PRECAD

Crop research project

The Agricultural Research Station in Cinzana

1 Background

The Cinzana Agricultural Research Station was conceived in 1979 as a joint project of the Government of Mali, the United States Agency for International Development (USAID), the International Crops Research Institute for the Semiarid Tropics (ICRISAT), and the Syngenta Foundation for Sustainable Agriculture (then Ciba-Geigy Foundation for Cooperation with Developing Countries).

Cinzana is a small village lying about 35km east of Ségou between the Niger and Bani rivers in Mali's most important millet-growing area. The Station's 280 hectares of land comprise five different types of soil. As only about 80ha have been used to date, there are ample reserves for expanding research and breeding activity. Three generators supply the Station with electricity independently of the public grid. Water is pumped in through a subterranean pipeline from a source 7km away. The Station's main compound consists of laboratories, an office building, warehouses, workshops and living quarters.

The official opening of the Station on 15 July 1983, four years after the signing of the declaration of intent, marked the first milestone of success in what was to prove an, in every sense, unusually fruitful collaboration among the four partners. The Government of Mali provided the land and, in cooperation with ICRISAT, designed the Station and the research facilities, while USAID and our Foundation shared the investment costs.

Once inaugurated, the Station became a part of Mali's national research program under government authority with a Malian director in charge. The non-Malian partners helped to finance

running costs and contributed technical, scientific and management support. From the start, the Government paid the salaries of Station personnel employed in an official capacity and still does. Until 1989, USAID and our Foundation jointly covered all other operating costs - for equipment, instruments, vehicles, fertilizer, seed, fuel, etc. As had been formally agreed, that year ICRISAT and USAID withdrew from the project. Since that time we have funded the operating costs alone, and this commitment to an exceptionally successful project will be continued by the Syngenta Foundation for Sustainable Agriculture too.

2 Objectives

The Malian government had declared domestic food production to be insufficient. From the outset therefore Cinzana aimed at improving agricultural productivity with sustained increases in pearl millet yields as the principal target. Small farmers are the main pearl millet growers in Mali and throughout The Sahel. The research effort thus had to focus on making improved seed varieties and cultivation methods accessible to them without entailing additional, expensive inputs. All evaluations of the program confirm that this aim has been achieved.

The first task was to find varieties with genetic traits optimally suited to the conditions of the local environment. To this end the researchers first set about "filtering" the traditional local varieties in order to select the most productive. An essential requirement for breeding is plant material exhibiting a broad range of genetic variation from which a few genotypes having the desired characteristics can be selected and reproduced. To avert the danger of losing valuable genes from traditional varieties these as well as primitive forms and related wild species have to be systematically collected, evaluated and stored. Thus the start-up phase included the set-up of a seed bank of all local millet varieties and some wild species - about 1200 in all.

Trials with millets from India and North America rounded off the first investigations. They showed clearly that the varieties imported for experimental purposes were not suitable for cultivating or breeding In the Sahel. Among the local varieties, however, certain lines were identified as very suitable for breeding. Early-maturing varieties from southern Mali with a growing period of only 90 days were selected and planted in the north of the country.

These varieties made it possible to bring in tolerably good harvests even in the low-rainfall north. In the southern part of the millet-growing region the small farmers now plant parts of their fields with the same early-maturing variety as a kind of insurance against having to pay high prices for millet hoarded by dealers should their stores from the last harvest of the year get depleted.

Instead they can harvest their own early millet with which to feed their families.

Good results were obtained with Toroniou de Níngali, a millet variety from the Dogon Plateau that was re-selected and then crossed with varieties selected in Cinzana. This new variety brings yields exceeding those normally recorded in the south by some 60kg per hectare - around 514 kg/ha, compared with 454kg/ha. Moreover, its growing period is one week shorter and it exhibits superior resistance to both drought and pests. Toroniou de Níngali shows these results under conditions typical of subsistence agriculture in Mali and other Sahelian countries. To put what may at first glance seem a modest gain in graphic terms: 60 kilograms of millet is enough to feed a child for one year. Cinzana is now producing basic seed from the Toroniou variety as a prelude to more extensive seed production. So as to display the qualities of this re-selected millet variety to small farmers throughout the region the Station has planted demonstration fields and organized excursions for them.

Efforts to increase productivity with locally appropriate intercropping have also brought interesting results. Millet/cowpea intercropping increased the harvest by around 10%, from 646kg/ha to 722kg/ha. In contrast to the traditional practice of scattering the seed more or less randomly, alternate rows of millet and cowpea were laid carefully. Although quite a simple improvement, the method has several advantages. Thanks to its nodule bacteria, cowpea can fix nitrogen from the atmosphere and use it to enrich the soil. Because the available moisture is better utilized the risk of losing the harvest when the rains are uneven is reduced. This method also simplifies cultivation. Cowpea's tolerance of and in part resistance to Striga, a semi-parasitic wild plant, inhibits expansion of the weed. Since cowpea and millet have different growing periods, the fragile soils are covered longer and thus better protected against erosion by rain and wind.

Another research objective of the Cinzana Station is the selection and breeding of millet varieties resistant to downy mildew and the breeding of hairy grain husks to thwart birds as competitors for the harvest. It is also working to improve fertilization techniques by using farmyard manure and composted millet stalks. After studies extending over several years the researchers found that, for example, adding straw increased manure substance by 42% without impairing its nitrogen content. Field trials have established that with this simple fertilization technique it is possible to raise yields by 30-35%.

An evaluation of the Cinzana Research Station carried out by independent experts in January

1992 concluded, as had previous expertises, that the Station was doing an outstanding job. Whether its work need not shy comparison with that of kindred institutions in the United States, as USAID has attested, is less important than the fact that the Station has taken on model value for Mali and other countries of The Sahel.

The success of the research and breeding work done at Cinzana shows that it is not necessary to wait for some "major breakthrough" as the solution to highly complex problems - in this case the adequate supply of food In the Sahel. Many small steps undertaken in the direction of modest successes can also lead in time to a substantially improved situation.

3 Key factors of the research station's success

3.1 clear objectives

Right from the start, all of the partners had a clear - cut objective in common: *the establishment of a national agricultural research station with the mission of improving Mali's millet - based agriculture.*

3.2 continuity

During the construction of the station our Foundation regularly seconded engineers, technicians and other experts from company headquarters in Basel. They lent their support to coordinating and supervising construction and the purchase of materials.

Once construction was completed we set up four part-time support positions that were likewise filled by volunteers from the parent company: a project manager, a research support scientist, station management support, and an electrical engineer. Their presence at the Station is required for ten days or so a year. Their long-term, dependable commitment has helped create a solid working relationship of trust with the Malian partners. And since external support is confined to brief periods, the Malian staff have the chance to develop their own leadership qualities and initiative. Because the Foundation can draw on the know-how available in-house there is no need to employ expatriate specialists. As a result our financial support consists almost exclusively in covering the running costs of the Station.

Long-term technical backing is essential to a project such as Cinzana. It is feasible if the experts are delegated for short periods but maintain a long-standing and clearly defined association with the project. This arrangement ensures a continuous transfer of know-how at minimum cost and

at the same time gives the host country colleagues a motivation to take on full responsibility. They set their own goals and make their own decisions but can also count on external assistance if and when needed.

3.3 working partnership

Right at the start of the project a Board of Directors was formed consisting of the head of agricultural research in Mali, the Cinzana Station director, the Station accountant, a representative of the farming community, a representative of our Foundation and of another donor. Until 1990 ICRISAT was also represented.

The role of this body is mainly to oversee finances as well as determine the research orientation of the Station. The members meet formally once a year - informally, working contacts are much more frequent. Over the years, the board has served as a catalyst of clear communication, a mediator when there were differences of opinion, and a moral and political prop for the Station head.

A functioning steering committee such as this Board of Directors, whose membership includes both the local leadership and representatives of the most important donor organizations, helps first of all to bring about greater clarity in finances and management matters.

The creation and operation of a Board of Directors composed of both Malian leadership and representatives of key donors and support groups enhances transparency in finances and management and provides a legitimate forum for input from all key partners regarding the re-partitioning of the budget. This also ensures that donors have a forum in which to insist on result-driven research.

3.4 baseline studies

Research at the Station began with a number of baseline studies carried out to collect data on the region's water balance, nature of the soils, socio-economic conditions, crops grown, cultivation methods, and so on.

The results of those initial studies are periodically compared with subsequent surveys. In 1980, working together with Swiss hydrologists, the Cinzana researchers conducted a survey of wells in the villages surrounding the Station with a view to ascertaining high- and low-water levels in the course of a year. In 1982-83 all four soil types in the region were investigated in detail and

mapped. Since then the map has been used to keep track of fertility and yields. A soil "library" was also compiled, consisting of samples from 300 different sites. Topographic surveys provided an information base for terracing the Station's grounds. Planted with grass, the earthen terraces - and with them the fields they protect - have held up well against erosion.

A socio-economic survey carried out in 1984 encompassed the villages within a 50km radius of the Station. It gathered data on their ethnicity, social organization, field sizes and cropping patterns, sources and levels of income, etc. The survey was repeated in 1989 in order to measure the adoption rates of the agricultural technologies developed at the Station and their socio-economic impacts. A third follow-up study took place in 1994. The information gained from these reviews makes it possible to align planning and programming to the actual situation of the target groups.

3.5 on-farm research program

The necessity of an on-farm testing program became evident as early as 1985, when it turned out that some of the cropping methods developed at the Station failed in the farmers' fields.

Whereas millet yields on-Station regularly amounted to between 2-3 tons per hectare, among the farmers they seldom surpassed a ton. Moreover, several of the millet and sorghum varieties developed at Cinzana brought notably smaller yields under actual farming conditions than did the varieties traditionally used. One main reason had to do with significant differences in soil types.

As a consequence a group of agronomists from the capital, Bamako, set about designing, planning and carrying out on-farm research. The board of directors managed to convince the Government to approve the appointment of an agronomist at Cinzana who would be responsible for running the trials under the supervision of the Bamako group. He was gradually entrusted with more and more autonomy, and since about 1991 the job has been entirely in the hands of Cinzana Station staff.

Since some of the staff live in the villages during the growing and harvesting season, the Station has a number of "local antennae". Today the on-farm research program, supervised by the Station agronomist and the extension services, includes more than 50 farms. Several demonstration fields laid out along major roads are also part of the program. The Station agronomist is an important liaison with the regional extension services and participates regularly in planning meetings, training activities, and demonstrations. He is further responsible for

technology transfer.

To retain its relevance, a research station must continually update its core program to adapt to the changing needs of its target farming community. An interactive link between station and on-farm research helps to maintain links with farmers, and is determinant in a station's ability to produce appropriate technologies.

The extension agencies, which receive substantial funding from both the World Bank and the International Fund for Agricultural Development (IFAD), are important multipliers for the Cinzana Station. In their determination to bring about visible and measurable practical results in smallhold farming, these support services are also promoting the transfer of the technology developed at the Station and proved in the field.

4 The Cinzana research harvest

The Cinzana Station has continued to develop, no longer concentrating on improved millet varieties alone but broadening its activities to address a whole range of problems faced by the farming communities of the Ségou region. Among the technological advances that large parts of the farming population have responded to positively are these:

4.1 early cowpea varieties

In 1984 the Station produced new cowpea varieties that were then grown on state-run farms. Some of the seed got into the hands of seasonal workers - and two years later demand for the new varieties exploded. The two most popular ones, originating with the International Institute of Tropical Agriculture (IITA), were screened at Cinzana. By 1986, under the aegis of an IFAD-funded project, several tons of seed had been distributed to the small farmers of the region. The socio-economic survey of 1989 found that 45% of them within a radius of 50 kilometers had gone over to the new varieties.

4.2 cowpea-millet flour blend

The Nutritional Technology Institute in Bamako found out that a 25% admixture of cowpea flour with millet flour, while not altering the taste of infant and adult food, doubled its protein and lysine content.

With the unexpected success of the new varieties the households of the region had an abundance

of cowpeas. An information campaign using radio spots, demonstrations, posters and other channels was launched to promote the use of the flour blend. It had an impact all over the country. Many women in the rural areas now blend the flour using their own home-grown ingredients, and in the urban areas the finished product is sold by a retail distributor under the trade name Mileg.

With the backing of KIT, the Dutch Royal Tropical Institute, and the Syngenta Foundation young, dynamic Malian nutrition technician has been enabled to produce a flour blend of impeccable quality in a small-scale operation and to market it. (The first quality controls were carried out in the Nestlé laboratories in Switzerland.) The overriding aim of the whole venture is to improve children's diet and to open up to the farmers better marketing opportunities for their millet and cowpeas.

4.3 intercropping

Following initial failures with more complicated methods, the Cinzana researchers found a simple intercropping technique in which millet and cowpea are planted in alternating rows.

Field trials demonstrated that this method gives yields 10% higher than a millet or cowpea mono-culture. Besides the greater yields the technique very effectively protects the soil against erosion. Introduced through the extension services in 1991, by 1993 it was being used everywhere.

4.4 toroniou, a dogon millet variety

Toroniou is one of the 850 local millets that were screened for various characteristics in 1981-83.

This variety came from a remote village in the Dogon country and was until then unknown in the Ségou region. Toroniou shows remarkable tolerance to stem borer and adapts readily all over the country. At Cinzana it was re-selected and upgraded, then tested in numerous field trials. With grain yields from Toroniou 10% higher than those achieved with the customary local varieties, it has since come into widespread use.

4.5 technology package

Since 1993, Toroniou has been distributed together with an all-round technology "package": the millet cowpea intercrop containing a Striga-resistant cowpea variety and the seed protectant

Apron-Plus®.

Under smallhold farming conditions this package can bring yields outstripping those achieved with local varieties and the usual tilling methods by some 50% - and without having to use more fertilizer Seed treatment, in particular with Apron-Plus®, has been such a hit with the farmers that available supplies lag behind demand. Most importantly though, this technology makes life easier for the farmers because birds do not eat the treated seed, so after-sowing is no longer necessary. And the farmers' incomes are increasing, provided they work the qualitatively improved fertilizers and compost into their seedbeds as instructed by the researchers rather than, as has been the usual practice, broadcasting them.

4.6 social marketing of natural vitamin sources

Fruit from the baobab tree contains a very high concentration of vitamin C (2200 ppm on average), and are found in abundance In the Sahel.

While people do use the fruit for drinks and gruels, they are unaware of its vitamin content and health benefits. Similarly, the baobab leaves contain a high level of vitamin A. Vitamin A deficiency is a chronic health problem in rural Mali, yet the vitamin A benefits from baobab leaves are not widely known. In collaboration with agronomists, foresters, and food technologists from other institutes, Cinzana researchers will undertake a social marketing campaign 1998-99 to inform the population about these benefits.

5 Key technologies in the pipeline

5.1 new millet and sorghum varieties

After more than 10 years of breeding work, new experimental millet and sorghum varieties appear promising enough for on-farm testing.

The CIVAREX series of millets are medium height (about 1.5m while local varieties are 2-3m) and offer yield potential slightly greater than local varieties. Selections were grown on-farm in 1994. The sorghum varieties are local tall varieties and high-yield, short-statured varieties, but with significantly higher yield potential than the locals. In both cases, the research objective is to establish intensive and sustainable intercropping systems.

5.2 rational use of manure and compost

Experiments are now under way to maximize the fertilizer effectiveness of farmyard manure by composting it with straw, and by changing the method of application.

Already, on-farm trials indicate that application of only 3-4 tons manure per hectare improves millet yields on the order of 20%. In exploratory tests, application placement, amount, and timing are being varied on the millet-cowpea intercrop in order to optimize the fertilizer effect while minimizing the amount of manure applied. The objective is to produce a manure recommendation that can be used to further enhance the millet-cowpea intercrop and crop rotations.

5.3 use of "living fences"

The agroforestry group at Cinzana discovered a native bush (Zizyphus sp) that establishes well without depressing yields of adjacent millet crops.

The berries produced by the bush are used as a household condiment. The use of living fences to protect areas against roaming animals is an idea welcomed by farmers. Traditionally, winter hedges are constructed from cut branches, competing with firewood uses. The first Zizyphus seedlings were distributed to farmers in 1994. Methods are now being developed to enable farmers to grow their own Zizyphus tree nurseries.

5.4 millet-manioc and millet-yam intercropping

Both the millet-manioc and the millet-yam intercrops have proven very promising in on-station experiments.

Success with these methods may lead to the widespread introduction of manioc and yam propagation stocks, now lacking in the Ségou area. Manioc cuttings were distributed to some farmers in 1994.

6 The evolving role of the Syngenta Foundation for Sustainable Agriculture

Initially, our Foundation established a number of criteria about the type of agricultural project it might support. The project should be in a poor country, it should benefit poor farmers, it should increase food production, and it should be part of a government effort rather than an expatriate enclave. Additionally, the project was to be noncommercial in the sense that it was not intended

or expected to develop market opportunities for products made by the parent company in Switzerland. The decision to support the Cinzana research station met these criteria.

The Foundation's role evolved as circumstances changed. Initially, it was to join USAID in co-financing the management and operation of the research station. The Foundation also provided some technical assistance, especially with regard to the layout and management of the station's workshops and the maintenance and operation of farm equipment. The technical aspects of the Cinzana research program were assisted by staff from ICRISAT. Our Foundation also had a representative on the research station's board of directors, which has met regularly to review station operations. With the withdrawal of USAID and ICRISAT, the Foundation took on a bigger role in the agro technical aspects of the station's work.

Over the long run it is likely that Syngenta will continue to be called upon to provide more scientific support to the researchers at Cinzana. Many of these scientists are recent graduates who could benefit from the advice and views of the scientific staff of the Syngenta corporation itself. Such support could be pivotal in reducing the sense of isolation of researchers and enhancing the quality of research.

In the years to come it will be increasingly important that the varieties and technologies developed by the Station find much wider application. In view of the immense food security problems In the Sahel region, the dissemination and adoption rates of Cinzana’s innovations is still unsatisfactory. The Station’s impact on the poor farming households depends highly on strong extension agencies that concentrate on smallholdings.

7 Additional information

7.1 recent updates

a. Cowpea-Millet intercropping to control striga. A cowpea variety was discovered to have both resistance to cowpea striga (Striga gesneroides) and also to have an aggressive depression effect on millet striga (Striga hermontheca). The cowpea variety is a selection from IITA (IT89KD245) and has been given a local Malian variety name "Sangaraka". 1997 on-farm trials indicated that this method could reduce millet striga up to 50%.

b. Millet variety "IndiaNa". This is a re-selected variety from the Dogon Plain. It was shown on station research to have extraordinary yield potential - with yield potential regularly attaining over 3T/ha under modest fertility. The high yield potential is thanks to the

uniform tillering and consistent long, well-filled spikes. In full season variety trials in 1997 we obtained yields 26 than local checks under low input trials and 20% higher than local checks under modest input trials. A downy mildew tolerant version of IndiaNa has been synthesized and will be tested for the first time in 1998.