Executive summary

Context

Traditional cereals constitute the staple diet of many African populations and regions, especially in the most isolated rural areas, and play an essential role in providing food for the poorest populations. They are well suited to local conditions, being reasonably resistant to drought, and help to maintain the environment by providing a covering of vegetation on ground which is ecologically fragile, and considered of little value.
Among traditional cereals, fonio (*Digitaria exilis*), is considered as the most ancient indigenous West African cereal. Nowadays, fonio still grows in farmers' fields in a vast area extending from Senegal to Chad mainly on eroded lateritic soils. In West Africa, farmers cultivate mainly white fonio *(Digitaria exilis)*, which is also called fundi, findi, acha or "hungry rice". The term 'hungry rice' well describes the role of this little plant in local population life. Fonio supplies to several million people food early in the growing season, when main crops are still too immature to be harvested and when other food resources are scarce. Fonio consumption varies between years and seems to be dependent on the availability of other cereals. When other cereals are not available, for example due to a failing harvest, fonio consumption is high, and thus fonio consumption could be considered as one of the coping strategies for increasing household food security.
The relative stagnation of production is partly explained by a lack of research and development devoted to this product. In order to ovoid the decline of this commodity, it is important to solve the many problems after the harvest, in particular by perfecting post-harvested techniques and by improving the quality and the follow-up of sales and distribution.
Today, fonio is produced by small enterprises and sold not only on local urban markets, but also to Africans emigrated in Europe and in United States. Indeed several small private enterprises, notably in Mali and Burkina, have been set up to cater for the export markets. There is strong consumer demand for fonio due to its nutritional qualities, and because it helps to satisfy the demand for a more varied cereal diet.
That is the reason why a research/development project named *FONIO - Upgrading quality and competitiveness of fonio for improved livelihoods in West Africa*- was elaborated to achieve the following objectives. The FONIO project started formally at January 1, 2006 per three years duration.

Objectives

FONIO's objective is to upgrade quality and competitiveness of fonio in West Africa by improving production (adapted varieties, appropriated production and farming systems, …), technology (innovation in post-harvest mechanisation and processing,…) and marketing systems for local and export markets. In Africa, the increasing interest for fonio, as well from consumers than from small enterprises, demonstrates the possibility for the development of good quality products based on fonio. For European consumers, the desirable criteria are nutritional quality, originality, healthier properties and environmental friendliness. The production of exportable value added fonio products is conceivable and must be promoted.

To achieve the overall objective, FONIO project promote an interdisciplinary and innovative approach involving scientists from various backgrounds: food technology, nutrition, process engineering, mechanization, social sciences, and agronomy. It support research/development actions with a participatory approach involving producers, processors, women's groups and small enterprises that will benefit directly and quickly from the research results.

The main research activities (workpackages) of the project are the following:
WP1 - Diversification of fonio products for niche export markets and local markets
WP2 - Nutritional aspects of fonio and fonio products
WP3 – Demand for new products and its effects on income generation and distribution
WP4 - Small scale enterprises and innovation in product and process
WP5 - Opportunities for diversification and multipurpose uses of fonio in crop-livestock systems
WP6 - Improving knowledge on fonio based cropping systems and ways for improving productivity

Participants

Research scientists are from three European countries and four West African developing countries (Mali, Guinea, Burkina Faso and Senegal). They belong to Research centres, Universities, National or International Research Systems.
Three from European countries:
Participant 1: Cirad (International Cooperation Centre in Agronomic Research for Development) France,
Participant 2: Wageningen University (Division of Human Nutrition) The Netherlands,
Participant 3: CRA-W (Walloon Center of Agricultural Research) Belgium.
Four participants from West African countries:
Participant 4: IER (Institut d'Économie Rurale) Mali.
Participant 5: IRAG (Institut de Recherche Agronomique de Guinée) Guinée.
Participant 6: CIRDES (Centre International de R&D sur l'Élevage en zone Subhumide) Burkina Faso.
Participant 7: ENDA-GRAF (Groupes Recherches Actions Formations) Sénégal.

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Work completed

The first three months of operations were primarily given over to funding aspects (opening of accounts by partners, transfer of funds, etc), defining administrative and financial procedures and preparing and holding the project kick-off meeting.

Kick-off meeting

The project kick-off meeting was held in Bamako, Mali, from 20 to 24 March 2006.
The meeting, which was organized jointly by CIRAD and IER, was attended by some forty people from the various partner organizations in Europe (France, the Netherlands and Belgium) and West Africa (Mali, Guinea, Burkina Faso, Senegal and Benin), and representatives of the private sector in Mali: AOPP (Association des Organisations Paysannes et Professionnelles), FENATRA (Fédération Nationale des Transformateurs) and SMEs (processors, women's groups, EIGs, etc).

The meeting was led by the project's overall coordinator (J.F. Cruz) and chaired by Dr Oumar Niangado, and set out to present the different partners in the project, finalize the annual programme of activities for 2006, and determine the strategies to be adopted to achieve the objectives set by the project. It was also very useful for creating links between the various researchers present and facilitating future collaboration. Lastly, the first workshops for WPs 5 and 6 were also held during the meeting.

This kick-off meeting in March 2006 thus marked the real start of the project, although the official date was 1 January 2006.

Activities completed

The second quarter of 2006 was given over to the actual launch of the FONIO project in the field. The first activities primarily concerned work packages 5 and 6, which needed to define their sectors of intervention (choice of sites for preliminary studies in each country, methodological approaches, etc) and to prepare for the agricultural season and trials at experimental stations. Over the same period, WPs 1 to 4 concentrated on drawing up identification and interview documents and carrying out surveys. These various documents were then finalized at the workshop for WPs 1 to 4 in Dakar in June 2006.

The main activities were thus conducted during the second half of the year. Given the constraint of the cropping calendar, WPs 5 and 6 naturally conducted the major part of their operations (on-station trials, diagnosis of cropping and production systems, etc) during the agricultural season, from sowing (June-July) to harvesting (September-October). The other WPs spent their time on the first field surveys (WPs 1, 2, 3 and 4) and the first tests of precooking and drying equipment (WP1).

WP1 is coordinated by Cirad (France) and concerns “Diversification of fonio products for niche export markets and local markets”. During 2006, task 1.1 has started by the identification of quality criteria of fonio in Bamako when buying, processing or consuming it depending of the fonio types (hulled, whitened, precooked) or the stakeholders involved (wholesalers, retailers, processors, cookers, consumers). Quantitative surveys were conducted through individual or focus group interviews by using open and semi-structured questionnaires, then were completed by sensorial tests (rank tests and triangular tests) in order to have a better perception of consumer preferences of cooked fonio. Task 1.2 has started by an identification of existing cooking processes in Burkina Faso. The first experiments in fonio parboiling at laboratory level have started by a study of grain behaviour during soaking and steaming with the measurement of technological and cooking properties but also the colour and starch characteristics. During this first year of the project, task 1.3 has been focused on drying mechanization. After the achievement of engineering drawings, two types of driers (*cross-flow drier* and *greenhouse ventilated solar drier*) have been locally manufactured and tested with a processor. Experiments in rainy or dry seasons will be progressing next year in comparison with two other existing driers.

WP2, led by Wageningen University (The Netherlands) concerns “nutritional aspects of fonio and fonio products”. The activities of the WP2 in 2006 were mainly focussed on preparatory work for substudy 1 (nutrient value of fonio and fonio products), substudy 2 (food consumption and role of fonio in dietary patterns) and substudy 3 (contribution of fonio to nutrient intake and nutrition status). In June 2006, the detailed proposals for the pilot studies were finalised. Literature research on nutrient values of fonio was finalised. Fieldwork concerning preparing the different sub-studies was carried from June-August 2006. Nutrient variation in different fonio varieties, effect of women’s processing skills on nutrient content and effect of processing on nutrient content of fonio and fonio products were determined in a pilot study. Chemical analysis of nutrient content of fonio and fonio products took place in The Netherlands. Preparatory work for substudy 2 comprised development of a sampling frame, compilation and updating of the Mali food composition table, listing of foods available in Bamako including selling units and prices, characterising of meal pattern of households in Bamako including composition of main dishes consumed, listing of household utensils used in meal preparation and eating in households including volume and weight. Analysis took place in Wageningen and based on this detailed proposals for sub studies 1, 2 and 3 were developed.

WP3 led by Cirad concerns “demand for new products and its effects on income generation and distribution”. To pinpoint that demand, based on prior studies of consumption, fonio product quality characteristics were determined through focus groups and individual surveys of consumers, fonio buyers, processors of traditional and new products, restaurant owners and traders (retailers and wholesalers). For each type of product and each player, the desired characteristics taken into account varied depending on the planned uses. A survey was conducted in Bamako of 174 purchases of hulled, whitened or whitened-washed fonio, and 65 precooked products. The analysis was intended to demonstrate the characteristics that currently determine retail prices. It revealed that the degree of hulling/processing accounts for almost every price variation. “Size”, “colour” and “origin” characteristics have only a slight effect on prices, and only in the case of hulled and/or whitened fonio. As regards precooked fonio, the main source of price variations is the point of sale, while cleanness also apparently plays a role, albeit a less significant one. The “hedonic price” estimation method was used to calculate the implicit value that consumers place in the different characteristics. The production chain surveys (activity 3.3) were conducted in Mali, Guinea and Senegal. The results will be available in 2007.

WP4 is led by ENDA Graf (Senegal) and concerns “small firms and innovation in terms of products and processes”. During 2006, a typology of fonio processing firms in Senegal was produced, identifying two types of SMEs: “domestic” SMEs are primarily characterized by their low production levels (less than 500 kg/year), the absence of dedicated infrastructures and a lack of mechanical processing equipment. “Mechanized” SMEs have at least one operational huller, cooking equipment, a clean building more or less suitable for production, an annual processing volume of at least a tonne and the capacity to pack their end products in polythene bags. A third type, more similar to small-scale enterprises, is made up of firms that do not process fonio but buy it from local firms and sell it on the export market under their own label.

WP5, directed by Cirdes (Burkina Faso) is entitled "Opportunities of diversification and multiple uses of fonio in production systems", has several objectives. The year 2006 was given over to the first objective, an analysis of the range of fonio-based production systems and importance of fonio in the production system. This meant a survey of 300 farmers in Guinea, Mali and Burkina Faso, evenly distributed throughout the main fonio production basins (two basins/country). In Burkina Faso, fonio production is split between two basins, one in a semi-arid zone (Kossi Province) and the other in a subhumid zone (Kenedougou and Houet Provinces). The typology revealed five types of production unit, according to the extent of fonio growing, the fonio volumes marketed and the proportion of fonio grown by women. Fonio accounts for 17% of cropping plans on average. It is a stopgap crop, primarily eaten from September to November. The volumes marketed are low. In the four villages surveyed, 13 local varieties were identified, split between early, intermediate and late varieties. Producers in the North prefer early varieties. Fonio is primarily sown on sandy plain soils, broadcast in freshly ploughed fields, and covered over using branches. It requires little upkeep (one weeding round) and no inputs, and has few enemies (striga). It is cut with a sickle between September and October, and produces 500 to 600 kg of grain/ha after threshing. Cutting, threshing and hulling are done by hand and are highly labour-intensive. Fonio is stored in grain lofts and keeps for several years without any particular treatments. The volumes sold are low and prices vary according to the type of product (paddy or hulled) and the time of year (after harvesting or at the end of the dry season).

WP6 is led by CRAW (Belgium) and involves IRAG, IER, CIRAD and CIRDES. The aim of WP6 is to find out more about fonio-based cropping systems and look at ways of improving productivity, in line with the production chain's expectations.

Firstly, the diversity and the plasticity were explored, in term of cycle length and production potential, of the varieties in collection or collected in three main area of production, corresponding to three eco-regional zonation from Guinea to Burkina Faso. To do so, the production potential of a panel of varieties with level of precocity ranged from 90 to 150 days was compared in a multilocal design, within three experimental stations, after a depth work of recorded parameters standardisation. In parallel, a state of the art exploring the knowledge existing on fonio varieties and fonio farming systems was established.

Secondly, the fonio response to abiotic parameters has been analysed with a special attention for soil, nutrients and climate parameters. In 2006, preliminary experiments were set up (1) to identify the main aspects (nutrients of interest, photo-period sensitivity,…) to explore in depth in 2007 and 2008 and (2) to characterize the heterogeneity of the fields to be used in 2007 to set up nutrients response experiments. This was done in parallel to the establishment of a climatic data-base across all the area of interest.

Thirdly, in collaboration with the WP5, the WP6 researchers participated to the definition of the survey aiming to diagnose present fonio based cropping systems and of the future follow up aiming to quantify actual biophysical performances under farmers conditions. This will allow to quantify the gap between the actual and the potential productivity and to identify, with the farmers, in the last step of this project, the ways to fill this gap.

Dissemination of knowledge

Very few results were available by the end of this first operational phase. This is quite normal, since the first year was primarily given over to setting up the project in the field, collecting plant material for the first trials on experimental stations and conducting the first surveys of producers, processors and consumers.

The most important advance in terms of disseminating information was the launch of a website six months after the kick-off date. Its URL is http://inco-fonio.cirad.fr/.

Several web pages have also been produced on the European FONIO project:
"CIRAD" page
http://www.cirad.fr/en/actualite/communique.php?id=501
"European Union" pages
http://ec.europa.eu/research/headlines/news/article_06_09_22_en.html
http://cordis.europa.eu/fetch?CALLER=EN_NEWS&ACTION=D&SESSION=&RCN=26409