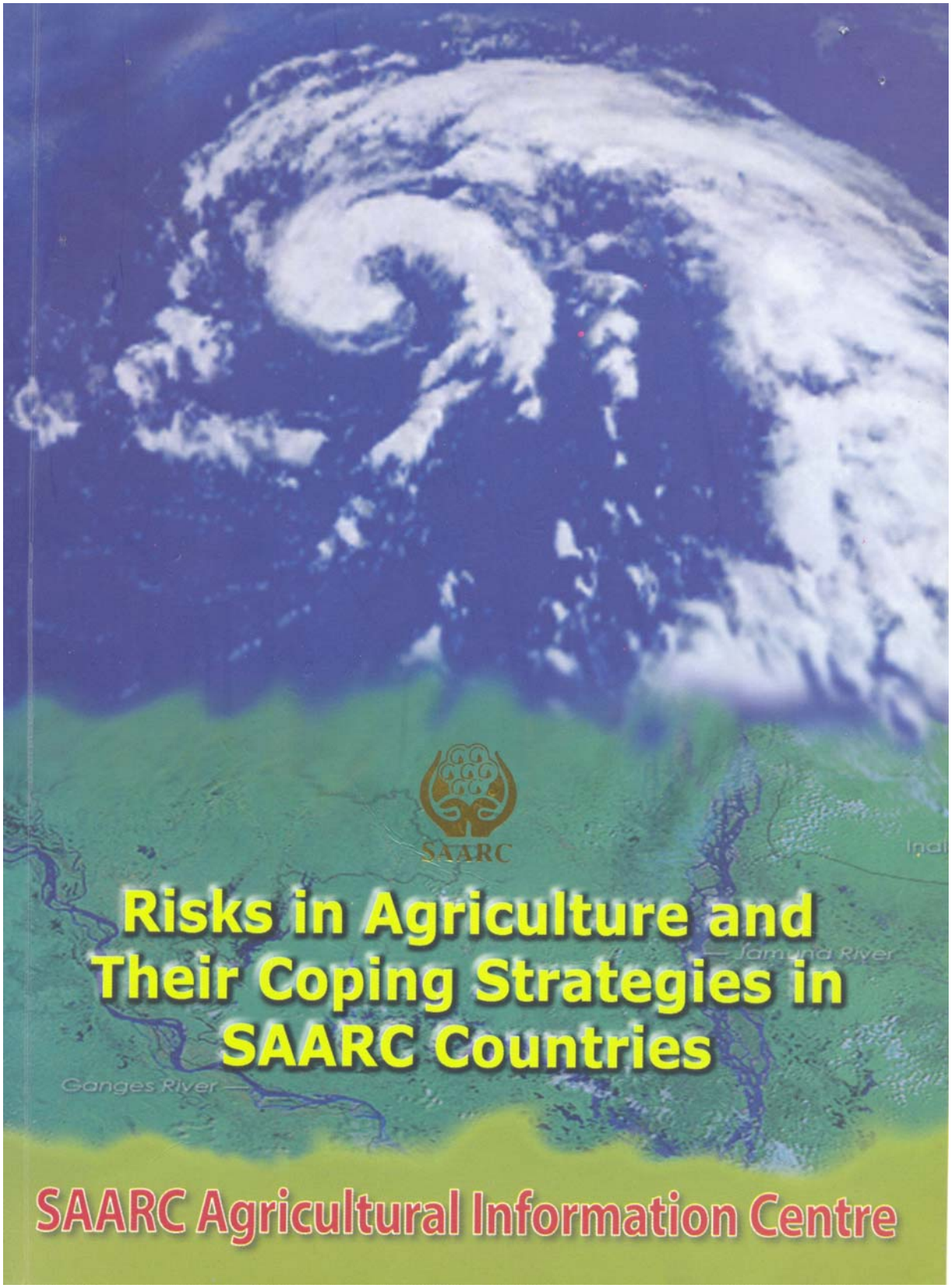
SAARC
Risks in Agriculture and Their Coping Strategies in SAARC Countries
Ganges River
Jamuna River
SAARC Agricultural Information Centre

Risks in Agriculture and Their Coping Strategies in SAARC Countries

SAARC Agricultural Information Centre (SAIC)
BA RC Campus, farm ate, Dhaka - 1215
Bangladesh

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BARC Campus, Farmgate, Dhaka - 1215
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Mohammad Abdullah

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Forward

The economy of the South Asia is predominated by agriculture and about 75% of the potation of SAARC countries deriving their livelihood from agriculture sector. Most of Ibe countries in the region are prone to natural calamities and always the poor farmers are mostly- affected by such hazards. The farmers are required to make decisions in this risky and ever changing environment. The consequences of their decisions are generally man, the outcomes are uncertain.

!east of the farmers of the South Asia operate on small farms but risks is an important aspect of farming. The uncertainties of weather, yields, government policies, prices and other several factors cause wide swings in farmers income. Management of risks involves choosing the best alternative measure which will reduce the turbidity of such sties.

The risks associated with agriculture are prevalent in all SAARC countries. The nature and depth of the sufferings of the risks vary from one country to another. However, it is possible to design custom-made survival strategies for each SAARC member countries dqxmding on the specific situations. Documenting the primary categories of risks on the w-fiok. management strategies developed in the different parts of the region and sharing the information in such circumstances is an urgent need for the SAARC member countries.

In the contest of South Asia. it would be more pertinent to analyse the risks that derive from the uncertainties caused by weather, disease, pests and other factors. Natural calamities. i.e.. flood, draught, tidal waves including the pest and disease attacks are the common hazardous events in most of the South Asian countries.

In the light of the above situations, SAIC organized a workshop during September, 2005 on Risks in agriculture in SAARC countries and their coping strategies'. The Governing Beard t iembers of SAARC Agricultural Information Centre participated and presented their country papers in the workshop.

The country papers presented in the workshop highlighted the above topics specially with the objectives to identify, categorize and documenting the risks with their coping strategies designed by each of the member countries. We believe, the outcome of the workshop will benefit the member countries mitigating the risks by sharing their experiences.

Dr. Wais Kabir
Direcotr, SAIC

Introduction

Risks in Agriculture are common phenomena among the SAARC countries. The repetition of disasters like floods, droughts, cyclones, storm-surges, etc., has forcefully put the farmers of SAARC countries in a position to discover the superior alternatives to survive better in a precarious situation. Understanding the significance of the problem of -irks in agriculture in the SAARC region, SAIC took a program that could provide the scope for sharing the experiences of the farmers of South Asia to diminish the magnitude T the risk factors in the agriculture and allied sectors. The Governing Board (GB) of SAARCAgricultural Information Centre prepared papers on the topic that were presented in a seminar during the 19th meeting of the GB on 27 September 2005 in Dhaka, Bangladesh. The information compiled from each country paper is expected to fulfil the :following objectives:

to identify the types and nature of common agricultural production risks encountered in the SAARC member countries
to categorize the coping strategies including the principles and methods involved in planning, precautionary and rehabilitation measures designed to reduce the impact of risks affecting the agriculture and allied sectors, and
to document the pertinent information and share the experiences among SAARC member countries.

Following are the highlights of the papers:

Bangladesh
The geographical location of the country makes it one of the most natural disaster prone :yeas in the world. Among the various economic sectors, agriculture is the predominantly ztfected sector by the natural disasters. The recurrence of disasters like floods, droughts, ,yclones, storm-surges, etc., has exposed Bangladeshi farmers to escalating risks.

The above risks are the major natural disasters inflict maximum devastation in terms of area; number of farmers and crop production affected. Although there are several other .al disasters like river bank erosion, burial of fertile land by alluvium, landslides, hail .strom, salinity, pest and disease epidemics, etc., that creep around every now and then over the country.

Bhutan
Almost all risks in agriculture in Bhutan are associated with its mountainous environment attributed to rugged terrain, topographical variation, adverse climatic conditions, etc. The geologically unstable topography and steep mountain slopes are highly prone to landslides, floods and other forms of mass wasting. To conserve its fragile ecosystems, high priority is accorded to forest cover. However, this rich endowment, besides assuring sustainable development, has imposed another challenge. Extensive forests has created favourable situation for the wildlife for destruction of crops that has put to test the balance of conservation with socio-economic development of the people. Land encroachment by urbanization, labour shortages, poor rural access to markets, pests and diseases are other risks confronted by agriculture. Strategies for coping risks in agriculture are yet to be fully

established in Bhutan. However, there are scopes and opportunities for developing them well. There are well conserved environment of 73% forest cover in Bhutan, with strong policy commitment among the various institutions, along with the right team spirit, large biological diversity and a glowing approach to development of agriculture, forestry and livestock present in the country.

India

The country paper from India focuses particularly on the case study of rice. It shows that higher rice yield growth with stability is achieved in areas where adoption of high yielding varieties and associate crop management practices is maximum. The paper also outlines polio options for risk management and technology-aided growth in agriculture. Climate-induced yield risk was considered to be the main source of risk in agriculture in India for a quite long time. Over a period of time, focus of analysis shifted to farm income which may fluctuate as a result of fluctuations in prices, area planted, input supply, and several other technology-related factors. Price risk is less relevant in subsistence agriculture when most of the production is for home consumption. There are a large proportion of small and subsistence farmers in India and for them yield risk is the major component. Price risk is also of less significance for those commercial farmers who experience negative correlation between in crop yield and price. But this situation is drastically changing when Indian agriculture is becoming increasingly commercial and farmers respond to price signals both for inputs and outputs.

Nepal

The major uncertainties associated with Nepalese agriculture are the unpredictable impacts of weather. pests and diseases and other natural calamities, price variations of the markets and inadequate information. In Nepal, all of these and in particular, unreliable monsoons cause great variations in agricultural outputs both in crop and livestock sector. Nepal. a mountainous country with a complex diversity of crop growing environment is also prone to various types of risks and uncertainties that are associated with natural
calamities similar to other countries in South Asia.

Pakistan

Agricultural production in Pakistan is mostly dependent upon the weather patterns prevailed during a particular year. The main weather parameter which affects the crop

growth are high temperatures, untimely rains, spontaneous hailstorm and floods. In Pakistan, more than 60 % of population is engaged in agriculture that provides food requirements, raw materials for agro-based industries and livelihood to majority of the country's population. Development of agriculture sector has been a crucial aspect in the economic development of the country for food security and sustainability. The agriculture sector has to face the environmental and natural hazards, both biotic and abiotic stresses from sowing to harvesting period. Although, farmers and other stake holders often adopt measures for coping the threat.

Due to various ecological zones and variety of crops produced in the country, risks to crop production is of assorted nature. In some cases, the rainfall and hailstorms that might cause up to 100 % damage for several areas. Although more than 60% of rainfall are received during

monsoon, during some exceptional years, uneven rains may cause severe damage to field crops. Consequently receiving excess amount of rain water within two to three months, floods also damage the crop.

Sri Lanka

The agricultural production in Sri Lanka is mostly dependent upon the weather patterns prevailed during a particular year. The main weather parameter which affects the crop growth is rainfall. The Country receives rainfall from two monsoons (North-East and South-West monsoon) supplemented by cyclonic depressions occurring at time to time depending on the weather patterns in the Indian Ocean.

The rainfall pattern in the country is very erratic, unevenly distributed and unpredictable. Thus agricultural producers of all categories including the small farmers are confronted with risk of producing their commodities. This risks mostly affect the food production sector where seasonal crops such as rice and other cereals, coarse grins, pulses, condiments, vegetables and some fruit crops are produced for the local consumption. In a drought situation, it is mostly the rice farmers who were at a great risk of loosing their produce.

In Sri Lanka, floods due to heavy rains are frequently reported in the recent times. This causes damages to most of the seasonal crops grown in lower landscapes. In addition to floods, excessive rains lead to soil erosion and sometimes landslides cause severe damages to agricultural crops and lands.

Apart from the risks from the climatic conditions, incidence of pests and diseases also affect the agricultural production. Losses from pests and diseases can be avoided if proper management practices are undertaken during the growing period. The risks from pests and disease attacks cannot be completely controlled. However, it could be managed to a certain level using various protective measures.

Contents

Risks in Agriculture and Their Coping Strategies in Bangladesh

Dr. M. Nurul Alamt and Dr. Sk. Ghulam Hussain2

1. Introduction

Agriculture is the main way of life and earning source of majority people of Bangladesh. Agriculture sector being the backbone of the country's economy continues to be the largest sector and a dominant driving force for growth and development of the national economy. About 56 p-ent of the country's population engages directly or indirectly in agriculture. It provides 65 percent employment opportunity. The economic grew at the annual rate averaging 5 percent and per capita income increasing 36 percent during the 1990s. Since 1991, the country's poverty level has declined from 59% to less than 50% in 2004. Nearly one quarter of the GDP is generated through agriculture. Services, an important sector in the economy of the country, contribute about 50 percent (The World Fact Book, 2003).

The effective land area of the country is roughly 11.96 Mha, about 0.78 Mha occupied by rivers and 1.65 Mha under forest cover (BBS, 2004). Bangladesh is a densely populated country with over 135 million people. Next to Maldives, Bangladesh has the second highest population density a de South via region (881 persons km-2) [BBS. 2003]. The country has an annual population Vowl9h rate (1991- 2001) of 1.47 percent. By the year 2025, the population is expected to grow up to 21.0 million (FAO, 2002).

Inerea-sing population pressure on the scarce land resource of the country is making it more tiutnzrable to landuse conflicts. The land-man ratio is diminishing at an alarming rate; the current estimated per capita land stands at less than 0.12 ha only. It has been estimated that about 80 thousand hectares of arable land go out agricultural use. This land is lost to infrastructure development and settlement and urbanization.

Agriculture being the largest income and employment-generating sector its contribution towards afk-uiating povem is significant. Its role in meeting the challenge of achieving self-sufficiency in food production and fostering sustainable of economic development is remarkable.

The climate of Bangladesh is generally sub-tropical in the north to hot humid in the south. SwomirR-est monsoon influences the climate during June to October, and during the winter the climate a controlled by the northeast monsoon from November to March. The summer is hot and iomid and the winter is mild. In one hand, the country is endowed with a climate, which is favourable for the cultivation of a wide range of both tropical and temperate crops. Rice is the dominant crop grown in three distinct rice growing seasons namely, 'Aus' (April to August), ' Oman' (July to November), and 'Boro' (December to May). There are also three growing seasons for other crops in the country, they are: 'Rabi' (dry season), 'Kharif I' (transition between dry and «-et seasons) and 'Kharif II' (wet season). On the other hand, the country is vulnerable to many environmental hazards, including frequent floods, droughts, cyclones, and storm surges that

- Executive Chairman, Bangladesh Agricultural Research Council (BARC), Dhaka 1215, Bangladesh - Chief Scientific Officer. Planning & Evaluation Division, BARC, Dhaka 1215, Bangladesh

damage life, property, and agricultural production. The occurrence of these hazards and the significance with different cropping seasons is presented in Figure 1.

The geographical location of the country makes it one of the most natural disaster prone places in the world. Among the various economic sectors, agriculture is the worst affected **by the** natural disasters. The recurrence of disasters like floods, droughts, cyclones, storm-surges, etc. has exposed Bangladeshi farmers to escalating risks of food insecurity both through risk failing own production as well as through reduced access to food.

The above four are the major disasters inflict maximum devastation in terms of area, number of farmers and crop production affected. Although there are several other natural disasters like river bank erosion, burial of fertile land by alluvium, landslides, line-squall, hail storm, untimely rainfall, salinity, pest and disease epidemics, etc. that creep around every now and then. These are in many cases are second generation problems or local in nature but which does affect crop production significantly.

Considering the relevance of these natural disasters to Bangladesh and their magnitude of impact on livelihood and economy, four frequently recurrent of disasters like floods, droughts, cyclones and storm-surges have been focused in this article.

2. Major Natural Disasters of Bangladesh and Risks in Agriculture

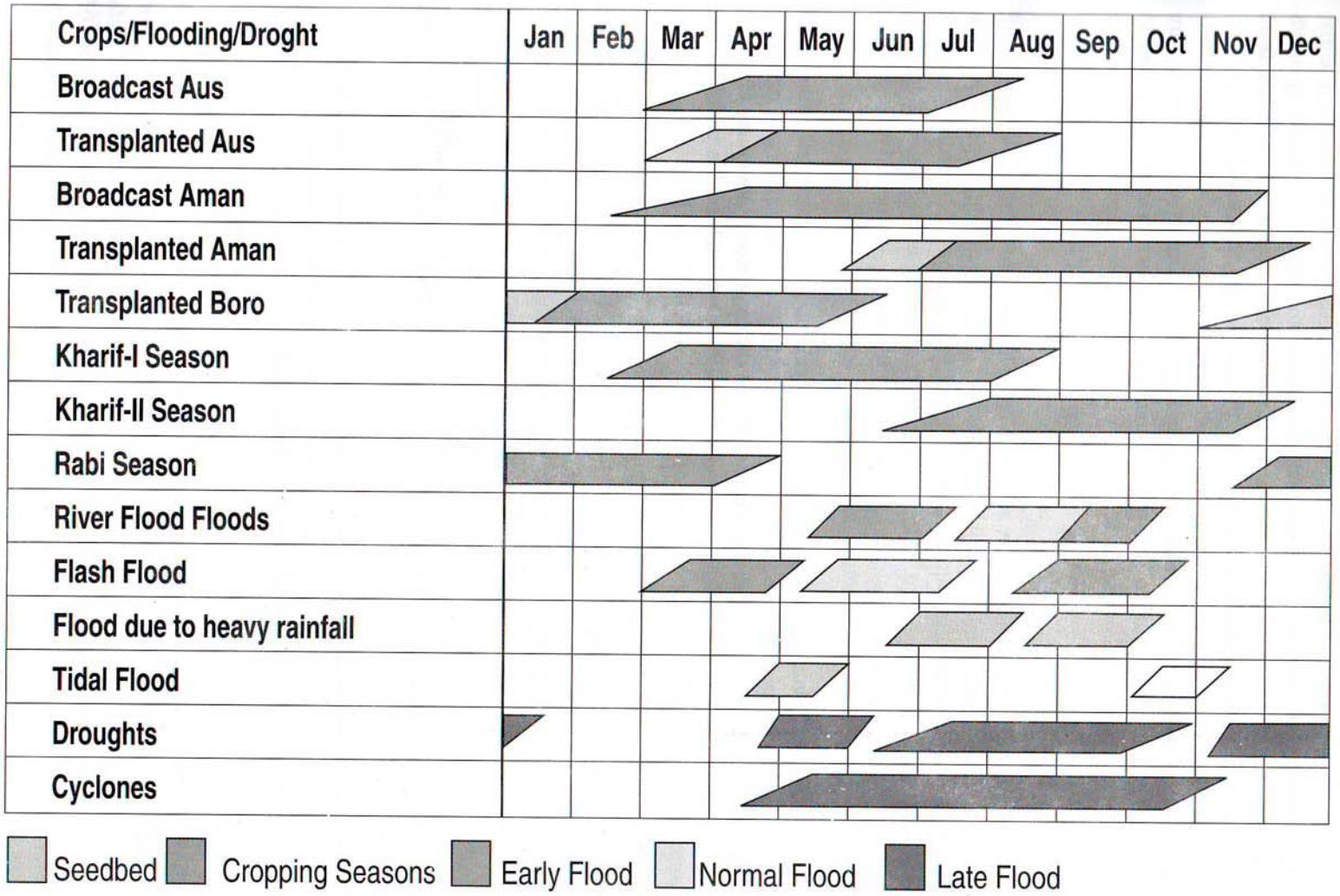
Floods

Different types of flood occur in Bangladesh. Normally, almost every year 22% of the land area is inundated and in extreme cases, about 80% of the land can go under water. About 1.32 Mha and 5.05 Mha of the net cropped area (NCA) is severely and moderately flood prone, respectively. The flood of 1998 inundated over 65% of the country's land area for a period of over 60 days. Crop loss was enormous, besides loss in human life and infrastructure.

Following are the types of floods in Bangladesh and their causes:

- Flash flood- overflowing of hilly steams and rivers of eastern and northern regions of the country
- Rain floods- heavy rainfall and drainage congestions
- Monsoon floods- overflowing of major rivers in the tloodplains
- Coastal floods- storm surge

The nature and causes of floods are varied; therefore, the magnitude of damage varies with timing, location and intensity. Overflow from rivers and tributaries causes extensive damage particularly when the three major rivers- the water level of the Ganges. the Brahmaputra and the Meghna rise simultaneously. Heavy rainfall accompanied by on rush of water from the upper catchments in India very often cause catastrophic flood in Bangladesh (Hossain et. al. 1987, Anonymous. 2003). These types of floods mainly affect rice crop at different growth stages.


Crops/Flooding/Droght
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Broadcast Aus
Transplanted Aus
Broadcast Aman
Transplanted Aman
Transplanted Boro
Kharif-I Season
Kharif-II Season
Rabi Season
River Flood Floods
Flash Flood
Flood due to heavy rainfall
Tidal Flood
Droughts
Cyclones
Seedbed
Cropping Seasons
Early Flood
Normal Flood
Late Flood

According to the extent of damage inflicted, Bangladesh floods can be categorized as early, normal and late. In particular, late dry season crops such as Boro and the early kharif crops such as Aus and jute, can be damaged by flooding; and later river floods and flash floods from adjoining hill areas can damage transplanted Aman. On the other hand, early and mid-dry land rabi crops are not normally affected. Disastrous flooding can be caused by river spilling over their banks, eroding land or depositing fresh alluvium on neighbouring land. These problems are extensive in the young charlands (sandbars) along the Ganges, Jamuna and Tista, river systems.

Droughts

Like floods, occurrence of droughts is also an annual event. Drought prevails during pre-kharif, late kharif and rabi season. Extent and magnitude of drought during the three cropping seasons again differs spatially and temporally. During the kharif and rabi seasons 2.20 million hectares and 1.2 million hectares, respectively are affected by droughts of varying intensities. Ten droughts of severe category occurred in Bangladesh during 1966 to 1998. During the period starting from 1961 to 1977, six droughts of moderate nature occurred in the country.

A severe drought could be as dangerous as a major flood or cyclone. Food grain production could be drastically reduced as a consequence of a drought. Transplanted Aman paddy is primarily cultivated as a rainfed crop, which contributes nearly 50% of the total rice production. This crop is most affected by drought resulting yield loss of more than 45% of the achievable yield. During dry and pre-monsoon season, wheat, potato, broadcast paddy also suffer yield loss.

Annual rainfall ranges from <1500 mm in th° dry northwest region to over 5000 mm in the wet northeast region of Bangladesh. These values az°(.~ not alarming for a nation if it is distributed evenly throughout the year. It becomes hazardous when the distribution is erratic and uneven. In one hand, too much in a single slot creates floods and on the other, too little causes drought. About ninety percent of the precipitation generally occurs during the monsoon (June to September); but the distribution within these four months varies greatly. These conditions are aggravated by the soil's physical conditions. In Bangladesh, there exists a large variety of soils, varying significantly with respect to moisture holding capacities, infiltration rates, ploughpan and other moisture related properties.

This problem is related to scarcity of moisture supply to crops under rainfed condition. Due to low plant available moisture contents of soils, the crops suffer from moisture shortage under nonirrigated condition. Barind and Madhupur Tract soils come under this category.

Cyclones and storm surges

Tropical cyclones are important features of the weather and climate of south Asia. The major cyclogenesis of this region exists in the northern Indian Ocean, which particularly affects Bangladesh and parts of India. Because of the funnel shape and geographic location of Bangladesh, severe cyclone and tidal surges are common along the 710 km coastal belt causing severe damage to life and property.

Records of last 200 years show that at least 70 major cyclones hit the coastal belt of Bangladesh. During last 35 years. nearly 900,000 people died due to catastrophic cyclones. The NoakhaliChittagong coast received 40 percent of the cyclones, which is the most vulnerable area for the landfall of cyclones. The Chittagong-Cox's Bazaar coast received around 27 percent, while Khulna

Sundarban and Barisal-I'voakhali coasts are relatively less vulnerable (Rahman, 2001). Some examples of severe tropical cyclones are the Barisal cyclone of 1584, the Bakerganj cyclone of 1876, the 12 November 1970 cyclone, the May 1985 Urir char cyclone, and the April 1991 cyclone. High intensity storm surges jeopardize the expansion of energy-recovery activities in the coastal areas and supporting industries, especially in the offshore areas (Islam & Ahmad, 2004).

Coastal tidal surges and Salinity

About 1.02 million hectares out of 1.459 million hectares of cultivated land in the coastal areas are affected by soil salinity of various degrees. About 0.282, 0.297, 0.191, 0.45 and 0.087 million hectares of land are affected by very slight, slight, moderate, strong and very strong salinity respectively (SRDI, 2003). The present spatial

distribution of different degrees of coastal saline soils is shown in soil salinity map.

During the period from 1985 to 1997 five devastating cyclones hit Bangladesh where million of peoples were affected. The cyclone of 1991 accompanied with tidal surge killed about 139 thousand people and damaged crop of several thousand hectares, caused immense loss of livestock and other properties.

In order to minimize fatal consequences of cyclones, construction of cyclone shelters commenced in the 1960s and subsequently increased following the severe cyclone in 1991. In 2004, there are 2,133 multi-purpose cyclone shelters (MoDM&R, 2004). The existing shelter capacity can accommodate only about a quarter of the population at risk. In the backdrop of increasing population, 100 additional cyclone shelters are needed annually.

3. Coping Strategies/ Risk Management Measures Disaster Preparedness Planning

The floods of 1987 and 1988, and the devastating cyclone of 1991 in Bangladesh changed the concept of acting only after the occurrence of disaster. In 1992 the Government of Bangladesh declared Disaster Management as a major thrust area. Now the Government has a proactive and holistic approach embracing the processes of hazard identification and mitigation, community preparedness and integrated response efforts. The Government has total commitment towards reduction of human, economic and environmental costs of disasters by enhancing overall disaster management capacity and thereby lowering their vulnerability to specific hazards. In line with the paradigm shift from relief and response to comprehensive disaster management, the Ministry of Relief and Rehabilitation was renamed as the Ministry of Disaster Management and Relief. Again, in 2003 it was renamed as the Ministry of Food and Disaster Management (MoFDM). (Ministry of Food and Disaster Management, URL: http://www.mofdm.gov.bd/)

Disaster management includes all aspects of planning of and responding to disasters. It refers to the management of both the risks and the consequences of disasters, and includes both prevention and preparedness measures taken in disaster-prone areas in anticipation of the known hazards - often referred to as "pre-disaster" and long-term rehabilitation (sometimes referred to as "reconstruction").

Disaster management is done in four phases. Namely- Normal Phase (A period when there is no immediate threat but long-term actions are required in anticipation of the impact, at some unknown time in the future, of known hazards), Alert and Warning Phase (The period from the issuing of an alert or public warning of an imminent disaster threat to its actual impact, or the passage of the threat and the lifting of the warning. The period during which pre-impact precautionary, or disaster containment measures are taken), Disaster Phase (The period during which direct impact of a natural calamity is felt. Disaster phase is long in case of slow on-set disasters (draughts, normal monsoon flood) and short in case of rapid on-set disasters (flash flood, cyclone, earthquake, fire, industrial accident, landslide etc), and Recovery Phase (The period, following the emergency phase, during which actions are to be taken to enable victims to resume normal lives and means of livelihood, and to restore infrastructure, services and the economy in a manner appropriate to long-term needs and defined development objectives. Recovery encompasses both rehabilitation and reconstruction, and may include the continuation of certain relief (welfare) measures in favour of particular disadvantaged, vulnerable groups).

Institutional Responsibilities

A series of inter-related institutions were developed to ensure that planning and coordination of disaster episodes were performed in accordance with the Standing Order on Disasters (SOD). Specific codes are developed to address cyclones, floods, drought and famine and the work has started to develop codes for earthquakes and to address the effects of Tsunami.

Standing Order on Disasters

The Government has issued the Standing Orders, which have been prepared with the affirmed objective of making the concerned persons understand their duties and responsibilities regarding disaster management at all levels, and accomplishing them. All Ministries. Divisions Departments and Agencies shall prepare their own Action Plans in respect of their responsibilities under the Standing Orders for efficient implementation.

The National Disaster Management Council (NDMC) headed by the Prime Minister and InterMinisterial Disaster Management Coordination Committee (IMDMCC) will ensure coordination of disaster related activities at the

National level. Coordination at the District. Upazila and Union (three-tire administrative units) levels is done by the respective District. Upazila and Union (lowest community level) Disaster Management Committees. The Disaster Management Bureau renders all assistance to them by facilitating the process.

The Ministries, Divisions/Departments and Agencies organise proper training of their officers and staff employed at District, Upazila, Union and village levels according to their own action plans so that they can help in rescue, evacuation and relief work at different stages of disaster.
The local authority shall arrange preparedness for emergency steps to meet the disaster and to mitigate distress without waiting for government help.

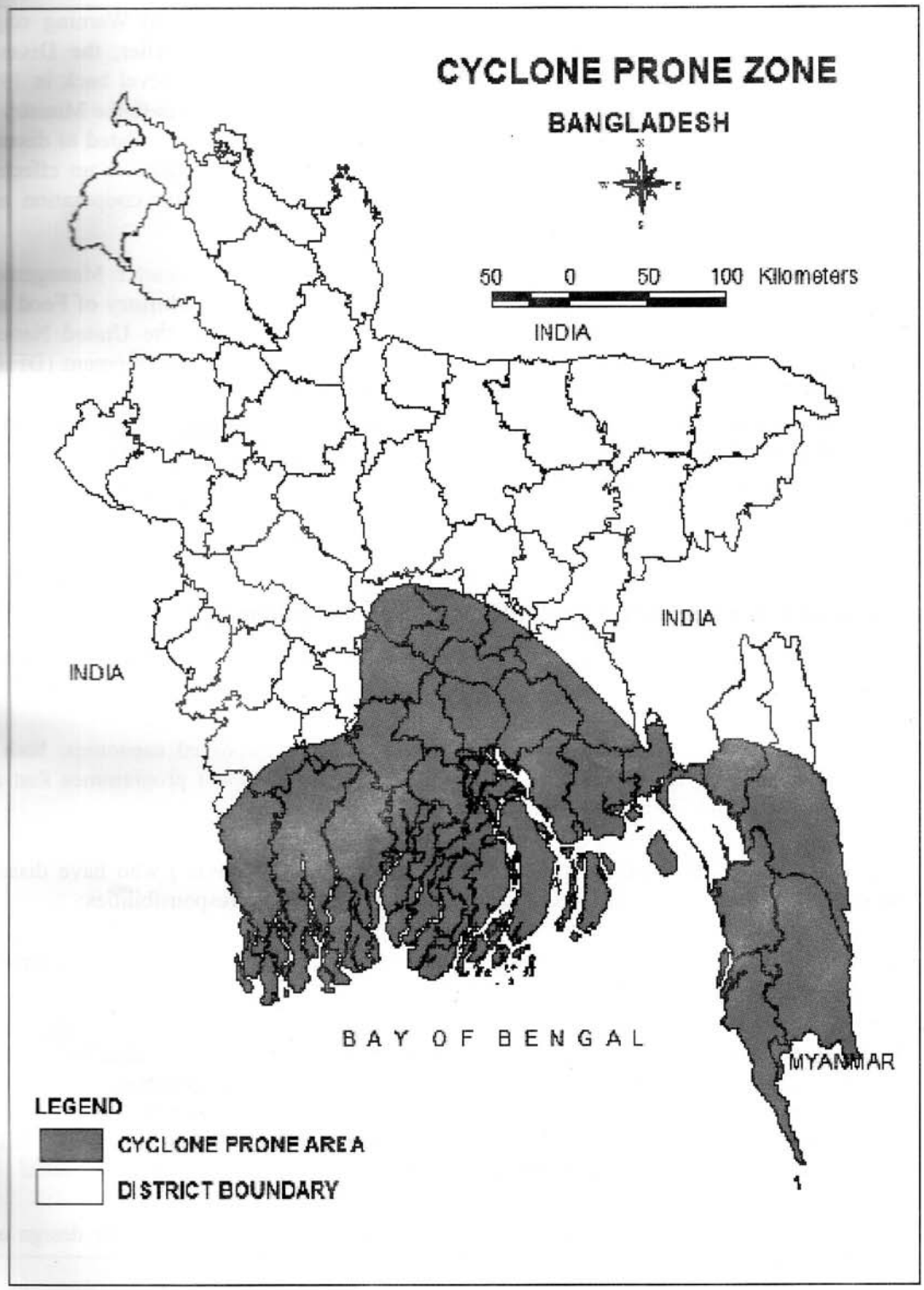


Figure - 2. Cyclone Prone Zone in Bangladeshi

The Standing Orders are followed during Normal times, Precautionary and Warning stage, Disaster stage and Post-disaster stage. As part of the paradigm shift earlier, the Disaster Management Bureau (DMB) was created as a professional unit at national level back in 1992 under the then Ministry of Disaster Management and Relief. As a technical arm to the Ministry of Food and Disaster management, DMB overview and coordinate all activities related to disaster management from national to the grass-root level. It is also entrusted to maintain an effective liaison with government agencies, donors and NGOs to ensure maximum cooperation and coordination in all aspects of disaster management.

As a continuation of the paradigm shift process, the Comprehensive Disaster Management Programme (CDMP) has been designed as a long-term programme of the Ministry of Food and Disaster management with multi-agency involvement. Funded jointly by the United Nations Development Programme (UNDP) and the Department for International Development (DFID), the programme was launched in November 2003. CDMP is a strategic institutional and programming approach that is designed to optimize the reduction of long - term risk and to strengthen the operational capacities for responding to emergencies and disaster situations including actions to improve recovery from these events.

The beneficiaries Comprehensive Disaster Management Programme

- CDMP is a whole-of-country strategy. Communities within high risk areas are the immediate beneficiaries of program interventions. The direct beneficiaries of the program are:

- Communities and community based organizations through improved capacities, both at national local level, to design and implement disaster management programmes that are based on formal and traditional community risk assessment.

- Key national, district, Upazila and Union officials (including NGOs) who have disaster management programming and operational response coordination responsibilities:

- Key government decision-makers, politicians and elected local Government officials through advocacy and awareness programmes.

- National planning officers and all line government departments or agencies involved in development planning activities, through the promotion and incorporation of risk management measures within the development project validation process by way of Disaster Impact and Risk Assessment (DIRA) like the Environmental Impact Assessment (EIA) which has been incorporated in all development project analysis.

- NGOs, through their formal involvement in disaster management programme design and implementation.

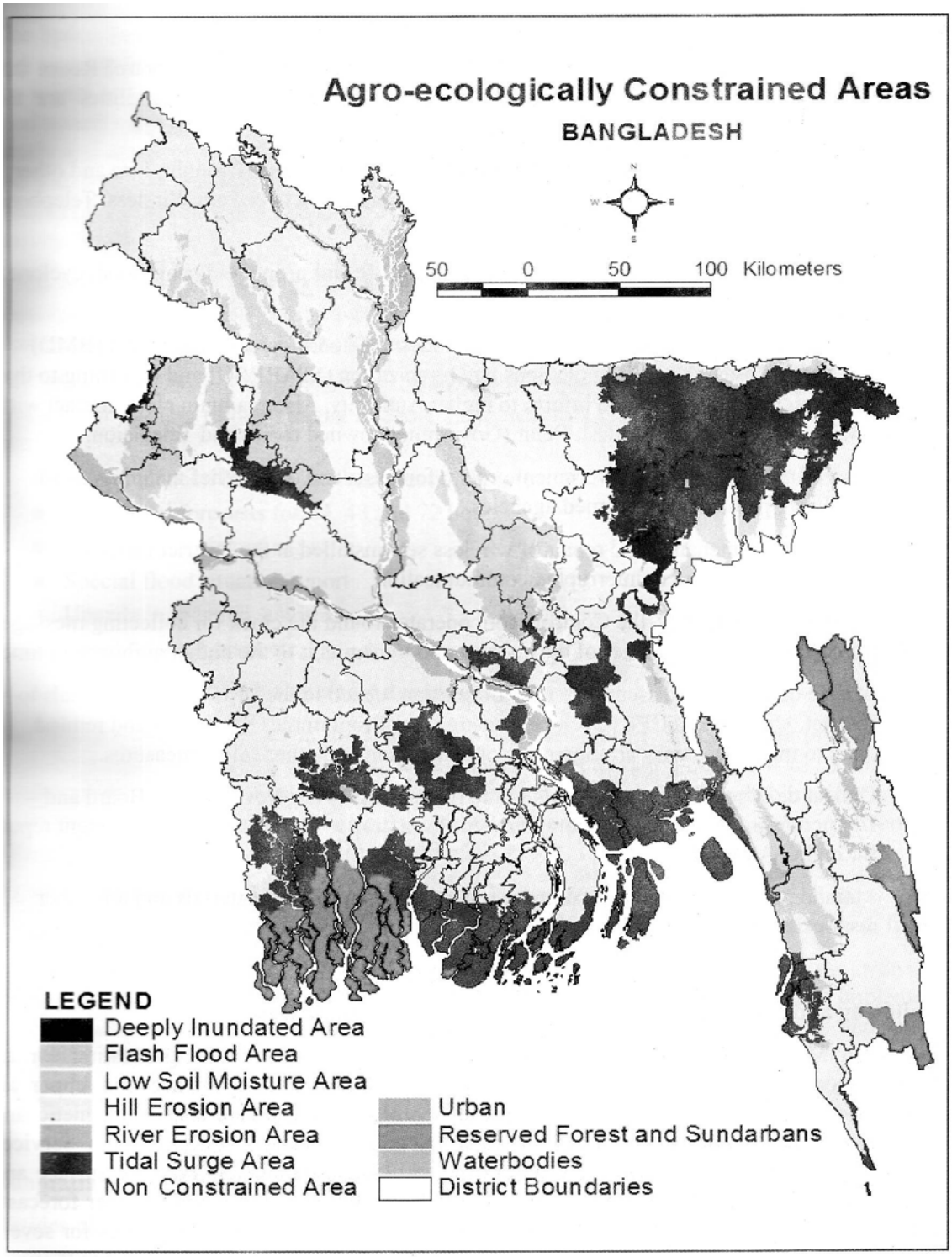


Figure - 3. Agro-ecologically constrained areas of Bangladesh.

Functions of Relief Control Room

Under the Ministry of Food and Disaster Management (MoFDM) there is a Control Room that has some specific functions and responsibilities. The functions and responsibilities are the following:

- Receive the information related to Flood, Cyclone, Earthquake, Drought, Fire and other natural calamities from District and Upazila administration over Fax. Wireless, Telephone and transmit the same to all concern persons.

- Prepare daily basis loss and damage statement of life and property during flood, cyclone, and other disasters and submit to higher Authorities.

- Collect weather forecast reports from Bangladesh Meteorological Department (BMD) and Space Research and Remote Sensing Organization (SPARRSO) and according to that report prepare statement and inform to higher Authority. Also maintain close contact with BMD, SPARRSO, Bangladesh Betar (Government owned radio) and Television.

- Disseminate all sorts of Government orders, forecasts and other relief materials to all Districts/Upazila and concerned agencies.

- Facilitate Maintenance and repair of wireless sets installed at the District offices for ensuring smooth and uninterrupted communication.

- During the emergency, the Control room operates round the clock for collecting message from every nook and corner of the country and transmits it to the higher authority in time.

- In case of cyclones, disseminate the information related to the BMD's danger signals to District, Upazila and CPP (Cyclone Preparedness Programme) Volunteers and remind them to make necessary arrangement for evacuation and other safety measures.

- Collect daily report of water levels of the rivers from Water Development Board and District' Administrations and compile the information and prepare daily assessment report for higher Authority.

- Maintain proper accounts and prepare report relating to relief materials and any other responsibilities assigned by the higher Authority.

Monitoring and Interpretation of Meteorological and Climatic Data

Bangladesh Meteorological Department is the authorized Government organization for all meteorological activities in the country. It maintains a network of surface and upper air observatories, radar and satellite stations, agro-meteorological observatories, geomagnetic and seismological observatories and meteorological telecommunication system. Major services provided by BMD include: observing different meteorological parameters both for surface and upper air all over Bangladesh round the clock and analyzing them. Providing weather forecasts for public, farmers, mariners and aviators on routine basis and also to issue warnings for severe weather phenomena such as tropical cyclones, tornadoes, nor'westers, heavy rainfall, etc (Source: http://www.bmd.gov.bd/.)

The Space Research and Remote Sensing Organization has the mandate for conducting survey and monitor the agricultural crops, estimation of major crop yield: rice, wheat etc. particularly the xna-inter crops. This forecast is used to plan the food situation in the country and helps attain food security. For disaster monitoring, satellite data on cloud formations in the region is received IrcwLrly and any impending disasters like depression, cyclone, floods etc are reported to the Govt. and also to BMD._ BWDB, BAF and other relevant agencies. Cyclones of 1970,1985,1991 were mo nitored. Floods of 1987, 1988, 1998 and 2004 were monitored (http:/ /www.sparrso.gov.bd/ activity html).

Flood Forecasting and Warning Centre under the Ministry of Water Resources issues Warning Message on daily basis covering rainfall situations and General River Conditions for Br-ahmaputra Basin, Ganges Basin, Meghna Basin and South Eastern Hill Basin.

The Flood Forecasting and Warning Centre issues the following on a regular basis and d6sseminate warning through media like telephone, wireless, Fax, radio & television and Internet etc.

- Daily monsoon bulletin & river situation report
- River level forecasts for ?4. 48 and 72 hours
- Current warning messages
- Special flood situation report
- Upazila inundation status map
- Flood forecast maps etc.

4. Agricultural Rehabilitation and Adaptations

The Ministry of Agriculture and the Ministry of Fisheries and Livestock ensure preparation and emplementation of their own work plan at field level. Full utilization of time is to be ensured for determination of disaster loss and damage and planning of agricultural rehabilitation. In doing these. various departments and agencies of the Government and NGO,s are involved. The fdlom-ing major functions and activities are done:

- Quantify the loss and damage of all assets and stores together with that of crops, cattle, poultry. fisheries, fish hatcheries, fish ponds, trawlers and other structures and finalize planning of agricultural rehabilitation.

- Ensure availability of adequate supply of seeds, seedlings, fertilizers, agriculture Implements/ including irrigation inputs for agricultural rehabilitation in the affected areas and quickly .ransport them to the people.

- Arrange for the distribution of inputs and loan through Bangladesh Bank.

Adoptation:
Besides all the efforts of the Government, the people of the country have their own mechanisms for coping with natural hazards. Some examples are presented in this section.

In the event of flood of greater magnitude, seeds of transplanted Aman either cannot be sown due to lack of nursery land or seedlings are damaged. In such situation, they raise the seedlings on floating rafts made out of water hyacinth. The farmers of the country are also capable of switching to local varieties in places of high yield varieties in case of drought or flood as local varieties are low water consuming and taller. Coping mechanisms vary with types of hazard, some of the techniques are as follows:

Deeply Inundated area

- Traditionally, the farmers of the deeply inundated areas grow Deep Water Rice (DWR) as broadcasted Arran but recently they are transplanting seedlings.

- Intensification of vegetables gardening in the homesteads

- Use older seedlings

- Increase the number of seedlings per hill

Flash Flood Area

- Farmers of the flash flood prone areas are continuously restructuring their cropping patterns, for example, interchanging Boro rice and transplanted Arran rice
- Intensifying winter crops, growing mustard, potato and winter vegetables
- For minimizing the loss farmers opt for low input use

Drought prone area

Irrigation either full or life saving is the major adaptation to drought. Supplementary irrigation is also used as an adaptation measure to combat drought (Miah et. x1.;2003). There are some instances of mulching in some fruits, vegetable and spices crops to reduce the affect of drought. Afforestation is used as a long-term adaptation measure against drought and desertification. Excavation and re-excavation of ponds to harvest rainwater for irrigation during drought is also used as an adaptation measure. For animal practically no adaptive measure is taken to combat drought. The animals are half fed with costly rice straw. For fisheries, short rotational culture is practiced.

Salinity Affected Area

- To reduce the impact of salinity and to maximize income, farmers of this area are doing fish-cum-rice (local variety) farming.
- Recently, they are growing forage crops that are salinity tolerant
- Compartmentalizing their fields for reducing the impact of salinity depending on the salinity gradient
- For irrigating their crops farmers are using brackish water small scale irrigation facilities

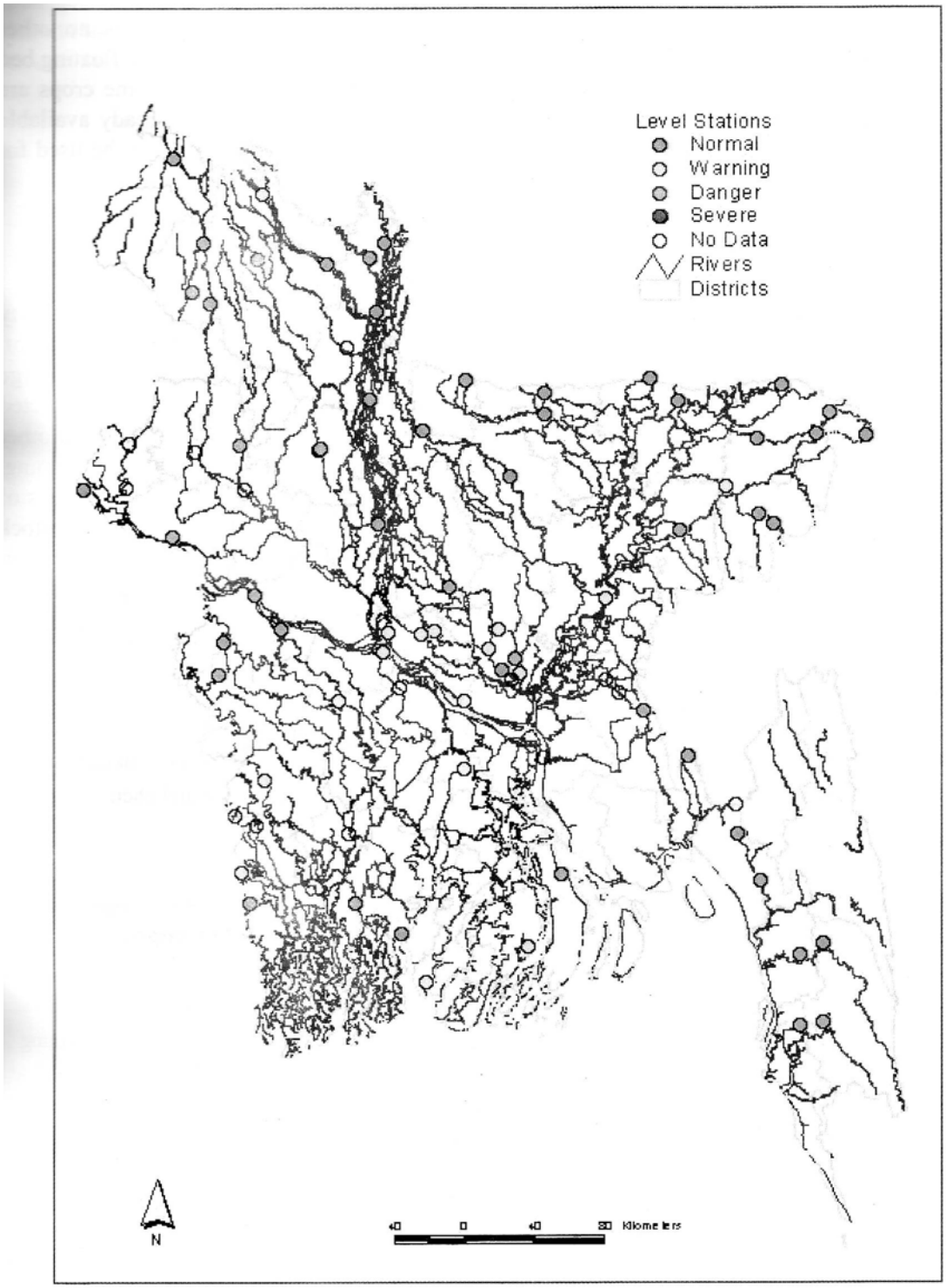


Figure - 4. River water level stations of Bangladesh Water Development Board

Except some sort of unmanaged, unorganized and uncontrolled fishing there is no other adaptation measure practiced by the affected community. No crop is grown except on floating bed (a rare practice). Effort is taken to improve the drainage systems. In that case some crops are grown in the periphery of the water bodies. Some improved technologies are already available with the research system (Satter, 1991 and Hussain, 1991). These technologies may be used for adaptation to water logging. For fisheries there is some sort of collective fisheries practices.

Cyclone, tidal surge and salinity intrusion

The coastal areas are specifically prone to be affected by sea level rise, tidal surge, salinity intrusion and cyclone. Vulnerability within the coast is spatially and temporally different. Vulnerability is high towards the sea relative to the main land. Cyclone and storm-surge forecasting and warning are used to help people take refuge in cyclone shelters. Affected community temporarily migrates from their abode to flood and cyclone shelters, cities and other localities for livelihood. Present adaptations practices include mix carping, shrimp farming, raising of dykes of 'gher' (compartments for shimp culture) and use of salt tolerant varieties of crops in one hand and construction of embankment and polders on the other. For livestock practically no facility exists for shelter and feed supply so that the farmers can arrange for their refuge from cyclone and tidal surge. More information is summarized in the following table:

Hazards		**Adaptation options**	
	Crop production	**Livestock production**	**Fish production**
Cyclone and tidal flood	• Provide mechanical support to plants • Transplant tall aman rice seedlings after high tide • Use modified Sorjan systems of crop and tree plantation	• Bring animals to shelter • Migrate to unaffected areas	• Rise embankment of pond and gher. • Enclose pond embankment and gher with net. • Mix carping
Salinity in ground water	• Construct polders • Harvest rainwater • Use deep tube well		• Practice shrimp farming
Soil salinity	• Use salt tolerant crops/ varieties • Use agronomic intervention		• Practice shrimp farming • Mix carping

Flood/Flash flood	• Raising seedling in flood free place- •Cultivation of early harvestable rice varieties •Cultivation of late rice varieties •Cultivating rice varieties having short submergence tolerance •Harvesting rice from under water • Tiller separation for double or triple transplanting	•Transfer livestock to unaffected raised places •Reduced feeding with non-conventional feeds	• Raising of dykes of gher •Culture of short rotational fish species • Culture of short rotational fish species
Exeeaive and irregular rainfall	•Change in cropping pattern •- Late planting •- Raising seedling on flood free land •- Crop diversification •- Afforestation	• Reduced feeding with non conventional feeds	
Drought/ desertification	•Supplementary irrigation • Cultivation of low water requiring crops/varieties •Crop dig ersification •Inter mixed cropping. Attore;tation •Agronomic manipulation		
Searcity of water during dry season	• Supplementary irrigation from pump • Cultivation of low water requiring crops /varieties • Crop diversification • Afforestation		

5. Conclusion

Natural hazards are nothing new to the people of Bangladesh. Farmers of Bangladesh are credited for their resilience towards the natural hazards. Bangladeshi farmers have proven many times their resistance to recurrent natural hazards like floods and droughts, cyclones and tidal surges. Their coping mechanisms are unique and innovative. Using the available technologies the impact of natural hazards can be reduced to a substantial extent. Agriculture is the sector, which suffers the most; as a result it has bearing on the food security of the subsistence farmers as well as on the overall economy of the country.

The traditional disaster management model focusing on relief and recovery has done little to redress these rising levels of risk. The Government has made a quantum leap in respect of disaster management, which includes all aspects of planning of and responding to disasters. It includes management of risks and consequences of disasters, focusing both prevention and preparedness measures in disaster-prone areas in anticipation of the known hazards.

The Government has total commitment towards reduction of human, economic and environmental costs of disasters by enhancing overall disaster management capacity and thereby lo«-erng their vulnerability to specific hazards. An effective disaster warning system is being developed. A comprehensive disaster management program (CDMP), under the auspices of the Disaster Management Bureau (DMB) and the Bangladesh Red Crescent Society, is being implemented.

Improved early warning systems with more accuracy and more lead-time and climate predictions models for different time spans would be of great use in combating natural hazards. In running such models, extensive and accurate data as inputs would be required. Data exchange mechanisms within the SAARC countries needs to be strengthened. Water sharing and related issues need to be resolved. If these are accomplished the intensity and magnitude of the some of disasters could be reduced.

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Riks in Bhutanese Agriculture and Their Coping Strategies

Ms. Pema Lhamo1
Mr. Ganesh Chhetri2

Basic features of the Agriculture sector

The Kingdom of Bhutan, comprising an area of 46,500 sq km lies in the southern slopes d t_tae Eastern Himalayas. The area extends from the foothills of the Himalayas at the plains of India in the south to the snow-clad great Himalayan ranges in the North. Bhutan is a rugged mountainous country with wide variations in altitude from 150 m to -_(K>0 m. The climatic conditions range from wet sub-tropical in the south to Alpine snow a&i ice in the north. Owing to extremely mountainous terrain, only about 7.8% of the Wtal land area, consisting mainly wetland, dry land, tsei i and pasture, is cultivable. Most agricultural lands are scattered around small settlements located on hills and valleys. The unique mountain terrain has led to the development of diverse agro-ecologies. Bhutanese farmers practice a subsistence-oriented mixed farming integrating crops, livestock, and forest.

Bhutan is predominantly an agricultural country, with about 79% of the population engaged in the agriculture sector. The traditional subsistence oriented mixed farming S%-Stems that integrate cropping, livestock rearing, and use of forest products have exolved over a long period of time characterized by diversity and a high degree of self reliance.

The unique mountain agriculture system characterised by diversity and heterogeneity hat-. led to the development of diverse farming systems specific to different localities. The traditional subsistence oriented mixed farming systems that integrate crop production. livestock rearing, and use of forest products have evolved over a long period of time characterised by diversity and a high degree of self reliance. Rice, wheat and maize are some of the important cereal crops while apples, oranges, and potatoes comprise the bulk of cash crops. Agricultural production is generally based on a low level of purchased inputs, cultivation being primarily undertaken with animal draught power or human labour, purchased inputs being mainly limited to improved seeds and small amounts of fertilizers and pesticides. Soil fertility maintenance depends mainly on use of organic manures.

The country is in the fragile Himalayan ecosystems and mountain slopes are very steep. The Royal government has therefore recognised the importance of forest cover and has accorded high priority to conserve and use the forest resources. The RGoB is pursuing a policy of maintaining at least 60% of the total areas under forest cover for all times to come. Today, the country has over 73% forest cover.

1. Programme Director, Information & Communication Services, Ministry of Agriculture, Thimphu, Bhutan
2. Joint Director, Department of Agriculture, Ministry of Agriculture, Bhutan

The Ministry of Auriculture (MoA) comprises of three sub-sectors namely Agriculture. Livestock, and Forestry called as the Renewable Natural Resources (RNR) Sector. The RNR sector remains the largest and single most sector of the Bhutanese economy. although its share in gross domestic product (GDP) is estimated to have decreased from 45% in 1988 to 35.9% in 2000.

Risks in Bhutanese Agriculture

Some of the un-sustainability factors affecting Agriculture include:

1. The unique mountain characteristic

By virtue of its location in the eastern Himalayas, which is still geologically unstable and due to the steep topography, Bhutan has a fragile ecosystem highly prone to landslides, floods and other forms of mass wasting. Hence, the benefits from any economic development scheme have to be carefully weighed against its environmental impact. The unique mountain characteristics are fragility, marginality and inaccessibility. The rugged terrain, topographical variation, and adverse climatic conditions impact agriculture in many ways.

2. Loss of agricultural land to other forms of land use

In recent years, the land conversion for infrastructure development and urbanization has become a national concern. Encroachment into fertile agricultural land for human settlement, model-township, and commercial enterprises is becoming more severe. Most of the newly planned urban sites are located on prime agricultural land. The expansion or relocation in some cases, of the present urban centres and creation of service facilities andd public amenities for the growing population will in all probability lead to encroachment of arable land. Although farm land is the most fundamental resources for agricultural production, it has been on a continual decline due to its transfer to nonagriculture use. Farmland once lost is difficult to recover. If continued will lead to a further decline in food supply capability. A major threat to sustained rice production would be the conversion of wetland to other uses because of the pressure from industrial growth, expansion of urban centres, and cultivation of cash crops.

3. Tseri farming

Shifting cultivation, locally known as Tseri and Pangzhing, is being practised as intergral part of Bhutanese fanning system. Tseri farming is characterised by long fallow-rotation system of cultivation mainly on steep slopes. Shifting cultivation, locally known as Tseri and Pangshing, is quite widespread particularly in the central and eastern parts of the country. The dominant feature of the Bhutanese Tseri is that it is practiced on very steep slopes, which is environmentally not sustainable. Alternative means of livelihood for the Tseri farmers is still a national challenge.

4. Land fragmentation

Almost 70 % of farms are less than 5 acres. The size of the holding is decreasing with increasing members in a household. If the fragmentation trend continues, the land holding of individual households may be reduced to very small plots in a couple of generations and it may not be possible to make a living from farming. The farm sizes may reduce to a level where farming may not be viable anymore. Some studies have also indicated that farmers typically own several scattered small parcels of land. This makes crop management task difficult and complicated.

5. Soil erosion and land slides

Farming is generally practiced on slopes of varying degrees. In high rainfall areas with steep slopes, land slides are a common problem. Also land degradation due to soil erosion is a major threat to agriculture. It is also observed that there is a trend of declining soil fertility due to the lack of organic matter.

6. High labour requirement

The terrain makes farming very labour intensive, with very limited potential for mechanization. Rice production is most labour intensive: requiring about 280 man days per hectare (Dorji et al, 1990). Labour shortages during peak periods undoubtedly affect farming practices. High labour requirement also increases the cost of production, thereby making it difficult to compete with the food grains produced across the Indian borders.

7. Farm Labour shortages

agricultural production is labour intensive and is generally done by family labour. Farm households throughout the country report labour shortages as a major constraint. Emphasis on increased education, off-farm employment opportunities, and changing values are leading to out migration from rural areas. It is anticipated that this trend will increase in future.

8. High crop losses due to diseases, insects:

Diseases and insect pests pressure on agricultural crops is a common phenomenon. The problem is more severe in

the mid and low altitude areas with hot and humid conditions.

9. Depredation of crops by wildlife

Wildlife depredations of crops are increasingly threatening food production and rural livelihood. According to the RNR Statistics 2000, wild animal damage ranked as the leading factor for substantial amount of food grain losses in rural areas. Worst among all, is the wild boar damage rampant throughout the country. Eight out of the 20 districts reported high losses where more than 50 percent of the farm households were affected by wild boar in 2003. This problem has been debated for the last 15 years without any feasible solutions and continues to be a major threat to sustained crop production. Other wild animals that damage crops include monkey, deer, elephant, bear, porcupines and birds. The policy of the RGoB is to ensure that the rich endowment of the country is preserved and that development remains sustainable. Wild animal problems are indications of increasing conflict between conservation and farming. The challenge is to balance conservation and socio-economic development of people.

10. Poor rural access
The lack of proper road infrastructure has been identified repeatedly as the most critical obstacle for increased agricultural production. Poor access severely limits production of marketable surplus due to high transportation costs. Delivery of services and inputs for agriculture production is also affected by the lack of road access.

11. Lack of market infrastructure and organized marketing system
Due to the lack of market infrastructure and organized marketing system, there is no incentive for producing marketable surplus

Coping strategies
Bhutan has good scope for designing realistic measures to cope with agricultural risks.

Opportunities for development

- Relatively well-conserved environment with about 70% forest cover. Environmental conservation has deep roots among the Bhutanese people who have strong cultural and religious traditions, a central element of which is profound respect for the environment and life in all forms.
- Strong policy commitment and support to safeguard the environment.
- Large biological diversity
- Integration of Agriculture, Livestock and Forestry sub-sectors
- Farming systems largely organic in nature with use of locally available organic resources like compost, farmyard manure, forest, litter, etc. and less dependence on external inputs.
- Undisturbed ecologies with minimal use of chemical fertilizers and pesticides.
- Availability of Technological options: Research System is relatively new having been formerly established during the early eighties but the process of evolution has been quite fast. The results are most encouraging and indicate substantial potential for improvements in the productivity in agriculture.

Strategic options

The protection of the country's monntzi+:;iwirc3nngent and its unique flora and fauna for future generations is an important objecri-,'e of the Royal Government. This requires the utilization of natural resources, including forest,

arable agriculture land, biodiversity and water resources in a sustainable way and involves trade-offs between short-term economic gains and sustained long-term economic development. The protection and management of forest areas, improved land husbandry practices in agriculture are essential to achieving this objective.

Some of the policy options and coping strategies include:

- Monitor and promote rehabilitation and conservation of natural resources in food producing areas as well as in adjacent forests lands, non-arable lands, and watersheds, and where necessary upgrade the productive capacity of these resources; and establish policies that create economic and social incentives to reduce degradation.

- Greater emphasis on planning and preparedness for disaster management like droughts, severe floods, land slides.

- • Rehabilitation of degraded forest and watersheds. Formulate and implement watershed management plans to safeguard the country's invaluable water resources besides preventing environmental degradation through landslides, floods and unsustainable human interferences.

- Formulation of water policy and promotion of water use efficiency

- Promoting sustainable agriculture through Improvement of farming systems with greater concern for : diversification of crop-production and broader-diversity in crops, Integrated plant nutrient and soil fertility management, soil conservation, integrated pest management

The following table describes the adaptation strategies for different types of risks in agriculture:

Risks and Vulnerabilities	**Adaptation strategies/Options**
Issues related to land use - fragmentation, conversion Loss of agricultural land to other forms of land use	• The Land Act 1979 is presently being reviewed by the Ministry of agriculture. A number of the concerns will be the basis for the revision. • National Land Management Programme initiated • The existing law protecting wetland needs vigorous implementation.
Soil erosion and declining soil fertility	Proper land management (terracing, contour bunding, hedge rows)

	• Promote use of organic manures and chemical fertilizers as supplements I • Promote appropriate soil conservation technologies • Cover crops and improved water management • Promote agro-forestry or agro-silvo-pastoral systems
Crop yield instability I (variable rainfall, temperatures) etc.	•Promote climatically adapted native crop species and varieties •Develop crop varieties with greater resilience to weather events
Shortage of water-decr eased water availability I for crop production	• Conserve water, adjust timing of field operations, and explore water harvesting possibility.
Loss of fields to flash floods, land slides, and rill and gully formations	• Land management, protection of gullies and land slips by planting fast growing tree species. • Develop national database on landslide prone areas to assess the risks of land slides • Capacity building on assessment and mitigation of Landslides • Reforestation of catchments areas, slope stabilization of Slopes • Improve watershed management - land use planning in degraded water catchment areas to promote afforestation • Promote community based forest management to conserve land and water resources
Deteriorated quality of fruits and vegetables due to hailstorms and untimely rains	• Develop early warning systems to inform farmers about the probability of extreme weather conditions
Outbreak of unknown pests and diseases	• Risk analysis and preparedness action plans Monitoring the occurrence of pest and diseases • Quarantine surveillance against invasive/alien pests • Develop control and management tools • Use of resistant crop varieties
_ Seasonal food shortages, Lack of access to adequate food in certain periods, such as during 2-3 months before harvest	• Improve or upgrade storage facilities to store and have access to food grains as an insurance against crop loss or damage or bad yields

Shifting cultivation (Tseri)	• In order to improve the living standard of the people and to conserve the environment, the government has adopted a policy of phasing out Tseri (77th Session of the National Assembly) in 1998. • Promote agro-forestry and horticulture
Shortage of Farm Labour	• Create access to markets and services by constructing farm roads; Mechanise farming and reduce dependence on manual labour; and • Re-orientate youth to rural employment for farming through the establishment of agriculture schools, vocational training and school agriculture programs.
Crop Depredation by Wildlife	• Culling of prolific pests like wild boar in selected severely affected areas; • Promote alternate sources of income to farmers in most severely affected areas.
Natural Disaster Management	• Capacity building to respond to future disasters and coping mechanisms - Department of Local Governance, Ministry of Home and Cultural Affairs - create a separate institution for Disaster Management. • Prepare National Disaster Management Strategy and Plans Installation of early warning systems; hazard mapping of key watershed areas; real time monitoring with automatic data recording and transmission • Relocation/resettlement of affected areas • Artificial lowering of lake levels • Early warning systems for flash floods • Improve capacity to monitor and provide timely • information on agriculture from districts and geogs

Disaster preparedness planning

Preventive and precautionary measures are designed and planned as discussed above. These measures include both short term and long term interventions.

Rehabilitation measures include - compensation of the loss in agricultural production through provision of food grains to the affected households, re-habilitation of land if possible, relocation/resettlement of the severely affected households, provision of agricultural inputs like seeds and planting materials to continue farming activities.

Department of Local Governance

The Department was only established in January 2005 and therefore it is still in its initial stage of establishment. The responsibilities that the Department is charged with are as follows:

1) plan and coordinate responses to disaster management in any part of the country in cooperation with concerned sectors;

2) coordinate all external assistance/collaboration in disaster management including training and formulation of projects;

3) develop rapid reaction strategies for all types of disaster management in collaboration with respective sectors without requiring separate establishments;

4) develop annual budgets in the centre and ensure procurement of essential equipment and other logistical needs;

5) raise public awareness, caution and preparedness with special focus on vulnerable groups;

6) include all civil society in all its disaster management plans and strategies;

7) all dzongkhags disaster management committees shell report directly to the Department of Local Governance which in turnn shah inform all particip;lting agencies;

8) any fund raised shall be pooled in a common kitty of disaster management and shall be named as "His Majesty's Relief Fund": and

9) establish disaster reduction/prevention and management committee in the centre with members from relevant sectors.

Rehabilitation programme Procedures
The content of the government's contingency rehabilitation plans includes: listing of the affected households, area of land affected, extent of damages including land and crop yield. The field level assessment is done by the District Agriculture Officers and extension staff placed in the gewogs (blocks). Based on the severity of the damages and the likely impact on the households, rchabilitation plans are prepared and implemented jointly by the Ministry of Agriculture and Ministry of Home and Cultural Affairs. Some of the specific rehabilitation procedures are:

- ✓ In case of severe damages on land, resettlement plans are made and the households are relocated in appropriate Government land.
- ✓ Proper land management activities like river bank- protection, land slides protection, soil conservation etc are initiated on lands that have minor damages.
- ✓ In severe cases of damages crop compensation is provided
- ✓ Agricultural inputs like seeds and planting materials are provided to the affected farmers

Contingency rehabilitation plans
Be-Sides. the rehabilitation programme discussed above, there is no set mechanism for preparing contingency rehabilitation plans.

Monitoring and interpretation of meteorological and climatic data
The Ministry of Agriculture has a Agro-meteorology Unit. This unit collects and analyses the met related data.

Daily weather forecasts are made through radio and TV. The capacity on agro-meteorology is still weak. Manpower and infrastructure are limited to undertake comprehensive analysis and interpretation of climatic data.

Conclusion

Mountainous environment and marginal resources reduce options and increase production .:osts. With a limited cultivated land base and a shrinking labour pool, it will be difficult to maintain the production base and the future production capacity without major changes to the land base, infrastructure, support system, and price structure for agricultural and forestry products. At the same time there is a urgent need to properly address the risks and vulnerabilities in agriculture. The main challenge lies in sustaining the agriculture development for food security and rural livelihood objectives while conserving the naturall resource base.

Disaster management capacity is weak. The Royal Government is currently making efforts to institutionalize a system to cope up with the natural disasters.

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Sources and Management of Risk in Indian Agriculture

Dr. Suresh Pall

1. Introduction

Agricultural production in developing countries is an inherently risky activity. Primary focus of the studies in the past has been climate variability and its implications for risk in crop production. The year-to-year changes in rainfall made crop yields highly unstable. particularly in dryland areas. The studies have clearly shown that rainfed agriculture was found to be more unstable than irrigated agriculture (Ray, 1983, Dhawan, 1987, Rao et al. 1988, Pal and Sirohi, 1989 and Singh and Byerlee, 1990). For irrigated areas, concerns were also expressed that increased crop production was associated with higher production variability because of positive association between area and yield changes (Hazell, 1982). If this tendency is also found in rainfed regions which are showing tremendous growth in the recent past, this will have important implications for the national food security. This is because the contribution of rainfed agriculture is critical in meeting food needs of the country.

Management of risk in agriculture requires an understanding of different sources of risk and farmers' risk coping strategies. An in-depth study of these factors is essential for developing technological and policy interventions to minimize excesses of risk and reduce the cost of managing risk, both at farm and sectoral level. With this objective, this paper first provides an overview of major causes of risk in agriculture and its impact on adoption of modern technology. This is followed by an analysis of variability in rice production in eastern India which is mostly rainfed but contributes significantly to increased food grain production in India. The next section spells out risk coping mechanism of farmers. Finally, the paper discusses the policy options to reduce the production variability and mitigate its impact.

2. Risk and Technology Adoption

Climate-induced yield risk was considered to be the main source of risk in agriculture for a quite long time. Over a period of time, focus of analysis shifted to farm income which may fluctuate as a result of fluctuations in prices, area planted, input supply, and several other technology-related factors (Pandey et al, 2000). Price risk is less relevant in subsistence agriculture when most of the production is for home consumption. There are a large proportion of small and subsistence farmers in India and for them yield risk is the major component. Price risk is also of less significance for those commercial farmers who experience negative correlation between in crop yield and price. But this situation is drastically changing when Indian agriculture is becoming increasingly commercial and farmers respond to price signals both for inputs and outputs.

Output price risk was neutralized to a great extent by support price scheme of the government. Benefits of this scheme were largely confined to the irrigated agriculture, having moderate fluctuations in yield and price, and rainfed regions were untouched. With the change in policy to reduce the size of the government procurement in the era of trade liberalization, farmers may be exposed to a higher level of risk. This coupled with changes in food demand because of urbanization and rising income, farmers will be confronted with high market risk. It is feared that there may not be adequate demand for some of the crops like coarse grains grown in rainfed areas. This coupled with high instability in the international market may enhance risk and vulnerability of rainfed farmers.

Variability in the supply and prices of inputs can make farm output unstable as farmers respond to input prices. The level of market infrastructure development and government price policies do affect the degree of risk associated with the use of inputs.

The impact of risk on use of inputs and adoption/choice of technology has been an area of interest to researchers. The effect of risk is greatly influenced by perceptions and attitudes of farmers towards risk. The studies available, indicate that farmers in developing countries are risk averse and therefore, are reluctant to invest in capital-intensive inputs and reluctant to adopt modern technologies (Binswanger, 1980). The nature of risk aversion could be attributed to economic status of farmers; poor farmers with limited access to credit are unlikely to venture into a risky activity. This has important implications for adoption of capital-intensive technologies like biotechnologies. This coupled with inadequate flow of information about technologies to farmers may limit their

wide-scale adoption, and thereby increasing interpersonal and regional disparities.

3. Production Variability in Rainfed Agriculture: The Case of Rice

Several measures of variability or instability are used in the literature. These measures have their own merits and demerits (Cuddy and Della Valle, 1978). Our choice of measure is decided by three factors, i.e.

(i) ability to measure variability around trend in time series data,
(ii) amenability to apply test of significance for change over time, and
(iii) ease with which the measure can be applied and explained.

All these criteria are met by square root of the mean squared error of the semi-log trend function. This is a relative measure of variability which provides average percentage

deviation from the trend, and eliminates much of the scale effect often encountered in time series data (Naylor et cal, 1997). Another advantage of this measure is that it can be directly computed and related with growth rate, which is useful in assessing association between growth and variability. The analysis is done for rice in eastern India, which is witnessing significant growth, and temporal changes are examined for two time periods: 1969-81 (period I) and 1982-94 (period ll). The period II corresponds to the period of comparatively higher growth in yield and production of rice.

Growth pattern

Before we examine yield variability, it may be useful to study the growth pattern. Most of the increased production during the 1970s came from the northern region comprising highly productive districts of Punjab and Haryana. The northern region registered an impressive growth of 14 percent (annual compound growth rate) in the production during 1969-8 1, contributed by the growth in yield as well as in area. The rate of growth however slowed down considerably during 1982-94 (Table-1). In the early phase of the green revolution, manifold increase in rice yield tilted economics in its favour and attracted more area under rice even from other crops like coarse cereals and pulses, giving a very high rate of growth. But at a later stage when there was no possibility of area expansion and yield improvement using presently available varieties, there is a sharp decrease in the growth rate. In fact, rice yield has now become almost stagnant. Several factors like homogeneity of production environment, increasing investment (both public and private) in agriculture, particularly in irrigation, research and extension, government programs for irrigated areas to increase good production, and price policy stimulated growth in yields in the 1970s in these favorable areas. These regions are now encountered with `second generation' problems relating to sustainability of production system, and technological intervention is essential to address these problems and to sustain yield growth (Chand, 1999).

Eastern India, in contrast to the northern region, did not show significant growth in the production and yield of rice during the first period. But in the second period, the rate of growth was about 4 percent, nearly doubling the yield and production and contributing nearly half of the increased production in the country. As seen from Table 1, West Bengal is the only state in the region showing statistically significant growth in the yield and production in both the periods. In the second period, east Uttar Pradesh, east Madhya Pradesh and Orissa also showed significant growth. In Bihar, the growth is statistically non-significant in both the periods, but taking both the periods together (1969-94) a significant growth of 1.4 percent in the yield and one percent in the production was noticed (Table-1). In spite of appreciable yield growth in the eastern region, current level of rice yield (1.5 tonne./ha) is about half of that obtained in irrigated areas of the northern region.

Part of regional differences in the growth rates of yield could be attributed to extreme diversity of rice production envil-onments in eastern India. Erratic weather coupled with varying soil types, soil depth, rainfall aid topographyresults invari varioof abiotic and biotic stresses. However, an a p preciable growth in rice production in the states of `'Vest Bengal and Utter 1':~3desh can be attributed to successful implementation of land reforms, encouraging private investment in agriculture, particularly in tube well irrigation and land improvement (Rao, 1994, p 232). Also, infrastructure facilities are comparatively well developed in West Bengal and Uttar Pradesh (Bhatia, 1999), placing these states ahead in terms of the yield growth.

Production variability

Table-1 also shows the magnitude of variability or instability measured as annual percentage deviation from the trend. The variability in yield and production of rice is higher in the eastern legion than that in the northern region or for the country as a whole. The eastern region did not shun any significant change in the variability of yield between the two time periods, w whereas it decreased significantly in the northern region. The area variability decreased in the northern region and it increased in the eastern region. The area lower and declining pattern of yield variability in the northern region is understandable as these have assured irrigation and wider adoption of HYVs developed primarily for irrigated areas.

Among the eastern Indian states, the variability is comparatively higher in Bihar and lower in West Bengal In fact, in Bihar the yield variability increased from 11.6 percent in the first period to 18.5 percent in the second period, and the increase was statistically significant at the 10 percent level. On the other hand, a significant decline in the variability of yield and production was observed in eastern parts of Uttar Pradesh and Madhya Pradesh, markedly in Uttar Pradesh where yield variability reduced to one-third of that in the first period.

Are growth and variability positively correlated?

The analysis further indicates that about 75 percent of the total rice area had significant growth in yield during 1p82-94. More than half of this area or 41 percent of the total rice area has low yield variability (annual percentage deviation from trend in yield less than 15 percent). These out performing areas have rice yield 1.5 t/ha or more, and are spread largely in alluvial plains of West Bengal and Uttar Pradesh. About one-third of the total rice area has significant growth in yield with moderate level of variability (15-30 percent). Rice yield is stagnant and moderate to highly unstable in 22 percent of the total rice area, and these are exclusively low productivity areas. In fact, nearly 80 percent of the low rice productivity area has moderate to high degree of variability, as against one-fourth of the high productivity area showing moderate degree of variability. Thus, we can infer from these trends that growth and stability are not mutually exclusive objectives.

By and large, variability in rice production was influenced by yield variability in both the low and high productivity areas. However, production variability in high productivitv areas was higher than yield variability, indicating significant contribution of area variability and covariate movements between yield and area. Year-to-year changes in rice area in high productivity regions could be due to farmers' response to change in output prices, wages and rainfall. In favourable environments where rice yields tend to be higher, farmers may shift some area to more profitable and less labour intensive crops like sugarcane. Increase in correlation between area and yield may also contribute significantly to the increase in production variability. As a matter of fact, much of the increase in absolute variability (or variance) of crop production until the mid-eighties was attributed to an increase in area-yield covariability (Hazell op. cit. and Pal and Sirohi op. cit.). A similar tendency is also observed for rice production in eastern India. In Uttar Pradesh and Bihar, rice area having positive and significant correlation between area and yield increased sharply from more than 40 percent in the first period to more than 80 percent in the second period.

Determinants of yield variability

Crop yield and its variability are governed by interactions between agro-climatic conditions and technology. In a production environment where farmers have more control on crop production methods, production tends to be less sensitive to weather. Availability of infrastructure facilities like irrigation, inputs and technology delivery system, etc. help better management of production processes and enable farmers to employ adaptive and compensatory strategies to reduce the likely adverse effect of weather on crop output. Although the quantification of all these effects is rather difficult, partly because of complexity of the relationship and partly because of non-availability of data, we have analyzed the possible causes of yield variability in this framework.

In order to quantify the effect of technology and agro-climatic factors on yield variability, annual percentage deviation in yield from trend was regressed on level of HYVs' adoption, irrigation and other infrastructure facilities, share of bozo rice in total rice area, and dummy variables for agro-climatic zones to capture the zone specific effects. The district-level analysis was done for the second time period as current level of variability is of more practical significance. All coefficients in the full model were statistically insignificant possibly due to multicollinearity. Variables like percentage of rice area under HYVs, gross irrigated area as percentage of gross cropped area, per hectare use of NPK, etc., are highly correlated, indicating high complementarities in the use of these inputs. When these variables were used once at a time, coefficient estimates were negative and significant.

We opted for NPK use (kg/ha) because of three reasons: (i) use of NPK also represents the quality attributes of technology adoption and farmers' adjustment behavior. Irrigated area does not indicate reliability of irrigation water, and area under HYVs tends to be less re?:able. The use of NPK not only captures these effects, but also shows how much ceu:rol farmers have on input use and crop management practices. (ii) NPK use also represents indirectly the effect of infrastructure facilities necessary for delivery of farm inputs. (iii) NPK use data are most consistent than HYV or irrigated area. The only limitation of NPK use is that it does not pertain to rice crop, but NPK used in all crops grown in a district. In the absence of crop-wise fertilizer use data this is an approximation. One significant omission in this analysis is the exclusion of rainfall variability. The reason being that the CV computed for the meteorological sub-division level rainfall does not capture inter-district differences in rainfall variability, making this variable redundant. The dummy variables included in the model, however, capture part of the rainfall effect.

The OLS estimates of the model are given in Table 2. The coefficients of the zonal dummy variables have to be seen considering Uttar Pradesh as base for which no dummy variable was used. The model has reasonably well explained the inter-district differences in the variability in rice yield (annual percentage deviation from trend) during 1982-94. The dummy variable for the Gangetic West Bengal has negative and statistically significant coefficient, while the coefficient was positive and statistically significant for the plains of Bihar. This confirms our results that in comparison to Uttar Pradesh the yield variability is lower in West Bengal and higher in Bihar Plains. The use of NPK has negative and highly significant coefficient, indicating that the adoption of modern rice varieties and associated crop management practices helped achieve high yield with greater stability. When NPK use alone was retained in the model, it explained 13 percent variations in the yield variability. However, the Chow test indicated that both the models were statistically different, and therefore both the dummy variables capture significant effect of the yield variability. In the final iteration, when all the zonal dummy variables were included in the model, all effects were captured by these dummy variables and NPK use became non-significant.

4. Options for Risk Management

The management of risk requires the study of risk coping mechanism both at micro and macro level. The micro or farm level evidence is more important to reduce excesses of risk to famners, so that their productive capacity is maintained. Analysis at this level focuses attention of the degree of risk and farmers' risk coping mechanism. Macro-level risk management, usually ex-post management of risk effects, issues are concerned with reducing effect at the sectoral level and stabilizing consumption. Both the options are explored here.

Farmers' risk coping mechanisms

Farmers follow a number of measures to reduce the degree of risk and to minimize the after-effects of risk. The most important among these is diversification of farming system, crops and varieties grown. 'The objective is to stabilize farm income by taking various agriculture enterprises like crops and livestock, inter-cropping and growing different varieties of a crop in different or same fields. This is a very erl , ective mechanism usually followedd in rainfed areas of southern, central and western India, but the cost of risk reduction is also very high. This is because returns foregone in a normal crop year are substantially high. In addition, farmers follow a number of crop establishment and management methods to reduce risk. The idea is to maintain flexibility in farm operations so that crop management practices and input use could be adjusted depending upon crop season and degree of ri,;k. The most common practices adopted in this category are: staggered planting, change in sowing method, inter-culture, split dose of inputs like fertilizer and pesticides. Besides these practices, tenant farmers who are risk averse in nature prefer sharing cropping mode of tenancy. In this method, a tenant farmer shares inputs and output with his landlord and thus shares risk also (Pandev et at, 2000),

Farmers also follow ex-post measures to minimize vulnera caused by risk. Selfinsurance measures like sale of crop inventory and farm asset-. ce livestock are quite common in high risk-prone areas like arid and scmi-arid tropic-:~~. If the shortfall in farm income is quite sharp, moderate to high reduction in consumption expenditure, especially on food items, is also observed. Some fan-ners take credit to compensate shortfall in farm income and to meet faun and family expenditure needs, and village money lender is the most reliable and accessible source of credit during the hardsl,,01. N::°n-farm employment opportunities if available are another import mechanism to cope Ix ith risk. In the high risk areas, or years, farmer often migrate to tar-oft places in search of non-farm employment.

Policy options

The need for an institutional mechanism for nianagement of risk can't be over emphasized for the marginal regions experieneWfwF All kinds tyl° risks. Farmers also face risk associated with the adoption of new technology and c1iNersification towards new crops, particularly fruits, and there are limited options with them to cope with such risks. These risks could be addressed through two kinds of interventions. Firstly, there should be adequate provision of information about produc't prices, weather conditions, and characteristics of new technologies such as crop v,irieties, quality of inputs, etc. This would help farmers in making rational decisions about choice of varieties, use of inputs and time of sale of products. Since information is of "public go-d" in nature, government has a major responsibility of providing such information. the private sector could be a useful ally as it can deliver information more effiiciewly. Several experiments are being tried in this area and most notable are medium-term weather forecast and agroadvisory services of the Department of Science and Technology. This scheme provides bi-weekly information to farmers about main weather parameters and suitable crop management practices in collaboration Nvith state agricultural utiis-C-sities. and the scheme is showing promising impacts. For markets, there are several agro-based private.

companies providing information on product prices to farmers, enabling them to sell their plu,,:luce to the company at the indicated price, or to sell in the market. Such experiments +nluld be replicated on a large scale.

Secondly, there should be an institutional mechanism to enhance risk coping/ bearing ability of farmers. Obviously, crop insurance is one such option, but unfortunately, it failed to take off in the context of Indian agriculture because of operational problems. Efforts to link crop insurance with credit also failed, as premium was a cost to farmers in -:ormal crop seasons, and also, farmers were not sure of benefits in the case of crop failures. There is further attempt to revive the insurance scheme through specialized agriculture insurance institutions. However, operational aspects of crop insurance need in-depth analysis to suggest a feasible solution. This itself requires a detailed study, but there is considerable scope for public-private partnership in this area. A private entity with some public funding support in the initial phase could be pilot tested for insuring crops against major risks or some other parameter highly correlated with risk, e.g. rainfall i for details see, Pal et al, 2004).

Farm credit is found to be an effective risk-coping mechanism, and therefore, efforts should be made to increase farmers' access to credit in the years of adversity like drought and flood. Two major experiments are being tried in India in this direction. First is the issue of credit cards to farmers with a credit limit, depending upon his/her credit absorption and repayment capacity. So far (2003/04), about 4 crore credit cards are issued to farmers and the cumulative amount sanctioned is 97,710 crore. This is very good progress since the beginning of this scheme in 1998/99 on a modest scale. In the SelfHelp Group Bank linkage programme, 3.6 lakh SHGs are financed so far with a cumulative amount of 3,904 crore. Although this program is mainly targeted to landless poor people, marginal farmers can also benefit from it. The success of this program is however limited to southern India, and there is need for drawing lessons for its implementation in eastern region of the country.

5. Conclusions and Policy Implications

This paper has clearly shown that the growth in crop yield and production has accelerated in rainfed areas since the early eighties. Unlike the northern irrigated areas, the growth in crop production in these regions is mainly contributed by yield growth. Owing to differences in agro-climatic factors and technology adoption, the patterns of yield growth and variability are rather diverse. But growth with stability could be achieved under better crop management systems. Although the level of relative variability in the yield and production may not be high at the regional level, it could be high at farm level in absolute terms, affecting farmers and rural poor adversely. The effect of shortfall in yield would be far more serious in the year of drought or flood. Both ex ante and ex post measures to deal with drastic fall in crop production and income are essential. Ex post management measures like public distribution of food grains and employment generation

programmes are already operating, albeit with varying degree of success. These should be strengthened and made more pro-poor. Crop insurance and institutional credit are other options to manage after-effects of risk, needing attention of policymakers to make them effective. A long-term strategy to check sharp shortfall in the production should incorporate appropriate measures in agricultural development strategy. Product diversification towards high value horticultural crops in low potential rainfed areas is often talked about to minimize risk and raise farm income. This option requires development of post-harvest and product handing facilities in these regions. Also. incorporation of risk reduction as one of the research objectives for high risk agriculture. and strengthening of

technology and input delivery systems should be accorded high priority to meet diverse needs of farmers.

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Table 1. Growth and variability in the rice production in eastern India

	Growth rate (%)'				Annual percentage deviation from trend			
	1969-	1969-81	1982-94	F ratio3	1969-94	1969-	1982-94	F ratio4
Kim L ttar Pradesh	1.08**	1.41***	0.51	(-) 1.40	5.52	4.12	6.47	2.46*
Area								
Yield	4.40**	1.28	4.92***	3.22*	19.25	23.76	7.82	(-)9.22*
Production	5.48** *	2.70	5.43***	2.07	20.87	25.19	12.87	(-)3.83* *
Fast 1ladhva Pradesh	0.80"*	0.75***	0.99***	5.65**	0.95	0.66	0.94	2.25*
Area								
Yield	1.99**	-0.86	3.08***	2.51	20.03	23.87	12.01	(-)3.95*
Production	2.79** *	-0.11	4.07***	2.58*	20.49	24.22	12.48	(-)3.77* *
Bihar	-0.33*	0.48	-0.57	(-) 1.69	6.59	4.45	7.90	3.14* *
Area								
Yield	1.37`x	0.63	1.95	0.34	15.01	11.64	18.46	2.51*
Production	1.05**	1.11	1.38	0.03	18.77	12.88	24.51	3.62* *
Orissa	-0.05	-0.57**	0.85**	6.76***	4.71	3.60	4.12	1.31
Area								
Yield	2.24**	0.67	3.73***	2.25	14.43	13.56	13.91	1.05
Production	2.20** *	0.10	4.59***	3.53"'	17.78	14.95	17.28	1.34
West Bengal	0.64** *	0.35	1.29`**	4.97**	3.60	3.48	2.71	(-)1.66
Area								
Yield	3.10`"`	1.69***	4.62***	5.04**	10.16	7.80	9.68	1.54
Production	3.74** *	2.04**	5.91"**	6.09***	12.73	9.84	11.43	1.35
Eastern region	0.36** *	0.40**	0.63**	1.18	2.63	1.89	3.17	2.78*
Area								
Yield	2.61	0.82	3.86***	4.46**	11.25	10.65	9.11	(-)1.36
Production	2.97** *	1.22	4.49***	3.44*'	13.12	12.04	11.87	(-)1.03
Northern region	6.62**	9.60***	3.50***	(-)	13.33	7.57	4.75	(-)2.54*
Area	*			42.34***				
Yield	2.54**	4.87***	0.83**	(-)	10.84	9.59	5.03	(-)3.64*
E Production	9.16** *	14.47***	4.33***	(-) 48.39***	21.91	11.51	7.83	(-)2.16
All India	0.56**	0.82***	0.63***	1.79	2.24	1.65	2.59	2.47*
Area	*							
Yield	2.46**	1.53**	3.08***	0.96	6.84	7.68	4.75	(-)2.62*
Production	2.96** *	2.33***	3.73***	0.21	8.17	8.95	7.01	(-)1.63

Table 2. Results of yield variability model

Explanatory variables	Mean yield (t/ha)	Dependent variable Annual percentage deviation from trend in yield		
(1) Constant	(2)	(3)	(4)	(5)
	1.40***	22.82***	21.93***	18.20***
	(11.68	(15.32)	(16.18	(5 .98)
Mean NPK use (Kg/ha)	0.005***	-0.08***		
	(3.69)		-0.07***	-0.04
Dummy variables		(3.35)	(2.99)	(1.39)
West Bengal Gangetic Plains	0.34***			
	(3.18)		-4.37*	-2.96
			(1.78)	(1.10)
Bihar Plains	-0.53***			
			7.82***	9.88***
	(4.81)		(3.33)	(3.53)
Eastern Plains	-0.29**			
	(2.23)			4.25
				(1.31)
Eastern Plateau and Highlands	-0.44***			
	(3.65)			3.54
				(1.16)
Coasts	0.04			
	(0.22)			4.04
				(0.95)
Adjusted R2	0.69***	0.13***	0.30***	0.29***

Notes: 1. East Uttar Pradesh is the benchmark region for dummy variables.
2. The Chow test `F' ratio for the equations in columns 3 and 4 was 9.2 at (2,66) degrees of freedom, which is significant at 1 percent level.
*** * * and * significant at 1, 5 and 10 percent significance level, respectively; n=70 Figures in parentheses are `t' values.

Source: Pal et al. (2000).

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Risks in Agriculture and Their Management Strategies in Nepal

Dr. Hari Dahalt

Risk Defined

Risk refers to a situation in which one is not sure of the occurrence of events but can assess the probabilities of the events or outcomes whereas in uncertainty the probabilities cannot be attached to the occurrence of events (Ellis, 1980). The likelihood of the occurrence of uncertainty is not known by the decision makers. Agriculture by its biological nature entails a strong exposure to risks of various kinds. The major uncertainties associated with South Asian agriculture are the unpredictable impacts of weather, pests and diseases and other natural calamities, price variations of the markets and inadequate information (Ramaswami et al, 2003). All of these and in particular unreliable monsoons cause great variation in agricultural outputs both in crop and livestock in South Asian region. Nepal, a mountainous country in South Asia with a complex diversity of crop growing environments is prone to various types of risks and uncertainties of which risk associated with weather is important one.

Geographical Setting

Nepal is a land locked country and is (26° 22' north to 30° 27' north latitude and 80° 4' to 88° 12' east longitude) situated between India and China. The total area of the country is 147181 square kilometers (CBS, 2003a). Although a small country, the climatic variation within a short span from north to south is very great. The country is divided into three well-defined physiographic regions-Terai, Hills and Mountains.

The Terai belt is an extension of the Indo-Gangetic flat land and lies to the south boardering India. Elevation ranges from 60 to 300 meters above mean sea level (msl). The area of the Terai is only 23 % of the total land area but consists of nearly 52 % of the total cultivated land of the country. As of 2001 census Terai accommodates 48.4 population of the country. The Terai has the most fertile land that permits a wide variety of crops cultivation particularly those of cereals and is also traditionally known as the breadbasket of the country (Karki, 2002; Manandhar, 1996).

The Hill region lies to the north of the Terai ranging the altitudes of 300-5000 meters above mean sea level. This region accounts for the largest land area (42 %) but with 40 of the cultivated area and 44.3 percent of the total population. The landscape of this region consists of mountain peaks, fertile valleys, basin and terraces suitable for fruit, vegetable, maize, millet and potato cultivation and livestock rearing.

'The north most region is the mountain region with elevation above 5000 up to 8848 meters. This is also the seat of the highest peak of the world-the Mount Everest. High snow clad mountains, narrow terraces and steep slopes are the main characteristics of this region. This region comprises of 35 % of the land area with only 2 'Yo cultivated area and about 7.3 % of the total population of the country. The cropping pattern is dominated by barley, wheat, millet, buckwheat, potato and livestocks specially Yaks and Sheep husbandry. Human settlements however, are found only up to 2500 meters from the mean sea level in the region.

Climate

Nepal is considered to lie under subtropical climate but the local climates extent humid subtropical in the Ter
ai region to Alpine climate in the northern Himalayas. In between these two extremes there are warm, and cool temperate and sub-Alpine climate in the hills and mountains (www.foa.org/nepal). The mountains slopes, aspects, valleys and their orientations have also provided several micro-climatic regimes within a short distance from south to north thus determining the crops and major farming systems in the country.

Broadly there are two major seasons-winter and summer but in sharp distinction there are four seasons in Nepal.

1. Spring Season (March-May)
2. Summer Season (June-September)
3. Autumn Season (October-November) 4. Winter Season (December-February)

Temperature and Rainfall are two most important aspect of climate variation in the country.

Temperature
Temperature has been an important climate factor determining the cropping patterns and quality of products in the country. Besides latitude, temperature in Nepal is profoundly associated with elevation. There is a drop of 0.5 degree centigrade temperature for every 100 meters rise in altitude, which means terai- a low land is much hotter than hills and mountains. The hottest temperature occurs during April to June. The lowest minimum temperature occurs in December and January throughout the country. Winter mean temperature in Kathmandu valley particularly in January averages at 9 degree centigrade. Usually temperature in the cultivated zones ranges as high as 40 degree centigrade in the terai to - 4 degree centigrade in the hills and mountains in the country.

Rainfall
Rainfall is the most important climatic factor affecting agricultural activities in Nepal. The amount and pattern of rainfall is determined by the monsoon. The mean summer wet season starts from the early June and continues until September or in some cases to October. The average annual rainfall is 1600 mm but it varies from about 250 mm in the rain-shadow area of Dolpa and Mustang districts to about 5000 mm in Kaski district (Pradhan et al, 2004; Manandhar et al, *1996)* Eastern parts of the country receives an increasing amount of rainfall in summer monsoon whereas reverse is true for the winter precipitation. More precipitation occurs on the southeastern slopes compared to western and northwestern slopes. The summer monsoon gives about 80 per cent of the annual rainfall, which covers the whole country except the northern Himalayan range. Pre-monsoon which occurs from March and continues to May in certain isolated areas. mostly in the form of brief thundershowers is important for spring season crops for both terai and hill regions. The annual precipitation is not evenly distributed across the country mostly because of topographical variations and partly due to late onset and early retreat of summer monsoon.

Agriculture
Agriculture is the mainstay of Nepalese economy contributing about 40 % of the GDP employing over 65 % of the economically active population (Dahal, 1999; MoAC, 2003a). Agriculture still depends on monsoon as only about 30 % of the arable land is irrigated in the country. Farming systems are mostly subsistence types and food grains dominate the cropping patterns. The share of cereals is about 75 % while cash crops (sugarcane, tea, coffee, jute, cardamom, cotton, tobacco etc.) are grown in about 10 % of the cropped area. Livestocks rearing in general is an integral part of the farming system particularly for milk, meat, manure and draft power. The average cropping intensity is calculated at 183 % in 2003 but the average productivity of cereals is less than the potential. Agricultural mechanization is very much limited and most farming activities are done through human and animal labor. Traditionally, cereals, fruits and livestock were identified as the principal commodities to promote in Terai, Hills and Mountains respectively. The 20 years Agriculture Perspective Plan (APP, 1995), which recognized livestock, high value crops, agribusiness and forestry as the priority outputs has also reemphasized the traditional approach of ecological planning in the country.

Population
The population as of 2001 census was 23 million with a growth rate per annum of 2.24 per cent. The population engaged in agriculture was 65.6 % (CBS, 2003) more than 80 of the populations are still residing in rural areas, where the incidence of poverty is high. In 2003/04 the percentage of population below the poverty line was estimated to be 31 of the total population (E S, 2005). The poverty distribution based on the ecological zones is about 52, 42 and 7 percent in Terai, Hills and Mountains respectively. The land resources distribution is highly skewed with 70 % households having only 30 % land area (Shakya, 1994). The average size of land holdings is estimated to be 0.80 hectare in 2004. The average national literacy rate as of 2001 was 54 %, 66 % for males and 43 % for females (CBS, 2003b).

Although important, risk in agriculture is an area, where little study has been done. Based on the available literature review, therefore effort has been made to assess the categories and nature of common agricultural production risks and identify their coping strategies. Among all the production risks weather is the most important factor affecting agricultural production in Nepal. Sunlight and Temperature do nct vary much year after year it is therefore rainfall or moisture deficit that has the most important effects on crop growth and agricultural production.

Risks in Agriculture

Risk of Rainfall

The most important of weather is rainfall that strongly influences the intensity and location of any farming system. Rainfall however is always uncertain and highly unevenly distributed (Singh et al, 2000; Husain, 1999). Scanty or heavy rainfall is the main cause of crop failure particularly for rice, maize and other summer season crops in Nepal. Rice, which is the principal crop, is affected most by the distribution of rainfall right from the planting to the maturing of the crop. The study of time series data on rainfall for the last few years based on 14 important stations gives no particular patterns of precipitation (Table - 6). It is however noticeable that the coefficient of variations are higher between the years than locations. The variations ranges a minimum of 40 percent to a maximum of 55 percent between the years while between the locations were 14-31 percent. It means there is wide variability of the amount and intensity of rainfall across the districts and locations in the country. There were years when the total rainfall was significantly lower than the average figures particularly in 1972, 1977,1982 and 1992 thus plunging the nation into drought situation in many places.

Table 1. Districts with an Excess and Deficit Monsoon Rain.

Excess (More than 120% of Normal)	Deficit (Less than 80% of Normal)
Bara, Makwanpur, Manang	Arghakanchi, Baglung, Banke
Rautahat, Saptari, Sarlahi	Bardiya, Dang, Gulmi
Siraha, Sunsari,'Udayapur	Kailali, Kanchanpur, Kapilbastu Pyuthan, Rolpa, Salyan

Source: Rajbahak, M- Disaster Review 2004/DWIDP, Kathmandu. A recent study for the year 2004 on the rainfall pattern suggests winter rain deficit (less than 80 % of the normal) in 27 districts out of 75 in the country. The monsoon rainfall however was mixed for many places. There were 12 districts with deficit rain while 9 of the 75 districts were having excess rainfall, more than 120 % of normal (Rajbahak. 2005). Therefore the pattern and intensity of rainfall is not predictable indicating ven high risk of production in agriculture, both from excess and deficit rainfall.

Agricultural Drought

Drought is a situation when the deficiency of rainfall is high. An agricultural drought is defined as a period of four consecutive weeks of drought during the growing season of crops. Drought can be experienced when rainfall deficiency exceeds 25 % of the normal rainfall and there will be severe drought if the deficiency is more than 50 % of the normal (Ramaswami et al, 2003). Irregular and uneven distribution of monsoon during the summer season is the major cause of drought in Nepal. Although some part of the country occasionally face drought situation most parts of hills and mountains in the mid western and far-western development regions usually suffer drought hazard due to erratic monsoons both in winter and summer. The major drought that was experienced in 1994 had razed the cropped area of about 157628 hectares in 35 districts of the country (Chhetri, 1999). Although irrigation is the answer of the drought situation, inadequate facilities of irrigation and low intake at the rivers in surface irrigation during drought period offer little relief to the farmer.

Finod and Landslide

Flood and landslides are by far the most serious natural hazards that Nepal faces every year.

Table 2. Deaths and Properties Loss of Floods, Landslides and Avalanches

Year	Death	Injured	Families Affected	Livestock Killed	Houses Destroyed	Agricultural Land Lost	Loss of Properties (Million Rs.)
1990	307	26	5165	314	~	1132	44
1991	93	12	1621	36	817	283	21.2
1992	71	17	545	179	88	135	10.78
1993	1336	163	85254	25425	17113	5584	4904
1994	49	34	3697	284	569	392	59
1995	246	58	128540	1535	5162	41867.28	1419
1996	262	73	36824	1548	14037	6063.4	1186
1997	87	69	5833	317	1017	636.4	104
1998	273	80	33549	982	13990	326.89	969.27
1999	214	92	9769	331	2543	182.4	365
2000	173	100	15617	822	5417	888.9	932.1

Source: DPTC, 1998 and Ministry of Home Affairs (as cited by Thapa and Khanal; www.southasianfloods.org)

With the rugged topography, steep slope, active tectonic process and very high intensity of rainfall during the monsoon season, the country exposes itself into severe landslides floods and other kind of disasters causing loss of lives, properties, and agricultural lands in the country. The number of deaths and losses of properties from 1990 to 2000 are given in Table 2.

Landslides are more pronounced in hills and mountains while flood problems are common in the plain area of term. The high intensity of rainfall in a short duration usually brings flash floods triggering erosion and landslides in the hill areas. The extreme 24hour rainfalls as recorded in various stations are given below.

Table 3. Extreme 24-hour Rainfall (mm)

Station	Rainfall	Date of Event
Tistung	540	20/7/1993
Musikot	503	29/7/1960
Hetauda	453	27/8/1990
Kankai	437	16/9/1984
Bajura	431	12/9/1980
Amalekhganj	399	21/7/1993
Daman	375	20/7/1993

Source: HMG/Department of Hydrology and Meteorology, Kathmandu (as cited in Thapa and Khanal).

A recent disaster due to heavy rainfall that took place during the month of July 2004 in 19 districts of eastern, central and midwestern regions had destroyed about 1 ? 1000 hectares of cultivated land. The affected area was as follows. Apart from this, 1419 large livestock and 1326 small animals were also affected.

Table 4. The Loss of Agricultural Land in 2004

Crop	Area (ha)
Paddy	73016
Maize	1468
Sugarcane	5538
Vegetable	5129
Fishpond	1238
Sand Filled	17815
River cutting and landslide	6991
Total	111195

Source: MoAC

Windostorms, Haistorms and Thunderbolts

Windstorms, hailstorms and thunderbolts though not serious occur frequently each year during pre-monsoon period particularly from March to may. These events specifically, windstorms and hailstorms cause substantial effect to the standing crops especially at fruiting stage. During 22 years (1983-2004) the number of deaths by these events were reported to be 605.

Other Disasters

Occurrence of epidemic, fire, avalanche, glacier lake outburst flood (GLOF) and earthquakes hazards were reported from various parts of the country. Besides, crops and livestock damage these events put together accounted for about 15000 deaths in 22 years time period. The most of the deaths were from epidemic incidents (11912) followed by fire (1185), earthquake (727 in 1988), avalanche (95) and stampede (71).

The effects of disasters in agriculture were also significant. In 2002 about 115000 ha of rice fields, 4435 ha of maize, 985 ponds of fish farming and 4700 livestocks were affected. The damage in 2004 was reported to be 116505 ha of rice field, 1293 ha of maize and 500 ha of millet crops (MoAC, 2004b).

Risk of Pests and Diseases

Pests and diseases have been posing a serious threat to field crops especially in irrigated agriculture with high yielding varieties. The damage inflicted by pests depends on the degree and virulence of attack ranging from a small to epidemic losses.

Table 5. Major Pests and Diseases of Important Cereals

Crops	Insects	Disease
Rice	Steam borer, Hispa, Gundhi bug, Hopper, Mealy bug, Leaf roller, Army worm, Caseworm, Seedbed beetle, Field cricket	Blast, Leaf blight, Foot rot, Bacterial leaf bight (BLB), Brown leaf spot
Maize	White grub, Borer, Cutworm, Army worm	Leaf blight, Ear rot, Head smut, Stalk rot, Downy mildew
Wheat	Aphids, Pink borer, Beetle	Leaf blight, Brown and yellow rust, Loose smut, Hill bunt.

If it is epidemic in nature a complete crops loss may take place even if all production inputs are optimized to the crops. The crop loss due to pests and diseases vary considerably across the crops commodities, stages and weather conditions. Crops pests are always present at low level in the fields and multiply quickly whenever weather conditions get favourable. The average crop loss due to pests and diseases vary anywhere between 5 to 45 %. The estimated post harvest losses in cereals are 17-20 % whereas for cash crops, fruits and vegetables are as high as 20-30 percent (Karki, 2002). The important pests and diseases of major cereals are given in Table 5.

Market Risk

Market risks are not important in such situations where the agriculture is subsistence in nature. Agricultural market risk therefore to be significant must have a marketable surplus and in general for food grains the surplus is low (Sundaram, 2002). Although the paucity of data on marketable surplus does not permit to generalize the amount of surplus produces reaching to market in the country, a study done in a Terai district located in the eastern part revealed the surplus quantity to be 40 % of the total production for rice. The percentage was 53 for wheat, 68 % for Jute, 35 % for pulses and 29 % for Potato (Dahal, 1996).

There is however higher market risk for cash crops than cereals. The cash crops important in view of market are sugarcane, jute, cardamom, potato, vegetables, fruits and perishable goods like milk, egg etc. Although the balance of supply and demand determines the crop prices they do not follow clear trends across the seasons and market places. Price risks are also due to seasonality, in harvest low and in off-season high. The Cobweb cycle is another factor responsible for price instability in which crop prices and planned supplies are distorted. The lack of market intelligence put the farmers into the risks of not having true market price, consumers taste, preferences and demand and supply situation of farm produces.

Risk Management Strategy

Institutional Arrangement

In order to address the disaster problems the government has taken a number of measures the important one was to formulate the Natural Disaster Relief Act (NDRA) in 1982. Before the formulation of this Act the relief and rescue works were done as a part of social service. Based on this act the Central Natural Disaster Relief Committee (CNDRC) headed by the Home Minister was established which is the apex body for disaster management in Nepal. This committee consists of the followings:

- Ministry of Home Affairs
- Ministry of Health and Population

- Ministry of Housing and Physical Planning
- Relevant Line Ministries
- Royal Nepalese Army
- Nepal Police
- Department of Mines and Geology
- Department of Hydrology and Meteorology
- Social Welfare Council
- Nepal Red Cross Society
- Nepal Scouts

To coordinate and carry out the disaster management in different levels, Regional, District and Local level committees have been made assigned with clear roles and responsibilities. Various government and non-government agencies have also been actively involved in disaster mitigation and relief works in the country.

Coordination with International Agencies

The UN residential office has been assisting the His Majesty's Government to coordinate the donors and INGO communities in time of disaster in the country. The major role of the UN then is to collect information relating to disaster, share ideas among the donor agencies and assist the government in the coordination of the ongoing disaster relief works. There are various international agencies involved at disaster management.

To mention a few are Japan International Cooperation Agency (JICA), USAID, GTZ, Luthern World Service, LJNDP, CARE, Save The Children Fund, World Food Program, UNICEF, UNHCR, International Centre for Integrated Mountain Development (ICIMOD), OXFAM, International Red Cross, Asian Disaster Reduction Centre (ADRC) and Asian Disaster Preparedness Centre (ADPC). A substantial assistance also made available time and again from the government of Japan, USA, UK, Switzerland and other friendly countries.

Table - 6. Rainfall Patterns Recorded in Various Stations in Nepal

Dadeldhura	Dhangadi	umla	Surkhe	S m a	Janakpur	Okhaldhunga	Dhanku a	Bi a nagar	Taplejung	Pohara	Bhairahawa	Ramp	Khumaltar	Mean	S de	C
1059.2	1802 9	5677	14396	3949	1050.2	1314.6	731 8	189	170 9	2917	1356	1334	876	1390	590	4
715.7	5944	4845	1146 8	17701	934.4	1378.6	7174	11485	1526	2890	1174	1619	630	1266	618	4
715.7	12462	5703	120 7	11204	582.6	1218.3	663 1	9343	10168	2458	924	342	630	1045	487	4
1183.5	15212	512 2	12319	12725	1157.7	1614.8	6807	1710	1119	3265	1267	1429	964	135	641	4
938.7	11295	6084	11358	11762	1013.6	1493.6	5414	6731	1354	3025	1108	1710	1010	1208	615	5
1126.5	2029	557 7	12474	11086	1192	1334.2	6914	1493 9	14979	4063	1520	1638	1070	1469	835	5
932.1	15245	493 1	1185.5	1347 1	1193.3	1576.9	7095	15699	1504	3 85	1749	1450	944	1383	633	
909.5	16357	427	1338 7	14243	1395	1645.8	6996	13278	15346	2593	1173	1677	773	1,15	533	4
1364.1	X092 7	5074	1396 8	2389 2	1829.3	14753	8764	2495 8	1442	3921	2080	2206	838	1780	863	4
635.9	1516 9	537	13742	18 3 9	1410.8	1541.1	879 7	1555 9	1377 8	3561	1681	995	1060	1496	730	4
1299	1818 6	6459	17087	1646 5	1304	1248.4	6212	18524	146 3	3673	1143	1619	920	1489	742	5
994	1562	537	1313	1497	1137	1402	723	5)3	1405	3127	1444	16 5	932			
235	312	121	239	453	363	212	155	421	202	459	363	263	159			
23	19	22	18	30	31	15	21	27	14	14	25	16	17			

Source: Department of Hydrology and Meteorology/HMG

Food and Agriculture Sectoral Working Group (FASWG)

In view of the occurrence of natural disaster affecting agriculture and vulnerability of the food supply, Food and Agriculture Sectoral Working Group has been established under the Ministry of Agriculture and Cooperatives. The group has prepared an implementation
manual called Disaster Risk Reduction in Food and Agriculture Sector to address the
strategies and procedures while assisting victims of natural hazards.

The FASWG is supposed to involve in the following activities:

- Public Awareness Raising Programs
- Exposure Visits
- Preparation of Roster of Seed Source (Companies or Industries)
- Training Organization on Disaster Preparedness
- Campaign and Food Hoardings Programs
- Other Coordinative Works.

Immediate Relief Program

The Ministry of Agriculture and Cooperatives so far has been able to support only minimally to the disaster victimized farmers with small packets of wheat, vegetables and pulses seeds on 50 percent subsidy. Farmers were

also supported partially with the installation of shallow tube wells and renovation of small irrigation establishments. Vaccines and drugs distribution and treatment for potential disease outbreak to the animals are also made in the disaster area.

The FASWG, as for the midterm and long-term support to the farmers, has recommended providing subsidy on winter crop seeds, and free agricultural tools distribution for the farmers with sand fill and undulated lands due to floods and landslides. Recommendations are also made for river training, forestation in the hills and disaster preparedness activities for disaster prone areas.

Risk Management Tools for Farmers

Resistant Varieties and IPM

Cultivation of resistant varieties to pests and diseases is one of the important methods to cover the pest risks for the farmers. With the continuous use of resistant variety too can evolve the target pest into a new virulent pathogen posing even greater risk to the farmers. Integrated pest management (IPM) therefore is one approach to fight the pest in a sustainable way and becoming popular among rice farmers in Nepal. IPM has been well established in 35 of the 75 districts especially in rice fields while the program on vegetable crops is setting up in some major commercial pockets in the country. Crop breeding and research works against pests and diseases are also important activities of risk management in agriculture.

Improving Agricultural Markets

Market becomes important as the rural economy develops. Agricultural markets particularly those in rural areas in Nepal are not well developed due to various reasons. Most of the rural markets in the central and eastern regions are one-day Hat-bazaar type of markets. These are unorganized, locally maintained and farmers do not get the reall values of their products.

Usually agricultural markets have poor physical infrastructures, transport facilities, andd market intelligence. The presence of the chain of middlemen promotes the malpractices and takes away the profits of the farmers. Traders do not give the price the farmers deserve. The main defect of agricultural marketing is the inability of farmers to have choice of time in selling their products. Farmers sell their produces immediately after harvests when the prices are in their lowest. This is mainly because of farmer's cash urgency and the lack of storage facilities to wait for better prices.

In order to reduce farmers' market risks government as well as private sector can initiate a number of measures such as allocating greater investment on market infrastructures, road networks, storage facilities and providing market information to the farmers and urban consumers. There must also be a regulatory mechanism to see that middlemen and traders do not exploit general farmers. Price support and subsidy to some farm produces and production inputs can also reduce the risk of farming which in fact is not effective in Nepal.

Diversification

Crop diversification is one of the most common risk management strategy adopted in developing countries. Crop diversification spreads the risk across the multiple crops in that even if one particular crop fails to perform well, the loss can be compensated by gains in another crop. Faiiners particularly small holders in Nepal have been practicing crop diversification from time immemorial. This is more popularly practiced in rain fed area than in irrigated where monoculture of improved varieties is commonly done. Diversifications can also include combination of crops and livestock or even sources of income other than farming. Crop diversification, however may not be effective in all situations, because a particular crop in one situation offers higher net returns than others while the resources are spread in all crops equally, without emphasizing most remunerative crop.

Crop Insurance

Crop insurance is an important tool of risk management to safeguard farmers against the losses due to weather, pests attack and falling prices. Crop insurance policy has been developed in Nepal but the implementation has been awaited for a long time while the insurance scheme in livestock has been effective but tied with bank credits as means of credit security program.

Contract Production

In a contract farming, a farmer agrees to sell a commodity at an agreed price to a buyer before the commodity is grown and harvested. Contract can provide farmers an assured market and dependable income. High value crops, vegetables, fruits and cash crops need contracting without which very less farmers would choose these crops to grow with significant market risks. Although important tool for risk reduction no significant work has been done so far in contract farming in Nepal.

Conclusions

Nepal is prone to varieties of disasters both natural and human made the effects of which are strongly experienced in agriculture. The major natural hazards are rainfall, floods, landslides, and drought that are almost regularly occurring in Nepal. Some measures to cope with the natural hazards have been developed in the country but are not sufficient. There are areas where the state needs to give its serious attention particularly in early warning of floods and other disasters, drought forecasting and provision for effective rescue and relief works. Financial constraints, shortage of technical manpower and the lack of public awareness are cited as the major causes of ineffectiveness of disaster management at this time.

Natural disasters are also the major causes of agricultural risks in which significant land area. crops, livestock and human losses are incurred every year in Nepal. The economic implication of the properties loss of this magnitude is also reflected in the reduced levels of production, low income andd high vulnerability of food supply in the country. Although present support has been bare minimal the approach to manage disaster has been changed from relief and rescue operations to preparedness and risk reduction. In a way thus to reduce risks in agriculture some policy decisions including risk management tools for farmers must also be made and implemented accordingly.

In a view to existing low incentives in risks management in agriculture, government as welll as private sector need to invest more on technology, market, and promoting crop insurance, price support and contract farming. For the last few years the increased armed conflict in rural Nepal has markedly affected the agrarian patterns and has triggered off accelerated labour migration from rural areas to urban centers and also to India and overseas for employment opportunities. This has left agriculture acute shortage of labor and vulnerability of food production and supply in the rural and remote regions in the country.

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Risks in Agriculture and Their Coping Strategies in Pakistan

Dr. Rashid Anwar'

Introduction

Pakistan situated in the West Asia where the three mighty mountain ranges of Himalayas, Karakorum and Hidukush join together. The country enjoys the climate ranging from sub-tropic to alpine with an altitude from sea level to high mountainous regions. Due to its geo-strategic position, it comprises of assorted biological and cultural heritage. Out of 79.6 million hectare, 21.4 million hectare is cultivated area that still has scope for extension (Table 1). Half of this area is under grain crops which mainly include wheat, rice and maize.

Table 1: Agricultural Profile of Pakistan

Land area	79.61 Mha
Note available for cultivation	24.35 Mha
Cultivable waste	8.83 Mha
Forest area	3.48 Mha
Cultivated area	21.40 Mha
Rainfed area	4.29 Mha
Irrigated area	17.11 Mha
Cropped area	22.44 Mha
Area under grain crop	11.94 Mha
Cropping intensity	99.91
Land use intensity	66.60

Source: Agricultural Statistics; Ministry of Food, Agriculture and Livestock of Pakistan.

The country has beenn divided into 17 crop ecological zones based on physiographic. climate and soils characteristics (EGO, 1976). The detail of these ecological zones is further elaborated as under:

	Zones	Areas and climate
1	Thatta zone	Indus delta with clayey and silty soil. The climate is marine sub tropical. tropical.
' 2	Hyderabad zone	Frost free part of Indus floodplains. The soils are well drained clayey and loamy.
3	Sukkur zone	Arid part of the Indus plains, with less than 200 mm rainfal, very hot summer and mild but not frostless winter. Well drained and restricted drainage areas with clayey and loamy soils.

4	Faisalabad zone	Semi-arid belt (rainfall 200 to 400 mm) of the Indus plains, it has loamy and clayey, well drained soils. May and June are very hot but dry and July and August are hot with high humidity.
5	_ Gujranwala zone	~ Sub-humid part (rainfall 400 to 500) of the Indus plains, it has clayey soils with restricted drainage and loamy soils with good drainage. May and June are hot dry but July and August are hot humid. December, January and February are also rainy.
6	Peshawar zone	Covering the Peshawar valley with mild early summer and cold but rainy winter, it has clayey soils in the central part but loamy on the sloping sides. The central part has high incidence of frost, while the sloping sides are nearly frost free.
7	Thal zone	Sandy soils with arid to semi-arid sub-tropical (rainfall 150 to 350 mm)
8	D.I. Khan - Sibi zone	Long strip of piedmont plain on the west bank of Indus with arid area which depends on the storm water originating from Sulaiman mountain range. Clayey and loamy soils.
9	Gujrat zone	It covers the Himalayan piedmont plain with a gently, continuous slope and receive 500 to 1000 mm rainfall (70% in summer; 30% in winter).
10	Rawalpindi zone	Sub-humid part (rainfall 500 to 900 mm) of the Potohar with silty soils (wind-deposited silt).
ll	Talagang zone	Semi-arid part of the Potohar Upland, with 300 to 500 mm rainfall and mainly loamy soils. J
12	Muree-Swat zone	Sub-humid to humid (precipitation 500 to 1400 mm) highlands 1000 to 5000 meters high with steep slopes. Summer is pleasant but winters are cold.
13	Chitral zone	It is arid and semi-arid area of high mountains (more than 3000 mash with precipitation of 150 to 500 mm.
14	Quetta-Loralai zone	Mountain area with large, nearly level valleys and 200 to 300 ~ mm precipitation. The soil in the valleys is deep, highly calcareous loamy.
' 15	Mekran-Jhalawan zone	It is a plateau, 500 to 1500 meter high and climate is arid sub tropical with 50 to 300 mm rainfall. The soils are highly calcareous loamy.
16	Tharparker zone	Sand ridges with 200 to 300 mm rainfall occurring mainly during July and August, soils are very sandy. ~
17	The Cholistan zone	Sandy ridges with arid climate.

The major areas of the country receive low rains and each zone has critical features that induce high range of risks and uncertainty for agricultural production. Agriculture has been the main stay of the Pakistan economy that contributes about 24 % to the GDP and high portion of the total foreign exchange earning. More than 60 % of population is engaged in agriculture that provides food requirements, raw materials for agro-based industries and livelihood to the majority of the country's population. The contribution from the agriculture sector exceeds the same from any other major sector. Development of agriculture sector has been a crucial aspect in the economic development of the country for food security and sustainability. The agricultural productivity is experiencing the following natural risks:

Environmental. Risks

Due to the fact that crop has to face the environmental and natural hazards, biotic and abiotic stresses; therefore, agriculture sector in Pakistan is always at risks that have to face with many uncertainties. Although farmers and other stake holders often adopt measures for coping the threat but it is more likely associated with the term "uncertainty". The terms `risk' and `uncertainty' can be describe in many ways, as "Risk is more related to poor knowledge where the probabilities of the possible results are known but one has to pass through, whereas in uncertainty the expectations are not even known". The uncertainty is only an event and risk describes the event with possible consequences and solutions.

The risk and uncertainty can be considered as inescapable factors in agriculture and it may or not be associated with the decision making process and executing forces. Since agriculture is often practiced in the open air involving management of living plants and animals, it is exposed to various risks. The nature of the risk varies according to the situation that it occurred. For the purpose of this inquiry, the occurrence of risks in the country in the agriculture sector can be categorize as follows.

Farm risks

Pakistan have the benefit of four distinct seasons and climate ranging from tropics to near alpine that enhances the scope of diversity for most of the crops for cultivation. Due to various crop ecological zones and variety of crops produced in the country, risks to crops are different in nature. Environmental hazards hit the crops at particular spots especially in case of rainfall and hailstorms that might cause up to 100 % damage, whereas nearby fields escape. Agricultural production of the country is mostly dependent upon the weather patterns prevailed during a particular year. The main weather parameter which affects the crop growth are high temperatures, untimely rains, spontaneous hailstorm and floods, whereas other biotic and abiotic stresses cause a considerable loss which are expected routinely to the crop production. Biotic and abiotic stresses could be considered as risks that are expected either due to poor knowledge or production technology. The environmental hazards like hailstorms could hit at any places at any time. Although more than 60 % rains are received during monsoon but during some exceptional years, uneven rains may cause sever damage to the crops. Thus, upon receiving high amount of rain water just within a very short period, the consequent floods also damage the crop.

Two crop seasons, i.e., kharif and rabi are being observed in most part of the country. Kharif season starts from July and the crops cultivated during this season are mostly cash crops including cotton, rice, sugarcane, oilseeds and summer pulses. The risks to crop production during this season are mainly excessive water, high temperature, terminal drought that is sometimes accompanied with hailstorm at the time of harvest that might cause more than 50 % losses. Due to conducive environments, insect pests quite often damage the crop during this season that range from 10 to 50 % depending upon several situations. During normal year, rain water is available but some exceptional years have witnessed severe drought during this season that cause an uncertainty for farming community. Uneven and unpredictable rains result in the droughts affecting the crop production leading to serious economic setbacks. Thus agricultural producers of all categories including the small farmers are confronted with risk of producing their commodities. This risks mostly affect the food production sector where seasonal crops such as rice and other cereals, coarse grain, pulses, condiments, vegetables and some fruit crops are produced mainly for the local consumption. The drought prevailed in most part of the country during the years 2002 and 2003 that caused ruthless losses to wheat, rice and gram in Punjab while it caused serious setback to deciduous fruits in Baluchistan.

Agriculture in Pakistan mainly depends on Indus water resources. During the years when ample rains are received floods are expected during August onward. The floods which have become a constant factor due to heavy rains,

poor water harvest and storage cause damages to most of the seasonal crops grown in low lying areas of Punjab and Sindh. The extent of damages depend upon the number of days that particular land stays under the flood. Floods for couple of days will not cause any significant damages. However, prolonged flood will result excessive crop losses. In addition to losses to crop production, floods and heavy rains lead to soil erosion. Sometimes, landslides also cause damages to agricultural lands. The nature and causes of floods differ; therefore, the magnitude of damage varies with time, location and intensity. Overflow from rivers and tributaries cause extensive damages. Particularly, when water from Ravi and Jhelum rivers are merged with Indus water, the water level rises in the plains of Punjab and Sindh. As a result, the collective magnitude of water severely affect the country's food basket.

Biotic Risks

Apart from the risks due to climatic conditions, pests and diseases also affect the agricultural production. Unlike in the former case, the risk of causing losses from pests and diseases can be mostly avoided if proper management practices are undertaken. However, the risks from pests and diseases cannot be completely controlled but it could be manage to a certain level using various measures. It is reported that the rust disease in wheat can decrease yield up to 10 % depending upon the stage at which the crop is infected. Similarly in legumes, various diseases are serious threats which are still needed to cope for better crop production. Pakistan has witnessed epidemics in chickpea due to blight that caused total crop failure during eighties. This problem was taken seriously by the biologists and now blight tolerant varieties are available. Blight may cause the yield losses up to 40 %. Weeds are serious risk that is often faced by the farmers. Some crops e.g., lentil can be seriously affected by weeds. In case of locust attack, the damage to crop is so high that the whole crop is destroyed and even it hinders aerial spay of pesticides.

Abiotic Risks

Other very important uncertainty occurs in the form of droughts that often prevails during pre-khan°if, late kharif and rabi season. Three important cropping systems, wheat - rice, wheat - cotton and rainfed (wheat - oilseed, chickpea - fallow) are predominantly existing in the country and extent of drought during the three cropping season again different spatially and temporally. A severe drought could more disastrous than a major flood or any other natural hazard. Food grain production could be drastically reduced up to 30 % as a consequence of a drought. Geographically, Pakistan lies predominantly in semi arid zone except few areas with high rainfall is observed in Gujrat zone, Rawalpindi zone and Muree-Swat zone. Therefore during the years with low precipitation, drought is

very often phenomenon that is seriously needed to be addressed either through water management or developing drought tolerant cultivars of major crops or by shifting the cropping patterns. More than 20 % of cultivable land is rainfed in the country that produce more than 90 % of chickpea, 20 % wheat and about 60 % oilseed crops. This area is highly prone to sever drought conditions that also give rise to various biotic stresses. The problem related to water scarcity to crops under rainfed condition is more sever than anywhere else. During 2003, due to even distribution of rains in rabi season. water availability to wheat crop ensured self sufficiency that was mainly due to high share from rainfed area in national production. Due to low available moisture to plants and poor water retaining capacity of soils, the crops suffer from moisture shortage under non-irrigated condition. A huge areas of cultivated land in the country are affected by soil salinity of various degrees that is increasing at an alarming rate due to poor soil management.

Drought conditions appear over any of the vulnerable zone when the rain producing systems fail in succession. Winter rainfall generally fails when the tracks of Western disturbances which move on the area from the west, remain at a latitude of 35°N or higher. Under such a situation, no secondary western disturbances form below 30°N and consequently Sindh province and parts of Balochistan can completely go dry. This situation has been found to occur quite often. The situation get aggravated if the subsequent months of April and May also go completely dry and temperatures become very high which is a normal feature of these months. Evapo-transpiration tremendously increases that results in perpetual drought. During the summer months June to September, if a monsoon fails to reach our areas, the rains very scanty. Conditions further aggravate if the failure of summer rains is further supplemented by no rains during October and November as was the case during 1998 in Cholistan region from where tribes and nomads has dot shift to other places and government had to take emergency measures during the drought period.

EI-Nino and La-Nova phenomena are the recent discoveries in the science of Meteorology; these are abnormal weather phenomena. Whenever they appear, they change the weather patterns over the globe. For instance, the strongest El-Nino on record occurred in 1982-1983. The monsoons in 1983 failed badly. Again 1997-98 was the strongest EI-Nino year comparable to that one in 1983. Summer season of 1987 during which drought conditions were observed over all of the southern regions was a very peculiar one in terms of monsoon rains. A significant number of monsoon depressions didd form over the Bay of Bengal and move north-westward, thus producing the expectancy of rains over the central plains of Pakistan. Drought of even one season in extent can significantly affect the biological and socioeconomic conditions of life of the people of Pakistan. The recent introduction of a computerized data base on climate in Pakistan combined with the advances in long range forecasting of seasonal precipitation and drought will be fulfilled (Kruss, 1989).

Socio-economic Risks

The risk involved in input as well as at output stages is known as Marketing Risk that is
quite a constant phenomenon in a country like Pakistan where good harvest may not necessarily ensure farmers' prosperity. This is very common from of risk faced in agriculture and as well as in all economic activities in day to day living. The prices of farm inputs as well as of the outputs are not constant and subject to changes. Most of the inputs including fertilizer (DAP), fungicides, herbicides and pesticides used in agriculture are imported. The prices of most of these items are subject to frequent changes with the government policies, exchange rate as well as prices in the international markets. Therefore, at the time of decisions about how much of which inputs to use or what and how much of various products to produce are being exposed to unpredictable situations. In some instances government declared minimum support price for the purchases of commodities but it could not be able to provide the necessary mechanism for procuring that particular commodity.

Institutional risks

Government agencies are another source that causes risks in agriculture. The policies towards agriculture are responsible for this type of risks that is concerned with various forms of production incentives that government can provide favourable rates and ensure agricultural loans, marketing interventions, and guaranteed price for farm produce that will contribute to reduce the risks involved in agriculture. Timely supply of inputs at appropriate prices and ensured procurement at attractive prices would greatly encourage the farmers for better management. Yearly fluctuation in prices especially for produce shatter the confidence of farmers in case of seasonal vegetables and minor crops.

Agricultural enterprises are most often faced with financial risks that are attributed toward small farmers, poor credits and lack of insurance of crop production. Although Government has launched policies for funds through Zarai Tarkiati Bank and Khushali Bank but due to unawareness or one other reason most of the small farmers are deprived from this facility. Except for one's own money all the other financing sources involved paying high interest on it and some farmers are reluctant to borrow on interest that cause
scarcity of funds for agricultural inputs. In addition the most significant of these are rise in interest rates on borrowed funds or as often happened crop losses due to natural calamities where farmers are unable to pay back and are thrown in sever economic deficit.

Human or Personal risks

The person who operates different activities of the enterprise may be source of risk for the profitability of the farm business. Major life crises such as a death, illness or sudden accidents of the owner or the partner of the faun may threaten the existence of the agricultural business. Carelessness by the farmer of farm workers in handling the various activities of farm may lead to significant losses. Such risks are referred to as Human or Personal risks.

Coping Strategy

The risk and uncertainty are unavoidable in daily life and so in agriculture - it is not something to be afraid o£ It is often said that, in business profit is the reward for risk - no risk means no gain. In agriculture, risk is easy to minimize but uncertainty or natural calamities are difficult to address. Therefore, the task is to manage risk effectively within the capacity of the individual, business or group is more important in agriculture. Farmers have understood the existence of risk and have adjusted to it in their own ways in running farming enterprises. There is need for farmers to plan for the risks they face and how well is the systematic application of management

policies, procedures and practices in identifying, analyzing, assessing, treating and monitoring risk. It should be the integral part of the management system which will pave the way to avoid losses and maximize opportunities. It is not a set of procedures that are followed once and for all rather it is day to day adjustment. However, in the changing would the nature and consequences of risk are also constantly evolving. Perhaps, it should be a continuous adaptive process that needs to be integrated into all relevant aspects of decision-making process of the organization.

The risk management options or coping strategies adopted to reduce or avoid risk may vary from one country to another. However, each country has designed its own coping strategies depending on the nature of risks encountered in their own specific situations. Pakistan has developed several coping strategies in order to minimize or avoid risks. It is observed that more than 60 % of the suppliers are from the producer category and most of the buyers are wholesalers. The middlemen either for inputs or farm produces in agricultural business are much influential that is serious needed to be investigated. Crop diversification is one of the oldest form of risk management strategies adopted by the farmers all over the world, especially in developing countries. This system was widely practiced in China where mixtures of crops were grown on the same piece of land. Similar system is being followed by farmers in mountainous regions of Pakistan, where risk in agriculture is high as compared to other areas. Since there are number of crops grown on the same piece of land the risk of losing the produce is minimized when compared to monoculture situation. Crop diversification is recommended for the areas with high environmental risks where single crop cannot be raised due to shortage of

inputs. Under these circumstances crops which require lesser amount of water such as Pulses (green gram, cowpeas, moth bean, rice bean) or oilseeds are grown in mixed culture. This will overcome risk involved and gives a better income for the farmer from the same piece of land. Crop diversification besides being useful in averting risks, it will make best use of available resources and allows more productive and sustainable crop rotations.

Number of credit schemes are operated by both public and private sector Banks. The public sector Banks always operate credit schemes with low interest rate enabling small farmers to obtain credit for their cultivations. During recent years, one window operation initiated by Zarai Tarkiati Bank got popularity among farmers that made much easy to get loans up to certain limit without involving length processing protocols. This enables farmers to over come financial risks faced during the cultivation season.

A huge network of research and extension services are provided by the government although lateral is not very much effective but with appropriate policies these resources could be mobilized that surely will minimize risks in agricultural production. Varietal development and technology generation are carried out by various research institutions of public sector and from where information is disseminated through extension department through a bridge of adaptive research farms whish are location in the hot - spot of agricultural commodities. With meagre resource spent on research, a considerable number of varieties and production technologies have been developed which are being adopted by the farmers, especially in wheat, rice, cotton, maize, pulses and oilseeds. Inclusion of hybrid seed technology in cotton and oilseeds has increase farmers' productivity at significant rate. Development of high yielding varieties of rice, wheat and cotton by national breeders have assisted the country for food security and selfsufficiency in agriculture. Inclusion of new crops in existing fanning systems could be another option for diversifying agricultural productivity. Owing to special features and the high yield potential of minor crops they have the potential to be grown in rainfed areas where they are expected to less competition with other important crops. Traditional pulses, like chickpea and lentil are under sever threat of elimination because of biotic and a-biotic stresses, therefore addition of new crops is imperative.

Conclusion

The integrated approach involving all the stakeholders of agricultural business could minimize risks, whereas uncertainty or natural calamities can affect inflamingly infrastructure including crops under field, products in warehouses or watersheds. Floods, sever drought, high levels of salinity need to be addressed seriously and taken as priority for long term planning and development. The most devastating recent earthquake caused a serious damage in vast areas of NWFP and AJK causing loss to life, infrastructure, crops in fields, grain stores and even biodiversity in that particular area. Although natural

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Risks in Agriculture and Their Coping Strategies in Sri Lanka

Mr. D.B. Weeratungal

Sri Lanka is a small Island in the Indian Ocean situated at the southern tip of the Indian subcontinent within the equatorial belt. Agriculture has been the main stay of the Sri Lanka economy. It contributes 19 per cent to the GDP and 22% of the total foreign exchange earnings in the year 2003. The agriculture sector provides most of the countries food requirements, raw materials for agro-based industries and livelihood to about 40% of the county's population which is exceeding the contribution of any other major sector. An estimated 1.8 million families are engaged in farming. Thus the development of this sector becomes a crucial aspect in the economic development of the country.

Like most of the South Asian Countries in the region, the agriculture of the country is always faced with risks. The term risk is always associated with the term "uncertainty". Therefore, it is pertinent to understand these two terms in the context of agriculture. The terms `risk' and `uncertainty' can be describe in many ways. However, for the purpose of this inquiry it is been describe as follows. Risk is the imperfect knowledge where the probabilities of the possible outcomes are known where as in uncertainty the probabilities or consequences are not known. The uncertainty is only an event but in risk it describes the event with possible consequences. Thus risk and uncertainty can be considered as inescapable factors in agriculture and it is always associated with the decision making process. These two terms are used in day to day in quite synonymously.

Since agriculture is often practiced in the open air involving management of living plants and animals, it is exposed to various risks. The nature of the risk varies according to the situation that it occurred. For the purpose of this inquiry the occurrence of risks in the country for the agriculture can be categorise as follows.

1. Production risks

As a tropical country situated within the equatorial belt, the agricultural production of the country is mostly dependent upon the weather patterns prevailed during a particular year. The main weather parameter which affects the crop growth is rainfall. Country receives rainfall from two monsoons (North-East and South-West monsoon) supplemented by cyclonic depressions occurring at time to time depending on the weather patterns in the Indian Ocean. The rainfall pattern in the country is very erratic, unevenly distributed and unpredictable with often expected rains were not received. This results in frequent droughts affecting the crop production leading to serious economic set backs. Thus agricultural producers of all categories including the small farmers are confronted with risk of producing their commodities. This risks is mostly affects the food production sector where seasonal crops such as rice and other cereals, coarse grains, pulses, condiments, vegetables and some fruit crops are produced mainly for the local consumption. In a drought situation it is mostly the rice farmers who were at a grate risk of loosing their produce.

Similarly floods due to heavy unexpected rains are quite frequently reported in recent times. This will cause damages to most of the seasonal crops grown in lower landscapes. The damages caused may depend upon the number of days it is under floods. Floods for couple of days will not cause any significant damages but if it prolongs for longer period it may results crop losses. In addition to floods, heavy rains lead to soil erosion and even sometimes landslides causing damages to agricultural lands.

Apart from the risks from the climatic conditions incidence of pests and diseases also affects the agricultural production. Unlike in the former case the risk of causing losses from pests and diseases can be mostly avoided if proper management practices are undertaken during its growing period. However, the risks from pests and diseases cannot be completely control but it could be manage to certain level using various measures which will be describe later.

2. Marketing Risks

This is very common form of risk faced in agriculture and as well as in all economic activities in day to day living. The prices of farm inputs as well as reasonable prices for the outputs are not constant and subject to many changes. In Sri Lanka most of the inputs used in agriculture are imported. The prices of most of these items such

as fertilizers, pesticides, machinery etc are subject to frequent changes with the government policies as well as prices in the international markets. So at the time of taking decisions about how much of which inputs to use or what and how much of various products to produce are being exposed to unpredictable situations. In some instances government declared minimum guaranteed price for the purchases of commodities but it could not be able to provide the necessary mechanism for procuring that particular commodity. This often happen in marketing the staple commodity, rice (paddy). Thus the paddy farmers face a risk in marketing their produce. Thus risk involved in both input as well as at output stages is known as Marketing Risk.

3. Institutional risks
Governments are another source that causes risks in agriculture. The Government policies towards agriculture are responsible for this type of risks. It concerned with various forms of production incentives that government can provide such as favourable interest rates for agricultural loans, marketing interventions, guaranteed price for farm produce etc. will always contribute to reduce the risks involved in agriculture.

4. Financial risks
Agricultural enterprises are most often faced with financial risks. It results from the method of financing the activity. Funds for the purpose can be obtained by two sources. own funds and burrowed funds from Banks, Money Lender or from a Financial Institutions. Except for one's own money all the other financing sources involved paying interest for the burrowed amounts. Thus a risk involved in paying back the burrowed capital and the interest accrued on it. The most significant of these are unexpected rises in interest rates on borrowed funds, the unanticipated calling in of loan by the lender or as often happened crop losses due to natural calamities.

5. Human or Personal risks
The persons who operates different activities of the enterprise (Farm) may themselves be source of risk. for the profitability of the farm business. Major life crises such as a death, illness or sudden accidents of the owner or the partner of the farm may threaten the existence of the business. Carelessness by the farmer or farm workers in handling the various activities of farm may similarly lead to significant losses. Such risks are referred to as Human or Personal risks.

The risk and uncertainty are inescapable phenomenon in day today life as well as in agriculture, so it is not something to be too afraid of. It is often said that, in business, profit is the rew and for risk bearing: no risk means no gain. Therefore the task is to mo.~jage risk effectively within the capacity of the individual, business or group. Farmers' world over have always understood the existence of risk and has adjusted to it in their own ways in running their farming enterprises. The need for farmers to plan for the risks they face and how well farming risks are managed is very important in any risk aversion strategy. Risk management is the systematic application of management policies, procedures and practices in identifying, analysing, assessing, treating and monitoring risk. It should be the integral part of the management system which will pave the way to avoid losses and maximize opportunities. It is not a set of procedures that are followed once and for all However, in the changing world the nature and consequences of risk are also constantly evolving Perhaps, it should be a continuous adaptive process that needs to be integrated into all relevant aspects of decision-making process of the organization.

The risk management options or coping strategies adopted to reduce or avoid risk may vary from one country to another. However, each country has designed its own coping strategies depending on the nature of risks encountered in their own specific situations. Similarly, Sri Lanka also has developed several coping strategies to minimise or avoid risks. Some of these strategies are discussed below:

1. Rice varieties of different age classes
Rice is the staple food in Sri Lanka and it occupies a central position in the economy, culture and society. The development of the rice sector is very much important in achieving food security of the country. The cultivation of rice is seasonal (Maha and Yala seasons) coinciding with two monsoons and can be categorised under two types, rain fed and irrigated. The source of irrigation for both these types is from the annual rain fall it received. Thus the total extent cultivated for a particular year depends on the amount of rains it received. However, the timely availability and the amount of rains received will drastically vary from year to year. The rice f :rmers9 thus faces risky situations at the beginning or during the season which may affect the production. This situation was quite prevalent in recent past. In order to minimise or to avoid the risk involved in this type of situations, rice

varieties are available in three different age classes, 4-41/2 months; 31/2 months and 3 months. These varieties will fit into different growing patterns depending on situation.

2. "Bethma" cultivation

It is a land tenure system practiced in the traditional villages of the country to overcome the risk in a drought situation. Instead of cultivating all the irrigable paddy lands in a village in a season of uncertain rainfall or poor tank storage, this system enables all the villagers owning lands in that village to cultivate lesser but proportionate extents in a favourable and compact area of land in the village. Under this system not only the risky ness of the drought loss potential is minimized, but every person is given an equal chance of getting some income rather than some is losing heavily and others gaining marginally by cultivating all the lands.

3. Crop Insurance Scheme

Natural calamities such as floods, droughts and as well as epidemics of pests and diseases can cause heavy losses to both crop production and livestock farming. This has led most of the agricultural enterpris es to operate with certain amount of risk. In order minimized or to avoid the risks involved, the crops and the livestock are insured against these hazards under Crop Insurance scheme. This scheme is operated by Agricultural and Agrarian Insurance Board (AAIB) which is state owned statutory organization under the Ministry of Agriculture. The Crop Insurance was started as far back as 1961 for the benefit of rice farmers in few districts. However, in 1974 with the establishment of new Statutory Board island wide coverage was given along with livestock farming. The scheme is governed by Parliamentary Act providing the necessary legal status for the scheme. The scheme was first started with rice and later extended to all the food crops including the perennial crops grown in the country. At present there are 18 different schemes covering almost all major cultivated crops. In addition to crops sector, Livestock Insurance Scheme also operated by the AAIB in order to ensure the economic stability of farmers engaged in milk production The principle of insurance is a risk-sharing device, which will provide the small farmer some sort of a security against natural calamities and other unforeseen circumstance faced during the production cycle.

The premium paid only once depends on the crop that is going to be insured and the expected indemnity if loss is reported. The seasonal crops are insured from planting to

harvest while the perennials are insured for much longer period, from planting to first bearing (3-4 year period). At present the crop insurance is not a compulsory but it is a voluntary programme. As such the extents of different crops that are been insured will vary from year to year. The extent insures And indemnities paid under the staple crop, Rice during the last six years is indicated below.

Table 1. Operation of the Crop Insurance Programme for Paddy 1996 – 2004

Year	**Extent insured ('000 ha)**	**I Premium collected (R-:_'000)**	**Indemnities paid (Rs. `000)**
1998	14	945=	5821
1999	13	8303	5809
2000	12	7079	3980
2001	4.7	2681	2969
2002	4	2539	1973
2003	8.4	5993	3804 ,
L 2004		5099	8571

It shows a declining trend in spite of it been ititroduccd as <i programme to nait7irnize the risks faced by farmers. However, by examirria-ig the above data further it revealed that the indemnities paid has not exceeded the premium collected. As such it has not incurred any loss to the Board. This implies that it can be further improve taking into factors such as indemnities paid should commensurate with the escalating cost of production. This may results in more farmer participation for the scheme.

The livestock insurance scheme is becoming more popular among farmers when compared with crops (Paddy) at the same period as indicated in Table 2.

Table 2. Livestock Insurance for Cattle from 1998 to 2004

Year	No. of animals insured	Premium collected `U00)	Indemnities paid ('000)
1998	7297	2566	1257
1999	10301	3659	1319
2000	10109	3673	1427
2001	8606	3102	1531
2002	7460	2575	2059
2003	9389	2979	12495
2004	6987	3567 12170	

The available data indicates that .ere i_ increase farmer participation andd the indemnities paid does not exceed premium collected. Thus it does not incur any loss to the Board. The livestock insurance is oenetited to ly-~cstock farmers as it provides a security for their animals especially agaln,t it) disea>e oat breaks which in, turn build the farrner's a confidence against facing risk. Thus both crop and livestock insurance schemes should be looked as mechanism available to guard against the numerous risks faced in the production process.

4. Farmer's Pension and Security Benefit Scheme

This is also another form of` government intervention against risk. In Sri Lanka tl~e employees in the both public and private sectors are provided with old age relief on the eve of their retirement by way of life time pension or a lump sum payment from provident fund. However, panners, who toil their lifetime to feed the nation do not enjoy the benefits of such social welfare programmes. It was, therefore felt that the contribution of these farmers to national development effort should be recognized with some tangible measure to reward there in old age. The Farmers' Pension and Social Security Benefit (FPSSB) scheme was introduced in 1987 in order to fulfil the above need. Like the Crop Insurance scheme this is also administered byAAIB.

Only farmers between 18 an d 59 years of age are eligib. for nerrib a, =ship in the programme. Land ownership is not a condition for joining tile scheme, evenn landless farmers and agricultural labours are eligible for benefits. Farmers who beeomle members are paid a monthly pension from the age of dJ until their death.. The premium and amount they receive is based on their age when they joined the programme. If a farmer joined at the age of 18, then the premium is Rs.130 per year. He is then eligible for Rs.4167 a month when reaches the age of 60. If a farmer joins the programme between the ages of 55 to 59 tl;en his premium is Rs.690 per year and he will receive Rs.1000 as his monthly pension at the age of 60. Younger farmers have to pay lower premium and older farmers , conversely; pay higher rate. This will encourage younger farmers to join the scheme. The pension premium are paid twice a year at the end of each cultivation season.

In addition to the monthly pension, this programme offers several other attractive benefits to member farmers. Every farmer is entitled to a disability allowance up to Rs.50000 on account of any disability resulting from illness or accident before reaching the age of 6o years. In a premature death the heirs will get a death gratuity of Rs.25000 and the total premium paid by the contributor with the interest thereon

Review of the scheme, after ten years of its establishment (1987-1997) indicates that 333,570 farmers have enrolled for the scheme and Rs.98.4 million have been paid as payment. During the first ten years of its inception, it was observed that 57% of the total number enrolled is among the age group of 18 -35. This is fairly good indication to show that younger people are opting for agricultural pursuit. At present the monthly pension bill is about Rs.30 million is paid to about 30,000 pensioners. Similarly under the social

security benefit scheme from inception in 1987 to 2005 August Rs.130 Million has been paid to 8137 farmers as disabled and death gratuity payments. .

The FPSSB scheme, thus can be consider as programme that will encourage the participation of youths in agricultural enterprises as well as a security measure that will find in any other employment. This will help the people to remain in agriculture rather than moving out by removing the risks involved.

5. Forward sales contract system

Is a mechanism used to manage marketing risks in agriculture. One of the serious problems of the small farmers in Sri Lanka is the marketing of their agricultural commodities at a reasonable price. Numerous attempts have been in the past by way of various government interventions such as setting up of purchasing organizations, guaranteed price schemes, liberal loan facilities for these institutions etc to solve this problem. But any of these proved to show any success. Perhaps, it incurred heavy losses forcing the government to close down these institutions. It has now been realized that granting fair prices for agricultural commodities through government intervention is futile effort crating many complexities. As such appropriate marketing system beneficial to all parties involved is formulated within the market mechanism. The parties involved are the farmers who expects a reasonable price for their produce, the buyers and processors who wants to purchase suchh produce and the Banks which provide loans for production and marketing of those commodities.

The Central Bank of Sri Lanka by considering all these aspects, introduced Forward Sales Contract (FSC) system in 1999. It is an agreement made between a buyer and a farmer to sell agricultural commodities to a buyer on a certain future date at pre-determined reasonable price. A contract could be entered into by putting the above consensus into a written form and getting the buyer and the seller to sign it. As a result of this contract farmer gets a stable market to sell his produce at a pre- determined reasonable price and the buyer agrees to purchase them at the same price. Thus it would be possible to maintain a stable price for agricultural commodities through such contracts.

In Sri Lanka legal provisions have been provided under the laws relating to the Sale of Goods of this nature. The contract made between the two parties is accepted as a valid legal document.

In order to streamline the activities involved in FSCs it needs services of a facilitator to assist the two parties in reaching consensus, finally to enter into an agreement. Very often the Bank officials will serve as a facilitator and he can be charge about 1% of the agreed amount for his services.

Thus in FSCs there is no government intervention. It is a self operative marketing system by which farmers, traders, Banks and industrialists will be jointly benefit. As such it is good coping strategy adopted in order to reduced or avoid risks. The system has now been accepted as very popular marketing system by farmers and buyers in many parts of the island.

6. Dedicated Economic Centres

This is also another form of market intervention by the government to establish a stable market for agricultural commodities thereby minimising the marketing risk of the farmers. Dedicated Economic Centres are establish in key producing areas of the country which are located in a strategically important place where it will have easy access to producers, buyers and other markets. These are set up exclusively for marketing of agricultural commodities with the objective of bringing the producers and the buyers under one roof with the involvement of a "commissioning agent". There is no involvement of "middlemen" or any other interventions. These centres are provided with facilities to do the business transactions in a much conducive environment. The commissioning agents are provided with office room cum store facilities, ample parking place for vehicles, banking facilities and

other necessary facilities. There are nine such centres established in key different producing areas of the country. These markets are mostly function from the evening to mid-night. This has become convenience for the farmers to work in the farm during the day time and bring their produce in the evening for sale. This will also helps to keep most of the agricultural commodities such as the vegetables, fruits etc. in fresh state so that it will be more attractive for the buyers.

A study done recently reported that over 60 % of the suppliers are from the producer category and most of the buyers are wholesalers. The middlemen category is very much less implying that producers have greater chances of selling their products directly to the trader. In this way producers get a better price for their produce and consumers also get a reasonable price for their purchases. Thus it will help to reduce the marketing risk of the farmer.

7. Crop diversification

This is one of the oldest forms of risk management strategies adopted by the farmers. This system was widely practiced in the Chena Cultivation where mixture of crops were grown on the same piece of land. As the chena type of cultivation is carried out under difficult conditions it may face several risks. Since there are number of crops grown on the same piece of land, the risk of losing the produce is minimised when compared to mono-culture situation. The crop diversification is recommended for the Yala season (dry season) in paddy fields where a successful crop of rice cannot be raised due to shortage of sufficient amount of water. Under these circumstances crops which require lesser amount of water such as Maize, Pulses (Green gram, Cowpeas, Soybean etc) or Vegetables are grown. This will overcome risk involved and gives a better income for the farmer from the same piece of land. Crop diversification beside being useful in averting risks, it will make best use of available resources and allows more productive and sustainable crop rotations.

8. Government Interventions

Ther(. are several ways by which the government intervene to minimise or avoid risks in agriculture. It can be direct or indirect involvement in the input supply or with the output supply which may finally useful in the farmers' decision making process. Some of the government interventions that are been functioning at present are indicated below.

i. Fertilizer subsidy

The fertilizers recommended for the crop production are imported to country. Its costs are often fluctuates with the international market prices leading to high prices which are unbearable for an average farmer. The escalating prices may lead to skip or reduce the quantities recommended for application which may cause drop in production of the particular commodity. In order to reduced or to avoid this risk of using fertilizers as per recommendation government has introduced the fertilizer subsidy. Out of the three types of fertilizers, most widely used and one that critically affect the crop yields, Ureaa has subsidized by the government. This has enable farmers to use urea in required quantities thus taking care of the risk involved. In the year 2003 fixed sutra of Rs.6000 per metric ton was given as subsidy for urea irrespective of the international price.

ii. Low interest credit schemes

Number of credit schemes are operated by both public and private sector Banks. The public sector Banks always operates credit schemes with low interest rate enabling small farmers to obtain credit for their cultivations. This will enable farmers to over come financial risks facedd during the cultivation season.

iii. Research and Extension

In Sri Lanka, research and extension services are provided by the government. Varietal development and technology generation are carried out by various Research Institutions belonging to the government. Large amounts of money have spent on this activity with some outstanding performances. Development of high yielding Rice varieties by our own scientist is notable achievement in this sector. This has led to achieve food security in our staple rice. Any problems related to pests and diseases affecting crops, soil or any agronomic problems related to crop production are referred to the concernedd research station and solutions are sought without being charged. Similarly extension services are provided to the farmers free of charge.