The establishment of needs for climate forecasts and other agromet information for agriculture by local, national and regional decision-makers and users communities

by

C.J. Stigter[11]

Abstract

An "end to end" scheme in agrometeorology, for the build-up and transfer of agrometeorological and agroclimatological information, which was recently developed by the author, is validated in this paper with case studies from the most recent literature from Latin America and Africa. The introduction places the establishment of needs for climate forecasts and other agrometeorological information for agriculture by local, national and regional decision-makers and users communities in the right context of the local, national and international livelihood conditions of farmers and their communities. It may be concluded that after this exercise this scheme is a good guideline for understanding the value of activities in the fields of data, research, education, training & extension and policies, for the design of agrometeorological services for end-users. The main bottlenecks appear to be: (i) insufficient considerations of these actual conditions of the livelihood of farmers and therefore; (ii) developments of inappropriate support systems. Local, national and regional decision-makers have to be honest and serious and have to come up with proposals and actions that create appropriate policy environments. The training of suitable intermediaries has now been considered in Latin America and Asia, but there is a need for serious pilot projects of this kind to not have this need suffering from the same bottlenecks as already mentioned.

Introduction

At the end of the previous century we have emphasized within the Commission for Agricultural Meteorology (CAgM) of the World Meteorological Organization (WMO) that the regionalization issue complicates operational agrometeorology tremendously (Stigter 1999). For each of the regions that are distinguished within WMO, as well as within these regions, we have to consider the existing farming systems and their positions in the economies of the countries concerned. We also have to take care of the possible future of these economies and the roles these farming systems and any changes in these farming systems may play in the economical dynamics of farming communities and the countries as a whole (Stigter 2001b). That is why important developments in such countries, so in their cities and communities, in the fields of for example education, health, population density, land distribution, migration, natural resources management, employment, income, poverty alleviation, food security, water security, nutrition and environmental conditions have to be understood as detailed as possible in any discussions on future developments.

In the developing countries, in particular the level of organization varies from region to region, from country to country and from community to community. Attempts of governments to "capture" the peasantry into a more centralized organization and a regional economy have met with mixed successes, particularly in more resource poor and more remote areas. Moreover, natural resources management other than that related to agriculture, forestry, livestock and fisheries is most often not in the hands of local communities but in those of a class of entrepreneurs with better connections to the powers in charge. Frequently land ownership complicates local economies and on-farm and off-farm employment conditions determine the income distributions within the rural communities and how they compare with those in trade, in exploitation of resources, in cities, where they are particularly complicated, and in services, including government services. These conditions, imperfect markets and "soft

[11] Intradepartmental Group on Tropical Agrometeorology TTMI/African Network and APM Project Liaison Office Department of Environmental Sciences, Wageningen University, Netherlands

states" are the very reason for the damages that globalization is doing to rural areas and intermediate cities in developing countries. Only regionalization and policies in favour of local communities may make it possible for rural areas, particularly the poorer and remoter ones, to catch up.

Whenever rural communities have to cope with change, all the above factors play a role. When conditions are changing fast and for the worse, like very often at present in many developing countries, the need to assist local communities in surviving the consequences of such disasters is growing. However, the pertaining levels of organization make this very difficult. It needs much political will and managerial skills to assist these communities. Non-governmental organizations and other non-political networks are increasingly playing a role in these matters. They need policies to use changing means and flows of communication and to empower rural people to manage their own environment for their own benefits, and those of others with which they have political, social and economical relations, in a win/win situation. Conflicting interests, indifference, lacking resources, lack of power, all kinds of weaknesses in people and systems stand too often in the way of any governance worth mentioning, let alone good governance. It is nevertheless impossible to do it otherwise.

In such situations, disaster preparedness in bad times and managerial talents in good times have to be fostered for survival and development and for protection of the natural resource base. Social structures and basic human feelings of security within the local population/communities as well as their ideas or their lack of confidence are crucial points of departure.

Talking in this paper below on establishments of needs in agrometeorology for user communities, and, in that context, on establishments of needs in agrometeorology for local, national and regional decision makers, they can only be derived from the needs as described above.

An End to End System for Build up and Transfer of Information in Agricultural Meteorology

I have last year in Hanoi (Stigter 2001a) and earlier this year in Bangkok (Stigter 2002a), Manado (Stigter 2002b) and Ljubljana (Stigter et al. 2002) developed some ideas on the realities of an "end to end" system for the build up and transfer of agrometeorological and agroclimatological information, that I want to use as a starting point for talking about build up and transfer of climate information in this keynote address. This is an extension of a simpler set up in Stigter et al. (2001) combined with proposals brought up by others (Stigter 2002b; Stigter et al. 2002a).

I want to go through this system (Figure 1) here from right to left, from activity domain C to activity domain A, in which direction our familiarity and successes as agrometeorologists diminish. However, in that direction the affinity to the establishment of needs for climate forecasts and other agrometeorological knowledge for agriculture by local, national, and regional decision makers and users communities increases. This is the direction in which most of the information actually flows but with diminishing flow density. Unfortunately this is also the direction opposite to which the establishment of needs should go, when based on the actual needs of farmers and other users.

In the C domain we find the support systems as originally defined by Stigter et al. (2000): data, research, education/training/extension (e, t & e) and policies. Of course there are activities of these kinds in all three domains as well as in the focal guiding activities E2 and E1, but only in the C domain are they to be considered of a purely supportive nature. In the B and A domains and in E2 and E1, "data, research, e, t & e and policies" are (or should be) actually used/carried out *in action*, not *in support of possible activities*. This is an essential difference that we so far failed to recognize.

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A      <-------|-------> B      <------ |-------> C
               |                        |
               |                        |
              E2                       E1
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Figure 1. Relations between the three activity domains (A, B and C) defined, guided by Agrometeorological Action Support Systems on Mitigating Impacts of Disasters (E1) and Agrometeorological Services Supporting Actions of Producers (E2). From Stigter (2002b) and Stigter et al. (2002).

A = Sustainable livelihood systems

B = Local adaptive strategies (knowledge pools based on traditional knowledge and indigenous technologies)

+ Contemporary knowledge pools (based on science and technology)
+ Appropriate policy environments (based on social concerns and environmental considerations, scientifically supported and operating through the market where appropriate)

C = Support systems to agrometeorological services: data + research + education/training/extension + policies

E1 = Agrometeorological Action Support Systems on Mitigating Impacts of Disasters
E2 = Agrometeorological Services Supporting Actions of Producers

With respect to the four ingredients of data use, research use, the use of a, t & e and the use of policies in E1 directly, they are used there in building Action Support Systems in agrometeorology to mitigate impacts of disasters. To make that possible we are carrying out a lot of basic support activities in the C domain. Without denying the absolute need for basic science, I want to argue that there are too many of these support activities, of which many lay idle and will never be used. What is worse, when they are used they are playing too much of a guiding role in technology development, which should in fact these days be guided by social concerns and environmental considerations (Norse and Tschirley 2000) (Fig. 1).

As scientists we are most familiar with these basic support activities: in education and training, in research to expand knowledge and methodologies, in data taking, handling and support systems, in developing theories about policies that could reorganize our world at different scales. The closest *action* is in E1. In E1 we have built systems that we deem suitable to mitigate impacts of disasters, they are the bulk of our good intentions to use the four ingredients in applications in the real world.

Unfortunately they have too often little to do with this real world, because we have insufficiently considered all the elements mentioned in the introduction to this paper. These elements form the real world of the livelihood of farmers (domain A), in which agrometeorological services should deliver support for the actions of agricultural producers. This support should in turn be carried by the right mixture of the three components of the B domain, containing the knowledge pools distinguished for use in this E2 guidance and other related actions in the A domain. In the E1 establishments of needs that led to these E1 support systems we have also never tried to make an optimal mix from the knowledge pools in the B domain of activities. We have therefore not considered the gaps in this mix that have to be filled to become actually able to develop the agrometeorological services needed. This happened in addition to our failure to consider the actual conditions in the A domain. Our good intentions led in most cases to E1 support systems that did not work for developing E2 guidance or any other sensible activities in the A domain in developing countries.

I will in the remainder of this paper consider case studies that illustrate what I have indicated above. They will show that as a consequence of the insufficient knowledge of the conditions that actually shape the livelihood of farmers, as pictured in the introduction, we have too often: (i) insufficiently taken into account local adaptive strategies (e.g. Stigter and Baldy 1993; Stigter and Ng'ang'a 2001; Stigter et al. 2002a); (ii) not made the right choices in the use of contemporary science; and (iii) indeed not understood the overwhelming effect of inappropriate policy environments. The latter are not only due to ignoring or misassessing the conditions brought up in the introduction but they are also brought about by the dark sites of politics. The social concerns and the environmental considerations that are at stake in the B domain need the scientific support from the focused E1 guidance and the C domain, but also the understanding of what is actually possible in E2 guidance and of the very conditions in the livelihood of farmers, the A domain.

I want to end this section by exemplifying how I want to consider what constitutes agrometeorological services. All agrometeorological and agroclimatological information that can be directly applied to try to improve and/or protect agricultural production, so yield quantity and quality, while protecting the agricultural resource base from degradation, we consider to belong to such services. The products of agroclimatological characterization, obtained with whatever methodologies; advises, such as in design rules on above and below ground microclimate management or manipulation, with respect to any appreciable microclimatic improvement; advisories based on the outcome of response farming exercises, from sowing windows to harvesting times, using climatic variability data and statistics of the recent past; climate predictions and forecasts and meteorological forecasts for agriculture and related activities, on a variety of time scales, from years to weeks, and from a variety of sources; or a specific weather forecast for agriculture, including warnings for suitable conditions for pests and diseases or advises on countervailing measures; these are all examples of such services.

Case Studies

Seasonal climate forecasting in Ceará, northeast Brazil: an example of an E1 action support system as yet unsuitable as E2 agrometeorological service

A very useful case study, that I came across after I wrote the above part of this paper, because it was published in the December 2002 issue of *Climatic Change,* is that of the introduction and use of seasonal climate forecasting in northeast Brazil for mainly maize/bean/manioc growers (Lemos et al. 2002). It can serve well to validate the scheme of Figure 1 and to illustrate the reasoning in the previous sections.

In this example, forecasts have been directed towards small-scale rainfed agriculturalists as well as state and local level policymakers in the areas of agriculture, water management, and emergency drought relief. Ceará state has the largest proportion of its territory characterized as semi-arid and is highly vulnerable to drought, which shaped culture, environment, politics and society. It is ravaged by poverty and over a century local and national governments have attempted to respond to the challenge of drought with limited success. It was also the first northeastern state to acquire technical expertise on regional climate science and to attribute climate forecasting to the mandate of a public institution.

That this was so far an example of an E1 action support system becomes already clear from the first lesson that the authors draw from the results. An emerging technology "was appropriated and pressed into service of a policymaking apparatus designed to reduce the impacts of severe droughts". Policymakers started to exaggerate the potential usefulness of the science product, "therefore creating a situation of cultural dissonance between science and local knowledge and belief systems that quickly eroded the value of the information". This illustrates a serious problem with E1 systems: that the right mix in the B domain is not used to lead to useful E2 agrometeorological services. It showed inherent shortcomings of the product as well as the danger of untempered use of the forecasts, without the appropriate user training, ideally by specially educated intermediaries, which is a necessity for agrometeorological services.

A second lesson drawn by the, mostly American, researchers in Brazil was the failure that the government wanted to use the forecast to manage agriculture for the farmers, particularly by interfering in the availability of seeding material, instead of leaving the decisions on planting etc. to the farmers. This gave unnecessary resentment and has recently been abandoned. Agrometeorological services are in first instance for farmers to increase/improve their production. Only if they request additional support after the creation of such services, this could be considered. The A domain should be left to the farmers or for activities, such as user training, together with farmers.

The third lesson that the authors of this case study want to draw is "that the forecast is limited by the socio-economic conditions of the beneficiary population". Most farmers in Cereá are so vulnerable to climate variability that they are unable to respond to raw climate predictions, irrespective of the quality and the precision of the forecast. The lack of resources among rainfed farmers critically limits their range of choice in terms of alternative crops, technologies, or cash generating activities. In this sense, the impact of forecasts is still insignificant among most farm households in the state and will continue to be so until levels of vulnerability are reduced in a more permanent fashion. This illustrates what we have indicated in the introduction of this paper.

Other agrometeorological services may be much more important under such conditions and only very specific forecasts geared to the actual conditions and to the most serious problems of farmers of the different categories of vulnerability distinguished may make a chance in the nearest future. Better E1 systems geared at filling the gaps of a balanced mix in the B domain would be helpful and could be underpinned by a more selective use of support systems from the C domain (Stigter 2002a; 2002b). The authors of the case study indicate that the researchers have now changed their focus from items around the start of the rainy season to studies of dry spells and pre-season weather/climate patterns. Comparable pleas for such better establishment of the needs of user communities were quoted by Stigter et al. (2002a). The development of such services from a response farming approach demands an appropriate consideration of the conditions in the B domain, including the role of traditional adaptation strategies (Stigter et al. 2002a).

The authors conclude that in the Cereá case study, the limits of the use of climate information in policymaking derive in part from the levels of skill and direct usefulness of the science products themselves and in part from the necessity for a policy making apparatus to learn how to apply it usefully, in this case to drought mitigation. In comparison to farming communities, the authors' assessments for the future give a more positive outlook for success with the use of forecasting products for policy making government extension programmes, drought relief organizations and water resource management bodies as well as for infrastructure planning and maintenance institutions, if a broad distrust by end-user communities of government policies and the role of government in their lives can be dissipated by examples of honest and appropriate assistance (Lemos et al. 2002).

The agency concerned has now begun to train rural extension agents in interpreting the forecasts in an effort to improve communication to the end-users. We will come back to this issue at the end of the paper. The case study also suggests "that much trial and error is needed to move up the learning curve".

Shelterbelt establishment in northern Nigeria, another E1 action support system unsuitable as E2 agrometeorological service, this time for millet farmers

Just recently Stigter et al. (2002b) published a review paper on agroforestry solutions to some African wind problems that are examples of research that is meant to lead directly to E2 agrometeorological services. This is not research in the C domain but in the B domain and the E2 focus activities. We made mainly use of widely available wind break and shelterbelt research results and technologies in the C domain and of some E1 action support systems established by government organizations. Onyewotu et al. (2003a; 2003b) elaborate on one of these examples, in Nigeria, as follows.

This work was carried out between 1989 and 1996 at the Yambawa shelterbelts, north of Kano, not far from the borders with Niger. The objectives were to assist farmers in returning to production on sandy soils reclaimed and protected from wind driven desertification by establishing multiple shelterbelts. These *Eucalyptus camaldulensis* belts had been planted by the government without sufficient planning or scientific preparation in a pilot project. An improvement of the traditional parkland agroforestry system of scattered trees had not been considered as an alternative and farmers had neither been consulted on the shelterbelts nor on their tree preferences. The above already suggests that this was again an E1 system established with good intentions, in which the needs of the farmers were not properly established. Also in this example the shelterbelts are not suitable as E2 agrometeorological service without serious modification.

Farmer participation in making the best of the present configurations and development of improved design rules were the approaches selected to come to an appropriate E2 agrometeorological service. Questionnaires were used to improve our understanding in the A domain. The belts had shown to be successful in settling wind blown sand directly and through enabling the return of grasses to the area. However, worsened because of a design error with respect to belt direction in relation to wind direction, the leewards protected area, in which high millet yields could be obtained after the application of tree root pruning, appeared not much more than five to six times the height of the belts. This quiet zone of a bit more than 60m was followed by a wake zone with increased turbulence, that even visually damaged a small crop area and returned yields to the much lower values obtained in conditions unprotected by the belts. A small windward protected area also existed.

Improved design rules as E2 agrometeorological service propose that distances between belts in their present direction should be not more than 75 - 85 m, and for such shelterbelts perpendicular to the wind 90 – 100 m, while they were between 115 and 300 m. The width of the belts could be halved (15 m instead of 30 m). It should be considered to plant scattered trees between the present belts and it has also been suggested that increasing the tree density in the indigenous parkland agroforestry systems still existing may be a better solution than using belts (Onyewotu et al. 2003a; 2003b). Farmers should be allowed to prune roots, but also the branches, diminishing the shade on adjacent intercrops. Economically yielding trees should be used.

In the above case study the knowledge was available to produce design rules as agrometeorological services, but for the time being no cooperation was obtained from the government to implement any of them. Because farmers with land outside the influence of the shelterbelts appeared better off economically, because they did not lose land to the shelterbelts and were therefore able to buy fertilizers, it is not sure what will happen in the area in the future. The advisory to increase the density of scattered trees that farmers would select stands, but the conditions of the farmers may again be the decisive factor for its application.

Other examples in the same paper (Stigter et al. 2002b) delivered design rules for shelterbelts to combat sand invasion and for the selection of scattered trees to capture sand, both developed in the Sudan. There is also work reported on the development of advisories to keep shade trees above coffee as wind protection on the slopes of the Kilimanjaro, and on the density of scattered Savannah woodland trees for soil protection from erosion, both in Tanzania. Finally we report on the design of hedged agroforestry plots for wind protection in mulched maize-bean intercropping in Kenya. In all this research we developed E2 agrometeorological services waiting to be applied after having been tried out in demonstration plots. Only the shelterbelts in Sudan and possibly the shade trees in Tanzania and the hedges in Kenya were made into actual services applied by extension organizations, but only the successes of extensive new shelterbelts and of scattered *Acacia tortilis* trees under contolled animal browsing in the Sudan are known to us. Application of the other services will depend on absorption capacity of such services, so on government or NGO support and on the conditions in the A domain.

Other case studies

In addition to the above, if time permits, I will also use some other case studies from India (sowing windows, crop choice) and Sudan (underground storage of sorghum) which I used for illustration before (Stigter 2002a; 2002b; Stigter et al. 2002a).

Conclusions

Conclusions have already been drawn in the above by each time using the scheme of Figure 1. It may be concluded that Figure 1 is a good guideline for understanding the value of activities in the fields of data, research, e, t & e and policies for the design of agrometeorological services for end-users after the actual establishment of their needs for climate forecasts and other agrometeorological information in their farming systems. The main bottlenecks are: (i) insufficient considerations of the actual conditions of the livelihood of farmers and therefore; (ii) developments of inappropriate support systems. Local, national and regional decision-makers have to be honest and serious and have to come up with proposals and actions that create appropriate policy environments.

The training of suitable intermediaries has now been considered in Latin America and Asia, but there is a need for serious pilot projects of this kind to not have this need suffering from the same bottlenecks as already mentioned. Such pilot projects are needed everywhere and have to be carried out in such a way that they can learn from each other. This paper has also made clear that through the use of the scheme of Figure 1, case studies form Latin American and India can be of as much value as case studies form Africa for the design of improved approaches to agrometeorological services in Africa. The bottlenecks are the same and in particular also the negative influences of a lack of suitable policy environments are the same.

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