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Chinese Agricultural Machinery for SSA

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EPAR Brief No. 218

Prepared for the Agricultural Policy Team of the Bill & Melinda Gates Foundation

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January 13, 2013

Introduction[1]

Timely access to inputs at key points in the production process is vital to agricultural productivity. In Sub-Saharan Africa, the vast majority of work on small-holder farms is still done exclusively by hand or draught animal power (FAO, 2005)[2]. Agricultural mechanization can drastically increase labor efficiency. However, efforts to promote agricultural mechanization in SSA for smallholder farmers have often been unsuccessful (FAO, 2008). In some cases, the problem is limited access to spare parts and repair services. In other cases, agricultural machines are prohibitively expensive to all but the wealthiest farmers.

Increased concern that African agriculture cannot meet future food demands without also increasing labor efficiency, however, has renewed interest in farm mechanization (Mrema *et al.,* 2008). Of particular relevance to smallholder farmers in SSA is small-scale agricultural machinery that is both more affordable and more easily integrated into smallholder farm production practices. Although data on the use of these technologies in SSA are still largely lacking, anecdotal evidence suggests that adoption of small-scale agricultural machinery has had an impact in some areas, particularly post-harvest technologies (World Bank, 2011). Small-scale tractors have also been adopted in some areas (FAOSTAT, 2012).

China has a well-established and rapidly growing agricultural and machinery sector (Gao, 2006). Due to the large number of Chinese smallholder farmers and the diversity of their crop and livestock production systems, many small-scale agricultural machines on the Chinese market may also be relevant for smallholder farmers in SSA (Sandrey *et al.,* 2010). Furthermore, Chinese public and private economic involvement in Africa's agriculture sector has increased over the last twenty years (Brautigam & Tang, 2009), implying that Chinese small-scale machinery may become an increasingly viable option for raising productivity among SSA smallholder farmers.

Literature on small-scale agricultural machinery is thin, and what constitutes "small-scale" does not appear to be officially defined. In this brief, we concentrate on machines with smaller energy needs (under 20 HP) that can be operated by one person, and that may be relevant for agricultural production (either livestock or crop) by smallholder farmers (farming between one and two hectares of land) in the targeted SSA countries.

This desk study reports on the small-scale machinery sector in China and a selection of SSA countries: Ethiopia, Tanzania, Nigeria, Burkina Faso, and Uganda. The report is organized into three sections. Section 1 discusses the current state of small-scale agricultural machinery in SSA for crop and livestock production in each of the SSA countries identified. It also seeks to identify major areas of need in terms of agricultural mechanization and major constraints to agricultural machinery adoption, dissemination and maintenance. Section 2 focuses on the agricultural machinery sector in China and Chinese Africa relationships in agricultural development. It also identifies the major government players in the Chinese agricultural machinery sector. Section 3 is a "directory" of small-scale agricultural machinery manufactured in China with

[1] Additional research support on this brief was provided by Sissi Du, Qinglian Gao and Mingxing Tu.
[2] See Appendix 1 for more details on this FAO farm power study

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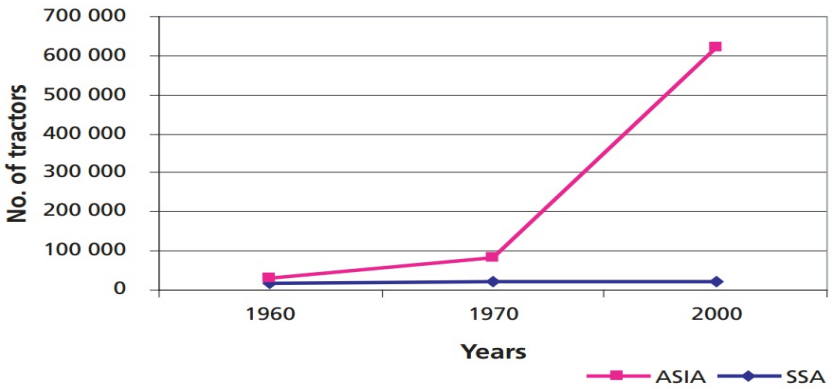
potential relevance for SSA smallholder farmers. We divide machines by function (e.g. threshing) although many Chinese machines are multi-function and can serve multiple purposes. We also note applicable crops, if listed by the manufacturers, and technical specifications as available.

Section I: Small-Scale Agricultural Machinery in Africa

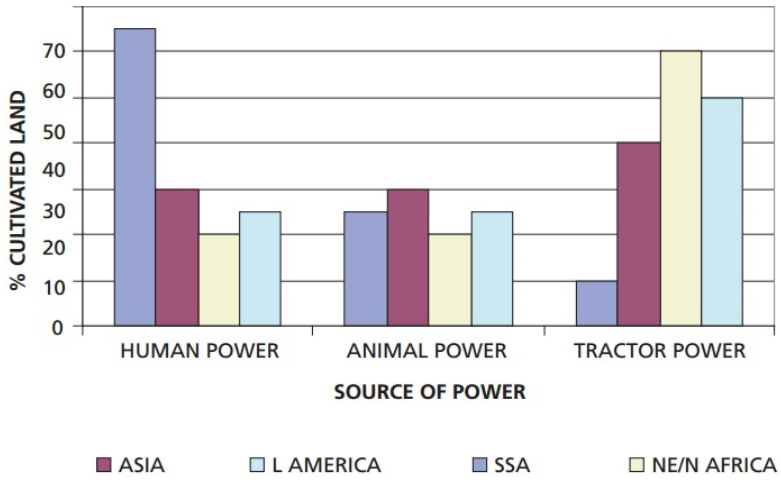
Agriculture is the dominant economic activity in many parts of Sub-Saharan Africa (SSA). However, the level of mechanization in agriculture in SSA is low. A study by FAO in 2005 on farm power reported that the vast majority of farm labor in SSA is done with either hand or animal power (over 90% of area cultivated). Land preparation was the only task where tractors were used by a reasonable proportion of farmers, but this was only in a small number of SSA communities. Even given historically low rates of tractor ownership, the use of tractors in SSA has actually fallen over the past 40 years (Ashburner & Kienzle, 2011).

Figure 1: **Changes in tractor numbers in SSA and Asia, 1961-2000**



*** Sims 2008**

Figure 2: **Comparison of area cultivated by different power sources in Sub-Saharan Africa, Latin America and Asia**



*** Sims 2008**

In Asia and Latin America, by contrast, mechanization has increased dramatically, associated with increased productivity and growth of the agricultural sector in those areas (see *Figure 1* and *Figure 2)*. Yields of maize in SSA, for example, are typically a third of what they are in Latin America and Asia (Ashburner & Kienzle, 2011). In 1980, there were 2 tractors per 1,000 ha of arable land in SSA, compared to 7.8 in the Asia and Pacific region; by 2003, tractor use had declined to 1.3 tractors per 1,000 ha in SSA and increased to 14.9 in Asia.

Past attempts to mechanize agriculture in Sub-Saharan Africa have generally been unsuccessful, but in recent years there has been renewed interest in identifying the causes of those failures and creating more sustainable plans for mechanization.[3] Africa's population is growing and becoming increasingly urbanized; urban residents are expected to exceed rural residents within the next 20-30 years (Ashburner & Kienzle, 2011). Mechanization in agriculture is one means by which farming in SSA may be made more productive, and increase incomes for local smallholders.

Increased concern that African agriculture cannot meet future food demands without also increasing labor efficiency has also renewed interest in farm mechanization (Mrema *et al.,* 2008). Of particular relevance to smallholder farmers in SSA is small-scale agricultural machinery that is both more affordable and more easily integrated into smallholder farm

[3] See, for example, Ashburner & Kienzle 2011, Bishop-Sambrook 2005, Mrema, Baker & Kahan 2008, Sim 2008, Sims & Kienzle 2006

production practices. Although data on the use of these technologies in SSA are still largely lacking, anecdotal evidence suggests that adoption of small-scale agricultural machinery has had an impact in some areas, particularly post-harvest technologies (World Bank, 2011). Small-scale tractors have also been adopted in some areas (FAOSTAT, 2012).

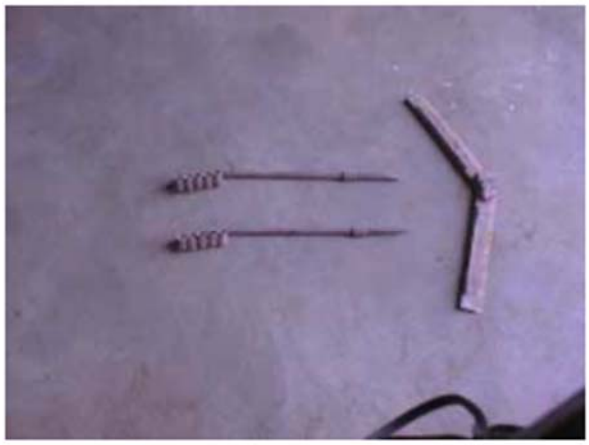
The following section gives an overview of the current use of small-scale machinery relevant to smallholder farmers in Ethiopia, Tanzania, Nigeria, Burkina Faso, and Uganda. Where available, information on the specific types of small-scale machines in each country is included. Also where available, information on the relevance of machines to specific kinds of crops or livestock is included. (Note: There is a wealth of information on mechanization in SSA generally, but information on specific machinery in use in these countries is often scarce. Nigeria appears to have the most machinery in use, though mainly power tillers.)

Ethiopia

Historically, farming communities in Ethiopia have relied on human and draught animal power in agricultural production (FAO, 2005; Lawrence *et al.,* 1993). Because of the heavy use of livestock power in Ethiopian cropping, previous efforts to promote mechanization have focused on livestock technology. Many Ethiopian farmers still use a traditional, and some argue inefficient, "maresha" plow for preparing and weeding land. A number of studies suggested improved, though still non-mechanized, livestock implements might improve labor productivity among Ethiopian farmers (Kebede *et al.,* 2006; Temesgen *et al.,* 2001). These implements included livestock powered ridge tiers, inter-row weeders, improved plows and winged plows (Goda, 2001).

Increased mechanization has also been proposed to improve the efficiency in the Ethiopian dairy industry. A number of studies reported that the use of improved churns might greatly reduce labor demands in butter production. Redda *et al.*(2001) found that use of larger wooden or metal churns reduced butter production time from about 3 hours to 15-20 minutes. An internal agitator that could be inserted into a traditional Ethiopian clay container was also reported to significantly reduce churning labor demands (O'Mahony, 1985; O'Connor *et al.,* 1993).

Figure 3: **Ethiopian Improved Plow (left) and Winged Plow (right)**

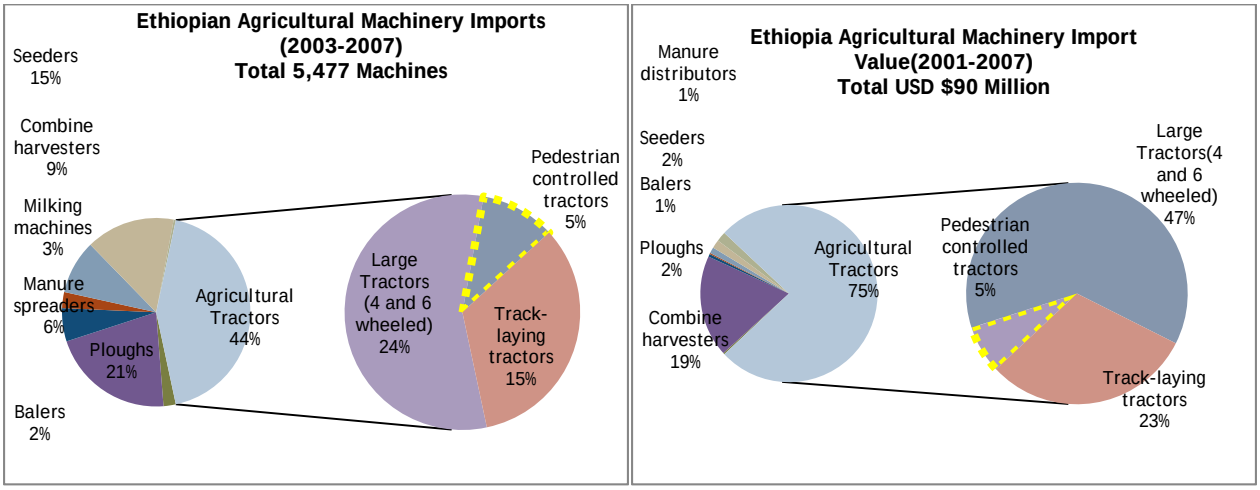


Data on small-scale agricultural machinery use in Ethiopia are limited. Available data from FAOSTAT indicate that small-pedestrian tractors make up approximately 5% of both the value and number of recent Ethiopian agricultural machinery imports (*Figure 4*).

Crop processing post- harvest technology is an area where increased mechanization might have an impact for Ethiopian smallholders growing rice. The Africa Rice Center has prioritized small-scale mechanized rice threshers, among other interventions, as part of their rice development strategy in Ethiopia (Africa Rice Center, 2012; Berhe & Mado, 2005). The Ethiopian Agricultural Transformation Agency (ATA) has also advocated mechanization for weeding, seeding and threshing of tef. In a recent study by the ATA, farmers using tef threshing machines reduced post-harvest tef losses by 50%, valued at roughly $87 per farmer (Fufa *et al.,* 2012). The threshing machine cost roughly $2000 USD and lasted for an estimated 10

years. The threshing machines could be rented for an estimated $5.50 per hour. Assuming the machine would be operable for six months of the year, daily profits for the machine owners were estimated to be about $40 per day. However, the study also cautioned that due to lack of repair service in some localities, some previously purchased tef threshers were not currently in operation (Ibid).

Figure 4: **Recent Ethiopian Agricultural Machinery Imports**



* FAOSTAT 2012

Tanzania

Roughly 70% of Tanzania's arable land is cultivated by hand hoe, 20% by ox plough, and 10% by tractor (Directorate, F.A.N.R., & Secretariat, S.A.D.C. 2008, p. 2). The current government program for agricultural development is known as *Kilimo Kwanza*, or "Agriculture First," and began in 2009. Among other goals, it aims to increase the use of technology and modernize Tanzanian farming. At the moment, there are only 6,000 working tractors in Tanzania, down from 20,000 in 1970 (Maghimbi, Lokina & Senga, 2011). One 2011 survey of 140 rural households (Lyamchai *et al.,* 2011), found that none of the respondents used tractors. The main reason given for lack of tractor use was the steepness of the terrain.
Some areas in Tanzania have higher levels of mechanization. A case study in northeast Tanzania found that 60-70% of farming in the Arusha region was mechanized (Ringo, Maguzu & Mariki, 2007). Small-scale machinery in use included tractor-drawn disc and mouldboard ploughs and animal-drawn implements. Approximately 30-40% of the arable land was farmed using hand hoes. In the 2004/2005 season, out of the 51,575 ha of arable land, 25,787 ha were ploughed by tractors, 23,209 ha by draught animals and 2,579 ha with hand hoes (Ringo, Maguzu, and Mariki, 2007, p. 14).

Table 1: **Cost of conservation implements**
Note: **TSZ 1,000 = USD 1**

Implement	Cost (TZS)
No-till ripper planter	250,000
Ripper with attachments	175,000
Jab planter	45,000
Zamwipe	20,000
Hand hoe	5,000
Panga	2,500
Slasher	2,000

Source: Ringo, Maguzu, and Mariki, 2007, p.23, p.64 (Karatu District farm implement numbers), p.123-4(Mbeya District number)

Of the farmers that do use tractors, most are hired, as tractors are too expensive for an individual farmer to purchase. Other agricultural implements that have been introduced in recent years include rippers, animal drawn no-till ploughs and jab planters. See Table 1 for a list of such agricultural implement prices in Tanzania. The study sourced focused specifically on "conservation agriculture," therefore the list is focused on those implements that have an environmental conservation focus.

Communities in Arusha have limited opportunities for financing the purchase of agricultural machinery. This is due to high supply prices combined with limited capital, agricultural credit facilities, competitive financing, and organized farmer groups (Ringo, Maguzu, and Mariki, 2007, p. 15).

Nigeria

A recent IFPRI study (2010) reported that agricultural machinery use in Nigeria was still low, with the vast majority of farmers relying primarily on hand power to carry out agricultural production (Takeshima & Salau, 2010). However, the government of Nigeria is currently making an effort to promote small-scale agricultural mechanization, although the scope of this effort is unclear. Under the Federal Ministry of Agricultural and Rural Development, the Nigerian National Centre for Agricultural Mechanization (NCAM) is currently promoting a number of small-scale machines designed for smallholder farmers. Although data on small-scale machinery use in Nigeria are still relatively limited, available research indicates that there has been some adoption of small tractors by Nigerian farmers, particularly rice-growers, in some areas.

NCAM was founded in 1990 in Llorin, Kwara State, with the mandate of "accelerating the pace of mechanization in the agricultural sector." According to its website[4], NCAM is currently promoting a number of improved hand implement and machines suitable for small-holder Nigerian farmers. Many of the machines are for cassava planting, harvesting and processing. Appendix 3 gives a sampling of machine images downloaded from the NCAM website. Further information on NCAM's budget and capacity, use of NCAM machines by Nigerian farmers, or pricing and specifications of NCAM machines was not available.

According to one definition (Fashola *et al*., 2007) in a study in Nigeria, "small tractors" are characterized by simple construction with mass-produced components, local assemblage when possible, safe and easy operation and maintenance, rugged construction, reliability, increased efficiency compared to animal labor, and a low start-up cost within reach of a smallholder farmer. Names used for tractors that fall under this category include two-wheel tractors, single-axle tractors, hand tractors, walking tractors, and walk-behind tractors. When a tillage implement is attached to a two-wheel tractor, it is called a power tiller. These types of tractors can be used for a variety of tasks in the production cycle, including tillage, planting, harvesting, and transportation. See *Table 3* for an overview of the characteristics of typical two-wheel tractors, based on an analysis of manufacturer catalogues from Europe and Asia.

Table 3: **Characteristics of two-wheel tractors**

Category	Dimensions (LxWxH, mm)	Track width (mm)	Clearance	Mass (kg)	Maximum traction (kN)	Speed (km/h)	Power (kW)	Engine
I	1500x410x1000	315	150	45-60	.3-.5	1.55	2.7-4	2- or 4-cycle gas or diesel
II	530-830x1800x1230	400-700	200	75-148	.6-1.2	1-12.6	5-7	4-cycle gas or diesel
III	1900-2680x560-960x800-1250	400-750	200	175-465	1.37-3.7	1-16.3	8-10.2	

Source: Fashola, Ademiluyi, Faleye, et al., 2007

Power tillers are effectively the only power tools currently being used for rice production in Nigeria, and demand for them has been high in the country since at least the early 2000s (Ademiluyi, Oladele,& Wakatsuki, 2009). Power tillers were re-introduced into Nigeria in 2001 by Watershed Initiatives Nigeria, who imported them for use in rice production (Ademiluyi & Oladele, 2008). They are relatively simple, inexpensive, and can be used in soft or muddy soil due to the small, lightweight design. Power tillers can be used for a variety of activities, including ploughing, puddling, leveling, and transportation. They can also be used to power other machines, including threshers and millers. They have an average lifespan of four to five years, sometimes longer if used only for paddy field land preparation. Power tillers can typically cultivate over 40-50 ha of land per season, and can be operated eight hours per day (Ademiluyi, Oladele & Wakatsuki, 2009).

Figure 5: **A power tiller in use in Nigeria for "puddling" and leveling**

* *Source:* http://www.kinki-ecotech.jp/download/kibanS/WIN-Nigeria.pdf

[4]Further information on NCAM available at http://ncam.gov.ng/index.php/home

Power tillers can be operated by a smallholder farmer after a short training course, and repairs are usually handled on-the-spot by the operator (Ademiluyi & Oladele, 2008). Regular maintenance includes cleaning after daily operation, re-tightening bolts, checking the water and fuel levels daily, and changing the engine oil every two to six days.

Figure 6: **VST - Shakti 130 DI Power Tiller**

* http://www.vsttillers.com/tillers/vst-shakti-130-di-power-tiller

One report (Fashola, Ademiluyi, Faleye, et al., 2007) evaluated the performance of a particular walking tractor (or power tiller) for use in rice production in Nigeria. The tractor was used at two sites over a period of five years. The walking tractor evaluated was an Indian-made model from VST Tillers Tractors Limited, seen below, called the VST-SHAKTI 130 DI (*Figure 6*). The study does not clarify why this particular walking tractor was chosen. The engine of this model is a 10 kW (13 horsepower) diesel engine, single-cylinder, water-cooled, and hand-cranking, with a 2400 rpm crankshaft speed. See the below link for more detailed specifications. See *Table 4* for key results of the walking tractor evaluation, and *Table 5* for usage and price statistics from the same evaluation.

A second article (Ademiluyi, Oladele, & Wakatsuki, 2009) using the same walking tractor evaluation, found that the walking tractor improved the quality of the soil at the two sites.

Table 4: **Field performance of the VST-SHAKTI 130 DI power tiller at two sites in Nigeria**

Parameter	Ejeti site	Shaba Maliki site
Effective field capacity (ha/hr)	.0470	.0888
Theoretical field capacity (ha/hr)	.0504	.0962
Field efficiency (%)	93.37	91.96
Working speed (km/hr)	2.66	2.66
Fuel consumption (L/ha)	11.19	12.91
Fuel consumption (L/hr)	.537	1.122
Average time of operation (hr/ha)	21.70	13.15

Table 5: **Annual use of the VST-SHAKTI 130 DI power tiller at two sites in Nigeria**

Year	Total annual use (hr)	Total annual coverage (ha)	Repair and maintenance cost per annum (₦)	Cost of fuel per annum (₦)	Total cost of operation per annum (₦)	Hiring cost per annum (₦)
2002	80	5	10,000	2,722.5	27,554.75	15,000
2003	120	10	10,000	6,050	32,855	40,000
2004	160	16	10,000	11,616	51,338	80,000
2005	220	25	35,000	25,606	132,466	175,000
2006	120	22	32,444.50	23,958	81,178	154,000

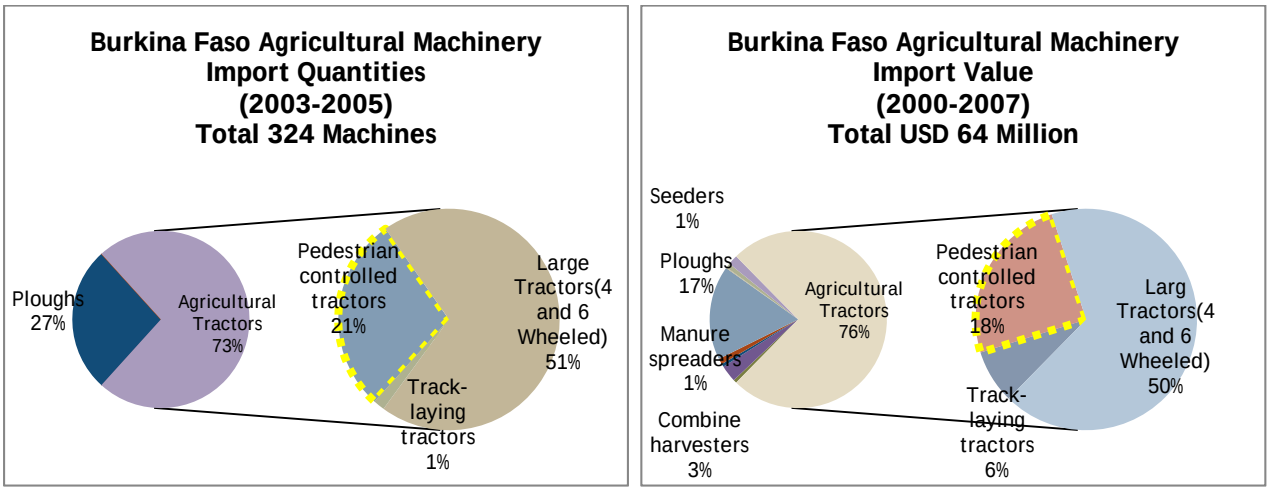
Burkina Faso

Farm labor in Burkina Faso is primarily done by hand. A joint study by IFAD and FAO estimated that only 5% of farmers on Burkina Faso's Central Plateau region had access to draft animal power (FAO/IFAD, 1998). The study found that the two main hand-held farm implements available to farmers were the "daba," a traditional hoe, and the "pioche," a traditional pickaxe (*Figure 7*). Small local blacksmiths were the primary producers of these traditional farm implements, which are generally made with low-quality materials (Ibid).

Figure 7: **"Daba" traditional hand hoe**

According to World Bank statistics, Burkina Faso had only 2.4 tractors for each 100 KM of arable land in 1990 (World Bank, 2011). A paper by Oudraogo *et al.* (2010) reported that due to increased investment in agribusiness in the province of Sissal, mechanized tractors were currently in use in large scale (40-100 Ha) maize and cashew farming enterprises. Data on small-scale machinery use in Burkina Faso are limited, however, FAO data suggest there is some limited use of small-scale pedestrian tractors (*Figure 8*). Between 2003-2005, Burkina Faso imported roughly 324 agricultural machines of which 21% were pedestrian tractors (FAOSTAT, 2012). From 2001-2007, the value of Burkina Faso agricultural machinery imports was an estimated USD $64 million, of which 76% was agricultural tractors; only 18% of the import value was pedestrian tractors.

Figure 8: **Recent Burkina Faso Agricultural Machinery Imports**



*Source FAOSTAT, 2012

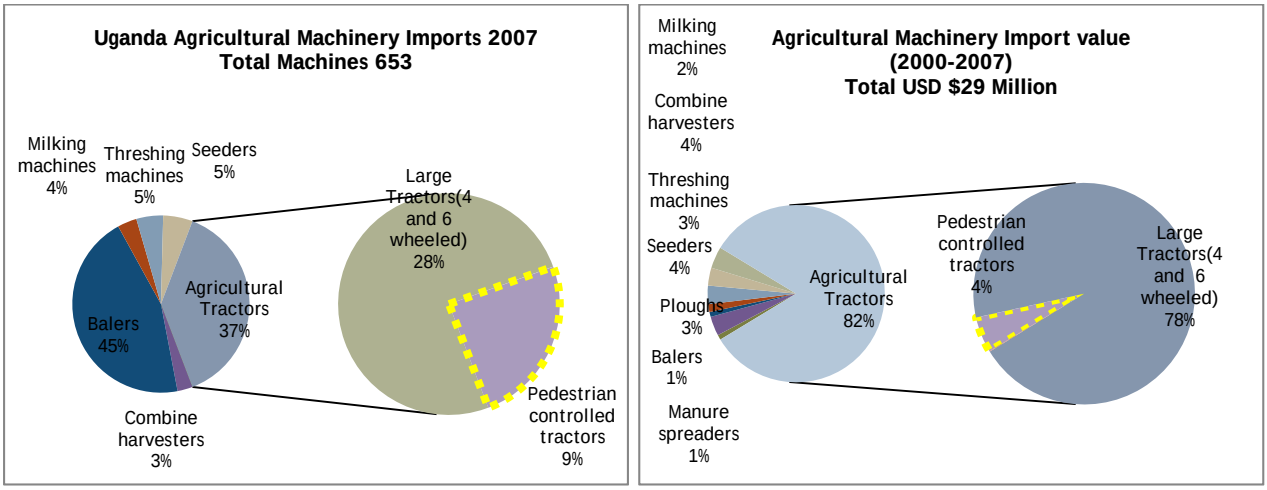
Uganda

As in other countries examined in this report, the majority of smallholder farmers in Uganda use hand implements (hoes and axes) for crop production, with very limited access to mechanized farm equipment (Johansson, 2012). Only 1.2% of agricultural production is accomplished with a tractor, as opposed to 10.2% with animal power and 88.6% with a hand hoe (Candia, Mugenyi, and Kavuma, 2011, p.7).

Mechanization has also not increased significantly in recent decades. During 1990-1994, farmers in Uganda used nine tractors per 100 square kilometers. From 2005-2008, that figure remained the same (Baffes and Onal, 2012). Most smallholder farmers that do use tractors hire them, due to the prohibitive cost of owning a tractor. In one survey in the Hoima District in Western Uganda, the researcher found that 10% of local households hired either tractors or ox-ploughs to assist with land preparation (Adur, 2007). Key constraints that inhibit mechanization in Uganda include limited access to affordable machines, limited access to financial services, lack of information among farmers about mechanized farming, and the belief among some farmers that mechanization causes soil degradation (Candia, Mugenyi, and Kavuma, 2011).

Figure 9 presents recent machinery import statistics from Uganda. Pedestrian controlled tractors represented 9% of the volume and 4% of the value of agricultural machinery imports in 2007.

Figure 9: **Recent Uganda Agricultural Machinery Imports**



Section II: China

The following section describes the Chinese small machinery sector, including farm mechanization levels in China, Chinese agricultural machinery exports, and agricultural machinery R&D, though data on small-scale machinery in China are scarce. We also include a very brief discussion of recent Chinese investment in and aid to Africa, the Chinese government's framework for engaging in African agriculture, and a discussion of Chinese development financing arrangements. Finally, the section highlights Chinese investments in agriculture in the selected African countries: Ethiopia, Tanzania, and Nigeria.

Chinese Small-Scale Agricultural Machinery Sector

The level of farm mechanization in China has increased dramatically over the last ten years. According to 2008 statistics, mechanized land preparation was used on roughly 91 million hectares of land, representing 62% of total farmland. Mechanized sowing and harvesting was used on 59 and 47.5 million hectares, representing 38% and 31% respectively of total agricultural land (Soni & Ou, 2010) (see Appendix 2 for tables). Data specifically on the Chinese small-scale agricultural machinery sector are limited, however, available evidence suggests that small-scale machinery use in China is increasing. A study by the United Nations Asian and Pacific Centre for Agricultural Engineering and Machinery (Soni & Ou, 2010) reported that from 2000-2008, small tractor ownership in China increased from about 12.6 to 17.2 million units. Over the same period, ownership of small towing tractors increased from 17.9 to 27.9 million units. [5]

Chinese Small-Scale Agricultural Machinery Exports

In 2009, the China Chamber Of Commerce for Import and Export of Machinery and Electronic Products (CCCME), reported that China exported 59 types (by custom codes) of agricultural machinery, 50% of which were small-scale machinery. The export value of small electrical machinery was $4.38 billion, about 9% of the total agricultural machinery export value.

Analysis of Chinese export data indicates that China exports some small-scale machinery to Africa. In 2008, exports of walking tractors to Africa reached 4,412 units, with an average cost per-tractor of US $938 (Sandrey *et al.,* 2009).

Chinese Agricultural Machinery R&D

In 2007, Chinese investment in R&D of agricultural machinery was an estimated 663 million RMB (approximately US $106 million) and represented 2.7% of total agricultural R&D investment (Chen & Zhang, 2011). This may underestimate

[5] Industry reports available for purchase were not consulted in this study, but might offer additional insight into the small-scale machinery sector in China. For example "Global and China Agricultural Machinery Industry Report, 2011-2013" Available at http://www.researchinchina.com/htmls/report/2012/6570.html

agricultural machinery R&D investment, however, because data were only available for investment in public research institutes.

A number of Chinese governmental and international organizations are focused on developing the Chinese agricultural machinery sector, though detailed information on specific R&D activities is limited. Furthermore, while agricultural machinery development is identified as a goal of each the organizations below, it is not clear to what extent *small-scale* machinery development is a priority relative to other mechanization development goals.

- *Chinese Academy of Agricultural Mechanization Sciences (CAAMS):* CAAMS is a large government institute focused on the research and development of agricultural machinery products. Research areas of interest include field machinery (e.g. tillers, transplanters, and seeders), harvest and post-harvest processing machinery (e.g. combine harvesters, pickers, grain drying machines) and water saving irrigation technologies. CAAMS promotes a mix of large and small-scale agricultural machinery products.
  Website: http://www.caams.org.cn/

- *Chinese Ministry of Science and Technology (MOST):* MOST is focused more broadly on Chinese science and technology development and is largely responsible for setting national technology development priorities and allocating government R&D funding (Chen & Zhang, 2011). Under the current Key Technologies R&D program, which provides the national blueprint for technology development, MOST has stated that one of its principle goals is to "upgrade technical levels in agricultural pre-production, production and post-production."
  Website: http://www.most.gov.cn/eng/programmes1/200610/t20061009_36224.htm

- *China Agricultural Machinery Testing Center (CAMTC):* CAMTC is under the Chinese Ministry of Agriculture and is responsible for testing and developing agricultural machinery and managing the "catalog" of agricultural machinery products with official state approval.
  Website: http://english.agri.gov.cn/ga/amoa/iumoa/200906/t20090625_1251.htm

- *United Nations Asian and Pacific Centre for Agricultural Engineering and Machinery (UNAPCAEM):* UNAPCAEM is devoted to promoting sustainable mechanization throughout Asia to further the poverty alleviation objectives of the Millennium Development Goals. UNAPCAEM promotes agricultural machinery development through providing technical assistance and facilitating regional cooperation and networking.
  Website: http://www.unapcaem.org/

Policy Framework for recent Chinese Government Engagement in African Agriculture

First convened in 2000, the Forum on China Africa Cooperation (FOCAC) has become the roadmap for Chinese government engagement with African agriculture. After the 2006 FOCAC meeting, President Hu Jin Tao agreed to increase aid to Africa and take the following actions to promote African agricultural development (Sandrey & Hannah 2009).

1. Send Chinese agricultural experts to Africa to provide technical support and guidance.
2. Set up fourteen agricultural demonstration sites in Africa.
3. Create the China Africa Development (CAD) Fund, under the China Development Banks, to facilitate Chinese private sector investment in Africa.

The countries selected to receive demonstration farms were: Benin, Cameroon, Congo, Ethiopia, Liberia, Mozambique, Rwanda, South Africa, Sudan, Tanzania, Togo, Zambia and Zimbabwe. The CAD Fund received an initial cash infusion of $1 billion, with the plan of increasing to $5 billion dollars in the future.

Chinese Aid to Africa and investment in African Development

Chinese economic involvement in Africa, by both the public and private sector, has increased dramatically in recent years. At the end of 2009, China had provided a total of $37.7 billion dollars in aid[6] to foreign countries (State Council, 2011).

[6] Aid includes grants, interest free loans, and concessional loans.

From 2004-2009 aid disbursement grew at an annual rate of 29.4% (Brautigam, 2011). In the 2009 fiscal year, an estimated 46.7% of Chinese aid went to Africa (Ibid).

Table 6: **The changing dynamics of Chinese investment in Africa.**

Table 1: Growth stages of Chinese companies in Africa

Stages	*Main features*
Stage One: 1949–1980s	Limited number of Chinese companies, mainly implementing Chinese Governments development Aid Projects
Stage Two: 1980s – mid-1990s	Large national and provincial level state-owned trading companies, closely associated with diplomatic agenda; few private companies.
Stage Three: Mid-1990s–2000	Emergence of large state-owned enterprises (SOEs) mainly resource-seeking, strategic asset-seeking, and infrastructure investments; Increasing number of private companies start exploring African market.
Stage Four: 2000–2005	Expansion of large SOEs and private companies; emergence of clustering development strategy, e.g. Trade zones; industry parks.
Stage Five: 2005 – Present	Acceleration of private companies in various sectors and continued expansion of SOEs; the development of clustering industry strategy.

Source: China–Africa Project Survey.

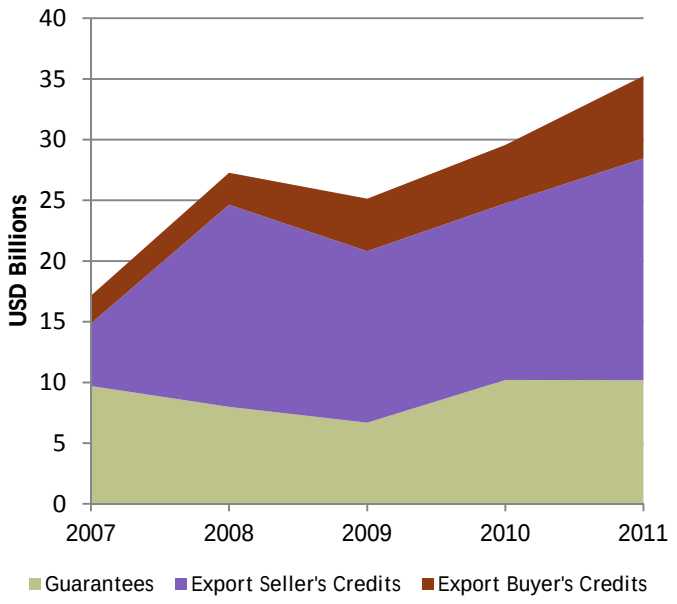
***** Source: Gu 2009

Chinese Foreign Direct Investment (FDI) in Africa has also increased dramatically, from $56 million in 1996 to $4.46 billion in 2007 (Renard, 2011). While previous Chinese involvement in Africa was often confined to state owned enterprises (SOE), recent years have seen increased private sector Chinese investment in Africa (Gu, 2009). In Ethiopia for example, many small to medium sized Chinese firms have invested in leather and textile enterprises (Brautigam & Tang, 2012).

Increased Chinese economic involvement in Africa has been partly facilitated by financing from two major government banks, the China EXIM Bank and the Chinese Development Bank (CDB)[7]. Chinese African investments have often supported the acquisition of natural resources (Reisen, 2007), including oil (Hanson 2008), land (Cotula, 2009), and minerals (Haglund, 2008) in exchange for local infrastructure development. In the wake of the 2006 Forum on Africa-China Cooperation, there has been an increasing emphasis on investment in African agricultural and agribusinesses (Brautigam & Tang 2012a, 2012b).

The banks use a number of tools to encourage foreign investments, including export sellers credits, export buyers credits, guarantees and loans at competitive commercial rates (Brautigam, 2009b). Export sellers credits are preferential loans for Chinese companies that operate abroad. Export buyers credits are issued to importers of Chinese products, facilitating the purchase of Chinese goods on credit, with interest generally set at competitive commercial rates (Ibid). Guarantees help international buyers to gain competitive financing at rates that might not otherwise be available.

Figure 10: **China EXIM Bank Disbursement 2007-2011**



* Source: China Exim Bank Annual Report 2011. Monetary values converted to USD using World Bank Reported Annual Official Exchange Rates. (Does not include concessional loans, for which not data is provided or import credits.)

Figure 6 shows the disbursement of the China EXIM bank from 2007-2011. In 2011, the China EXIM Bank disbursed roughly $32 billion in export sellers credits, export buyers credits and guarantees. Roughly 52% of the China EXIM Bank portfolio was export credits; export buyer's credits and

[7] In reality, the banks make financing decisions with input from a number of other branches of the Chinese government, including the Ministry of Commerce and the Ministry of Foreign Affairs. For me information on these institutional arrangements, see Brautigam, 2009b, Chapter 4.

guarantees represented 29% and 18% respectively (China EXIM Bank Annual Report, 2011). The EXIM Bank does not disaggregate financing by destination and as a result we have not included an estimate of financing going to Africa.

The CDB generally offers non-concessional development finance (Brautigam, 2009b). CDB non-concessional loans to Africa have increased in recent years. In 2007, the CDB reported financing 30 African projects, with financing valued at $1 billion. In 2010, the bank reported financial commitments to Africa valued at $10 billion, with $6.5 billion already disbursed to 35 projects throughout the continent (Brautigam, 2011).

Chinese involvement in African Agriculture: Ethiopia, Tanzania & Nigeria

Despite limited information on Chinese involvement in small-scale agricultural machinery enterprises, two recent IFPRI studies have reported on Chinese involvement in agricultural development in Tanzania and Ethiopia. The following sections report selected results of these IFPRI studies, as well as the results of our review of literature on Chinese involvement in Nigeria. Detailed information on Chinese agricultural investments in Burkina Faso and Uganda was not found.

Ethiopia

A recent IFPRI study on Chinese involvement in Ethiopian agricultural development found that China has strong ties to Ethiopia's agricultural sector, through both public and private sector investments (Brautigam & Tang, 2012a). Recent official government efforts have included an agricultural demonstration farm, agricultural trainings by Chinese agricultural experts and a textile plan upgrade. The report found that Chinese foreign investment in Ethiopian enterprises was lower than expected, primarily because the vast majority of proposed farming and agri-business proposals filed with the Ethiopia Investment Agency (EIA) by Chinese firms had not translated into actual investment. **Although it is only in the planning stages, one Chinese firm has signed a letter of intent to open an agricultural machinery factory in Ethiopia.** The following is a selection of Chinese investments in Ethiopian agriculture from the IFPRI study.

- **Changfa Agricultural Machinery Factory** (**Under Discussion):** The Chinese Changfa Group, a company from Changzhou, Jiangsu Province has signed a letter of intent to open an agricultural equipment factory to assemble tractors, combines and rice transplanters in Ethiopia's Eastern Industrial Zone. The company is currently seeking an Ethiopian joint venture partner.
- **South-South Cooperation Program:** In 2009, China set up a trust fund with the FAO of $30 million to support agricultural improvements in developing countries. Part of this money will be used to fund a $1.5 million Ethiopian agricultural productivity improvement program in the high potential regions of Oromia, Tigray and Amhara.
- **Agricultural Technical and Vocational Education and Training (TVET):** Since its inception in 2001, the TVET has brought more than 200 Chinese agricultural experts to conduct training at Ethiopian rural training facilities. The program was proposed and first implemented by a former Ethiopian Minister of Agriculture who had received his agricultural training at Beijing University.
- **Chinese Agricultural Demonstration Center:** In the wake of the 2006 FOCAC meeting, China agreed to set up 14 agricultural demonstration centers. The Ethiopian center will be an agricultural education facility in which Chinese agricultural technicians will train Ethiopian farmers in the cultivation, packaging and marketing of horticulture products for the export market. Construction of the facility has begun, but is not yet complete.
- **Textile and Leather Manufacturing:** Between 2000 and 2010, a number of large and medium size Chinese firms have invested in textile and leather manufacturing operations in Ethiopia.

Tanzania

An IFPRI report on Chinese involvement in Tanzanian agricultural development found a long history of official cooperation in rural development efforts between Tanzania and China (Brautigam & Tang, 2012b). However, there was little recent Chinese private sector investment in Tanzanian agricultural enterprises. The following is a selection of recent Chinese investments in Tanzanian agriculture identified in the IFPRI Study.

- **Agricultural Machinery Donations:** In 2005, China donated $123,615 of agricultural machinery to Tanzania, including three heavy-duty tractors, seven power tillers, two milling machines, and two water pumping systems.

- **Agrotechnology Demonstration Center:** In the wake of the 2006 FOCAC meeting, China agreed to set up 14 agricultural demonstration centers. The Tanzanian demonstration center will focus on improved seed technology, but will also include a modern egg and poultry complex, and a training center. The facility opened April of 2011. Initial tests of Chinese rice varieties produced yields 4 times higher than local Tanzanian varieties.
- **China State Farm Agricultural Company of Tanzania Sisal Farm:** This project was initiated in 1999 after an initial investment of 3.2 million dollars, and a loan from the China EXIM Bank of 9 million dollars. The farm now operates on roughly 1,200 hectares and is the second largest sisal farm in Tanzania.
- **Suzhou Pesticide Factory:** Since 2005, a Chinese company from Suzhou has manufactured pesticide and herbicides for wholesale. The investment is approximately $2 million.
- **Honey out-grower scheme:** A Chinese company, Honey King, will finance bee hives to be provided to local farmers but will charge approximately $50 per hive, with the beekeepers paying for the hives over time in honey, "without interest." It will also provide training for the local beekeepers, which it believes will increase production from 20 kg per box to 50 to 80 kg/box. As of 2012, honey production had yet to commence.

Nigeria

Nigeria and China have a longstanding trade and diplomatic relationship, although Chinese investment in Nigerian agriculture appears to be relatively limited. A 2011 study by the OECD reported Nigeria was China's 4th largest African trading partner, with total trade value of $17.7 billion (Egbula & Zheng, 2011). The majority of Chinese investment in Nigeria has been concentrated in energy, manufacturing and telecommunications (Taylor 2007, Ogunkola *et al.,* 2008). There is some indication that Nigerian agriculture may become a more important target of Chinese investment in the future.

- **Rice Processing Plants:** The Nigeria Federal Ministry of Agriculture and Rural Development have concluded arrangements with China EXIM Bank to procure 100 integrated rice processing plants from China.[8]
- **Agricultural Machinery Factory in Kogi State:** The Government of Kogi recently announced that it had set aside $23 million and 100 Ha of land for a farm equipment factory to be built by a Chinese firm (Egbula & Zheng, 2011)
- **Chongqing Seed Corporation:** The OECD (2011) reported that China's Chongqing Seed Corp employed local Nigerian farmers to cultivate hybrid Chinese rice varieties on a 300 Ha farm, with half of the rice to be exported back to China and half to be marketed locally (Egbuala & Zheng, 2011)
- **South-South Cooperative Program:** The South-South Cooperation initiative between China, Nigeria and the FAO aims to send 500 hundred agricultural experts to improve agricultural productivity and water management. More than 400 experts have already travelled to Nigeria to work on a number of dam projects (Egbula & Zheng, 2011)
- **Nigeria Ogun-Guangdon Free Trade Zone:** The free trade zone in Ogun State, set up in 2004, is currently devoted to manufacturing construction materials, ceramic, ironware, furniture, wood processing, medicine, small home appliances, computers and more. However, the zone may be slated to receive a high-tech agricultural demonstration park in the future (Brautigam, 2011b).

Section 3: Directory of Small-scale Agricultural Machinery with Potential Relevance for SSA

Introduction

Smallholder farmers in China (less than 2 hectares of land), often use small-scale agricultural machinery (Xu & SU, 2010). Smaller machinery is likely chosen for economic and technical reasons, because many farms in these regions are located on sloped, highland terrain where larger machines are not feasible (Ibid). Smallholder farmers in these areas often grow rice, wheat, sorghum, maize, and pulses which are also prevalent in SSA countries such as Ethiopia (Schneider & Anderson, 2010). Chinese made small-scale, and relatively low cost, agriculture machinery tailored to these production environments are widely used in China, and may be suitable to meet the needs of African smallholders.

China has a diverse and active agricultural machinery market, with many companies manufacturing similar types of machinery. The machinery in the directory was identified from online searches of major Chinese agricultural machinery sellers and manufacturers. Important sources included:

- Chinese Academy of Agricultural Mechanization Sciences (CAAMS)

[8] Per communication with BMFG Program Officer Kate Kuo in November 2012.

- Alibaba.com
- Sinofarm.net
- Sinofeed.net

Micro Soil Tillage Machines

Micro soil tillage machines (walking tractors), powered by gas or electricity, can be used on both sloping and flat lands, and may drastically reduce labor demands of preparing land and weeding compared to hand power. Micro soil tillage machines are made by a large number of manufacturers across China. Below is a representative Chinese walking tractor.

Specifications	
Product Name: IZ-23 walking Tractor	
Company: Zhuzhou Modern Agricultural Equipment Company	
Link: http://www.caams.org.cn/products/xdnmyzb/gzjx/2011/05/2876.shtml	
Price	Quotes available upon request to manufacturer
Dimensions (L × W × H)	1960 × 760 × 1070(mm)
Weight	159 kgs
Power Usage 12 hours	2.94 KW
Transmission Type	Manual transmission
Tilling Depth	10 ~ 15 cm
Tilling width	23 cm

Picture 1: Walking Tractor

Specifications	
Product Name. LP-81Y	
Company: Weifang Lampak	
Link: http://www.walking-tractor.com/sdp/1236687/4/pd-5565109/8036403.html	
Price	Quotes available upon request to manufacturer
Dimensions (L × W × H)	2180× 890 × 1250(mm)
Weight	215
Crankshaft speed	2600 rpm

Picture 2 Walking Tractor

Other Examples of Micro-Soil Tilling Machines

Product	Link
3ZP320B	http://www.caams.org.cn/products/xdnmyzb/gzjx/2011/05/2874.shtml
1GQ-130	http://www.caams.org.cn/products/xdnmyzb/gzjx/2011/05/2875.shtml

Seeding and fertilizer machinery

Picture 3: Multi-Crop Planter and Fertilizer Distributor

Specifications	
Product Name: 3WG5 Small Planter/ Fertilizer Distributor	
Company: Weifang Three Country	
Link: http://www.nongji360.com/company/shop2/product_38795_155899.shtml	
Price	$321
Dimensions (L × W × H)	1280 x 600 x 900(mm)
Crops: Maize, Wheat, Peanuts, Vegetables	

Picture 4: Cassava Planter

Specifications	
Product Name: CASSAVACN-2 cassava planter fertilizer	
Company: Nanning Langwo Agricultural Science and Technology Co.	
Link: http://cassavacn.icn.caexpo.cn/ibooth/productShow.shtml?productid=144273	
Price	$126
Horsepower	60
Planting row space	.8-1.2 Meters
Fertilizer Capacity	220 Kgs
Weight	570 Kgs
Crops: Cassava	

Specifications	
Product Name: Maize and Millet Planter	
Company: Shouguang Agricultural Machinery Company	
Link: http://detail.china.alibaba.com/offer/1035719572.html	
Price	Quote Unavailable
Productivity	9.9 ha/hour
Number of Rows	3
Sowing Depth	50-70mm
Weight	570 Kgs
Crops: Millet, Maize	

Picture 5: Millet and Maize Planter

Harvest machinery

Picture 6: Multi-Crop Harvester

Specifications	
Product Name: 4G120 Multi-Crop Harvester	
Company: Yangcheng Mingya Company	
Link: http://www.5u-jixie.com/product/132821406796702.htm	
Price	Quote Unavailable
Dimensions	2.15 x 1.5 x 1 (mm)
Crop Loss Rate	1%
Power Type	5 Watts(Diesel)
Weight	246Kgs
Crops: Sorghum, Wheat, Maize, Rice, Soybean, Pepper, Tobacco	

Picture 7: Multi-Purpose Crop Harvester

Specifications	
Product Name: 40-5 Multi-Crop Harvester	
Company: Chen Chen Tools	
Link: http://detail.china.alibaba.com/offer/983328981.html	
Price	$80
Dimensions (Diameter x Thickness)	28 x 2 (mm)
Power Type	1.85 KW(Gasoline)
Power Supply	5 Watts(Diesel)
Crops: Maize, Wheat, Rice, Straw	

Crop Processing Machinery

Picture 8: Corn Threshing Machine

Specifications	
Product Name: JG-022 Maize Thresher	
Company: SEIKO Mechanical Plant	
Link: http://detail.china.alibaba.com/offer/1171063499.html	
Price	$50
Dimensions	600 x 300 x 600 (mm)
Weight	20 kgs
Processing speed	1000-2000 kg/hour
Power Supply	220 Volts
Crops: Maize	

Specifications	
Product Name: SLDG-6 Peanut Harvester	
Company:	
Link: http://detail.china.alibaba.com/offer/1180121947.html	
Price	$160
Dimensions	560 x 460 x 800 (mm)
Weight	40 kgs
Processing speed	1000-2000 kg/hour
Power Type	2.2-3KW(electric, diesel, gasoline)
Crops: Peanuts	

Picture 9: Small Peanut Harvester

Specifications	
Product Name: DH-MGM15 Small Miller	
Company: Danhua Mechanic Limited Corporation, Changzhou	
Link: http://detail.china.alibaba.com/offer/1036297001.html	
Price	Quote Unavailable
Power Type	Electricity
Dimensions	355 X 245 X 400 (mm)
Weight	15-16kg
Processing capacity	5-100 (kg/h)
Crops Processed: Rice, Wheat, Tomato, etc.	

Picture 10: Grain Millers

Specifications	
Product Name: Corn Thresher 5TY-600	
Company: Danhua Mechanic Limited Corporation, Changzhou	
Link: http://detail.china.alibaba.com/offer/1060319221.html	
Price	Quote Unavailable
Power Type	Electricity
Dimension:	800*480*810 (mm)
Weight:	170/200kg
Processing capacity:	500-1100kg/h
Crops Processed: Corn	

Picture 11: Corn Thresher

Specifications	
Product Name: GFSJ-16 Corn Miller	
Company: Guibao Company, Jiangsu	
Link: http://detail.china.alibaba.com/offer/1176219964.html	
Price	$5120
Power Type	Electricity
Dimension:	1000 X 2400 X 4400 (mm)
Weight	250kg
Processing capacity	50-300kg/h
Crops Processed: Corn, or other crops are all suitable for miller	

Picture 12: Corn Miller

Animal Fodder Grinding Machines

Picture13: Fodder Grinder

Specifications	
Product Name: 9FZ350 Fodder Grinder	
Company: Guangdong Xinfeng Machinery	
Link: http://www.nongji360.com/company/shop2/product_33518_260127.shtml	
Price	Around $160
Power Type	Electricity or Diesel
Makes Fodder Suitable for: Cows, Goats	
Crops Processed: Maize, Beans, Rice, Tubers, Grass	

Specifications	
Product Name: 9CFZ40 Fodder Grinder	
Company: Guangdong Xinfeng Machinery	
Link: http://www.wjw.cn/product/mbr100410113241500912/pro111021103031015482.xhtml	
Price	Around $160
Power Type	Electricity
Makes Fodder Suitable for: Cow, Goats, Geese, Fish	
Crops Processed: Straw, Maize Stalk, Wheat Stalks	

Picture 14: Fodder Grinder

Milking Machines

Picture 15: Piston Milking Machine

Specifications	
Product Name: **9J-I** Piston Milking Machine	
Company: Zibo Yuejiang Machinery Limited.	
Link: http://www.jinaiji.net/Article_Show.asp?ArticleID=14	
Price	$200
Power Type	Electricity 550 watt 220 volt or 380 volt
Vacuum	50kPa
Processing Speed	10-12 heads / hour
Machine Suitable for: Cow, Goats	

Picture 16: Vacuum Milking Machine

Specifications	
Product Name: 9J-II Vacuum Milking Machine	
Company: Zibo Yuejiang Machinery Limited.	
Link: http://www.jinaiji.net/Article_Show.asp?ArticleID=15	
Price	$620
Power Type	Electricity 1.1kw watt 220 volt or 380 volt
Vacuum	50kPa
Processing Speed	20-24 heads / hour

Irrigation Pump Machines

Specifications	
Product Name: Water Pump Machine	
Company: Linbo Pumping Machinery Limited.	
Link: http://detail.china.alibaba.com/offer/128464418.html	
Price	$30-$100
Power Type	Electricity 1.5kw 220 volt or 380 volt
Machine Suitable for: Water from wells and rivers	

Picture17: Water Pump Machine

Post-harvest/Storage equipment

Specifications	
Product Name: STG-U1600 Crop Drier	
Company: Leyurunjie Mechanic Factory, Zhangjiagang	
Link: http://detail.china.alibaba.com/offer/1082590732.html	
Price	$600
Power Type	Electricity
Dimensions	1500 X 1800 X 2500(mm)
Weight	1000kg
Crops Processed: rice, wheat, fodder	

Picture 18: Crop Drier

Specifications	
Product Name: FK Low Temperature Storage	
Company: Fengke Cooling Equipment Limited Corporation, Shanghai	
Link: http://detail.china.alibaba.com/offer/1022562173.html	
Price	$25-$28/square meter
Power Type	Electricity
Temperature	0-10 Celsius
Crops Processed: Seeds, fodder, fruits, meat, vegetables	

Picture 19: Storage

Appendix I

Types of "Farm Power" in SSA

Farm power is defined as the "availability of people animals and machines to carry out work." A 2005 FAO study examined smallholder farm-power systems in SSA, based on data from two communities in each of seven countries (Ghana, Nigeria, Ethiopia, Malawi, Uganda, Tanzania, Zambia). The fourteen communities selected comprised five of the most prevalent cropping systems in SSA.

Of the farm systems surveyed, hand power inputs were the main source of power for almost all farm production activities from land preparation to harvest. Preparing the land was the only production activity where there was substantial use of either animal or mechanized power.

Land Preparation Systems in SSA

1. Predominantly hoe: Mixed hand power and Draft Animal Power Communities
2. Predominantly hoe: hand power using hired labor communities
3. Predominantly draft animal power
4. Communities with tractors as a significant power source

TABLE 8
Percentage of households using different sources of power for primary tillage

Field site	Hand power		Draught animal power		Tractor power		Farming system
	Family	Hired	Hired	Own	Hired	Own	
	(%)						
Predominantly hoe: mixed hand power and DAP communities							
Mwansambo, Malawi	70	-	20	10	-	-	Maize mixed
Lodjwa, Malawi	55	-	30	15	-	-	Maize mixed
K Maracherere, Ethiopia	50	-	-	50	-	-	Highland perennial
Nteme, Zambia	no data	no data	no data	no data	-	-	Maize mixed
Simupande, Zambia	no data	no data	no data	no data	-	-	Agropastoral
Predominantly hoe: hand power using hired labour communities							
Gyangyanadze, Ghana	27	64	-	-	9	-	Cereal–root mixed
Ojo, Nigeria	11	89	-	-	-	-	Tree/cereal–root
Predominantly DAP communities							
Habru Seftu, Ethiopia *	-	-	7 *	93	-	-	Highland mixed
Kacaboi, Uganda	15	-	10	72	2	1	Maize mixed
Kapchesombe, Uganda	12	9	23	50	5	1	Maize mixed
Msingisi, United Republic of Tanzania	15	15	48	12	9	1	Maize mixed
Communities with tractors as significant power source							
Sanchitagi, Nigeria	58	-	-	-	30	12	Cereal–root mixed
Babatokuma, Ghana **	30	-	8 **	2	59 **	1	Cereal–root mixed
Mvomero, United Republic of Tanzania	55	-	5	5	34	1	Maize mixed

Notes:
No data: percentage data not available for Nteme and Simupande, Zambia: both communities use hand power, hired DAP and own DAP; tractors are not used.
* Habru Seftu: hired DAP represents households which prepare land by sharecropping or occasionally borrowing oxen.
** Babatokuma: the figures for hired DAP and tractors include hiring for transport as well as primary tillage.
Source: Community estimates at field sites.

* FAO. 2005. Contribution of Farm Power to Smallholder Livelihoods in SSA

Appendix 2

The figures below show statistics on the level of agricultural mechanization in China. Table 2.6 shows total agricultural machinery use in China by units and power capacity in kilowatts. Table 2.7 shows the percentage of total farmland that utilized mechanized plowing, seeding and harvesting by year.

Table 2.6: Agricultural production basic conditions (China Agricultural Yearbook, 2009)

Item	2000	2007	2008
Total Agricultural Machinery Power (10 000 kW)	52573.6	76589.6	82190.4
Number of Large and Medium-sized Agricultural	974547	2062731	2995214
Tractors (unit)			
Capacity of Large and Medium-sized Agricultural	3161.1	6101.1	8186.5
Tractors (10 000 kW)			
Number of Small Tractors (10 000 units)	1264.4	1619.1	1722.4
Capacity of Small Tractors (10 000 kW)	11663.9	15729.2	16647.7
Number of Large and Medium-sized Tractor Towing	140.0	308.3	435.4
Farm Machinery (10 000 units)			
Small Tractor Towing Farm Machinery (10 000 units)	1788.8	2733.0	2794.5
Number of Diesel Engines (10 000 units)	688.1	861.5	898.4
Capacity of Diesel Engines (10 000 kW)	5232.6	6282.8	6561.7
Irrigated Area (1 000 hectares)	53820	56518	58472
Consumption of Chemical Fertilizers (10 000 tons)	4146.4	5107.8	5239.0
Number of Hydropower Stations in Rural Areas (unit)	29962	27664	44433
Generating Capacity of Hydropower Station in Rural Areas (10 000 kW)	698.5	1366.6	5127.4
Electricity Consumed in Rural Areas (100 million kWh)	2421.3	5509.9	5713.2
Total Sown Area (1 000 hectares)	156300	153464	156266

Table 2.7: Statistics of agricultural mechanization (China Statistics Yearbook 2009)

Year	Total power (KW)	tractor (ten thousand)	combine harvester (sets)	tractor plowing (%)	mechanical sowing (%)	mechanical harvesting (%)	Total level of mechanization (%)
1978	117, 499, 000	193.04	19000	40.9	8.9	2.10	19.66
2001	551, 721, 000	1388.07	282900	47.41	26.06	17.99	32.18
2002	579, 299, 000	1430.56	310100	47.13	26.64	18.30	32.33
2003	603, 865, 000	1475.76	365000	46.87	26.71	19.02	32.47
2004	640, 279, 000	1566.79	410500	48.90	28.84	20.36	34.32
2005	683, 978, 000	1666.49	477000	50.15	30.26	22.63	35.93
2006	726, 359, 600	1728.34	567800	55.39	32.00	25.11	39.29
2007	768, 786, 500	1834.31	632400	58.89	34.43	28.62	42.47
2008	821, 904, 100	2021.91	743500	62.92	37.74	31.19	45.85

* Source: Chen, Kevin. Zhang, Yumei. (2011). Agricultural R&D as an engine of productivity growth: China. UK Government's Foresight Project on Global Food and Farming Futures.

Appendix 3

The images below are examples of small-scale machinery currently being promoted by the Nigerian National Centre for Agricultural Mechanization (NCAM). All images were downloaded from the NCAM website. (http://ncam.gov.ng/index.php/home)

NCAM Manual Chipping machine

NCAM Treadle Cassava Grater

NCAM Cassava Washing Machine

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