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Agriculture Management Plan for Small Scale Farmer in Senegal : Case of Rice and Peanut Cultivation

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ABSTRACT
Senegal is one of the best located and stable country in West Africa. It is bounded in the western part by the Atlantic Ocean (about 500 km of beach). Senegal belongs to the Sahelian Countries which is characterized by a long dry season (about 7 to 9 months) and a low rainfall. In this work our objective is to propose the best management plan for the small scale farmer specialized in peanut and rice cultivation by using the farm management index. Country data related human power (working day/hour, total working time per year), performance test of machine (field efficiency, Theorical and actual field capacity etc …), variables cost (labor cost, seed cost, pesticide cost, fuel cost, etc…) and to fix cost (machine cost, repair and maintenance cost, tax and others tax cost, etc…) are using for the calculation of the net profit for farmer in case of rice and peanut cultivation. For rice cultivation system, our result show that for the actual situation of rice cultivation based generaly on hand tools and draft animale, small farmer have a negative profit (-27 US $) when they cultivated an area almost egal to 0,5 ha. The result of the four cases of simulation (**case 1** : 60% subsidence for draft animal; **case 2** :60% subsidence for draft animal and intrant; **case 3** : Introduction of small power tiller and **case 4** : hiring tractor) show that the case 4 give the highest profit compared to the other cases. But when farmer cultivate more than 2 ha of land, the case 3 can provide more profit (286 US $) than case 4 (58US $). For this reason, a good chance for the farming system on rice cultivation in Senegal can be obtained from the case 3 (introduction of small power tiller) which can be proposed for the best farm management plan for rice cultivation for small farmer in Senegal. For peanut cultivation system, our result show that for the actual situation of peanut cultivation, small farmer still have a positive profit (261 US $) when they cultivated almost egal to 1 ha of land. From the simulation of four cases **(case 1** : 60% subsidence for draft animal; **case 2** : 60% subsidence for draft animal and intrant; **case 3** : Introduction of small power tiller and **case 4** : introduction of a small power tiller + 60% subsidence for draft animal and intrant), the case 3 give the highest profit (355 US $) compared to the other cases. It means, the introduction of small power tiller can reduce labor cost, can increase farmer's land size and can provide to farmer more income. For this reason, a good chance for the farming system on peanut cultivation in Senegal can be obtained from the case 3 (introduction of small power tiller) which can be proposed for the best farm management plan for peanut cultivation for small farmer in Senegal. According to the results of these simulations, it can be said that the using of small scale power tiller can be increase farmer's income in case of rice and peanut cultivation in Senegal. Other similar studies applied to other crops such as maize, cowpea, etc. should be carried out in order to complete the database of the agricultural management index that makes it possible to make decisions of change in the cropping system in order to maximize the profit of the small scale farmer in Senegal.

Keywords: Small scale farmer, Management plan, Mechanization, Peanut, Rice, West Africa, Senegal

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I. GENERAL INFORMATION

1.1. Area-Cultivated area

The Republic of Senegal is one of the best located country in West African Region. It is located between the 12 degree 30' and 16 degree 30' of latitude North and 11 degree 30' and 17 degree 30' of longitude West. It is bounded in the Northern part by republic of Mauritania, the Eastern part by the Republic of Mali, the Southern part by the Republic of Guinea and Guinea Bissau and the Western part by the Atlantic Ocean (500 km of beach). The Republic of Senegal has 196722 Km^2 from which 20% can be used for crop production. The area cultivated is almost 2.3 million hectares representing 61% of the cultivable area and 11% of the total area (UNDP, 2012).

1.2. Climate

There are four climatic regions in Senegal :

- The Sahelian region in the North, where annual rainfall is about 250 to 500 mm ;

- The Sub-Sahelian in the Centre, annual rainfall is about 500 to 900 mm ;
-The Soudano-Sahelian in the South Centre ad South East, where the annual rainfall is 900 to 1100 mm ;
- The Soudanian and South-Guinean in the South where annual rainfall is over than 1100 mm.

The territory of Senegal is characterized by a flat relief. There are three major types of winds : maritime « Alize », drought and hot wind called « Harmattan » and the monsoon.

1.3. Population

According to the last results of 2013 National Census the population is estimated about 13, 508,715 inhabitants. The main density is 69 hbt / km^2. It is a young population (42.0% are under 15 years), dynamic with a growth rate of 2.7% per year. In this population, 54.8% is rural and 45.2% in urban areas. The population of Senegal increase day by day and it will reach 25.7 million inhabitants by 2035 (ANSD, 2016).

The results of the 2013 census show that the population of Senegal is unequally distributed over the territory. The western and central parts of the country concentrate more than half of the population and still today, the phenomenon of macrocephaly of the capital still persists. The department of Pikine have 1,170,791 inhabitants, Dakar 1,146,054 and Mbacké 929,765 are distinguished by their strong concentrations (ANSD, 2016).

Women represent almost half of the population and the majority of them live in rural area. The main ethnic groups are : Wolof, Serere, Pulaar, Diola, Sarakolé, etc…

1.4. Agriculture

1.4.1. Crops

Much of Senegal, a stable country in West Africa, lies within the drought-prone Sahel where rainfall is irregular and soils are of poor quality. Senegal's food security relies on rainfed agriculture, highly vulnerable to climatic variations and food price volatility. It is a net food importer and second largest importer of rice in Africa. Agriculture employs around 75% of the working population and comprises 13% of GDP. Groundnuts (40% of cultivated land) and cotton (33%) are the main export commodities while millet, maize, sorghum and rice are the main staple crops, grown by a majority of resource-poor smallholder farmers (ICRISAT, 2015).

Only cereal and tuber/root yields in Senegal have has a growth rate of more than one per cent.

Specifically, cereal yields, fruit yields, oil crop yields, and tuber/root yields grew by 2%, 0%, 0%, and 2%, respectively. Tuber/root yields and fruit yields experience a sharp increase in the early 2000's, but almost half of that increase disappeared a few years after. Cereal yields and oil crop yields experienced multiple fluctuations over the years. However cereal yields have kept an upward move while oil crop remained constant.

1.4.2. Soils

In Senegal there are in general three main types of soils :

- Sandy soils,
- Clay-sandy soils,
- And clay soils.

A growing population and land intensification have caused overexploitation of natural resources and land degradation (soil erosion, salinity of soil and acidity of soil), impairing both agriculture productivity and ecosystem services. The country's forests are declining at a rate of approximately 45,000 ha per year (CIAT; BFS/USAID. 2016).

1.4.3. Irrigation and drainage system

Water source : The surface water comes from four major catchment basins: (i) Senegal, (ii) Gambia, (iii) Anambé-Kayanga, and (iv) Casamance. The development undertaken under the Senegal River Development Organization (OMVS) provided a basis for electricity production (Manatali Dam) and irrigated farming (about 60,000 ha developed). The irrigable potential exceeds 200,000 ha, but has to be limited given the conditions for operation of the common structures envisaged by OMVS. The irrigation potential in eastern Senegal is estimated at about 9,100ha. The Casamance River is a veritable extension of the sea carrying a heavy concentration of salt that invades the adjacent land. There are other similar zones seriously deteriorated, in Siné-Saloum. The total volume of runoff water is estimated at 140 m^3 yearly, and part of it is controlled.

The country's water table potential (under water and surface) is in the order of 450 to 600 billion m^3; the annual recharge rate is estimated at 3-4 billion m^3, while the collection rate is between 150 and 200 million m^3 yearly. The irrigated crops are often grown as a supplementary activity around drinking or stock water points.

Crops produced by irrigated farming: The irrigated crops are divided into two groups: (i) cereal production, with rice dominating, and some experiments concerning corn and sorghum (in Middle and Upper Senegal River Valley); and (ii) horticultural crops, with onions and tomatoes covering the largest areas. Also to be considered is the recently emerging planting of sweet potato around Lac de Guiers and in the north. Irrigated cereal production covers the greater part of the developed areas; It is concentrated in the Senegal River Valley, accounting for approximately 65% of the production and 40% of the area under crops. Market gardening, which tends to fall into clear geographical areas, is carried out in the Niayes, (63

% of the production), along the Senegal River, (22% of the production), and in the Thiès and Kaolack regions (15 %, particularly watermelons). The fruit production is spread over the country, but concentrated in Lower and Middle Casamance, which account for 54 % of the production.

About 80 percent of all rice production is irrigated with flood irrigation (108 000 hectares), and approximately 60 percent of vegetable production is irrigated (16 000 hectares). However, much of this irrigation occurs on the same land. Sugarcane is fully irrigated. The irrigation installed for commercial rice production is used for vegetables as a second annual crop, while some vegetables under irrigation are double-cropped.

1.4.4. Agricultural production systems

The country is divided into six agro-ecological zones (AEZs) based on biophysical and socio-economic characteristics. Although most crops are grown across the country, some are more dominant than others in the zones of the River Valley (irrigated rice, vegetable growing); Niayes (80% of the horticulture produced in the country); the Groundnut Basin (groundnuts, millet); Silvo-Pastoral zone (livestock); Eastern Senegal and Upper Casamance (rainfed rice) and Lower Casamance (rainfed rice).

1.4.5. Land preparation

Tillage is generally done in dry conditions. These are plowing, harrowing and farrow (Kanté, 1995).

Plowing is done with plows at varying depths, in dry condition, in mechanization by engine, or after draining water the soil become dry and animal traction can be used. Its demand for energy and its high costs are its major disadvantages. The peasants of the middle valley still practice it in harnessed cultivation. The plowing is used to control weeds, bury residues plants and to obtain a crop profile favorable to root development plant.

Harrowing, in one pass, is the most widespread. The dissemination of the broadcasting method, less demanding in land preparation, in replacement of line sowing, has enabled to reduce the number of passages, to eliminate the plowing. Nearly all cultivated areas are prepared in dry conditions between January and March for hot dry season cultivation, and in June and July for the rained season. The opportunity to work in other soil condition (wet, muddy), a parcel size reduced, led to the introduction of new techniques for the land preparation of complement or replace existing ones.

Furrowing is practiced on irrigated perimeters cultivated in tomatoes, maize and peanuts. It consists in forming ridges and furrows which allow the gravity irrigation and avoid the contact of the water with the collar and the fruits of certain plants sensitive to stagnant water. It follows a plow or a passage of harrow.

II.POLICY OF AGRICULTURAL MECHANIZATION

The aging of the agricultural equipment park, mentioned in the work of some authors such as Sow (1995), Précheur (2012) and Sarr (2013), constitutes a major constraint to the development of agriculture. Some materials such as hoes and seed drills were received by farmers during the agricultural program denoted in French ‘’ Programme Agricole (PA) from the 1958 to 1980 agricultural program (AP) “and have never been renewed.

This aging of the agricultural equipment park has been taken into account in the current agricultural policy by Government of Senegal, which has set up in 2012 an important system for the supply of farming equipment (draft Animal, Engine and Post harvester machine) for the modernization of Senegalese agriculture. This mission was entrusted to the Ministry of Agriculture and Rural Equipment (MAER) through the Direction of the Modernization of Rural Equipment (DMER). It concerns the PRACAS program financed by the State of Senegal with 5 billion Fcfa per year for at least 5 years and the Maïs Alimentos program financed by the Brazilian Federal Republic for 42 billion Fcfa (DRDR/Kaolack, 2016).

III.AGRICULTURE MANAGEMENT INDEX PROPOSED

It can be said that the introduction of Agriculture Management Index which is a socio-economic tool can permit to calculate the Break-Even Point (BEP) which studies the relationship between total fixed costs, total variable costs and returns.

Generally in Senegal, no studies on the economic analysis of mechanization based on Agriculture Management Index were done. That is why farmers get always not profit without knowing it. For this reason, we try to use the Agriculture Management Index which has many success in Japan in order to apply it to the Senegalese agriculture.

In this work our objective is to propose the best Agriculture Management Plan for the small scale farmer specialized in Peanut and Rice by using the farm management index.

3.1. Present Agricultural index for rice cultivation system in Senegal

3.1.1. Cultivation management for rice cultivation

Table 1: Cropping time for rice cultivation in Senegal

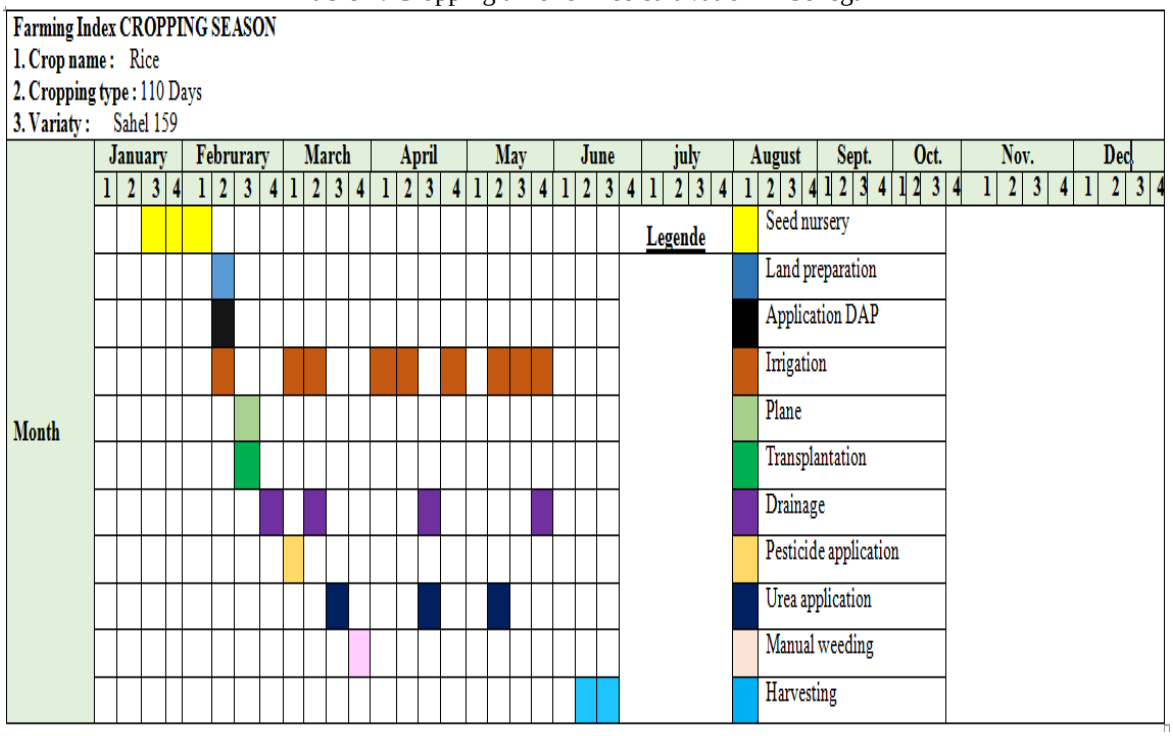

Table 2 : Total cost, income and profit provided by the initiale case for 0,5 ha of rice cultivation in Senegal

Income

Income		
Shipping (Kg)	**Unit price (US $)**	**Total (US $)**
1500	0,25	**375**

Content

Content			Expense (US $)
Fix cost		Machine	102,76
		Other managing cost	0,00
		Landrecramation cost and Irrigation charge	0,00
		Rental cost	0,00
		Taxes	0,00
		Maintenance cost	0,00
		Insurance	0,00
		Total	102,76
Variable Cost	Labor cost	Family labor	113
		Hired labor	45,50
		Total	158,34
	Shipping	Materials	140,81
		Commission	0,00
		Other cost	0,00
	Rental land charge		0,00
	Others		0,00
	Total		**299,00**
Total Cost			**402,00**
Selling income			**375,00**

Profit	**-27,00**
Family income	86,00

The figure below show that the break-even point for 0,5 ha of rice cultivation. Using 0,5ha, the break-even point is (0,7 ha ; 525 US $). It means that :

- if farmer cultivated below 0,7 ha ; in this case farmer will not get profit ;
- if farmer cultivated upper than 0,7 ha ; in this case farmer will get profit.

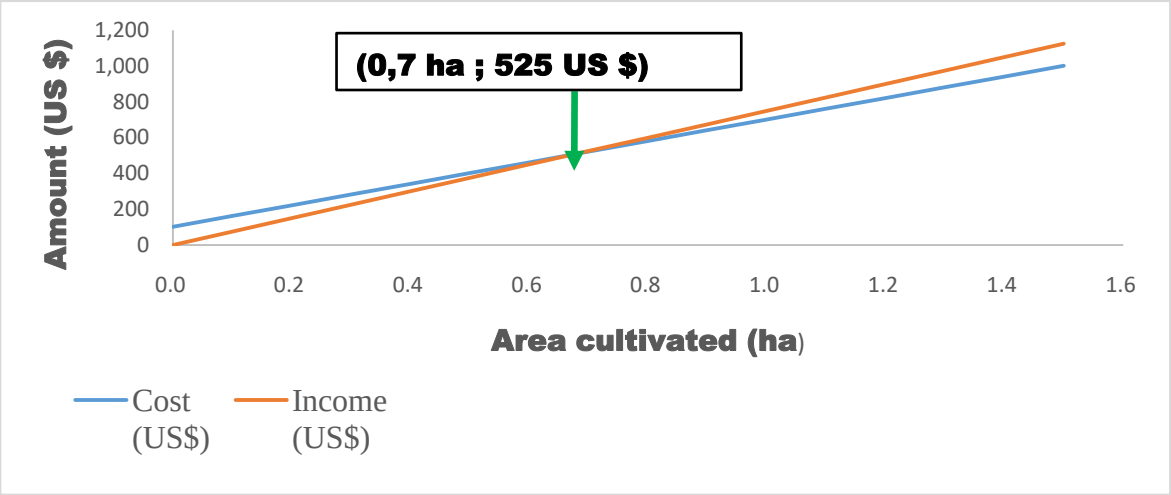

Figure 1: Break-Even Point for actual rice cultivation system by small scale farmer in Senegal

3.1.2. Simulation of Rice cultivation in Senegal (Minimum 4 cases)

Table 3: Profit of the four cases of simulation compared to the profit of the initiale case in case of 0,5 ha of rice cultivation

Case	Type of Simulation	Area used (ha)	Fix cost (US $)	Variable cost (US $)	Income (US $)	Profit (US $)	BEF (ha; US $)	Profit compared to Initiale Situation (US $)
Case 0	**Actual Situation**	**0,5**	**102,76**	**299,15**	**375**	**-26,91**	**(0,7; 525)**	**0**
Case 1	**60% Sub Draft Animale**	**0,5**	**83,75**	**299,15**	**375**	**-7,9**	**(0,5 ; 375)**	**19,01**
Case 2	**60% Sub (Draft Animale+Intrant)**	**0,5**	**155,27**	**626,45**	**375**	**-406,72**		**-380**
Case 3	**Introduction PT**	**0,5**	**171,37**	**260,61**	**375**	**-56,98**	**(0,8 ; 600)**	**-30,1**
Case 4	**Hiring Tractor**	**0,5**	**75,5**	**341,86**	**375**	**-42,36**	**(1,3 ; 975)**	**-15,5**

From this table, our results show that case 4 is the best profil farm management plan for rice cultivation in Senegal compared to the others cases. But when we compared it to the case 3 when farmer cultivate more than 2 ha, we find that the case 3 can provide more profit than case 4 as respectively a profit of 286 US $ for case 3 and a profit of 58 US $ for the case 4. For this reason, we choice case 3 for the best proposed farm management plan for rice cultivation for small farm in Senegal.

3.1.3. Best Farm management plan for rice cultivation based on the Case

Table 4 : Total cost, income and profit provided by the case 3 for 0,5 ha of rice cultivation in Senegal

Content			Expense (US $)
Fix cost	Machine		171,37
	Other managing cost		0,00
	Landrecramation cost and Irrigation charge		0,00
	Rental cost		0,00
	Taxes		0,00
	Maintenance cost		0,00
	Insurance		0,00
	Total		171,37
Variable Cost	Labor cost	Family labor	113,30
		Hired labor	45,50
		Total	158,80
	Shipping	Materials	101,81
		Commission	0,00
		Other cost	0,00
	Rental land charge		0,00
	Others		0,00
	Total		**260,61**
Total Cost			**431,98**
Selling income			**375,00**
Profit			**-56,98**
Family income			56,32

This figure show that in the case of farmer cultivate 0,5 ha with small cheep power tiller, the Break-even point will be (0,8 ha ; 600 US $). It means that :

- if farmer cultivated below 0,8 ha ; in this case farmer will not get profit ;
- if farmer cultivated upper than 0,8 ha ; in this case farmer will always get profit.

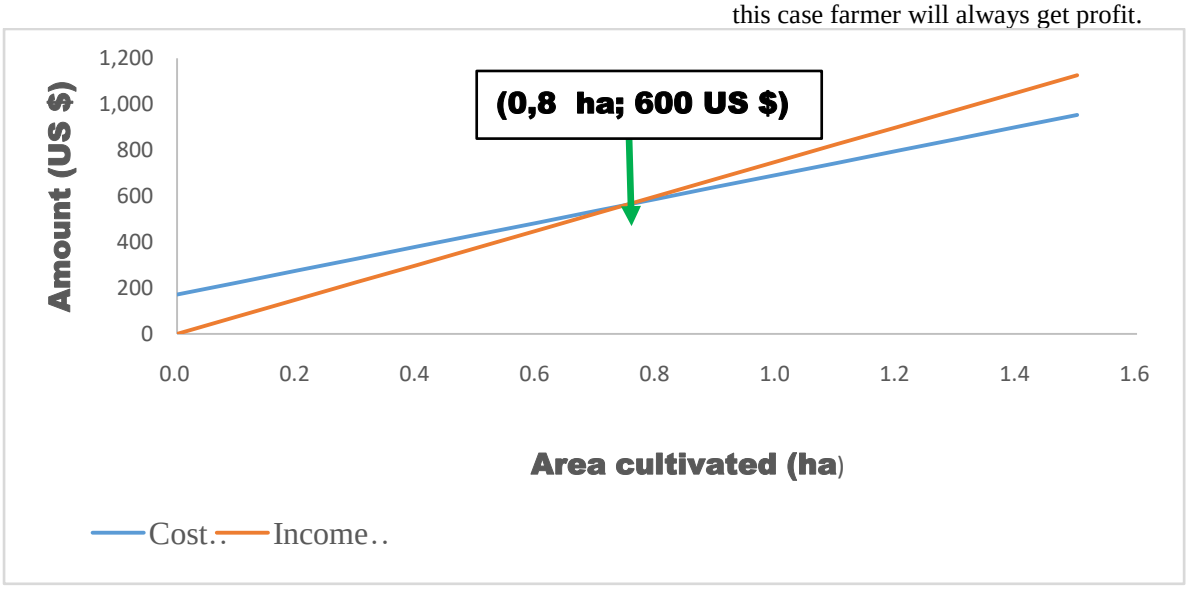

Figure 2 : Break-Even Point for the best profile of rice cultivation system by small scale farmer in Senegal

3.2. Present Agricultural Index for peanut cultivation system in Senegal

3.2.1. Cultivation management for peanut cultivation

Table 5 : Cropping time for peanut cultivation in Senegal

Farming Index CROPPING SEASON

1. Crop name: Peanut

2.Cropping type : 105 Days

3.Variaty: 73-33

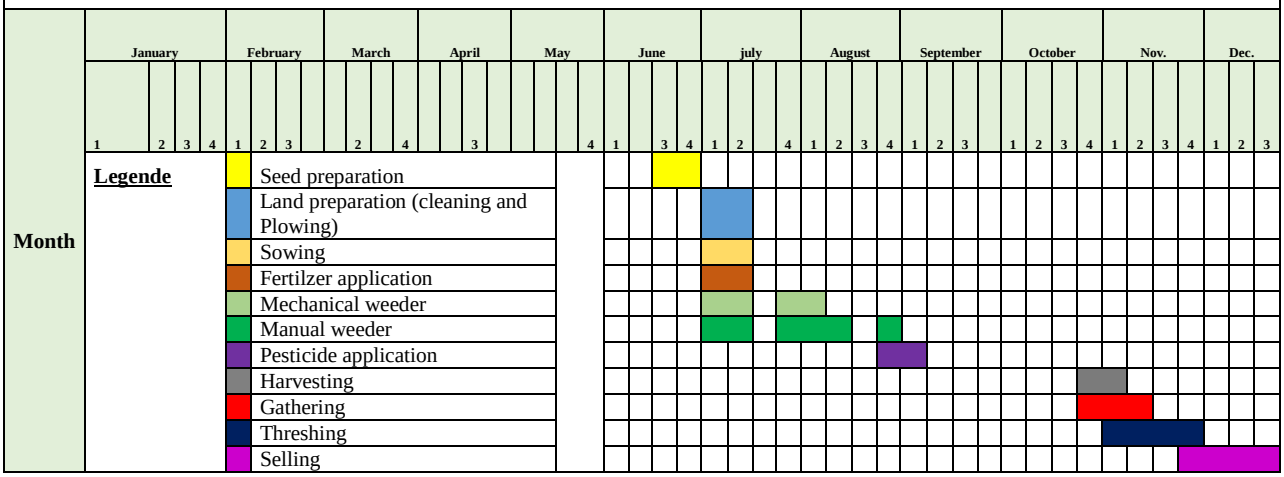

Table 6 : Total cost, income and profit provided by the initiale case for 1 ha of peanut cultivation in Senegal

Income

Income		
Shipping (Kg)	**Unit price (US$ /kg)**	**Total (US$)**
1700	0,38	**646**

Content

Content			Expense (US $)
Fix cost	Machine		65,08
	Other managing cost		0,00
	Landrecramation cost and Irrigation charge		0,00
	Rental cost		0,00
	Taxes		0,00
	Maintenance cost		0,00
	Insurance		0,00
	Total		65,08
Variable Cost	Labor cost	Family labor	161,98
		Hired labor	63,70
		Total	225,68
	Shipping	Materials	294,25
		Commission	0,00
		Other cost	0,00
	Rental land charge		0,00
	Others		0,00
	Total		**519,93**
Total Cost			**585,01**
Selling income			**646,00**
Other income			**200,00**

Total income/Gros income	**846,00**
Profit	**260,99**
Family income	422,97

The figure below that the break-even point for 1ha of peanut cultivation. Using 1 ha, the break-even point is (0,2 ha ; 169, 2 US $). It means that :

- if farmer cultivated below 0,2 ha ; in this case farmer will not get profit ;
- if farmer cultivated upper than 0,2 ha ; in this case farmer will always get profit.

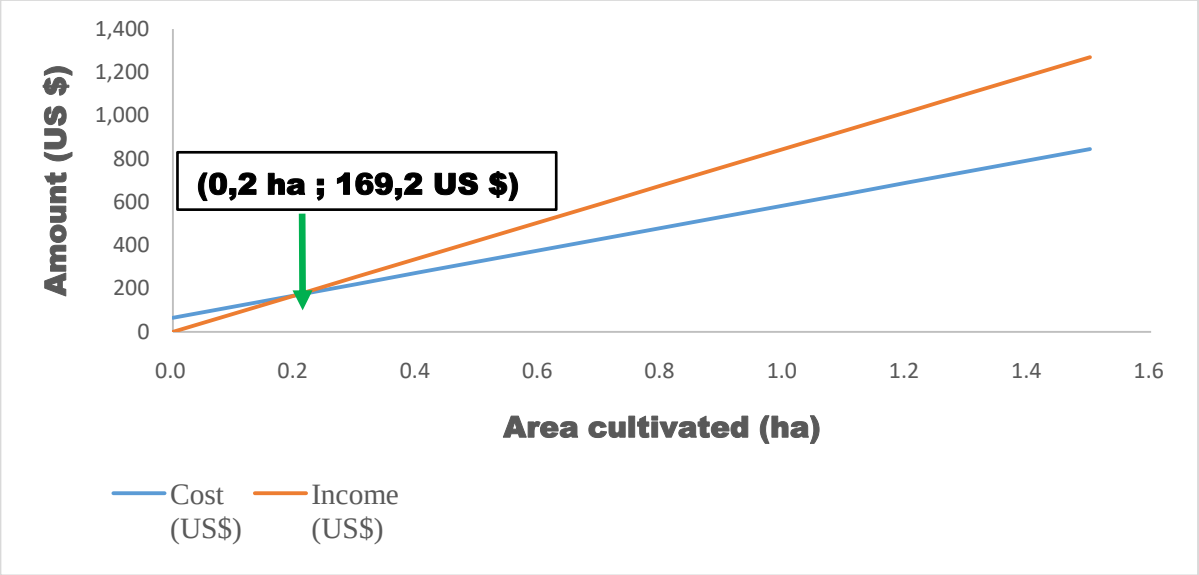

Figure 3 : Break-Even Point for the best profile of peanut cultivation system by small scale farmer in Senegal

3.2.2. Simulation of peanut cultivation in Senegal (Minimum 4 cases)

Table 7: Profit of the four cases of simulation compared to the profit of the initiale case in case of 1 ha of peanut cultivation

Case	Type of Simulation	Area used (ha)	Fix cost (US $)	Variable cost (US $)	Income (US $)	Profit (US $)	BEF (ha; US $)	Profit compared to Initiale Situation (US $)
Case 0	**Actual Situation**	**1**	**65,08**	**519,93**	**846**	**260,99**	**(0,2 ; 169,2)**	**0**
Case 1	**60% Sub Draft Animale**	**1**	**45,47**	**533,58**	**846**	**266,95**	**(0,1; 84,6)**	**5,96**
Case 2	**60% Sub (Draft Animale+Intrant)**	**1**	**140,74**	**409,17**	**846**	**296,09**	**(0,1; 84,6)**	**35,1**
Case 3	**Introduction PT**	**1**	**137,8**	**353,85**	**846**	**354,36**	**(0,3; 253,8)**	**93,37**
Case 4	**PT + 60% Sub (Draft Animale+Intrant)**	**1**	**140,74**	**409,17**	**846**	**296,09**	**(0,3 ; 253,8)**	**35,1**

From this table, our results show that case 3 is the best profil agriculture management plan for peanut cultivation in Senegal compared to the others cases. For this reason, we choice case 3 for the best proposed agriculture management plan for peanut cultivation.

3.2.3. Best Farm management plan for peanut cultivation based on the Case 3

Table 8 : Total cost, income and profit provided by the case 3 for 1 ha of peanut cultivation in Senegal

Income

Income		
Shipping (Kg)	**Unit price (US$ /kg)**	**Total (US$)**
1700	0,38	**646**

Content

Content			Expense (US $)
Fix cost	Machine		137,80
	Other managing cost		0,00
	Landrecramation cost and Irrigation charge		0,00
	Rental cost		0,00
	Taxes		0,00
	Maintenance cost		0,00
	Insurance		0,00
	Total		137,80
Variable Cost	Labor cost	Family labor	149,70
		Hired labor	63,70
		Total	213,40
	Shipping	Materials	140,45
		Commission	0,00
		Other cost	0,00
	Rental land charge		0,00
	Others		0,00
	Total		**353,85**
Total Cost			**491,64**
Selling income			**646,00**
Other income			**200,00**
Total income/Gros income			**846,00**
Profit			**354,36**
Family income			504,05

The figure below that the break-even point for 1ha of peanut cultivation. Using 1 ha, the break-even point is (0,3 ha ; 253,8 US $). It means that :

- if farmer cultivated below 0,3 ha ; in this case farmer will not get profit ;
- if farmer cultivated upper than 0,3 ha ; in this case farmer will always get profit.

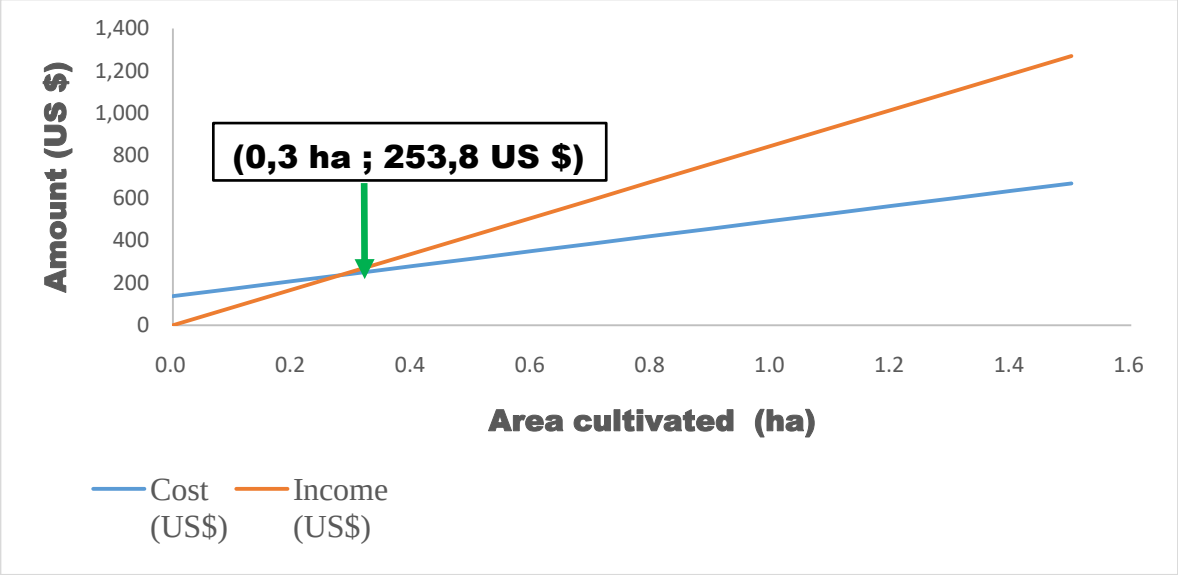

Figure 4 : Break-Even Point for the best profile of peanut cultivation system by small scale farmer in Senegal

3.3. Discussion of simulation

From the simulation of 0,5 ha of rice cultivation by small farmer, our result show that by using hiring machine and power tiller farm can explore more area than the initiale situation of rice cultivation. By adopting these two cases such as hiring machine and introduction of small power tiller, farmer can get more income and also more profit. The break-even point from the figure 1 in the initiale case show that farmer can increase his profit when he explore more than 2 ha of land by using small power tiller will get 5 time profit (286 US $) than hiring tractor (58 US $). It means the hiring tractor give less profit to farmer compared to the small power tiller which give more profit when farmer cultivate more than 2 ha of land.

Also, our results show that small farmers get mostly negative profit when they cultivated rice. This low performance for small farmer can explain by the high labor cost and also by the high irrigation cost. Actually most farm working in the field of irrigated rice complain that irrigation cost is higher and the government have to solve this problem. Also farmers complain that the cost for the hiring tractor is very expensive instead of using labor and permit to reduce labor cost.

From the simulation of 1 ha of peanut cultivation by small farm, our results show that by introducing power tiller, farmer can explore more area than the initiale situation of peanut cultivation. Farmer by adopting a small power tiller in his farming system, he will increase 2 time the total fix cost compared to the initiale case but farmer can get more profit (355 US $). It means a profit around 93 US $ more than initiale profit which is 261 US $. Also the Break-even point from the figure 4 move compared to the initiale position of the break-even point obtained from the figure 3. It means, they have a positive change in the farming system of peanut cultivation by the introduction of a small power tiller. In this case, farmer can increase more area and also get more profit by using power tiller.

As you know, in Senegal, peanut is an industrial crop where small farmer still get positive profit because of the another income getting from the sale of fane. Also farmer when the yield is very bad due to lack of rainy season or climate change, farmer get income from peanut fane.

For both crop such as rice and peanut, their break-even point show that farmers have to cultivate more area if they want to get more profit by introducing a small power tiller.

3.4. Recommandable Agricultural mechanization plan for small farmers in Senegal

In case of rice cultivation system for making small farmer strong

- Remove all irrigation cost ;
- Make a policy for the introduction of small cheep power tiller by farmers ;
- Subsidence 60% of power tiller.

In case of peanut cultivation system

- Introduction of small cheep power tiller can improve the profit of small farmers ;
- Subsidence 60% of Power Tiller.

For the Ministry of agriculture and rural equipment of Senegal

- The ministry of agriculture and rural equipment of Senegal can use this tool to simulate the best decisions to take relative to their policy of agriculture in Senegal such as subsidence or not for intrant or equipment or cost of irrigation ;
- To work with the department of socio-economic of ISRA (ISRA-BAME) for the diffusion of this tool.
- To work with Universities in Senegal for the diffusion of this tool because new farmer have to learn and understand look like Japanese's farmers who have good level on education that help them to do the minimum of machine reparation.

For farmers

- To regroup in cooperatives or GIEs in view of the very limited means in order to be more strong
- To purchase together machine as small power tiller that can explore more area
- To do service provider for others farmers in order to have more income

IV. PERSPECTIVES

4.1. Activities of my Institution

The Senegalese Agricultural Research Institute denoted ISRA where I work is the only Agricultural Research Institut in Senegal. It has two departments of agricultural machinery; one is located in the Diourbel region and the other is located in the Saint-Louis region. Actually, in my country, there is a lack of experts in the field of agricultural machinery. This is a reason why my Institution (ISRA) accepts my training course in Development and Improvement of Agriculture mechanization for small scale farmer in Japan through the JICA/TSUKUBA where its agricultural machine laboratory is very advanced to get this Knowledge with a very good professors.

4.2. Future Development

The new orientation of Senegalese Government is to

This orientation necessitates the intensification of crops production by improving the actual utilization level of all agricultural inputs (seeders, fertilizers) in general and equipment in particulary. The development of mechanization requires the implication of the Research through their departments of agricultural machinery to test, to homologue and to improve equipment for getting the sustainability of Agriculture machinery in Senegal.

Also, ISRA through his department of agricultural machinery can spray this Knowledge and train all actors involved in the field of agricultural machinery in Senegal.

ACKNOWLEDGEMENT

From this work, I would like to thank :

In Senegal

The Ministry of Agriculture and Rural Equipment of Senegal for the proposal of name for the participation of this training in Japan.

The Director General of ISRA and the Director of the CNRA of Bambey for having authorized me to do the training in Japan.

To all the CNRA colleagues in Bambey, who continue to encourage me to go even higher and in particular to Dr. Ibrahima Sarr (Acting Chief of the Department of Agricultural Machinery at the CNRA of Bambey).

In Brasil

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In Japan

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REFERENCES

[1] **ANSD, 2016.** Atlas démographique du Sénégal. Rapport final, 67 p.

[2] **CIAT; BFS/USAID. 2016**. Climate-Smart Agriculture in Senegal. CSA Country Profiles for Africa Series. International Center for Tropical Agriculture (CIAT); Bureau for Food Security, United States Agency for International Development (BFS/USAID), Washington, D.C. 20 p.

[3] **DIAKHATE, D., 2009.** Analyse de l'Offre et de la demande en prestation de service motorisé dans une perspective de mise en valeur intensive des aménagements hydro-agricoles du Bassin de l'Anambé : cas des tracteurs et des moissonneuses-batteuses, 120 p.

[4] **ICRISAT, 2015**. Creating a brighter tomorrow for smallholder farmers. 4 p.

[5] http://www.icrisat.org/who-we-are/investors-partners/donor-flyers/Senegal_ICRISAT.pdf
[6] **ISRA, 2002 :** Traditional Cowpea in Senegal, a Case Study.
[7] http://www.fao.org/ag/agp/agpc/doc/publicat/cowpea_cisse/cowpea_cisse_e.htm
[8] **KANTE, S., 1995.** La motorisation de la riziculture irriguée dans la vallée du fleuve Sénégal, 16 p**.**
[9] **PRECHEUR, 2012**. Quelle place pour la motorisation dans les villages d'agropasteurs dans le Sud du Bassin arachidier (Sénégal) ?
[10] **SARR, S. 2013**. Mécanisation agricole et productivité des filières céréalières : cas du Bassin Arachidier. Mémoire de Fin d'études école Nationale Supérieure d'Agronomie (ENSA), p. 88
[11] **SOW S. D., 1995.**Le parc de matériels de culture attelée et ses contraintes de maintenance dans le Bassin arachidier : le cas du département de Nioro du Rip. Mémoire de confirmation. Sénégal : Secteur du Centre Sud de Kaolack (SCS).
[12] **UNDP, 2012**. Food Production and Consumption Trends in Sub-Saharan Africa: Prospects for the Transformation of the Agricultural Sector. 76 p.
[13] http://www.undp.org/content/dam/rba/docs/Working%20Papers/Food%20Production%20and%20Consumption.pdf
[14] **WORLD MAP, 2017**. Senegal Latitude and Longitude Map
[15] https://www.mapsofworld.com/lat_long/senegal-lat-long.html

Mr Demba Diakhate. "Agriculture Management Plan for Small Scale Farmer in Senegal : Case of Rice and Peanut Cultivation." International Journal of Engineering Research and Applications (IJERA) , vol. 7, no. 10, 2017, pp. 36–47.