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Smallholders' Access to Agricultural Equipment and Agro-Inputs in Mali

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Abstract

Farm equipment and agro-inputs are essential to raise the labor and land productivity. Due to low incomes, smallholder farmers are not able to acquire quality equipment and agro-inputs timely and at cost effective. Poor farmers, especially women have to wait until men finish with their activities to benefit from farm equipment. Although the government of Mali adopted a subsidy program since 2008, still many farmers couldn't access to quality and cost effective fertilizer or equipment. Because the share they should pay is beyond their financial capacities. Farmers don't have the same needs depending to their age, education level, belonging to an organization, size of farm and their willing to change. To increase smallholders' productivity and income, they should access sustainably timely quality inputs and equipment at an effective cost. The key is to engage all the stakeholders in the supply chain and offer a range of suitable options from which the user can select. Sustainability of mechanization includes financial and social, as well as environmental factors. There are local manufacturers that should be supported where feasible as they can provide machines adapted to local conditions and better technical service and replacement part supply. The public sector role in providing access to equipment and agro-inputs should be restricted to promulgating enabling policies, building technical and business management skills and stimulating demand. Lessons from other experiences in making farm equipment and inputs available to smallholder farmers include subsidies, strong extension services, infrastructure development and a solid manufacturing sector that prioritizes the smallholder sector. The implications for Mali appear to be that group ownership and custom hire service provision are the models to follow.

Keywords:

Essential Agricultural Input, Value Chains, Demand Creation, Provision Mechanisms, Local Manufacture, Chinese Experience, Center for Sustainable Mechanization.

Introduction

Background

Achieving the "Sustainable Development Goals" (SDGs) in Mali must pass through agricultural development. Sustainable Development goals including poverty, hunger and malnourishment reduction at the national level are of primary importance for the government of Mali (CREED, 2016-2018). The key to reduce these goals is accelerated economic growth and employment generation (FAO). Economic growth and employment generation could incur through the development of demand driven agri-food systems which will connect all stakeholders and favor increase smallholders farm incomes and improve livelihoods (Sims and Kienzel, 2016). The development of agri-food systems will require a pressing need for sustainable crop production intensification and as the country population continues to increase, the rural population decreases due to youth migration towards urban centers, labor and land productivity improvement in the smallholder farming become important. Access to better quality seed, fertilizer, irrigation and mechanization are means to boost production and productivity in smallholder farming.

According to UN sources, Mali ranks 173 out of 177 countries on the Human Development Index and 151 out of 157 on the Gender Development Index. Approximately 51.4 % of the populations live under the poverty line and 28% of the population is undernourished. Smallholder farming system is site-specific therefore areas cultivated vary in size depending on possession of equipment, application of fertilizer and adoption of improved seeds. According to the data provided by the DNGR (office for agricultural land development, irrigation and equipment), only 0.4% of farm households possess tractor while more than 66% possess a plow. The latest agricultural census stated that only 11.3% of farm households in 2004 applied chemical fertilizer.

Mali's agricultural sector, despite the important agro-sylvo-pastoral potentials, is not able to cover the populations' food and nutritional needs to reach a sustainable satisfactory level of food security. Several factors explain this situation and include: (i) availability of appropriate equipment and inputs; (ii) resources to purchase appropriate equipment and inputs; and (iii) capacity to appropriately use equipment and apply inputs to optimize benefits are lacking or insufficient.

It is clear that appropriate inputs application and mechanization are essential to raise labor and land productivity and reduce drudgery in smallholder farming. Specifically, mechanization can also be used to add value to primary products and so produce employment and income potential along crop value chains. However, poor smallholders with no access to credit facilities have no choice but to continue farming without the benefit of modern equipment and inputs.

To enhance suitable access to equipment and agro-inputs of smallholders, specifically women have to wait till men finish plowing their land before having access to farm equipment, this will require creating networks where farmers can access loans for equipment and inputs at low cost and within a long-term payback time or hire equipment timely at a relatively low cost. This may help smallholders improve their livelihoods.

The Government of Mali since 2008 adopted inputs and equipment subsidy (50%) initiative but the share farmers are paying still remains very high for poor smallholders (specifically with big tractors ranging from $25,000 to $35,000 per unit). There is evidence of the presence of all stakeholders on the field; the question is how poor smallholders could access timely quality inputs and equipment at low cost? This will require a deep understanding of farmers' demand for equipment and inputs and the supply possibilities of vendors. There are two hypotheses: the first one is that farmers are not organized based on their own situation and resources at their disposal; the second is that farmers are not involved in the identification of their needs and the types of interventions they receive.

This study is about understanding the type of equipment and inputs farmers need for different operations, the timeframe for executing the operations, the costs of operations with and without equipment and their accessibility. To carry out the study two main agricultural production areas (cotton and rice areas) are considered. Focus group discussions and farm surveys are conducted to collect information and data on equipment and inputs availability, constraints to access and the strategies to be developed for smallholders.

Objectives

The main objective of the study is to develop strategies to allow poor smallholder's access farm equipment and inputs timely at low cost. Specifically:

- Understand the demand side for equipment and other agriculture input and services needed by underserved farmers operating in rice and cotton areas disaggregated by gender;
- Understand the supply side of the agriculture equipment, input and services and major constrains that prevent existing agro-dealers (or other entrepreneurs) to provide timely, cost effectively and a quality wide range equipment and other agriculture input and services to the targeted farmers;
- Recommend a model that suits smallholders' sustainable access to equipment and agro-inputs timely and at a relatively low cost.

Methodology

Study area, sampling, and data

The study was conducted in two agro-ecologies: the "Delta" (rice producing area) and in the "plateau de Koutiala" (cotton producing area), where equipment and agro-inputs use is highest in the country. These zones are also the bread basket of the country. In the Delta, rice production is mostly by irrigation with full water control; while in the plateau de Koutiala the main crops are rainfed. The survey that generated the data for the study was therefore conducted in these two zones.

Selection of crop-producing communities and households began with listing of communities in both zones. From this list 40 communities, were randomly selected for the community level interviews.

Within each community selected, 10 households were randomly selected from a lists generated during the community interviews. In all a total of 400 households are interviewed. Due to

resource constraint during the final round of interviews a subsample of 200 households from 20 randomly selected communities were interviewed for the equipment modules of the survey. This sample is therefore a representative sample of the crop producing communities and households in the study zones. It however does not represent the crop systems in the entire study area which includes communities and households doing livestock, rain-fed cereals, and vegetables in the zones.

The data was collected through rounds of interviews with representatives of the selected crop-producing and communities. Using semi-structured modular questionnaires, the data collected describe community and household characteristics, household livelihood, and equipment and agro-inputs usage patterns. For equipment data recall of cropping activities practiced by the household during the last season were collected. This round of data collection was repeated for crop types by production system. Preliminary discussions with members of selected communities reveal that there is huge need of equipment during tillage, weeding, harvesting, threshing and transportation. This guided the timing of the interviews on equipment.

Respondents had to fulfill two important criteria: they had to be farmers and decision makers in the farm. Both the household head and the spouse were interviewed. The main reason for interviewing both was to generate a comprehensive database allowing the following investigation: analyze gender related phenomena such as sharing of household resources and labor allocation. The following map presents the study area.

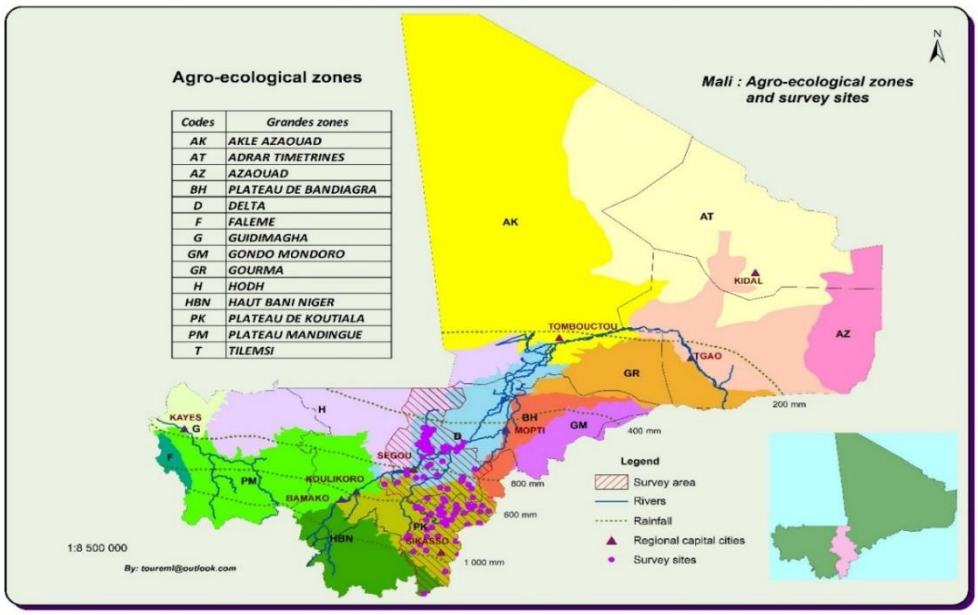


Figure 1: Survey sites and agro-ecological zones

Data Analysis

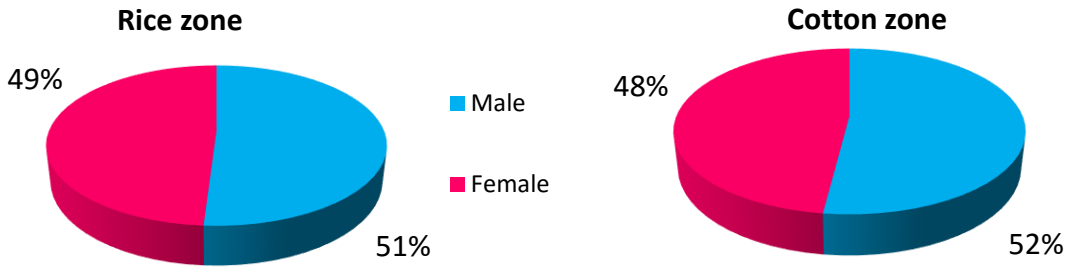
The analysis reported here has separate but related components: a) Descriptive analysis, to help us describe and understand the profile of farmers, and their attitude toward change. b) Value chain analysis is used to assess equipment and inputs supply, farmers' access to equipment and inputs and appropriateness. c) Focus group discussion was conducted to determine the interest of some of the major dealers in having a network of sub dealers in the

working areas, and whether they would be willing to invest in the process of setting up such a network in areas where they have low coverage. d) Develop a business model of what the network of micro-dealer will look like and how it would function, building on similar experience developed else-where.

Results and Discussion

Characteristics of the farmers

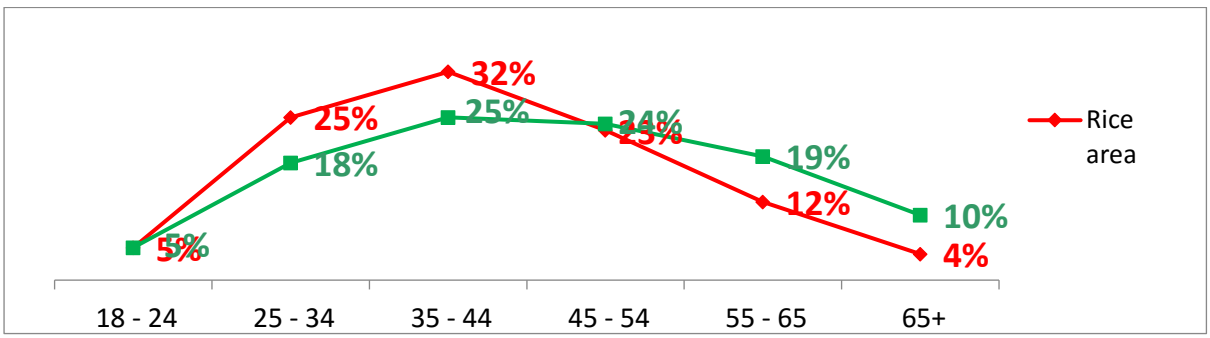
The process of double interview in households has generated a sufficient sample of male and female respondent for separate analysis as it could be seen on the following graphics. The proportion of male is higher than female in the sample because some spouses were unavailable during the survey period.



Graphic 1: Proportion of male and female respondents in the sample

Age distribution of respondents

On the graphic below, the rice zone has slightly older profile farmers than the cotton zone. In both zones, farmers with age ranging between 35 and 44 years are the most frequent. This is the range at which farmers gain responsibility in the farming household.

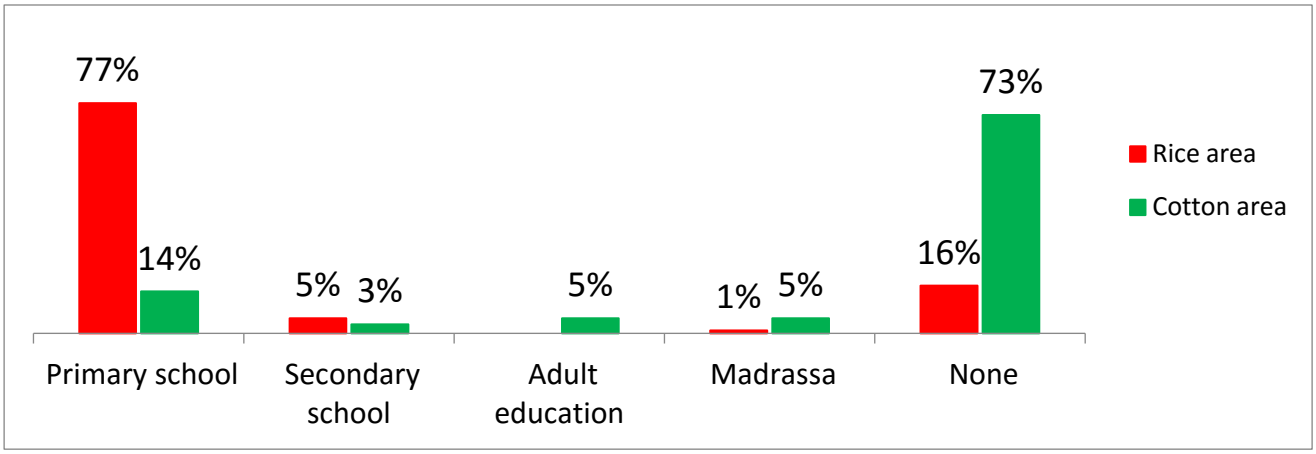


Graphic 2: Age distribution of farmers in the two production zones

The difference between the two ages distribution is due to access conditions of a farm plot in the zones. In the rice one where plots are developed for irrigation by the government, access conditions are tighter.

Level of education interviewees

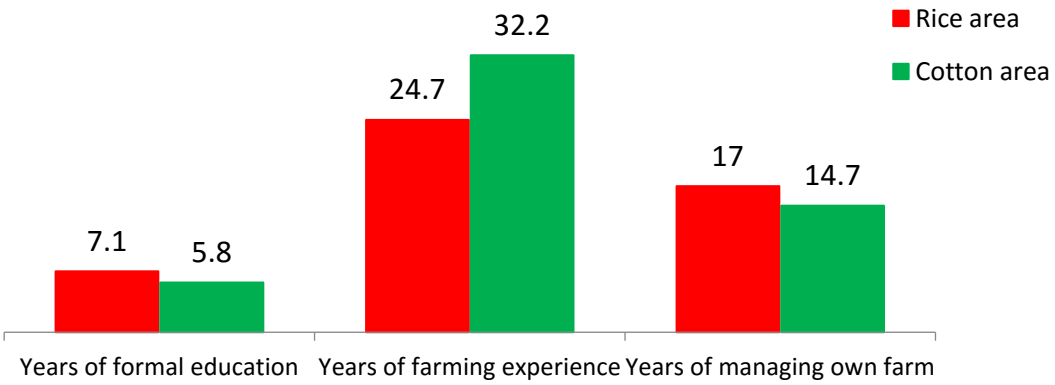
From the graphic below, the rice zone is more likely to have farmers with basic education. The cotton zone seems to have high proportion of farmers with no formal education.



Graphic 3: Education level of surveyed farmers

Average farming experience of interviewees

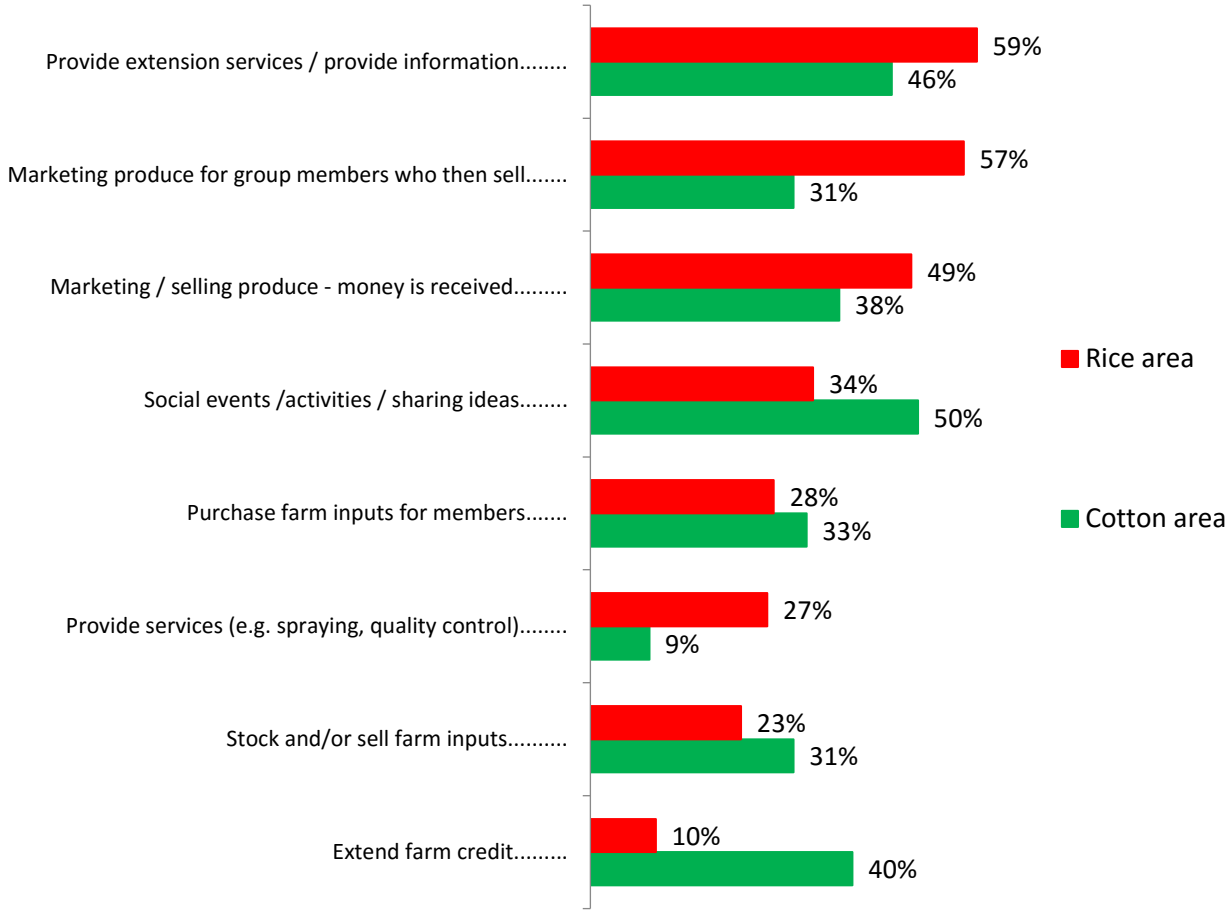
Farmers are likely to gain farming experience because they have worked with their father or grandfather before managing their own farm. In the rice zone farmers start managing their own farm earlier than in the cotton zone; because family links are tighter in the cotton zone. Fields are common to the family and the elder member of the family or his representative becomes the head and makes all decisions. Individual fields belong mostly to women in the family for producing legumes and leaves to improve the food. The graphic below gives the average years of farmers formal education, farm managing and farming experience.



Graphic 4: Average years of formal education, farming experience and managing own farm.

Membership in farmers' cooperative

In both zones farmers belong to a cooperative or other farmer organization; but men are keener to attend meetings than women. By belonging to an organization facilitates access to credit and support from extension agents or NGOs. The two zones are le most organized in the country. In both zones administrative reasons (management and fees) significantly hinder joining organizations. The most helpful functions of the group are depicted in the chart below.



Graphic 5: Most helpful functions of the group

Segmentation of farmers

Multiple Correspondent Analysis (MCA) has been carried to segment households for understanding their access or need to equipment and agro-inputs. From attitudinal and traditional socio-demographic variables six groups are constituted and described as follow.

Segment Description

Traditionalists Cotton zone = 27% Rice zone = 22%	• Happy about that they do in farming, but don't rely muh on information and don't look for change.
Trapped Cotton zone = 19% Rice zone = 26%	• Farming is not the first choice for livelihood, negative towards farming and see no hope in farming. Doesn't want his/her children to be farmers
Dependents Cotton zone = 21% Rice zone = 14%	• Is very positive about farming but requires the assistance of others
Survivor Cotton zone = 4% Rice zone = 19%	• Looking to make the best out of farming and improve him/herself but if a better alternative came up would easily stop farming. Probably sees his/her future elsewhere
Market oriented Cotton zone = 24% Rice zone = 13%	• Seeks information and networks with others, very independent and truly enjoys farming
Independents Cotton zone = 5% Rice zone = 6%	• Generally information user. Not very experienced in farming and not engaged and derives no excitement in farming

Traditionalists Cotton zone = 27% Rice zone = 22%	•These are the laggards. They believe that farming is their destiny, and they feel confortable with that. To them, there is no need to change. They are somewhat negative and don't want people telling them what to do on their farms.
Trapped Cotton zone = 19% Rice zone = 26%	•Would rather get out of farming since they see no hope of improvement, but probably cant. Would not want their children to be farmers but don't have any idea of what to do about it. Are not interested in collecting information or making change.
Dependents Cotton zone = 21% Rice zone = 14%	•Are optimistic that things can improve and don't mind being a farmer – after all, its their destiny, but the only way of improving is to enlist the help of others like NGOs and other people. May lack confidence due to past failure.
Survivor Cotton zone = 4% Rice zone = 19%	•While unhappy they are looking to make the best out of farming and improve him/herself . Do not believe their destiny is in farming. If an alternative came up he would easily stop farming.
Market oriented Cotton zone = 24% Rice zone = 13%	•Seeks information and networks with others very independent and truly enjoys farming
Independents Cotton zone = 5% Rice zone = 6%	•Generally information user. Derives no excitement in farming Have no problem with change and seek information, have hope, do not think that farming is their destiny. Don't want people telling them what to do

The agro-inputs and equipment supply chains in Mali

In Mali, the fertilizer value chain comprises four primary supply channels: (1) a channel for farmers in cotton-growing areas; (2) a channel for irrigated rice farmers; (3) a channel for farmers in DRA zones; and (4) a channel for farmers whose crops are not eligible for subsidies, such as vegetable crops. The Malian fertilizer value chain, with its four supply channels, is depicted in Figure below.

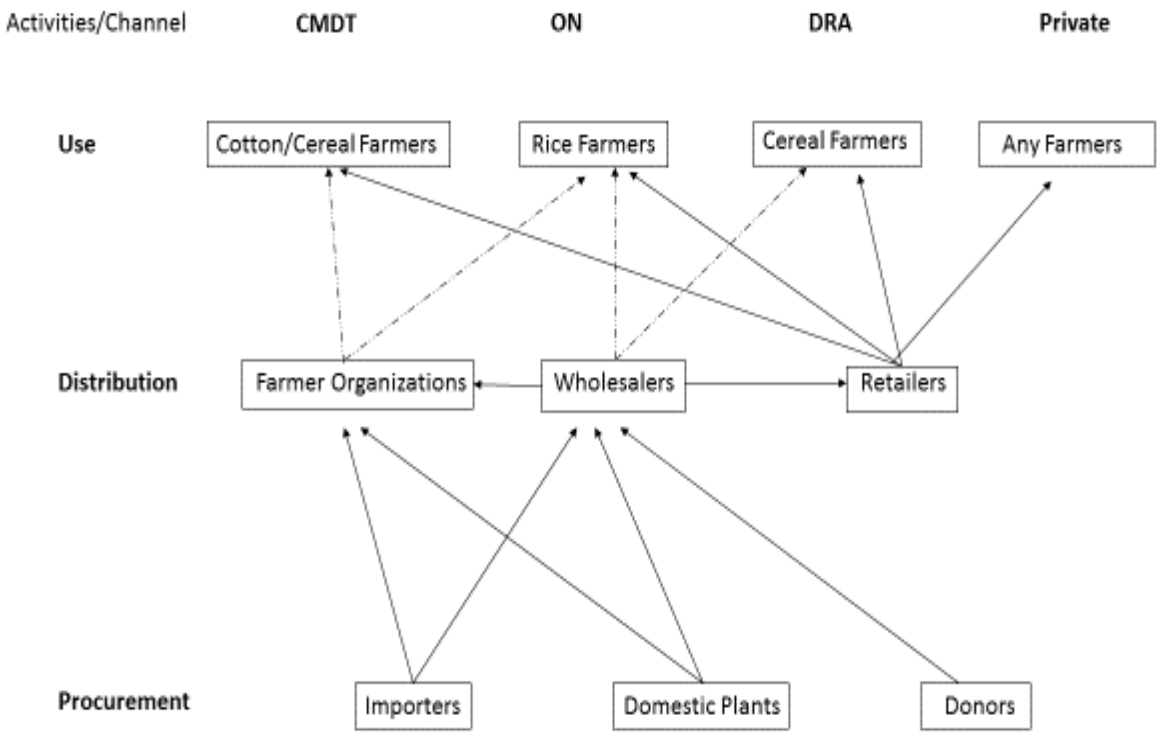


Figure 2: Structure of fertilizer value chain in the study zones

Source: Theriault et al, 2017

For the purpose of this study we are interested to the cotton zone and the rice zone supply chains.

Fertilizer supply chain in the cotton zone

The Malian cotton sector is highly structured. Cotton farmers are organized in cooperatives at the village level under the parastatal company, *Compagnie malienne de développement des textiles* (CMDT). Cotton is grown in rotation with coarse cereals such as maize, millet, and sorghum. These coarse cereals benefit from the carry-over effects of the fertilizer applied to cotton, the diversion of fertilizer originally intended for cotton, and easier access to cereal inputs (Theriault, Serra, and Sterns 2013). All cotton production is coordinated and sold by CMDT. Although CMDT's participation in rural development activities has waned since the

structural adjustment reforms, it continues to be active in supplying inputs. In addition to providing technical support for the international calls for tender, CMDT is involved in fertilizer supply via needs assessments, the issuance of cautions techniques, transportation, and credit provision. Cotton farmers have access to subsidized fertilizer, for both cereal and cotton crops, on credit at the start of the crop year, with the promise of payback at cotton harvest time. Both credits for cotton and cereal are paid from the cotton production. The credit is extended by a financial institution, which accepts ginned cotton from CMDT as collateral. The fertilizer is delivered to the CMDT warehouses where it is stored until it is handed over to the farmer organizations (cotton cooperatives).

Fertilizer supply chain in the rice zone

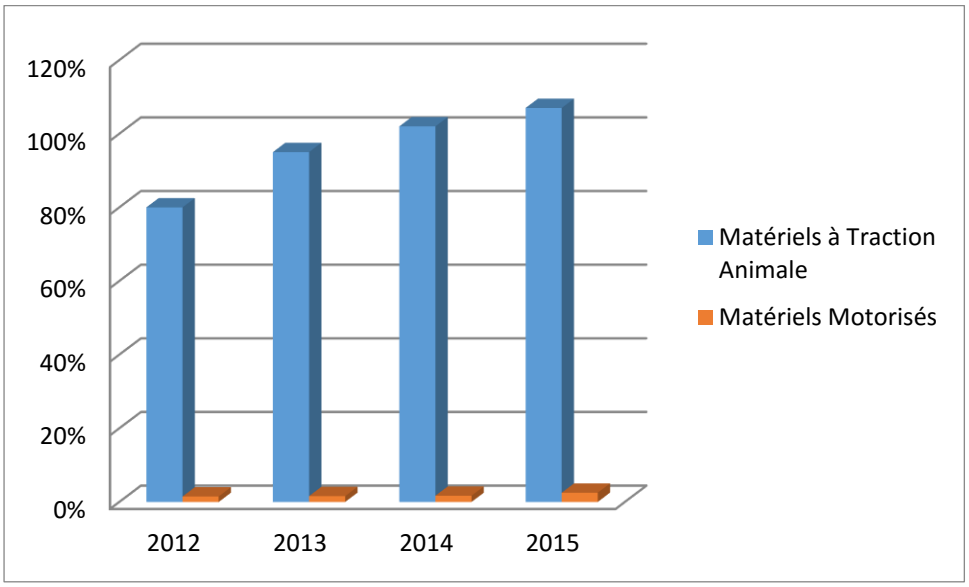
Irrigated rice is mainly grown in the Office du Niger (ON) area. The ON rice growing system is one of the best organized systems, along with the cotton system. Rice growers are organized at the village and national levels. In 2012, the ON comprised more than 800 farmer organizations (DNA 2012). These organizations receive technical support from several donors, especially when evaluating fertilizer requirements, issuing cautions techniques, and arranging calls for tender for joint procurements. The inputs are mostly supplied through the private distribution networks of wholesalers and retailers. Through their farmer organizations, about 70% of rice farmers have access to fertilizer credit provided by financial institutions (Staatz et al. 2011). The rate and speed at which the organizations pay back their loans affects the interest rate (Fuentes, Bumb, and Johnson 2011). Credit is denied to organizations with significant arrears and to farmers who did not repay their previous loans. This means that those who do not receive credit are forced to buy their fertilizer from wholesalers and retailers in cash or on credit. Fertilizers obtained on credit from wholesalers/retailers are reportedly 30% to 50% more expensive than those purchased on credit through farmer organizations (Staatz et al. 2011).

Equipment supply chain

Two types of agricultural equipment are available on the market: motorized equipment and animal drafted equipment. The drafted equipment' park includes mainly ploughs, hoes, arrows, carts and seeders. Despite the abundance of drafted animals (bullocks, donkey, horses and camels), their usage problem remains in their weakness at critical period of plowing after long and difficult dry season. This type of equipment is made by local fabricants in all zones in the country.

Motorized equipment are tractors (70 HP, 50 HP and 39 HP), two wheel tractors, motor-pumps, threshers (simples and winnowing), dehullers, mini-millers, transplanters, reapers, seeders, etc. Generally spare parts and motorized equipment are imported and assembled in specialized shops through the study zones. Imported spare parts are usually from Asia or Europe with a dominance of spare parts originated from China because of their cheaper cost. The presence of an assembling tractor factory in Mali made Mahindra tractors make very popular in the country. Other tractor makes are: Massey Ferguson, Ford, Foton 600, Sonalika among others.

If there have been a huge increase in the number of drafted equipment possessed by households, the number of motorized equipment has not known any significant increase as it could be seen on the following graphic.



Graphic 6: Evolution rate of equipment in Mali from 2012 to 2015

Source: DNGR, 2015

The rate is computed by considering the total number of drafted or motorized equipment divided by the number of farms (805,000) in the country. Small motorized equipment are very appreciated by farmers because of their adaptability, the low price and the time gain in executing activities. Thus, in the rice zone (Office du Niger) the annual work time is estimated at 512 hours for small motorization while it is 1560 hours manually and 796 hours if it is by drafted animal. However, efforts made by special programs (Initiative Riz, s'équiper en reboisant), existence of constructing or assembling factories of agricultural equipment have contributing up grading producers' equipment level.

From 2012 to 2015 the number of tractors increased from 1890 units to 3400 units in the country, thus a relative increase of about 80% (DNGR, 2015). This big increase in 2015 is mainly due subsidizing of 1000 tractors by the government. To access a subsidized tractor at 50% of the value, the demander should deposit up to 20% of the value and the remaining 30% to be funded by a bank from which the demander require a 4 years-credit at an interest rate of 8,75% with one year delay. Even with the subsidy, the tractors are still expensive for smallholders because of their high unit cost ($23 000 to $26 000). During the same period without any government intervention the number of two wheel tractors (motocultors) has increased from 1119 units to 3330 units thus a relative 197% increase rate. This increase justifies the importance of motorcultors specifically in the rice zone.

Existence of Fabricants at national level

Within the study zones there are individual fabricants making animal drafted equipment; they are in all villages and a limited number of units or factories assembling or making animal drafted and motorized equipment. The most known ones are:

- *L'Atelier de Découpe et de Perçage (ADP) of Koutiala*, created in 1990 with support Netherland to sustain mechanization in the cotton producing area. It possesses the capacity to make 40 000 units of drafted equipment, and a hundred of wagons for tractor.
- *L'Atelier d'Assemblage de Matériels Agricoles (AAMA) of Niono*, created in 1978 through the collaboration between Mali and the Netherlands to rehabilitate Office du Niger zone (main rice producing area). Through this collaboration the lower equipment of rice farmers could be solved; their training can be insured and a service after sale can be provided by a team of mechanics highly trained operating in a network; spare parts can be locally available. This center can also adapt prototypes of several machines. Nowadays the status of the center changed and became a cooperative under le name of SOCAFON.

Le Réseau des forgerons professionnels implemented by CMDT, OHVN and ON for making locally spare parts for different equipment made by the SMECMA. The network builds 31 130 units of equipment yearly, but this represents only 47% of its' capacity. There is an emerging informal sector developed the last 10 years. At regional and local levels also many fabricants are specialized in making and selling animal drafted equipment.

Farm labor supply

The following tables present appreciations of labor allocation to the main farm activities by gender and study zone. From the tables men are seen as doing more farm work in the study zones compared to women by both gender. Children are also engaged in farm work but to a lesser extent than adults.

Table 1: Men rating participation of men, women and children for main farming activities

	Men rating men		Men rating women		Men rating children	
Activity	**Rice zone**	**Cotton zone**	**Rice zone**	**Cotton zone**	**Rice zone**	**Cotton zone**
Land preparation	4.94	4.29	1.77	1.45	1.26	1.47
Planting	4.55	4.93	2.76	2.04	1.45	1.25
Weeding	4.61	4.55	3.9	3.83	1.46	1.45
Harvesting	4.58	4.85	3.9	4.18	1.48	1.29
Threshing	4.92	4.63	3.98	4.14	1.23	1.53

Table 2: Women rating participation of men, women and children for main farming activities

	Women rating men		Women rating women		Women rating children	
Activity	**Rice zone**	**Cotton zone**	**Rice zone**	**Cotton zone**	**Rice zone**	**Cotton zone**
Land preparation	4.85	4.76	3.94	3.32	1.19	2.68
Planting	4.38	4.35	4.23	4.73	1.36	2.39
Weeding	4.29	4.36	4.25	4.71	1.44	2.66
Harvesting	4.40	4.28	4.1	4.15	1.47	2.4
Threshing	4.79	4.02	4.01	4.22	1.16	1.56

These activities are those in which farmers need equipment to respect the crop calendar; any delay in these activities could affect total production. Other activities improve the value of crop on the market; to account for them a value chain approach has been used to identify potential equipment needs.

Table 3: Potential for the equipment along the rice and cotton value chains in Mali

Production	Post – harvesting	Processing	Marketing
Land preparation; Planting; transplanting; weeding; harvesting; threshing; crop protection.	Drying; winnowing; cleaning; grading; storage	Ginning; de-husking; milling; pressing	Packaging; Transport

Considering the table above there are such as transplanting and harvesting that have socio-cultural connotations. Women are organized in the rice producing area for transplanting and it is an important source of income to them. Also during cereal harvest, each farm woman participation is compensated by a quantity of crop daily. The total quantity is kept for later use when the household stock is low or sold to make money for school fees, health fees, cloves, etc.

By mechanizing the whole process of agricultural crop, from planting to marketing, higher value outputs can be produced, rural employment can be created and sustained, post-harvest losses

can be reduced, quality can be enhanced and smallholders can be integrated into the market economy (Sims and Kienzel, 2016).

Potential Equipment and agro-inputs demand

The population of Mali increases at a rate of 3.6% yearly meaning increasing food demand; and at the same time potential farmers is diminishing because of youth migration towards urban areas. To satisfy food demand, access to essential crop production inputs including quality seed, fertilizer and farm equipment should be improved.

Many farms are unable to buy directly or access a credit to purchase equipment/agro-inputs because of their poverty level. The following table presents the number of poor f arms in the study area. This number estimates the household farms in need of at least a set of equipment or a quantity of agro-input; representing the potential demand.

Table 4: Number of poor household farms in the study zone

Production zone	Number of household farms	Poverty index	Number of poor household farms
Rice Production area	118 294	52.2	61 513
Cotton production area	97 725	58.1	56 681
Total	**216 019**		**118 194**

Source: Adapted from the agricultural census report 2006

Several equipment are expensive therefore beyond the means of individual smallholder producers; also farm sizes are relatively small therefore not worth purchasing some type of equipment. However, if farmers are organized into cooperative they could access expensive equipment or “uber” equipment to execute timely at relatively cost effective activities. This will necessitate existing credit institutions and not expensive aimed at mechanizing smallholder crop production.

Proportion of equipment possession in the study zones

In both zones farmers possess more animal drafted equipment than motorized equipment as it could be noticed in the following table. Plows, carts, multicultors and seeders seem to be the most important animal drafted equipment farmers can access in the study zones. Motorized equipment are out of the financial capacity of most of farmers in the zones. In the following table the proportion of farms possessing different equipment are presented.

Table 5: Proportion of farms possessing different equipment in the study zones (%)

Type of Equipment	Cotton zone (N=200)	Rice zone (N=200)
Plow	55	40
Seeder	40	8
Harrow	17	7
Multicultor	26	24
Cart	35	28
Tractor (4w)	2	0
2 wheel tractor	0	3
Motor pump	0	7
Miller	2;5	1.5
Huller	0	1.5

It is important to notice that farms in the cotton zone possess more tractors than the rice producing zone, but they have less 2 wheel tractors. During the survey rice farmers stated that they need more 2 wheel tractors than 4 wheel tractors. The explanation is that farm size in the rice zone is smaller and has canal system which is easily destroyed by the 4 wheel tractor. Also the cost of a 2 wheel tractor is cheaper. One of the farmer leaders in the rice zone stated that "the job that a 2 wheel tractor or a peer of bullock can achieve in our zone a 4 wheel tractor can't attain it".

Rate of farms applying agro-inputs in the study zones

Farmers apply different types of agro-inputs to improve their production and productivity. Main inputs used are manure, fertilizer, herbicide and fungicide. The following table presents the rate of farms applying these types of agro-inputs by production zone.

Table 6: Rate of agro-inputs use in the study area

Type of agro-inputs	Rice zone (N=200)	Cotton zone (N=200)
Manure	39	65
Fertilizer	86	88
Fertilizer + Manure	13	45
Herbicide	65	70
Fungicide	37	55

Farmers use more fertilizer than the other agro-inputs because the government of Mali adopted a 50% subsidy program on fertilizers since 2009. The program makes fertilizers accessible to many farmers. However, farmers in remote areas still have difficulties to access fertilizer. Many reasons are stated, but the most important ones are: poverty level of farmers, weak distribution network, and corruption.

Herbicide which is not subsidized is heavily used by farmers because a flood of off-patent herbicide formulations has hit global markets, enabling low-cost Asian suppliers to dramatically scale up productive capacity. Together, these disruptions have increased availability and driven down herbicide costs.

Farmers were supposed to apply manure at a high rate, thus the relative low rate of application is explained by the insufficiency of transport equipment.

From tables 5 and 6 one could notice that farmers are under equipped and use agro-inputs at low rate in the zones. This situation is explained by the poverty level of farm households and the lack of access to credit facilities on one hand and on the other hand the priorities of farmers. The study carried out an exercise of priority setting of farmers in different cash situations: gaining less than 50000 CFA equivalents to $100 and more than 50000 CFA. The tables bellow present farmers' investment priorities depending on their wealth status and sex.

Investment Priorities of farmers gaining less than 50000 CFA ($100)

Table 7: Investment Priorities

-	**All zones (%)**	
	Male	**Female**
	N = 400	**N = 390**
Build a house	0,3	**0,3**
Improve existing house	1,1	**0,2**
Buy equipment and agro-inputs	27,2	**2,6**
Funds for children	0,5	**2,6**
Buy trees plants	0,7	**0,3**
Buy livestock	37,7	**27,0**
Buy durable goods	6,1	**7,4**
Buy food	30,4	**24,6**
Start a new business	26,0	**60,1**
clothing	1,7	**9,4**
Social events	3,6	**7,6**
Emergencies	4,3	**3,9**
Others	**0,6**	**0,3**

Investment Priorities of farmers gaining more than 50000 CFA ($100)

Table 8: Investment Priorities

	All zones **(%)**	
	Male	Female
	N = 800	**N = 79**0
Build a house	2,7	0,5
Improve existing house	7,8	0,5
Buy equipment and agro-inputs	49,3	5,6
Funds for children	1,3	12,6
Buy trees plants	1,3	0,6
Buy livestock	59,4	48,5
Buy durable goods	18,2	24,9
Buy food	23,9	22,5
Start a new business	34,2	62,8
clothing	2,5	14,2
Social events	7,5	19,5
Emergencies	6,9	6,6
Others	0,5	0,3

In both situations investment in livestock is first, equipment and agro-inputs come whether on second or third position if farmer is a male. Usually investment in equipment and agro-inputs lag behind in women priorities. Since most of smallholder farmers are resource-poor, their priorities are first to invest in quick revolving revenue activities (raising small ruminants and poultry) or buy food.

Appropriate equipment and agro-inputs

The importance of equipment and agro-inputs varies by zone and type of farmer. In the rice zone farmers prefer the 2 wheel small tractor (motorcultor) to the 4 wheel tractor. Women in the cotton zone purchase more herbicide than fertilizer because they can't have access to farm equipment before men finish their activities. The "traditionalist" farmer wants to increase the number of animal drafted plow he has, while the "market oriented" farmer wants to acquire new motorized equipment. In other situations all three power sources may be appropriate: manual, draft animal and motorized.

For sustainable equipment and agro-inputs access, all stakeholders' public, private sectors and farmers should be involved to create an enabling network, in which farmers and other end-users have as wide a choice as possible suited to their needs within a delivery support system.

The Business Model to Access Farm Equipment and Inputs

A win-win relationship should be established between different stakeholders and actors in a network including agro-inputs dealers, agro-equipment suppliers, fabricants, financial services, public sector, distributors, and farmers.

The following figure depicts a model for smallholders' access to equipment and agro-inputs timely at cost effective.

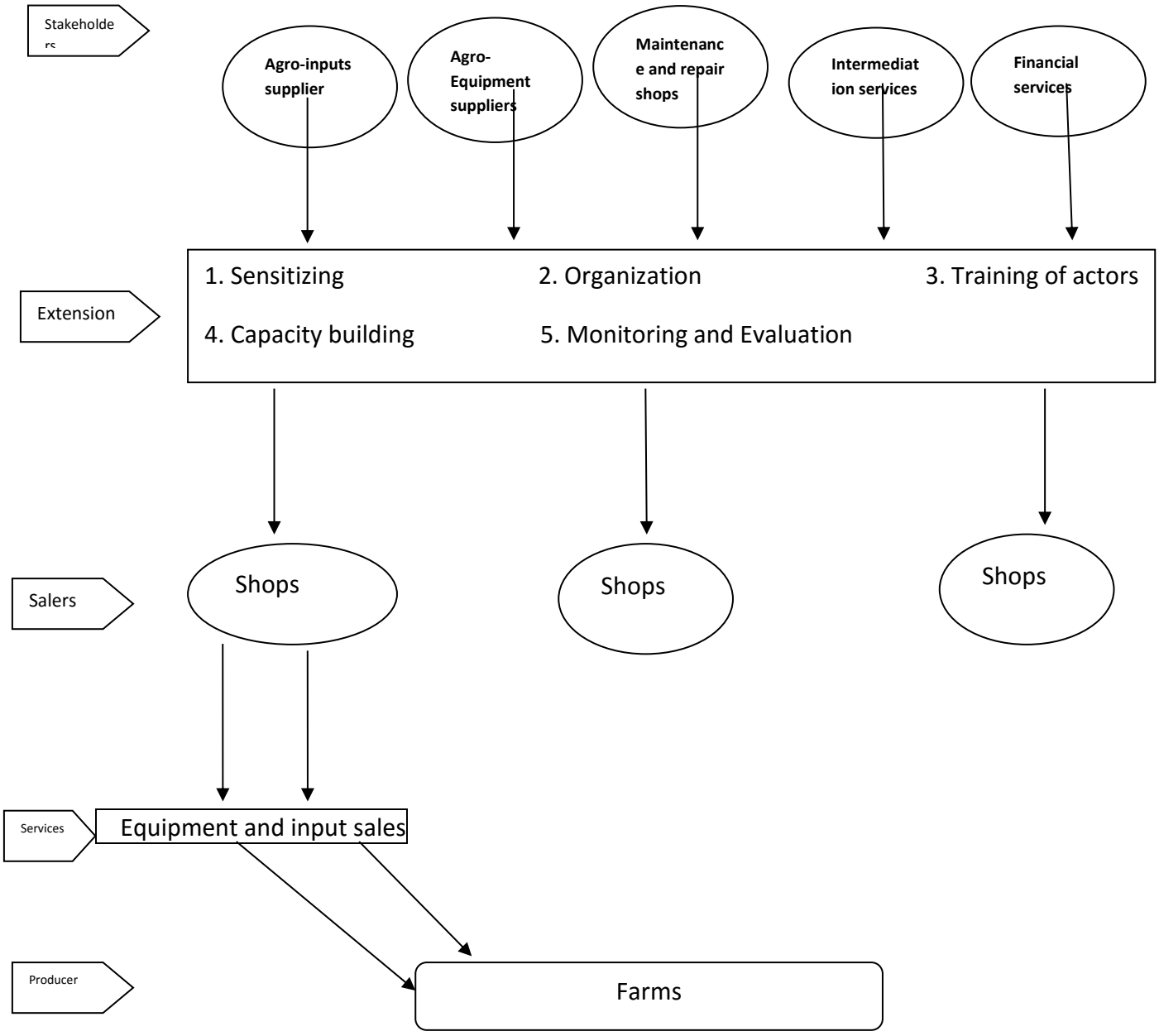


Figure 3: Model to access equipment and agro-inputs

The role of the public and the private sectors

The public sector should facilitate access to farm equipment for smallholder farmers, but not supplying it. Conversely, the private sector should be empowered to supply equipment demanded by smallholders through commercial supply chains. This implies that only viable business models will survive. However, the public sector can play an important supporting role which includes: Promulgating enabling policies such as reduced taxes and import duties on agricultural equipment and inputs; improvement of rural infrastructure; building technical and business management skills through targeted and focused training programs and offering

financial incentives to stimulate demand (preferential interest rates on loans for agricultural machinery purchase).

Other ways to stimulate demand for private sector mechanization services include issuing e-vouchers for mechanization services to the least well-off farms of the smallholder community.

The ways that the private sector can become involved in the supply of equipment and agro-inputs services to smallholder farmers include: Group ownership, whereby several neighboring farmers can unite to form a group that can then invest in agricultural machinery for the use of all members (Uberization). Groups (as opposed to individual farmers) will often gain easier access to credit on more favorable terms, but there are recurrent problems associated with this type of arrangement. Firstly, there is the problem of timeliness—all members will probably require the same machine at the same time. Then, there are the questions of who will operate the machine; who is responsible for maintenance and repairs; and how is that to be funded? However, the model can work in situations where there is mutual respect and confidence. Also, a service provision by an owner of agricultural machinery who satisfies his own needs first and then supplies services to neighbors; or it could be a full-time service provider.

Smallholder farmers need public sector support to sustain and develop their farms. Public sector assistance can be provided in form of financial incentives and subsidies. In addition there is a local manufacturing capacity that can provide a solid technical backup to smallholder farm mechanization.

Conclusions

Smallholder farmers need agro-inputs and equipment to raise the productivity of their land and labor for improving farm family livelihoods. Equipment is not only needed for agricultural production, but along the value chain for farm produce. Equipment alleviates drudgery on farm labor force (men, women and children).

In order to feed the increasing population and diminishing agricultural labor force, sustainable inputs and equipment access should be employed. There is a wide range of appropriate equipment suited to smallholder farming conditions (manual, draft animal and motorized). The important point is to make them available to farmers by involving all stakeholders in the chain. This means including farmers, fabricants, dealers and policy makers. The private sector must be the main supplier of equipment and inputs to ensure sustainability of supply and service into the future.

Equipment on the market are from a variety of sources, but the locally made offer some advantages; because local fabricants focus more closely on local needs. Therefore a constant supply of spare parts and service backup exists.

The public sector should only be involved in facilitating the supply of equipment and inputs to the private sector. Only profitable businesses will survive.

Group ownership is a possibility that can be supported by public sector incentives and training. Service networks close to users need to be put in place such as “UBERIATION”.

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Appendix

Table 4: Evolution of agricultural equipment in Mali

YEARS	2012	2013	2014	2015
Animal drafted equipment	80%	95%	102%	107%
Plow	496024	511000	524959	566500
Donkey Hoes	14976	15169	15363	15400
Multicultors	156600	160900	162235	162300
Seeders	115461	117371	119285	120.000
Carts	709500	809500	973503	1000.000
Draft animals	1082000	1082000	1500331	1600000
Motorized equipment	1,5%	1,6%	1,7%	2 ,5%
Tractors and accessories	1890	2000	2100	3400
Motorcultors	1119	1200	1328	3330
Threshers	1750	2110	2470	4200
Millers	950	1000	1150	1200
Dehullers	1658	2007	2355	3860
Motor-pumps	3930	4000	4150	4500
Plate forme Multifonctionnelle	1160	1200	1300	1300
Mini-rizeries	10	12	28	32

Source: DNGR, Division Mécanisation Agricole 2015

Demand and satisfaction for equipment service

	% who looked for equipment		% successful in finding equipment	
	Rice area	Cotton area	Rice area	Cotton area
	%	%	%	%
Plowing	59	43	91	97
Sowing	55	30	91	95
Weeding	43	20	87	94
Fertilizer use	56	22	92	94
Harvesting	54	24	91	95
Threshing	42	15	89	91