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HORTICULTURE SECTOR ASSESSMENT IN THE WULA NAFAA INTERVENTION ZONE IN SENEGAL

January 2010
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ACRONYMS

ANCAR	Agence National de Conseil Agricole et Rural
ANDH	Association Nationale Des Horticulteurs du Sénégal
APPN	Association des Producteurs Privés de Nianga
CDH	Centre pour le Développement de l'Horticulture
CDS	Cercle des Sécheurs
CMS	Crédit Mutuel du Sénégal
CNCA	Caisse Nationale de Crédit Agricole
DCI	Direction du Commerce Intérieur
DCE	Direction du Commerce Extérieur
DH	Direction de l'Horticulture
DPS	Direction de la Prévision et de la Statistique
DPV	Direction de la Protection des Végétaux
DSRP	Document de Stratégie de Réduction de la Pauvreté
FAO	Food and Agriculture Organization
GOANA	Grande Offensive Agricole pour la Nourriture et l'Abondance
IDA	International Development Association
ONAPES	Organisation Nationale des Producteurs Exportateurs du Sénégal
PAEP	Projet d'Appui à l'Entreprenariat Paysan
PAPIL	Projet d'Appui à la Petite Irrigation Locale
PDMAS	Programme de Développement des Marchés Agricoles du Sénégal

EXECUTIVE SUMMARY

The USAID/Wula Nafaa Project (WN) intervention zone does have a potential for horticulture development because of its good soils, abundant surface and groundwater, an available labor during the dry season versed into horticulture, and favorable market conditions. In Senegal, the consumption of horticultural products has greatly increased in recent years - 230,000 tons in 1991 and to reach 630,000 tons in 2003. Just like elsewhere in Senegal, in the WN intervention zone, the consumption was supported by a larger production generated primarily by a larger number of producers and higher imports. Constrained by many factors, the production could not keep up. The most important constraints to vegetable production are the following:

1. **Insufficient water control for irrigation due to lack of adequate drainage and adapted wells.** In many places, water is abundant. Unfortunately, horticultural producers are under-equipped, having no pumps or necessary drilled wells to effectively exploit groundwater.
2. **Low productivity of land due to a number of factors including lower quality seeds, poor mix of inputs and techniques which do not meet established standards.** Better yields can be achieved with better technology. According to the Departmental Services for Rural Development in Tambacounda, this improvement in technology is capable of increasing the yield per hectare between 50 percent and 185 percent and incomes of almost 3 million CFA Francs.
3. **Few rainy season production because of the lack in mastering techniques adapted to the rainy season.** This reduction in production leads to higher prices up to four times more expensive in the case of some crops (such as tomatoes) in the dry season. A better control of the technology in the rainy season will make the horticulture sector more competitive and maximize the income of crop producers.
4. **Low mastery of production techniques of fruit trees creating an overproduction of fruit at certain periods and very little during other periods.** The fruit production may already be more widely grown at different periods to take advantage of higher prices. Moreover, the production of fruit less produced can be increased.
5. **No possibility of an improved post-harvest processing.** Processing units, including for drying purposes, will open markets for local horticultural production, creating added value and quality jobs.
6. **Underdeveloped input supply system.** This system is underdeveloped in the WN area. The development of this system is essential for the adoption of productive technologies and for the sustainability of horticultural activities which will be introduced by the USAID/Wula Nafaa Project.

The horticulture sector assessment highlighted a number of promising interventions. They include the following:

1. **Business marketing of simple and inexpensive technologies for better water control.** Manufacturers and installers of treadle pumps and drilled wells will be trained and their products promoted among the horticultural producers. These trainings and promotions will target high potential areas. As a whole, 700 pumps and more than 550 drilled wells will be sold, creating or consolidating 1,400 jobs and generating a income increase of approximately $ 700,000. More than 60 manufacturers and installers of these technologies will see also see their incomes increase.
2. **Support to producers for a better mastery of vegetable production techniques during the dry season.** In order to increase the yield of vegetable harvested, farmers expressing an interest in

improving their technical skills and meeting other criteria will be trained in soil preparation, application of fertilizers and seeds, etc. At least 400 gardeners will receive this training.

3. **Support to producers for a better control of vegetable production during the rainy season. The** best individuals among those trained in irrigated vegetable production techniques will be trained, during the second year, in the production of rain-fed vegetables. With higher sale prices, producers can considerably increase their incomes even in limited areas using appropriate techniques and inputs.

4. **Promoting the development of private fruit tree nurseries.** Developing decentralized nurseries located near high potential areas, seedlings of fruit trees will be promoted among farmers. This activity will benefit over 20,000 farmers who will dub over 200,000 seedlings of fruit trees which will generate $ 2, 5 million in additional incomes.

5. **Introduction of a drying system enabling quality processing on a larger scale.** This system will add value to fruits and vegetables which provide incomes during the off-season vegetable production. Four manufacturers trained by the USAID/Wula Nafaa Project produce about 65 dryers which will serve about 600 users.

6. **Improved input supply system.** Wholesalers, including producers of inputs and equipment, will be linked with retailers who will then be put in contact with horticultural producers. The result of these efforts will be the sales of more than 200,000 inputs.

Expected results

Number of technologies sold	230,000
Additional incomes	$3, 7 million
Number of beneficiaries	25,900
Number of improved hectares	446 ha (232 ha created)
Proposed budget:	**291 million CFA Francs**

1. CONTEXT

1.1 NATIONAL CONTEXT

Since the colonial era, food habits of the Senegalese population, mainly urban, have first evolved with the introduction of imported broken rice in the food diet and more recently with vegetables and fruits. Actually, all dishes cooked with rice contain important quantities of vegetables.

The horticulture value chains got developed to meet the increasing demand of vegetables. In this respect, the vegetables production was almost multiplied by seven between 1960 and 2007 going from 42 000 tons to 285 000 tons [FAOSTAT, 2009]. This evolution of the production was favored by several factors, mainly the drop of rice production in the Senegal River Valley with the competitiveness problems in relation with the imported rice, the devaluation of the CFA Franc in 1994, and the liberalization of the peanut value chain in 1997. The effect of these trends led Senegal to launch ten years ago a policy of intensive diversification and promotion of horticultural activities throughout projects and programs (PMIA1, PAEP, PPMEH, PPEA, PSAOP, Plan REVA, and GOANA).

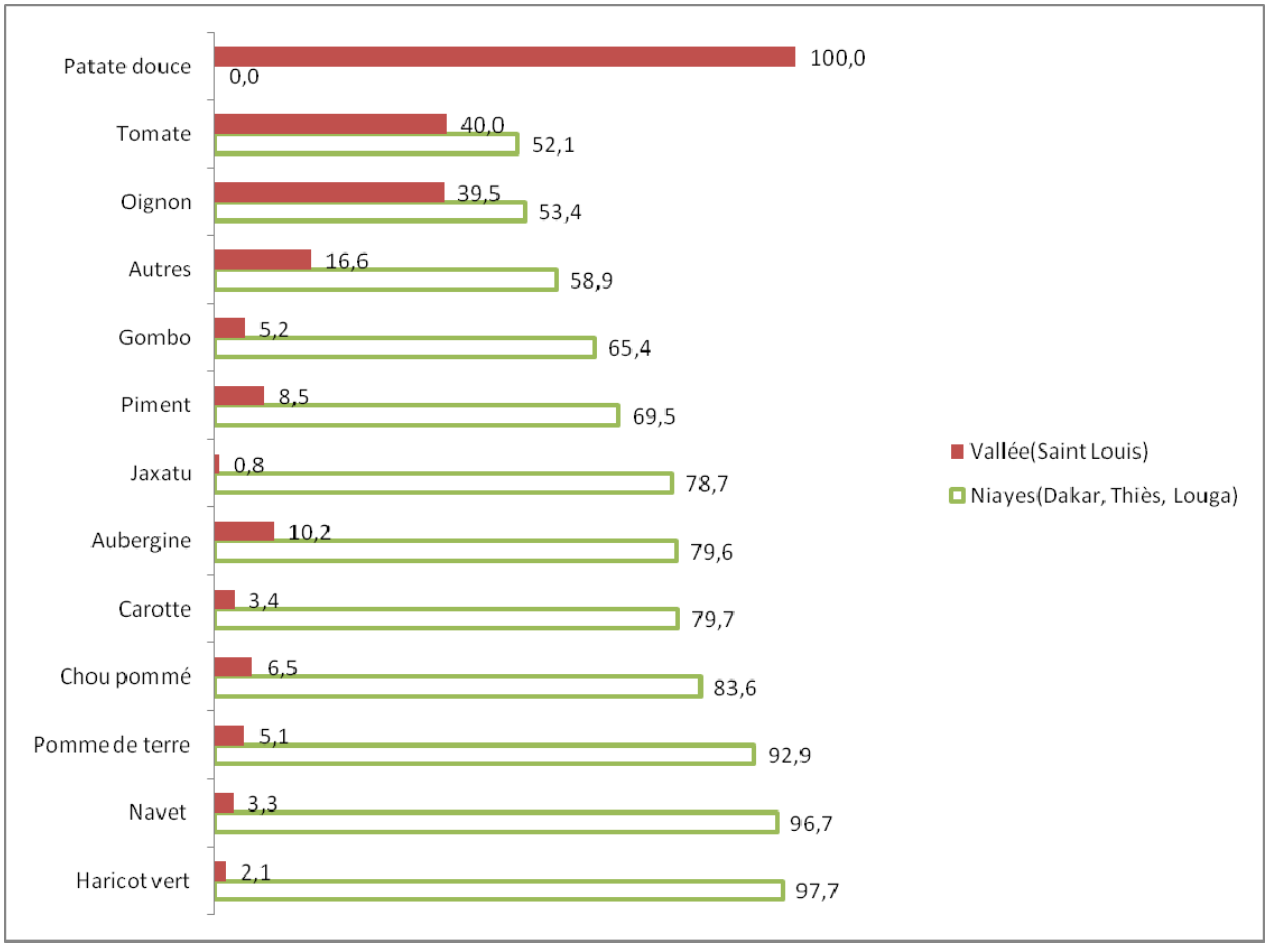
1.1.1 MAIN HORTICULTURAL PRODUCTION ZONES IN SENEGAL

The horticultural production essentially comes from two zones: the Niayes and the Senegal River Valley. The Niayes zone concerns a coastal strip which spreads from the suburbs of Dakar to those of Saint-Louis in the Northern part of Senegal. It constitutes a privileged space for horticulture which is developing in the basins between the dunes. The crops cultivated there are different according to the remoteness of the urban centers. In this respect, if the North of the zone is known for onion production, le South closest to Dakar is experiencing a diversification of crops mainly the cultivation of more rapidly perishable crops. In the Senegal River Valley, the horticultural crops got developed more recently, following a low profitability of rice and the difficulty to market it. The horticultural crops occupied 20 to 34% of the cultivated areas during the period of 1997/1998 to 2000/2001 and played a central role in the money incomes of the Middle Valley farms [David-Benz, 2002].

The analysis of the horticultural production importance per crop according to the zones shows that horticultural development in the Fleuve region is mainly based on two crops: tomatoes and onion (see Figure 1). In addition to the fact that there a high demand for these products, according to the varieties, they can be transported and marketed along long distances.

[1] PMIA: Projet de Modernisation et d'Intensification Agricole, PAEP : Projet d'Appui à l'Entreprenariat Paysan, PPMEH : Projet de Promotion des Petites et Moyennes Entreprises Horticoles, PPEA: Projet de Promotion des Exportations Agricoles, PSAOP: Programme des Services Agricoles et d'Appui aux Organisations de Producteurs. Plan REVA: Retour vers l'agriculture, GOANA: Grande Offensive Agricole pour la Nourriture et l'Abondance.

Figure 1: Importance of the horticultural production according to the zones in relation to the national production in percentage from 2002 to 2006

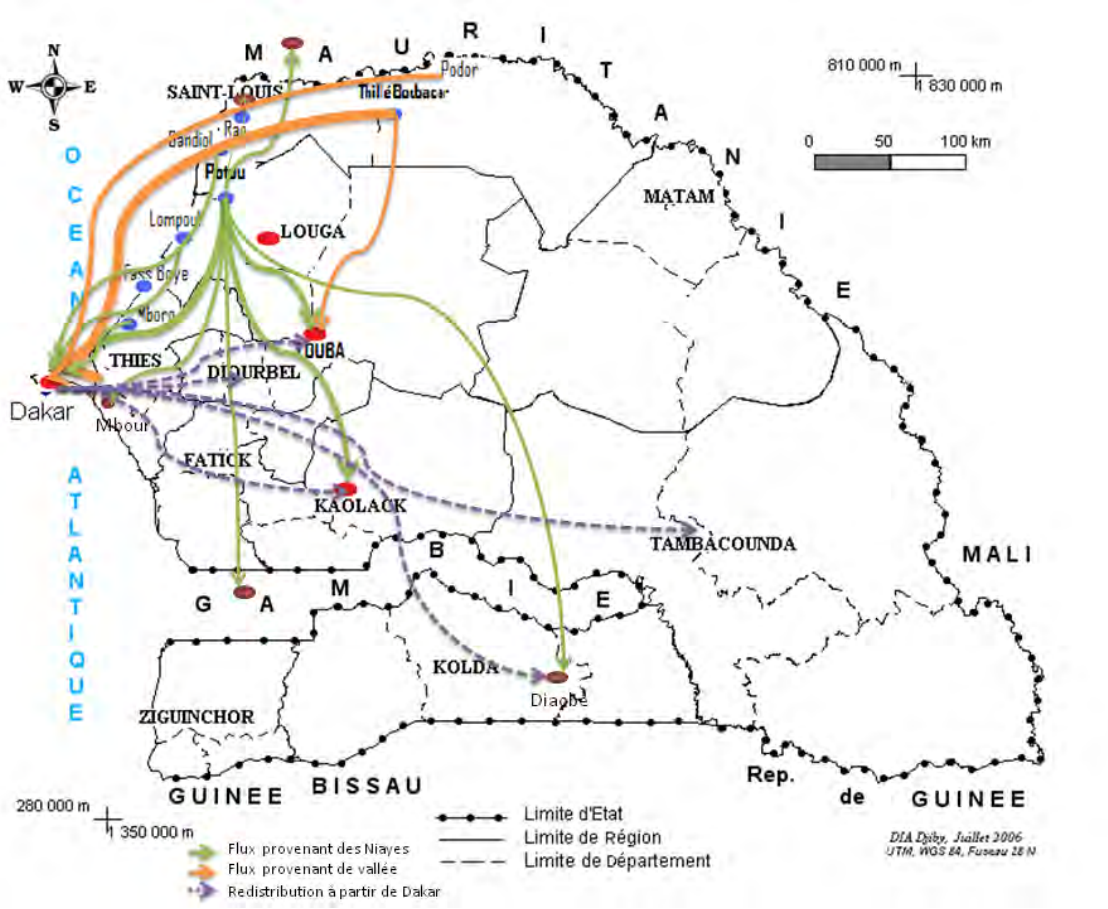


Source: Directorate of Horticulture, 2007, and our computations, 2009

1.1.2 THE MARKETS OF HORTICULTURAL PRODUCTS IN SENEGAL

Towns constitute the biggest centers of vegetable consumption. Forty five percent of the production from these areas comes, in priority, to feed the Dakar region (see Figure 2). Thiaroye, Dalifort and Castors are the biggest wholesale and redistribution markets of Dakar where important quantities are re-shipped to Tambacounda and Dioabé in the WN intervention zone. With migration and demography, other shipment hubs of horticultural products in Senegal were established, for example Kaolack and especially Touba. Thanks to a religious influence, the population of Touba will increase and thus become an « urban » hub. For this reason, the « OCAS » and « Nguiranène » markets in this religious town became wholesale and redistribution markets for horticultural e products.

Figure 2: Map of the horticultural products' flows



Source: Mbaye and Moustier, 2000

1.1.3 ACTORS OF THE HORTICULTURE SECTOR IN SENEGAL

Four big types of actors can be identified in the marketing channels of vegetables between the production zones and the big urban centers [Seck, 1989; Wade et al, 2004; Wade, 2009]:

- *Bana-banas*, itinerant traders charged with the collection and transportation of horticultural products up to wholesale markets, which sometimes develop privileged linkages with some producers by loaning them seeds and fertilizers
- *Coxers*, intermediary agents charged with receptioning the commodity, finding buyers and negotiating the prices for the *bana-banas*
- Wholesalers, who ensure a classical function of regrouping at the urban markets level
- Retailers, who sell by pile or sometimes per kg upon the clientele's demand on the market

These actors are found along the different channels which go from the farm to the wholesale market by passing through the collection markets located in the production zones. They enable the transportation of vegetables produced up to the big consumption centers.

1.1.4 RESORT TO IMPORTS

Despite the rapid development of the horticultural value chains, the production does not totally meets the demand, which led to resort to imports. In 2008, more than 150, 000 tons of horticultural products were imported of which about 57% are onions (see **Error! Reference source not found.**).

Table 1: Monthly imports of vegetables in 2008 (in tons)

Months	Potatoes	Garlic	Onion	Carrot	Other vegetables
January	2746	-	3610	-	32
February	5333	520	13966	-	27
March	2693	316	56	-	110
April	1723	343	-	-	2
May	4326	723	-	-	96
June	2706	234	-	-	73
July	3795	460	-	175	99
August	4598	1408	12974	1038	943
September	9528	1008	14199	925	2744
October	1290	54	14323	755	50
November	6270	54	13196	1347	100
December	8656	95	16706	325	30
Total	53664	5214	89030	4565	4306

Source: National Agency of Statistics and Demography, 2009

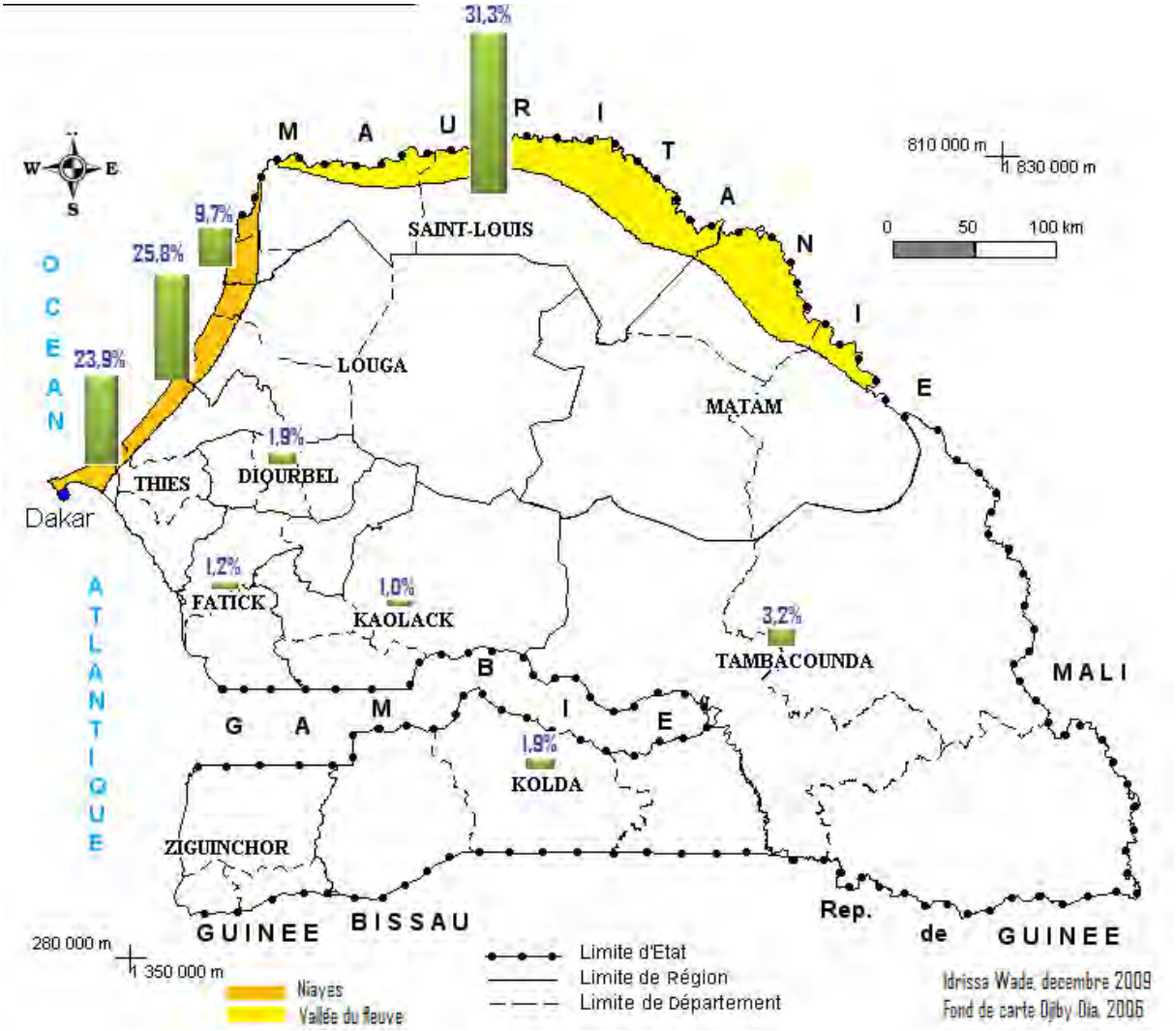
These imports lead to an important exit of foreign currency of which 14 million US dollars in the case of onions in 2007 (http://faostat.fao.org/site/342/default.aspx). And yet, development opportunities of the production exist.

A better control of the horticultural production during these import periods would increase the producers' opportunities to increase their incomes. In addition, it would enable in the end to improve the balance of payments (increase of horticultural products' exports and import substitution).

1.2. CONTEXT OF THE WULA NAFAA INTERVENTION ZONE

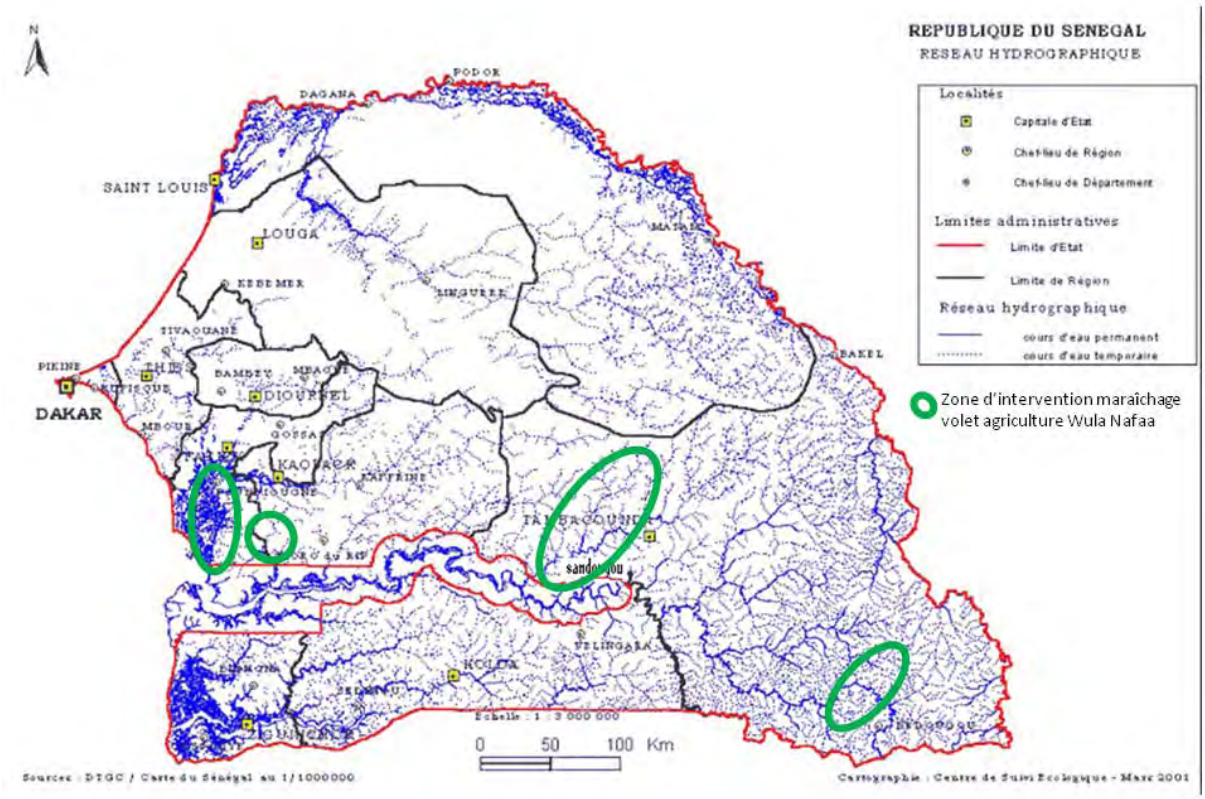
The analysis of the distribution of the national production in vegetables shows, by comparison with the Niayes and the Senegal River Valley, that horticulture is relatively not very developed in the WN intervention zone, i.e. , the regions of Fatick, Kaolack and Tambacounda (see Figure 3). By observing the hydrographic map (see Figure 4), we see that these regions are crossed by several lowlands called « khour » in wolof, « faro » in mandingue and of valleys in which sweet water flows during most of the year (example : Ndenderleng) or even the whole year, like in the Djikoye valley. The development of horticultural production started a long time ago around these valleys and lowlands, but especially since ten to fifteen years ago. Three forms of farms can be identified: the home gardens, the individual perimeters and the horticultural perimeters under the impulse of project and extension services.

Figure 3: Distribution of the vegetable production from 2002 to 2006



Source: Directorate of Horticulture, 2006, and our computations, 2009

Figure 4: Map of Senegal's hydrographic network



Source: Directorate of Geographic and Mapping Works, 2001

The **home gardens** are perimeters located not far from the houses**.** They are exclusively cultivated during the rainy season. Okra**,** eggplant, *jaxatu***,** hot pepper, and bissap are generally cultivated there by women for the daily household consumption.

The **individual perimeters** represent more than 80% of the cultivated areas in the lowlands or valleys (Dieng, 2008). As these perimeters are bigger than the home gardens, demanding more work time, they are cultivated both by men and women. These perimeters enable to supply the different weekly markets (*loumas*) with vegetables. In fact, 70% of the production from these zones is marketed (Dieng, op.cit.).

The **collective perimeters** are most often put in place with project assistance, examples being the perimeter of Keur Ousseynou Dieng with the support of PAPIL, that of Néma Bah by the PROMER, etc. These perimeters are most often divided into equal plots allocated to different members. The different infrastructures in these perimeters are e realized by the support organizations which also provide the necessary equipments.

Finally, horticultural perimeters are established around towns in order to supply urban consumers with rapidly perishable vegetables, mainly cabbage and lettuce.

Horticulture production is an important source of income for these different types of farms in a context characterized by a worrying food situation in Senegal's rural areas – 51.2% of the households in severe food insecurity situation and 41.3% in moderate food insecurity situation, with a vulnerable population estimated at 2.1 million inhabitants (see Annex 1 for the definitions of the different vulnerability

categories). It is particularly the case of Kaolack and Tambacounda, where the average self-sufficiency of the households is indeed high (9 months), but which concentrate vulnerability rates of more than 50% (DSRP II, 2008). In addition, horticulture is practiced by an important number of households (see Table 2). All farms taken together, we counted almost 60,000 horticultural households, which majority practices horticulture in home gardens, and more than 65,000 households producing fruits for more than ten years.

Table 2: Number of households practicing horticulture or tree farming according to the departments

Department	Number of households practicing horticulture	Number of households practicing tree farming
Kaolack	14468	14031
Fatick	15434	19164
Tambacounda	10398	18577
Kédougou	8135	6399
Kolda	11410	7345
Total	59845	65516

Source : National Agriculture Survey, 1998-1999

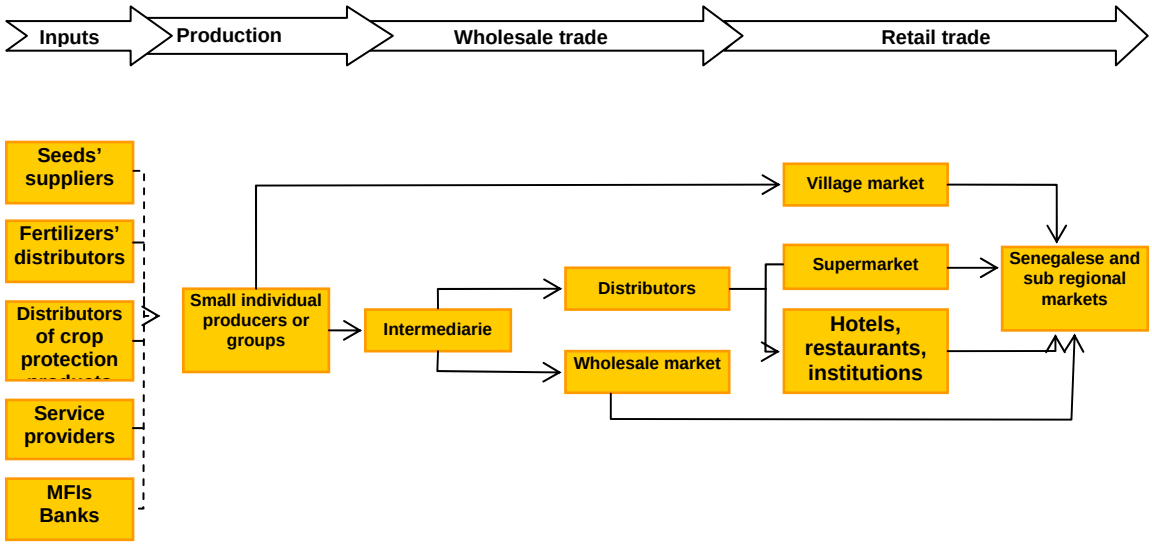
In this respect, the USAID/Wula Nafaa Project, through its horticulture component, seeks to improve horticulture production and productivity in order to contribute to poverty reduction through a local sustainable development.

2. ANALYSIS OF THE HORTICULTURE SECTOR IN THE WULA NAFAA INTERVENTION ZONE

2.1 DIAGRAM OF THE SECTOR

The horticulture sector is still embryonic in the WN intervention zone where it is characterized by a production per person reduced but with a good potential. A diagram of this sector is presented below.

Figure 5: Diagram of Horticulture Sector



The following analyses will underscore the sector's important aspects associated with its development.

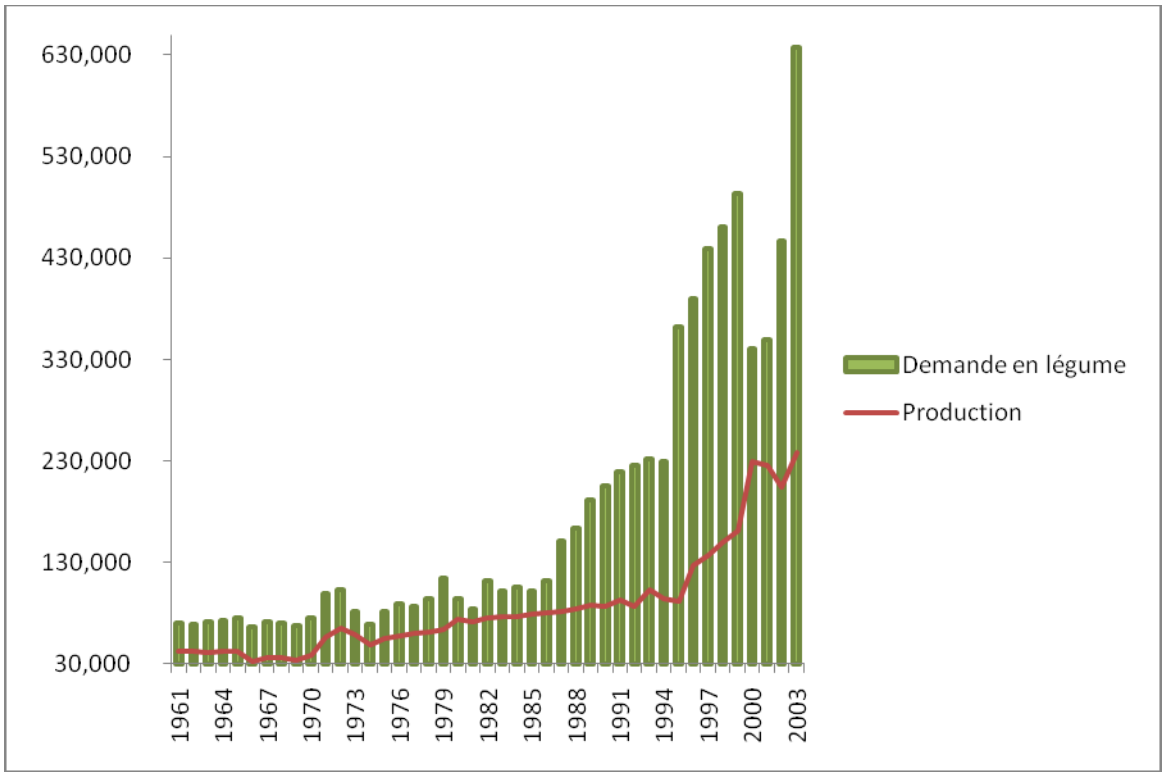
2.2 THE DEMAND FOR HORTICULTURAL PRODUCTS AND THE SUPPLY CONDITIONS

A high demand for vegetables and fruits is necessary for the development of the horticulture sector. If the demand for vegetables and fruits is low , i.e., if the prices are low in relation to the production costs, the active producers are not sufficiently motivated to increase or maintain even start production in the case of the non producers. Also**,** if the demand for horticultural production is low, the agricultural producers who decide to produce vegetables or fruits could not increase significantly increase their incomes.

To bear an increasing production, the result of a higher productivity and/or a greater number of producers, the horticultural producers need an expanding market if they intend to increase their incomes. This condition is met in the case of Senegal and the WN intervention zone where the market of

horticultural products was very good, even excellent, these past years. The strong absorption capacity of the local market – especially constituted by urban households (and more and more of rural households), hotels and restaurants – is constantly increasing. According to FAO, the market for entire Senegal went from almost 230,000 tons of vegetables in 1991, to more than 430,000 tons in 1997 and to about 630, 000 tons of vegetables in 2003 (see Figure 6). Another sign of the existence of favorable market is the increasing number of new horticultural producers attracted by the increase perspectives of incomes which saw the incomes of their neighbors increase.[2] The market potential in the short run for horticultural products will depend on the local demand and the substitution of imported products by locally produced vegetables and fruits. Based on recent trends of an increase in consumption of 7.8 percent per year, a vegetables market of a more than one million tons before the end of 2009 is conceivable. In the longer term, once the process for a quality production is mastered, one could be more and more oriented towards vegetables production for export.

Figure 6: Evolution of the demand and vegetables production



Source: FAO, 2009

2.2.1 DEMAND FOR HORTICULTURAL PRODUCTS

The existence of a dynamic local market perhaps constitutes the greatest strength of the horticulture sector in Senegal and in the WN intervention zone. The main factor which contributed to this phenomenon is an urban population which increases at a yearly rate estimated at 3.5% and represents about 47% of the country's total population.[3] Two other factors are dependent on urbanization:

[2] According to several sources, including the horticulture producers in the Wula Nafaa intervention zone, the majority of horticultural producers entered the sector during the past ten to fifteen years.

[3] This rate went to 55 % in 2012, and 62 % in 2025 according to a World Bank report (*l'IDA en action: Renforcer la coordination de l'appui en faveur de la croissance*).

- A progressive change of consumers' tastes which led to a greater and more generalized consumption of vegetables and fruits
- An increase of the available incomes despite an economic recession these past years[4]

Informed observers noted long ago a trend according to which the inhabitants of towns in West Africa increased their consumption of vegetables and fruits. The local market potential of horticultural products was reinforced by this same trend in the rural areas, and which did not exist ten to fifteen years ago.

Senegal, including the WN intervention zone, is not an exception to this rule. During these past years, as the urban population grew in Senegal and that the tastes of urban and rural consumers changed to incorporate greater quantities of vegetables and fruits in their diet, the local demand increased. As long as this growth phenomenon of urban populations and the changes of taste will persist, one contemplates an increasing demand for fruits and vegetables at the national level and in the WN intervention zone.

When the demand for horticultural products exceeds the national capacity to produce, a country like Senegal is obliged to import from outside. Senegal is still importing a substantial quantity of vegetables and fruits from other countries of the sub region, and in some periods potatoes and onions from Europe (see Table 1 above). Although there seem to be a limited agro-climatic potential for potatoes production in Senegal, good quality onions can be produced in most part of the country, including the WN intervention zone. Horticulture development could enable the zone producers to become more self-sufficient for many horticulture products including onions. The sale of onions during the period of their import from "Europe will increase the producers" incomes since, when imported in Senegal, this foodstuff is excessively expensive at the end of the dry season when most of the Senegalese onions are harvested. This marketing is conceivable with the application of techniques, particularly the preservation of onions in appropriate soils (sandy-clayey), and adapted technologies such as the small bulbs **of** onions and simple storage techniques.

2.2.2 CONDITIONS OF THE HORTICULTURAL PRODUCTS SUPPLY

The demand for horticultural products is then increasing in Senegal and in the WN intervention zone. The horticultural producers met this increasing demand by increasing their production. The supply of this products could increase with new producers entering the sector, contributing their production to the total supply, and a better productivity of producers in the Niayes and the Senegal River Valley, who have a better mastery of techniques and water than producers in the WN intervention zone thanks to specialized support/advisory services and more investments, in the case of the Fleuve region. Due to a lack of favorable access to inputs and a non mastery of techniques, this increase of the productivity did not follow in the WN intervention zone. Increasing productivity will be necessary to fill in the gap between the demand and supply of horticultural products and to make enterprises more competitive.

Even if the demand is high and the basic conditions (availability of water, land, labor, attractive markets, etc.) are generally good, horticultural producers in the WN intervention zones remain hampered by a lack of techniques and also by an important lack of key technologies. Some examples of these deficiencies are:

- Weak control of water for irrigation due to a lack of drainage means and adapted wells
- Low productivity of lands due to a certain number of factors including lower quality seeds, a bad mix of inputs and techniques which do not conform with the established norms

[4] According to a World Bank study, between 1994 and 2004, Senegal's economic growth increased on average by 5 % per year , and the proportion of the population living in poverty went from 67.9 % in 1994 to 57.1 % in 2001, two indications of a substantial availability of money for the consumption.

- Little production during the rainy season due to a lack of mastery of adapted techniques during this period of the year
- Wandering of the cattle during the dry season, which in some instances can destroy an important part of a harvest
- No possibility for an improved post-harvest processing

Nevertheless, the horticultural conditions in the WN intervention zone are good, and can be summarized as follows:

- The irrigable lands are sufficiently available to enable a considerable increase of the horticultural production provided that the more modern and less costly means of drainage **and** well boring are used.
- Water must not constitute a major constraint for the expansion of horticultural production provided that still the more modern and less costly means of drainage and well drilling are used. The underground water is still not abundant enough if the traditional methods are used to build a well. Figure 7 shows a traditional well. Sometimes also the surface waters, t ponds and streams created by the dams are relatively abundant and under-utilized, lacking drainage **means** more productive than the dipper or the watering can.

Figure 7: Water from a hand-dug well water in the Fatick Department

However, the cost of water is very high considering the little productive system of dipper which is used by more than 98 percent of the horticultural producers in the WN intervention zone. For example, the irrigation of 0.5 ha of vegetables with a dipper costs about 155 CFA Francs/m^3 or almost three times more than the irrigation cost with a treadle pump and twice more that the irrigation cost with a motor pump (see Annex 2). These high irrigation costs explain largely why vegetables produced during the dry season are so expensive.

- The family labor is not always sufficient and constitutes a constraint to a booming of the horticultural production when a cheap salaried labor and/or more modern irrigation means are not available.

- Inputs such as seeds, fertilizers and pesticides are available in the weekly markets and shops managed by companies such as TROPICASEM and Traoré et Fils. However, these inputs, particularly seeds bought in the weekly markets, are not always of good quality, because they have a reduced germination rate, in the case of seeds.

- The active horticultural producers of a certain size do not lack incomes gained from their production. For example, a horticultural producer who uses the family labor and cultivates a garden of 1,000 m² will earn about 169,000 CFA Francs. If he goes to 2,000 m² with the assistance of a pedal pump, he will earn about 400,000 CFA Francs (see Annex 3). This capital, with what he has eventually earned from the sales of peanuts and cashew nuts, can be used to invest in an expansion of the horticultural business provided that the amount of the investment is a reasonable.[5] Unfortunately, regarding equipments and infrastructure, it is not presently the case, with a well in cement of a depth of 10 meters which costs about 500,000 CFA Francs and a motor pump which costs around 200,000 CFA Francs. The more affordable equipments and infrastructure **are** not practically available in the WN intervention zone.

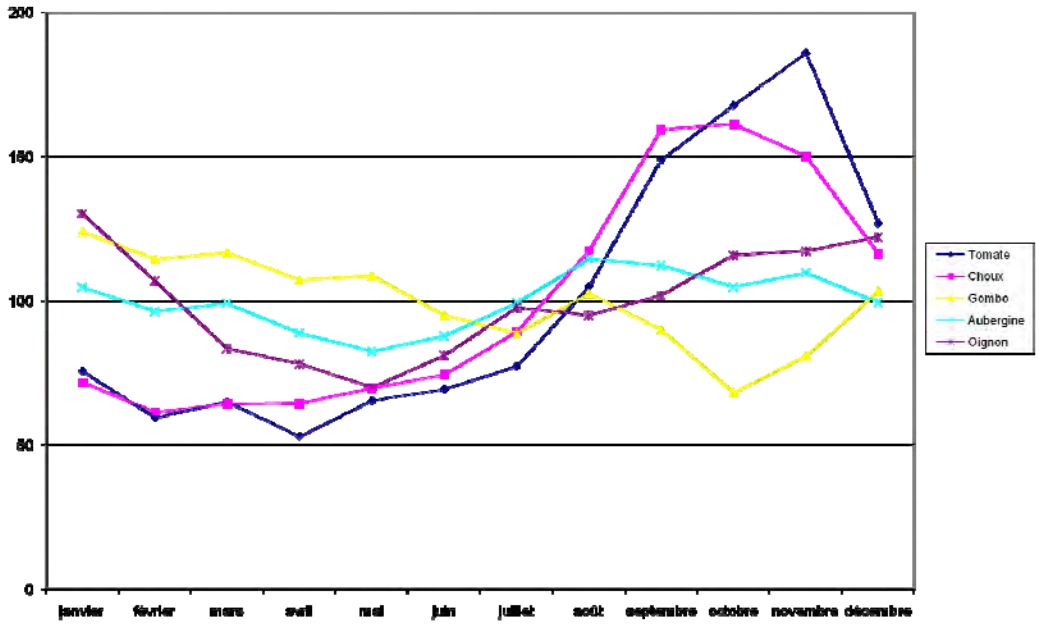
- A limited capacity of horticultural production even at the national level and a high demand for horticultural products, made the vegetables and fruits market highly lucrative. With a high rate of urbanization and a very high cost of water, the prices of horticultural products in Senegal are among the highest in the sub region. Even with their actual means, producers in the WN intervention zone report that horticultural production is the first or second source of income.

- The water drainage systems are generally very rudimentary because only a small number of producers have a motor pump or a treadle pump. The hand drilled wells of the type of those which were introduced in the past 15 years or more, and in the Casamance less than 5 years ago, do not exist in the WN intervention zone. The lack of technologies for water control constitutes the greatest impediment to horticultural development in the WN intervention zone because, with these technologies, the producers can substantially increase the area of their gardens or orchards, increase the yields of their lands, and produce longer during the dry season giving them access to higher prices.

This gives a general view of the conditions of supply of the horticultural products. However, it can be noted that the supply of horticultural products is fluctuating, varying according to the capacity to produce which is determined by the mastery of production techniques and the availability of inputs and adapted equipments. This production capacity varies at different periods of the year. For example, it is better during the dry season than during the rainy season when the agro-climatic conditions are less favorable, bring pests and diseases. This more or less high production, according to the period, has a great effect on the market prices. The better prices are applied at the beginning of the dry season campaign/end of the rainy season, when the supply is less important. Figure 8 shows the seasonal trends for some main vegetables.

[5] It is the development model occurring in the Niayes for more than 10 years.

Figure 8: Evolution of prices per kg of the main vegetables



Source: Directorate of Horticulture and Société MANOBI

As we can notice, prices at the end of the rainy season and at the beginning of the dry season are much higher than during other periods of the year. This is due to the fact that the local production is much lower during these periods as the producers do not master the production techniques during the rainy season, but also because they devote less time to horticultural production, and are more concerned by the rain-fed traditional crops (millet, sorghum and peanuts). The resolution of production problems at a lesser cost will make the sector more competitive and will maximize the producers' incomes.

In the case of vegetables, the marketing of fruits produced in the zone occurs more or less according to the period of the year. The fruit prices also vary. For the case of mango for example, most of the production of the WN intervention zone goes to markets during May, June and July. Only the producers who have access to grafted varieties can produce during other periods of the year when prices are more attractive. Unfortunately, most of the producers do not have access to grafted fruit tree plants. In other respects, this overproduction **in** May, June and July **reduces** more or less the price of mango on the market, creating much favorable conditions for processing into dried fruit.

In summary, the market conditions provide to the suppliers a very good opportunity to increase their incomes. The challenge is to remove the constraints to enable a higher productivity which would lead to increased production and incomes and a more competitive sector.

2.3. FACILITATING FRAMEWORK

To unblock this present situation in order to enable the horticultural producers to produce more and during appropriate periods to meet the demand, local existing institutions or to be created could play an important role. These institutions include:

- Support/advisory and research institutions
- Private sector service providers
- Credit

- Lands management

2.3.1 SUPPORT/ADVISORY AND RESEARCH INSTITUTIONS

There are several worthy support/advisory and agricultural research institutions in WN intervention zone. In addition to WN agricultural services the **Agence Nationale de Conseil Agricole et Rural (ANCAR) is** the more active support/advisory institution in the zone. Research services are provided by the **Centre pour le Développement de l'Horticulture (CDH) – Center for Horticulture Development**.

ANCAR is the support/advisory institution created by the Senegalese Government with its partner producers' organizations and other institutions intervening in the agricultural sector to provide advisory services in the area of agricultural production. In the WN intervention zone, ANCAR provides advisory services in several areas including horticulture and agricultural machinery. Seventeen percent of its contracts in 2002-2003 were for horticultural development. An agreement should be signed between the USAID-funded Wula Nafaa Project and ANCAR which will facilitate a productive cooperation between the two institutions. ANCAR's Regional Directorates in Fatick, Kaolack, Tambacounda and Kolda cover about forty Rural Communities. This coverage provided by ANCAR could complement WN's capacity and enable it to extend its horticultural activities to zones which are not covered by its facilitators.

The **CDH**, a research center of the l'Institut Sénégalais de Recherches Agricoles (ISRA) – Senegalese Institute for Agricultural Research, plays an important role in horticultural development in general and truck farming in particular in Senegal. It mission is to make available to the Senegalese horticultural producers with crop management sequences techniques adapted to the needs of each main crop and to the agro-climatic conditions of each production zone. The following can be included among the technologies made available to the users:

- Several varieties of citrus fruits and other fruit species
- Performing crop management sequence techniques for the development of horticulture and truck farming
- Inputs such as the small bulbs of onions and the neem-based insecticide

The CDH will then be a potential resource for the horticultural activities planned by USAID/Wula Nafaa. Furthermore, WN conducts field tests of the technologies developed by the CDH like others did in the past for improved seeds, neem-based crop protection products, and small bulbs of onions. If the tests' results are positive, WN could afterwards promote the dissemination of these technologies.

The USAID-funded Wula Nafaa Project, with its 30 facilitators, also has the capacity to support a horticultural activity. These polyvalent agents could integrate into their program training on the horticultural techniques and planning, and the promotion of new technologies for water and eventually for processing. Because they have not received any training in horticulture, the majority of the facilitators will need to be trained. However, they will only be able to devote part of their time to the horticulture component considering the other responsibilities they are already assuming.

2.3.2 PRIVATE SECTOR SERVICE PROVIDERS

With a limited capacity within the public support/advisory institutions, a very promising option to be studied is that of the providers of goods and services. The private sector actors especially intervene at three levels – the provision of production inputs (seeds, fertilizers and crop protection products), of fruit tree plants and equipments (pumps, drilled wells, dryers, etc.).

Vegetable seeds, chemical fertilizers and crop protection products are available in weekly markets and among national suppliers of horticultural inputs such as TROPICASEM and Traoré et Fils, who are located in the urban centers in the WN intervention zone. According to the crop, most seeds come from the producers' previous harvest. It is the case of non-hybrid seeds of tomatoes, okra, and *jaxatu*. The seeds are bought for other crops such as onion and eggplant, (see Table 3 for the seed prices applied in Kaolack). However, the seeds imported and resold in small bags of 100 grams must be avoided. The horticultural producers interviewed unanimously complained about the quality of the seeds bought in weekly markets which often have a high germination rate.

Table 3: Prices of some hybrid seeds

Crops	Prices (in CFA Francs/500 grs)
Onions	22 500
Eggplant	15 000
Okra	4 500
Tomatoes (Roma)	40 000

Source : Traoré et Fils, 2009

The small bulbs of onion are produced in limited quantities by a few individual producers in the Fatick region. These quantities seem to be for their own use and not for sale to other horticultural producers. If the production is well controlled, , this technology can enable the horticultural producers to produce anions twice or three times before most of the onion producers, thus benefitting from prices five to six times higher than during normal period .

Considering the fact that chemical fertilizers are expensive, producers use them less and complement them with organic manure. The NPK proportions are not always adapted to vegetables and fruits production.

The costs of inputs can constitute an obstacle to their use. This can be alleviated by a better mix of seeds, chemical fertilizers and crop protection products. The WN assessment team noticed that most producers increase the mixture of these inputs both by reducing the efficiency and wasting their money. Figure 9 shows the example of a nurseryman who uses too many seeds to grow onion plants.

Figure 9: Onion nursery with an excessively high density of plants

A producer who uses the full complement of inputs needs a certain level of capital. The inputs (seeds, fertilizers and pesticides) for the production of 2,000 m2 of onions cost about 80,000 CFA Francs. Although this is not negligible, it is reasonable to believe that these costs are within the reach of active

commercial horticulturists having a steady capital flow. Assuming that the labor is provided by the truck farmer and his family, the net income for 2.000 m2 of onions is about 400,000 CFA Francs. Those who newly start will face more difficulties to handle such fees, but over time and with proper management of incomes gained, they will also be able to do it.

Outside of the Kolda and Kédougou areas, there are few nurserymen in the WN intervention zone. Those who are present generally have few species, focusing mainly on cashew and mango, two species well-known by the area's producers. Very few nurseries produce other species such as lemon, orange or mandarin. The two nurserymen of Boussourah Mansarinko and Namandine in Fatick region are the exceptions. Table 4 indicates the prices of non-grafted fruit trees collected from several nurserymen in the area. Some individuals produce papaya and banana trees from seeds and sprouts they get from their own trees. The assessment team did not find out any expertise in grafting, which would enable earlier producing, bigger fruits (and thereby more expensive and bringing more incomes to the market) and the best harvest periods (June, July and August when the price of mango may increase by 50%). Tree farming is more developed in the Kolda and Kédougou areas where the focus is primarily on the production of mango and cashew.

Table 4: Prices of non-grafted fruit tree plants produced in the WN intervention zone

Crops	Price (in CFA Francs/plant)
Mango tree	100
Cashew tree	100
Lemon	150 to 300
Papaya	75

Source: Numerous nursery workers, 2009

Apart from one manufacturer / installer of treadle pumps and filter points in Thiadiaye (Fatick region) and one manufacturer of treadle pumps in Kédougou (Kédougou Region), there is no supplier of horticultural equipment in the current area of intervention where WN implements its agricultural component. A large number of horticultural producers have heard about the Diambare pump, but very few people bought it. The assessment team met with two owners of the Diambare pump one of whom got it for free from a project and another who bought it second hand in the Gambia. There is a glaring need for the manual drilled well given the hydro-geological conditions of the area: sandy soil and shallow groundwater. Yet, it seems that such technologies have not penetrated the area (except some recent installations in community gardens funded by an FAO project, while knowing that the drilled well model installed is way too expensive and therefore less accessible compared to other models for a private). With better access to water (unlike many current areas where the dug wells) and increased drainage capacity, the extension of treadle pumps (including more efficient new models and cheaper than the Diambare pump) and manual drilled wells could stimulate a significant increase in the area's horticultural production.

2.3.3 FINANCIAL INSTITUTIONS

Capital is very important for the expansion of horticultural production, particularly because of the high cost of labor and irrigation equipment. In general, the incomes drawn from irrigated horticultural production are relatively substantial and well above those of the average farmer who practice rain-based agriculture. Unlike farmers practicing traditional rain-based agriculture who often have low cash incomes, the cash incomes of horticultural producers enable them to make new investments in the horticulture sector and, do not need to resort to formal financial institutions for credit purposes. The statistics related on the production of vegetables and fruits are not available. However, even 1 / 10 of a hectare of onions can draw nearly 170,000 CFA Francs, if family labor is employed, and almost 400,000 CFA Francs, if a

treadle pump is used with a family labor (see Appendix 3). These incomes can be reinvested to increase production.

Despite the important incomes, the development of horticultural production is limited by the high costs and scarcity of labor in addition to the high cost and inappropriate nature of the motorized irrigation equipment. While the incomes generated by the production of vegetables and fruits could be sufficient to cover the physical production inputs (seeds, fertilizers and pesticides), and depending on the circumstances and ambitions of each horticultural producer, they do not necessarily cover the costs of labor associated with irrigation or the costs of investment with powered irrigation equipment. Assuming that the manual irrigation of one hectare requires 900 persons-days or 7,200 hours6, and that the average daily wage is about 1,250 CFA Francs, the labor costs for one hectare would be 1,125,000 CFA Francs.

A quick survey conducted among suppliers of irrigation equipment indicated that the prices of fuel motor pumps vary between 200,000 and 325,000 CFA Francs. At the same time, small producers who start with horticulture need funding even if the amounts are not necessarily very important because they are generally producers of rain-based agriculture with very little savings.

To respond to these two types of situations, producers may resort to at least two financial institutions – the Caisse Nationale de Crédit Agricole (CNCA) and the Crédit Mutuel du Sénégal (CMS). However, to benefit from the resources offered by these institutions, producers need to organize themselves in a group even if individuals are afterwards free to cultivate alone in their owns gardens. In the WN intervention zone, a number of groups have already benefited from credit granted by these institutions. WN could play a facilitating role by linking truck farmers with the CNCA, the CMS or any other institution.

2.3.4 LAND MANAGEMENT

The success of the efforts to develop irrigated horticultural production up to now depended to a large extent on the availability of irrigable land. In the Niayes, truck farmers have improved their net annual income drawn from horticultural production by approximately 400,000 CFA Francs through the use of medium-scale irrigation equipment; irrigated areas have increased by about 40% on average to occupy a total of almost 0.5 hectares per truck farmer (Hyman and Singh, 1995). In Mali, the expansion of irrigated area by about 60% has significantly contributed to the improvement of net annual incomes by approximately 200,000 CFA Francs for the benefit of truck farmers who use similar improved pumping systems (Niambélé and Togola, 1996). In the case of Mali, the average irrigated area has reached 0.24 hectares, whereas it was only 0.13 hectare before the introduction of improved equipment. In Burkina Faso, farmers using pumps irrigate an average of 2.74 hectares (Gay, 1994).

In the WN intervention zone, irrigated vegetable production takes place in and along lowlands. Unfortunately, these lands are very limited and, in many cases, they are no longer available at all, and are being already used for growing vegetables in the dry season and rice in the rainy season. The potential for increasing horticultural production in these areas is further limited by inadequate access to water and often by an informal land ownership system. Despite these land constraints, not far from the lowlands and on the upper lands, groundwater is often abundant. Exploited with drilled wells and drainage technologies that are appropriate and inexpensive, these lands would permit a significant increase in production owing to the expansion of irrigated areas.

According to the study of Mamadou Thiam (2005), in the arrondissement of Toubacouta, there are four types of farms – individual perimeters, collective perimeters, home gardens and semi-modern perimeters.

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[6] We consider that 80 m3 are required per day during approximately 90 days, and that one person is capable of distributing 1m3 per hour manually

The individual perimeters occupy 80 percent of the land cultivated for truck farming in the arrondissement with the cultivated lands varying between a few hundred square meters and several hectares. Among about twenty horticultural producers' groups or individual producers in the WN intervention zone who were interviewed during the field visit, almost all had their plots in the low lands or on their periphery, or on the shore of lakes created by water blockades or on the rivers created by these dams. The people interviewed have often said that they had access to additional land at least as extensive as the ones they are currently irrigating. Many among those interviewed clearly stated that they could not take advantage of this potential to increase the size of their plot because they lacked the means to increase the water's drainage capacity (that is to say, either mechanical pumping means, or a cement well or human resources).

The land ownership situation in rural areas in the Wula Nafa intervention zone varies according to local economic conditions. In rural areas, the traditional land tenure system is generally applied. In other words, access to land is based on inheritance or the approval of traditional community leaders who give permit to use community land. With the exception of urban and suburban areas, land is generally not bought or sold.

Where the traditional land tenure system applies, access to land should not prevent the expansion of horticulture. Gardeners met by assessment team in those areas said they inherited their gardens or obtained them after sending a request to the local traditional authorities and sometimes to the President of the Rural Community. The purchase and lease of land for agriculture are therefore generally not practiced in the WN intervention zone, except sometimes in peri-urban areas.

It is necessary to have suitable soils in order have a productive horticulture. There will be problems if the land is sandy or too clayey. The excessively sandy lands will result in significant losses of water due to infiltration at the pipe system level and in the basins. The low retention ability of sandy soils also reduces the availability of water for cultivation. If the soils are too heavy, the low infiltration rates will cause excessive delays for the watering of plant roots. The sites visited do not seem to suffer from any of these constraints, at least not at significant levels.

In summary, the available land for horticultural production is usually under-exploited in the WN intervention zone, particularly upland on the watershed streams. These areas have a certain potential to develop the production of vegetables and fruits. The irrigable land is available in sufficient quantity to allow a significant increase in horticultural production during the dry season. The efforts to promote the expansion of irrigated production of vegetables and fruits should focus on areas where land and water are still relatively abundant.

2.4. COOPERATION BETWEEN ACTORS OF THE SECTOR

The cooperation between horticultural enterprises is crucial for a sustainable development of the sector. There are two forms of cooperation - horizontal and vertical. Within the WN intervention zone, there are many organizations of horticultural producers. They especially group truck farmers, but there also are tree farming organizations. These organizations can enable producers to receive training to improve their management and their technical abilities, or to have access to financial loans which would provide access to appropriate inputs.

With the sector maturing, these organizations can become an association or federation in order to have access to even larger markets or to purchase quantities of inputs at prices that are even more attractive.

In relation to the vertical aspect, this cooperation exists but mostly between individual enterprises – vendors of inputs, producers and buyers of horticultural production (coxers, semi-wholesalers and retailers).

USAID/Wula Nafaa can benefit from the existing producers' organizations to disseminate technical messages and possibly to improve the marketing of horticultural products. In the long run, it would be interesting to see the possibilities of associating different groups which already exist to facilitate the transmission of technical and commercial information.

2.5. MODERNIZATION OF THE SECTOR'S KEY ENTERPRISES

Based on the analysis in the previous sections, several interventions seem to be crucial to unblock the potential of the horticulture sector. They include:

1. Efficient technologies for better water control
2. Improving the production of fruit trees in strategic decentralized locations
3. Training for active and beginner truck farmers to improve their technical skills and their ability to plan a production which fully takes into account of the periodicity of supply
4. Better supply of inputs
5. Development and implementation of a strategy to address the wandering cattle problem

2.5.1 PROVISION OF TECHNOLOGIES FOR A BETTER WATER CONTROL

In the previous sections, we have shown the widespread existence of conditions required for the success of irrigated horticulture. Only labor and capital appear to be serious obstacles, but these are factors that can be dealt with by the introduction of appropriate irrigation equipment and at an affordable price. The key attributes of this equipment are as follows:

- high flows compared to the traditional drainage system;
- lower recurrent costs and low levels of maintenance of the pumps

Three options for the drainage water were assessed in the WN intervention zone: the traditional method of the dipper, the motor pump and the treadle pump. An assessment of the other pumps using human power was not done here since they are relatively expensive and unsuitable for irrigation because of their low outputs and their huge requirements in terms of human energy.

The dipper method. This traditional drainage tool is produced by local craftsmen using local materials. Among the examples of traditional methods used in Africa, one can mention the chadouf (found in Niger, northern Cameroon, northern Nigeria, and in Chad) and the dipper. Their major advantage is their low cost. The main drawback of these traditional drainage systems is their low outflow which justifies the small irrigated area, and which limits the production and incomes. Figure 10 shows a female truck farmer with her buckets she uses to draw water.

Figure 10 A female truck farmer using the dipper to water her garden

In the case of the dipper, the truck farmer holds the end of the rope and drops the bucket into the well which goes deep into the well to collect water. Once the bucket is filled the truck farmer brings it back up to the edge of the well and decants the water collected into a sprinkler (or previously in a catchment area near the well which supplies a storage basin further down). Then, the farmer goes to the closest section of its non-irrigated field to pour the content. After distributing the water in the sprinkler, the truck farmer resumes the operation. This task is very arduous and time consuming, so that the flow is only 1,000 liters per hour if the water is 4.5 m from the ground level. Some truck farmers who are on the edge of a surface water opt for the use of watering can, going down into the water to fill it, then coming back up to pour water on the plants.

Throughout Senegal, we estimate that about two-thirds of the truck farmers use these methods for collecting and distributing irrigated water in the gardens. Based on the observations carried out during this assessment, the proportion of horticultural enterprises in the WN intervention zone using these traditional manual methods is estimated at more, perhaps around 95%. The prevalence of dippers and low capacity watering cans, small and the low capacity of water sources, largely explains the small size of the average garden in the WN intervention zone.

Motorized drainage. Senegal has witnessed a significant increase over the past 10 to 20 years of the number of pumps; this has not been the case in the WN intervention zone. The main constraint to the adoption of the pump is the high level of capital, the technology's operation cost which is not affordable to the majority of horticultural producers in the area, and the low flow of water sources which is not related to the pump's high capacity. The models of fuel pumps currently marketed in Senegal cost (regardless of aspiration and distribution pipes) between 100,000 and 250,000 CFA Francs. In the WN intervention zone, fuel costs 680 CFA Francs per liter. The costs of maintenance and repair of pumps are also relatively high and require sometimes traveling considerable distances to find a qualified mechanics with the appropriate replacement spare part. In addition, pumps' spare parts (especially in regards to the engine part) are not always available on the market.

Given that the vast majority of users use their pumps below the recommended speed for the engine in order to save on fuel costs, their actual flows are way below their planned capacity. In Burkina Faso, we found out that the actual capacity was an average of 5.2 m3 per hour when the pump is installed on wells less than 6 meters and 11.3 to 15.6 m3 per hour if we pump water surface (Gay, 1994). Although the assessment team did not observe any motorized pumps installed in wells in the WN intervention zone, this discovery is interesting in that it indicates that, in some cases (such as the drainage of wells water), advanced technologies of hand-pumps can compete with the pumps, especially on the flow.

Treadle pump. The treadle pump is from Bangladesh where it was developed in the late 1970s. Its marketing in Senegal began in late 1990's, particularly in the Niayes, and was afterwards extended in the Casamance. Between 4000 and 5000 pumps have been sold so far by more than 40 manufacturers in Senegal. The treadle pump has a number of characteristics which distinguish it from other manual irrigation pumps. The standard version can draw 5000 to 7000 liters of water per hour from a well, drilled well or a source of surface water reaching up to 7 meters of depth. Given that the pump uses the user's body weight and leg muscles, it is less tiring than other manual pumps which use the upper body and arm muscles. Thus, it is possible to use this technology during relatively longer periods of time and irrigate 0.5 and 1 ha if there is water in sufficient quantity. Manufactured with locally available materials, it can be built by metal fittings workers equipped with weld material and using simple hand tools such as those observed in several key locations such as Djilor, Fatick, Kaolack, Kédougou Kolda Missira, Passy Sokone, Toubacouta and Tambacounda. It should be mentioned that since the Diambar version, new improved versions, better and less expensive have been developed; and the latest model in West Africa is the one developed in Niger, which was sold very quickly in a small area of Zinder when it was introduced (180 pumps sold during the period from March to September 2007). Figure 11 shows this new version of the treadle pump.

With an aspiration reaching 4.5 m, the treadle pump has a flow of 1.7 liter per second. On the basis of the cost of the pumps manufactured in Casamance, it is estimated that the treadle pump (model draw – push back) can probably be manufactured and sold for about 60,000 CFA Francs, including 30m of PVC pipe to draw and distribute water. This pump can irrigate an area of at least 5,000 sq. m, if the water is taken from a surface source or a well with sufficient capacity.. If introduced, the Niger model (aspiring model only), could probably be offered for around 50,000 CFA Francs truck farmers in the WN intervention zone

Figure 11: Treadle pump developed Winrock in Niger

Table 5: Comparison of drainage technologies

Drainage Technologies	Capacity at 4,5 m (liters per second)	Initial cost (in CFA Francs)	Aspiration height (in meters)
Dipper	0,3	1 000 to 5 000	0 – 7
Treadle pump	1,7	50 000	0 – 7
Motorized pump	5,0	200 000 to 325 000	0 – 7

Source: Vendors of drainage technologies, 2009

Annex 2 and 3 present a water cost analysis and a financial analysis of three types of drainage systems.

Improved wells. In many areas, ground water is abundant. Unfortunately, this water is not usable because of the hydro-geological conditions which prevent the installation of wells dug by hand extending to over 2 to 3 meters. In other regions of Senegal and other countries of the sub region, there are technologies for the development of groundwater resources for irrigation purposes. The **PVC wells** (called **mini-drilled wells** in Senegal) are small diameter wells dug with hand tools and reinforced with plastic tubing (poly-vinyl chloride). This technology makes available to small growers a cheaper access to groundwater. The PVC wells use metal equipment manufactured locally for the drilling, which limits expenditures for their location. The fact that the pipes are the standard type found on the local market at a low price makes PVC wells affordable for small truck farmers. In Niger, PVC wells usually cost between 35,000 and 45,000 CFA Francs, including the installation costs. The PVC wells can be installed at depths which correspond to the capacity of treadle pumps and motorized pumps, that is to say, where the water can be reached at 7 or 8 meters. The installation of PVC wells is particularly well suited to the hydro-geological conditions which include a sandy layer after an initial layer of clay, the exact conditions that one comes across in many areas in the WN intervention zone.

Figure 12: Installation works of PVC well in Niger

The **filter point** is another technology to provide irrigation water to truck farmers. If we have a traditional well with a large diameter (cemented or non-cemented) which water is not sufficient for watering, the filter point is like a PVC well located inside the old well which multiplies the amount of

water available. The filter point goes deep 3 meters below the bottom of the traditional well. Tests conducted in Senegal on thirty filter points showed that this technology increases on average the flow of wells by about 100%, i.e., it allowed the wells to produce twice as much water. However, it is noted that the performance of this technology can vary greatly depending on the hydraulic conditions.

The expansion and intensification of horticultural production is limited by the restricted capacity of wells, a traditional manual drainage method, and the high costs of motorized pumps.

These constraints to production can be solved with the availability of manual drilled well and human powered drainage equipment at affordable prices. Promoting the extension of improved human-powered drainage equipment will generate greater horticultural production. In the long run, incomes drawn from this production could permit producers to invest in motorized drainage means, a phenomenon observed among many producers in Senegal, particularly in the Niayes, and in many other countries in West Africa which initially, had invested in the treadle pumps.

2.5.2 IMPROVEMENT OF THE PRODUCTION IN DECENTRALIZED NURSERIES OF FRUIT TREE PLANTS

A fruit tree is capable of providing a significant incomes flow **flux**. There is perhaps no other investment in rural Senegal which is as profitable as a fruit tree. Although the national demand for fruit is high, the nurseries in the WN intervention zone all are underdeveloped. Those which exist are producing poor quality seedlings and are unable to provide sufficient quantities to meet the demand. The introduction of superior varieties of mangoes and lemons, for example, as well as the training of nursery staff to graft, produce and market, will increase productivity and enable to produce during certain period the year when the demand is highest. Figure 13 shows a nursery developed with the support of Winrock.

Figure 13: Fruit tree nursery in northern Cameroon using improved techniques

Table 6 shows the incomes which could be generated with the establishment of only ten nurseries each producing 2000 plants. Perhaps, the choice of trees should be reexamined, but it is clear that investment in fruit trees is highly profitable, generating significant incomes and production. In addition, ten nurseries will create twenty jobs.

Table 6: Incomes for different fruit trees species

Species	Number of plants sold by 10 nurserymen	Annual income of trees in full production (in CFA Francs)	Total income during the trees' life (in FCFA)
Mango	5000	206250000	4125000000
Lemon	5000	250 000 000	5 000 000 000
Papaya	5000	75 000000	375000 000
Cashew	5000	187 500 000	3 750 000 000
Total		718 750 000	13.250.000.000

Source: Interviews with fruit producers, November and December 2009

2.5.3 IMPROVEMENTS OF TECHNIQUES AND CAPACITIES TO PLAN PRODUCTION

The horticultural producers in the WN intervention zone do not master enough the techniques of truck farming production, because they learned on the job without any or very little supervision. The aspects to be strengthened are:

- To work on vegetable nurseries aspects to prevent loss of seeds and money
- To support the truck farmers on the preservation techniques, for onion in particular
- To establish a production planning system (for instance, production of small bulbs of onions) to target the best sale periods
- To support the application of fertilizers and pesticides which are generally costly to producers. In general, the recommended intakes are minimal but the producers put a lot of it because of lack of information.
- The spacing between plants determines the appropriate development of plants (see Figure 14). The size of the fruit often depends on that. This can be a source of decrease in yield.
- The provision of simple technical tips related to the appropriate practice of truck farming (the wind breakers which can be valued (maize, etc...), the rotation (succession of different crops on the same plot), and mulching are all techniques with can not only increase production but also increase the producers' incomes.

Figure 14: Good alignment and spacing of onions

These instructions will be strengthened by meetings between truck farmers from different villages and radio announcements to sensitize producers on correct mode of use.
This capacity building can have significant impacts on yields and therefore on incomes. For some main crops, without taking into account the improved preservation techniques, Table 7 shows the potential impact of this crop management sequence.

Table 7: Incomes after application of crop management sequence techniques

Crops	Current yield per hectare (in tons)	Improved yield per hectare (in tons)	Increased yield per hectare (in tons)	Increase income (in CFA Francs)
Onion	10	20	10	1 785 714
Hot pepper	8	12	4	4 000 000
Tomato	7	20	13	2 762 500
Jaxatu	10	20	10	3 750 000
Eggplant	17	25	8	1800000

Source: Interviews with vegetable producers and Rural Development Departmental Offices, 2009

2.5.4 IMPROVEMENT OF INPUT SUPPLY

The horticultural sector is characterized by a poor development of its input supply network. To solve this problem, an approach based on 7 steps is recommended.

1. Quick analysis of value chains: In addition to the two value chains identified by the assessment team, which will be studied further in the near future, these analyses could be carried out on other channels with high potential based on the criteria chosen. They will identify and discuss bottlenecks in the search for investment opportunities.

2. Identification of solutions to the bottlenecks: Inputs which have proven themselves in Senegal or elsewhere will be identified. These inputs may include technical and business management training as well as training in the management of products such as improved seeds, equipment or other physical inputs. Credit is also considered as an input.

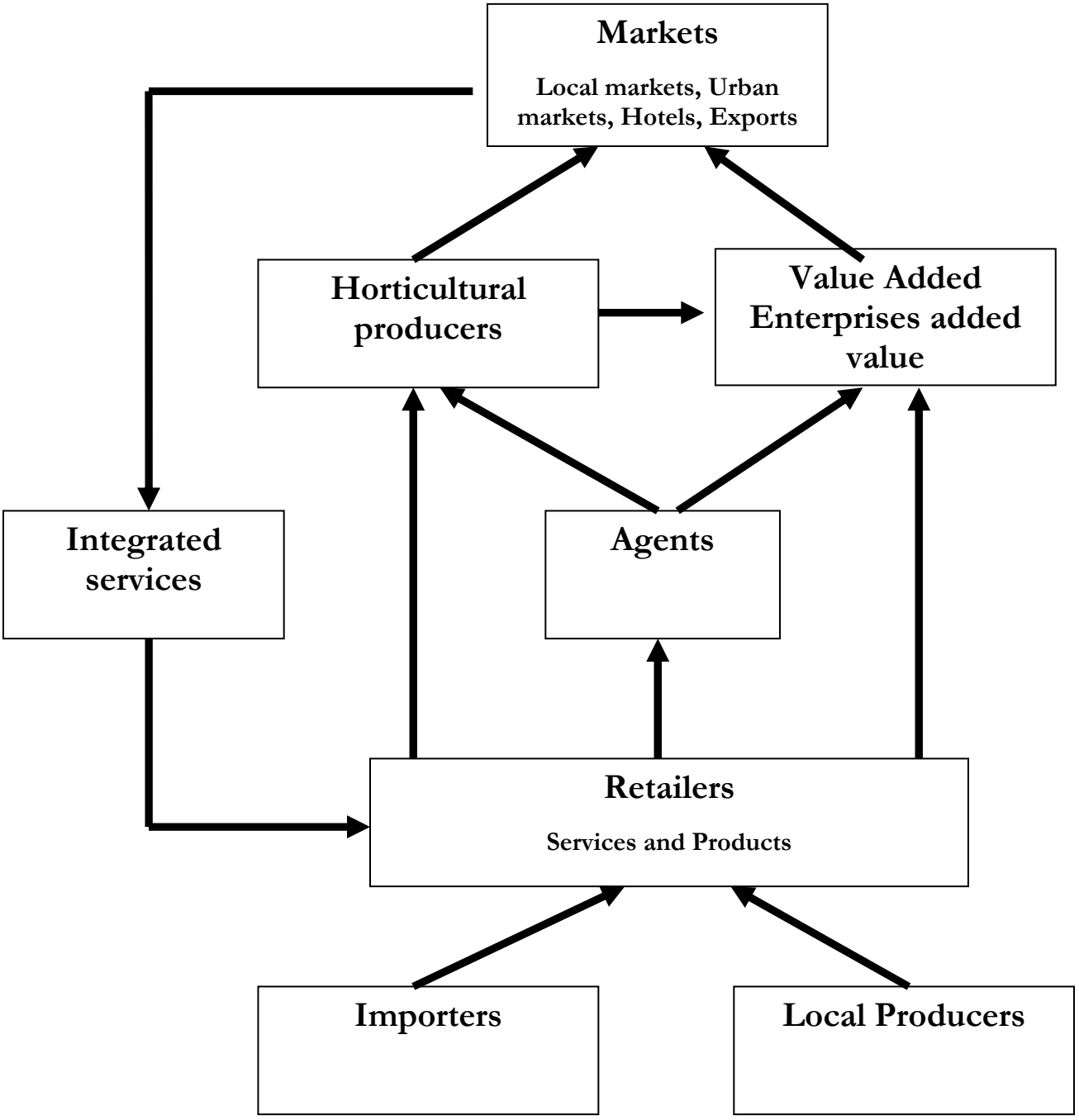
3. Implementation of tests, pilot activities and modified inputs: Identified inputs will be tested and possibly modified to achieve an outcome which meets market expectations.

4. Promotion of supply chains for wholesalers: The emergence of wholesalers will be supported by Wula Nafaa. A wholesaler may be an importer or producer (Tropicasem, Traoré et Fils) but it could be a local manufacturer of pumps and / or drilled wells.

5. Promotion of retailer networks: The wholesalers will be supported so that commercial links are established with retailers who will deal directly with the producers.
6. Development of input markets: In collaboration with input dealers, the market will be developed through promotional activities such as equipment demonstrations, demonstration plots, commercials, etc.

6. Using the feedback received from producers: The feedback received from producers using the services and promoted products will be used to improve them. Monitoring will be initially done by the project and before the end of the project by the chain members.
These interventions and their implementation are represented in the chart below:

Chain of agricultural inputs



2.5.5 DEVELOPMENT AND IMPLEMENTATION OF A STRATEGY TO ADDRESS THE PROBLEM OF CATTLE WANDERING

The cattle wandering, according to the producers interviewed, causes damages to the market crops and transplanted fruit tree seedlings. This problem exists because the cattle owners are sometimes also gardeners, fail to control their animals. Two solutions seem to emerge:

- Empowerment of livestock owners with an organization of areas reserved for the cattle, including the involvement of rural communities to establish community agreements on livestock
- Construction of better adapted fences to prevent cattle from entering into gardens

Some communities have started to organize themselves to limit the damage caused by livestock. USIAD/Wula Nafaa should applaud these efforts and evaluate them. There may be an opportunity to promote this approach in other communities that are experiencing these same problems.

Furthermore, we believe that effective fences can possibly be made of local materials just like the inhabitants of the Casamance and other regions in Africa do. During the training of gardeners in improved techniques and fruit nurseries, they could also be trained to make this type of fence. Nevertheless, further research needs to be conducted to ensure that these fences are resistant to the cattle found in the WN intervention zone, including oxen, and that materials selected are not destructive to the environment.

3. INTERVENTION OPTIONS AND DESCRIPTION OF ACTIVITIES

Our evaluation above of the horticultural sector has highlighted a number of promising interventions. They include the following:

- Dissemination of simple and cheaper commercial technologies for better water control
- Supervision of producers for a better mastery of production techniques
- Supervision of producers for a better control of the vegetable production during the rainy season
- Promotion of the development of private fruit tree nurseries
- Introduction of a drying system enabling a larger scale quality processing

The following description of activities focuses on key indicators of USAID/Wula Nafaa's agricultural component, namely:

- Potential for an increased area
- Potential for greater production for many producers and households
- Potential for increased volumes of agricultural products sold on the market and higher incomes drawn from horticultural production for many producers

3.1 INTRODUCTION OF TECHNOLOGIES FOR A BETTER WATER CONTROL

We believe that the average market-garden in the WN intervention zone does not irrigate more than 500 m2. However, the truck farmer who will be interested and has enough capital to invest in a mini-drilled well and a treadle pump has a garden measuring at least 1,000 m2. With the drilled well and pump, greater human productivity will enable doubling its size. At the same time, greater availability of water will enable it to increase by about 20 per cent the yield of his garden. Assuming an onion production and the use of family labor, these changes will increase the production and net income by approximately 1.4 tons and 230,000 FCFA, respectively, after the first season of the drilled well and pump use. In the second or third year, based on our experience in the sub-region, including in Senegal, some truck farmers add another 1,000 sq. m. for a total increase in net income of about 460,000 CFA Francs. With an investment in the pump and the drilled well of about 150,000 FCFA, the investment profitability will be more than 50 percent during the first year and more than 200 percent during the second year. In regards to the life of the water technology for a conservation period of 6 years, this rate will rise to 820 percent. These pump and drilled well technologies are considered crucial to the success of the entire horticultural sector in the WN intervention zone.

3.2 SUPERVISION OF PRODUCERS FOR A BETTER MASTERY OF PRODUCTION TECHNIQUES

As mentioned above, the technical abilities of horticulturists are a constraint that may have negative effects on yields and on the decrease of the producers' incomes. It is not uncommon to find that a truck

farmer does not use well inputs reducing yields, or having s no effect at all on yields. At the same time, the costs of these unnecessary inputs or adverse effects (notably on the environment) reduce the producer's net income. Better technical capacities will enable an increase and, in some cases, lower costs associated with production. If we take the case of the tomato, better technology and the implementation of appropriate crop management sequences could increase the yield of cultivated land. A plot of 1,000 sq. m. could increase from 700 kg to 2000 kg of tomatoes or an increase of 1,300 kg. In terms of income, this change would represent an increase in income of about 275,000 FCFA.

3.3 SUPERVISION OF PRODUCERS FOR A BETTER MASTERY OF VEGETABLE PRODUCTION DURING THE RAINY SEASON

If during the dry season the average horticultural producer goes through some difficulty to master the techniques, it is even more the case for those who produce during the rainy season, a period in which the production conditions are even more difficult with more problems related to insects and diseases and sometimes associated with large quantities of rainfall. On the contrary, if you manage to master these conditions, since the prices are higher during that period of the year due to a decrease in production associated with these conditions, the producer can expect prices at least two to three times higher compared to the dry season. So, for the producer with its 1000 sq. m. of tomatoes, he could earn more than 500,000 CFA francs with a good control of insects and diseases.

3.4 FRUIT TREE NURSERIES

The fruit tree benefits from a good market for its fruit as well as an income flow for many years. The grafted tree begins to produce during its third year after planting and not after seven or eight years in the case of a non-grafted tree. Assuming about 100 kg per year from a grafted lemon citrus tree and approximately 20 years of productivity at this level of production and an average price of 500 CFA francs per kg, a single tree will generate 2 tons of fruit and a gross income of 1 million CFA Francs, or 50,000 CFA Francs per year, a sum of money considered important by most producers in the WN intervention zone. A grafted mango tree produces 200 kg per year in its maturity and generates 80,000 CFA Francs per year.

3.5 A DRYING SYSTEM ENABLING A LARGER SCALE QUALITY PROCESSING

The lack of storage systems does not encourage horticultural producers to produce knowing that this production will be lost if it cannot be sold. Winrock has developed a simple but high capacity technology for drying fruits and vegetables (see Figure 15). This technology is currently manufactured in Cameroon, where it is sold for 300,000 CFA Francs, and could be manufactured and sold in Senegal for about the same cost and price. In the southern region of Kolda, the affordable mango could be dried. A ton of fresh mango would give 200 kg of dried mangoes that could be sold at 750 CFA Francs for 250 grams or 3,000 CFA Francs per kg - the current price of dried mango sold in Ziguinchor - and thus generate a gross income of 600,000 CFA Francs. Following the reduction of the other operating costs of the unit, we found that this transaction gives a net income of 430,000 FCFA. It would be interesting to conduct tests on the cashew apple to produce a dry product which might find an attractive market in the Senegalese towns. At 100 CFA francs / kg of fresh apple, a high value added would be possible. In times of surplus or in the rainy season, other fresh horticultural products7 would also have some potential once dried. The availability of this technology could also open other possibilities such as the drying of onion, a product apparently requested by the Nestle Company in Niger. For larger quantities than the Nestle Company could request, a much larger model would be needed.

Figure 15: Dryer having processed several types of fruits

[7] And even fish products

4. THE DIFFERENCE OF THE "ENTREPRENEURSHIP APPROACH

Contrary to most the activities proposed here integrate the private sector and relies on the entrepreneurial energy of the populations of the WN intervention zone, for their success. They refer to this energy through the introduction of innovative and powerful technologies which removes barriers to the sector and release the entrepreneurship spirit pushing them to think about otherwise unimaginable opportunities. This section of this paper provides more details on how the proposed approach is different.

Numerous projects had to work in the horticulture sector in Senegal, and each of them claims to have been successful in the past in this sector. We would like to explain why the horticultural activities we offer will be different.

Transfer of technologies and techniques: The proposed activities include a strong technology component including training of local enterprises in the production of equipment, infrastructure and planting fruit trees, as well as training of horticultural producers in the use and maintenance of these technologies. They also transfer well targeted techniques which will increase productivity and decrease costs for horticultural enterprises. Other projects focus on management training, credit and literacy training; if these elements are important, they cannot be effective without having concrete means to increase productivity, such as pumps and drilled wells which enable to expand the area of the truck farming gardens, or the fruit tree plants or dryers or the onion storage locations. The credit will not produce results if the producers do not invest in something which t will allow them to increase their production.

Some projects introduce technologies and techniques, but these projects do not have the technical expertise in metal fittings, hydro-geology, agronomy, processing of horticultural products and mostly maybe on approach to entrepreneurship to successfully and definitely transfer these skills. Through its staff and its experienced consultants in the sub-region, USAID/Wula Nafaa has the necessary expertise.

Marketing: Many projects promote new techniques, new methods and even new technologies, but very few of them failed to do so without the provision of subsidies in one form or another to convince producers to accept them. When a project ends and the grant comes to completion the activities often stop. We propose to apply the marketing and distribution techniques used with success in the private sector to really convince the public to accept inputs and equipment on which we teach our beneficiaries to ensure the production, in order for them to be definitely part of the national economy.

Given the small difference between the price near the plot and the price in the area's local market and the trouble which producers with no experience have when they sell in the market, we do not think we will give priority to an organization for marketing horticultural production. However, organizing a collection in collaboration with traders, like the activity undertaken by Winrock in Nepal, needs to be taken into account. The activity in Nepal is to organize producers of fruits and vegetables so that they gather their harvest on certain days of the week based on an agreement with traders who used to roam the area. Well designed and managed, this system will increase farmers' incomes and reduce costs for traders.

Activities continue long after the end of the project: Each project naturally qualifies itself "sustainable", but the number of projects which activities continue after the funding ends is very limited.

Given that we train people to do business with each other, our beneficiaries do not need the project to continue their activities.

Use of local suppliers, local material and local purchasing power: Many development projects are used to import new technologies which cannot be bought, repaired or replaced in the country. We encourage only those technologies which can be produced locally. Given that users must pay the full cost of their equipment, either in cash or on credit, they do not count on USAID/Wula Nafaa to buy or maintain them.

5. A VISION – THE PROPOSED ACTIVITIES

Our vision on the sector is a horticulture using practices and state-of-the-art technologies produced locally, giving as a result a significant increase in yields per hectare and person-day. This result will lead to a significant increase in household incomes. These activities will be sustainable because the individuals undertake commercial transactions between them in which everyone will gain. The implementation of this vision will begin during the first quarter of 2010 and will continue long after the end of the project.

The proposed activities will introduce the treadle pump, the manual drilled well and planting of fruit trees. The active truck farmers and beginners will be trained to better master techniques of the truck farming production, initially during the dry season and then during the rainy season for the best individuals. The dryer will be introduced in collaboration with interested entrepreneurs.

The first nine months of activities (January-September 2010) will cover the first phase of implementation and will focus on the marketing of treadle pumps and drilled wells, training of truck farmers, starting the fruit tree nurseries and commercial use of the dryer in the WN intervention zones.

During the second phase, that is to say, the last three years of the current phase of USAID/Wula Nafaa, the first nine months activities will be spread to other areas inside the WN intervention zone. At the same time, an activity to train truck farmers in truck farming production during the rainy season will be initiated. In the course of these activities, lessons learned will be applied to upcoming activities.

To achieve the objectives of horticultural activities, the agricultural component of USAID/Wula Nafaa will put together an internal team to focus particularly on horticultural component and ensure that activities are implemented and the expected results are achieved. This team will be headed by the Head of the Agriculture / Water Resources Management component. He will be responsible for the management of activities. He will recruit, lead and evaluate a number of consultants to perform specific tasks (training and monitoring of manufacturers and installers of pumps and drilled wells, for example). He will be assisted by the agricultural production specialist. The irrigation team will consist of several consultants, one to train and monitor the manufacturers and installers of pumps and drilled wells, one to train and monitor truck farmers, one for the implementation of the nursery activity and one to train people to use the dryer. Since the technologies of irrigation grafting and drying are new to the WN intervention zone, trainers will perhaps need to be trained by technicians of the sub-region and other regions of Senegal.

Winrock staff or a consultant could provide regular technical assistance and management. Monitoring visits could be organized twice a year. The training of trainers of the pumps manufacturers and drilled wells' installers will be provided by a trainer of trainers either from Burkina Faso or even Senegal. The evaluation of the potentials of drilled wells and the training in their construction will be conducted an expert from Senegal or Niger. The trainer in truck farming will be Senegalese.

The following activities have been designed to meet the Annual Work Plan (see Annex 4).

FIRST PHASE: YEAR 1 (FROM JAN 1ST 2010 TO SEPTEMBER 30TH 2010)

DRAINAGE COMPONENT

The average size of truck farming plots remains small given the absence of technologies more productive than the dipper. The proposed activity will introduce the treadle pump by the private

sector based on 20 years of experience with this technology in some parts of Senegal and the sub-region.

GOAL 1: TO IDENTIFY AND DEFINE ON A PRIORITY BASIS THE IRRIGATION AREAS WITH A HIGH IRRIGATION

Strategies:

A. The criteria for the selection of areas include:

- A water layer between 0 and 7 m from the surface of the soil or surface water in adequate quantity
- Wells which currently or potentially recharge at an average rate of at least 3m3 / h
- A significant number of farmers actively involved in the production and marketing of vegetables and fruit and whose truck farming is already a major source of income
- Land available in sufficient quantity to allow the expansion of irrigated crops
- An adequate agricultural labor
- The existence of substantial equipment and capital invested in horticulture and a location found between 25 and 50 km from the nearest market to sell cultivated products

Intermediate Results:

A. A list of at least 4 geographical areas planned for manual irrigation arranged by potential size

GOAL 2: TO IDENTIFY LOCAL CRAFTSMEN WHO COULD MANUFACTURE AND MARKET IDENTIFIED DRAINAGE SYSTEMS BEGINNING WITH THE AREA WITH THE GREATEST POTENTIAL

Strategies:

A. To identify local metal fittings workers for the manufacturing and marketing of pumps

The ideal candidate should have the following credentials:

- Own a workshop with a minimum of equipment, including an electric weld, an electric drill and a grinder
- Be able to guarantee regular electricity supply to workshop
- Already manufacture a variety of quality products
- Be dynamic while having enough potential for expansion to guarantee the manufacture of treadle pumps
- Be used to serve a rural market
- Have a workshop located at a distance less than 50 km of the main private irrigation areas currently exploited by local farmers, and have access to a vehicle which can be used to bring the pumps to the sites targeted for the demonstration, installation and repair

Intermediate results:

A. A list of skilled metal fittings workers working alongside the high potential areas. Between one and three metal workshops will be identified in the 1st year to begin manufacturing and marketing of improved drainage systems in each of the already identified high potential areas already, first in the area with higher potential.

GOAL 3: TO TRAIN LOCAL METAL FITTINGS WORKERS IN THE CONSTRUCTION OF TREADLE PUMPS STARTING WITH THE GEOGRAPHICAL AREA WITH THE GREATEST POTENTIAL FOR THE EXPANSION OF IRRIGATED HORTICULTURAL PRODUCTION

Strategies:

A. The training will include:

- The selection and use of raw material and required equipment
- The use of manufacturing prototypes
- Instructions for the installation, use and maintenance of improved drainage equipment

Intermediate results:

A. Between 4 and metal fittings workers working in 2 workshops will be trained by the end of this phase of the project

GOAL 4: TO DEVELOP A MARKET FOR THE TREADLE PUMP

Strategies:

A. The market for treadle pump will be developed as follows:

- Demonstrations in localities
- Campaign in the media especially with the radio to inform the target population of the existence and performance of the improved technology

Intermediate results:

A. Approximately 25 to 50 demonstrations will be conducted among 1000 to 2000 horticultural enterprises before the end of the project's first phase of nine months in collaboration with equipment manufacturers, vendors and interested horticulturists. Starting the 2nd year, when there is enough production capacity, campaigns will be conducted on the local radios.

GOAL 5: MARKETING OF TREADLE PUMPS

Strategies:

A. Following the training of manufacturers, the treadle pump will be sold to interested farmers

The marketing will be conducted by:

- The manufacturers themselves and
- Vendors will be paid on a commission basis by the manufacturers

Intermediate results:

A. Among horticultural producers in the WN intervention zone, about 3000 of them will be interested in improved irrigation equipment. Among these, about 700 horticulturists will actually buy this equipment during the nearly 4 years of marketing. By establishing a sustainable system of production and marketing by the private sector before the end of the fourth year of the project's second phase, the sale of equipment will be fully launched and will continue in a sustainable manner long after the project ends.

DRILLED WELL COMPONENT

The hydro-geological conditions in the WN intervention zone require improved wells. Without a manual drilled well, which is much less expensive than a cemented well, irrigation with treadle pump or motorized pump is virtually impossible. Following their training, local craftsmen will manufacture and install manual drilled wells.

GOAL 1: TO TRAIN WELL-DIGGERS, AND / OR MANUFACTURERS OF PUMPS IN THE PRODUCTION AND INSTALLATION OF SMALL DIAMETER WELLS, IN ADDITION TO THE TRAINING OF METAL FITTINGS WORKERS IN THE MANUFACTURING OF THE STANDARD TREADLE PUMP AND OTHER DRAINAGE SYSTEMS.

Strategies:

A. The training will include

- The selection and use of raw materials and suitable equipment
- The use of tools (drilled well equipment)
- The instructions for installation, use and maintenance of small diameter wells

Intermediate results:

A. Approximately 4 teams of diggers where pump manufacturers will be trained by the end of the project

GOAL 2: TO BEGIN MARKETING OF DRILLED WELLS WHILE CONTINUING TO DEVELOP THE PUMP MARKET

Strategies:

A. The market for drilled wells will be developed in the same manner we have developed the marketing of treadle pumps (demonstrations and campaigns through local radio stations)

B. For promotional purposes, to encourage investment in technologies which are either poorly or not known at all, the first 50 to 100 people who buy a pump will get a free drilled well pump

Intermediate results:

A. Demonstrations on drainage systems and wells with horticulturists will be conducted in collaboration with equipment manufacturers, vendors associated with manufacturers, and interested truck farmers. Campaigns will be regularly organized through the media. In almost 4 years of marketing, about 560 drilled wells will be sold.

TRAINING IN TRUCK FARMING PRODUCTION COMPONENT

The non-mastery of truck farming production techniques reduces the competitiveness of truck farming producers in the WN intervention zone and prevents them from maximizing their incomes. This training will teach farmers techniques which will enable them to bridge this gap and to plan their production based on the demand. It is also an opportunity to show them how

to produce an effective and less expensive fence with local materials, and to demonstrate advanced technologies such as the treadle pump, the manual drilled well and the dryer. A demonstration of these technologies will enable trained farmers to articulate a vision of the future.

GOAL 1: TO IDENTIFY PRODUCERS' GROUPS TO CONDUCT TRAINING IN OR NEAR AREAS WITH HIGH IRRIGATION POTENTIAL

Strategies:

A. Groups should have the following characteristics:

- - Be able to gather in small groups of 10 to 20 people with at least half being women
- - Have immediate access to a land of 1,000 m2 to 2,000 m2 according to the number of people in the group
- - Be ready and able to gather materials for the construction of a fence and follow the instructions of the WN staff for its construction
- - Be ready and able to contribute in cash or in kind to the training

Intermediate Results:

A. A list of 10 groups to be trained in truck farming techniques bringing a total between 100 and 200 people

GOAL 2: TO TRAIN THE PRODUCERS' GROUPS TO UNDERTAKE TRUCK FARMING

Strategies:

A. Groups will be trained for the following tasks:

- Construction of a fence made of local materials (following the research to design a fence resistant to livestock in the WN intervention zone, including oxen, and not destructive to the environment)
- Choice of vegetables and appropriate inputs
- Planning of production based on the demand for horticultural products
- Application of appropriate techniques for the production of vegetables during the dry season, including the creation of a nursery and irrigation with a watering can
- Use of irrigation and drying technologies which could enable greater production and value added in subsequent years

Intermediate Results:

A. 100 to 200 farmers trained in truck farming during the 1st Year and 400 during the project

FRUIT TREE COMPONENT

The fruit tree nurseries exist in the WN intervention zone. Unfortunately, they usually have few species and only local varieties which all produce at the same period. The introduction of grafted varieties will enable production within two to three years after planting (instead of seven to eight years), a production which will not take place at the same time as local varieties when

prices are more attractive . By making seedlings more available, the proposed system of decentralized nurseries, which is similar to horticultural producers, promote the adoption of seedlings, including those already well known such as cashew and papaya.

GOAL NO. 1: TO EVALUATE THE RURAL AND PERI- URBAN AREAS IN ORDER TO IDENTIFY SPECIFIC AREAS WITH HIGH POTENTIAL FOR FRUIT PRODUCTION

Strategies:

A. The criteria for selecting areas include:

- A shallow water layer but in an area which is not subject to flooding
- A significant number of active farmers in the production and marketing of fruit
- Land available in sufficient quantity for tree farming, including land which is unsuitable for the production of other crops

Intermediate result:

A. A list of at least 4 geographic areas planned for the development of nurseries and fruit trees

GOAL 2: TO IDENTIFY EXISTING LOCAL ENTERPRISES WHICH ARE NEAR AREAS WITH HIGH POTENTIAL, AND WHICH MIGHT PARTICIPATE IN THE DEVELOPMENT OF IMPROVED FRUIT TREE NURSERIES

Strategies:

A. The criteria for the selection of enterprises include:

- Have a plot of at least 500 m2 with access to good water quality of an aquifer which is not too deep
- Interest in the production of tree seedlings
- Production of good quality horticultural crops
- Have financial resources to be able to participate in the training and expansion of the business of producing improved seedlings of fruit trees

Intermediate results:

A. A list of at least 10 people who could be trained in the creation of nurseries

GOAL 3: TO IDENTIFY AND OBTAIN MATERIALS FOR THE PRODUCTION OF SCIONS AND ROOT STOCKS

Strategies:

A. The root stocks will be obtained in the WN intervention zone as close as possible to the nurseries which will be put in place. The scions may come from elsewhere. In the case of mango, for instance, the scions might perhaps come from the Casamance.

Intermediate Results:

A. Identification of a quantity of scions and root stocks of different species sufficient for the establishment of 10 nurseries

GOAL 4: DEVELOP THE CAPACITY AMONG LOCAL ENTERPRISES TO PROVIDE IMPROVED SEEDLINGS OF FRUIT TREES, BY STARTING WITH THE GEOGRAPHICAL AREA WITH THE HIGHEST POTENTIAL

Strategies:

A. The training will include:

- Selection of root stocks and scions
- Practice of grafting
- Creation and maintenance of a nursery
- Planting and maintaining trees once the plant is transplanted
- Management of the enterprise including marketing

Intermediate result:

A. 10 nurseries trained in year 1 and about forty during the life of the project

GOAL 5: TO PROMOTE INVESTMENT IN FRUIT TREES INCLUDING SPECIES AND SPECIFIC VARIETIES

Strategies:

A. The market for fruit trees will be developed as follows:

- Presentations in villages and markets of the advantages of different types of fruit trees
- Media campaign with the radio to inform the target population of the existence and performance of fruit trees

Intermediate result:

A. Approximately 50 to 100 presentations will be made to 1000 to 2000 horticulturists in collaboration with interested nursery men and horticulturists. From the second phase, once there is enough production capacity of seedlings production, the campaigns will also be conducted with commercials on the local radio.

GOAL 6: TO SUPPORT HORTICULTURAL PRODUCERS IN THE TRANSPLANTING OF SEEDLINGS, IN TREE MAINTENANCE, AND IN FRUIT MARKETING

Strategies:

A. With the trained nurseryman, WN will support producers who have invested in improved seedlings. The support will show how to:

- Transplant seedlings of different species
- Irrigate and generally maintain the plants at different stages of their development
- Market fruit products

After an initial phase with each nursery, this support will be taken over by the nursery man for his own interest.

Intermediate result:

A. Support provided to the majority of buyers of plants and all nursery men.

DRYER COMPONENT

There is no horticultural processing unit in the WN intervention zone. However, the need exists. In collaboration with local entrepreneurs, including possibly certain groups, the profitability of drying horticultural products including mango, cashew, pepper, etc. will be tested. This technology will be an opportunity to produce and test other dried products such as tomatoes and onions which could be reconstituted with water during shortage of fresh products on the market.

GOAL NO. 1: TO ORGANIZE DEMONSTRATIONS OF THE DRYER TO PUBLICIZE THE TECHNOLOGY AND ITS DIFFERENT DRIED PRODUCTS

Strategies:

A. To train a local craftsman who will produce dryers to show interested entrepreneurs and producers

B. To identify dried products which have a commercial potential based on preliminary financial studies

C. To demonstrate the dryer showing the performance of the technology, including the quality of finished products

These demonstrations will be organized in urban areas where consumers of finished products and investors in the technology will be found.

D. To collect information on these demonstrations to learn about possible failures, ease in use, customer satisfaction on various products and cost of operations

E. To calculate the dryer's equipment and manufacture cost, and then through information from the demonstrations, calculate the profitability of different products

Intermediate results:

A. Profitability calculations and preliminary identification of dried to be targeted

GOAL 2: IDENTIFY TARGET AREAS TO PILOT THE DRYER

Strategies:

A. The criteria for selecting the areas include:

- Strong production by at least two fresh horticultural products at different periods of the year making prices drop down
- Vicinity to potential urban markets of dried products
- Presence of entrepreneurs interested in investing in the dryer
- Presence of metal fittings workers who could become dryer manufacturers

Intermediate results:

A. A list of at least 2 geographic areas planned to test market the dryer

GOAL 3: TO IDENTIFY LOCAL ENTREPRENEURS WHO ARE INTERESTED IN PILOTING THE USE OF THE DRYER

Strategies:

A. Identify local contractors for the commercial use of the dryer

The ideal candidate should have the following characteristics:

- Owning your business, preferably in the food business
- Be in the production and / or trade in fresh horticultural products which could elicit a high demand when they are dried
- Have the resources to buy raw materials
- Have a commercial network for the sale of the dried product

Intermediate results:

A. A list of at least two to three entrepreneurs fulfilling the selection criteria above

GOAL 4: IDENTIFY LOCAL CRAFTSMEN WHO COULD MANUFACTURE AND MARKET THE DRYER

Strategies:

A. To identify local metal fittings workers for the manufacturing and marketing of the dryer

The ideal candidate should have the following characteristics:

- Have his workshop near the targeted area(s)
- Have a workshop with a minimum of equipment, including an electric weld, an electric drill and a grinder
- Be able to ensure regular supply of electricity to his workshop
- Already make a variety of quality products
- Be dynamic while having enough potential for expansion to ensure the manufacture of treadle pumps

Intermediate results:

A. A list of one to three skilled metal carpenters working alongside target areas

GOAL 5: TO TRAIN AT LEAST ONE METAL FITTINGS WORKER IN THE CONSTRUCTION OF THE DRYER

Strategies:

A. The training will include:

- The selection and use of appropriate raw materials and equipment
- The use of manufacturing prototypes
- Instructions for installation, use and maintenance of improved drainage equipment

Intermediate results:

Between 2 and 3 metal fittings workers working in a workshop will be trained by the end of the project's first phase

GOAL 6: DEVELOP A MARKET FOR THE DRYER

Strategies:

A. The dryer market will be developed as follows:

- Demonstrations in localities
- Campaign in the media especially with the radio to inform the target population of the existence and performance of the improved technology (to be established if there is a high demand for this technology)

Intermediate results:

Approximately 25 to 50 demonstrations will be conducted to 1000 to 2000 consumers by the end of the project's first phase in collaboration with equipment manufacturers and potentially associated entrepreneurs. From the second phase, if there is sufficient demand, campaigns will be conducted with the local radios.

GOAL 7: MARKET THE DRYERS

Strategies:

A. Following the training of manufacturers, the dryer will be sold to interested entrepreneurs who may include groups of horticultural producers

The marketing will be conducted by:

- - The manufacturers themselves and possibly
- - Some retailers

Intermediate results:

Possible sales of 2 to 3 in this phase of the project

SUPPLY CHAIN COMPONENT

In support of these intervention components, the USAID / Wula Nafaa Project will promote the creation of supply chains. They will mainly concern the inputs (seeds, fertilizers and pesticides) but if necessary, they could potentially affect other products and services which will be introduced. A better supply chain will make products and services which are currently missing, more accessible by giving better served areas as an intermediate result. With a better use of critical inputs, the horticultural production will increase as well as the producers' incomes.

The input supply chain starts with wholesalers who are also often importers. Companies like SPIA, TROPICASEM and Traore et Fils expand their networks up into small towns. They still need to go further to reach even more producers in many villages. This last step could be made by employing certified officers. Trained and equipped by the wholesalers, with support from USAID/Wula Nafaa, if necessary, these agents can provide high quality inputs. Backed by a consultant, such a system could be promoted in a confined area starting from this current year.

SECOND PHASE: Years 2, 3, 4 (from October 1st 2010 to September 30th 2013)

In Years 2, 3 and 4, the activities started during the first nine months will be spread to other areas with high potential. Moreover, the best among the farmers trained in truck farming will be trained to grow vegetables during the rainy season. Some will also equip themselves with pumps and wells to become model truck farmers.

Table 8 below presents the main project activities during its implementation of three years and nine months.

Table 8: The horticultural activities program

	1st Phase									2nd Phase		
Activities	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Year 2	Year 3	Year 4
Identification of the intervention zones												
Identification of the groups to be trained in horticulture												
Identification of the artisans to be train to manufacture pumps, drilled-wells and dryers												
Training of trainers												
Training of manufacturers/well drillers												
Training of horticulturists' groups												
Training of nursery men												
Promotion												
Sales of pumps, drilled-wells, dryers, fruit trees												

Table 9 shows the importance of the main results during the project three and a half duration.

Table 9: Expected results

Activities	Year 1	Year 2	Year 3	Year 4	Total
Number of trained enterprises					
Manufacturers of pedal pumps	2	2	2	2	8
Manufacturers/installers of drilled-wells forages	2	2	2	2	8
Horticulturists	100	100	100	100	400
Nurserymen	10	10	10	10	40
Planters		2063	3562	5813	11438
Dryers' manufacturers	1	1	1	1	4
Total	**115**	**2178**	**3677**	**5928**	**118 98**
Number of technologies sales					
Pumps	75	125	200	300	700
Drilled wells	60	100	160	240	560
Plants	0	41250	71250	116250	228750
Dryers	5	10	20	30	65
Total	**140**	**41485**	**71630**	**116820**	**230075**
Incomes					
Sales of technologies	$17000	$49000	$100 000	$170 000	$336000
Producers trained in horticulture	$9000	$18000	$27000	$36 000	$90000
- Production of vegetable with the assistance of pumps/drilled wells	$38000	$101000	$202000	$353 000	$694000
Fruit producers		$225000	$765 000	$1 575 000	$2 565 000
Total	**$64 000**	**$393 000**	**$1 094 000**	**$2 134 000**	**$3 685 000**

Number of beneficiaries					
Manufacturers of pumps/drilled-wells/dryers	17	17	17	17	68
Horticulturists	350	450	600	800	2.200
Users of dryers	100	100	200	200	600
Nurserymen	30	30	30	30	120
Fruit producers		4125	7125	11625	22875
Total	**497**	**4722**	**7972**	**12672**	**25863**
Number of irrigated hectares – created area1	11	46	71	104	232
Number of irrigated hectares – total improved area[2]	19	87	137	203	446
Number of tree plants planted		41250	71250	116250	228750

1 Number of additional irrigated hectares resulting from WN interventions such as the dissemination of pumps and drilled-wells and the horticulturists training

2 Number of hectares affected by the new or improved water management systems

6. BUDGET OF THE PROPOSED INTERVENTIONS OVER A PERIOD OF THREE YEARS AND 9 MONTHS

The budget presented in Table 10 is in accordance with the activities and results presented above (see Annex 5 for the detailed budget of the proposed horticulture activities).The staff is the project staff. It is composed of the Head of the Agriculture/Water Resources Management Component and the Agricultural Production Specialist. National and international consultants, all residing in West Africa, will provide technical assistance in production of pumps, drilled wells, dryers, tree fruit plants and vegetables of several species and varieties. This budget should be implemented during the first week of January 2010.

Table 10: Summary budget of proposed horticultural activities (in CFA Francs)

	Year 1	Year 2	Year 3	Year 4	Total
Staff (covered by the USAID/Wula Nafaa Project)	0	0	0	0	0
Travel	35 600 000	33 372 000	34 373 160	35 404 355	138 749 515
Consultants	21 282 000	19 776 000	20 369 280	20 980 358	82 407 638
Other Direct Costs	1 6305 000	18 339 150	17 866 882	17 349 773	69 860 805
Total Direct Costs	73 187 000	71 487 150	72 609 322	73 734 486	291 017 958

Table 11 is the summary budget by category of proposed activity. With this presentation, it is possible to better understand the cost of category.

Table 11: Summary budget by category of proposed activity (in CFA Francs)

Components	Year 1	Year 2	Year 3	Year 4	Total
Drainage	13236500	14412275	14674236	14938944	57261955
Drilled wells	13136500	14309275	14568146	14829671	56843592
Training in horticulture production	14592500	19304775	19713511	20129397	73740183
Fruit trees	16.442500	16472275	16796036	17124.398	66835209
Dryer	6686500	3648775	3587831	3519947	17443053
Supply chain	9.092500	3339775	3269561	3192129	18893965
Total Direct costs	73187000	71487150	72609322	73734486	291017958

7. ENVIRONMENTAL MANAGEMENT ISSUES FOR SMALL-SCALE IRRIGATED HORTICULTURE: PROPOSED MITIGATION AND MONITORING MEASURES

USAID / Senegal has prepared an Environmental Impact Assessment for Strategic Objective 11, which covers the USAID/Wula Nafaa Project, and has determined that the activities of small-scale irrigation do not have a negative impact on the environment under certain conditions . Thus, to satisfy these conditions, and therefore to avoid any negative impact on the environment, we propose that the planned activities in the horticulture realms include a series of mitigation and monitoring measures to manage the environmental issue at the start of the activities' implementation. And we believe that understanding the overall requirements for environmental management activities of small-scale irrigated horticulture represents a very good example of improved management of natural resources (water and soil) included under the USAID/Wula Nafaa Project.

We emphasize that this is "small scale" irrigation because pumping is done at shallow horizons, from treadle pumps used to irrigate plots with an average size of 2 500 m², and the program's targets are to work with about 700 irrigators located throughout the WN intervention area.

In order to mitigate any potential adverse impacts associated with these activities, we propose that activities be conducted by following the guidance provided in Chapter 1 on agriculture and irrigation included in small-scale activities environmental guidelines in Africa, 2nd edition, see website www.encapafrica.org . Moreover, we use the more detailed guide available in the "Programmatic Environmental Assessment of Small-Scale Irrigation in Ethiopia", and in particular the checklist "environmental design". This document is also available on the website www.encapafrica.org

The advice in these USAID guidance documents for small-scale irrigation will be used even beyond the design and implementation of each activity, that is to say, for training both technical staff and producers in environmental management of their improved farming exploitation systems.

The improved agricultural technologies which will be promoted for horticultural producers will also include the use of appropriate amounts of fertilizer so that investments reach their full potential. For that, the USAID/Wula Nafaa Project follows the guide developed by the Africa USAID Bureau, through the use of the "fertilizer fact sheet for Africa". USAID/Wula Nafaa is currently translating this document into French so that it can be more fully assimilated here in Senegal and elsewhere.

Production systems may also require the use of pesticides, as part of an integrated approach to pest management. The USAID/Wula Nafaa Project will lead a "PERSUAP (Pesticide Evaluation Report User-Safe Action Plan) for the small-scale horticultural irrigation to ensure that these agro-chemicals are properly used. It should be noted that the PERSUAP takes into account the current national and regional practices (CILSS) in force on the registration and use of pesticides.

Note that the project plans to work with the private sector manager of input supply stores. A training session for the input suppliers may be provided to bring technical advice on the appropriate application of fertilizer and pesticide to the producer's customers of their stores. This training would be similar to what the advisors / facilitators would give directly to producers.

In regards to monitoring, as part of our regular reporting on this activity of small irrigated horticulture, a monitoring will also be conducted on the environmental mitigation measures, with particular emphasis on possible impacts on the depth of the groundwater, on the proper use of pesticides.

8. CRITERIA SELECTION OF THE VALUE CHAINS

The USAID/Wula Nafaa Project evaluates two high potential value chains to identify the most promising interventions. The objective of this section is to choose two value chains based on three selection criteria:

- The existence of a of a high demand, current, or potential, and growing
- The competitiveness (price, quality, volume) of the product
- The Government support

Based on these criteria, we selected the onion and dried mango value chains.

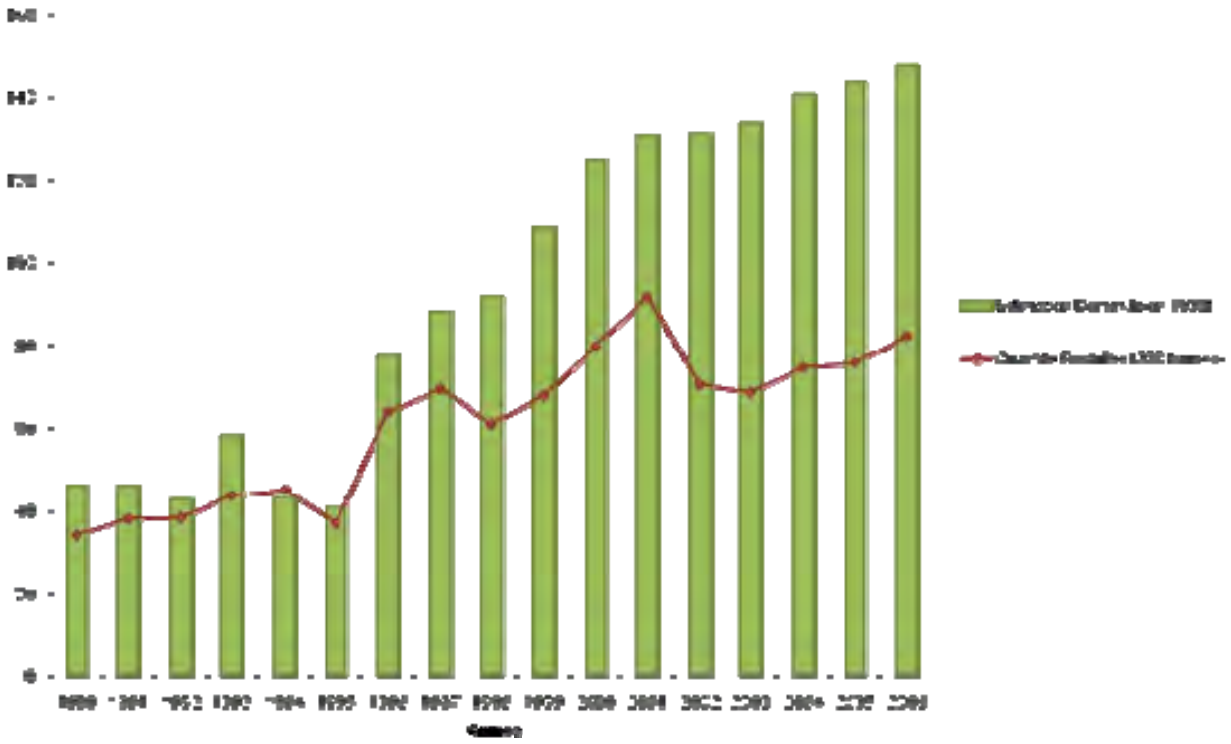
8.1. ONION VALUE CHAIN

8.1.1 EXISTENCE OF A HIGH DEMAND

In fact, the onion industry is one of the most dynamic agricultural sectors in Senegal. The onion is the leading vegetable crop with an area of nearly 4,485 ha in 2006 and a production of about 82,300 tons [Horticulture Division, 2007]. The onion is the most consumed vegetable and represents 20% of total expenditures for vegetables (DPS, 2004). Its consumption has increased from 6 kg / person / year in 1990 to 13 kg / person / year in 2003 (Pelletier, 1997 FAOSTAT, 2006).

However, domestic production does not cover the entire market demand, hence the need for imports. These imports are always increasing. They increased from 16,140 tons in 1990 to 89,030 tons in 2008 (Horticulture Division, 2009) (see Figure 16).

Figure 16: Evolution of the demand and onion production



Source: Horticulture Division, 2007 and 2009, and FAOSTAT, 2009

8.1.2 POSSIBILITY OF POSITIONING ON THE NATIONAL MARKET

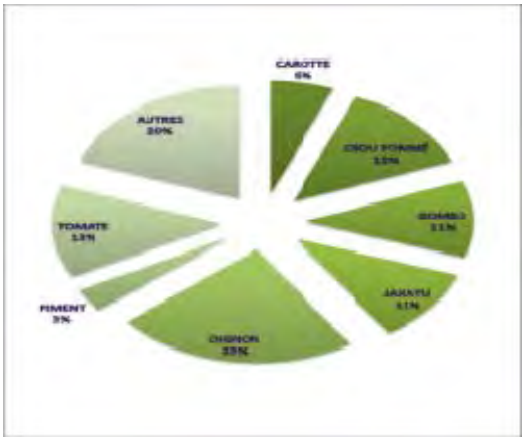
The domestic production comes mainly from two areas. From 2002 to 2006, over 53% of this production came from the Niayes and nearly 40% from the Senegal River Valley area (Horticulture Division, 2007). In the Niayes, the favorable climatic conditions enable to grow several varieties (Violet of Galmi, Noflaye, Yaakar, Red Amposta, and F1 Gandiol). Hence, production there is possible for nearly 10 months out of 12. In the Senegal River Valley area, the Violet of Galmi is the main variety grown. It is a strictly short-day variety which is perfectly suited to sub-Saharan conditions, including high temperatures. It can be harvested early in the months of January to February.

The onion production is primarily for national consumption and is directed to urban consumption centers. The market supply is characterized by two periods of abundance of onion. The first runs from March to May. It corresponds to a period when both onion from the Niayes[8] and onion from the valley can be found in the market. The second goes from July to September. It coincides with the major period of onion harvest in the Niayes.

In order to satisfy an increasingly high demand, with relatively easy mastery of crop growth and management, and with an efficient organization of marketing channels, it is possible to develop the onion value chain in the WN intervention areas. These areas contribute only 5% of the national production (Horticulture Division, 2007). However, onion remains the most cultivated crop there. It represents 23% of harvested vegetable products (see Figure 17). In addition to the national markets and the WN area which are recognized, opportunities may possibly exist with some companies such as Nestle, which might be interested in buying dried onions.

[8] Onion produced by the truck farmers using the Violet of Galmi and Noflaye varieties

Figure 17: Distribution of horticultural production according to crops



Source: Horticulture Division, 2009

Real progress margins are achievable since the yields in these areas are around 8.75 tons / hectares (Dieng, 2008) while the minimum according to the CDH technical standards is about 20 tons / hectare. They are also simple techniques and technologies of production, storage and processing that could enable small producers to produce during high periods of demand in order to take advantage of much higher prices. Moreover, the onion industry benefits from a strong commitment by the government.

8.1.3 GOVERNMENT COMMITMENT TO REDUCE IMPORTS

With a clear intention to decide between the local onion and the onion imported through a dialogue among stakeholders, the Government e has established a procurement regulatory agency. The latter initiated since 2003 consultations on the marketing of onions. Thus, the producers through their umbrella organizations (APOV, AUMN, ANDH[9], UJAK[10], APPN[11], ONAPES[12]), the main importers of onions and commerce organizations (UNACOIS[13] and UNACOIS / DEF), representatives of traders / intermediaries (coxers), consumer associations, as well as the ARM and the government's technical departments (DCI,[14] DCE,[15] DPV,[16] Customs, DH,[17] SAED[18]) were gathered around a table. The discussion initially focused on local production periods and the need for quality onion production with selected varieties to facilitate sales.

Moreover, under the program to develop agricultural markets in Senegal (PDMAS), the Government seeks to strengthen local and regional distribution systems and to improve food security in domestic markets. Thus, the PDMAS intervenes in the onion sector in order to improve market conditions including the establishment of a platform to facilitate harvest collection, storage and marketing. An action plan has been developed to test a SIM model under a pilot activity in the Senegal River Valley area where PDMAS builds commercial infrastructures (depot for example).

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[9] Association Nationale Des Horticulteurs du Sénégal (National Association of horticulturists in Senegal)

[10] Union des Jeunes Agriculteurs de Koyli-Wirnde (Union of Young famers of Koyli-Wimde)

[11] Association des Producteurs Privés de Nianga (Association of private Producers of Nianga)

[12] Organisation Nationale des Producteurs Exportateurs du Sénégal (National Organization of Export Producers of Senegal)

[13] Union Nationale des Commerçants et Industriels du Sénégal (National Union of Industrial Traders of Senegal)

[14] Direction du Commerce Interieur (Directorate of Domesctic Trade)

[15] Direction du Commerce Exterieur (Directorate of External Trade)

[16] Direction de la protection des Végétaux (Directorate of Crop Protection)

[17] Direction de l'Horticulture (Directorate of Horticulture)

[18] Société Nationale d'Aménagement et d'Exploitation des Terres du Delta du Fleuve Sénégal et des Vallées du Fleuve Sénégal et de la Falémél

Due to the number of households involved, because of the market demand, and with the existence of a development potential, the onion value chain seems to be one to de studied in order to improve its competitiveness and increase in a sustainable manner the income level of the actors.

8.2. DRIED MANGO VALUE CHAIN

8.2.1 EXISTENCE OF A HIGH DEMAND

Mango is cultivated in 89 countries with a global production of 26.3 million tons in 2004 (Faostat, 2009). India is by far the largest producer with about 60% of the world's production, followed by Pakistan, China, Thailand, Mexico, Philippines, Brazil, Indonesia and Nigeria.

Nevertheless, the international trade of fresh mango is insignificant compared to its global production of 99% or mangoes are consumed locally or processed.

However, opportunities for export to international markets, especially to countries with a tempered climate, are fully growing. The international demand increases every year, either for fresh mango, dried mango, concentrated or mashed mango.

The processing of mango in the form of dried mango slices is a way of valuing this fruit. It was developed in West Africa since the early 1980s, particularly in Burkina Faso. This country is considered as the pioneer of this food chain. The first drying units were then installed with the support of the Governments and Western NGOs, and by targeting and securing an export market to Europe. As noted by Daniel Dyoma, quality manager at Circle dryers (CDS): "In 1997, he continued, we had ten drying units with about 200 employees and a capital of 150 000 dollars. We now have sixty drying units in the country, 800 actors and a turnover estimated at two million dollars. This is economically important particularly with an inflow of foreign currency of almost because 97% of the production is exported" (Yves and Delouvier, 2006). Despite its deficiencies, (heating without air flow which does not enable uniform drying), the diffusion of the ATESTA dryer enabled to address the channels for dried mango exports.

This expansion was supported by an increase of the demand particularly on the European market and the lucrative prices. The packages of dried mangoes in the some supermarket shelves in the local market are sold around 1,500 CFA Francs per kilo for the second choice and 3,000 CFA Francs per kilo for the first choice. For exports, this price doubles, varying between 6,000 and 7,000 CFA Francs per kilo19. For the organic product channel, the price is around 20,000 CFA Francs per kilo20.

Senegal could follow this example and dramatically improve the competitiveness and profitability of the mango industry by focusing on drying. In fact, mango is a fruit that once it is ripe, cannot be kept for a long time at room temperature. The current management of the sector, lack of organization and infrastructure at the local market are the reasons why over 30% of the fruit harvested in Senegal (USAID, 2006) are lost along the chain without having the possibility to be valued. In high production season, the price of mango in the local market reaches very low levels, thus justifying its processing into dried mango, or possibly into mango jam. The mango processing activity is not enough exploited and remains marginal whereas real opportunities exist.

[19] i.e. 10 Euros per kilo - Source: www.lesprixducoin.com
[20] i.e. 30 Euros per kilo - Source: www.naturable.com

8.2.2 DIVERSIFICATION OPPORTUNITY AND POSSIBILITY OF POSITIONING ON THE INTERNATIONAL MARKET

Mango is a fruit that once it is ripe, cannot be kept for a long time at room temperature. The production season, by region, can be spread from May to October (see Table 12). The current management of the sector, including the lack of processing units, and lack of organization and infrastructure at the local market is that over 30% of fruit harvested in Senegal are lost along the chain with no opportunity to value them (USAID, 2006). In high production season, the price of mango in the local market reaches very low levels.

Table 12: Mango production period according to the various regions in Senegal

Region	May	June	July	August	September	October
Western Casamance	X	X	X			
West Sine-Saloum	X	X	X			
Small Coast Mbour		X	X			
South Niayes		X	X	X	X	X

Source: USAID, 2006

Consequently, drying offers an opportunity to better value harvests. It is an activity that is still marginal whereas real opportunities exist given the level of prices on the domestic market (see Table 13).

Table 13: Indication of the price of mango on the national market (CFA Francs/kg)

Marketing location (site)	Local varieties of mango	Improved varieties – Local market
Near the plot	25-35	50-100
Wholesales in popular markets (Pikine -Thiaroye -Touba)	50	150
Urban wholesalers (Sandiniéry-Tiléne)	-	200
Urban stands and major road corridors	-	400

Source: USAID, 2006

Government enabling policy

In early 2005, the government laid the grounds for an accelerated growth strategy (AGS) of the economy. The mango value chain was chosen as a value chain which could generate growth through job creation, the diversification of rural incomes, the inflow of foreign currency and the recovery of trade imbalance. Thus, it has been working through APIX to create an environment to encourage investment. The investment code and the status of a duty free enterprise offer facilities and benefits to enable investors to improve their competitiveness. The PDMAS in its private irrigation component will develop thousands of hectares in new areas for crop diversification in order to create jobs, supply consumer markets with greater local added value.

The USAID / Economic Growth program in support to the Government of Senegal in its objective of accelerated growth and diversification of agriculture, has already conducted a study on the mango value chain. The analysis of the dried mango value chain falls within that framework.

9. TERMS OF REFERENCE – VALUE CHAIN ANALYSIS

9.1 CONTEXT

In January 2003, USAID/Senegal awarded International Resources Group (IRG) a five-year contract for the provision of long term assistance, as well as other services aimed at supporting the achievement of objectives and results of the AG/NRM program. This contract was renewed in August 2008 for a five-year period.

The program general objective is to contribute to poverty reduction and to sustainable local development, by increasing incomes of rural producers, through the empowerment of local authorities and the promotion of integrated participatory and decentralized management of resources.

The program applies a private sector/enterprises development approach based on decentralized policies for better local governance. This approach conducted with the local populations collaboration, aims at intensifying and diversifying the agricultural production systems, and improving natural resources management.

A new agriculture component was put in place under the second phase of the AG/NRM program. In conformity with the USAID/Wula Nafaa Project approach, (nature, wealth and power) the global objective of this component is to improve agricultural production and the access to markets in order to fight against food insecurity. Thus, following the horticulture assessment in the WN intervention zone, this study using the « value chain approach », was funded regarding onion and dried mango in order to increase their productivity and competitiveness in relation to the demand of consumption markets.

9.2 OBJECTIVES OF THE STUDY

The objective of the study is to conduct a detailed analysis of the onion and dried mango value chains in the WN intervention zone, and to make clear recommendations for strategic initiatives which will enable to increase productivity, efficiency and profitability of the value chains in order to strengthen their competitiveness over time.

In priority, this study should provide specific information on the structure and operation of the value chains at the level of the WN intervention zone and at the national level (products description, quality, prices, actors, behaviors of various actors).

The study should also provide detailed information on the demand characteristics, and clearly indicates how the market opportunities can be capitalized by the BDS development for the onion and dried mango value chains.

The value chains analysis will provide as much as possible the maximum of specific information on the local markets, the national market and eventually the international market through literature review , field visits, interviews at the level of national development organizations, government's departments, etc..

The analysis will be coordinated and monitored by an internal team of the project.

9.3 THE CONSULTANT'S TASKS

The consultant will work under the supervision of the Head of the Agriculture component of the USAID/Wula Nafaa Project.

The activities under this analysis are as follows:

9.3.1 LITERATURE REVIEW

The tasks at this level will consist of:

- Discussing with the internal team the main aspects to be covered, the expected results, and the definition of the main themes of the study in relation to the value chain approach
- Review existing studies and reports available in the sector ; the secondary sources, the results, the recommendations as well as the strategic approach to establish the value added sequence and the characteristics of the market demand in relation to the value chain analysis
- Establish a list of reference documents, and studies on onion and dried mango
- Identify additional information needs in order to proceed with the value chain analysis.

9.3.2 FIELD WORK

The consultant shall:

- Meet with the main actors, i.e., producers and producers' groups, rural and urban *coxers ,bana-banas* for the onion value chain and planters, plants producers, producers' professional organizations (Association des Producteurs de Mangues de la Zone des Niayes, Association des Unions des Maraîchers des Niayes, etc.), processors' professional organizations(Transfruleg, Fédération Professionnelle de l'Agro Alimentaire, etc.), main projects and programs, and NGOs
- Proceed with a detailed and analytical analysis of the local availability of onion and dried mango, and the competition with the other production zones and eventually the imports
- Review the practical techniques at the production level (agronomic, harvest and post-harvest practices including preservation), processing, marketing channel), and conduct an analysis relating to the characteristics of onion and dried mango in relation to the demand of each segment and of the market
- Establish a map geographically locating each segment of the value chain, the volume and the commercial flows
- Gather information on the market opportunities which can sustain upstream investments in order to increase productivity and the incomes of the value chain actors and promote an improvement of the competitiveness ; analyze the constraints for preventing to benefit from the opportunities
- Analyze the place and importance of the target product in the exploitation zone in relation to other crops in terms of profitability and development potential
- Contact research/development departments and organizations working on the targeted product and analyze the results in terms of competitiveness improvement and profitability of the onion and dried mango value chains

9.3.3 MARKET STUDY

The consultant shall:

- Study the specific characteristics (prices, quality, availability over time, etc.) of onion and dried mango in relation to the demand and in comparison with other competing products coming from the other production zones or from production and /or import countries
- Identify how onion produced in the WN intervention zone, and dried mango can be positioned in order to increase its share of the market
- See whether there is an opportunity to conduct a market study at the national and international levels for these value chains.

9.3.4 ANALYSIS AND VALIDATION OF THE VALUE CHAIN

The consultant shall:

- Conduct a value chain analysis and identify the major constraints which, once resolved, would enable a sustainable improvement of the value chain competitiveness
- En relation to the constraints, identify and describe the short term strategic interventions promoting the value chain competitiveness
- Prioritize these interventions according to their likelihood for success
- Draft a report and discuss the proposals with the project team ultimately responsible for validating the final document among the actors and partners
- Present the study results during a first restitution meeting
- Propose an action plan for the implementation of other steps of the study
- Finalize the report taking into account all the observations made by the project team.

9.3.5 THE CONSULTANT'S SPECIFIC TASKS

The consultant shall:

- Design and propose data collection tools to other members of the team for validation
- Design and propose a summary of the final report to other members of the team
- Develop the Terms of Reference (TOR) of the workshop for the study start-up with the key partners of the value chains
- Develop the TOR of the validation workshop with the key partners of the onion and dried mango value chains
- Contribute to the conduct of surveys and data collection related to the onion and dried mango value chains
- Establish the operating accounts of the actors of the onion dried mango value chains, and consolidate the operating accounts of the zone under study
- Gather the data collected and verify their validity
- Facilitate the organization of meetings
- Draft the final report

9.3.6 DELIVRABLES

Deliverable 1: Work Plan

A planning with the work steps proposed by the consultant, their implementation deadlines and a planning for drafting the study report, -- is proposed by the consultant

Deliverable 2: Preliminary report of the study

This document will include the description and presentation of the onion and dried mango value chains as well as their analysis in conformity with the guideline note. This report should be well organized, clear and pragmatic in terms of objectives and recommendations.

Deliverable 3: Final report of the study

After the restitution, the consultant will provide a final report which will take into account the recommendations and comments.

9.3.7 THE CONSULTANT'S QUALIFICATIONS AND DURATION OF THE STUDY

The consultant must have the following skills:

- An experience in value chain analyses
- A good capacity of economic analysis particularly the reconstitution of the chain global value added and its distribution
- A good knowledge of onion and dried mango value chains in Senegal
- An experience in working with the value chains' actors cited above
- A capacity to draft a report in French

ANNEX 1.THE HOUSEHOLDS VULNERABILITY CATEGORIES

Considering that self-sufficiency agriculture is only an income among others for the majority of the rural populations, the vulnerability was estimated from all levels of households. The relative 'importance of these different sources of incomes, an important factor of the households' capacities to face shocks and crises, was also taken into account.

This approach enabled to classify the households into four categories with a different vulnerability level according to the level of incomes and assets.

Table 14: Households Vulnerability Levels

Category	Level and profile of income
Very vulnerable	These households have very low and not too diversified annual money incomes (135,000 CFA Francs). The cereals production is low compared to the other groups, with little cash crops and truck farming. The cattle represent a potential income, and constitute three times as much as the households' annual incomes. These households are not in permanent food insecurity, but the fact that they do not have cattle to face shocks and crises makes them very vulnerable.
Moderately vulnerable	This group has a profile of income comparable to the very vulnerable group (money income of about 250,000 CFA Francs) but the money incomes level, agricultural production and livestock are at a much higher level, which enable these households to better face shocks. The money incomes are also more diversified than in the first group. These populations can become vulnerable in case of a disturbance of average duration.
Little vulnerable	These are the households that have sufficiently important money incomes (450,000 CFA Francs on average), but also important cattle or an important agricultural production. These populations are little vulnerable because they have enough capacities to face crises.
Not vulnerable	An important money income (1,200,000 CFA Francs on average) or a stock of cattle much more important in value or a very important production of cash crops. These populations have developed very efficient survival strategies.

ANNEX 2. PRELIMINARY ANALYSIS OF THE WATER COST

As noted above, a major constraint for increasing irrigated horticultural production in the WN intervention zone is the low capacity of drainage and water distribution. Any pump capable of providing higher flow rates than the traditional system of the dipper will increase the irrigated area and reduce work time, which will lead to increased production. In Senegal, a study conducted in the early 1990s on 70 owners of treadle pumps showed that these operators were saving an average of 7.5 hours per person per day compared to traditional methods of drainage and water distribution. This time savings allowed owners of treadle pumps to enlarge the size of their garden to about 39% and reach 4600 m2.

The question is which improved method - the treadle pump or motor pump - is more cost-effective for these areas which the treadle pump is able to irrigate. Assuming that both pumps will allow a similar increase in production on the areas which can be watered with the treadle pump, this section will show which of the two types of pump will enable the cheapest water supply and maximize as much as possible the net income of horticulturists.

The comparison of the pumping costs between the treadle pump and a motorized pump of Chinese brand, available on the market, and presented below, is based on gardens of 0.5 ha.

General Assumptions

The general key assumptions to conduct this comparative cost analysis are:

- 80m3 of water per hectare per day, or 40 m3 per half-hectare;
- 180 days of irrigation per year;
- 14,400 m3 per hectare per year, or 7,200 m3 per 0.5 ha.

Assumptions for the treadle pump

- The treadle pump is operated by 2 individuals and can get 6 m3 per hour. While one person operates the pump, the other directs the water to different parts of the field. Hence, 6.6 hours of work are needed for 2 individuals paid 155 CFA Francs per person per hour to irrigate 0.5 ha of vegetables. The total labor cost is 2,046 CFA Francs, therefore 51 FCFA per m3.
- The treadle pump with 30 m of PVC pipe costs about 70,000 CFA Francs with an expected lifespan of 6 years for the irrigation of 0.5 ha. Therefore, if one considers the annual depreciation of 11,700 CFA Francs and 7,200 cubic meters of water pumped annually, the depreciation cost per cubic meter is 1.6 FCFA Francs.
- Based on previous experience in Senegal, we estimate that spare parts and repair costs will rise to 3,500 CFA Francs or 0.5 FCFA per cubic meter, and lubricants will cost 13,500 CFA Francs per year or 1.9 CFA Francs per cubic meter. Therefore spare parts, repair costs and lubricants will cost a total of 2.4 CFA Francs per cubic meter.

Assumptions for the motor pump

- Only one person is required to operate the pump with a flow rate of 10 cubic meters per hour. Almost all the working time of the individual is devoted to direct the water pumped to various parts of the irrigated field. Therefore, 2 hours of work are necessary for a person at a rate of 155

CFA Francs per person per hour to irrigate 0.5 ha of vegetables. The total cost of labor is 620 CFA Francs, i.e. 15.5 CFA Francs per cubic meter.

- The pump with 6 m aspiration hose and 30 m of distribution pipe cost a total of 200,000 CFA Francs and has a lifespan of 2 years if irrigating 0.5 ha of land. Therefore, assuming an annual depreciation of 100,000 CFA francs for 7,200 cubic meters of water pumped per year, the depreciation cost per cubic meter will be 13.9 CFA Francs.
- Spare parts and repair costs are approximately CFA 50,000 CFA Francs per year i.e. 6.9FCFA Francs per cubic meter.
- The pump consumes 0.5 l fuel per hour with 680 CFA Francs per liter for 4 hours of work per day. So we spend every day 1,360 CFA Francs or 34 CFA Francs per cubic meter. The consumption of lubricants is 1 liter to 50 hours of pump operation at 1,400 CFA Francs per liter, that is to say, 61.6 FCFA CFA Francs per day or 1.5 per cubic meter.

Based on these assumptions, we can say that the treadle pump is very competitive compared with the motor pump because the cost of 1 cubic meter of irrigation water of 0.5 ha with a motorized pump amounts to 71.8 CFA Francs per cubic meter against 55.2 CFA Francs per cubic meter for the treadle pump.

However, one major advantage of the treadle pump compared to the motor pump is its low price (about 1 / 4 of the motor pump's price), which enables to overcome the main obstacle for small farmers who wants to get an improved drainage equipment. Thus, treadle pumps become available among a larger number of horticulturists who could not otherwise buy a pump, and with this one, increase the size of their farm. In addition, while over 90 percent of the cost of the water supplied by the treadle pump is for labor with a limited amount on hardware, more than 78 percent of the cost of water from the motor pump is for imported items such as fuel, oil and equipment. Therefore, the treadle pump has a clear economic advantage e compared to the motorized pump.

These same comparisons are presented in Table A2 below for fields of 0.33, 0.66 and 1 ha.

Table 15: Comparative costs of the pumper water (in CFA Francs/m3)

Costs	PP (0,33 ha)	PP (0,50 ha)	PP (0,66 ha)	PP (1 ha)	MP (0,33 ha)	MP (0,5 ha)	MP (0,66 ha)	MP(1 ha)
Labor	51.2	51.2	51.2	51.2	15.5	15.5	15.1	15.5
Depreciation								
1 year								13.9
1,5 years							13.8	
2 years						13.9		
2,5 years					16.8			
3 years								
4 years				1.2				
5 years			1.5					
6 years		1.6						
7 years	2.1							
Spare parts and repairs	0.5	0.5	0.5	0.5	6.9	6.9	6.9	6.9
Oil	1.9	1.9	1.9	1.9	1.5	1.5	1.5	1.5
Fuel	0.0	0.0	0.0	0.0	34.0	34.0	34.0	34.0
TOTAL	55.7	55.2	55.0	54.8	74.7	71.8	71.7	71.8

PP = Treadle Pump MP=Motor pump

For comparison purposes, without considering depreciation costs of the rope and the bucket used in the case of the dipper, the irrigation cost of 0.5 hectares with vegetable using a dipper is approximately 155 CFA Francs/m3, i.e. almost three times more than the irrigation cost with treadle pump. These high irrigation costs largely explain the high price of vegetables grown during the dry season. The use of the treadle pump will make gardening producers more competitive in the WN intervention zone.

ANNEX 3: FINANCIAL ANALYSIS OF IRRIGATION

In Senegal, a thorough assessment indicated that the increase in net annual incomes, which is attributable to the adoption of the treadle pump in the Niayes, totaled more than $ 700 per truck farmer, in other words, the profitability of investment was nearly 1,000 percent, just for the first year, while the unit's lifespan averages six years. The interest for investment is then clear, even if one accepts, in this case, the most conservative assumptions. It is estimated that the truck farmer in the WN intervention who adopts the treadle pump, will increase his net annual income by 227,000 CFA (see computations below in Table A3).

In addition, the following computations show the differences between the irrigation with dipper, the irrigation with a treadle pump and the irrigation with a motor pump for small commercial onion producers and the differences between those who have family labor and those who have less or not at all.

Table 16: Cost analysis of various pumping technologies for onion production

	Dipper	Treadle Pump	Motor Pump	Assumptions
Water drainage capacity (liters/second)	0,6	1,7	5,5	At least 4,5 meters deep, 2 workers for rope and bucket and treadle pump, 1 motor pump
Water drainage capacity (liters/day)	21.600	61.200	198.000	Work day of 10 hours
Probable irrigated area (ha)	0,10	0,20	1,0	80,000 liters/day/ha required
Onion production (tons)	1,0	2,4	10,0	10 tons/hectare
Income (CFA Francs)	170.000	408.000	1.700.000	170 CFA Francs for the kg of onion bought from the truck farmer
Initial cost of drainage equipment (CFA Francs)	1.000	70.000	200.000	
Total water cost per campaign (CFA Francs)	223.200	158.400	1.033.900	See computations presented in Annex 2
Total water cost with unpaid own labor and family labor	1.000	13.000	810.700	Labor is family labor (this is usually the situation in the WN intervention zone) and is therefore not paid
Net income of irrigation per campaign with own labor (CFA Francs)	169.000	395.000	889.300	Labor is not paid
Net income per m^2 (CFA Francs)	169	198	89	

For those who have enough money, land and water available, a motor pump is the most profitable investment to ensure water supply for truck farming. But, since the price of a motor pump is largely unaffordable for the vast majority of truck farmers in the WN intervention zone, and its management problematic for a producer who is used to a much smaller enterprise which requires less liquidity and the ability to manage production and marketing, the treadle pump is the best investment for most small producers. Furthermore, you clearly see that the net income per square meter of the treadle pump is more than twice higher than the motor pump. In other regions of Senegal, the treadle pump has also been the first technology for truck farmers who started humbly and whose incomes rose thereafter to the

point where they could buy one or many motor pumps. In addition, for the small producers who do not have more than one hectare of land available or where water supply is limited (given the wells' recharge rate) and work their own plot rather than resorting to paid labor, the pump provides little additional value and, in this case, the treadle pump is the most efficient use of investment funds.

ANNEX 4: ACTIVITIES OF THE ANNUAL WORK PLAN CORRESPONDING TO THOSE PROPOSED BY THE HORTICULTURE SECTOR ASSESSMENT TEAM

Objective 1: Increase of the agricultural productivity and production **Result 1. Water management systems improved or created**
Planned activities
To introduce agricultural and NRM practices for the development of farms
To train the producers in cultivation techniques

Objective 1: Increase of agricultural productivity and production **Result 2. An agricultural and animal production improved**
Planned activities
To conduct a Value Chain Analysis of key products
To identify key horticultural products by region (according to their importance in quantity) and develop TOR for Value Chain Analysis
To contract with the consultant in charged with the study and conduct value chain analyses
To organize a restitution
To introduce the best practices for key targeted products (maize, millet, sorghum, fonio, rice)
To identify promising techniques (including Conservation Farming) and develop crop management sequence techniques by key products (including fonio)
To develop a strategy to disseminate the crop management sequence techniques, in linkage with the ANCAR / CLCOP action plans
To share and train the technical agents in the mastery of these crop management sequence techniques
To implement and monitor the dissemination among the farmers (demonstrating farmers, demonstration plots)
To promote the multiplication and distribution of improved seeds varieties (rice, maize, millet, sorghum)

Objective 1: Increase of agricultural productivity and production **Result 2. An agricultural and animal production improved**
Planned activities
To develop a strategy to improve the dissemination of improved seeds (farm level preservation, private sector)

Objective 1: Increase of agricultural productivity and production **Result 3. A better integration in the production market of small producers for a certain number of key commodities**
Planned activities
To put in place services for improving the yields and supporting the market
To assess the market (supply, demand) of some opportunities and test the market for new products(through demonstrations) : hulling-machines, plowing, treadle pumps / truck farming drilled wells, private nurseries (fruit trees , truck farming)
To identify promoters and train them (business, technique)
To help in the development of their business
To develop market linkages
Based on the Value Chain analysis, to share with producers information on the prices fluctuation and the pricing mode
To work with the local financial institutions to improve the access to credit for producers
To establish typical operating accounts by product showing the activity profitability
To develop borrower – bank / MFI linkage (including involving the Producers' Organizations)

Objective: Promotion of principles based on a sound market/Implementation of a sound agriculture and a food policy **Result 1. More rigorous conformity with the rules related to the production and use of technologies by small producers**
Planned activities
To conduct training on the mastery of the use, the appropriate rules and regulations of techniques and technologies to serve agriculture
To implement the plan (including training on the rational use of crop protection products and chemical and natural fertilizers)

ANNEX 5: DETAILED BUDGET OF PROPOSED HORTICULTURAL ACTIVITIES (IN 000 CFA FRANCS)

	Unit Cost	Units	Year 1		Year 2		Year 3		Year 4	Total
Staff										
A. Local field staff										
1. Facilitators										0
B. Supervision										
1. Coordinator (Laurent Gomis)										0
2. Agricultural Advisor (Patrice Beaujault)										0
Sub Total Staff			0		0		0		0	0
Travel										
Description										
A. Air fares										
1. Intraregional	450	10	4.500	0	0	0	0	0	0	4.500
B. Per Diem										
1. Transit	10	10	100	0	0	0	0	0	0	100
2. In Senegal										
- Short term consultants (international)	30	300	9.000	0	0	0	0	0	0	9.000
- Long term consultants (national)	30	720	21.600	1.080	33.372	1.080	34.373	1.080	35.404	124.749
C. Miscalleneous										
1. Visas	297	0	0	0	0	0	0	0	0	0
2. Transit expenses (taxis, tips, etc.)	50	8	400	0	0	0	0	0	0	400
3. Car rental	75	0	0	0	0	0	0	0	0	0
Sub Total Travel			35.600		33.372		34.373		35.404	138.749
Consultants										
Description/rate										
1. Trainer manufacture cture/use of the dryer (R Tchana)	297	2	594	0	0	0	0	0	0	594
2. Trainer pump manufacture pump (L Zongo)	297	2	594	0	0	0	0	0	0	594
3. Trainer manufacture and installation of the drilled-well (O Abdou)	297	2	594	0	0	0	0	0	0	594

4. Trainer nursery and fruit production (A Kovarik)	900	2	1.800	0	0	0	0	0	0	1.800
5. Trainer supply chain (T Munro)	1.650	2	3.300	0	0	0	0	0	0	3.300
6. Local trainer vegetables production (M Thiam)	400	3	1.200	6	2.472	6	2.546	6	2.622	8.840
7. Local trainer pump manufacture (Kelountang Sagna)	400	3	1.200	6	2.472	6	2.546	6	2.622	8.840
8. Local trainer manufacture and installation of the drilled-well (To be determined)	400	3	1.200	6	2.472	6	2.546	6	2.622	8.840
9. Local trainer nursery and fruit production (TBD)	400	3	1.200	6	2.472	6	2.546	6	2.622	8.840
10. Facilitators	400	24	9.600	24	9.888	24	10.184	24	10.490	40.162
Sub Total Consultants			21.282		19.776		20.369		20.980	82.407
Other Direct Costs										
Item/Quantity										
A. Training pump manufacturers	125	2	250	2	257	2	265	2	273	1.045
B. Training drilled-wells installation	75	2	150	2	154	2	159	2	163	627
C. Training dryer manufacture	300	1	300	1	309	1	318	1	327	1.255
D. Training vegetables production (inputs)	50	100	5.000	100	5.150	100	5.304	100	5.463	20.918
E. Training production of fruit tree plants	225	10	2.250	10	2.317	10	2.387	10	2.458	9.413
F. Training supply chain	3.855	0	0	0	0	0.00	0	0.00	0	0
G. Promotion	3.855	1	3.855	1	3.970	0,75	3.067	0,50	2.106	12.999
Budget facilitators motor bikes, including depreciation	125	24	3.000	24	3.090	24	3.182	24,00	3.278	12.550
Budget moto local consultants motor bikes, including depreciation	125	12	1.500	24.0	3.090	24	3.182	24,0	3.278	11.050
Sub Total Other Direct Costs			16.305		18.339		17.866		17.349	69.860
Total Direct Costs			73.187		71.487		72.609		73.734	291.017

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