

**PROGRAMME TO IMPROVE CROP-LIVESTOCK PRODUCTIVITY
THROUGH EFFICIENT NUTRIENT MANAGEMENT
IN MIXED FARMING SYSTEMS OF SEMI-ARID WEST AFRICA**

Abstract

*The abstract should provide the following information:
the project title, the main research outcomes/impacts, the replicability perspectives (scaling-up/out) and
the overall context in which the research has been conducted
(geographical, political, socio-cultural and economic dimensions).*

In semi-arid West African regions the productivity of crop–livestock systems is greatly hampered by the inadequate availability of nutrients (i.e. metabolizable energy, protein and phosphorous for livestock production). Moreover, growth in human and livestock populations has led to an expansion of cultivated land and has shortened fallow periods; this, in turn, has accelerated land degradation and decreased soil fertility. At the same time, low rural incomes, inappropriate public policies and infrastructure constraints prevented the widespread use of purchased inputs such as inorganic fertilizers and feed supplements. In response to the increasing pressure, farming systems in the region evolved towards more integrated forms of crop and livestock production depending on the quantity and quality of available forage, which, in turn, depends on soil fertility and land use. This has led to land degradation, low productivity and rural poverty mainly due to the management schemes that do not respond to demographic pressure or drought. However, this interdependency also provided an avenue for improving soil fertility, and thereby increasing agricultural production and the well-being of rural dwellers.

The project No. 384 “*Improving crop–livestock productivity through efficient nutrient management in mixed farming systems of semi-arid West Africa*” addressed major biological, bio-physical and social problems of smallholder farming in areas with poor infrastructure, generally low and erratic rainfall conditions and declining soil fertility. It aimed at increasing the productivity of crop–livestock farming systems through better nutrient management. Specific objectives included to: i) assess, ex ante, the potential impact and acceptability to farmers of technical alternatives for nutrient management integrating animal manure, crop residues, legumes, fodder or inorganic materials; ii) improve farmers’ income by increasing meat and milk production and the supply of nutrients for soil improvement through better use of available resources; iii) improve the efficacy of livestock-mediated nutrient transfers within village territories through better land use and institutional arrangements; and iv) promote the adoption of nutrient management interventions through the identification of appropriate economic incentives and policy options.

The project registered the following impacts on the human capital (e.g. increased knowledge in nutrient management and more efficient use of farm residues, animal manure and local phosphate rock), the social capital (e.g. strengthened interaction between farmers and herders in the manure utilization and stronger networking among NARS, national research centers and farmers and herders) and the natural capital (e.g. increased productivity of crop-livestock farming system and improved nutrient management).

**Main successful technical
components of the
research programme:**

- Development of improved nutrient-management packages;
- Increased food crop and fodder production and maintenance of soil fertility;
- Socio-economic and anthropological analysis (SEA) on mixed farming systems.

SECTION ONE: THE INSTITUTIONAL CONTEXT

The project within the IFAD context, relevance to/linkages with other IFAD programmes/initiatives, implementing partners and main activities carried out.

- Existing linkages with other IFAD initiatives:

- Grants:

- Burkina Faso: [South West Rural Development Project](#) and [Special Programme for Soil and Water Conservation, Phase II](#) ;

- Loans:

- Mali: [Village Development Fund Programme, Phase II, Zone Lacustre Development Project, Phase II and Income Diversification Programme in the Mali Sud Area](#);

- Niger: [Aguié Rural Development Project and Special Country Programme, Phase II](#);

- Senegal: [Rural Micro-enterprise Project, Village Organization and Management Project and Agroforestry Development Project](#).

- Target regions and implementing partners:

- Burkina Faso, Mali, Niger and Senegal.

- ILRI, ICRISAT, IFDC and NARS (IER, INERA, INRAN, ISRA).

SECTION TWO : THE PROGRAMME IMPLEMENTATION

The research programme:

Description of the technology/participatory methodology/approach developed, costs of the inputs used to implement the research programme, rural areas and context where the research has been implemented (specifying environmental conditions)

- The research programme was designed to test and find methods of smallholder development in important conditions of Sahelian countries with long farming traditions. The research demonstrated through the integration of crop-soil management and livestock production packages several possibilities to increase the productivity of the farming systems. The investigated options involved: improved methods of corralling, introduction of compost making and enriching it with phosphate, manure and fertilizer application methods, trapping of urine in bedding material, diversification of cropping patterns, introduction of new dual purpose food-fodder crops, saving on fattening rations, improvement of dairy production and strategic supplementation of animals with phosphorus during the dry season. The trials have often been country-specific.

- The following methodology has been employed:

- i) introduction of sweet sorghum for cattle feeding;
- ii) field trials to investigate strategies to optimize nutrient cycling;
- iii) use of rock phosphate and other fertilizers to improve the soil fertility, food and fodder crop production;
- iv) cowpea to improve the intercropping of millet;
- v) compost application to develop more productive irrigated crops;
- vi) phosphorus enriched manure to get productive millet-groundnut rotation;
- vii) diets to fatten sheep;
- viii) protein and mineral supplements for dairy goats;
- ix) sweet sorghum as dairy feed;
- x) supplementation for fattening cattle;
- xi) trials on the effect of transhumance and supplementation on reproductive performance of cows.

- For the calculation of livestock generated nutrient transfers, most national teams have measured nutrients in manure and have analyzed soil properties under the experimental conditions before and after manure applications.

The soil nutrient balances for the main elements were established analyzing the main nutrient flows: forage uptake from grazing, excreta

deposition during grazing, corralling and manure application, harvest of crop residues. Other sources or losses of nutrients such as wind deposition, nitrogen fixation, leaching losses and erosion were not analyzed in the study.

- During the research on the animal health and the animal health services, attention has been given to the trypanosomiasis. The drier parts of the Sahel are not affected by this disease, however where gallery forests are present, treatments were found to be necessary. In wet areas with inundations, animals are treated against endemic fascioliasis every 6 months. National animal health services have generally devolved vaccination to the private sector and thus private veterinaries travel to the villages to perform the vaccinations. However, it was not possible to clearly understand how many animals undergo each year the compulsory vaccinations. Officials of the various teams met during the research programme, reported a large coverage of vaccinations, but real rate of vaccinations at herd level may be much lower than 100%.

Target group and impact:

Description of the target group, the beneficiaries and the benefits and the main research outcomes/impacts (vulnerable groups, project impacts and effects on the human, social and natural capital).

- *Impacts on the human capital:*
- *Impacts on the social capital:*
- *Impacts on the natural capital:*

Project target groups:

Farmers and herders in semi-arid regions of West Africa.

Impacts on the human capital:

- Increased knowledge in nutrient management;
- Increased self-confidence on use of farm residues, animal manure and local phosphate rock;
- Increased awareness of possible uses of locally available forages and crop residues.

Impacts on the social capital:

- Increased farmers' income (by increasing meat and milk production);
- Strengthened interaction between farmers and herders in the manure utilization;
- Stronger networking among NARS, national research centers and farmers and herders.

Impacts on the natural capital:

- Increased productivity of crop-livestock farming system;
- Improved nutrient management;
- Improved soil fertility, food and fodder crop production.

The gender dimension:

Women's role in the research programme, impacts on the gender equity and women's empowerment.

- The use of crop residues improved the performance of animals owned by women (mainly, goats, sheep and poultry).
- Women producers were often less able to fetch the same sale price as men especially for small ruminants meat; they had to entrust their products to relatives to sell them on the market. Moreover, milk is often sold by women and directly contributes to their revenues and to the improvement of the diets and the living conditions of the household.
- Women's groups indicated that the credit system often met the needs of more wealthy women but not of the majority. Poor timing of the availability of credit and the large requirements for guarantees limited adoption potential of sheep fattening for women.

Accessibility:

Identification of the physical availability of the research outputs in different time and places as well as their affordability by the rural poor.

- In several countries, clear progress has been made to enhance farmers' capacity to gain access to resources. Many technologies required inputs for success and the access to those resources is often determinant of whether there is adoption. While the initial response of farmers was to request someone to supply them with the necessary inputs, the more sustainable solution was to create initial mechanisms that give them access.
- Under common grazing practices - namely in Mali - fallows are communally grazed; therefore the proposed technology based on the sole cowpea has not found adoption on fallow lands.

Constraints faced during the programme implementation:

Difficulties faced during the implementation of the research programme, specifying the internal (limited infrastructure, lack of inputs etc) and the external (socio-political and environmental aspects) constraints.

Constraints related to:

- *Internal conditions:*
- *External conditions:*

Constraints related to the internal conditions:

- Difficulties in collecting data on local crop-livestock productivity (except for Senegal and Niger).

Constraints related to the external conditions:

- Inadequate availability of livestock nutrients (e.g. protein and phosphorus for livestock production, organic matter, nitrogen and phosphorus for crop production);
- Environmental constraints (land degradation and decreased soil fertility);
- Limited access to the technologies for the poorest farmers (mainly due to the lack of economic resources);
- Difficulties in accessing the feed resources (especially in the late part of dry season, when forage and crop residue resources become critically limited to appropriately feed the animals);
- High volatility of markets for feed resources (in some countries like Senegal, agro-industrial by-products -molasses from sugar cane, cottonseed cake- are mostly directed to export markets and thus they are available only in limited amounts for internal markets).

Institutional sustainability and degree of farmers' involvement in the research programme:

Underlying the degree of farmers' meaningful involvement in the definition and implementation of the main research steps/research process - which determines also the level of social and psychological acceptability- and explanation of the measures taken to support the institutional, organizational and professional changes at all levels.

- The institutional approach on farmers' involvement was mainly based on the combination of the analysis of social rules with an economic rationale.
- Local sites to be involved in the field tests have been selected on the basis of socio-economic surveys and the SEA approach. On the same basis, the researchers worked to find dialogue and encourage farmers' active participation especially in the trials both on-station and on-farm. When these close interactions were not developed and then technological choices provided in a top down approach, farmers' perception and acceptability of the research results was low.
- The degree of farmers' involvement in the research programme, especially in the market analysis, has been relevant: farmers' knowledge of local markets was critical to understand the potential use and impacts of the research outcomes.
- For some of the components studied during the research project, the farmers' involvement was determined on the basis of the ownership of dairy cows or on the animals fattening status. This has introduced a certain bias against the poorest households in the villages.

Dissemination pathways:

Description of the ways through which the project results are made available at the village level and at the national/international level (workshops, reports, seminars etc).

- *The communication strategies at the village level:*

- *The communication strategies at the national and international level:*

The communication strategies at the village level:

- Farmer field days;
- Use of ongoing development projects in the areas as demonstration.

The communication strategies at the national and international level:

- Sub-regional, regional, national and international workshops;
- Scientific reports and publications.

Further research needs:

Identification of the new areas considered to be relevant and needed to be taken into account since they influence the adoption and/or the relevance of the research results (new problems or links not investigated by the research).

- An attempt should be made to investigate means of analysis alternative to on farm trials (often NARS scientists were not completely satisfied by them);
- Further researches on couple credit need to be done as it can increase adoption rates and reduce poverty in women;
- New credit lines need to be investigated in order to facilitate farmers access to the inputs;
- Socio-economic analysis is needed to determine the constraints to adoption of proven technologies (for optimal dissemination of research results);
- An attempt should be made to investigate alternative means of analysis often used in sociology and ecology to provide more scientific analysis to this work;
- Analysis is needed to understand the changes in labor requirements and the reasons for farmers' decision making to cope with risk.

SECTION THREE: USEFUL INFORMATION

Keywords:

crop-livestock productivity, semi-arid West Africa, soil fertility, crop residues, fertilizer, trypanosomiasis, manure, corralling.

Useful links:

IFAD:

- <http://www.ifad.org/lrkm/tags/384.htm>;
- <http://www.ifad.org/lrkm/about.htm>.

ILRI:

People, Livestock and Environment Division: <http://www.ilri.org/research/Index.asp?SID=6>

Operating projects: <http://www.ilri.org/research/>

Gateway to global agricultural knowledge : <http://vlibrary.cgiar.org/V?RN=749752783>

References:

ILRI publications: www.ilri.org – InfoCenter

A list of studies and reports related to the project available at IFAD upon request.

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Acronyms:

- International Organisations:

ICRISAT: the International Crops Research Institute for the Semi-Arid Tropics

ILRI: International Livestock Research Institute

IFAD: International Fund for Agricultural Development

IFDC: International Fertilizer Development Centre

- National Agricultural Research Systems (NARS):

IER: Institut d’Economie Rurale, Mali

INERA : Institut de l’Environnement et des Recherches Agricoles, Burkina Faso

INRAN : Institut national de recherches agronomiques du Niger

ISRA : Institut Sénégalais de recherche agricole