III.2.2 Coping with Climate Variability and Climate Change

III.2.2.(i) Improving the Issuing, Absorption and Use of Climate Forecast Information in Agricultural Production: Monocropping

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In an agrarian economy, an ideal way to cope with climate change/climate variability is to develop strategies/plans that are implemented at multiple spatial (national, provincial, county/district or at grass-root/farm scales) and temporal (annual, seasonal or daily) scales. This ensemble of strategies in the form of agro-meteorological advices/services should be implemented simultaneously to get the maximum benefit to the local farmer and the economy (e.g. Hellmuth et al. 2007). Unfortunately, the term "risk management" remained in use here and elsewhere, while all evidence shows that farmers in poor countries have the largest difficulties to cope with climate risks and uncertainties and do not manage these risks at all. The issue is preparedness in various forms (Rathore and Stigter 2007).

"Agrometeorological services for agricultural production" and "agrometeorological support systems to such services" are critical in this regard, as long as they are taking place within the livelihood of farmers (Stigter et al. 2000; Stigter 2005, 2008). It should be considered that not only scientific or operational limitations, but also political, economic, socio-cultural and financial factors are important aspects (Stigter et al. 2000; Stigter 2008). Climate forecasting information is only one kind of information that only under well understood conditions of probability, uncertainty and limitations can be brought to farmers (see also Box III.2.10).

Box III.2.10 (Contributed by Kees Stigter)

The success of long-lead El Niño and La Niña forecasts in North America has led to enormous interest in seasonal prediction worldwide, including in developing countries, and has led in many instances to unrealistic expectations about them. The fact remains that climate predictions have at best modest skill, and in many circumstances no or marginal skill, in the absence of a strong ENSO signal. See also Chap. IV.12. Nevertheless, it has been argued forcefully by a number of groups that these sets of forecasts have tangible

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economic value for a class of decision-makers and users. The credibility of the arguments depends on whether real decision-makers and users behave in the manner assumed in the models. Estimates of the uncertainty in forecast value for different forecast skills and realistic iterations of the forecasts/decisions have been made, with different simple assumptions about the psychology of the user (for example, the user abandons use of the forecast if the forecast was wrong two winters in a row).

The computed uncertainties cast considerable doubt on the utility of marginally skilful forecasts sets for individual users and provide a sense of what skill levels are necessary to increase likelihoods that relatively short sequences of forecasts/decisions will be of value. These levels turn out to be relatively high, comparable to the performance of the strong ENSO event "forecasts of opportunity." Including again the presently most common form of these forecasts, care should be taken that this agrometeorological service tool is not overestimated by wishful thinking. Much more case studies should be collected on actual attempts to use such forecasts and in what form this has been successful for which target groups of users under what conditions (WMO 2010). This will assist in the needed improvements of successful production, presentation and use of seasonal and other long term climate predictions (Livezey and Mayes 2004; WMO 2010).

Since farmers should be prepared to meet the vagaries of meteorological parameters on crop performance, *climate information* needs to be efficiently disseminated to them. Interesting examples may be found in recent reports on several years of identifying and researching of agrometeorological services in five provinces in China (Stigter et al. 2008a,b,c,d,e). This featured the importance of the art of reaching farmers with the information available/needed in the Chinese "cascade" system from Provincial Level, Sub-Provincial Level, County Level and Township Level to Village Level (Stigter et al. 2008a). At the lower levels, extension officers and village technicians must play an important role (see also Stigter et al. 2007). This should be compared with a system of Climate Field Schools as recently developed elsewhere in Asia (Winarto et al. 2008).

The use of climate forecasting was important in the examples of "Sowing advice for spring wheat depending on the frost melting condition in the autumn irrigated top soil in Bayabnaoemeng" (Stigter et al. 2008a); "Forecasting fungus disease conditions for wolfberries" (Stigter et al. 2008b); "Refined agro-climatic zoning used for planning of growing navel oranges, and protection advisory services after planting" (Stigter et al. 2008c); "Water saving irrigation determined by soil moisture forecasting for wheat farms in the Huang-Huai-Huai Plane, Henan" and "Forecasting peony flowering periods for various varieties and places in Luoyang city, Henan" (both in Stigter et al. 2008d) and "Early warning of low temperatures and less sunshine for plastic greenhouse crops in winter" (Stigter et al. 2008e).

A study was conducted in the Brazilian Amazon that examined the farmers' coping strategies in the in response to El Nino and the related weather events (Moran et al. 2006). It was concluded that hitherto, little attention was explicitly given to the impact of ENSO events by the farmers. This study deciphered the existence of a range of locally developed forecasting techniques and coping mechanisms that the farmers adopted even when they were ignorant about the physical reasons for the ENSO events. Increased access to scientific forecasts would greatly enhance the ability of the farmers to cope with El Nino related weather events that the farmers have sustained over the years (see also Box III.2.10). Moran et al. (2006) speculate that the distribution of an El Nino Prediction Kit at the end of the study and a series of workshops (such as climate field classes) may lead to better local information on rainfall variability and create a farmer-maintained grid of collecting stations to sensitize farmers to the variability of precipitation in the region, and on their property.

Box III.2.11 (Contributed by Kees Stigter)

An example of an organizational context in Africa is shown in that in 2003 the Drought Monitoring Centre of Nairobi was changed into the IGAD Climate Prediction and Applications Centre (ICPAC) in order to reflect better all its new mandates, mission and objectives. One of its three objectives is to improve the technical capacity of producers and users of climatic information, in order to enhance the input to and use of climate monitoring and forecasting products. Its mission is described as "fostering sub-regional and national capacity for climate information, prediction products and services, early warning, and related applications for sustainable development in the IGAD Sub-Region". The recent past climate over the Horn of Africa is provided through decadal, monthly and seasonal summaries of rainfall and drought severity and monthly temperature anomalies. The current state of climate is monitored and assessed using climate diagnostics and modeling techniques. These are derived from information on the state of the sea surface temperature anomalies over all the major ocean basins, surface and upper air anomalies of pressure, winds and other climate parameters.

The prediction products are provided through outlooks for a decade, month and season. Consensus pre-season climate outlook fora are also organised in conjunction with the major climate centres world-wide in order to derive a single consensus forecast for the region. An assessment of the vulnerability together with the current and potential socio-economic conditions and impacts (both negative and positive) associated with the observed and projected climate anomalies is also made on decadal, monthly and seasonal time scales. These products are disseminated to all NMHSs of the participating countries to serve as early warning information to a variety of sectoral users of meteorological information and products including policy makers, planners, health, energy, agricultural and water resource sectors, farmers as well as research institutes among others, where they can be used to establish services (WMO 2006).

One of the several effects of climate change is the increased occurrence of droughts (e.g. Hellmuth et al. 2007). In order to achieve self-reliance and reduce the impact of drought, there is a need for a national drought policy that supports the necessary research and educational infrastructure so that farmers, agri-business and rural communities can better anticipate and cope with droughts. Efficient drought policy and increased awareness makes the farmers more self-reliant making them "proactive rather than reactive" as seen in Australia and southern Africa (White 2000). There is a need for integrating drought forecasting and preparedness efforts, farmers' understanding of climate-crop interactions and interventions that support the capacity of resource-limited households. In the literature, there are several Africa-centered studies that have taken a household-level approach to understand farmer's perception to environmental change (e.g. Bratton 1987; Corbett 1988; Campbell 1999; Roncoli et al. 2001; Vogel and O'brien 2006). See also Box III.2.11 (WMO 2006).

Climate information, in addition to seasonal climate forecasts, is a potential tool for early-warning systems such as for the occurrence of pests, diseases and related weather conditions (e.g. Stigter and Rathore 2008; Stigter et al. 2008b). It is also required by applied agrometeorologists to assess the risks associated with the existing and newly developed plans to forecast pest and diseases, and to assess the impact of these techniques on productivity, profitability and sustainability in the event of climate change (Strand 2000).

Information has value when it is disseminated in such a way that the end-users get the maximum benefit in applying its content (Weiss et al. 2000). Applied agrometeorology should therefore explore the potential of new information and communications technologies to improved crop production (Stigter et al. 2007). The World Wide Web can play a critical role in the collection and transfer of information between the scientist and the farmers, especially in developed countries where the computer literacy and the economic and educational levels of the farmers are quite high (USA, Canada, Australia etc.). However, in developing countries, where the internet-mediated information transfer is practically difficult, strategies such as Multi-Purpose Community Telecentres (MCTs) will be the equivalent of an information hub (Weiss et al. 2000). Radio can be used to transfer information from MCTs to rural areas.

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