Natural resources utilization the sylvopastoral region of Senegal: the answers of the pastoral populations facing technological innovations

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Summary

To promote a sustainable pastoral production, some ecological regions of Senegal particularly the one in the sylvopastoral Zone (ZSP) have been devoted to livestock raising. At the same time as the installation of water supply equipments was done, natural resource management techniques such as the delimitation of protected areas, application of a stocking rate in rangelands and recently, the adoption of a holistic approach of resource management, were implemented with the participation of divers stakeholders with the aim of enhancing production in the region.

However, heavy climatic constraints have revealed the limits of these technologies and sometimes of their non adaptation. This situation has also shown the efficiency of pastoral practices that have allowed pastoralists to save their livestock when regressive tendency was observed on the rangelands.

This paper describe the evolution in the utilization of natural resources in the sylvopastoral realize and the reactions of pastoral people face to proposed natural resource management techniques.

Keywords : Sylvo-pastoral regions - Practices- Innovations - Adoption rate.

Introduction

The sylvo-pastoral zone (ZSP) is one of the agro-ecological regions of Senegal. It is located at its northern part in the sahelian zone (100 to 600 mm of rainfall during the 1991/2000 decade). Its important animal production potentials were recognized very early. Actually, this region has a large livestock population and its community dominated by Fulani people with an enormous capital of experience in pastoralism and wide rangelands. Previously, natural resources consisted of important stands of *Acacia senegal* and a very diversified wildlife. Cropping activities mainly dominated by subsistence crops are not very significant, except in its southern part, but they have always played a strategic role in food self-sufficiency.

This region was occupied only during the rainy season until the late 40s because of the lack of water in dry season. The development of livestock production have also faced difficulties such as: severe animal epizootics, predation by wild carnivores, and poor feeding during some periods of the year.

Thus, different technologies have been introduced to "enhance the animal production and enable ZSP communities to capitalize on their cattle by using them for food and trade." (Merlin, 1951). Following the disease control programmes, techniques used for the improvement of water resource availability have played a major role.

In spite of all these measures, communities are faced with droughts resulting in high mortalities in the livestock and in some woody species. At the beginning of this event, some "experts" (around 1972) recommended that the area "be evacuated" so that its productive capacity could be restored.

Several years later, the ZSP continues to contribute for a large proportion of the animal production in Senegal [35% of the national cattle population and 50% of small ruminants (Anonymous, 2000)]. Though the region has been subjected to significant ecological changes, local communities are well adapted to the new context by using different technologies to develop new production strategies in order to take advantage of their environment.

1. Strategies to develop and transfer technological innovations in ZSP

1.1. Significant technological innovations particularly focussed on the improvement of productivity

Formerly neglected, the ZSP started really to interest public authorities only by the 1940s. One of the objectives set-up for this region at that time was to increase the livestock which is regularly subjected to animal epizootics and wild carnivores attacks.

Thus, vaccines against some major diseases in this region (cattle plague and contagious bovine pleuropneumonia) were developed at the "Laboratoire National de l'Elevage et de Recherches Veterinaires" de Dakar. Some prophylactic measures and early warning systems were also developed to control and monitor new diseases (Rift Valley fever) due to ecological disruptions caused by droughts and development of irrigation.

Research on livestock improvement have started in this region with the creation of the "Centre de Recherche Zootechnique" de Dahra in 1949. Researches carried out at this station started with horse breeding and were extended to cattle and small ruminants in 1952 and 1954. Artificial insemination programme for horses was set up and cattle selection programme was also conducted and breeding stocks made available to farmers who were in demand.

In the animal nutrition field, studies carried out on native pastures in this region, have allowed to gain knowledge on the nutritive values of woody and herbaceous fodders. Techniques and methods were also developed to better conserve fodders. As for the animal production, different breed potentials and production were evaluated and variation factors identified. Also, genetic parameters and genetic gain for "*Gobra"* cattle breed have been evaluated.

Forest researches launched from Mbiddi station in 1984 have particularly focussed on the improvement of the regeneration and exploitation of *Acacia senegal*. Knowledge on the ing the environmental behaviour of fodder trees as well as their biomass yield provided a referential on the adaptation of species based on soils and rain conditions. The studies undertaken on *A. senegal* on incision techniques led to a better optimization of utilization of natural gum tree stands.

Researches carried out on plant productions were successful and resulted particularly in diversification and the development of cropping techniques. They were mainly focussed on rain-fed crops such as millet, black-eyed peas and groundnuts. Specialized laboratory works were led to better understand the mechanism of plant resistance against drought. As far as horticulture is concerned, planting materials and techniques used in ZSP result mainly from researches led by the "Centre de Developpement Horticole" de Dakar, though there were not many studies on the adaptation to the ZSP specific conditions.

1.2 Commitment to focus researches on local communities' actual concerns

The adoption rate analysis for technological innovations showed that out of 45 technologies surveyed at the CRZ de Dahra, nearly 50% have an average adoption rate and 13% have a good adoption rate, whereas the remaining percentage has low adoption rate. Many results allowed only to better understand resources potentials and farming systems.

Due to the adoption of these technologies, the production of some resources has been improved. Therefore, in the animal husbandry area, the livestock has increased and is more and more productive due to the eradication of many animal epidemics and a better control of the livestock production environment. Similarly in the forestry field, the regeneration of gum tree plantations near certain borehole areas constitutes a significant asset.

However, only few research results affected significantly communities' activities because they were based on the sedentarisation/intensification concept. Breeders didn't approve the option to increase mainly the productivity of resources (For example, the growth rate of animal) in a risky environment. This proves that the paradigm sedentarisation/intensification needs to be changed and replaced by securisation of pastoralism "Securisation is the main concern for pastoralists".

Therefore, form 1994, the analysis for constraints resulting form previous studies in the area and for participatory diagnosis results (Anonymous, 199?) has led to the adoption of an approach different from the previous one and based on a sustainable management of natural resources, for the agricultural research. In fact, activities such as extensive livestock production, gathering and a certain type of cropping appear to be the most economical options for the use of local resources (plant, animal et human resources).

2. Case studies on breeders' response to technological innovations

2.1. Continuation of breeders' mobility in spite of advanced techniques used for the development of water resources

During the first half of the 20th century, local communities used to leave the ZSP with their cattle because of the scarcity of water points. Thus, there were large pasturelands undeveloped during such period.

Wells have been drilled to bring the inhabitants to stay longer with their livestock in the ZSP. Some times later, grasses decreased quickly around water points and ground-waters were so deep that they require an important dewatering effort.

Unexpectedly, after the introduction of a well test technique developed in United States of America (USA), the Maestrichtian groundwater was found in 1937 in the groundnut region. This groundwater located between 200 and 300 meters depth, could enable the creation boreholes with flow rates up to more than 50 m^3/hour.

From such achievement, programmes have been launched for the establishment of boreholes, though there was not enough technological knowledge on deep ground waters at that time. Results from the establishment boreholes, along with geological studies provided more comprehension on this groundwater. Such technology enabled the setting up of a performing water point supply system (figure 1). In 2001, the total number of boreholes in ZSP was about 169 (Anonymous, 2001).

However, to continue their mobility, breeders have developed a water transportation system (figure 2). Thus, the *wiir*[1] with 30-liter capacity was created with the first generation of boreholes and was used by 66% of ZSP breeders. Subsequently, this was taken over by more large containers, the *soumaledji* and the *girba*. During this period, transportation of water was on ass back.

Figure 1: Boring techniques for the reinforcement of animal production and the settlement of communities

Figure 2: Water transportation system to enable mobility

The actual revolution or "triumph" - as Juul (1996) mentioned - of water transportation was characterized by inner tubes with which up to 1000 litres could be transported. Therefore from 1975 to 1991, the number of carts was increased tenfold (Santoir, 1994) and water transportation vehicles are more and frequent in these last years, which leads to a diffuse distribution of populations and their cattle in the ZSP.

[1] The *wir* is made of thick cloth while the *soumalédji* and the *girba* are made of goat skin.

The increase of boreholes affected the ZSP population general growth between 1976 and 1992 with an average of 1% per year (Santoir, op.cit). However, this rate includes the important emigration if the natural growth is estimated at 2.7%, which means that the number of boreholes didn't have a significant impact on the population growth. On the other hand, inhabitants and camping sites are scattered, particularly in the dry season.

Peul communities don't live in small towns, but are scattered on camping areas located around boreholes (such as Lagbar borehole indicated in the box). Camping areas in rainy season, unlike those in dry season in which settlement changes depending on the period of the year, tend to be a permanent settlement pole. The settlement mode in this area shows a high tendency to dispersion. In certain zones, there are camping areas equidistant from two or three boreholes. Anyway, it is recognized that land occupancy is well organized in a real pastoral system.

Settling communities around a well bore : Labgar case

- *The borehole was set up in 1953*
- *In 1975, Lagbar was expected to be a viable sedentary economic community (Reboul, 1978) with the establishment of the "Société de Développement de l'Elevage en Zone Sylvopastorale" (SODESP) (Reboul, 1978). In 1977, a birth center and a nursing center have been built along with a vegetable garden created with the financial support of IUCW (International Union for Child Welfare). The vegetable garden cultivated by women provides the vegetable and fruits needed to improve child feeding. Nurseries for gum tree stands and even fruit-bearing trees are planted. Lagbar is provided with a modern training center for breeders with the support of ILO (International Labor Officel).*
- *In 1992, due to political reasons, SODESP changed its approach and according decreased its staff in Lagbar. Later the center was closed.*

The « centre de France » (France Center) as designated by communities has become a well-bore as all those in the ZSP where there are only communities whose animals live in camps far from water points, even if they are breeders

- *The borehole has remained a water point that was used for seasonal pasture operations*

houses) is generally low, that is there are 2 camping areas out of 10 in the zone of influence of Mollodi borehole, 1 out of 10 in Namarel; none in Tessekre (Toure, 1985).

At the beginning of the century, the livestock density was fixed in the Djoloff (western part of ZSP) at 1 cattle for 100 ha and between 1950 and 1975, at 1 cattle for 24 ha (Barral and *al.*, 1983). In 1982, is estimated in the northern part of the Ferlo at 1 cattle for 9.3 ha **(**Sharman,1982). In 1994, similar results (Anonymous, 1995) were obtained for certain boreholes (Thiel et Thiargny).

A significant growth is particularly noted with small ruminant. In fact, if the number of cattle in 1973 exceeds three times that of small ruminants (Fayolle, 1974), in 1982, there was twice more small ruminants than cattle (Sharman, 1982). Data collected during these last years have indicated the evolution of such tendency (Anonymous, 1995).

This situation reflects the evolution of husbandry practices all over the ZSP. Small ruminants increase quickly and are easily sold in order to acquire zebus. The increase of carts is also a determining factor for small ruminants raising. Such growth has affected equine and particularly donkeys.

Apart from some technologies as three-shaft carts (Diop, 1991), innovations realised in this field were managed by local communities themselves. Thus, in every borehole area, a handcraft activity was developed to ensure cart repairing and manufacture as well as equipment needed for the improvement of dewatering and water transportation.

2.2. Delimiting protected areas for a better management of the pastoral area

Management standards should be elaborated and applied for a sustainable development of natural resources. In this prospect, the "Reserve de faune du Ferlo" (RFF) was created in 1952, in the eastern part of the ZSP. Its size was extended to 850,700 ha (current size) in 1972 on which it was erected as the wildlife conservation area.

The existence of several ponds and a vegetal cover (woody and herbaceous) relatively important, its geographical situation an the type of soil have made this part of the ZSP, an hibernation area for big antelopes and big carnivores living in the Sudanese zone (namely the Niokolo Koba park) such as: hippotragus (*Hyppotragus equinus*), lion (*Panthera leo*), african hunting dog (*Lycaon pictus*), blotched hyena (*Crocuta crocuta*), etc.

The creation of this reserve aims at protecting the Ferlo endemic and wildlife animals such as: red-forehead gazelle (*gazella rufifrons),* ostrich (*Struthio camelus*), arabian bustard (*Otis arabe stebieri*) and poule de pharaon (*Eupodotis senegalensis*). The degradation of the vegetation cover constitutes also an other justification for the creation of this reserve, which is endowed with plant species such as *Acacia senegal*, *Pterocarpus lucens*, *Dalbergia melanoxylon*

As in any protected area where people are established, the settlement of villages is regulated by legislations. People living in the RFF must settle along tracks designed as the limits of certain valleys, but the actual situation is quite different. In fact, authorizations granted by the administrative authorities for well drilling, has allowed immigrant to settle definitively beyond the authorized lands. Therefore, the increase of the local community and the entry of new migrants have resulted in the increasing clearance of areas and even shallow water areas are included. Migrants coming more frequently from everywhere settle all over the northern part of the reserve. These situations decrease wildlife life areas in the southern part, and accordingly, they cut off the wildlife migration way from the Niokolo Koba Park.

A borehole was established in Pethiel for inhabitants, in the middle of the ostrich concentration area. This provoked an irregular presence of such species in the reserve, which is the only place where they can be found in Senegal. In fact, the historical cause of this situation is that when the site was proposed for the establishment of a borehole, the park managers were not on place, so only the other representatives (breeders, administrative authorities, Managers of the project in charge of borehole establishment) accepted the proposition.

For inhabitants, this project aims at improving the quality of pasturelands, the reason why they provide any arguments to defend this project. Therefore, they refuse the presence of any wild animal, except jackals. One of them even mentioned: *I am more than sixty years old and I have never seen an ostrich in Pethiel.*

Therefore, breeders have implicitly convinced administrative authorities to provide them with conditions for a better development of resources (water supply improvement) in order to participate in the wildlife protection action. However, they know the RFF so well that they can operate as they like, even if it is illegal. The reserve has now become an area increasingly occupied by cattle to the disadvantage of wild animals.

2.3. Controlling the livestock carrying capacity as the basic factor for the improvement of livestock productions

The determination of the carrying capacity pastures in the sahaelian region has been subjected to studies in many livestock farming areas, but it is still difficult to ensure its application. Also, a test was performed on the area surrounding the borehole of Widou tiengoli by the 1981 under the supervision of the national forestry office, in collaboration with the German cooperation. It was concluded that to enable a sustainable pastoral production in this region, the carrying capacity was set at 10 ha/TLU (Tropical Livestock Unit - animal of 250kg of liveweight).

Based on these results the extension of the project has decided: major investments (water supply system from the borehole over 7 km, enclosing wall built with German materials) were granted to allow breeders to carry sedentary activities without "damaging" the environment. In return, they should reduce surplus stocks for compliance with the determined carrying capacity.(Richter, 1989).

Several years after the implementation of the approach, the evaluation has indicated that the question related to the carrying capacity in the area surrounding the borehole of Widou tiengoli, hasn't been solved. On the contrary, real disturbances have been identified in this area.

It has been noted that all inhabitants let their cattle go beyond their own areas, so we can certainly consider that exceeding livestock is not sold but it is included in their external herds or flocks. The animal transfer in the area depending essentially on their physical condition and their production cycle, underweight animals should be dealt

with first (Laoualy, 1992). Therefore, it would be better to start with female and producing animals, and priority should be given to pregnant females and if there is place available, underweight animals should be included in order to reduce losses.

It was decided that, for bigamous families, the wife living in the area has to keep as many animals as the second wife living outside the area and must take care of the second's herd/flock. So every each other take profit from the area all along the pastoral year. For families with three wives, two of them live simultaneously in the area while the third takes care of the external herd/flock. As for those with four wives, two of them live the area and two outside and vice versa.

Speculations for small ruminants became more important. Thus, the number of small ruminants held by breeders has doubled that of cattle and there are more sheep than goats.

However, breeders have slowed down the policy consisting of reducing the livestock surplus by using multiple arguments and excuses. On the one hand, external herds/flocks go too far that reduced animals cannot reach them, on the other hand, young calves are hardly adapted to the same conditions as external flocks and they are too weak to join the external flocks in dry season. For that reason, the carrying capacity of the areas generally exceeds 10ha/TLU.

From now, for the implementation of the approach, resident breeders that cannot comply with regulations are required to leave their plots (Richter, 1989) and some of them have lived in this place for many years. At the end, it was noted that the project rather supported more wealthy families. Unfortunately, the experience of pastoral areas has been stopped and the pastoral auto-promotion took place in 1993.

Presently, breeders who own plots keep on occupying pastoral areas at their convenience, as there is no more relevant regulatory structure and no appropriate organization. Therefore, plots are managed in the same way as external, though breeders have landlord status.

Actually, they used plots to stock fodders. They use existing pasturelands and return to their plots if there is no more grass and some of them lease their plots to others.

This experience in Widou tiengoli is similar to that on plot leasing in the "CRZ de Dahra". In 1996, within the framework of its development research activities the center has initiated a partnership with breeders living around it. So breeders were authorized to graze in the center plots by considering the carrying capacity of the plots set at 18.75 kg of DM/day/TLU. The number of animals was determined and subjected to regular controls. All the initiative period, there was no violation to the contract provisions.

But later, we noticed that even if breeders complied with provisions as far as carrying capacity is concerned, they didn't enter the same animals. So they used plots to stock fodders, exactly as what happened in Widou tiengoli. For these reasons, we couldn't say on the basis on the body condition of the animals or milk yield to state that animal performances of plot owners' livestock had increased, which were our objective and not that of breeders.

This means that the ZSP breeder's behaviour with respect to carrying capacity concept cannot be changed. He is aware that there might come difficult years and he might face hard times during a year that can affect his pastoral activities. The most important for him is the security of his herd/flock during the periods of shortage.

2.4. Application of the holistic management ZSP pasture lands

The holistic management model of resources is based on the theory that for interaction between ecological, economical and social factors must be taken into account in a sustainable management of resources (Savory, 1999). It is based on three observations:

- the specificity of arid and semiarid environments known as friable. In these dry lands, the diversity and stability of vegetal cover depends on the nature of pasturelands. If they are not in a good condition, vegetation decreases and becomes instable. In such environments, if pasturelands are undeveloped during a long time, degradation occurs;

• the importance of animal effects on soils and vegetation. Treading, faeces, urines, vegetation squashing and animal grazing, have a decisive and positive impact- with a good management - on the sustainability of vegetal communities;

• the importance of the period within which vegetation is exposed to grazing: Overgrazing depends more on the duration than the number of animals for a given area. In traditional farming systems, pasture is intensively used for a short period and is non operational for a long time. With the development of breeders settling process, grazing periods are longer and intervals are reduced or even eliminated, which results in the extinction of most palatable plants, the invasion of less desired plants ad finally the extinction of any edible plants.

Before taking decision related to the management of pastoral resources, communities that are involved in the implementation of the approach should agree on certain concepts:

• They should agree on "everything" to be managed (lands, communities, resources);

• Users have to set a common goal consisting of three interactive elements: - the quality of their desired lifestyle - production activities they intend to perform in order to get this lifestyle condition - the landscape description (and its ecosystem features) that might provide sustainable production activities.

The ecosystem safety is evaluated under different approaches (animal and plant species succession, water and mineral cycles, energy flow) to know the reason why the landscape can't reach the identified situation. Then, tools and technologies that are most likely to help removing these constraints are selected by using all appropriate guidelines. Finally, based on that process, an agreed plan for the management resources is designed and implanted by all users.

From 1994, with the financial support of World Bank, the "Projet Pilote Pastoral de l'Afrique de l'Ouest" (PPPAO) was implemented. Its objective is to prove that with an appropriate management, it is possible to reverse the degradation process of soils and vegetation currently observed in the Sahel most pastoral areas and provide agropastoral production with main services.

In 1996, the Senegalese branch PPPAO was assigned to test the applicability of the approach in ZSP, to popularize the management model within the test site and to extend it progressively to other pastoral lands. For that purpose, two sites have been chosen: Asre bani (in the zone of Thiel borehole area) and Lol lol (in Thiargny borehole area).

Training sessions (basic literacy) were provided to populations in order to develop their capacities of participating in the project activities. Study trips in the sub-region countries were also granted to leaders. They also needed a water point as the borehole branch line .

During the last three years, communities had ensured themselves the project follow-up. At every evaluation mission of World Bank experts, they declared unanimously that disappeared species were coming back, that "*tocconde"* [2] were reduced and cattle produced much more milk.

Subsequently, the follow-up system implemented by an external team showed that there was no difference between managing herds/flocks living in test sites and those living in the surrounding areas and that the return of disappeared species was identified nowhere at the end of the rainy season.

After these declarations are made, communities decided to tell about difficulties they met during the conduct of the project: - areas being located on the a transhumance road; lack of water points - early fodder shortage - misunderstanding of transhumants - no control of livestock - low flow rate of de Lol lol and Thieul boreholes - non delimitation of plots - lack of means and motivation for plot controllers - no legislations relating to pastoral areas - no guard service for the livestock; non compliance with communities' commitments.

A large part of the Asre bani test site has been cleared by "daara mourides" (religious schools for mouride brotherhood) to whom plots have been granted by the Thiel rural council. For rural community representatives, the attributed area is not included in the test site, but the ligneous cover has been already damaged. The Lol lol site is

[2] According to breeders it is bare tasks of soil in rainy season

experiencing the same degradation because people from Afe, a Wolof neighbour village, who get firewood and charcoal from plots. That means that degradation of such species is not linked to the animal density.

When World Bank experts came in March 1994 to discuss on the applicability of such approach in ZSP, they were informed by national experts [3]who worked with them, that there were not many promising possibilities; cattle is not kept. Besides, this technique is used in the Bakel region (eastern part of Senegal), where communities resort to the livestock production in order to recover *diarral* areas (lands scarified by water erosion). This practice was regular in Senegal, but ZSP breeders are confronted to the increasing mobility.

In spite of the research team evaluation results, the Animal Husbandry Department in charge of the project implementation kept on setting up sites by creating two other units. Then, we understood it would have been better to follow World Bank's guidelines.

2.5. Using food supplement to better improve livestock productivity

The complementation technique is intended to make up for deficits in feeds ingested by ruminants on pasturelands by adding a certain quantity of feed (supplement) with energetic, nitrogen and mineral content. It also aims at addressing the livestock health and production needs in order to make animal husbandry more economical.

In Senegal the ZSP livestock are used to be fed exclusively with natural grass until the 1970s. But concentre-based animal feed begun to be distributed in ZSP during the 1972/73 severe droughts. Later, its utilisation became regular with the setting up of the "Societe de Developpement de l'Elevage en Zone sylvo-pastorale" (SODESP).

After a period of trials on site, breeders living in the company operating area overwhelmingly subscribed to that technical approach (Pouillon, 1984). In fact, they realized its significant and almost immediate impact on livestock: animals begun again to put on weight, their coats became more beautiful and females produced more milk. Thus, there was a mimetic response that enabled to spread the innovation quickly and widely.

Actually, if breeders intended to resort to supplementation because of its short-term effects (narrowing the gap between calving periods), only some heads of the herd should benefit from it under the contract passed with the company. They had to reduce rations attributed to each registered animal in order to allow maximum animals being in bad conditions to profit from it.

Contrary to the company's objective that considers supplementation as a long-term operation intended to enhance the livestock productivity, breeders use it to recover some animals that have lost too much weight, just as a livestock preservation.

Some breeders considered that mineral and vitamin supplementation is expensive, so they reduced the normal quantity of use per head. Moreover, they found that supplying regularly a nitrogenous supplement to an animal would make it weak because it became more and more demanding and grazed selectively on pasturelands. In fact if the supplementation is stopped, it stands hardly and wastes away, it becomes less hardy and during the rainy season, it is not easily adapted to get back to natural grazing. It produces much less milk than the other animals.

Presently, with the end of SODESP activities, the supplementation feed supply is done through informal ways depending on offer opportunities and transport possibilities. ZSP animals remain attached to their natural pasturelands as soon as it starts raining; they only eat grass even if they are given concentrates. During the dry season, they are brought to best pasturelands and breeders go and fetch water from anywhere, regardless the distance, by using inner tubes. This allow them to put on weight and to be incomparable economically speaking.

[3] Mission constituted by Dr Pape Ibrahima THIONGANE, old general director of ISRA, Dr Ibrahima DIEME, old director of national breeding office and Dr Amadou Tamsir DIOP of ISRA.

3. Analysis on breeders' response to the transfer of innovations: their refusal to intensification is permanent

The analysis performed on the innovation transfer technologies has proved that decisions were taken by researchers, development agents and funding officers instead of local communities, without taking into consideration their practices and strategies. Therefore, they decided to adopt the most suitable innovations and acquired them while the popularization process was not launched (water-related technologies, three-shaft carts, etc.) (Figure 3).

Figure 3: Fences didn't help intensifying productions.

When choosing innovations, policy makers mainly intended to intensify production in favour of the national economy (supplying urban populations at lower prices, exporting products for hard currency). In favourable conditions, communities didn't hesitate to resort to a wide range of innovations in order to produce enough (sheep production for Tabaski [4]).

Many improvements have been noticed within the last years due to the fact that multidisciplinary teams are more involved in the identification of generation and transfer processes for innovations. However we should mention that debates on the riddling of innovation are limited because the main concern is to report to line supervisors (funding agencies, administrative or political representatives who need supporting data) in the best terms or to get resources for work.

On the other hand, communities and targeted people are honoured that their locality is designated as the Administration operating site. They managed intelligently to get other advantages in form of assistance for innovations setting up (trainings, trips, inputs etc.)

This is why the determination of the adoption rate of technologies is not easy. Local leaders (politicians, marabouts, etc.) are generally targeted based on their status (or even designate people to target). Such situation makes difficult to evaluate any innovation. Besides, technologies related to commonly managed resources (soils, natural pasturelands, surface water resources,..) that should be considered with the involvement of all stakeholders are more difficult to adopt.

The main goal of pastoral communities remains the preservation of animal productions. Relevant researches (strategic supplementation, improvement of arid area species such as donkeys, etc..) have been launched even if they are limited for the time being and financial inputs are not significant.

However, the diversification of resources in pastoral environments shown by PPZS recent studies, has given rise to many debates on the evolution of securisation strategies which no longer entirely depend on herds/flocks and may change communities dependence on their environment and on the management of natural resources.

The long-term effects of most technologies are not always controlled and the issue arises more as pastoral ecosystem such as the ZSP are subject to high variability. Some climatic events that have never been experienced (or

[4] Religious feast during which the demand in sheep is strong; prices are raised therefore

unexpected, for example off-season rain that occurred in 2002) by most actors, undermine the efficiency of many technologies.

Competition between departments (for example between national parks and Matam development project in the RFF) doesn't facilitate the transfer of technical approaches. Another problem is the implementation period that depends generally on financial opportunities.

Approaches on the transfer of technologies are theories from international institutions that have supposedly performed successful results on other areas ("Training and visit" and "Conseil Agricole et Rural"). They are elaborated for sedentary targeted people, which is not the case for ZSP pastoral breeders.

Although the ZSP is a pastoral environment, it is important to identify problems with communities before transferring a technology. The lack of legislative measures is a major hindrance that the land tenure law has not yet solved, especially for pastoral communities.

The evaluation of structures involved in the generation and transfer of technologies haven't been done yet or are late. Recommendations are usually filed away and when the next project will be evaluated, other experts will come to make the "same mistakes". Breeders will say yes to whatever is proposed to him; but they will adopt what is suitable for them.

4. Conclusion

ZSP communities have participated to the generation and transfer processes of technologies for a better management of natural resources. The most effective innovations depending on their objectives and visions for the environment have been favourably adopted by populations without the involvement of any organisation. Others have been adopted but after having been modified and most of them have not been used yet.

Their pastoral area is very different from its previous state at the beginning of the century or more recently before the establishment of first boreholes. They are aware of this fact, but they all believe that it was due to recurring water shortage they experienced within the last decades.

The major and key strategy is to secure the system and management risk. For that, a general approach (economical, social, ecological) should be developed and much time should be taken to elaborate in collaboration with communities good and sustainable strategies for the environment.

Peul breeders are so well adapted so they have succeeded to improve their productions, better than any other rural development actor, in more delicate conditions. Although some researches related to the securisation of productions are currently in the formulation phase, it is sure that breeders are able to secure their productions in advance.

Bibliographical References

Anonymous (1995). Caractérisations des unités pastorales de Thiargny et de Thiel – Rapport d'étape. Dahra, ISRA/CRZ, 50p.

Anonymous (199?) Plan stratégique régional 1998 – 2003 – Zone sylvopastorale ; ISRA/CRZ Dahra – Comité régional de Prospective et de Planification Stratégique ; 55 p.

Anonyme (2000) Recensement national de l'Agriculture - 1998/99 - Rapport général du recensement de l'agriculture pluviale ; volume 4 ; Ministère de l'Agriculture et de l'Elevage/ Organisation des Nations Unies pour l'Alimentation et l'Agriculture (FAO) : Dakar : 536p.

Anonyme (2001). Base de données informatiques de la Direction du Génie rural et de l'Hydraulique (DGRH) et celle du service de planification et de Gestion des Ressources en Eau (SPGRE).

Diop A.T. (1991).Note préliminaire sur l'amélioration du système de transport de l'eau en zone sylvopastorale: utilisation d'un nouveau type de charrette.- Dakar: LNERV, 8p.- Réf. 34/AGROSTO.

Barral H. et *al*. (1983) . Systèmes de production d'élevage au Sénégal dans la région du Ferlo – Synthèse de fin d'études d'une équipe de recherches pluridisciplinaire. Dakar, ISRA – ORANA ; France, OCCGE ; GERDAT – ORSTOM; 172p.

Fayolle A.F. et al. (1974) . Valorisation du cheptel bovin Zone sylvopastorale de la république du Sénégal – Rapport d'enquêtes. Paris, EMVT ; Dakar - Hann , LNERV;126 p.

Laoualy, A. (1992)Rapport de mission d'étude du concept de gestion des parcours des peulhs dans le nord Sénégal.

Merlin P (1951). L'hydraulique pastorale en AOF.- Bulletin des services de l'Elevage et des Industries animales de l'Afrique Occidentale française, Tome IV – n°1, Janvier Mars 1951, pp. 169 – 206.

Pouillon, D.G (1984) Evaluation de l'Elevage bovin dans la zone sahélienne du Sénégal – Etude sociologique II. Ministère Français des relations extérieures ; Pp 69 –112.

Juul K.(1996) . Migrations et innovations technologiques chez les Peuls du Sénégal suite aux sécheresses : le triomphe de la chambre à air.- Dossier n°64 IIED ; 29 p.

Reboul C. (1978) . Danger d'oasis ? Aléas d'une politique de sédentarisation – Le forage de Labgar au Sénégal .- Civilisation (Brussels), 28 (1/2) ; pp. 120 – 139.

Richter M (1989) Description des exigences du système de pâturage contrôlé pour le groupe cible des peuls (premier inventaire établi à la suite des entretiens avec les collègues, de l'étude des dossiers et des observations personnelles) ; Saint Louis : PSAE ; 30p

Santoir C (1994). Essai d'estimation de la population pastorale de la zone des six forages. Dakar, ORSTOM, 3 p.

Savory A. (1999) Holistic management – A new framework for decision making ; Island Press Washington D.C/Covelo, California; 616p.

Sharman M.J (1982) Résultats du vol systématique de reconnaissance au Ferlo de juin 1982.- Dakar, ISRA/UNEP-FAO- Ecosystèmes pastoraux sahéliens, 26 p.

Touré O (1985) . Etude de l'organisation sociale et familiale des sociétés pastorales du Ferlo occidental et de son évolution. Mémoire de titularisation , Dakar, ISRA, 127p.