared to admit the degree of risk they face as long as the loss does not strike them. This may call for more education.
5. The farmers may have other more acceptable and cheaper means of risk mitigation. Social networking, regular off-farm employment and even the support of local money lenders (often their trading middlemen), could be more economic to them than crop insurance.

6. The process of buying a policy could be considered complicated and time consuming and the farmers might be more receptive if insurance were available close to home in a simplified process.
7. The cost of borrowing inclusive of the premium may make even the loanee insurance uneconomic and the money lender charging a higher interest could be considered cheaper. Such non institutional lenders may be amply available and be more convenient.
8. Ineligibility for loan due to default at the individual level (not synchronous with the majority of the farmers and hence not indmnifiable) may be a factor diminishing participation.
9. Government's contrary policies of disaster management such as relief payment and debt relief may generate a perception that insurance coverage is unnecessary. In the year 2007-08 the government approved a package for distressed farmers of Rs 16,978.7 Crores for 31 suicides prone districts in Andhra Pradesh, Maharashtra, Karnataka and Kerala.
10. Wide heterogeneity within what is assumed as a homogenous area may be making the particular contracts unattractive to many farmers.
11. Factors other than those mentioned in the contract such as weather and pest may be relevant as risk to the farmers.

New Designs under experimentations and the use of technology

NAIS has been a moment of graduation in the history of crop insurance. The road ahead would expectedly be a path of experimentations and developments. No doubt, the Government has been toying with various innovative insurance schemes through micro level Pilot ventures. Some of these and their problems may be mentioned here.

Farm Income Insurance Scheme (FIIS)

Farmer's income variations are caused not only by yield instability but also by the fluctuations of prices especially in an open economy. The latter are however out of the purview of NAIS crop insurance. The FIIS was initiated as a Pilot scheme during the rabi season of 2003-04 with the following purposes:

1. To protect the income of the farmers
2. To reduce government expenditure on Minimum support prices (MSP)
3. To encourage crop diversification and private trade.

The FIIS operated in many ways like the NAIS, based on a homogenous area approach, it was compulsory for the loanee farmers and voluntary for others and it was subsidized. Rice and wheat were the two crops covered but the premium rate was acturial at the district level. Small farmers and other farmers were both subsidized to the extent 75% and 50% respectively, and there were two levels of indemnity (LOI) at 90% and 80%.

The scheme was based on the following formulae:

Actual income = Current yield X Current market price

Guaranteed income= Average Yield of 7 years X LOI X MSP

If Actual income< Guaranteed income then compensation was paid.

One salient policy associated with FIIS was that in the Pilot districts, both MSP and NAIS for the select crops were suspended. Due to the pressure from the farmers the MSP was restored in the harvest period. Punjab and Haryana did not agree to join because of the MSP suspension plan. In rabi 2003-04 the FIIS was implemented in 15 districts in 8 states for wheat and 3 districts in 3 states for rice.

Table 11.2: FIIS Schemes in India 2003-04

Crop	**States**	**Districts**	**Farmers**	**Area**	**Sum insured**	**Claim**	**Premium**
	Names	No.	(000)	(000hect.)	(Rs lakh)	(Rs lakh)	(Rs lakh)
Wheat	BHR, CHH, GJ, JH, MP, MH, UP, UA	15	178.2	189.5	23,744	136.6	1,399
Kharif rice	GJ, JH, MH, WB	19	216.4	186.0	16,450	-	1,276
Rabi rice	AS, KRN, TN	3	2.0	1.5	23,914	144	1,406

The FIIS faced the following problems in implementation:

1. Because yield and price usually had compensatory directions, there was little gain for farmers who showed their disinterest.
2. Despite the subsidies the net premiums payable were deemed high
3. The risky crops like soyabean, groundnut and redgram were not included in the scheme
4. With significant varietal variations in the regions, the standard MSP was not always meaningful to the farmers.
5. Availability of data was a problem especially with the improper functioning of the marketing departments that reported the market price
6. Prices received by the farmers were not generally uniform and depended on local market conditions and farmer's bargaining power. The market price considered may not be relevant for individual farmers.

Weather Insurance

Agricultural performance is known for its sensitiveness to the weather conditions, especially the rainfall in the growing period. Several studies including the National Commission on Water have established that rainfall variations account for near about 50% of the variations in crop yields. While several inputs and cropping practices are important for agriculture, but the significance of rainfall surpasses all, because of its contribution to the productivity values of these variables also. In India nearly two third of the cropped area is still rainfed and many crops like cereals, oilseeds, millets largely depend on rainfall. Also irrigation of many types eventually depends on rainfall. The experience with crop insurance in India during the period 1985-2003 found that rainfall accounted for about 95% of the claims, 85% of them by deficit rainfall and 10% by excess rainfall.

The idea of weather insurance mainly rests on the contribution to the deviations on crop output coming from adverse weather conditions. Such dependencies can be measured by using methods like multiple regressions. Crop insurance, as a conventional instrument as in NAIS has several shortcomings that inhibit its success such as moral hazard, adverse selection, high cost, lack of reliable methods and subjectivities of the formulae selected and delays. The area yield insurance which circumvents some of these hurdles misses the finer components of the farmers' problems in undertaking the risky activity. Weather insurance may be a way to address the farmer's needs while overcoming many of the problems.

The positive attributes of the weather insurance are the following:

1. The trigger event is adverse rainfall performance that can be independently and objectively verified and measured. The Meteorological Department of India (MDI) is such and independent body with its scientific expertise specialized at generating regular rainfall data at a national scale.
2. There is no chance of moral hazard as the scheme has nothing in it to encourage negligence. Hence, the urge for a good harvest remains unaffected.
3. The scheme has no need for information of the individual risk profiles of farmers and saves enormous resources in this respect. In principle an unsubsidized policy can be purchased by a also person who is not a farmer. This also avoids the problem of adverse selection.
4. The insurance should be relatively inexpensive having no need for extensive networks.
5. The processing could be speedy and possible as soon as the rainfall data are available.

Besides rainfall, soil moisture, sunlight and temperature are other natural conditions that are important for agriculture. In particular, the impact of temperature on wheat output is significant. In 2003-04, nearly 4 million metric tonnes of wheat output was lost due to higher temperature in a critical period of cultivation and germination. Compared to another year 1999-00 which was good in terms of the performance (76 million tones of wheat output) the average maximum temperature was more by 3 to 6^{o} C during March at various places and the average minimum temperature was also more by 3 to4 ^{o} C compared to 1999-00.

Three Pilot Project of Weather insurance in India

1. *ICICI –Lombard General Insurance Co.* introduced an insurance based on a composite rainfall index in 2003-04 in Mahboobnagar district in Andhra Pradesh for Groundnut and Castor. This was extended to other areas subsequently. A similar scheme for Oranges was also introduced in Jhalawar district in Rajasthan in 2004.
2. *Agricultural Insurance Co. (AIC)* introduced the 'Varsha Bima' in 2004 south west monsoon period with five different options taking account of the various dimensions of rainfall failure (Sowing failure, Rainfall distribution index, seasonal rainfall index, agronomically optimum rainfall, catastrophe cover). Varsha Bima was implemented in 20 areas with rain-guage facility in Andhra Pradesh, Karnataka, Rajasthan and Uttar Pradesh.
3. *IFFCO-Tokio general Insurance Co. (ITGI)* had a pilot 'Barish Bima' in 2004 in nine districts in Andhra Pradesh, Karnataka, Gujarat and Maharashtra based on a rainfall index compensating for deficient rainfall.

Table 11.3 Weather Insurance Schemes in India in 2003-04						
Implementer	**Year**	**States**	**Farmers (000)**	**Sum insured Rs Cr.)**	**Premium (Rs lakh)**	**Claim (Rs lakh)**
ICIC-Lombard	2003,2004	AP, MP, UP, RJ, TN	2.9	3.5	36.3	24.1
IFFCO-T	2004	AP, GJ, KRN	3.2	10.0	46.4	Not reported
AIC	2004	AP, UP	1.0	2.2	6.1	5.6

Even though the rainfall or weather index based insurance has a number of plus points the effective usefulness and advantage of the scheme will depend crucially on several conditions. The rainfall must have the dominant if not the complete responsibility for a crop loss. So long as other factors such as the poor quality of inputs, improper practices induced by lack of knowledge, failure of infrastructure (power failure, poor maintenance of canals and drainage, disruption of traffic affecting input supply) and failure of a new technology contribute to deviation of yield from the expected value, the insurance will not have a significant effect on risk mitigation. Analogous to the case with crop insurance, the index based insurance also encounters the issue of homogeneity. Weather conditions too exhibit wide spatial variation and the presumption of homogeneity in the area is crucial. Finally, the whole idea of the weather insurance is based on the timely availability of weather data.

Package Insurance Policy

This is an idea that is explored for providing a composite package of insurance on all assets used by the farmers over and above the standing crop. In practice a similar Kisan Package Policy is sold by general insurance companies but to individual farmers separately for different assets. For example ICICI Lombard offers personal accident policy, health cover, Home insurance, Cattle insurance and Tractor insurance.

Insurance for Perennial Horticultural Fruits and vegetables

This a policy that is cherished and aimed at in the road map of the NAIS. In practice many fruits and vegetables are not provided the insurance cover and the scene is gradually evolving. Fruits and vegetables, in today's agriculture are a priority area and different development schemes are promoting their cultivation. The intelligence in this area is also experiencing development. The problems of covering the horticultural and perennial crops are the following: (a) Past yield data is not available to enable the fixing of the acturial premium rates and the threshold yields, (b) The peculiarity of these activities, such as the cyclical nature of production, the initial non-bearing period for about 3 years in many cases, (c) different age compositions of plants even in an orchard within a unit and (d) the scattered character of their locations (grown by railway tracks and rivers, in backyards and forests).

Coverage of crops not sown and crops already harvested

These two issues are important aspects of risk actually faced by the farmers. Weather conditions during the sowing season (untimely rain or storm/ dry spell) often prevent sowing and cause all the investment and efforts undertaken to be wasted. Similarly, even when the crop is harvested and the cut grain is dried, unexpected storms, floods or tidal waves can negate all the efforts of the past many months. While these vicissitudes are real and require coverage no less than the crops on field, insuring them presents a host of complexities especially in relation to the availability and verification of information.

Review by a Joint Group in the Ministry of Agriculture (2004)

India's crop insurance was reviewed internally by a Joint Group of Crop Insurance which was headed by the Additional Secretary of Agriculture. The Group took a view of the performance and constraints of the NAIS as well as that of the other experimental insurance schemes for agriculture and came out with a wide ranging list of suggestions for improvement and implementation. All this is proposed to lead to a modified scheme. Some of the suggestions and comments are listed below.

1. The present unit of insurance (Taluka/Block) is largely administrative in character and hardly appears as uniform or representative. The Group suggests the reduction of the unit to panchayat level for major crops.
2. There is a huge need for manpower resources and the Group suggested training of surplus staff in state governments and also out-sourcing of work
3. The formula for threshold yield has been a contentious as also a politically sensitive issue as essentially, this formula determines the chances of indemnification of farmers. The Group also suggests a revision of the formula such as considering one worst year and one best year to be excluded from the preceding seven years in order to smooth the long period data or considering the best three of the previous five years or the best five of the preceding five years.
4. The Group also suggests fixing either one level of indemnity (LOI) at 90% or fixing the LOI at two levels 90% and 80%.
5. The Group has recommended the extension of insurance coverage on prevented sowing due to adverse weather conditions. Recognising the difficulty involved in the process, the Group advised the determination of

loss based only on the adverse deviation of rainfall during the months June and July.

6. In a similar way the Group also recommended the coverage of harvested grain damaged at the drying stage.
7. Although compulsion for the loanee farmers is a source of coercion and exclusion in the NAIS, keeping in view the positive role of this feature the Group advised the continuation of compulsion.
8. The Group also suggested the extended coverage towards perennial and horticultural crops such as mango, grapes and oranges.
9. The Group made elaborate studies on the financial implications of the NAIS and its modifications and recommended that the scheme be placed in the acturial regime. While higher commercial rates may be imposed, the IA it is suggested should be responsible for the claims and be motivated to become professional.
10. The government will decide the actual premiums payable and will pay the difference between the actual and acturial premiums as subsidies. The Group suggests a maximum payable premium of net 8% for the small farmers and 12% for other farmers.
11. Interestingly, the Group also suggests that the banks should also bear 1% of the premium burden to lessen the loads of the government and the farmers as they too gain from the collateralization. The regulatory authority IRDA has to adjust the reinsurable and solvency margins accordingly. The scheme may be made exempt from income taxes.
12. The Group solicits for the presence of the IA at the village and the Taluka level especially to encourage participation of non-loanee farmers and also suggests that the support from village and micro-insurance agents need to be utilized.
13. The Group recommends inclusion of personal accident insurance as part of the insurance.

14. Commenting on the Farm income insurance scheme (FIIS) the Group describes it as 'most inconceivable' to substitute a deep-rooted MSP regime by an income insurance. The Groups draws attention to the fact that MSP is not priced while insurance has a premium charge and MSP is a 'theoretical price' that can protect against fluctuation of market prices. The Group describes the FIIS as a' futile and luxurious' wastage of government money and recommended that it be wound up.
15. In the scheme of Weather insurance the Group finds a 'bright future' and a 'promising field'. The Group however has a few practical reservations. The Group found that the IMD was not geared to provide the data required for the operation of the scheme. IMD which provided a list of 6256 rain gauges, managed only 500 out of them and the data it could provide as a demonstration showed huge gaps and inadequacies. The Group recommended significant expansion of its network, up gradation of technology and innovation of equipment. The data yet available only at the district level could in the presence of spatial weather diversity, give rise to basis risk and so more micro level data needed to be given. The Group also marked that the premium rates charged by the insurers were high. ICIC-L charged 15% for oranges in Rajasthan, 40% on apple. AIC's catastrophe premium was only 2 to 3% but despite an adverse southwest monsoon, no claims were paid in benefit of the farmers. The farmers had opted for this insurance policy against other because of the relatively low premium rate. In all cases the pay-off started at high levels. For example, the IFFCO-T scheme started payment at a deficit of 30%, AIC at 20% and ICIC-L effectively at 30% also.
16. The Group also recommended involving private insurers in providing 'meaningful risk mitigation support to the farming community'. However, it recommended that the AIC should spearhead the area yield insurance

programme and the private insurer be considered on the merit of the competitive premium rates they propose.

Financial issues

The NAIS has not been till now a financially self-supporting scheme. A typically fair insurance is expected to have a balance between the premiums collected and the pay-outs as claims. The premiums collected are also expected to take care of the cost of administration cost that arises in the entire process. As discussed in the Appendix 1, this remains largely a theoretical notion rather than a practical possibility in the experiences of nearly all crop insurance schemes operating in the world. In India's NAIS, the understanding is that the government will bear all claims above 100% of the premiums in case of food crops and oilseeds and above 150% of the commercial crops for which the acturial regime is operational to a larger degree. Administrative expenditures add to the government's burden as also the cost of conducting the CCEs which will increase as the size of the insured area comes down.

The financial burden depends on the premium regime. It is to be admitted that a higher and acturial premium may be unaffordable for the Indian farmers especially the small farmers. Also, risk mitigation in agriculture is beneficial to not only the farmers who grow the crop but also the society at large. Therefore, subsidies to an extent are justified and essential on crop insurance. Also the NAIS at the national scale has a short history so that a teething allowance for some time will also be inevitable. However, the contract design can be modified and diversified to inculcate maximum commercial viability taking into account the effect of the changes in premium rates and threshold yields. The Joint Group has suggested that premiums be acturial but specified subsidies be paid by the government to mitigate the load. Various formulae have suggested a grading of premium rates with the average rate of 15 to 18%. The financial scheme they propose have a target of 50% penetration by the XI th Plan.

Table 11.4: Support (Rs lakh) from the Government 2004-05					
Crop	Premium	Claims	Difference	Subsidies	Total support
Paddy kharif	11934.5	36080.2	24145.7	797.1	24942.8
Paddy rabi	1842.7	4890.6	3047.9	130.6	3178.5
Wheat	2211.9	7487.4	5275.5	94.7	5370.2
Potato	1397.7	1692.9	295.2	120.2	415.4
Groundnut-kharif	9680.7	32236.8	22556.1	361.9	22918
Bajra-kharif	2496.9	7087.7	4590.8	64.9	4655.7
Sugarcane-kharif	902.1	214.6	-687.5	67.9	-619.6
Cotton-kharif	9449	1473	-7976	354	-7622
Total kharif	45894	103763.7	57869.7	2009.2	59878.9
Total-rabi	7585	16059	8474	412	8886
Grand total	53479	119822.7	66343.7	2421.2	68764.9

Table 11.4 provides a statement of government financing of NAIS for the year 2004-05. A very large part, over 95% of the direct support (excluding administration and statistics) reaches the crop insurance scheme as deficit financing. In Wheat, groundnut and Bajra, the share of small farmer subsidy is lowest. The total support is modest for Potato and is negative for Cotton and Sugarcane because of the favorable (to insurer) claim premium balance. The latter are commercial crops. Kharif Paddy and Groundnut take the lion share (nearly 70%) of the support. In the case of deficit finances the major constituting crops are kharif paddy (36%) and Groundnut (34%) but in premiums Cotton (14.6%) joins kharif paddy (32.9) and Groundnut (14.9%)

The Use of Remote sensing Technology

Crop insurance is extremely sensitive to the availability of information. Remote sensing (RS) is an emerging technology that can have a significant synergy with the business of crop insurance. The technology offers a way of acquiring information about the earth's surface without actually being in contact with it. This is done by sensing and recording the reflected or emitted energy produced by the earth or the objects on the earth. Usually devices sensitive to electromagnetic energy such as light (cameras and scanners), heat (thermal scanners) and radio waves (radar) are used for the purpose.

The launching of the Landsat satellite in 1972 started a new era for agricultural surveillance for USA and the world. In India the CAPE project made a successful demonstration of the use of the technology in 1987 and with time the Space Application Centre (SAC) of the ISRO in collaboration with the NRSA has been developing appropriate methods and fine-tuning them through deliberations in various forums. While the CAPE project and the subsequent programme FASAL seek to provide regular estimates of crop production for statistical purposes, for the crop insurer, it provides tools like hazard mapping, crop health reports, acreage sown confirmation and yield modeling. The RS can significantly help in verifying claims. The technology is yet used in a limited degree by insurers in countries like the USA, Canada and Australia. The use is mostly confined to certain specific peril insurances but in principle, RS can help individual assessment by identifying an insured field, calculating planted acreage, identifying boundaries and finally assessing the loss. In practice, however the use of RS for crop insurance is largely at an experimental stage. The Iowa Grain and Feed Insurance Company in US is one such insurer that uses imagery for detecting and locating the relative level of hail damage in cropped areas. The Fireman's Fund insurance Company is another insurer that uses the geographic system and the satellite technology. In 2001 the Arkansas District Judge used satellite information as evidence to rule on behalf of the US Department of Agriculture against several claimant farmers. The evidence suggested that crops allegedly destroyed by bad weather had in fact never existed. In India, too the RS offers a powerful potential to facilitate crop insurance operations though the method at best is at a development stage yet.

New Directions

Crop insurance is at a paradoxical stage today. Crop insurance has become important for protecting farmers from the risk of crop failure and from the interruption of the flow of credit necessary for a progressive agriculture. The NAIS based on an area yield approach, undoubtedly suffers from several conceptual shortcomings, not least of them being the possibility of exclusion of a large section of farmers from its benefit. Not inconsistent with this implication, we have found the favourable impacts expected of the NAIS to be either limited or not perceptible. The NAIS has not visibly improved the institutional reach and inclusiveness of financial access. It has not significantly benefited commercial farming and its contribution to improvements of crop yields is not borne out by the evidence. Above all, the subsidized NAIS has shown no visible tendency to target the small farmers. In this milieu, the very desirability of having a crop insurance scheme can be questioned.

In tandem wit the lessons learnt from NAIS the Indian government has been experimenting with alternative insurance schemes but the desired solution has yet been elusive. The alternatives tried out are either not politically acceptable, or are no reasonable substitutes to the regular multi-peril crop insurance or they suffer from the same exclusion problems as the regular one. The NAIS has regularly been under fire from critics who point out the pointlessness of having such as costly scheme. The dilemma therefore arises on the way ahead indicating the following options.

1) Do away with the scheme and continue with the usual agricultural developmental instruments,
2) Modify the scheme or
3) Replace the scheme.

Doing away with the scheme is not as easily said as it was two decades back, when subsidization was easy and state ownership and state control described the organization of agro-inputs and agro-credit. Also, today the farmers' risk exposure means even more vulnerability both for the farmers themselves and the nation in a globalised economy. Subsidies and relief packages both encounter considerable fiscal restraints. Perhaps a market consistent risk instrument in the form of insurance has a greater appeal in today's regime. Moreover, crop insurance seems to provide a way to carry on with the agricultural loan business in a relatively equitable way even while there is a concern for prudence and when there is extensive poverty and inequality in society.

Replacing the scheme with other insurances as described above may not mean the same merit. For example, the FIIS (experimented in 12 states in 2003-04) does not serve as an insurance in the way the yield insurance is. The yield insurance insures for the unpredictable variations of crop yields while the FIIS is tied to a notion of a normal price (MSP) when the MSP is itself an artificial construct. Moreover, such an income support scheme at the crop level may in fact distort incentives, hinder market signals from reaching the farmers and stall an exit option in times of free market. Above all, it may be wiser to compare its merits with the safety net programmes rather than with the NAIS and one programme may not require the suspension of the other. We may add that a safety-net can only be at a holistic level and not at the crop level. The weather insurance (tried in 7 states in 2003-04) would be easier to operate so long as the weather data is available, but this instrument can hardly be enough to cover all risk and will suffer from exclusion problems too. It is at best a component of the multi-peril insurance but is not a substitute.

Some critical questions that arise at this juncture are as follows:

1. How far has the crop insurance served by insuring loans?

The role of the crop insurance in maintaining credit flow especially to the small farmers is an important argument for the continuation of the NAIS. While the crop insurance has been marked as a mere banker's insurance serving the bankers' rather than the farmers' interests, the indirect benefit to the farmers of the resultant credit flow is an important aspect that deserves consideration. The issue can be resolved by answering queries like (a) Does the compulsion of paying additional premium charge discourage institutional borrowing and further alienate the small farmers from the formal system, (b) How is the benefit allocated between the banker, the farmer and the society at large and is the cost shared in tune with the benefit allocation and (c) To what extent is the homogeneous area based insurance serving in maintaining credit eligibility of the individual and vulnerable farmers and to what extent do the latter default due to factors uncorrelated with the area experience?

2. How far is the crop insurance addressing the need for risk coverage of farmers, as distinct from credit access?

The compulsion of the loanee farmers to insure has visibly diminished the interest of relative less risk exposed farmers. This is demonstrated by the unwillgness to participate by the state of Punjab, by the majority of farmers in irrigated states like Haryana and Tamilnadu and the high risk profile of the participants on non-loanee insured farmers in general. All this possibly points to the failure of NAIS to serves as a risk management tool for the farmers replacing methods like diversification and periodic migration and the demand for relief. The compulsion also creates a redistribution among the farmers (or crops) who are more risk exposed (They get more claims) and those who are less so and such a redistribution may not be vindicated by theory. As the participant learns of this loss, he or she shifts out and possibly moves towards private money lenders. Thus the distribution aspects implied by the crop insurance and its contract design need to be carefully assessed.

3. To what extent the policies taken in respect of farmers' distress stand in contradiction to crop insurance?

The packages dealt to farmers under distress as loan forgiveness, interest waivers and disaster payments may contradict with the crop insurance and its call for premium payments. While such packages are sometimes politically unavoidable, crop insurance must be designed to be insulated from this impact.

4. To what extent does the crop insurance address farmers' risk as considered relevant by the farmers and for the progress of agriculture?

The farmer is more concerned about a loss and so the emphasis only on the coefficient of variation may be questioned. Moreover, the crop insurance is neither found favourable for commercial crops nor has anything to encourage use of new technology.

5. To what extent is the design in terms of the perils covered, the parameters of premium rates, threshold yield and the determination of the acturial premium rates appropriate and to what extent does participation respond to these parameters?

Suggestions

Based on our study, the reviews of other studies and reports and intuitive understanding we make the following suggestions for NAIS:

1. Continue with NAIS because of the conceptual linkage with finance and the benefits intuitively expected for risk coverage.
2. The measure of viability of a crop insurance scheme needs to take account of the social benefits and the benefits made by bankers in their economic and social functioning. Besides initial support for a teething allowance is necessary. Subsidies are justified as a society's payment for the purpose.
3. Design contracts such that commercial crops can have a comparable benefit as food and oilseed crops on a level playing field. Commercialization of a agriculture can have a powerful potential for increasing agricultural incomes and insurance for commercial crops has proved relatively viable in other countries. The present systems incorporates a bias against the commercial crops and in favour of oilseed crops and creates a distortion of incentives. The traders, processors and the exporters may become part of the scheme.
4. Allow private insurers to operate as competitors perhaps under the regulation and supervision of the AIC. Allow a number of alternate designs to emerge and compete paving the way for the discovery of the ideal schemes.
5. Design for insuring against perils such as (a) infrastructural failures such as unexpected disruption of power supply, roads and civil unrest, (b) failure of new inputs like pesticides and fertilizers (this can be packaged as product insurance with involvement of the sellers), (c) insurance against personal accident and illness, (d) failure of new technology such as newly developed seeds or equipment.

6. The threshold yield may take account of the yield dynamics as also other aspects of risk. The maximum historical loss, average loss, skewness and kurtosis may be considered besides the coefficient of variation.
7. Insurances for different crops and perils make packages separately so that no crop is deemed to pay for another and the relative benefits and cost be insured for regular assessment.
8. De-link catastrophes eligible for reliefs and loan waivers from crop insurance. Specify the perils or the extent of devastation for crop insurance and catastrophe so that the benefits are distinct.
9. Promote voluntary insurance for non-loanee farmers actively through attractive designs, value-added services and incentives.
10. While compulsion for loanee farmers is indispensable, as the Joint Group has recommended there is a strong rationale for inviting the banks to share the cost.
11. Proceed towards an individual based scheme. Progress in remote sensing will be an aid towards this aim.
12. While the individual based scheme may not be practicable in near future, the mythical homogeneous based scheme may be replaced by a group based scheme. This is consistent with the group based development strategies advanced in today's context (Agarwal, 2008). However, such groups need be based on contiguity alone. Rather than the membership to an area be imposed by the insurer, group memberships can determined voluntarily by the participants based on their own perceptions of their profiles and needs. This can be done by distinguishing different contracts for different Groups. The contracts may incorporate penalties and incentives other than the premium rate and the LOI.

Appendix I

International Experiences in Crop insurance

FAO (1991) listed a total of 81-crop insurance scheme in the world, that included cases of multiple schemes operating in a few countries. Nevertheless, crop insurance still has a minor place in agriculture and its related policies of the countries. In 2001 total agricultural premiums in the world amounted to US$6.5 Billion compared to a value of US$1.4 Trillion of agricultural production. The asymmetry in the regional distribution of this record is also conspicuous. The developed countries covering North America, Western Europe and Australia-New Zealand accounted for 87% of the premiums in that year as opposed to 13% share of the developing countries. Latin American and the Asian countries account for 4% each and Africa for only 2% of the premiums. In many of the countries there is no commercial agricultural insurance available. This section provides a review and seeks to provide with an international perspective through a glimpse of the history of evolution of crop insurance and to outline the contours of the schemes in different countries.

Crop insurance Schemes

The history of crop insurance is not a very long one though single peril (hail) insurance is known to have existed in the 18th and 9th century. Hail insurance originated in Germany in the late eighteenth century and in USA in 1880. Insurance against frost in Europe and against windstorm in USA were other such early examples. The suggestion of a multi-risk or all-risk crop insurance is said to have come from the American statesman and scientist Benjamin Franklin in 1788, after France had suffered crop losses resulting from a severe storm (Radha Krishna 1971). USA and Japan have two of the oldest crop insurance programmes. The Great Depression, the World Wars and Land reform policies provided the motivation for initiating crop insurance programmes. In most countries crop insurance schemes originated and evolved in the 20th century. Special interest was shown to crop insurance by the Food and Agricultural organization of the United Nations (FAO) in which a more specialized department called the Marketing and Rural Finance Service was created for developing competence in the area. The FAO had convened expert consultations on crop insurance in 1986, 1989 and 1992. Particular aspects of distinction among the schemes as operated in different countries relate to (1) risk coverage i.e., multiple or single peril type, (2) crops covered and their nature, (3) government participation and organization of implementer and (4) mode of operation. The following account will emphasize these aspects.

Perils

The schemes in different countries were mostly of a named- peril type (41%) or multi-peril type (52%) while single peril and all risk schemes constituted few cases **(FAO**).** Recently there is an evolution of alternatives such as the income or revenue based crop insurance and weather insurance[1]. In Mauritius, Cyprus and Chile the programmes covered only a limited range of risk. The Mauritian scheme had insurance against only windstorm for 27 years at which point rainfall and fire were included but was reluctant to cover pests and diseases. The yellow spot disease was addressed after 37 years. The Cyprus scheme covered rust (pest) and droughts for cereal crops only but hail on a wide range of crops and frost for grapes and citrus. The perils of frost hail wind and rain and certain diseases that were linked with excesses of rain were covered in Chile, only wind (single peril) was covered in Windward Island and in Venezuela and the Dominican Republic the coverage was broad. In Philippines and India, (under the CCIS) insurances were all risk type but in the currently operating NAIS in India a large number of natural perils are mentioned[2] .In Philippines natural calamities typhoons and volcanic eruptions are covered. In majority of the countries in which a scheme existed, the public sector was the promoter.

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[1] The parametric or index based product for rainfall insurance in India run by the ICICI-Lombard in India is a particularly novel experiment

[2] Natural fire and lightening, storm, hailstorm, cyclone, typhoon, tempest, hurricane, tornado etc., flood, inundation, landslide, droughts, dry spells, pest, diseases etc.

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Government role and Finance

Crop insurance programmes evolved over time in most countries often through legislation rather than people's initiatives, and the characters changed gradually. Some countries like the US, Brazil, Costa-rica, Cyprus, the Dominican Republic, Israel, Jamaica, Mauritius the Philippines, the Windward Island and Sri Lanka have legislation on crop insurance. India after decades of having crop insurance on a limited scale also passed an insurance bill in recent years and established an autonomous company to implement the scheme that was already on-going.

Roberts (**) listed Mauritius, Cyprus, Philippines Venezuela, Dominican Republic and India having public sector driven crop insurance scheme and Chile, Pakistan and the Windward Island having schemes under the private sector. In Cyprus, where a significant portion of the population depend on agriculture directly or indirectly, crop insurance is implemented by the para-statal body (the OGA) that built on the experiences of the country's drought relief fund and the provident fund that existed prior to OGA's inception by the enaction of a law in 1977. The ADACA in the Dominican Republic, created in 1984 is a public-private partnership in which the majority stakeholder in the Government represented by the various relevant departments and the President of the State appoints the representatives of the private sector. In India a comprehensive crop insurance scheme that followed a Pilot scheme in 1985-86 was implemented by the General Insurance Corporation of India a public sector insurance company and at present by an autonomous company called the Agricultural Insurance Company (AIC). The AIC is set up as a para-statal body running on commercial norms has been implementing the scheme since 1999-00. In Mauritius, the MSIF is a public sector body that operates with commercial orientation and the insurance evolved through a number of legislations.

Many of the schemes are state financed. US is a principal example where the most experienced scheme still calls for large subsidies towards premiums and administration. Japan also has a subsidised programme. In India's crop insurance subsidies are targeted towards the small farmers. In Cyprus the scheme was subsidised but subsidies were phased out. As a supporting measure, there is a provision for bringing down payments if funds are insufficient though this is not desirable. The Chile and Mauritius the schemes are self financed.

Table A1.1 Subsidies for crop insurance	
Country	Subsidies
Argentina	Yes
Chile	No
Mauritius	No
Dominican republic	Yes
Brazil	No
Venezuela	Yes
USA	Yes
Cyprus	No
Source: Wenner, 2005, Roberts and Dick, 1991	

Crops, target beneficiaries and Linkages

The crops covered varied but tended to be commercial in many countries. In Mauritius for 40 years only sugar was covered, and in Windward Island it was banana. Fruits, cereals and oilseeds were covered in Chile. In the Dominican Republic rice is the main beneficiary of crop insurance, followed by certain vegetables, maize and fruits. In India insurance extends to rice, what, millet, pulses and oilseeds under NAIS but the inclusion of commercial crops is relatively recent and is expanding. Plantation crops tea and rubber are also now included and coverage for small farmers is particularly addressed.

In the Dominican Republic some crops raised by large farmers are not insured. The Chilean programme targets larger farmers but is likely to address the smaller farmers as commercial performance improves with time. In Japan insurance is not compulsory for very small farmers. In Mauritius insurance is compulsory for all growers except the very small (up to 0.04 hectares). The Indian scheme targets the small farmers who are more vulnerable by subsidising their premium payment but participation is compulsory if they borrow from institutional sources.

The schemes in different countries also vary in their nature of compulsion and linkages with credit flow. Only the Chilean example was reported as fully voluntary. Most schemes link compulsion to borrowing only but voluntary participation if allowed has been poor. In US participation is voluntary but even here it has been occasionally linked to other support programmes. Efficiency of operation is crucial for viability. Crop insurance is an extensive administrative affair involving assessment, premium collection and indemnity payments. Generally, it pays to link operations with other organizations that have dealings with the farmers, so that the cost of premium collection and indemnity payments becomes marginal to the whole cost. In Cyprus the agricultural insurance organizations use the connections enjoyed by exporters, processors and wholesalers for collecting premiums and the village cooperative credit network for paying claims. In Mauritius, these tasks are relatively easy because of the organised nature of milling and selling of sugar, the insured commodity. Similarly the centralised marketing channel of banana is utilised in the Windward Islands. In Chile the private company reaps the economics of integrating insurance operations with the general business of the Company. In India the public sector banks with their lending activities with farmers contribute substantially to the operation of the crop insurance. In US the wholly owned public agency FCIC implements the scheme but several private companies also now act as agents. The operation is usually at the individual basis. Although the Area based scheme is special for India, zoning for yield assessment is practiced in some cases as in Chile. The cost of cultivation incurred in taken into account in some countries as in Venezuela and Philippines and in others the yield shortfall is only considered.

Table A1.2: Crop insurance schemes in selected countries in South and North Americas, Africa and Asia						
	Venezuela	Chile	Mauritius	Philippines	USA	India
Ownership	Parastatal body	Private	Public sector	Public sector	Govern ment	Parastatal body
Linkages		Staff of the company, other insurance products	Mills, marketing agencies, banks	Banks, threshers, cooperatives	Private company -ies	Banks
Crops	Cereals, oils cotton	Exportable, cereals, fruits	Sugar	Rice maize	Wheat, corm and others	All major crops, growing number of comm.. crops
Peril	Weather, fire, pest	weather	Weather fire, specific-disease	Weather, typhoon, volcanic eruption	All risk	All risk
Reinsurance	France	Domestic, European	European, US,Australian	Only for rice	Plans	Plans

Performances

The financial performance of a crop insurance scheme is usually measured by the loss ratio or the indemnity to premium ratio (I/P). Since insurance is pooling of horizontal risk, ideally the average I/P ratio would be one with some individuals paying more in premiums than their claims and others claiming more than the expenditure on premium. The ratio may vary from year to year but is expected to be smoothened over time. Table 4.3 indicates that commercial viability is yet a dream in major schemes. Only in the case of Japan the ratio is less than one but such performance came at the cost of intense monitoring that shows up in the administrative cost.

Table A1.3: Financial performance in Selected countries			
Country	Period	I/P	(I+A)/P
Brazil	1975-81	4.29	4.57
Japan	1985-89	0.99	4.56
USA	1980-1989	1.87	2.42
Note: I=Indeminity, P=Premium, A=administraton cost Source: Hazell, 1992			

Country wise experiences

Mauritius

Sugar is the dominant crop in Mauritius and is grown by a range of farmers from small, backyard growers to large estates. Sugar exports are the major foreign exchange earner and production, processing and marketing of sugar constitute important economic activities.

Crop loss is caused by droughts and excessive rainfall but cyclones though less frequent can be heavy damages to sugar planters and industry. A major cyclone in 1945 provided the incentive to set up the Mauritius sugar insurance fund (MFIF) that served in times of subsequent cyclones of 1960, 1975 and 1980. Till now sugar is the only crop insured but tea and tobacco are under consideration.

The MSIF started with little experience and data and evolved with a series of amendments. The principal risk covered was Cyclone to which drought was added in 1967, excess rainfall and fire in 1974 and yellow spot disease in 1984.

The insurance is compulsory for all growers except the very small (upo 0.04 hect.). Both planters and millers stand to lose from crop loss ad are insured. MFSIF is a public sector body but operates on commercial lines with strict disciplines. The claim history of the insured is taken into consideration and intense monitoring is done to st the parameters to rank the grower and decide the premium late and the compensation eligibility. The thee best years in the previous 12 years are used calculate the insurable sugar per hectare on which the compensation is calculated. Moreover negligence as specified is penalised and the problem of moral hazard is also overcome by ranking and penalising (if required) through monitoring and adverse selection is avoided by compulsion. The **loss ratio (claim to** premium) slightly exceeded 1 historically but claim is financed by not only premium but also **investment** and sometimes by a levy set by the industry under emergency condition. However, public subsidy is not involved. The MSIF is advised by an international actuarial firm.

Chile

This west-coast country in South America stretches from north to south, covering a variety of climatic conditions from desert to cold arctic. Expectedly, agriculture is also diversified. Desert crops are grown in the north with irrigation, horticultural and cereal crops in central mountains regions and in the river valleys and plains of the South, cereals dominate supplemented by oilseeds and sugar beet. Different sources of risk including catastrophes affect agriculture such as droughts, frosts, un-seasonal rains, floods and storms. In Chile, small family farms operate alongside commercial and export oriented farms that produce cereals and supply apples, peaches and grapes to the world market. Export is severely affected by calamities like untimely rain.

In 1980, after heavy rains caused devastation, producers' associations approached the state for a scheme to protect them against natural disasters. In keeping with the Chilean policy, the government encouraged the private sector to take up the challenge. The government provided encouragement but did not extend funds.

The CNS, a private company established the crop insurance scheme in Chile. Groups of Communes (district) with similar agro-ecological characters were classed as 'homogeneous yield zones' or HYZs. Due to rapid diffusion of technology yield rates tended to be similar in a zone. Based on historical data on yield, the expected yield of the HYZ is worked out. A farmer chooses from several conversion price levels to reflect his farm gate price and arrives at the insurable sum, and is indemnified for his loss (sum insured less his actual gross receipt) if his yield falls below 70% of the expected yield to start with. Higher coverage was allowed for farmers with superior track-records.

The CNS faced the usual difficulties of inexperience and lack of actuarial data. It trained and utilised the services of agricultural professionals who made innovative use of the statistical and climatological data available. The CNC economised by using its existing personal and marketing channels. Moreover, to make profit, it attempted to develop products that met the genuine needs of farmers. Interestingly, the programme targeted larger farmers who were more exposed to risk. Cereals and fruits were the crops covered for named perils.

The loss ratio for the period 1981-82 to 1985-86 was 101 for fruits and 172 for cereals. The high ratio was due to the performance in the first year only. Over-all the scheme was found viable. The loss ratios of the two groups cereals and fruits also were moving in different directions, a feature that helps in risk pooling.

USA

The programme of United State of America is a most valuable demonstration of how a crop insurance schme can function. On of the oldest scheme in the world, it plays only a minor role in the country's farm programme and faces severe contradictions and challenges.

Commercially provided single peril insurance had worked for a long time but attempts by private underwriters to provide multiperil insurance did nt succeed and the inadequacy of the private crop insurance was discussed in the Senate in 1923. the debate was strengthened b the droughts of 1934 and 1936. Interestingly, crop insurance became a political issue when president Roosevelt supported a government sponsored crop insurance programme. In 1938 the Federal crop insurance Act was passed as part of a Farm bill and the crop insurance began with the coverage of wheat only, later extended to cotton, flax, maize and tobacco.

Crop insurance had an uneven course in history. Its poor performance led to its cessation in 1943 but in 1945 it was revived on a restricted scale and on an experimental basis. During this period the loss ratio fell below one but the prgramme continues at a curtailed level with a fairly good performance in terms of the loss ratio during the 1950s and 1960s. In the 1970s it faced the challenge created by the bills passed on disaster relief.

With the passage of the Food and Agricultural Act 1977 the availability of 'free insurance' for major crops in the price support programme possibly made crop insurance unattractive. The coverage however inched upwards since the benefits were not substitutes though the participation remained below 10%.. The disaster programme was described as the 'disaster itself'.

In 1980 a legislation again enabled some desirable changes such as the expansion of coverage over Counties and crops, federal contribution to the capital stock increase, a maximum of 30% subsidy on premium and the entry of private companies to offer insurance with FCIC reinsurance. This helped to improve participation to 25% even then far below the target of 50% (participation was made compulsory for the drought assista**nce in 1949-50)** and even without considering the subsidies and the public expense on administration the loss ratio ros e to 1,4 in 1981-85.. In the 50 years 1939 to 1988, the loss ratio fell below one only in 19 occasions.

In the 1980s the disaster programme was phased out only to be replaced by a series of disaster bills enacted in low yield years making it even more costly to the budget. Crop insurance also remained a high cost programme because of poor actuarial practices and adverse selection. Even the 30% subsidy did not make participation attractive to risk averse producers in certain states. So participation remained poor. The 1991 Budget and the subsequent budgets emphasised the need for a fundamental change in the programme. Under consideration are alternatives

(1) Abandonment- may lead to more frequent disaster payments,
(2) Compulsion- may face resistance and be seen as a tax,
(3) Area yield insurance with County as a unit –
(4) Crop and price insurance – in progress.

FCIC Scheme

The FCIC has a largely voluntary and individual based scheme, the FCIC (Federal Crop Insurance corporation) is an agency of the US Department of Agriculture, completely owned and managed by the Government. There is participation of private companies now. The programme is subsidies by the government.

An APH (Approved Production history) yield of the farmer is calculated as a 10years average of the yields in the farm (if that is verifiable, otherwise the FCIC assigns an APH yield). Similarly 3 alternative prices are offered for choice wit the maximum being the expected market price and the minimum being at least 90% of that. The farmer is indemnified if the average yield on farm is less than the insured yield level to the extent of the difference valued at the chosen price level. The premium level depends on the selected yield and price levels, the APH yield and the County level premium rate reflecting the local risk, The Federal government subsidises the premium up to 30% of the 65% level yield

In the more privatised regime, the programme is iimpemented by about 15 private insurers besides the government owned FCIC. The Risl Management Agency (RMA) administers the programme on behalf of the US Department of Agriculture (USDA). The RMA gets the premium rates calculated for the different crops/states/counties but any approved insurer can sell the products at the rates certified by the RMA. All the insurers are also eligible for the subsidy and further, the entire administrative and operating expenses of implementation are disbursed by the government.The government also provides reinsurance support.

Philippines

Agriculture is important in Phillipines contributing 56% to employment and 60% to export earnings. In 1972 a devastating flood lasting several delays led to various Government support programmes including the establishment of the Phillippines crop insurance corporation (PCIC) in 1978. PCIC is a public sector organization but with substantial autonomy at the regional levels

Cyclones are a common peril in northern and southern parts of the country but droughts and pests are of greater concern in the south. The PCIC started with covering rice and included maize subsequently against natural calamities of typhoons, floods. Droughts and volcanic eruptions and pest infestation and plant diseases. Most of the farmers grow rice and maize using advanced technology and the crop insurance programmes operates in these more favourable areas where extension agents also support the farmers.

Insurance is compulsory for borrowers but voluntary participation has improved with time. Premium rates are between 7 and 13% but they are highly subsidised. Indemnity is based on the shortfall of yield from the average normal yield and the sum insured. Standard production costs, farm plans and budgets prepared by extension service determine the sum insured but deductions are made for costs not incurred at the time of loss. Loss assessment is made through reports of commercial threshers and accredited farmers cooperatives and professionals adjusters in recent times. Lending institutions serve in selling the insurance and playing indemnity. Investment of initial capital serve to cover administrative cost.

Venezuela

Agricultural is mostly commercial mechanised and use modern technology. Climatic hazards at various points growth period of are important. During planting scanty rain can prevent germination white excessive rains cause soil damage and see rotting. Excessive rains at harvest cause lodging but drying facilities for crops are widely available.

The Agroseguros a pauastatal body was establishing had in 1984 for providing crop insurance but its range of products expanded and more than 60% of premium income comes from life and general insurance. Insurance is compulsory for borrowers and includes maize's soy hum, rice, groundnut, seasonally soybeans, cotton onion sunflower and patella covers against the perils of excessive rain, flood strong wind fire, pests and diseases.

The sums insured are calculated at 60% of the standard production costs and indemnities are based on costs considered to be incurred at the time of the loss. The premium ruby from 5 to 7% and agronomist's services help in loss assessment. The performance has been reasonably well due to low risk of agriculture and compulsion for borrowers.

Japan

Japan has a long history of crop insurance. Crop insurance on scientific basis was recommended to the Meiji Government by a German specialist called Paul Mayet and a survey in 1928 brought to light the existence of insurance societies operations in certain prefectures. A plan was prepared and a bill was introduced in the diet in 1931. The bill was however approved years later and a programme was initiated in 1939, At the start it was voluntary with no state support but with Japan's entry into World was II crop insurance became very important to step up domestic food production. Participation became compulsory and subsidy was provided to farmers for paying premiums. During 1939 to 1946 extensive cop failures in different parts of the country depressed the performance of insurance.

After the world war the crop insurance scheme was revised and evolved as a vital aspect of agricultural planning. Insurance was compulsory for four crops paddy, upland rice, cocoons and maize and voluntary in others. A long list of hazards such as cold, drought, earthquake flood, snow volcanic eruption wind, damages due to birds, beasts, insects and pests and plant diseases are covered. The agricultural loss compensatory law enacted in 1947 reorganised crop insurance to help the newly created owners-farmers avoid reverting to tenancy status due to losses. Since 1948 crop insurance is integrated with short-term agricultural credit through the agricultural bill system, under which the insured farmer can get credit from the local cooperation.

Administration at the Gun (county) level was placed in the hands of agricultural insurance association (AIA). The AIAs in each prefecture federated to a prefecture federation. The AIA offered insurance to the agricultural society in each village. Crop insurance in Japan was conceived as traditional system of mutual relief,

The premium rate in determined by a risk classification based on past history and within a prefecture rates between 4 and 12% apply to different risk groups. The rates are however uniform for all participants within a local association. The state continued to subsidise premiums to a large extent and participation remained compulsory.   Loss ratio was mostly adverse. Insurance principles apply to transitions between association and federations and between federations and national level insurance account in a three tier system.   Thus the government role in subsidisation, administration at various organizational levels and coordination with farmer's organisations helped to sustain the scheme.

Insurance in Africa and Middle east

Crop insurance in African countries began between the years 1946 and 1967 though even more recently in Nigeria. In Zambia the state run insurance corporation introduced multi-peril crop insurance in 1981 covering loss of damage to maize from fire, lightening, storm, flood drought and also riot and strike. Zimbabwe also has a multi-peril insurance and in Mauritius the crop insurance though in limited crops has been relatively successful. Israel had multi-peril crop insurance, since 1967. In Saudi Arabia and Turkey private companies run single peril schemes while the Agricultural Development Bank of Iran initiated crop insurance in Iran in 1984.

USSR, the Caribbean and America: The Caribbean schemes mostly have recent origin and are designed to meet specific needs. Though the governments encourage the schemes both state (as in Cuba) and private (as in Windward Island) operate. : In USSR a crop insurance scheme started a scheme in 1968, understandably in the public sector and multi-peril type. Most programmes **in Latin America** started in the last 40 years and were initiated by the governments, cooperatives, and development banks or by farmers. Brazil and Mexico have highly subsidised schemes. In Mexico a crop insurance law was enacted to support land reforms and the new peasant class and a public company NAGSA was set up. Multi-risk, voluntary insurance was offered and the maximum amount of insurance was related to the cost in different zones. Premium was differentiated by regions crops and station of farmers. There is a crop-credit insurance programme and the insurer is obliged to offer.

Asia: The oldest scheme is in Japan, started in 1939. China introduced insurance for cotton growers in 1950. Most schemes were multi-peril type and largely compulsory. Sri Lanka initiated a programme in 1956,. Sri Lanka passed an Act in 1961 following a feasibility study with FAO's assistance in response to food deficiency. The administration was entrusted to an autonomous board within the Ministry of Agriculture. Insurance was voluntary to start with, but was made compulsory for all land under two paddy crops after 1973 and was linked to loans in 1986. Premium are based on risk classification of areas. Pakistan's experimentation with crop insurance involved mostly private endeavour with public collaboration. Crop insurance has been under consideration since 1948.

Appendix II

National Agricultural Insurance Scheme India

The National Agricultural Insurance Scheme or the NAIS was launched in 1999 rabi season in India under the charge of General Insurance Corporation as the implementing agency (IA). Subsequently from 2003 an autonomous organization called the Agricultural Insurance Company of India Ltd. with its head office in New Delhi was created to look after the implementation NAIS. The objectives of the NAIS are as follows.

1. To provide insurance coverage and financial support to the farmers in the event of failure of any of the notified crops as a result of natural calamities, pests and diseases.

2. To encourage the farmers to adopt progressive farming practices, high value inputs and higher technology in agriculture.

3. To help stabilize farm incomes, particularly in disaster years.

The scheme is multiple-peril type but offers comprehensive insurance to yield losses due to a few risks mentioned, namely.

(a) Natural fire and lightening (b) storm, hailstorm, cyclone, typhoon, tempest, hurricane, tornado etc. (c) flood inundation and landslide (d) drought, dry spells (e) pests/diseases etc.

The contours of the NAIS

The salient features of the scheme can be described as follows:

***Selective compulsion*:-** Insurance is compulsory for all farmers growing notified crops and availing seasonal agricultural operations (SAO) loans from financial institution. All other farmers growing notified crops can also opt for the scheme voluntarily.

Multiple crops Covered:- Food crops (cereals, millets and pulses), oil seeds, annual commercial/Annual horticultural crops. The set of commercial and horticultural crops have been enlarged over the years. The crops earmarked for coverage depend an availability of adequate past yield data from crop cutting experiments (CCE) and the requisite number of CCEs during the season.

Wide coverage of States and Union Territories (UT):- The scheme extends to all states and UTS but those opting for the scheme (1) will have to take up all the crops identified for coverage and (2) will have to continue for a minimum period of three years.

Unit of Insurance:-_ The scheme would operate on the basis of (1) area approach for widespread calamities and (2) on an individual basis (experimentally) for localized calamities like hailstorm, landslide, cyclone and flood. The defined area may be a Gram Panchayat, Mandal, Hobli, Circle, Phirka, Block, Taluka etc. to be declared by the state. However the unit is to reach the gram panchayat level in three years.

Crop Yield Estimation:- The state will conduct a required number of crop cutting experiments or CCEs for all notified crops in the insurance units to assess crop yield. The state will maintain a single series of CCE-based yield estimates both for the sake of crop production statistics and for crop insurance. A technical advisory committee comprising of representatives from NSSO, Ministry of Agriculture and the IA will decide the sample size of CCEs.

***Indemnity levels, Threshold Yield and Loss*:-** The areas are classified into three groups as low risk, medium risk and high risk measured by levels of indemnity (LOI) at 90% and 80% and 60% respectively, based on the coefficient of variation in yield of last 10 years.

The insured farmer can ask for higher LOI for payment of additional premium. The threshold yield (TY) of a crop in the unit is the moving average based on past three years yield in case of rice and wheat, and five years on case of others, multiplied by the state LOI.

If the actual yield per hectare of the insured crop in the area based on the CCE falls short of the specified TY, then all the insured farmers growing that crop in the defined area are deemed to have suffered a loss.

Indemnity= [(TY- actual yield)/TY] of area X sum insured of farmer

Localised/specified perils:- For localized perils, loss assessment is done at the individual basis experimentally. Loss assessment and indemnity procedure are formulated by IA. A cadre of loss adjusters has to be created and officers to be trained

LOI Table

Sum Insured (SI):-The SI may extend to the TY valued at the minimum support price or at the previous year's market price at the option of the insured farmer and beyond TY for payment of actuarial premium. For those who have borrowed from institutional sources (loanees), the SI must be at least equal to the amount of crop loan. The financial institutions shall also compulsorily cover all crop loans distributed through Kissan Credit Card (KCC).

Premium:- Premium rates are fixed at 3.5% for Bajra, 2.5% for other kharif crops, 1.5% for wheat and 2% for other rabi crops. The actual premium rates are required to be the fixed rates or the acturial rates which ever are less. For commercial crops the rates are necessarily actuarial. The scheme foresees a transition to the actuarial regime in five years but the actual rates shall be applied at the option of the states. Fifty percent subsidy on premium is allowed in respect of small and marginal farmers but will be phased out in three to five years subject to review. The central and state governments will share the burden.

Dates:- For loan period April to September in Kharif season, declaration for insurance will be received by November and for rabi loaning season of October the ‘cut off’ date is May . Correspondingly the cut-off dates for receipt of the yield data from the government are January-March and July-September.

Bank’s role:- A nodal system has operated for the earlier CCIS and continues in the operation of NAIS in which the IA does not have to deal with the loan dispersal point. Each Scheduled bank shall with the concurrence of the IA fix the Nodal points. The Nodal Bank will communicate to its branch offices on the notification of crops and areas from the Governments. The individual bank distributing loan for an insurable crop grants additional loan towards premium charges and the bank branch sends a statement crop wise and area-wise to the nodal branch every month. The banks maintain all back-up records relating to Kissan Credit card loans for insurable crops. The Nodal banks submit the declarations in a prescribed format to the IA in the stipulated time. On an experimental basis, the non-loanee farmers may submit the proposal directly to the IA depending on IA’s infrastructure. In addition financial institutions (FIs) are expected to educate and guide the farmers on the scheme and its formalities and to maintain records.

Claim settlement:- The state government will plan, conduct and maintain a single series of CCE’s and furnish the yield data to IA within the stipulated cut-off dates. Claims will be worked out by the IA using the declarations received from FIs and the yield data from State Government.

The funds needed for payment of claims beyond the risk sharing limits of IA shall be provided by the Government. The claim cheques and particulars are released by the IA to the Nodal Banks. The Banks at the grass-root level in turn credit the accounts of individual farmers and display the particulars on a notice board. The IA has a responsibility of professional building up the crop yield database and the preparation of acturial premium rates as well as in organizing training, awareness and publicity programmes. The IA also seeks to procure reinsurance from international market.

Roles of the Government:- The state government notifies the crops 'area's and the premium rates as applicable. It also supplied the IA with past 10 years area wise yield data and the current yield data from CCEs. The premium subsidies to small and marginal farmers are shared by the State and central governments. The central and State governments contribute for building up a corpus fund to meet catastrophic losses. The corpus fund is also released as per the scale and date given. The corpus fund meant for catastrophic losses are shared by with central and state governments. The two governments also share the administration and operational cost (A&O) on a sun set basis for five years. The State government is implemental in setting up various monitoring Commitees as required.

Benefits and exclusions:- The scheme is expected to be a critical instrument for the development of agriculture. It will encourage farmers to adopt progressive practices and modern technology and helping maintain the flow of credit and benefit to farmers and entire community with multiplier effects. The NAIS is also a route to streamline loss assessment procedures and in that process build up a good statistical data base for Indian agriculture.

The loans given to areas that remained unsown will not be covered and in areas where a crop is sown but is damaged or destroyed due to natural causes, no further loaning should be made by FIs. The scheme covers a period up to harvesting stage and damages at the time of drying, cutting are excluded for scope.

Appendix III

Comments on Indian Agriculture and and Technical Notes

III-1. Cropping Pattern and Diversification 1999-00 to 2003-04

Indian cropping pattern is dominated by food crops and especially by cereal crops that are the staple food of the people. This is a traditional practice reminiscent of a subsistence economy in which the farmers raised crops primarily for their own family consumption needs rather than for the market. We could work out the crop shares at any reasonable reliability level up to 2003-04 owing to the availability of data on gross cropped area only till 2003-04.

Even in recent years 1999-00 to 2003-04, cereals have taken up 52.6% to 54.1% of the total gross cropped area in India. The simple average over the same years of the share of cereals works out to 53.6%. Within the group of cereals rice and wheat are important together constituting over 37.5% of the cropped area. Similarly within the oilseeds the traditional crops are groundnut and rapeseed-mustard that together makes up 6% of the total cropped area, out of the total of 25.7% allocated to pulses and oilseeds crops. They constitute about half of the total oilseed area in the country. Crops other than the food crop group, often loosely termed as commercial crops comprise only 21% of the area.

The data suggests a high degree of concentration between the two broad groups namely, food crops and commercial crops as manifested by the rati**o 79:21.** Crop concentration or diversity can be measured more comprehensively by the Hirschman-Herfindahl index (HHI). This indicator makes a distinction between greater diversification or competition among multiple crops and dominance of a few crops by squaring the area shares prior to being summed thereby giving additional weights to crops with larger area shares.

$$H = 1 - \sum_{i=1}^{n} S_i^{2}$$

where s_i is the area share of crop i in agriculture, and n is the number of crops. The right hand side term right of the equation is the sum of the squares of the shares. Intuitively it means the probability of obtaining the same crop in two similar draws of crop areas and indicates the level of concentration. This sum is subtracted from 1 to get an idea of the diversity of cropping pattern. Ideally, the index approaches a value of 1 in a perfectly diversified case when the share of each crop tends towards zero and of zero in a case of complete specialisation when on of the crops takes up all the cropped area. The crop shares have largely been steady. Only for Cotton, the coefficient of variation exceeds 10%, probably in response to the decline in share in the last year of the period.

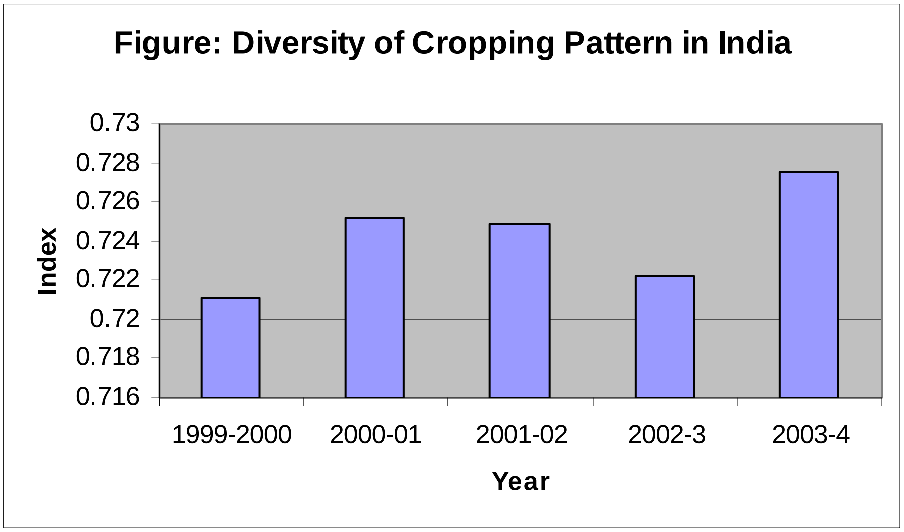
We have considered the crop groups RW (rice and wheat), CCER (coarse cereals) PLOLS (pulses-oilseeds) and COM (others) and multiplied the indicator by 100 to present DIV in Table AIII.1.1.

Table AIII.1.1: Diversity of Cropping Pattern in India							
	Years					Average	CV%
Crops	1999-2000	2000-01	2001-02	2002-03	2003-04	(1999-03)	
Share %							
RW	38.38	37.64	37.39	38.05	36.31	37.55	2.11
CCER	15.75	16.49	15.83	15.58	16.32	15.99	2.44
CEREALS	54.13	54.13	53.22	53.63	52.63	53.55	1.19
PULSES	11.62	11.33	12.15	12.08	12.86	12.01	4.86
GNRM	6.83	6.04	6.00	5.84	6.09	6.16	6.27
PLOLS	25.72	24.79	25.37	25.62	26.65	25.63	2.63
OLS	14.10	13.46	13.22	13.54	13.79	13.62	2.47
GNRM(OLS)	48.44	44.87	45.39	43.13	44.16	45.20	4.42
FGOLS	79.85	78.92	78.59	79.25	79.28	79.18	0.59
SUGARCANE	2.36	2.44	2.46	2.70	2.30	2.45	6.23
COTTON	4.74	4.67	4.76	4.36	3.38	4.38	13.3
COM	20.15	21.08	21.41	20.75	20.72	20.82	2.25
Diversity index %							
DIV	72.11	72.52	72.49	72.22	72.76	72.42	0.35

RW=Rice and Wheat, CCER=Coarse cereals, OLS=oilseeds, PLOLS=Pulses and Oilseeds, GNRM=Groundnut and Rapeseed mustard only. GNRM(OLS) is share of groundnut and rape-mustard in total oilseeds, FGOLS=Foodgrains-oilseeds, COM=Commercial (crops other than in FGOLS). The index DIV is built over the four composite crop groups RW, CCER, PLOLS, OTHERS. CV=coefficient of variation.

The diversity of cropping pattern (DIV) index is 72% on the average. The variation is low and DIV has not shown any particular tendency over the years 1999-00 to 2003-04. It has increased in 2000-01 and then come down gradually in the following two years and has increased in 2003-04. The cropping pattern has shown little variation over the five years. The coefficient of variation is extremely small and below 1%.

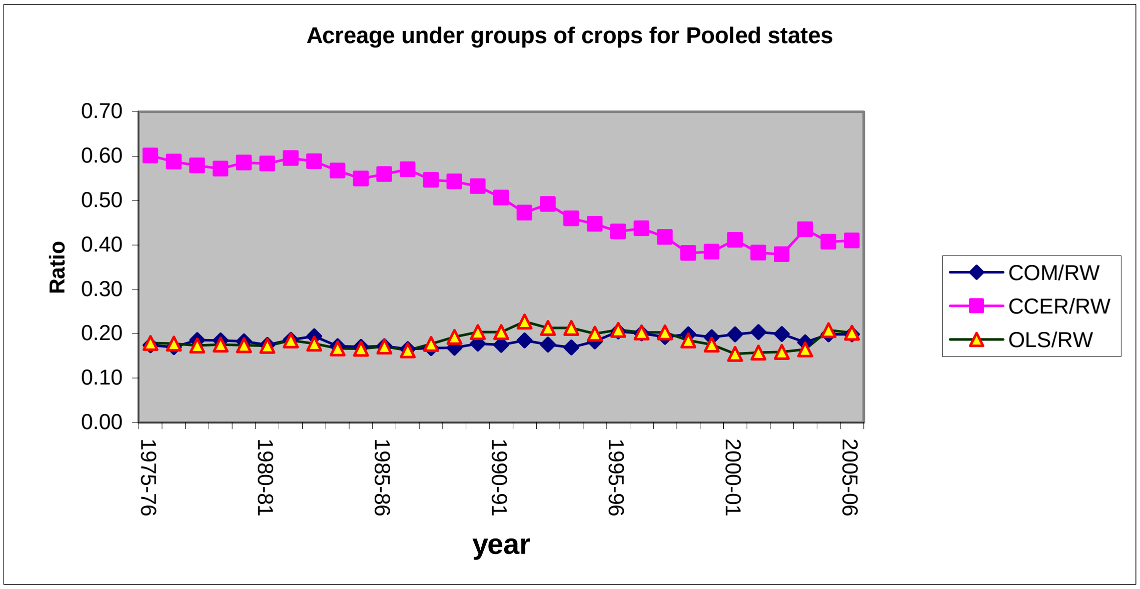
Figure AIII-1.1



III-2. Diversion of Area from Rice and Wheat 1975-76 to 2005-06

To further explore the tendency of diversification away from conventional food crops we look at the acreage ratios between groups of crops RW (Rice and Wheat), CCER (Jowar, Bajra and Maize) and OLS (groundnut and Rape-mustard) and COM (Sugarcane and Cotton). Together these crops constitute about 60% of the gross cropped area. In Figure III-2.1 we have given the areas under CCER, COM and OLS relative to RW over a long period. Only the coarse cereals appear to have lost acreage share consistently but there is no distinct tendency in respect of the other two groups. While the RW group share has fluctuated in the short run, the two oilseed crops together shows medium term phases of gain and loss in relative terms reflecting changes in policy regimes. Sugarcane and Cotton together remained largely invariant in acreage share relative to the two dominant cereals.

Figure AIII.2



III-3. Regional dimension with respect to irrigation endowment

It is well recognized that the irrigation endowment is a crucial determinant of risk in agriculture and can be a parameter for risk classification. For analytical convenience we have classified the thirteen major states into three categories Highly irrigated (HI), Medium irrigated (MI) and Low irrigated (LI) . **HI is represented by states with irrigation intensity exceeding 50%, MI by states with irrigation intensity between 30% and 50% and states with irrigation intensity up to 30% are classified as LI.** The HI region includes states Uttar Pradesh, Tamilnadu and Bihar located in different parts of the country (north, south and east respectively). Similarly, in cases of the other regions it is found that this criteria of classification has little association with locational proximity.

Going by official data 2002-03 we have classified the States covered by crop insurance as follows: **High Irrigated**- Haryana, Tamilnadu, Uttar Pradesh and

Bihar; **Medium irrigated** -Rajasthan, Andhra Pradesh, West Bengal and Gujarat, Himachal; **Low irrigated** - Meghalaya, Uttaranchal, Madhya Pradesh, Karnataka, Orissa, Chhattisgarh, Maharashtra, Kerala, Jharkhand, Assam etc.

To explore the essential differences in agricultural practices and advantages among the irrigation based regions we have compared the regions with respect to indicators like significance of crops, crop productivities and cost of cultivation. The comparison is done for recent period following the year 2000. Since rainfall is basic variable guiding agriculture and is also an important influence on irrigation the performance of the monsoon in the recent period needs attention Table AIII-3.5 indicates this by reporting three variables. Going by all three the years 2002 and 2004 appear to be years of insufficient rainfalls and 2006 also joins the rank if only the first two factors are considered. The year 2002 was a particularly poor year when 21 out of 36 subdivisions received deficient rainfall , more than 60% of the districts fell short of the normal rainfalls and the rainfall was measured as only 81% of the long period average rainfall in the country. The other years (2000, 2001, 2003, 2005, 2007) are found to be normal years so that three out of eight years had poor monsoon. If rainfall were the only index of risk the probability of loss could be 36% on a temporal perspective. Based on the availability of required data from Ministry of Agriculture sources over the years and the complexities generated by the reclassification of states and creation of new ones we have considered the select states in their pre-1999-00 forms in the following exercises as given in Table III-3.1.

Table AIII-3.1: Irrigation endowments of States in three Regions 2002-03						
	HI (>30%)		MI (30%-50%)		LI (<30%)	
	Name	Irrigation	Name	Irrigation	Name	Irrigation
1	Uttar Pradesh	70.3	Rajasthan	39.9	Madhya Pradesh	25.6
2	Bihar	57.5	Andhra Pradesh	39.2	Karnataka	24.5
3	Tamilnadu	50.5	West Bengal	36.7	Orissa	21.8
4			Gujarat	31.4	Himachal Pradesh	
5					Maharashtra	18.1
					Assam	5.5
Note: Irrigation = Net irrigated area/Net sown area (%). Source: Agricultural Statistics at a Glance 2005.						

The distribution of area under different crops in respect of the irrigation based regions comes out in Table AIII-3.2 which highlights the dominance of the regions in the cultivation of particular crops. In general, one would expect lucrative and water intensive crops to be concentrated in irrigated states. Although kharif rice, which depends on natural rainfall mostly, is raised in significant degrees throughout the country, the dominances of both the less irrigated and highly irrigated regions (LI and HI respectively) are evident from the shares of 42% and 35% in total rice area. Similarly, the significance of the LI and MI regions for cotton, MI region for groundnut, LI for Soyabean and Tur and HI for wheat, which needs irrigation, and sugarcane are observed. Maize and kharif rice are relatively even in distribution. The MI region in turn is significant for crops Cotton, Groundnut, Potato, rabi Rice and Maize , HI for kharif Rice, Potato, Wheat and Sugarcane and LI for kharif Rice, Cotton, Tur, Soyabean and maize. It is worth mentioning that some crops have only a minimal presence in certain regions. The crop's specific degree of dependence on the availability of irrigation is a factor behind the distribution but other geographical compulsions, both constraints and opportunities can lead to the absence of the crop in a particular region. The HI region has a share of less than 2% in cotton area. The same region also has low shares less than 10% in rabi rice (which requires irrigation but competes with wheat in Bihar and Uttar Pradesh) and groundnut. Soyabean is practically concentrated in the LI region and is absent in the HI region, the MI region has only modest shares with respect to Wheat, Sugarcane, Tur and Soyabean. Thus, while the water intensiveness and the dependence on natural rainfall determines the spatial distributions, other factors like mutual competition are important influences and while a few crops like kharif Rice and Maize are well dispersed, most crops are concentrated heavily in one or two irrigation based regions.

Table AIII-3.2: Distribution of Area (%) under different Crops over the three Regions

Crops	HI	MI	LI	ALL
Rice-kharif	35.4	22.1	42.5	100
Cotton	1.8	43.6	54.6	100
Groundnut-kharif	9.4	65.1	25.5	100
Potato	49.6	32.6	17.8	100
Rice-rabi	8.2	68.6	23.2	100
Wheat	57.5	16.0	26.5	100
Tur	14.1	24.0	61.9	100
Sugarcane	65.5	11.3	23.2	100
Soyabean	0.1	10.1	89.8	100
Maize	26.5	34.9	38.6	100

Crop yield rates are expected to be higher and less variable in the more irrigation endowed areas since controlled water is an important input for modern agriculture. The mean yield in the period 2000-05 is found to be the highest in the MI region for a number of cases such as for Rice in both the seasons, Wheat, Cotton and Soyabean. In general the mean yield is higher in the HI and MI regions and lowest in the LI region as could be expected. On the whole the most irrigated region HI is not the leading in respect of mean yield. The variability is measured by the coefficient of variation (CV) computed over the same period. Considering the pooled region, Cotton and Groundnut yield rates are found to be most variable followed by Soyabean. For all other crops the CV is within 10%. Comparing the regions, the relative variability of Cotton is found to be accounted for by MI region in which the CV is nearly 43%. Groundnut yield too is most variable in the MI region. The CV is high also with respect to Maize, Tur and Soyabean. Rice, Wheat and Sugarcane yields are stable. In HI region Cotton, Tur, rabi Rice and Soyabean (insignificant crop in the region) show significance yield variability with CV exceeding 10% and in LI all crops except Tur, Maize and Wheat, have shown yield variability. Among all crops Groundnut and Cotton yield rates are identified to be most variable cutting across the regional distinctions. On the whole, yield variability is low in the irrigation endowed region and low in the less privileged one as expected, the mean yield rates are not generally not leading in the endowed region where they are dominantly grown.

Table AIII-3.3: Yield rates of crops Region wise -Mean and variability 2000-01 to 2005-06								
Crops	HI		MI		LI		Pooled	
	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.
Cotton	251.6	18.88	304.8	42.83	165.5	18.02	228.97	32.19
Groundnut	1246.3	13.14	985.6	38.18	808.9	12.97	967.2	25.56
Maize	1820.7	8.63	1854.1	19.33	2029.5	4.86	1914.9	7.95
Potato	19561.9	5.60	23306	9.50	9143.1	16.83	18910.2	5.51
Rice kharif	1819.3	8.13	2330.98	5.17	1224.1	15.20	1679.5	7.87
Rice rabi	2570.1	11.62	3274.5	3.66	2171.8	19.96	2964.2	3.83
Tur(arhar)	1108.8	15.50	559.3	24.73	637.2	8.25	685.3	8.64
Wheat	2523.6	4.29	2578.1	4.56	1513.7	8.30	2265.6	4.00
Sugarcane	61588.4	4.46	72575.1	4.58	72631.1	12.65	65613.9	5.34
Soyabean	631.2	48.47	1061.4	34.28	939.7	16.55	951.9	17.46
Note: C.V. is coefficient of variation%. Yield mean is in Kg/hectare.								

The three regions differ in a most vital requirement of agriculture which is controlled water supply for crops. The availability of irrigation is an encouragement for the use of other productivity enhancing inputs. This is because of the synergy among inputs as even irrigation and fertilizer can be viewed as complements (Ghosh, 2000, Ghosh, 2004, ***) and because of the possible risk reducing property of irrigation. Further, the higher productivity in irrigated areas can promote advanced (but costly) technology through an income effect. All this can generate a high cost agriculture in this region. For the same reasons the region lacking in irrigation facility is liable to lag in investment on costly and productive technology.

Although cost of cultivation is high in some states, given the appropriate management techniques the returns are also likely to be high so that the high cost might also be associated with higher commercial returns. Thus the three regions are expected to vary not only in their cropping patterns and yield performances but also in their cost of cultivation and the benefit to cost ratios.

We have used cost of cultivation data for major reported crops as available from official sources and averaged across states falling in the three regions. Table AIII-3.4 demonstrates that the cost of cultivation is indeed highest in the HI region in most cases but is highest in the MI region in the cases of Rice and Maize and in general it is lowest in the LI region that lacks irrigation facility. However despite the low cost, the LI region has the highest cost to returns ratio (least profitable) in five out of the seven crop cases reported here i.e., for Cotton, Rape-mustard, Maize, Pulses and Groundnut. The MI region has the lowest cost relative to returns for the largest number of cases which are Cotton, Rape-mustard, Wheat, maize and Groundnut but the ratio is highest though by a small margin in case of rice. Thus the middle irrigated region has in important place in Indian agriculture. The most privileged HI region has the lowest relative cost only for Rice and Pulses and the highest cost in Wheat.

Table AIII-3.4: Cost of Cultivation (Rs./Hect.) and Cost of Return ratio Region wise

Crop	**High**		**Med**		**Low**		**All**	
	COST	**C.R.**	**COST**	**C.R.**	**COST**	**C.R.**	**COST**	**C.R.**
Paddy	11454	0.57	13187	0.58	9748	0.58	10583	0.58
Cotton	13304.3	0.57	10605.6	0.52	8320.3	0.60	9203.5	0.59
Rape-mustard	5715.7	0.36	7246.5	0.16	3977.2	0.53	6286.5	0.19
Wheat	9507.6	0.51	8198.6	0.31	6402.9	0.46	8036.4	0.41
Maize	3971	0.56	6777.7	0.52	4438.8	0.65	4571.6	0.57
Pulses	4625.2	0.34	3886.8	0.43	4270.8	0.51	4258.8	0.41
Groundnut	15378.5	0.72	8580.7	0.66	9689.8	0.74	10859	0.71

Note: Cost is A2 in Rs/Hectare. CR=Cosat to returns ratio

Table AIII-3.5: Performance of Monsoon in recent times

Year	No. of MS with deficient Rainfall	%Districts with Normal or Excess Rainfall	%Rainfall relative to LPA
2000	8	66	91
2001	5	68	91
2002	**21**	**39**	**81**
2003	3	75	102
2004	**13**	**56**	**87**
2005	4	72	99
2006	**10**	**60**	**99**
2007	6	72	105

Note: MS is meteorological Subdivisions, LPA is Long period Averge

AIII-4. Crop yield dynamics: Evidences of a slow down with variable break-points

India's agricultural policy bestows substantial emphasis on the positive movements of yield rates of the crops. These movements are a reflection of the progress taking place agricultural technology and management practices. The largely static yield rates in the pre-independence days were associated with stagnation of the sector and often with irrationality and even perverse responses of **farmers**. The rejection of these notions and the advent of a new technology marked the unfolding of a green revolution. This was a period in which the crop yields responded to higher inputs of fertilizer and water along with pesticide, machinery and advanced scientific methods while farmer's practices responded to price policies of the government. There was however much debate on the success of the revolution in respect of crops other than wheat and rice and in regions other than the most endowed and on the possible ecological impacts of the technology that required high doses of inputs. The late 1980s started revealing the ecological pressures created by water logging, excessive withdrawal of groundwater and deterioration of soil quality due to over-use of chemicals. There was a also an emphasis on carrying the technology towards areas that had not been benefited. There was also a renewed thrust towards oilseeds and coarse cereals. In the 1990s trade liberalization created further opportunities as also threats to Indian agriculture. In recent times the dynamics of crop yield rates has been causing concern with India returning to the international market as an importer of grains in 2006-07.

The following exercises seek to model the yield dynamics and to unravel if yield rates have encountered a slow down in recent times and to identify the break points. The trajectory of the yield rates along with the structural changes if they were found would be conjectured to be the representative dynamics that would also be evident to the farmers for their decisions and expectation making process. The results of the exercises are utilized in Chapters 6 and 9.

In this study we have used data on crop yields covering the years 1973 to 2005 to estimate simple linear time trends. The trend equation must also take account of any structural change that may have taken place in the model that farmers may conceivably have taken note of in making their future projections. In particular, yield rates in India are said to be affected by a slow down that is characteristic of a so-called post-green revolution era. Ecological imbalances are also associated with the phenomenon. We have addressed this by studying the behaviour of the data itself. Firstly, we have made a visual inspection by looking for possible changes in the plots of the data over the period 1990 to 2004. We postulate that a post-green revolution syndrome may have brought down the trend rate of increase, i.e., in the annual increase in crop yield rate in Kg per hectare. We do this by first fitting a simple time trend to the data and applying the Chow structural break test for each year in the relevant period time for the period 1990 to 2004. Wherever the significance of the F-statistic indicates a break to have taken place, we have searched over the entire period. Considering a break for each year in the sub-period of the time series the F-statistic is computed and compared. The relevant break period is located at the time point where the F-statistic is found to be a maximum (see Kurosaki, **). Considering this point as the break point (B) we then created a dummy variable for the structural break as follows.

D_{sb} =1 if Time is greater than or equal to B and

=0 otherwise.

We then introduced a variable measuring the interaction between time and dummy as in the trend equation

$$Y' = a + b\,Time + c\,Time \times D_{sb}$$

Where Time = 1973 ….. 2005.

A negative value of c would indicate that the rate of increase of yield (Y) is b in all years up to the year B and falls thereafter. In cases where no significant break could be identified by our test, we simply estimate the following equation.

$$Y' = a + b\,Time$$

The trend exercise involving a deterministic time trend may not be correct unless we rule out the possibility of a stochastic trend. We have looked for the stationarity of the residuals, since the violation of the underlying presumptions of the trend equation would be reflected in the residuals. We have estimated the Augmented Dicky Fuller test statistics for the de-trended yield series, presented **in Table AIII.4.1.** In nearly all cases the unit root hypothesis is rejected at 5% level. For rabi Rice the hypothesis could be accepted at 5% level but even then it is not accepted at 10% level. Only Tur in MI region shows non-stationarity and a time trend may not be appropriate.

Table TableAIII-4.1 Dickey-Fuller test Statistics for Stationarity of Yield rates (de-trended)				
Crops	HI	MI	LI	POOLED
Kharif Rice	3.40	4.97	4.95	4.18
Rabi rice	2.68	4.13	3.59	2.93
Wheat	3.63	3.28	5.71	3.38
Maize	3.73	4.19	3.75	4.31
Groundnut	3.18	5.80	3.35	
Soyabean	5.08	3.54	3.12	3.55
Tur	5.46	2.00*	3.30	6.25
Cotton	4.44	4.38	3.92	4.48
Sugarcane	5.50	3.22	3.60	5.17
Potato	4.75	3.53	3.64	4.71
Note: ADF test with lag one is conducted. Critical values are 10% -2.6, 5%- 2.9.				

Except Tur in which case the regression is extremely poor, the other crops have yielded equation with satisfactory fit (Ta**bleAIII-4.2). The** method therefore has little implications for the trend in Tur and this result will not be discussed here. The trend is significant and positive in all the cases. The interaction of slope and dummy comes out in all cases barring Maize and Groundnut. In the latter cases the simple linear trend describes the data. The coefficient of the dummy interaction term is negative in all cases except Cotton and is also statistically significant except for Potato suggesting that that there gas been a slow down in the rate of increase of yield rate. The break point is identified to be 2000-01 in most cases but for rabi Rice and wheat the break point came earlier in 1998-99 and 1997-98 respectively. The positive shift of the trend rate in case of Cotton in 2000-01 could be due to the advent of the Bt. Cotton technology.

TableAIII-4.2: Time trend of crop yields with a break							
Variable	con.	t	t*d	Adj-R2	DW	F-stat	break
Ricekh	914.3	32.5(12.5)	-7.4(-3.5)	0.86	2.50	6.1	2000
Ricerb	1820.5	44.6(14.3)	-5.8(-2.5)	0.91	1.60	10.7	1998
Wheat	987.1	52.0(23.3)	-7.8(-4.6)	0.96	2.3	18.6	1997
Maize	818.5	35.6(14.2)		0.86	2.2		
Groundnut	683.3	9.2(3.3)		0.23	2.7		
Soyabean	308.8	29.4(5.8)	-8.2(-3.1)	0.61	2.6	5.3	2000
Tur	701.0	0.29(0.16)	-0.7(-0.5)	-0.61	1.7	1.5	2000
Sugarcane	49909.6	840.3(8.53)	-329.3(-4.1)	0.71	1.9	9.7	2000
Potato	10626.0	309.8(10.1)	-39.8(-1.6)	0.82	2.1	3.1	2000
Cotton	104.8	4.34(8.45)	1.6(3.2)	0.86	1.7	19.2	2000
Note: * is significant at 10%, ** is significant at 1%							

At the regional level there is more diversity but in the majority of the cases a break point between 1997 and 2000 could be identified. In the case of maize in the LI region the break point goes back to 1992-93 but in this case the rate of increase of mean yield rate had actually moved up as seen from the positive coefficient of the dummy term. In the other two regions the interaction term did not appear (no slow down was indicated) as there was no break and the linear equation was considered. In general a slow down is indicated for most crops by the negative coefficient of the interaction variable. For Tur the equation was meaningful only in the MI region and for the other two regions the R^2 is negative so that the equation did not say much.

TableAIII-4.3:: Time trend of crop yields with a break in trend for the three regions							
CROP		C	T	T*D	R2	D.W.	Break
RICE KHARIF	R HI	869.2 (16.7)	42.4 (13.0)	-11.4 (-4.4)	0.86	1.7	2000(12.2)
	R MED	1125.2 (29.9)	39.32(20.33)		0.93	2.1	
	R LOW	826.6 (15.8)	22.1 (6.53)	-8.92 (-3.40)	0.58	2.8	1999(5.97)
RICE RABI	R HI	1037.4 (7.3)	79.3 (8.9)	-29.4 (-4.1)	0.72	0.81	2000(9.7)
	R MED	1888.9 (46.3)	49.9 (18.9)	-4.83 (-2.36)	0.95	1.83	1999(2.7)
	R LOW	1685.8 (18.68)	25.5 (4.34)	-8.26 (-1.81)	0.39	1.83	1999(7.5)
SOYABEAN	R HI(1)						
	R MED	157.9(0.88)	41.1 (4.42)	-11.2 (-2.3)	0.47	2.4	2000(5.5)
	R LOW	328.3 (3.43)	28.1 (5.64)	-8 (-3.07)	0.59	2.5	2000(4.8)
TUR(ARHAR)	R HI	1107.9 (-0.21)	-0.20 (-0.07)		-0.03	1.3	
	R MED	326.2(9.2)	11.05 (4.99)	-3.21 (-1.8)	0.46	1.5	2000(7.7)
	R LOW	606.4 (20.4)	1.14 (0.75)		-0.01	2.13	
POTATO	R HI	10864.6 (19.24)	284.3 (9.81)		0.75	2.1	2000
	R MED	13645.6 (20.99)	484.5 (10.63)	-171.47 (-5.13)	0.81	1.78	1997(13.7)
	R LOW	5798.5 (14.6)	169.5 (6.84)	-61.8 (-3.08)	0.6	1.5	2000(9.4)
MAIZE	R HI	661.5 (11.82)	38.27 (13.33)		0.85	1.8	
	R MED	763.7 (8.35)	33.8 (7.22)		0.61	2.3	
	R LOW	1264.5 (18.24)	15.34 (2.50)	10.15 (2.32)	0.77	1.65	1992(2.8)
COTTON	R HI	213.5 (12.2)	3.09 (2.85)	-1.89 (-2.14)	0.16	1.2	2000(2.5)
	R MED	151.7 (11.3)	5.59 (4.12)	-0.5 (0.43)	0.44	0.97	2000(20.4)
	R LOW	73.1 (1.2)	3.2 (7.8)		0.65	1.85	
GROUNDNUT	R HI	707.3 (10.7)	25.7 (5.8)	-6.2 (-1.8)	0.59	1.37	1998(14.9)
	R MED	689.0 (7.0)	6.93 (1.08)	0.82 (0.17)	0.03	2.48	1999(3.1)
	R LOW	603.8 (15.26)	12.35 (4.82)	-5.86 (-2.95)	0.4	2.1	1999(4.8)
SUGARCANE	R HI	42979.6 (21.6)	954.1 (7.41)	-326.7 (-3.2)	0.66	2.2	1999(5.6)
	R MED	62111.9 (37.8)	333.4 (3.95)		0.31	1.8	
	R LOW	68572.8 (26.5)	420.2 (2.4)	-161.1 (-1.23)	0.13	0.87	1998(18.7)
WHEAT	R HI	1090.1 (28.04)	50.5 (21.46))	-0.43 (-4.1)	0.96	2.15	1997(15.9)
	R MED	1296.6 (26.82)	49.86 (14.72)	-7.31 (-2.94)	0.93	2.5	1997(4.6)
	R LOW	669.5 (19.8)	37 (17.5)	-9.24 (-5.4)	0.92	2	2000(14.9)
(1) Not grown to any significant extent.							

AIII-5. Effect of the crop insurance programme on crop yield: Crop yield dynamics with a break-point at 2000-05

To examine the position of the Crop insurance (CI) period in the long run yield dynamics of the crops we have estimated linear time trends of the crop yields over the sample period 1975 –76 to 2005-06 using a slope dummy variable for the CI period 2000-01 to 2005-06. This exercise in similar in nature to that presented in AIII-4 but with the break pre-specified at 2000-01 and is used Chapter 6. The possible increase or decrease of trend rate of increase of yield rate in Kg per hectare per year is measured by the following equation:

Y+ a + b Time + c Dummy*Time

Where Dummy =1 for Time= 2000-01…2005-06 and 0 otherwise.

The results are consistent with the earlier exercises with flexible break points.TableAIII-5.1 finds a positive long run long run trend for all cases barring *Tur* in which case the coefficient of time is insignificant. Trend equations without the Dummy variable are not reported here. However, the coefficients of the Dummy-Time interaction term are nearly uniformly negative. Maize and Groundnut are exceptions in which cases the t-statistics also fall below unity and are not reported. The linear trend equation without the dummy is retained. Also, the negative coefficients are not significant at 1% level in the cases of Potato and Cotton.

TableAIII-5.1: Time trend of crop yields with dummy for 2000-1 to2005-2006			
Variable	Constant.	t	t*d
Kharif Rice	914.3	32.5**	-7.4**
Rabi Rice	1814.0	45.0**	-7.5**
Wheat	1007.0	49.6**	-8.4**
Maize	818.5	35.5**	
Groundnut	683.3	9.2**	
Soyabean	308.8	29.4**	-8.2**
Tur	701.0	0.3	-0.7
Sugarcane	49909.6	840.3**	-329.3**
Potato	10626.0	309.8**	**-39.9**
Cotton	102.1	4.49**	-0.2

From the trend analysis conducted for the three regions separately also the slow down in trend rate is evident widely. The coefficients (**TableAIII-5.2**) are insignificant (or positive) only in select few cases which are for kharif Rice, Groundnut and Sugarcane in MI region, Potato in HI region, Maize in all regions and Cotton in MI and LI regions. For Soyabean in HI region, Tur in HI and LI regions and Groundnut in MI region, no positive and significant time trend is also evident.

TableAIII-5.2: Time trend of crop yields with dummy for 2000-2006 for the three regions						
Crop	Region	C	t	t*d	adj-R²	D.W
Rice kharif	HI	869.2 (16.7)	42.4 (13.0)**	-11.4 (-4.4)**	0.86	1.7
	MI	1129.5 (26.6)	38.9 (14.7)**	0.5 (0.23)	0.92	2.1
	LI	843.2 (15.8)	20.3 (6.1)**	-7.73 (-2.9)**	0.54	2.8
Rice rabi	HI	1037.4 (7.3)	79.3 (8.9)**	-29.4 (-4.1)**	0.72	0.81
	MI	1903.7 (45.7)	48.4 (18.6)**	-3.5 (-1.7)**	0.94	2
	LI	1669.4 (19.6)	26.9 (5.1)**	-10.8 (-2.5)**	0.44	1.9
Soyabean	HI	508.8 (2.89)	10.3 (1.12)	-6.2 (-1.3)	-0.11	3.1
	MI	157.9 (0.88)	41.1 (4.42)**	-11.2 (-2.3)**	0.47	2.4
	LI	328.3 (3.43)	28.1 (5.64)**	-8 (-3.07)**	0.59	2.5
Tur(arhar)	HI	1112.3 (16.8)	-0.62 (-0.15)	0.503 (0.15)	-0.06	1.3
	MI	326.2 (9.2)	11.05 (4.99)**	-3.21 (-1.8)*	0.46	1.5
	LI	605 (18)	1.28 (0.61)	-0.16 (-0.09)	-0.05	2.12
Potato	HI	10862.4 (17.1)	284.6 (7.2)**	-0.26 (-0.008)	0.72	2.1
	MI	14537.6 (19.2)	385 (8.1)**	-100.2 (-2.6)**	0.71	1.6
	LI	5798.5 (14.6)	169.5 (6.84)**	-61.7 (-3.08)**	0.6	1.5
Maize	HI	652.1 (10.3)	39.2 (10.0)**	-1.09 (-0.34)	0.84	1.8
	MI	800.7 (7.86)	30.3 (4.8)**	4.31 (0.84)	0.61	2.3
	LI	1167.98 (18.1)	27.5 (6.8)**	0.67 (0.21)	0.73	1.6
Cotton	HI	213.5 (12.2)	3.09 (2.85)**	-1.89 (-2.14)**	0.16	1.2
	MI	146.9 (6.45)	5.85 (4.12)**	-0.5 (0.43)	0.44	0.97
	LI	70.8 (7.9)	3.4 (6.11)**	-0.26 (-0.58)	0.64	1.83
Groundnut	HI	616.2 (7.1)	35.4 (6.6)**	-14.9 (-3.4)**	0.57	11.7
	MI	729.7 (7.7)	3.01 (0.51)	5.63 (1.18)	0.77	2.5
	LI	618.1 (15.2)	10.84 (4.3)**	4.69 (-2.3)**	0.34	2.3
Sugarcane	HI	43275.6 (22.1)	918.7 (7.5)**	-319.3 (-3.2)**	0.65	2.2
	MI	62266.6 (33.6)	318.4 (2.7**)	18 (0.19)	0.29	1.8
	LI	66580.5 (32.4)	605.5 (4.7)**	-416.6 (-4.0)**	0.4	1.2
Wheat	HI	1111.4 (28.6)	55.9 (23.0)**	-9.73 (-4.96)**	0.96	1.9
	MI	1323.5 (27.7)	46.7 (15.7)**	-5.58 (-2.3)**	0.92	2.4
	LI	669.5 (19.8)	37 (17.5)**	-9.24 (-5.4)**	0.92	2
Note: * is significant at 10%, ** is significant at 1%						

The flexible break point trend analysis is possibly more meaningful but in any case, both analyses suggest a slowdown in the dynamics of yield in recent time.

Appendix IV

The Ahsan, Ali and Kurien model

A simple model presented by Ahsan, Ali and Kurien **(A,A,K,1982)** traces out how crop insurance can positively influence resource allocation and productivity in agriculture and help the risk adverse farmer to behave as a risk neutral, profit maximising entrepreneur and invest optimally in cultivation. The basic decision in agriculture is about the allocation of aggregate available resources (like work effort, water and finance) between uncertain activity (cultivation) and certain prospect (wage labour, financial security, real estates etc.). The model assumes that insurance contracts are traded in a competitive market and that the risk averse (diminishing marginal utility from returns) farmer maximises his expected utility subject to the competitive premium. Two possible states of nature are considered (i) *bad*, in which case the farmer loses all his potential output and (ii) *good*, in which case he is able to retain all the output. The following notations are used

A0 = Aggregate resource endowment (physical unit) of representative farmer

A=Amount of A0 devoted to risky production

r= marginal and average returns on riskless investment

Zi= farmer's total income in absence of insurance in state i

Yi= farmer's net income under insurance in state i

a= insurance coverage ratio

p=probability of occurrence of a bad state of nature

U(Y)= utility of income

Z, Y, r measured in physical units (distinction between income and output irrelevant). The production function is F such that $F'>0$ and $F''<0$ – implying farming is risky with diminishing returns.

Gross before insurance income is a random variable

$Z1 = F(A)+r(A0-A)$ with probability (1-p) ……1(a)

$Z0 = r(A0-A)$ with probability p……………….1(b)

Utility Function is U such that

$U'>0$ and $U''<0$ implying risk aversion

The insurer's profit under competition is given by the condition

$$\text{Profit} = (1-p)\,qAa - p[aF(A) - qAa] = 0 \quad \text{……2}$$

Which means

$$q = pF(A)/A \quad \text{……………………….2(a)}$$

The farmer's profit maximisation exercise with insurance is as follows:

$$\text{Max}V = (1-p)U(Y1) + pU(Y2)$$

Subj. to $q = p[F(A)/A]$

Where

$Y1 = F(A)+r(A0-A)-qAa$ with prob 1-p ……………..3(a)

$Y2 = aF(A) + r(A0-A)-qAa$ with prob p……………….3(b)

$$dV/da = -p(1-p)F(A)U'(Y1) + p(1-p)F(A)U'(Y2)$$

$$dV/dA = (1-p)[F'(A)-r-apF'(A)]U'((Y1)$$

$$+p[aF'(A)-r-apF'(A)]\,U'((Y1)$$

The functional forms ensure the second order condition.

The solution obtained is given by the following equations:

1. a=1 which means the farmer opts for complete coverage and
2. (1-p)F'(A)=r implying that the expected marginal product of resource use would be equal to the opportunity cost (i.e., the returns on riskless investment), a behaviour consistent with risk neutrality.

With insurance however the solution is as follows:

Max V=(1-p)(U((Z1) +pU (Z2)

dV/A=(1-p)[F'(A)-r] U'(Z1)

-p(r U'(Z2))

where Z1> Z2, and U'(Z1)< U'(Z2)

(1-p)[F'(A)-r]> pr

(1-p)[F'(A)]>r

If A_n and A_f are resources used with no insurance and full insurance respectively equation * gives that

[F'(An)]>F' (Af)

An<Af

Since resource use under full insurance is less than that under no insurance, it is reasonable to conclude that crop insurance will have a positive impact on the outcome effect i.e., yield rate.

References

Agarwal Bina (2008) "Rethinking Collectivities: Institutional Innovations in Group farming, Community Forestry and Strategic Alliances", B.N. Ganguli Memorial lecture delivered at the Centre for the Study of Developing Societies on 11th April 2008.

Ahsan, Sayed M., Ali A. G. Ali and N. John Kurian (1982), 'Towards a theory of Agricultural Insurance', American Journal of Agricultural Economics, 64.

Ahsan, Sayed M., Ali A. G. Ali and N. John Kurian (1982), 'Towards a theory of Agricultural Insurance', American Journal of Agricultural Economics, 64.

and Political Weekly Vol. XX, No. 25 and 26 June 22-29.

Anerson Kym and Anna Strutt (1996), "On measuring the Environmental Impact of Agricultural Trade liberalisation" in M.E. Bredahl, Nicole Ballenge, John C. Dunmore and Terry L. Roe (ed) *Agriculture, Trade and the Environment; Discovering and Measuring critical Linkages*, Westview Press, USA.

Arrow, K.J. (1963), "Uncertainty and welfare economics of medical care"*American economic review* 53 (Dec. 1963).

Askari and Cummings (1975) "Estimating Agricultural Supply response with Nerlove model: A survey" International Economic Review Vol. 18 (2)

Baltagi Badi, H. (2001),Econometric Analysis of Panel data, John Wiley & Sons.

Barker R. (1069), "Economic aspects of High Yielding Varieties of Rice with Special Reference to International Rice policies" IRRI Report, Food and Agricultural Organization of the United Nations.

Bhende M.J (2005), Agricultural Insurance in ndia: Problems and Prospects, NABARD.

Bhende M.J. (2005), Agricultural Insurance: Problems and Prospects.

Binswanger Hans P., (1978), " Risk attitudes of Rural Households in Semi-arid Tropical India" *Economic and Political Weekly*, June.

Binswanger Hans P., (1978), " Risk attitudes of Rural Households in Semi-arid Tropical India" *Economic and Political Weekly*, June.

Binswanger Hans P., (1980), "Attitudes towards Risk: Experimental Measurement in Rural India" *American Agricultural Economics Association* August.

Binswanger Hans P., (1980), "Attitudes towards Risk: Experimental Measurement in Rural India" *American Agricultural Economics Association* August.

Charnes A.,and W. W. Cooper (1959) Management Science.

Chaudhary K.M. (1977), *4-P Plan Crop insurance scheme for Hybrid 4 Cotton in Gujarat* (Research Study No. 51) Sardar Patel University

Chopra, Kanchan (2006) 'Withdrawal of Subsidies from Irrigation and Fertilizer; Impact on small and marginal farmers "in R. Radhakrishna et al (ed) India in a Globalizing World, Academic Foundation.

Chopra, Kanchan (2006) 'Withdrawal of Subsidies from Irrigation and Fertilizer; Impact on small and marginal farmers "in R. Radhakrishna et al (ed) India in a Globalizing World, Academic Foundation.

Dandekar, V. M (1976), "Crop Insurance in India", *Economic and Political Weekly*, June.

Dandekar, V. M., (1985), "Crop Insurance in India: A Review 1976-77 to 1984-85", *Economic and Political Weekly* Vol. XX, No. 25 and 26 June 22-29.

Day Richard H., (1965) "Probability Distributions of Field Crop Yields" Farm Economics, (47) August.

Duncan and Meyer

FAO crop insurance compendium 1991 Rome

Fertiliser Association of India (various), *Fertilizer Statistics*

Frontline (1998), Vol 15, No.24 November 21 to December 4.

Gallagher P. (1987), " U.S. Soyabean Yields, Estimation and ForecastiIng with nonsymmetric Distributions" American Journal of Agricultural Economics, 69 (November).

Ghosh Nilabja (1998), *Studies of Supply Responses in Indian Agriculture*, Unpublished Ph.D. Dissertation submitted to Indian Statistical Institute, Calcutta.

Ghosh Nilabja (2007) "Trade liberalization and Diversification in Indian Agriculture" in Kanchan Chopra and C.H.Hanumantha Rao (ed) Growth Equity Environmental and Population: Economic and Sociological Perspectives, Sage.

Ghosh Nilabja (2007):Trade Liberalization and Diversification in Indian Agriculture", in Kanchan Chopra and C.H.Hanumantha Rao (ed) Growth, Equity, Environment and Pouplation, SAGE.

Ghosh, Nilabja (2007), “Trade liberlaxation and Diversification in Indian Agriculture” in Kanchan Chopra and C.H. Hanumantha rao (ed) *Growth, Equity, Environment and Population: Economic and Sociological Perspectives*, SAGE.
Goodwin Barry, K. (2001), “Problems with market insurance in Agriculture”, American Journal of Agricultural Economics, 83 (3) August 2001.
Government of India (2004) Report of the Joint Group on Crop insurance, Ministry of Agriculture.
Government of India (2006-07, 2007-08), *Economic Survey*
Government of India (GOI, 2004), Report of the Joint Group on Crop Insurance, Ministry of Agriculture.
Government of India (various) *Area Yield and Production of Principal Crops*, Department of Economics and Statistics, Ministry of Agriculture
Government of India (GOI), Agricultural Statistics at a Glance
Government of India (GOI), Agricultural Census, 1995
Gulati A., (1998)"Indian Agrculture in an open Economy" in Isher Ahluwalia and I.M.D. Little (ed) India's economic Reforms and Development: Essays for Manmohan Singh, OUP.
Gulati A., A. Sharma, K. Sharma, S. Das and V. Chhabra (1994) Export competitiveness of selected agricultural commodities, NCAER, New Delhi.
Halcrow G. (1949), “Acturial Structures of Crop insurance”, Journal of Farm Economics 31.
Harrington, Scott E. and Gregory R. Niehaus (2003) Risk management and Insurance, Tata Mc Grawhill Publishing Company Ltd.
Haussman J.A. (1978),”Specification test in Econometrics” Eonometrica 46.
Hazell, P., and Valdes A. (1985), *‘Is there a Role for Crop insurance in Agricultural Development?’* International Food Policy Research Institute, Food Policy Statement No. 5, IFPRI, Washington D.C.
Hazell, P., and Valdes A. (1985), *‘Is there a Role for Crop insurance in Agricultural Development?’* International Food Policy Research Institute, Food Policy Statement No. 5, IFPRI, Washington D.C.
Hazell, P., Pomareda C. and Valdes A. (1986) Crop insurance for Agricultural Development: Issues and Experience, Johns Hopkins University Press, Baltimore MD.
Hazell, P., Pomareda C. and Valdes A. (1986) Crop insurance for Agricultural Development: Issues and Experience, Johns Hopkins University Press, Baltimore MD.
http:// Wikipedia.org/
Hueth Darrel L. and William H. Furtan: 1994 Economics of agricultural crop insurance: Theory and evidence. Kluwer Academic Publishers. .
Hueth Darrel L. and William H. Furtan: 1994 Economics of agricultural crop insurance: Theory and evidence. Kluwer Academic Publishers. .
Indian Meteorological Department
Jai Singh Rathore (2004), Drought and Household Coping strategies, Indian journal of Agricultural Economics, Vol. 59, No. 4, October-Dec.
Jodha (1978), “Effectiveness of Farmers’ adjustment to Risk” *Economic and Political Weekly*, June 1.
Jodha (1978), “Effectiveness of Farmers’ adjustment to Risk” *Economic and Political Weekly*, June 1.
Just Richard E. and Quinn Weninger (1999), “ Are Crop Yields normally Distributed?”American Journal of Agricultural Economics, 81(May).
Just Richard E. and Roulon D. Pope (1979) “Production Function Estimation and Related Risk Considerations” American Journal of Agricultural Economics, (May).
Kamath Rajlaxmi: “Financial inclusion vis-a-vis social banking” *Economic and Political Weekly*, Vol. XLII, No.15, April 14-20, 2007.
Knight F.H. (1921), Risk Uncertainty and Profit New York, Harper and Row.
Krishna R. (1963) Farm supply A case study of Punjab Region”, Economic Journal (73)
Kuroshaki Takashi (2003), “Specialisation and Diversification in Agricultural Transition: A case of West Punjab' American Journal Agricultural
Lipton M. (1979), “Agricultural risk, Rural Credit and Inefficiency of Inequality” in Roumasset (ed) Risk, *Uncertaity and Agricultural Development*, Agricultural Development Council, New York.
Mellor (1969),’The Subsistence Farmer in Traditional Economics’ in Clifton R. Wharton (ed) Subsistence Agriculture and Economic Development, Frank Cass and Co.
Mellor (1969),’The Subsistence Farmer in Traditional Economics’ in Clifton R. Wharton (ed) Subsistence Agriculture and Economic Development, Frank Cass and Co.

Menon Sudha Venu (2006) *Globalisation, State and disempowerment: Study of farmer suicides in Warrangal*, ICFAI Business School
Miranda M.J. (1991), "Area yield crop insurance Reconsidered" American Journal of Agricultural Economics, 73 (May).
Miranda M.J. and J.W. Glauber (1997) "Systemic Risk, Reinsurance and the informat Failure of Crop insurance Markets", American Journal of Agricultural Economics, 79 (Feb).
Mishra Shrijit (2007) "Farmers' suicides in Maharashtra", Economic and Political Weekly April 22.
Mishra, Pramod K (1996).: Agricultural risk, insurance and income: A study of the impact and design of India's comprehensive crop insurance scheme.
Mitra Siddhartha and Sangeeta Shroff (2007) "Farmer suicides in Maharashtra" *Economic and Political Weekly*, December 8.
Moss Charles B. and J. S. Shonkwiler (1993), Estimating Yield Distributions with a Stochastic Tend and Nonnormal Errors" American Journal of Agricultural Economics, 75 (November).
NSSO (2005), Situation assessment survey of farmwers : Indebtedness of farmer households. NSS 59th Round. January –DECEMBER 2003. Govt. of India. May
Nelson, C. H. and E.T. Loehman (1987), "Further towards a theory of Agricultural Insurance", American Journal of Agricultural Economics 69.
Nelson, C. H. and P. V. Preckel (1989), " The Condition Beta distribution as a Stochastic Production Function" American Journal of Agricultural Economics, 71 (May).
Nerlove M. (1971), "Further evidence on the Estimation of Dynamic Economic Relations from a Time Series of Cross sections", Econometrica 39.
Nigam J.N. (1971), Crop insurance Report, Kanpur University.
NIRD (2004) *Farmer's suicides in Andhra Pradesh and Karnataka; Report*, Hyderabad
NSSO (1998) Indebtedness of Rural Households as on 30.06.1991: All India debt and investment survey. NSS Forty-eighth round. January-December 1992. Government. of India.
NSSO (2005) Household indebtedness in India as on 30.06.2002: All India debt and investment survey. NSS Fifty ninth round. January-December 2003. Govt. of India. December
NSSO(2005) Situation assessment survey of farmers : Some aspects of farming. NSS 59th Round. January-December 2003. Govt. of India. July
Patil Balasaheb V. (2008) "Agricultural indebtedness: Crisis and Revival"*; Economic and Political Weekly* February 2-8.
Pope Roulon D. and Rod F. Ziemer (1984) "Stochastic Efficiency, Normality and Sampling Errors in Agricultural Risk Analysis"," American Journal of Agricultural Economics, 75 (November).
Priolkar: G.S(1949). Note on problems of crop insurance under Indian conditions. Govt. of India.
Priolkar: G.S. (1950) Problems of crop. Insurance: Under Indian conditions. Govt. of India. February
Radhakrishna, R. (2008), India Development Report 2008, Indira Gandhi Institute of Development Research, Oxford.
Rajan, Raghuram*: Fiancial sector reforms in India: Why? Why how? How?"*
Ramkumar, R. , Pallavi Chavan (2008): "Revival of agricultural credit in the 2000s: An explanation". *Economic and Political Weekly*, Vol. XLII, No.52, December 29, 2007 to January 4, 2008.
Ramkumar, R. , Pallavi Chavan (2008): "Revival of agricultural credit in the 2000s: An explanation". *Economic and Political Weekly*, Vol. XLII, No.52, December 29, 2007 to January 4, 2008.
Raviv, A. (1979), "The Design of an optimal insurance Policy", American Journal of Agricultural Economics 69.
Ray P.K. (1967) *Agricultural Insurance*, Pargamon Press.
Ray P.K. (1974), *A manual of Crop insurance for Developing Countries*, FAO, Rome.
Reddy Amarender A., (2004) " Agricultural Insurance in India- A perspective " presented in the *6th Global Conference of Actuaries February* 18-19, New Delhi.
Reserve Bank of India `(2007), Handbook of statistics on the Indian Economy. Reserve Bank of India..
Roberts R.A.J. And Dick W.J.A: 1991. *Strategies for crop insurance planning*. Food and AgricultureOorganization of the United Nations.
Rothschild, M. And J. Stiglitz (1976), "Equilibrium in Competitive Insurance Markets; an Essay on the Economics of Imperfection", Quarterly Journal of Economics (90).
Roumasset James A. (1976), *Rice and Risk*: *Decision Making among Low-Income Farmers* , North-Holland.
Rustagi Narendra K. (1988) *Crop insurance in India*, B.R. Publishing Corporation

Satish, P: (2007), “Agricultural Credit in the Post-reform Era : A Target of systematic policy **”. *Eonomic and Political Weekly*, Vol. XLII, No.26, June 30-July 6, 2007. June 30,

Schultz T.W. (1964) *Transforming Traditional Agriculture*, Yale University Press, London.

Second Lecture in the Golden Jubilee Series, .Institute of Economic Growth February, 2008.

Shah Mihir, Rangh Rao, P.S. Vijay Shankar: (2007) “Rural Credit in 20th Century India: Overview of history and perspectives”,. *Economic and Political Weekly* Vol. XLII,

Skees Jerry R., J. Roy Black and Barry J. Barnett (1997) “Designing and Rating an Area Yield Crop insurance Contract” American Journal of Agricultural Economics, 79 (My).

SmithV.H. and A.E. Baquet (1996), “The Demand for Multiple Peril Crop insurance: Evidences from Montana Wheat Farms” American Journal of Agricultural Economics, 78 (February).

Tata Institute of Scoial Sciences (2005) , *Causes of Farmer Suicides in Maharashtra: An Enquiry* , Final report submitted to the Mumbai High Court, March.

The World Bank (2008), Agriculture for Development, World Development Report.

Tripathi S.L. and C. Dinesh (1987) Crop insurance in India, Vaikunth <ehta National Institute of Cooperative management, Pune.

Vaidyanathan A. (2006) “Farmers’ Suicides and Agrarian Crisis”, *Economic and Political Weekly*, Vol.41, No. 38, September 23-29.

Von Neumann J. and O. Morgenstern (1953) *Theory of Games and Economic Behaviour*, Princeton University Press.

Wallace T.D. and Ashiqu Hussain (1969), The Use of Error Components Models in Combining Cross section with Time series Data, Econometrica Vol.37, No.1.

Wenner, Mark (2005), Agricultural Insurance revisited: New Development and Perspectives in Latin America and the Caribbeans, (RUR-05002) Inter-American Development Bank, Washington D.C.

Wharton C. R. (1968), “Risk, Uncertainty and the Subsistence Farmer: Technological innovation and Resistance to Change in the Context of Survival” *Joint Session of the American Economic Association and Association for Comparative Economics*, Chicago, December.