Protocol

Form for the collection of information on a good example of agrometeorological services or other agrometeorological information successfully provided to (or developed by) farmers in general or to (by) specific farming systems

A. Country/Province where the example was found.
Nigeria, Kano Province, Minjibir

B. Institute providing the example (with address).
Ahmadu Bello University, Soil Science Department, Institute of Agricultural Research, P.M.B. 1044, Samaru-Zaria, Nigeria

C. Researcher(s) that collected/described this example (with their e-mail addresses).
Tunji Oluwasemire (kooluwasemire@yahoo.com), Joseph Owonubi (josephowonubi@yahoo.co.uk)

D. Field(s) of Agrometeorology to which this example belongs.

[Use the fields of interest defined for registration of members of INSAM.]

Agrometeorology and Development (AD), Agrometeorological Services (AS), Crop Micrometeorology (CM), Drought (DR), Education and Training (ET), Extension (EX), Multiple Cropping (MC), Operational Agrometeorology (OA), Policy Matters (PM), User's Needs in agrometeorology (UN)

E. Natural disaster(s) and/or environmental problems to which the example is related.

Drought and erratic rainfall, Low and decreasing soil fertility as well as organic matter contents of sandy soils with low water holding capacity

F. Way, in which the example was found, defined and collected.

The hypothesis was tested, for the most abundantly occurring intercrops in semi-arid northern Nigeria, that these systems are generally more efficient in resource use under drier conditions than sole crops. This was done for dryland intercropping, with heterogeneous mixtures derived from patterns and varieties that farmers preferred, at low densities on-station. A quantitative Ph.D.-project was set up on resource use, with soil water balances, dry matter production and yield determinations, leading also to numerical crop productivity/water use relationships.

G. Farming system(s) in which the agrometeorological service is applied or to which the agrometeorological information is provided for actual use.

Rainfed millet/cowpea and millet/sorghum/cowpea intercropping systems.

H. Regions of the county (or counties) where the example can be found.

The Nigerian Sudan and Sahel savanna zones, which are also representative of the arid West African sub-region.

I. Villages where the example can be found.

Not applicable because the work was done on-station.

J. Description of the good example of operational agrometeorological services (maximum of one page A-4), with emphasis on agrometeorological components of the problem(s) concerned.

The most dominant crop mixtures are millet/cowpea, millet/sorghum/cowpea, millet/cowpea/ groundnut, sorghum/cowpea and sorghum/cowpea/groundnut. Cowpea has a dual purpose: the grain is used for human consumption and the remaining biomass as fodder for animals. Some cowpea varieties are planted specially within the intercrops for fodder production, producing little or no grain, to take care of animal feeds during the dry season The cowpea component of the mixtures also often consists of two types, i.e. fodder and grain types that differ in growth habit and maturation period. The cereals are grown for consumption and cash. Intercropping components adopted by farmers are grown at low densities, to minimise risks and exploit resources in a good cropping season.

High year-to-year variability of rainfall, serious deep percolation and high wet soil evaporation losses are additional stresses. The efficient use of the limited effective rainfall in this zone is therefore a crucial factor for future increases in crop production, which should come primarily from increased yield per unit area of land. Low harvest index (HI) may result from the reduction in the supply of assimilates, when competition for water in the root zone occurs during the yield production stage.

Dry matter production and system productivity of the intercrops were higher or equal to the sole millet, when the relay planted cowpea productivity was higher in two dry years than in a wet year in between. When the rainfall was below normal, the intercropping systems showed better water use efficiency than all sole crops, with the exception of the case of millet with inorganic fertilizer side dressing, due to millet dominance exerted by earlier planting and heavy tillering. In a dry year,

millet, particularly when intercropped, used limiting resources more efficiently for grain production. It showed better adaptation to moisture stress. In a previous wet year sole millet used water more efficiently than its intercrops with cowpea. The soil fertility treatments did not create any statistically significant increases in yield and yield components of millet at harvest within the intercropping systems.

All the crops sown sole and intercropped rooted beyond 1m in the loose sandy soil. Sorghum root production was greater than for millet, while both cereals produced greater root densities than cowpea. Overlap of the roots of component crops suggests competition for resources. Cowpea produced greater root densities and achieved deeper rooting when intercropped with millet and/or sorghum than sole, suggesting adaptation and competitive ability under intercropping. Rooting depths of crops were shallower in a relatively wet season than when water was limiting. Root densities and proliferation of the cereals below the surface layer were much higher in low fertility soils than when nutrients were readily available. This is immediately useful knowledge as an agrometeorological service for designing such systems.

K. Success and advantages of the example as judged by farmers concerned, where possible also expressed as estimated increase in income due to the services or information.

The soils of the Northern Savanna zone are known to be inherently low in organic matter, N and P while K and micronutrient deficiencies are becoming important in arable lands that are being subjected to intensive and continuous cropping. The government and its agencies are promoting the use of high inputs as chemical fertilisers and insecticides, but the structural adjustment programmes diminished subventions. The seasonal increases in the prices of these inputs that rose earlier because of the decreasing value of the local currency, have caused a decline in the use of such inputs.

Moreover, the generally unfavourable economic factors related to prices for agricultural produce are not encouraging the use of increased inputs either, while land use intensification continues. There is, therefore, more need for better understanding of the traditional intercropping systems that we have been working on. This would improve the possibility of mitigating the limiting factors, as well as make optimum use of the limited resources.

L. Difficulties encountered in introduction and use of this good example of agrometeorological services or information.

Crop water use of millet-based cropping systems was increased by high annual rainfall. Improved soil fertility status compared to OM caused no or only marginal increases in 1994 and 1995 in the low density intercrops, and only an appreciable

response (of 20%) in sole millet in 1995. The generally lower planting densities in intercropping (≈50%) than recommended in sole cropping, suggest that the varieties in use may not be the most appropriate, while their optimum planting densities with intercrops have not been achieved at the farmers' level to optimise soil water conservation and use.

To fight land degradation, a consistent incorporation of organic manure at seasonal level is a way of improving soil physical and chemical conditions aimed at conserving soil water. The generation and increased use of farmyard manure during this period of annual removal of government subsidy on inorganic fertilizer would enhance soil water conservation in these farming systems. The improvement of the soil nutrient status by an increased application of organic manure may also encourage the manipulation of the intercrop components, such that an increase in plant densities would make better use of soil water that would otherwise have been lost to soil evaporation and deep percolation beyond the rooting zones.

M. Difficulties of the service or information as seen by the farmers concerned.

The farmers' practice of planting millet and/or sorghum earlier in the intercropping systems relative to the cowpea components affords the cereal components, especially millet, with a relatively faster rate of assimilate accumulation, more competitiveness for resources than the other crops in association. The implication of this practice is the negative effects on cowpea yields as shown in our case.

N. Improvements envisaged or wanted/proposed in the service or information by the farmers, and the feasibility of such improvements.

Other design consequences for further agrometeorological services are that an improvement of these cereal/legume intercropping systems in terms of microclimate improvement may involve a reduction in plant densities of the tillering and faster dry matter accumulating millet component, while the low growing and ground covering cowpea component density is increased. This may result in more efficient use of soil water while the intercropping systems radiation interception, soil water conservation, ground shading for weed suppression and reduced soil temperature fluctuations and soil evaporation are enhanced. The introduction of shorter duration sorghum must combine superior yield with farmers' desirable traits that would meet their socio-economic needs.

O. Chances of expanding the application of the improved example.

The density and morphological characteristics of crops in association influence the microclimate within the various cropping systems. The reduction of soil radiative and heat exchanges (reduced surface soil temperature fluctuation), by a well

developed low growing cowpea component in an intercropping system, is capable of reducing soil evaporation better than in the sole cereal systems and hence offers a better soil water conservation practice in the arid and semi-arid zone of Nigeria.

An answer with a view of improving the cereal/legume systems in the Nigerian arid and semi-arid zones should therefore include genetically superior crop cultivars and the manipulation of the component densities along with the improvement of microclimatic variables. An amelioration of the cereal/legume intercropping systems may involve a reduction in plant density of the tillering and faster dry matter accumulating millet component, while the low growing and ground covering cowpea component density is increased.

The results learn that abundant organic manure in combination with agrometeorological services on intercrop manipulation related microclimate improvements may control near surface land degradation in northern Nigeria under acceptable sustainable yields. Appropriate policy environments, in economics and research, must enhance this.

P. Related examples found elsewhere in the Province (or in the country for that matter).

We have no knowledge of comparable research.

Q. Do any research results exist on this service/information or on the agrometeorology from which it was derived?

For the above summaries we made use of the following papers:

K.O. Oluwasemire, C.J. Stigter, J.J. Owonubi & S.S. Jagtap, 2002. Seasonal water use and water yield of millet based cropping systems in the Nigerian Sudan Savanna near Kano. Agricultural Water Management, 56: 207 – 227.

Kees (C.J.) Stigter, Josiah Kinama, Yingcui Zhang, Tunji (K.O.) Oluwasemire, Dawei Zheng, Nawal K.N. Al-Amin and Ahmed el-Tayeb Abdalla, 2005. Agrometeorological services and information for decision-making: some examples from Africa and China. Journal of Agricultural Meteorology (Japan), 60: 327 – 330.

C.J. Stigter, S.B.B. Oteng'i, K.O. Oluwasemire, N.K.N. Al-amin, J.M. Kinama and L.O.Z. Onyewotu, 2005. Recent answers to farmland degradation illustrated by case studies from African farming systems. Annals of the Arid Zone, in print.

Kees Stigter, Tunji Oluwasemire, Lambert Onyewotu, A.G.M. Rashidi, Silvery Oteng'i, V.R.K. Murthy, Nguyen Van Viet, Yonny Koesmaryono, Nageeb I. Bakheit, 2005. Agrometeorological services making a difference for poor farmers. I. Why it does not happen. Paper prepared for presentation at a National Policy Workshop "Meeting Nigeria's Food Security and Agricultural Export Target - the Weather Factor" (postponed), Abuja, Nigeria, 8 pp. [Also Agromet Vision publication 2005/3.]

Kees Stigter, Tunji Oluwasemire, Lambert Onyewotu, Silvery Oteng'i, Josiah Kinama, Zheng Dawei, Zhao Caizia, Zhang Yingcui, V.R.K. Murthy, A.G.M. Rashidi, Ahmed T. Abdalla, Nawal K.N. Al-amin, Nageeb I. Bakheit, 2005. Agrometeorological services making a difference for poor farmers. II. How it can be done. Paper prepared for presentation at a National Policy Workshop "Meeting Nigeria's Food Security and Agricultural Export Target - the Weather Factor" (postponed), Abuja, Nigeria, 10 pp. [Also Agromet Vision publication 2005/4.]

R. Could research assist in improvement of the service/information and how?

As indicated above under N. and O.

S. Any other comments from the collectors of this example that can help in understanding the many aspects of such services/provision of information.

None.