

Natural resources and land-use management: conditions for the adoption of mulch-based cropping system by migrant farmers in the Benoué river basin (North Cameroon)

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Summary

Economic growth in North Cameroon is based on agriculture relying mainly on the cotton crop. Confronted with the short-comings agricultural intensification model developed 30 years ago which rely on the use of mineral fertiliser and draught animals and the integration of animal and crop production; SODECOTON in collaboration with CIRAD and IRAD are working towards developing Direct seeding Mulch-based Cropping systems (DMC) for the cotton crop and related crops in rotation. Adoption of these systems by farmers is being met with certain difficulties, notably those related with work organisation within the farm holding, poor land tenure regime, rational use of plant biomass between animal feed and soil mulch. Some of these constraints cannot be analysed only at the level of the cropping system nor at that of the farm holdings, since the rules of decision-making do not depend entirely on the farm family head. This work describes the present state of natural resource and land use management at different levels, by grazers and farmers of two village communities and their environs. At the level of farm holdings a structural type-description was done in order to bring out the various strengths and weaknesses in the adoption of DMC from the standpoint of the different farmers. Visit of on-farm experimental fields and plots were organised for farmers and grazers. These visits provided a forum for debate in which the system's weaknesses were corrected so as to render the mulch-based cropping system compatible with grazer practices, fodder-biomass and landed-property management.

Key words: conservation agriculture, mulch, cotton, land-use management, farmer-cattle raisers relationship

Media summary

In North Cameroon introduction of Direct Seeding Mulch Based Cropping systems cause changes at farm and village level.

Introduction

North Cameroon represents almost 1/3 of the land mass and population of Cameroon. This area is delayed to the rest of the country because of its remoteness, its specific climate and an agricultural based economy. The early rural and agricultural development programmes started around 1970, and gave priority to cotton and irrigated rice production. Faced now to the problem of decrease in soil fertility and increase in land occupation within the cotton belt, agricultural research is urged to design sustainable land management technics. Under this framework, ESA Project (Water-Soil-tree) in collaboration with CIRAD¹ and IRAD², try to implement Conservation Agriculture for cotton based cropping systems (Naudin and Balarabe 2005 a, b). Learning from the experiences developed by its researchers in the Cerrados region of Brazil in the early 90's, CIRAD works on designing diversified DMC (Direct seeding Mulch based Cropping system) options in few pilot countries such as Laos, Madagascar, Cameroon, Mali and Tunisia. Several constraints related to either reorganisation of labour within the farm or the use of crop residues within the whole village territory (to fit both mulching and animal feeding) were encountered.

In perspective of future extension, it seems necessary to evaluate DMC according to:

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- + farming system production components: deriving difficulties in work organisation, crops diversification, fodder availability assessment, net margin, capitalisation and investment.
- + agrarian system components: reasonable use of biomass at territorial scale, agriculture and livestock integration.

It is the entire question on rural stakehold and management of pastoral agro-sylvatic activities.

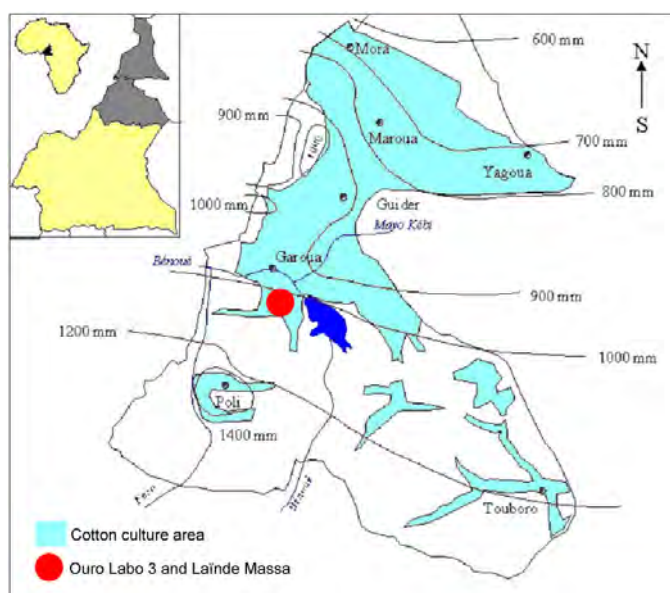
This study was carried out as field work to the Master of Science of Caroline Seugé (Seugé 2004), from May to November 2003. Main objectives were supplying facts permitting to assess conservation agriculture adaptation within the context of migrants settlements in north Cameroon, and proposing the most favourable supportive mechanism and measures for the adoption of this innovation by the farmers. The general problematic of the study lies on the following questions :

- + Are the innovations designed from research, particularly DMC, compatible to agricultural and social realities of north Cameroon?
- + If yes, how to support farmers, rural societies to adopt these innovations?

Answers to these questions imply some knowledge of farmer's environment, mainly identifying farms characteristics and objectives , and possible ways of improving of farm's record.

Context of the study

The study was carried out in two villages : Ouro labo (x :13.3467, y : 9.29806) located in the lamida³ of garoua, lagdo sub-division; and Laïndé Massa (x :13.4714, y :9.095) in the lamida of Tchéboa, Ngong sub-division. (Map 1) .



Map 1: localisation of villages according to cotton zone and main annual rainfall of north Cameroon

The Bénoué basin

The Bénoué basin is a large plain between the Mandara Mountains in the north, the Adamawa plateau in the south, and the Alantika mountains (1885m) in the west. The bénoué basin is made of precambrian rocks in the north and south, and in the centre by cretaceous sedimentary rocks mostly fragmented reaching about hundred of metre in size in the bénoué axis. Apart of the hydromorphic soils of the basin near the river bénoué, poor ferruginous sandstone soils, deficient in phosphorus and easily erosive are found. Areas close to high lands (hills iselbergs) are particularly exposed to streaming and erosion.

The climate is of sahelian type, with total annual rainfall varying between 900 to 1200 mm (map1) . The unimodal rainy season covers almost 6 months with uncertainty on the beginning of the season. This factor explains the necessity to master weed control techniques before crops establishment: they consist mainly of ploughing and, since 10-15 years use of total herbicides.

The conventional cropping system.

Main features of the conventional cropping system include:

³ a traditional boundary

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- + Cotton-cereal-legumes rotation. Except sorghum commonly intercropped with legumes, cotton and maize are monocropped.
- + Soil tillage including mechanical ploughing, weeding and ridging. Sometimes, precociously sown crops (sorghum, groundnut) are installed without ploughing.
- + Use of chemical fertilisers (urea and NPK) on cotton and maize, provided on loan by Sodecoton⁴.
- + Exportation of the major part of cereal stalks for livestock and burning of both cotton stems and non consumed cereal stalks before installing the subsequent crop for the next season. This system has neither input nor recycling of organic matters (OM).

Direct seeding using herbicides is in full extension in the north Cameroon since 15 years ago (Olina et al.2002a) . This technique concerns 40 % (west Garoua region) to 70% (Touboro region) of the land mass cultivated with cotton (Olina et al.2002 b). Adoption of direct seeding is related to a deliberate attractive herbicide sales by Sodecoton and to the availability of total herbicides (paraquat and glyphosate) in local stores. This technique allows rapid and precocious planting of crops.

The situation of livestock in north Cameroon

Livestock in northern Cameroon is made of two different components:

1. The traditional Mbororo bovine husbandry system is of extensive type. It uses transhumance, and though needs large surfaces for pastoralism. This activity is hampered by several constraints due to transhumance (land occupation by farmers, game reserves, insecurity, arbitrary taxation ...) This situation favours poor livestock management and conflicts. Mbororo are trying to settle, leaving part of their family and animals settle during long transhumance.
2. Farmers also rear animal but at small scale; this activity serves mainly two purposes: animal draught and income generating.

Agriculture and livestock integration within a farm or the entire village is hardly practised. Fodder production is inexistent, and even organic manure use in farms is not common, due often to lack of means of transport. For illustration, in one of the study village, first application of manure on a field occurred in 1993 (Dugué,1999).

Soon after harvest, cattles are allowed to feed on crop residues, weeds and sorghum regrowth; this is the communal land-use agreement. Practically, animal feeding on crop residues does not imply any right of the farmer on manure, which means there is no manure contract between the farmer and the cattle keeper, as common in other regions of Sub-saharian Africa.

DMC in North Cameroon

Various practices of Conservation Agriculture based on minimum or no tillage and soil cover have been developed all over the world and in different agricultural ecologies. Especially, designing CA by Cirad and its partners is based on cropping systems improvement. It is based on the three main principles of CA and referred to as DMC (Direct Seeding Mulch-Based Cropping system) (Séguy *et al* 2003).

According to mulch availability, Erenstein (2003), distinguishes several ways of developing DMC. Three of them are implemented in North Cameroon :

1. **Ex situ producing mulch** : mulch is imported from surrounding areas. These options are easily applied but are labour intensive and soil improvement and nutrients recycling are limited.
2. **In situ producing or residual mulch** : using a cover crop, natural vegetation, or crop residues. This option requires limited technical skills and labour, but there is risk of competition between the cover crop and the main crop.
3. **In situ live mulch**: using a cover crop kept alive but under control during the main crop cycle. This option may be the most efficient but requires high technical skills and most permanent living cover crops are not adapted for semi-arid conditions of northern Cameroon.

Generally, DMC options using imported mulch are found to be technically easy to implement by farmers. Although their low performances, these options are able to bring out advantages of mulch regarding weeds control, water harvesting and erosion control. However, for these semi-arid conditions, systems based on in situ mulch production is the most suitable.

Practically, four main options for high biomass production can be proposed:

1. **Reclaiming fallow land**, using natural vegetation (e.g. *Andropogon sp*, *Rottboellia sp*) as in situ residual mulch.

⁴ Cameroon Cotton development company

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2. **Improving fallow lands** by cultivating for at least one year perennial legumes (e.g. *Stylosanthes sp.* or *Crotalaria sp.*) or grasses (e.g. *Brachiaria sp.*) which will produce an important biomass while rapidly improving soil structure. However, these systems may be suitable land available context, where fallowing is practised.
3. **Producing biomass at the beginning of the rainy season**, before planting the main crop. This system is adapted for cotton and maize in 5 to 6 months-length rainy season (south of the cotton belt in North Cameroon), and for cowpeas with even a short rainy season.
4. **ensuring biomass production and conservation**, at least one year over two, intercropping a **cover crop with the main crop** in order to produce a sufficient amount of crop residues for the next season. In this two year rotation, the second year crop is produced on the residual mulch. The choice of the cover crop depends on its ability to be associated (preferring a cereal + legume association), its main interest (soil structure improvement, N –fixation, etc.) and the different uses for human and/or animal consumption.

All the above options are tried in north Cameroon but this paper will focus only on the last option, based on a two year rotation, and associating a cover crop with a cereal the first year. Therefore, the adaptation pattern of DMC will be assessed according to this specific option.

Method and tools for a research-action

Working hypothesis

The working hypotheses are:

- + The adoption of DMC consist to divert fodder to make mulch
- + The adoption of DMC will modify the work plan of the farmers
- + The adoption of DMC will introduce changes in land and natural resources management

Scale of analysis

Two different scales of analysis are considered:

- + Farm scale: a classification of farmers was done so as to determine the types of farms that are fit to practice DMC. This classification will bring in parallel the space management rules, because farmers may not be able to modify them. In other hand the working plan of the farm unit was studied, to identify its possible modification.
- + The scale of the customary territory. There are two sub-units :
 - o The village territory where it is easier for the farmers to organise themselves by considering the established organisations (village cotton association, traditional ruler and his assistants, with the help of external services: NGO, church,.....)
 - o The customary territory to handle cases of animal movement, relation with the neighbouring villages, validation of new management rules by traditional rulers.

Farm characterisation

The first series of survey have as objective to characterise the farms in order to make a structural classification of farmers according to the asset and constraints that can be brought in by DMC adoption. This survey was done in collaboration with a Cameroonian agronomist (Aboubakary, 2003). In every village, about 40 farmers have been selected randomly and interviewed (that is 20% of village farmers). This survey was a “closed” type with some opened questions allowing farmers to express themselves fully. The questionnaires were tackling topics such as land problem, production, working plan, husbandry practices. These data were treated and analysed with MODALISA software (basic analysis : mean by farmers’ class).

Characterisation of livestock camp

The two different types of livestock owners were considered: the mbororo pastoralist or sedentary, and farmers rearing animals in or around the village. The two study villages are near <<Horum>>, a demarcated territory for livestock owner. A series of survey in the nearby mbororo camps have made a better understanding of this milieu. Interviews with local authorities and livestock owners were semi-oriented. Knowing that animal owners are very sceptic to give quantitative informations on their wealth, quantitative questions were deliberately avoided. This approach has permitted to establish a kind of trust. The information were gathered by interviewing different tribes, sometimes with different interpreters, and also triangulating collected informations with other livestock experts of North Cameroon.

Perception of DMC by the different actors

Survey

Full paper

A series of semi-oriented survey permitted to tackle the perception of soil fertility by the different ethnic groups in the villages, the main purpose was getting a representative diagram of farmers. The different experimenting farmers involved in DMC trials were interviewed in order to get their opinion on the innovation.

Exchange visit of stakeholders in experimental sites

Visits on experimental sites by farmers, followed with opened discussion, has permitted to gather their opinion on DMC. The visit was carried out on Kaelé site (far-north) even though the area is different from the one where the concerned farmers work. About 20 farmers have participated to the visit. They were represented by DMC experimenting farmers of the two villages and also farmers from different classes (averagely young, averagely equipped).

A series of individual discussion have permitted to get their appreciation on DMC. The debate either on individual or collective basis were carried out in form of dialogue, and brought out restrictive factors, or necessary conditions for succesful implementation of DMC.

Concerning the livestock owners, a visit was carried out in the Pitoa site, focusing on fodder production, in order to introduce them to DMC and to present different fodder plants. Eight mbororos attended the visit, and a trainer of a livestock promoting NGO (APESS : Association pour la Promotion de l'Élevage en zone Soudano Sahélienne) was also associated to the visit. The attendance of mbororos to this program is a first step of their integration in DMC implementation. This may induce further negotiation on communal land-use agreements especially on agriculture-livestock effective integration. This could also provide livestock owners opinions on DMC options developpment.

Restitution

A final restitution was carried out in each village at the end, using a short presentation of the main results of the study (translated into fulfulde, the principal local spoken language), followed by a debate with questions and observations by every one. The questions on DMC are generally of technical scope, and related particularly to the contradictions made by Sodecoton technical instructions : “with DMC there is no ridging, but sodecoton says if there is no ridging 40% of yield will be lost?!” . The situation permitted to launch a debate on the ongoing progress in the villages, notably on the issue of increase in population in this context of migrant villages.

Results

The two village, medium age settlement of multi-ethnic groups.

Ouro labo 3 :

- + lamidat of Garoua
- + 235 farmers in 2003
- + village created by NEB³ project in 1985
- + dominant ethnic groups:Guiziga, Guidar Moundang

Laïnde Massa :

- + lamidat of Tchéboa
- + 210 cotton farmers in 2000
- + migrants village created 1980
- + dominant ethnic groups: Massa, Tupuri, Musey

A three crop-based rotation....unadapted to the main DMC option implemented.

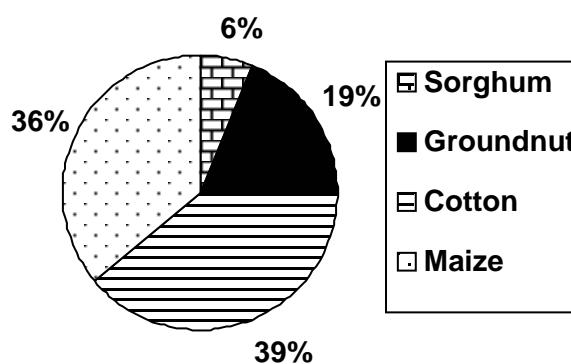
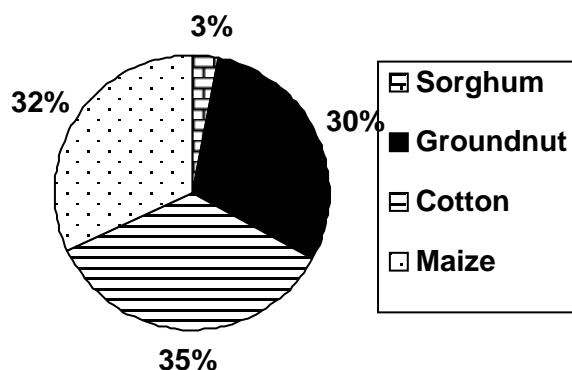


Figure 1 : rotation in the village Ouro Labo 3

Figure 2 : rotation in the village Laïnde Massa

These results bring out the importance of groundnut within the rotation in Bénoué basin. Also, maize is the most cultivated cereal of the farmers. Therefore it seems necessary to integrate groundnut in the rotational system to be developed in DMC, and also to combine maize (the principal cereal) with an appropriate cover

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crop. In Laïnde Massa, where sorghum is practised by more farmers, its combination with a cover crop shall be implemented.

Farmer's classification

The classification obtained was made on structural basis: owing a yoke and a cultivated farm

Table 1: distribution of different types of farms

Types	Characteristics	Laïnde Massa	Ouro labo 3	
A	No cattle	Less than 1 hectare	15%	16%
B		1 to 3 hectares	15%	16%
C		3 to 5 hectares	5%	7%
D		5 hectares and above	10%	5%
E	Cattle	Less than 1 hectare	7%	2%
F		1 to 3 hectares	12%	20%
G		3 to 5 hectares	12%	16%
H		5 hectares and above	24%	18%

Perception of fertility by farmers ... some predisposals for DMC adoption!

The perception of soil fertility by farmers is supposed to help them understanding the interests of DMC.

Several indicators are used by farmers and the general ideas on soil fertility may be summarized as follow:

- + A fertile field is first and foremost a field that can give a better yield (DMC shall for instance be convincing)
- + A bad field is an exhausted field, dead because over worked without crop rotation.
- + Before cultivation of a field the fertility indicators are: the content of clay, the presence of earth worm path, the <<black colour >> (indicating organic matter) and trees.
- + Ploughing is considered as the main cause of soil degradation
- + Fertilising a field consists of supplying it with domestic waste. In some areas, roofing hay are thrown on the field
- + Cultivation of legumes is considered as a supplementary mean to a soil, the leaves decay and help the soil.
- + Crops combinations are sometimes considered as conservative measures of soil.

Perception of advantages and inconveniences of DMC according to farm types

During the survey, farmers were asked to give their opinion on advantages and inconveniences of DMC. It is prior opinion since nobody has tried it yet. They referred to the on-farm plots conducted by few farmers in the village or simply to the explanations given by the field technicians of DMC. The advantages are mentioned on fig 2 and the inconveniences on fig 3

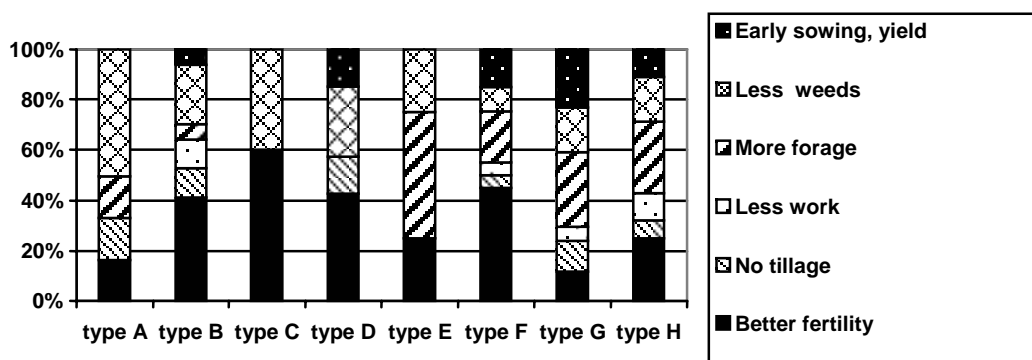


Figure 3 : a priori advantages of DMC according to farmers

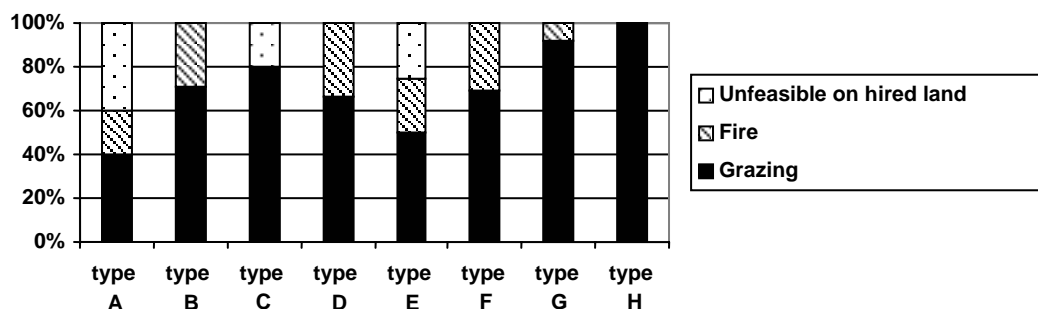


Figure 4 : a priori inconveniences of DMC according to farmers

These opinions were completed after the visit of controlled field of experimentation (concerning these fields see Naudin *et al* 2005 b). During the visit and the restitution that were made in the villages, the following advantages and inconveniences were highlighted by the farmers:

Advantages:

- + Decrease in labour requirement
- + Decrease in yoke hiring cost for tillage (50 to 60 000F CFA/ha)
- + Better yield in cotton: deriving from a better water use by plants in presence of mulch
- + Efficiency of living fences, according to the farmers, prevent from animals, and appear to be the first step before implementing DMC.
- + Fodder production more interesting for livestock owners but also the other farmers, as source of income
- + Positive effect of combination of crop/cover crop on striga infestation
- + Soil fertility improvement

Inconveniences:

- + Land tenure system: the land ownership in the village is never questionable, land renting may influence DMC adoption. An arrangement may be needed between the renter and the land-owner
- + Investment for living fence establishment
- + Forming groups to minimise the cost of the living fences establishment, and to show its importance to mbororo
- + Involving local cotton farmers association to finance living fence establishment
- + Construction of dankis in the bush to stock hay avoiding transportation
- + Negotiation with mbororo, (involve the project and the traditional chief)
- + Proposing alternative solutions such as fodder cultivation

Discussion – recommandations

The objective of the study was mainly to identify ways (1) through which DMC can be adapted to the migrants settlements in north Cameroon and (2) to define supportive measures at individual and collective level. According to this, specific recommendations can be made.

At village scales

Adapting DMC to an open grazing context

As stated above, crop residues preservation during dry season for mulching the subsequent crop seems to be the major constraint. Open grazing seems to be a right for livestock owners. They will not abandon it immediately for any other restrictive alternative. Different DMC options can serve as transitory steps before assuming controlled grazing practices. This include:

- Suitable combination of cereal/cover crops, ensuring sufficient biomass production to fit mulching and animal feeding. In this perspective most of the tested cover crops were selected according to their ability to serve as fodder (*Brachiaria*, *Mucuna*, *lablab*, *cow peas*, *stylosanthes*...) and therefore must be cut down from the field and brought out to animals. The choice of these fodder species, which will be exported from the field, must assess minimum nutrients use by them, to avoid decrease in soil fertility. Another option is to intercrop a cereal with an unapeteable cover crop, followed by an open grazing of the field. Such cover crops include some *crotalaria* species and *sesbania*.

- Improving fodder availability by introducing high fodder producing species in the village. This can be done in the farms as intercropping or monocropping systems or even as hedges, and in pastoralist areas. Interesting species include: bana grass, fodder shrubs, *Andropogone sp*, *Panicum sp*, *Cajanus*.

Adapting DMC to local land tenure system

It is generally assumed that land tenure system is an important factor influencing adoption of Conservation agriculture (Anderson *et al* 2001). In the study hypothesis, we stated that migrant farmers of the two villages who have no guaranteed right of permanent use of their fields, may be reluctant to DMC. The study shows that, long time settle migrants consider themselves as owners of the land and that the lamido does not interfere in the management if there is no particular problem that arises. These farmers therefore seems to be able to work for the purpose of soil conservation and improvement. However, for the innovation to be sustainable, it may be necessary to focus on short term effects in this migrants context. These effects may be: decrease in labour requirement, and Nitrogen fixation by legumes and effect on weed control. DMC options to be implemented shall therefore focus on these short term constraints.

Adapting Actual communal land-use agreements to fit sustainable natural resources management

Not only in accordance with DMC implementation, natural resource sustainable management requires a fundamental change in their communal use. Therefore, DMC appears to be the most globalised entry-point to initiate this change. For soil sustainable utilisation, it is necessary either to move from the open grazing agreements, or link it to a manure contract for fields to benefit from livestock.

In relation with DMC, different steps (medium term actions) may be achieved to change the actual communal land-use agreements. These actions are to be pursued both at farm and village scale (larger plots). This include:

1. designing transitory DMC options based on open grazing with no manure contract agreement. This options, whereas they could improve soil fertility, are low performances and have less long term effects.
2. designing at the same time and place alternative DMC options with a maximum nutrients recycling and no grazing, and which are able to restore soil fertility more rapidly and have short term effects (deriving from the better mulching)
3. Comparing progressively the two different options and initiate a communal debate of the stakeholders on the specific advantages and constraints and ways to master them.

Designing DMC : which future scenario according to different communal land-use agreements?

Scenario 1: the actual land-use agreement is maintained. Cattles continue open grazing after harvesting. Crop residues are consumed, and mulch is supplied from the the surrounding areas. This option seems unadapted for large surfaces, therefore, only small surfaces will be implemented. In this scenario, large scale benefits of DMC (erosion control, nutrients recycling) will not be achieved.

Scenario 2: the actual communal land-use management is improved and there is no more open grazing of crop residues. Then arise 3 major problems:

- Need for incenting traditional rulers formerly relying on animal grazing taxation within their territory
- The need for living fence establishment.
- The need for alternative solutions for animal feeding, and even the acceptance by livestock owners to move from a free feeding resource to fodder production.

Scenario 3: the village land is divided into DMC and non DMC areas, allowing new communal land-use agreements. More crop residues should be produced in the open grazing area (non DMC areas) in order to fill up the feed-stuff deficiency deriving from DMC area. Combination of main crops to fodder plants are recommended. The choice of these cover crops should assess minimum use of nutrients, and must focus on fodder legumes. However it may be uncertain that farmers will agree to make this extra effort just to feed animal not necessarily belonging to them. Therefore, an arrangement must be found between these farmers and the livestock owner (a manure contract for example). This scenario must also focus on fodder availability improvement.

At farm scale

Adapting labour organisation within the farm unit

Generally, the modification of labour requirement deriving from DMC seems to be positive (IFAD-FAO 2004, FAO 2001), especially on cotton year in Northern Cameroon. However, labour organisation within the farm unit may vary considerably, due to the non-use of mechanical tools and introduction of new plants (crops, cover crops, new varieties). Principal change in labour organisation concern crops installation and establishment (sowing, resowing), weed control (manually or chemically done) and harvesting. Especially for weed control, it may be necessary for large surface to introduce masking sprayers, which permit to spray

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low cost total herbicides (glyphosate and paraquat) and efficiently control weeds. Specific counselling may also be needed according to farm characteristics.




Adapting crop rotation in accordance with the farmers needs and expectations

The main tested rotation in on-farm trials is a two year cereal + cover crop/ cotton rotation. Mulch production is done the year of cereal +cover crop combination and cotton is produced on mulch residues the subsequent rainy season. In this rotation, groundnut is lacking, and may be introduced by:

- replacing cotton in the two year rotation (rotation became : cereal + cover crop/groundnut)
- shifting to a three year rotation (cereal/cotton/groundnut). Some DMC fields of groundnut were experimented by the project in Kaelé and Pintchoumba sites.

It has been showed that groundnut cultivated after a cereal + cover crop combination develops very well, is easily harvested, even without the need of rain. Therefore, it is possible for farmers to delay its harvesting, avoiding labour concentration, and also enhancing better use of groundnut residues for animal feeding, since it can be conserved longer when harvested in dry season.

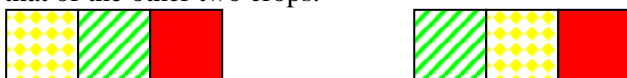
Example of DMC rotation integrating groundnuts

( maize,  cotton,  groundnut)

1) Groundnut and cotton conducted on DMC, maize field is two times larger than that of cotton and groundnut combined. The proportion of cotton and groundnut can vary, but maize surfaces remain fixed. (two year rotation)



2) A two year rotation with maize and cotton, and monocropping of groundnut on another field, continuously. The maize field size is equal to that of cotton; The surface of groundnut is not dependant on that of the other two crops.



3) Three year rotation, the three fields are of the same size. Biomass is produced after the harvest of groundnut, benefiting from the residual rain (1 month to 1 month and ½).



It has been noticed that most often, biomass production on the cereal surface may be sufficient to provide soil cover for cotton the next year, but not enough mulch will still be available for groundnut in year 3. Therefore, (1) itinerary is not advisable.

For farm with cattle, it is possible to reserve part of crop residues to feed animal. Itinerary (2) or (3) can then be implemented.

The necessity of identifying and understanding farm'needs and expectations is important for DMC adaptation and adoption. As it was done in Latin America (Anderson *et al*), specific strategies based on effective expectations and criterias of the farm unit is needed. Therefore, a conseilling-survey of 15 farm units among DMC experimental farmers will be achieved. This procedure will consist of adapting technical references on DMC to farmer's effective expectations and realities. The survey will include farm needs (in term of products and inputs, labour and capital), resource availability, assessment of fitness between practical rotations and available resources (Djamen *et al* 2003).

Conclusion

In Northern Cameroon DMC is at experimental stage, and still not at large scale extension. However, there is a real need of adapting this technology to each specific socio-economic environment. The major DMC adaptation constraints are above the limits of the farm territory, and do not only depend on individual farm decision. These constraints concern communal land-use agreements, influencing crop residues preservation; and land tenure system which can guarantee right on permanent use of the fields. The first step of DMC implementation will imply adapting the technology to the actual environment. Progressively, these options will move from this stage to more suitable DMC options, which in term will appear to be more able to improve soil fertility and economic impact of Conservation agriculture. This step will therefore require great changes in communal land-use agreements.

Given that it seems difficult in short term to modify socio-economic factors, it is therefore necessary for the stakeholders (farmers and livestock owners) to find immediate communal solutions. The social organisation in northern Cameroon strongly relied on hierarchy and Sodecoton is in line with this: for a long time, farmers

Full paper

have been considered to be the ultimate piece of an entire chain, and was urged by extensionists to respect the technical instructions they were given; this has developed a feeling that agricultural activity is subdued and non valorised. "The difficulty to design other operational ways than the one based on hierarchy system blocks the emergence of other alternative initiatives (Legile, 2002). Rural society is not that static and homogenous, these society bring changes and innovations and are permanently transformed. DMC, according to its adaptative ability, must consider the farmer's knowledge, realities and expectations, when developping different feasible options, and in term, may generate socio-economic evolutions.

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