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STATUS OF AGRICULTURAL MECHANIZATION IN GHANA:

A CASE STUDY OF MAIZE PRODUCING FARMERS IN EJURA/SEKYEDUMASE DISTRICT, ASHANTI REGION

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Abstract- ***It is the aspiration of virtually every country in the world to achieve economic prosperity through the exploitation of her available resources to the optimum level possible without damaging the environment. In the case of Ghana, Agriculture is the basic industry and national policies have always aimed at achieving increased agricultural for self-sufficiency in food, and generate more foreign exchange resources with which to improve the standard of living of the farming community, especially and the entire country at large. The role of mechanization in enhancing agricultural productivity is well recognized. This paper reveals the status of agricultural mechanization in Ghana, especially among the small scale farming community, by presenting a case study of level of mechanization of maize production by farmers in Ejura/Sekyedumase district of the Ashanti Region. A survey was carried out in 12 operational areas within the 4 zones of the district where maize is produced in commercial quantities with a view to study the available mechanization inputs and utilization by the maize producing farmers. Questionnaires that were carefully designed to obtain information on the type of machinery, equipment/implements and tools available and their levels of utilization by the maize farmers were administered to 60 maize producing farmers and 20 Ministry of Food and Agriculture (MoFA) extension staff in the identified 12 operational areas . The identified available machinery, equipment/implements and tools were categorized into traditional hand-tools, improved hand-tools, draught animal-powered implements and mechanical motorized-powered equipment while their level of utilization were measured and expressed in percentages. It was revealed from the results of the data collected and analyzed that too many missing links in the mechanization value chain of the maize production process in the study area which resulted in over reliance on human power. Some key field operations like seeding (planting), cultivation, fertilizer application, crop protection (spraying), harvesting and drying are still being carried out solely with the use of human power. It is only few operations like land preparation, transportation and maize shelling that are partially mechanized despite the availability of four-wheel tractors in reasonable numbers. The results further indicated several challenges facing mechanized maize production within the district which include poor farm gate price, lack of credit facility, and lack of good policy for maize production, poor supply of mechanization inputs, poor land ownership and tenure system, lack of engineering extension services just to mention but few. As a result of these, the average yield of maize within the district is only 1.8 metric tons per hectare compared with average yield of 4-5 metric tonnes/hectare obtainable from maize producing farmers in most developed countries of the world. The paper recommended that the provision of quality, durable, efficient and ample supply of mechanization inputs backed up by comparable extension services be provided for the maize producing farmers in the country without damaging the environment. To ensure the sustainable provision of these a maize production policy will need to also be put in place as this is the only way food security that leads to uninterrupted supply of raw materials to the industries could be guaranteed.***

Key Words: Agricultural mechanization, Maize, Ejura/Sekyedumase district, Crop protection, Crop harvesting.

1. INTRODUCTION

In modern usage, "agricultural mechanization" has come to mean the use of engines, especially tractors, for farm operations, but the word as used in this paper is in its fuller meaning to include all tools, implements and machines which can help the farmer or agricultural practitioner to use his muscles and mind to better advantage: in view of this, the use of a hand-pushed rice weeder, an animal drawn plough or a self-propelled mechanical cotton-picker are all expressions of mechanization at different levels[3].

This explains why Agricultural mechanization has been redefined as "the process of utilizing different combination of power, tools and equipment for agricultural production purposes over time". With this definition, the implication is that Agricultural mechanization also includes irrigation systems, food processing together with their related technologies and equipment [6].

Africa is about the only region of the world where agricultural productivity is presently largely stagnant. Yields of maize and other staple cereals have typically remained at about 1,000 kg/ha, which is about a third of the average achieved in Asia and Latin America [2].
According to [8], farm mechanization has also been defined by some experts as the "development and introduction of mechanized assistance of all forms and at any level of sophistication in agricultural production to improve efficiency of human time and labour".

The present state of mechanization in Ghanaian agriculture is still far from being able to have meaningful impact on the quest to increase productivity and earnings from agricultural production activities. This is because the National agricultural mechanization strategy has not been formulated on the basis of a well-designed, reliable and thorough analysis [2]. This is in spite of the fact that it is a well-established fact that a typical agricultural mechanization involves the use of tools, implements and machines with the ulterior motive of improving the efficient utilization of time and human labour. This implies that the selection process of the most appropriate machinery and power source for any operation depends on the work to be done, cultural settings of the users, affordability, availability and technical efficiency of the options. These indications have clearly made it evident that agricultural mechanization is not an end in itself, but a means to a developmental end that must be sustained. Therefore, a socially beneficial agricultural production is determined based on a wide range of socio-economic and ecological factors. It is these factors that determine whether a particular technology is practicable, beneficial and sustainable within an area [11].

According to [10], all crops used for human sustenance were produced and processed by the power of human muscles in the beginning of time. Many centuries have passed by before the power of animal muscles started to be harnessed for relieving those of human beings in farm work .With the discovery of iron, steel tools of various types were fashioned out to further reduce the intensity of labour input from human muscles. The transition from hand tool farming to the modern day power farming was at first very slow, but with the development of the steel ploughs, internal –combustion engine(ICE), the farm tractor, and other modern farm machineries, the movement has been accelerated beyond the wildest dreams of our ancestors. The changes which occurred within the past two decades have so tremendously affected human values that one wonders what effect farm machineries of the future will have on our welfare.

Many developing countries in Asia which depend solely on agriculture have been endowed naturally with an abundant supply of solar energy and water essential for raising the intensity of cropping and productivity. Most of the countries have given priority to bringing more area under irrigation in their national economic development plans. With an assured continuous adequate supply of water, the high-yielding varieties and multi-cropping programmes have been expanded to cover larger areas. Since high-yielding varieties need intensive and precise cultural practices coupled with the fact that multiple cropping reduces the time available between two successive crops, the power input has to be correspondingly increased for achieving timeliness in operations. Power required for crop production in most developing countries, including Ghana, is mostly obtained from human and animals and to an extent through machines.

Table 1 developed by [9] shows a typical relationship that exists between power and yield when the crops considered were cereals, pulses, oil seeds, potatoes, cassava, onions and tomatoes. The table shows that the yield of crops increases directly with power input per hectare. But at lower yield levels up to about 2000 kg the

ratio between yield and power was about 6, which gradually diminished to 4 with the increase in yield up to 2500 kg, beyond which the ratio remained more or less constant at 2.16 (2.9) up to about1.86 kW/ha (2.5 hp/ha). On this basis, the belief is that a power input of above 0.56 kW/ha (0.75 hp/ha) might be desirable to sustain a yield exceeding 2500 kg/ha.

The barriers that impede the growth and sustainability of farm mechanization industry and programs in the Ghana can be classified into technological constraints, socio-cultural and behavioral barriers, financial and economic problems, as well as environmental issues.

In terms of environmental issues, high energy-consuming large machines with emissions that pollute the environment have become an important concern. Human being, as a component of the environment, is also now being considered as an important element of the man/machine development systems. "Machines with a human face" is now the catch phrase in most developed countries, which place great emphasis on the plight of the ageing and women farmers as well as safety issues [1].

Table 1: Relationship between power and yield

Power		Yield	Yield-hp ratio	Yield-kW ratio
Hp/ha	kW/ha	kg/ha	'000 kg: 1hp	'000 kg: 1 kW
0.13	0.097	800	6.2	8.3
0.16	0.119	1000	6.3	8.5
0.24	0.179	1500	6.3	8.5
0.37	0.276	2000	5.4	7.2
0.53	0.395	2500	4.7	6.3
0.87	0.649	3000	3.4	4.6
1.37	1.022	4000	2.9	3.9
1.74	1.298	5000	2.9	3.9
2.05	1.529	6000	2.9	3.9

Source: [9].

Agricultural mechanization (AMS) is not an end in itself but it is just one of the inputs that need to be mobilized to meet National development objectives. The formulation and implementation of an AMS should therefore be an integral part of a national development planning process. Successful implementation of the AMS therefore depends on social and economic stability, adequate infrastructure, reliable utilities, adequate fiscal policies, and a well-trained and disciplined workforce [6]. This paper aims at determining the current level of agricultural mechanization among maize producing farmers in Ghana using the Ejura/Sekyedumase district as case study and also identifies the missing link(s) in the chain of mechanized production system. Specifically, the objectives are to: 1. identify maize farmers in twelve (12) operational areas within the four zones of the Ejura-Sekyedumase district where maize is grown in commercial quantities. 2. Study the tools, machines and equipment used by the maize farmers for land preparation, seeding/planting, cultivation, plant protection, irrigation and drainage, harvesting and shelling. 3. Classify the identified tools, machines, and equipment used into manual-, mechanical- and draught animal technology. 4. Establish the percentage utilization of each category of technology by the maize farmers. 5. Use the results obtained in 4 to establish the level of mechanization of the field operations of the farmers in their production systems.

2. Methodology

The study area is one of the 27 districts of the Ashanti region of Ghana which was established by the legislative intrument1400 (LI 11400) on the 29th of November, 1988 by calving it out of the then Sekyere and Offinso districts [5].

The district, located in the Northern part of Ashanti region, is bounded in the North by Nkroransa and Atebubu districts of the Brong Ahafo Region. It is bounded in the East by the Sekyere Central, south by Sekyere west (Manpong) and west by three districts namely: the Offinso North, Nkoransa North and South districts. The district covers a total land area of 1,782.2 Sq. km which is about 8% of the total land area of the Ashanti Region. Ejura, the district capital is 106 km from Kumasi, the Ashanti regional capital [7].

According to the DADU- MoFA-EJURA (Profile), the district lies in the transitional zone of the semi-deciduous forest / guinea savannah zones and has bimodal rainfall pattern. Its annual average rainfall ranges from 1,200mm to 1,500mm.

The district has its major raining season from April to August whereas the minor raining season is from August to November.

It experiences high temperatures with monthly mean of 21-30 ^{o}C. The soil in the district falls under the forest and savannah ochrosols group. Others also classify the soil under Ejura- Amantin or Sene soil Association. The soil is deep, light in colour, well aerated and drained with moderate supply of organic matter and plant nutrients. Most of the soils have good water-holding capacity, very easy to work and are well adapted to mechanized cultivation. These soils are mostly sandy loam with a slight quantity of clay content which makes them suitable for cultivating maize, millet, groundnuts, cowpea, guinea corn, yam, cassava, garden egg, tomato among others.

Ejura /Sekyedumase district has a population of 81,115 out of which 51.77% are males and 8.23% are females. Interestingly, over 60% of the entire district population is engaged in agriculture. This indicates that farming is the major occupation of the people of the district[5; 6].

For this study, three operational areas of commercial maize production were randomly selected in each of the four zones of the district. Then, in each operational area, the carefully designed questionnaires for low level farm managers were administered to five randomly selected maize farmers thus making the total number of maize producing farmers administered with questionnaires to be sixty(60). Then, twenty (20) MoFA extension staff members consisting of four (4) district agricultural officers/zonal supervisors and sixteen (16) Agricultural Extension Assistants (AEAs) were administered with the questionnaires carefully designed for high level farm managers.

3. Results and Discussion

The average age of the farmers was 39 years ranging (from 20 to 70 years). On the average they had about 8 years of experience in farming i.e. they had taken up the responsibility of maize farming at the age of 31 years. Their average level of education was at Primary education level. Table 2 shows the ownership of land by the farmers who cultivated maize and their average yield in metric tonnes per hectare for each of the 12 operational areas in the 4 zones of the district studied. The table shows that the highest yield of 1.9 mt/ha was obtained in only two operational areas of Hiawoanwu and Kyenkyenkura both of which are in Kasei zone of the district while the lowest yield of 1.6 mt/ha was obtained in only Ejura operational zone of Ejura zone.

Nearly 98 % of the farmers made use of manual technology for seed planting operations. Only 5 % of them had access to the use of drought animal technology for their transportation operation. Table 3 shows the level of mechanization utilized for their various cultural practices.

Table 2: Average Size of Land Holdings per Farmer and Yield in the 12 Operational Areas in the 4 Zones

Zone	Operational Area	Average Size of Land Holding per Farmer(ha)	Average Yield(mt /ha)
Ejura	Ejura	18.2	1.6
	BayereNkwanta	9.5	1.7
	Sabonline	15.5	1.8
Babasco	Babaso	9.5	1.8
	Serikyi/Tailorkura	81.5	1.8
	Nokwareasa	15.7	1.7
Sekyedumase	Sekyedumase	12.5	1.7
	Frante	13.0	1.8
	Drobon	15.2	1.8
Kasei	Dromankuma	16.7	1.8
	Hiawoanwu	14.4	1.9
	Kyenkyenkura	17.1	1.9

Availability of mechanical power meant better production, yield and hence a better economic return. So it is only those who have access to high mechanical power that could expect substantial economic returns. It is only in land preparation, shelling/drying and transportation that substantial amount of mechanical power is utilized. Eighty (80), seventy five(75) and fourty (40) percent of the farmers make use of mechanical power for their land preparation, shelling/drying and transportation operations respectively while only 2% of them make use of it for their seeding and planting operations.

3.1 Tractor Utilization

Nearly 70 % of the serviceable tractors available in the district are in Ejura zone while the remaining 30 % were shared between the remaining 3 zones . Babasco is the zone with the list number of tractors among the 4 zones with only 19 tractors translating to about 5.4% .

Most of the farmers believed that ploughing with the tractor produced better soil tilth, especially well-suited for seedbed preparation all the farmers were still using manual technique for fertilizer application, cultivation(weeding), plant protection(or crop spraying with chemical pesticides and herbicides) and harvesting.

About 64% of the mechanical power contributed by available serviceable tractors in the district was utilized by farmers in Ejura operational area. The distribution of mechanical power contributed by tractor was not commensurate with the size of land cultivated and their yield. While Babasco zone which has the largest cultivated land area of 106.7 ha and average yield of 1.76 mt/ha had access to only 5.6 % of mechanical power contributed by tractor while Ejura zone with only 43.2 ha of cultivated land and an average yield of 1.7 mt/ha had access to 64.4 % of total available mechanical power contributed by tractor. The tractors are grossly underutilized. They hire the tractors from government and private sector hiring units to use mostly for land preparation and transportation. When these yield figures are compared to those in Table 1, they are extremely low despite relatively high available mechanical power within the district as depicted in Table 4 [9].

3.2 Preferences for the Make and Models of Tractors

Table 4 also shows the preference of the farmers on the makes and models of tractors. The Farmtrac tractor was most preferred by the farmers because it was considered to be most suitable for field work and other rough work. The second preference was given to Massey Fergusson tractor as it was considered handy for driving due to its compact configuration. It needs less maintenance and has a good resale value in the country. John Deere was preferred for its low price and Mahindra for its ergonomical aspects. Ford was comfortable to drive and had good resale value but the maintenance and repair cost was very high.

The study revealed that 32.9 % of the tractors utilized by the farmers were of Farmtrac model with Massey Fergusson and John Deere coming second and third with 25.4 and 24.8 % respectively. The list utilized models are New Holland and Kubota (0.57 % each).

3.3 Cross-tab Analysis

The farmers' cultural practices were grouped into 3 categories according to the type of technology utilized, viz. (1) Mechanical; (2) Manual; (3) Draught Animal. Dependent variables like average size of land holding per farmer (ha), average yield (mt/ha) and distribution of mechanical power (kW) contributed by tractors were all analyzed with respect to the type of technology utilized.

Table 3: Type of Technologies Used by Farmers in the Study Area for their Cultural Practices

Cultural Practice	Mechanical (%)	Manual (%)	Draught Animal (%)
Land Preparation	80	20	-
Seeding/Planting	2	98	-
Fertilizer Application	-	100	-
Cultivation	-	100	-
Plant Protection		100	-
Harvesting		100	-
Shelling/Drying	75	25	-
Transportation	40	55	5

For better understanding, the strengths and weaknesses of maize farmers in Ejura-Sekyedumase district were described in terms of available maize production equipment and machinery, adopted cultural practices, farm size, yield as well as other relevant resources and mechanization inputs. These include:

(1) Identification of maize farmers in the twelve operational areas within the four zones of the district where maize is grown in commercial quantities.

(2)Studying of tools, machines and equipment/implements used by maize farmers in the district;

(3) Classification of the tools and equipment used by the farmers into mechanical, manual and draught animal powered technologies.

(4) Determining the percentage of work done with each category of tools, machines and implements

(5) Classification of the maize producers into manual-, mechanical- and draught animal-powered farmers.

The cross-tab analysis showed that average yield and farm holding per farmer in the district is 1.78 mt/ha and 19.91 hectare respectively while the Ejura, Babasco, Sekyedumase and Kasei zones are average yield and land holding per farmer in 1.7mt/ha and 14.4 ha, 1.77 mt/ha and 35.57 ha, 1.77 mt/ha and 13.57 ha, 1.87 mt/ha and 16.07 ha respectively. A further detailed relation of the average yield to farm holding per farmer showed that there seem not to be any relationship between farm holding and yield as given in Table 2. The reason why the size of land holding does not seem to have any effect on average yield is because the unit operations are partially mechanized as shown in Table 3 despite the fact that tractors, albeit mechanical power, are available in reasonable numbers in some of the operational zones(e.g. Ejura) as shown in Tables 4 and 5. Another reason for this observed scenario in the district is because the farmers generally do not have easy access to other essential inputs like fertilizer, soil test and tractor implements for other field operations apart from land preparation.

Table 4: Models, Powers and Makes of Serviceable Tractor Distribution in the District

Make	Model	Rated Engine Power(kW)	Zone				
			Ejura	Babasco	Kasei	Sekyedumase	Total
Farmtrac	60 70 80	44 52 64	32 42 12	- 4 2	6 8 2	3 4 -	41 58 16
John Deere	5303 5403	56 60	35 20	4 2	12 4	7 3	58 29
Mahindra	605DI 705DI	60 70	8 6	2 -	12 4	2 1	17 7
Kubota	M8200	73	2	-	-	-	2
Ford	-	82	11	-	7	3	21
Massey Fergusson	165MF 185MF	73 75	38 20	3 2	15 8	3 -	59 30
Shanghai	-	64	6	-	3	1	10
New Holland		80	2	-	-	-	2
Total			234	19	70	27	350

Table 5: Distribution of Mechanical Power (kW) Contributed by Tractors in the District

Ejura	Babasco	Kasei	Sekyedumase	Total
14286	1169	5181	1561	22197
64.4%	5.3%	23.3%	7.0%	100%

4. CONCLUSIONS

1. This study concludes that the current level of agricultural mechanization among maize producing farmers in Ejura/Sekyedumase district of the Ashanti region of Ghana is still at pedestrian level. Although they produce maize in commercial quantities, nearly all their unit operations are still dependent on the use of manual technology which makes use of hand tools which belong to antiquities.

2. Only a few of them make use of improved hand tools.

3. Apart from the fact that mechanical technology is only used to a large extent for land preparation (specifically ploughing and harrowing), maize shelling and drying, there are too many missing links in their unit operations. Some of these are land levelling, construction of peripheral canals and bunds for protecting the farm from flooding and washout as a result of run-off from nearby water shed areas.

4. The tractors in the four zones of the district are grossly underutilized because there are no implements for other field operations such as fertilizer application, cultivation, crop spraying(plant protection), harvesting. Only 2 % of the farmers make use of mechanical device for their seeding/crop planting.

5. The use of the tractors are only restricted to transportation and partial land preparation.

6. The current low level of application of agricultural mechanization in the unit operations of the production system of the maize producing farmers is partly responsible for their low yield, which in turn, will result in low income level.

7. The government's effort at improving the mechanization level of commercial maize production by farmers is not based on a carefully-formulated strategy because the machines are not distributed according to the needs of the various zones.

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