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**Department of Vehicles and Ground Transport
Faculty of Engineering**



**Maintenance and servicing comparative
study of farm machineries and equipments
for case Ghana**

DIPLOMA THESIS

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DECLARATION

I hereby declare that maintenance and servicing comparative study of mobile technology for case Ghana is my own work, it does not include any material published or written by another person, or has been submitted for the award of any other university degree and that all the sources I have used and quoted have been indicated and acknowledged by complete references.

Prague, March 28, 2014

.....
Edwin Wallace

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ABSTRACT

Ghana has all the natural and political preconditions to become among the surplus food producers. But the current situation shows that Ghana has not been able to feed its population because farmers cultivate in a primitive way which has affected the productivity level in agriculture. Farming on a large scale and improved production of agricultural products can be achieved only when there is a gradual transition to modern agriculture using mechanization equipment. The introduction of modern agricultural machinery in Ghana by the Ministry of food and agricultural in 2000 was to encourage small-scale farmers who cultivate (up to 2 hectares) to expand their farm to reduce drudgery and tediousness associated by manual farming operations.

Maintenance and servicing system of Ghana is entirely different from that of Czech Republic. One of the principal problems can be the import of various kinds of farm machineries and no service representative to maintain. Service centre like Strom Praha, Czech Republic, which is a representative of John Deere perform maintenance of farm machinery at various region in Czech Republic. In addition, vocational training educational has reached its climax in Czech Republic due to proper structures made by the government to promote this form of education. In Ghana there is no plan to improve vocational training in Ghana since 1987.

Maintenance and servicing of farm machinery and equipment has been a major problem for developing countries which Ghana is also included. This is due to lack of qualified service men, out-dated maintenance centre, lack of spare parts, unqualified service men, lack of access to loan, poor infrastructure in Vocational training as well as inappropriate teaching methods both practical and theory. This thesis examines the maintenance and servicing of farm machinery in Ghana and compare to Czech Republic and tries to find possible solution to improve on the lives of Ghanaians in terms of agriculture. Comparing the vocational training in Czech Republic to that of Ghana, I came out with a first level curriculum and timetable for service men to educate graduates on advanced technological approach and experiences used by developed countries in farming. In addition, a regional maintenance workshop for Tamale (important northern region in Ghana) to train operators and service men to boost the agricultural industry since Tamale is the regional capital of the largest region to which population livelihood depends on Agriculture.

Keywords: normative, education, mobile farm technology, tribotechnics, environment

Abstrakt

Ghana má všechny předpoklady jak přírodní, tak i politické, aby se mohla stát vývozní potravinářskou zemí. Současná situace je však taková, že Ghana není schopna uspokojit ani své domácí potřeby z důvodu primitivních způsobů pěstování plodin a s tím spojeného nízkého stupně produktivity. Potřebného zefektivnění zemědělské výroby může být dosaženo pouze postupným přechodem na moderní zemědělství za použití mechanizace.

Představení nových zemědělských strojů Ministerstvem zemědělství a přírodních zdrojů v roce 2000, mělo za cíl podpořit drobné farmáře obhospodařující plochy o maximální rozloze dvou hektarů a pomoci jim s rozšířením hospodářství a eliminací únavné dřiny spojené s manuálními úkony při všech zemědělských pracích. Údržba a servis těchto strojů se však v Ghaně diametrálně liší od postupů uplatňovaných v České republice.

Servisní centra jako Strom Praha, reprezentující společnost John Deere, disponují servisními a školicími centry v různých částech České republiky. Jejich odborný výcvik dosahuje nejvyšších standardů díky vhodné struktuře a nastavení základních pravidel této formy výuky ze strany vlády České republiky. Bohužel v Ghaně nejsou vládou implementovaná pravidla pro tento způsob odborného výcviku od roku 1987.

Údržba a servis farmářských strojů jsou v současné době hlavním problémem rozvojových zemí, mezi které Ghana také spadá. Důvodů je více – množství specializovaných strojů různých značek, nedostatek vyškoleného personálu a kvalifikovaných techniků, zastaralá servisní centra, nedostatek náhradních dílů, špatný přístup k půjčkám a také nevhodný způsob výuky jak po teoretické, tak po praktické stránce.

Tato práce si klade za cíl porovnání údržby zemědělských strojů mezi Českou republikou a Ghanou a s tím spojené nalezení vhodných řešení pro zlepšení situace v zemědělství. Díky porovnání způsobu odborného výcviku v České republice a Ghaně jsem navrhl první stupeň osnovy a časového rozvrhu pro výuku absolventů servisním personálem na základě zemědělských technologických postupů a zkušeností používaných v rozvinutých zemích. Práce je zaměřena na regionální údržbovou stanici v Tamale (největší zemědělský region na severu Ghany s hlavním městem Tamale), k vyškolení místních techniků a operátorů, kteří se nepřímo, ale vysokou měrou, podílejí na podpoře zdejšího zemědělského průmyslu, jehož existence je závislá na zemědělství.

Klíčová slova: normativ, vzdělání, mobilní zemědělské technologie, tribotechnika, životní prostředí

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1.0 Introduction

Ghana is in West Africa and its capital town is Accra. It is bordered by the Ivory Coast, Togo, Burkina Faso and Gulf of Guinea to the south. The country has an area of 238,530 km² and is divided into 10 administrative regions. The last National population census which was organized by the Ghana Statistical Service (GSS) was in 2010. It shows that the population increased from 18,912,079 in 2000 to 24,658,823 in 2010 which represent a population growth rate of 2.5 percent per annum.

Agricultural industry is the major contributor in the nation's economic growth and poverty alleviation in most developing countries. Agriculture is essential as it provide national survival, food, foreign exchange and employment (Adebayo and Okuneye, 2005). It is estimated that more than 60 percent of the Ghana's population engaged in agricultural activities. Statistics show that about 80 percent of the agricultural activities are done on a small-scale basis with primary tools (Ahmed 2006). To my experience, as a native will take this statistics as informative. The use of primary tools such as hoes, cutlass etc. makes expansion of farm extremely difficult due to tedious labour work. Therefore, the introduction of agricultural mechanization was necessary since human effort cannot supply the required power input for large scale farming. Agricultural Mechanization is the used of tools, implements and machines from land preparation to storage of agricultural products. Sources of farm power include hand tools, draft animals and mechanically-powered technologies (Rijk, 1999).

In 2000, the government of Ghana and individuals started to import farm machinery and equipment to be among the surplus food producers in Africa. Gradually in 2007, the Ministry of food and agriculture introduced agricultural mechanization service centre (AMSEC) so that farming is done on a large scale using farm machinery and equipment. The aim of such centre was to provide timely and affordable service to farmers who cannot acquire their own farm machinery. But the major setback of this centre is maintenance and servicing of these farm machineries.

Maintenance and servicing of farm machinery and equipment has been a major hindrance life time problem to the developing countries like Africa which Ghana is also part. This had led to the breakdown of farm machinery due to lack of service centre to train repair men, poor roads to farm, the used of faked spare parts, inadequate vocational training school, lack of credit for

small scale farmers, high duties imposed on spare parts imported and improper driving by farm operators. Most European countries have been able to overcome maintenance and servicing problems of farm machinery. This is due to good policies made by the European Union and its member states abide by these policies in terms of maintenance and servicing of farm machinery.

Hence, the study is to analyze the current maintenance and servicing system of farm machineries and equipment in Ghana and compare to Czech Republic. Since the problem has been solved in 1970's and 1980's in Czech Republic, this study will help in finding the approaches to problems and possible solutions in Ghana to increase the agricultural productivity in the country.

2.0 Objectives and methodology

The primary aim of this thesis is to critically analyze the maintenance and servicing system in Ghana and compare to that of Czech Republic. After that I tried to make suggestions to improve on the maintenance and servicing system to increase the level of productivity in the agricultural sector as well to review the current situation and control of agricultural mechanization in Africa especially Ghana. After my research, I came out with the following proposal.

1. First level curriculum and time-table for service men.
2. Structural layout plan for Vocational training School in Ghana.
3. Reform of educational structure for vocational training school in Ghana.
4. Structural layout plan for maintenance and workshop centre for repair men in regional level (Tamale).

During my research, I visited the Czech representation of maintenance and servicing centre of John Deere at Strom Praha to have a general picture of maintenance centre in Czech Republic and compare with the current situation in Ghana. I also had the opportunity to visit a vocational School called “SOÚ, *Nové Strašecí*” for a couple of days to understand the Vocational training educational system in Czech Republic and make few suggestions to that in Ghana to train qualified repair men and operators.

3.0 Literature review

Maintenance and servicing of farm machinery has been a major problem since time memorial for developing countries like Africa which Ghana is also part. This has created low productivity of agricultural products in Ghana. About 44.1 percent of Ghanaians who engaged in agriculture had no formal education, 35.2 percent middle school education, and 10.7 percent had tertiary education (Ghana Statistical Service, 2010). The farmers and farm machinery owners turn to neglect maintenance due to ignorance, absence of service centre nearby and lack of resources. Due to this fact, training should be organized for farm machinery owner, operators and service men to upgrade their knowledge on the importance of maintenance and servicing.

With reference to (Whitney, 1988) periodic maintenance and servicing is necessary to increase the life span of farm machinery and save money. Whitney concluded that, regular maintenance help prevent major accident and damage of property on the farm. Whitney also noted that good safety practice of farm machinery on farm can help reduce the cost of maintenance and breakdown time. Vast majority operators and service men in Ghana are not familiar with the various types of farm machinery which causes frequent breakdown.

(Bukhari et al., 1997) made an observation and supported the need of maintenance and servicing of farm machinery. Bukhari concluded that proper and timely repair and maintenance can give the require function of farm machinery. This made (Schippers et al., 1987) to conclude that health risk, injuries and unnecessary accident can be avoided due to proper maintenance on the farm.

According to a report made by the Ghana Statistical Research and Information directorate in 2011, more than 90 percent of farm in Ghana are small-scale which has less than 2 hectares of land for farming. Farmers find difficult to get funds from the government to perform preventive maintenance on their farm machinery and expanding of their farm. The farmers turn to access loan from the bank but because of low investment in the agriculture sector in Ghana, it deters farmers including service men from the industry (Kwesi Boamah, 2008). In addition, based on the SWOT analysis (Strength, weakness, opportunities and treats) and findings, (Twum, 2002) conclude that the main constraint to agricultural mechanization was lack of access of credit by farmers.

Preventive maintenance and servicing of farm machinery is the only parameter that can reduce the downtime of a machine. This allows farm machinery to fulfil its desired function and keep in a good running condition. Safe working condition can be achieved if qualified service men and operators are used. It was noted that the main objective of maintenance and servicing of farm machinery is to bring cost under control throughout the life time of the machinery (R.C Mishra and K. Pathak, 2002). Efficient mechanization in agricultural is a major factor that help in high productivity (Raper, 2005).

Farm mechanization is very important in this 21st century. This made (Rozelle et al., 2002) to conclude that without mechanization, farmers will find expansion of their farm difficult due to tedious labour work on the farm. Mechanization is paramount to development of agriculture in Africa to prevent farmers to cultivate in a primitive way. In addition, the purpose of mechanization is to increase land productivity, labour productivity and decrease cost of production. With farm mechanization, Ghanaians will have (better perception) interest in farming both in the rural and urban area to boost the agricultural industry in the country (Adrianis G.Rijk, 1989).

Farm mechanization can be increased in Africa especially Ghana by efficient and effective maintenance and servicing of farm machinery. This gives an in- depth knowledge to why maintenance and servicing of farm machinery is important in farm mechanization. Not only to keep the farm machinery running but to prevent failure and major breakdown. Without maintenance and servicing of farm machinery, there will be frequent failure and farmers cannot meet the deadline of their customers (Swanson, 2011).

For good maintenance and servicing of farm machinery to be achieved, proper maintenance records of history of machinery should be made to support the preventive maintenance when the farm machinery is in operation. With this, service men knowledge will be improved to find solution to problem of farm machinery easily when it breakdown to reduce downtime and provide necessary information for making proper maintenance decision. History of farm machinery can also control the inventory and purchasing of spare parts for the farm machinery (Tsang, 1999).

According to (Steve Krar, 2009), Maintenance and servicing can be considered as similar to a health care of farm machinery and equipments. Steve Krar further explained that, the cost of preventive maintenance is very small when it is compared to major breakdown cost when the farm machinery is not working. Steve Krar formed a conclusion that, the main reason of maintenance and servicing of farm machinery is to effectively reduce waste, run farm machinery efficiently as possible and continuously. Daily inspection, lubricating, cleaning and minor problem can be detected and corrected to prevent major shut-down of farm machinery. Maintenance intervals of farm machinery and equipments are very vital in farm mechanization. This can be done only by a maintenance manager or a qualified estimate of the machine manufacturer. It can result in increase in cost if the farm machinery maintenance interval is too short and also lead to increase in cost if maintenance interval is too long which means that optimum of maintenance interval must be determined (Wiest,1998).

4.0 Characteristics of agricultural production in Ghana

Agriculture in Ghana must play a significant role in the accumulation process, because currently it is still the most important economic sector of the national economy. Between agriculture and industry in relations of mutual dependence, and therefore the program of industrialization of developing countries including Ghana is based on the development of agricultural production.

Backward socio-economic and production structure of agriculture in Ghana is a result of low transverse market production. A significant number of families produce little more than it consumes. However, Ghana has all the natural and political preconditions to become among surplus food producers. To achieve the standard of surplus producers, the following tasks must be taken into consideration:

- Introduce highly productive varieties of field crops, along with maintenance plant breeding
- Apply a minimum amount of agrochemicals for fertilization, and weed control, plant protection and disease and pest control
- Select suitable virgin land for reclamation – both in terms of size and fertility, thus minimizing the cost of cultivation, including an irrigation system
- To provide enough high-quality technology for reclaiming of virgin soils
- In advance educate qualified personnel.

Only some developing countries have sufficient financial and other resources that are necessary to make the above points implemented. Ghana does not have enough resources to implement mass industrialization of agriculture. Lacks qualified manpower, agricultural machineries, and especially financial resources. The concentration of agricultural production to the wider version and implementation of agricultural research in this sector of the national economy and create the conditions for the application of skilled workers. This can be achieved only when through the gradual transition to modern agriculture using mechanized equipment.

4.1 Current situation of agricultural mechanization in Ghana

Mechanization of work in field production gives users many advantages, but in developing countries also considerable concern with maintaining the machine sets in working condition. The introduction of agricultural technology in the field of production developing African countries must increase gross agricultural production, so it is first necessary to feed the population. Ghana has enough suitable agricultural land of 1,634,973 hectares (Food and Agricultural organization, 2012) for the cultivation of grains, which are the basis for the livelihood of the population. Agricultural land is not cultivated to a sufficient extent and quality. It is due to the fact that farmers use constantly unproductive ways to cultivate as much land that is not enough to satisfy the caloric requirements of the population (Kic, Zewdie 2013).

Currently, there are more than 7500 small-scale crop farmers who are registered under the Rural Infrastructure Co-coordinating Unit (formally Village Infrastructure Project) waiting for the supply of simple farming technologies (Dian 2008). The aim of the project is to review the current situation and control of agricultural mechanization in Africa especially Ghana.

The government train 100 beneficiaries of agricultural machinery, mechanics/operators and technician annually on proper selection of operators, handling tractors, combine harvesters, boom sprayers etc.

The government since 2000 have imported various tractors including Massey Fergusson (MF), Farm track (India), Landini (Italy), Zetor (CZ), Lamborghini (Italy), Agromechanika (Slovenia), Same and HMT (John Mensah 2013). Other tractors which have been brought in by individuals are Ford, Fiat, and Deutz etc. With the help of foreign support they have been able to purchase this agricultural machinery and equipment. In 2009, the Japanese government assistance programme delivered agricultural machinery and equipment to Ghana. These machinery and equipment were distributed to 6 regions namely Northern, Upper East, Upper West, Ashanti, Accra, and Volta region. To reduce harvesting losses, the sectors has provided about 165 combine harvester to increase the production of rice and maize which are cheap foods in Ghana.

In the year 2007, the Ghanaian Ministry of Food and Agriculture established a sector known as the Agricultural Mechanization Service Centre (AMSEC).

This sector is supposed to provide (*Kwesi, Boamah 2008*):

- Mechanized service to all 10 regions of the country.
- Imports farm machineries and accessories for farmers on credit and subsidies prices.
- Promote farmers to get their own tractors for farming by providing them duty free on all agricultural machinery and equipment they import into the country.
- Formal training (education)
- Provide rural employment in agriculture
- Efficient utilization of farm machinery and equipment
- Reduction in post-harvest losses

Although the aim of the service centre is to provide timely access of mechanized service to farmers, a recent study shows that AMSECs is running below its expectation. Majority of the centres invest in tractors since ‘there are little incentives to invest in other farm equipment’ (*Diao et al., 2013*).

Introduction of farm mechanization in Ghana have focussed mainly on tractors and implements. According to (*Mahama and Seidu, 2011*), the country tractors increase drastically from 2250 to 5200 in 2008 whiles operational combine harvesters went up from 20 in 1964 to 156 combine harvester in 1984. In 2008, only 9 of the combine harvesters were in operation. This means that one of the important parts of agricultural production which is harvesting and processing will be under-mechanized. Before a highly mechanization can be achieved in Ghana, farmers must have access to appropriate farm technology from land preparation, planting, harvesting, processing and storage.

In Ghana, there are four regions that have the highest production of agricultural products. These are the Upper East, Upper West, Brong-Ahafo and the Northern region (*refer to table 1*). Because farming is done in the rural areas of these regions; one of the major hindrances to effective mechanization is social amenities. Transportation system is one of the core and crucial problem. Farmers find transporting their farm equipment extremely difficult and frequently experience breakdown of farm machinery due to poor roads to their farms. As farming is the major occupation there, farmers have no option to use faked spare parts which they can afford for maintenance which affect the productivity level of agriculture in these regions.

Region	Total labour force	Agriculture (Farming, forestry, fishing and hunting)	Percentage of agriculture labour force in each region
Ashanti	1,612,467	706,888	43.8%
Greater Accra	1,377,903	145,034	10.5%
Eastern	927,699	531,635	57.3%
Western	856,830	511,826	59.7%
Northern	727,553	523,278	71.9%
Brong- Ahafo	819,190	566,066	69.1%
Volta	697,752	424,458	60.8%
Central	617,003	371,703	60.2%
Upper West	241,209	176,600	73.2%
Upper East	360,508	242,077	67.1%
All region	8,292,114	4,199,185	50.6%

Table 1: Economically active population (15 to 49 years) by region

Source: GSS-Based on 2000 population and housing census

The table shows the total labour force in each region and those who engage in agriculture out of the total labour force from age 15 to 49 years. In the Upper West region, 176,000 Ghanaians out of 241,000 were into agriculture. Almost 72 percent out of 819,190 labour force in the Northern region practice agriculture. The lowest percentage was in the Greater Accra region which is the capital of Ghana. This is because majority of Ghanaians in this region are working in companies, offices, industry and do not focus on agriculture.

List of farm machinery in Ghana

1. TRACTORS	Origin	HP	2007	2008	2009	2010	TOTAL
Farmtrac-60	India	49	230		200		430
Farmtrac-80 (2x4)	India	73	76				76
John Deere	U.S.A	30		500			500
Mahindra	India	40		232			232
Agromechanika	Slovenia	29				120	120
Landini	Italy	50			60		60
Massey Ferguson	U.S.A	10				40	40
Shanghai	China	58	185			215	400
Lamborghini	Italy	40		30			30
Yukon compact	Japan	10	120				120
Kubota	Japan	40	78				78
Vari	China	10	250			400	650
2. COMBINE HARVESTERS							
Kukje	South Korea	100			12		12
Foton (D200)	China	25	4		5		9
Foton maize/rice	China	75			10		10
Thailand(KT09)	Thailand	90		5		2	7
Crawler	Japan	75	3				3
China run Yuan Ying	China	30				10	10

Table 2: Quantity of perspective farm tractors and combine harvester from 2007 to 2010 in Ghana by AMSEC.

Source: Agricultural Engineering Service Directorate, MOFA

List of agricultural equipment in Ghana

3. AGRIC. EQUIPMENT	Origin	2007	2008	2009	2010
Maize Shellers	Denmark	220			
Vari mini system	China	250		10	
Hurricane slashers	China	50			
Adela slashers	Japan	750			
Shakti power tiller	India		200		
Dongfeng power tiller	China			50	
Rice threshers	China				30
Rice mills	Japan			4	12
Rice reapers	China		8		30
Japan power tiller	Japan	100			
Grainpro cocoons (50MT)	China		100		
Grainpro cocoons (20MT)	South Africa				150
Rice destoner	China			5	2
Water pumps	Japan		16		
Irrigation pumps and accessories	Japan	70		40	40

Table 3: Farm equipment used in Ghana from 2007 to 2010 by AMSEC*Source: Agricultural Engineering Service Directorate, MOFA*

From the data (*table 2 and 3*) it is clear that the techniques for field production are low and it is not yet a decisive factor. Taking into account that the arable land in Ghana is about 5,033,173 hectares representing 21.1 percent of land area and Ghana has about 45,000 hectares of grassland, it is evident that the mechanization of agriculture is waiting for this big field of assignments (SRID, 2011). Department of animal production situation is even worse rather talked about the program than the current situation. Feel the technique for the preparation and preservation of fodder for treatment of meadows and pastures, with a technique for peri-urban dairy farms, straw splitters and crushers, grinders, cutters, mixing equipment and self-unloading cars.

Mechanization currently in Ghana is very uneven. They vary by farm systems and management.

- a) Large scale farmers: they are relatively at higher levels. This means that they have a greater number of tractors, combine harvesters and other agricultural machinery for tillage, from its preparation to cleaning up the land.
- b) Small scale farmers: they have small land area usually up to two hectares; where is practiced completely backward way of growing. Majority of the work is performed by hand.

Farm machineries and equipment concentrating on relatively rich farmers, represents roughly 10–15 percent of the area. According to (Josiah *et al.*, 2008), only 13.4 percent of farmers used farm machinery and equipments as at 2002. Still, improper utility of technology in the fields leads to very rapid depreciation of equipment and reduce the life primarily due to the lack of prevention. The absence of well-equipped workshop; obviously low-skilled personnel cannot remove complex failure. Unqualified personnel and lack of spare parts leads evidently to premature depreciation of machinery and tractors.

4.2 Characteristics of personal training for machine operators and service men in Ghana

Tractor operators are mostly trained on the job and do not require any formal education. Both the machine operators and the servicemen are given training by the Ministry of Food and Agriculture under the farm power machinery directorate.

Operators of tractor are classified under special equipment operators and have to be 18 years and above and have passed a driving test organized by the division of vehicle and licensing authority.

The maintenance persons are in two folds;

1. Formal training education
2. Informal (traditional) training

4.2.1. Formal training education

The technician education has two options and both have a compulsory (basic) six years primary education and three years junior high school education.

One option requires a three years senior high school education in technical and a three years higher national diploma education which is a tertiary education in Mechanical Engineering.

The second option requires basic education, a three years intermediate course and a three level technician course with the level three being a tertiary education.

The craft men are those with technician one and two courses.

The tradesman requires a basic education with an additional two years (grade two) or a three years (grade one) course in the vocational training institution which can be seen in *Chart 1*.

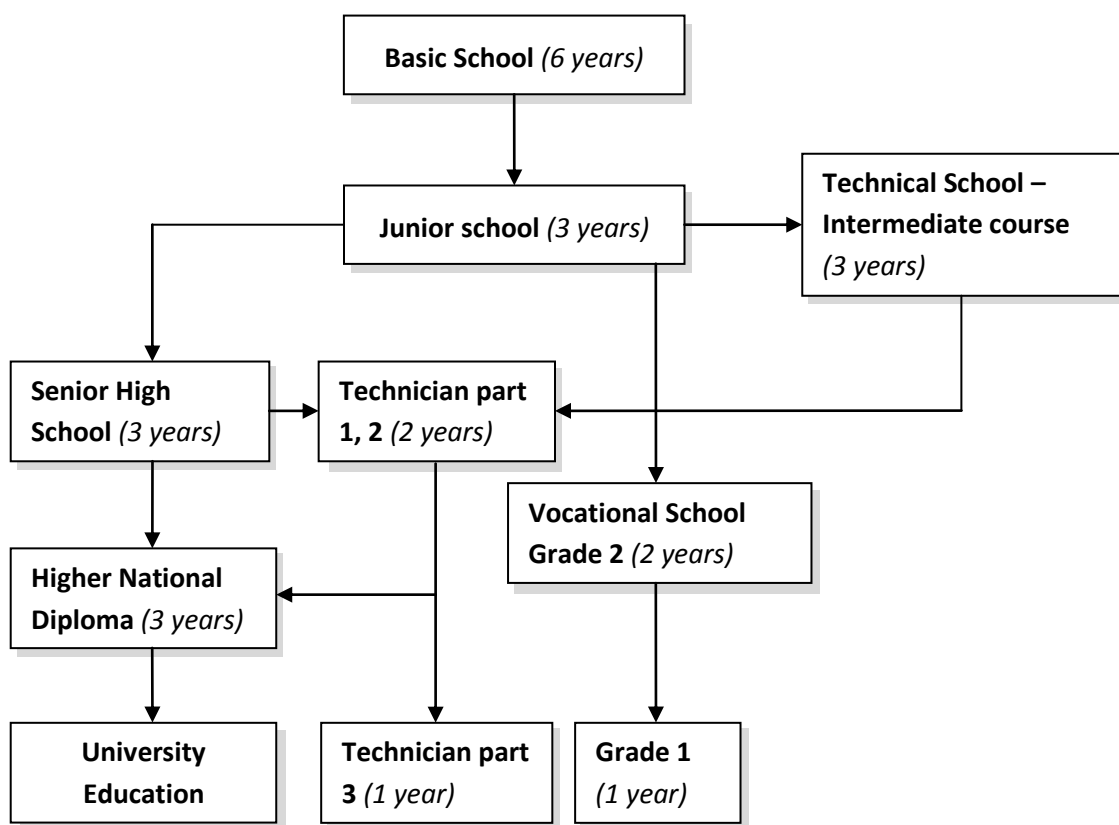


Chart 1: Formal training in Ghana for technician and vocational training education.

Source: <http://www.classbase.com/Countries/Ghana/Education-System>

4.2.2 Informal (traditional) training

The artisan requires no formal education and the minimum age is 18 years. Another name is traditional form of training. This group of persons are trained directly on the job for a minimum of four years. To be qualified for this training, there is a list of items and tools which are required depending on the financial situation of the shop owner (Master mechanic). There are no specific tools and items an apprentice should bring before going through the training. The chief apprentice and the master mechanics take care of the overall supervision of the training. The training is done in an open place (service centre) mostly under trees with the tools and machine parts kept in wooden structured rooms. In few cases, training is done under shade. The floor for the training is not concrete but bare floor where dirty oil is used to coat. After the training, no certificate is given. The basic training comprise of the following;

- Identification of tools and equipment.
- Usage of correct tools during maintenance and servicing
- Steps on how to di-montage and montage
- Ways of trouble shooting of farm machinery
- Estimation of cost for customers

After the training, artisan works with the master technician for a number of years to be experience on the job. There are no specific years. It depends on how fast the artisan learn the job and then be promoted to senior most apprentice. The artisan decides to work with the master mechanic or open a shop.

4.2.3 General Equipment and tools for servicing in master mechanic shop

General tools such as the double ended, flat, combination and the box spanners, screw drivers, pliers, circlip pliers, hammer, piston clamp, valve grinding tool are used. Injection pumps and injectors are sent to specialist shops to perform the pump test bunch. The hydraulic jack and rollers are used on a flat platform when splitting the farm tractor to work on the clutch or removing the engine.

4.2.4 Description of the hierarchy of positions in the maintenance shop

Master mechanics

There are two types of master mechanics. The first type owns the shop and has no knowledge on maintenance and servicing of farm machinery and equipment. The second type owns the shop and a mechanics. Because of the knowledge on maintenance, the master mechanic works with both the senior most apprentice and servicemen. The master mechanic or the shop owner markets the shop so that various farm machineries and equipment can be sent to the shop for maintenance and servicing.

Senior most apprentice

The senior most apprentices are under supervision to the master mechanic and supervise the servicemen. Training programs are organized by the senior most apprentices for servicemen so as to upgrade themselves to learn new technology of farm machinery and equipment. The senior most apprentice also makes sure that maintenance works are done and completed on time to customers.

Servicemen

The servicemen are trained by the senior most apprentices and sometimes the master mechanic depending on the type of master mechanic. The servicemen come early and make sure that the maintenance shop is clean every morning for work to commence in the shop. The servicemen are always supervised by the senior most apprentices so that minimal damage occurs during their first week in the maintenance shop. The hierarchy of position in the maintenance shop can be seen in *Chart 2*.



Chart 2: Hierarchy of positions in a maintenance shop.

Source: Author

4.3 The basic concept of training qualified personnel

Ghana has a shortage of qualified staff in all categories-from workers through high school students to engineering professionals in the field of mechanization of agriculture. The low level of agriculture is one of the indicators for low levels of skills and workers. Ghanaian government is faced with a big dilemma.

- a) Teaching at least basic reading and writing
- b) Promote an urgent need to increase food production for the nutrition of the population.
- c) Without technology in agriculture, this task cannot be fulfilled.
- d) In addition to the lack of funds for technology there is a problem, as people learn the technical treatment, maintenance, and handling.

When analyzing the above facts it is clear that Ghana, in preparation of specialists of all levels is not able to overcome without international assistance. The experience of many developing countries show that it is necessary to pay great attention to the problem, which article of the system Labourer - high school graduate - college graduate should receive priority in solving (as soon as possible to address the problem and where to start) and what forms to achieve the desired target.

University student and high school student, even assuming that they are acquiring qualification or even study abroad, are in direct production activities that are very difficult to fully exercise because of the low level of expertise, most workers and engineers or high school itself usually does not have enough practical experience and artisanal skills. Perfect knowledge of the blue-collar workers cannot be replaced by other means.

Perceptions that an engineer must handle perfectly all the elements of lower categories of staff – high school students and workers to have their craftsmanship and professional career forever, are currently completely naive and outdated. Each category has its own special status. To a certain extent (although it is not correct) it is minor crime to educate skilled workers and have a shortage of engineers than vice versa. An excellent engineer without a skilled maintenance worker is unlikely to good use. It offers, therefore, to consider whether it would be effective to secure for the mechanization of agriculture in general and for the maintenances, repairs and diagnostics particularly education mainly of blue-collar workers.

4.4 Challenges of Vocational training education in Ghana

Different names are given to Vocational training as one move from one country to another. Such names are Vocational education and training (VET), technical and vocational education (TVE), technical and vocational education and training (TVET). All these names mentioned above means the same thing. According to (UNESCO International Standard Classification of Education, 1997), it is defined as education and training to obtain the practical skills, know-how and acquire the necessary knowledge for employment in a particular field, group or occupation. Since there is a practical training involve, students understand why things are done in a particular way and how to improve upon it. This is the main reason why vocational and technical education is important in maintenance and servicing of farm machinery.

Vocational training had face a lot of challenges in other countries and difficulty which Ghana is also part. The government of Ghana commissioned a body in 2003 to review the educational system to find ways to improve vocational training for the year 2003–2015. After the commissioned finish their review, it was reported that the public educational system has neglected vocational training education (*Government of Ghana, 2003*). It further reports that, the educational reform which was introduced in Ghana in 1987 had no plan to improve vocational training.

Students interest in Vocational technical education which agriculture is also part has decline due to the fact that there is no policy direction type of education and training needed to help graduates from all level of education to engage in agriculture. This is because of poor infrastructure condition, outdated school curriculum and training facilities, inappropriate teaching methods both in theory and practical training. Vocational and training education is more expensive than other forms of education because it does not involve only theory but practical training which includes workshop, tools, equipment and materials. This made (Akplu and Amankwah, 2008) to point out that graduates from developing countries lack requisite practical skills and find it difficult to fit into the engineering industries in Ghana. Teachers in the vocational education should be in service training regularly to upgrade their skills to be abreast with the technological advancement in the world. Another reason is the negative public attitude and perception of students. Students in Ghana are of the notion that those who attend vocational school are not academically good. That is an important part where the Government of Ghana is supposed

to play a vital role. The government has to be committed in focusing on vocational education since graduates are the driving force of any developing economy.

4.4.1 Comparison of Ghana and Czech Republic vocational training education

After junior school, technicians have two options. Students can either attend a senior high school or technical school. Students who attend technical school further their education by studying technician part 1 and 2 and then continue to Higher National Diploma for a period of 3 years before students have the opportunity into the university education. Others too continue from technician part 2 to part 3. The craft men or trade men attend vocational school for grade two which takes 2 years and then further to grade 1 for a year as is shown in *Chart 1*.

In Ghana, there has been no structure made available for vocational student to fit into the university or polytechnic education. After completing grade two (2 years) and then grade 1 (a year), students cannot further their education in the tertiary institution. In this case, students who may in future want to study in the tertiary institution do not attend vocational training school.

Unlike in Czech Republic, its educational system is different in terms of vocational and technical education. Secondary Vocational School usually offer three-year programme which prepare students for manual work and other occupation. Students who wish to continue to the university level have to pursue a two-year follow course (Post-non tertiary education) which give them the opportunity to take the “*maturita*” (*literary meaning-matriculation*) exams. Secondary Technical School is completed four-years by “*maturita*” exams. The program is technically oriented and prepares students for technical business or jobs. Graduates may continue to the university as their other colleagues from Secondary Vocational School. Due to this fact, vocational education has reached its peak in Czech Republic. Below is the structure of the Czech Republic educational system.

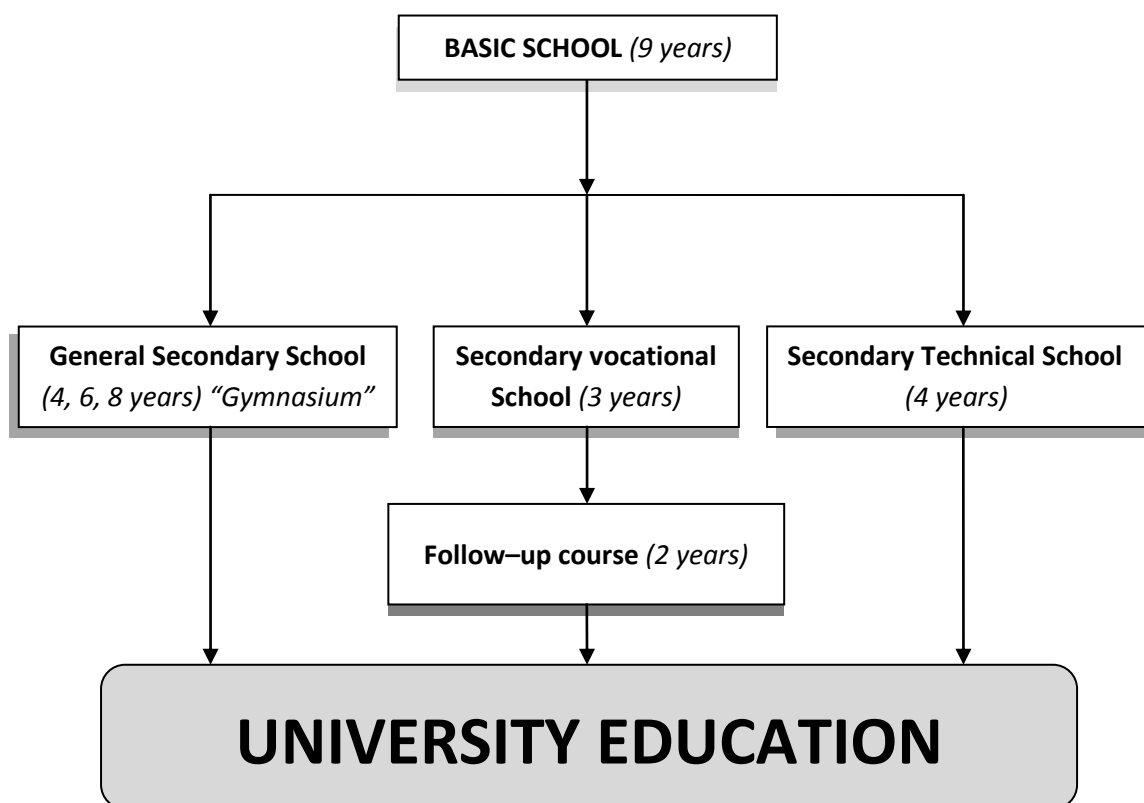


Chart 3: Czech Republic education structure for Technical Vocational Education
 Source: <http://www.unevoc.unesco.org/worldtvtdatabase1.php?ct=CZE>

Adapting the educational system of Czech Republic in the field of vocational training will not only improve the lives of Ghanaian but bring development to the nation. This is because small scale enterprise will be open either by private or partnership in training the future generation to have a better perception of vocational training. African countries which Ghana is also included are strongly advised to learn from the developed countries by setting up a standard for vocational training and education in the continent. Regular meeting should be held annually to discuss about the current situation of vocational training in Africa and find a better way to cure those problems.

4.5 The existing maintenance networks assessment

Ghana imports tractors and relevant machines in a complete state from abroad. These machineries are either purchased or acquired under international assistance. Their distribution and technical service are provided by a government organization; Technical Directorate – Agricultural Engineering service and a very important part of a stretch being Farm Power Machinery and Transport which are all subjects to the Ministry of Food and Agriculture (*see Chart 4*). The organization, Farm Power Machinery and Transport, which is a very important part of the Agricultural Engineering service is at a sufficient level and corresponds to the volume delivered Machinery Park both in terms of organizational, the technical and human resources.

This organization, Agricultural Engineering service, which its importance is evaluated as positive was founded in 1997. So far, it is the only organization having its own extensive network of centers throughout Ghana (*Table 4*). Ghanaian government has plans to build a new complex repair center as well in other regions. It is expected with sufficient capacity, modern instruments, and "skilled workers". These regions are administrative and repair agricultural zones designated by the Ministry of Agriculture and are taken on a central management body in Accra. Their task is to create a new repair centers in smaller cities as needed.

Regions and agricultural mechanization services enterprise centres (AMSEC)

REGIONS	NUMBER OF CENTRES	REGIONS	NUMBER OF CENTRES
GREATER ACCRA	3	UPPER EAST	7
CENTRAL	5	UPPER WEST	9
WESTERN	1	ASHANTI	5
NOTHERN	27	EASTERN	11
VOLTA	9	BRONG AHAFO	13

Table 4: The 10 regions of Ghana and their respective number of agricultural mechanization service enterprise centers for farm machinery.

Source: <http://www.mofa.gov.gh/>

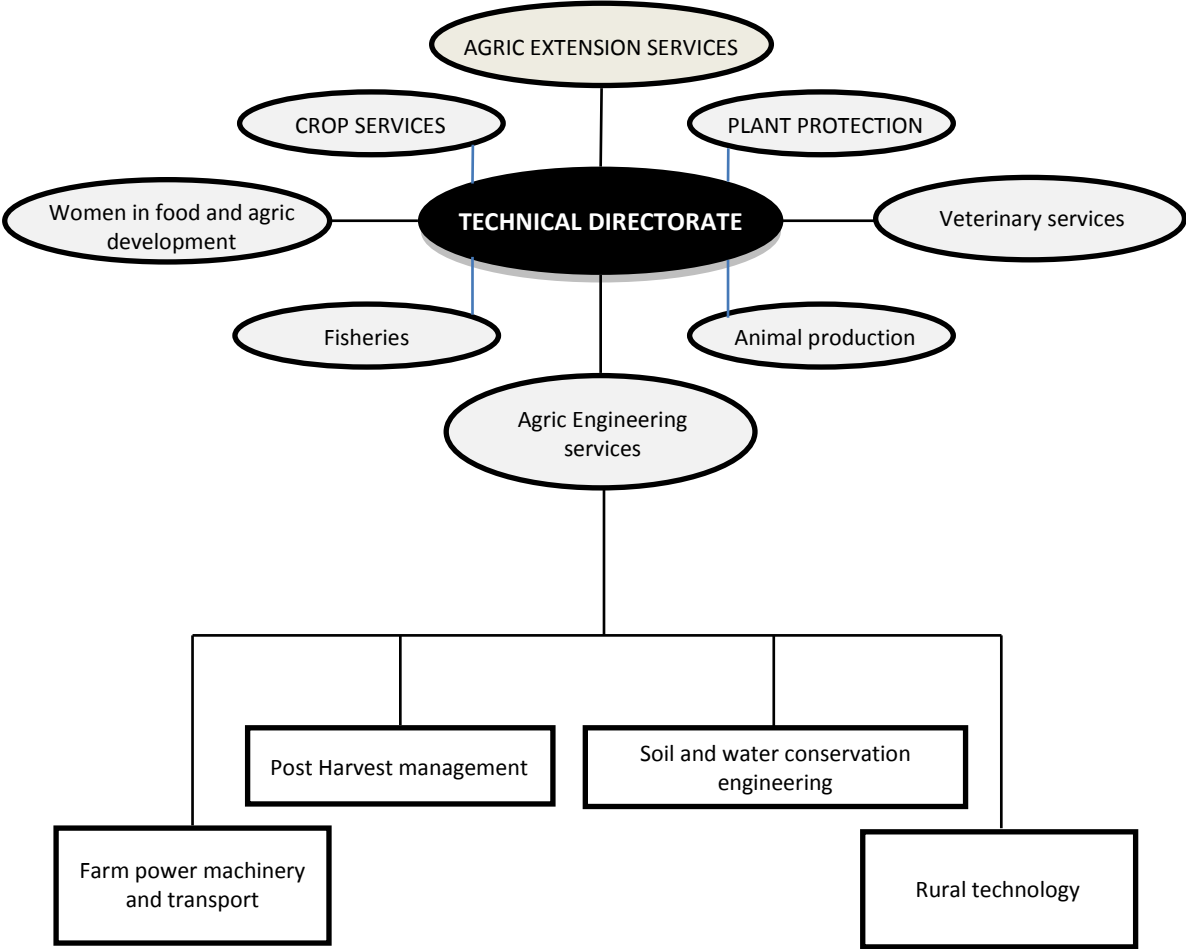


Chart 4: Divisions of the technical directorate in the Ministry of food and Agricultural in Ghana.

Source: http://mofa.gov.gh/site/?page_id=70

What I've indicated are actual plans taken from publicized materials from Agricultural Engineering Services and plays a vital role on a decision making policy to the government.

Farm power machinery and transport division, which is one of structurally subordinated institutions to Agricultural Engineering Services, plays a particularly crucial and important role in the area of mechanization and currently performs:

- a) Repair and service their own machinery, larger farmers and other organizations
- b) Maintain and repair, if the extents of repairs are beyond the capacity of local maintenance workshops.
- c) Assist farmers in building workshops and improving the efficiency of operations in repair.
- d) Mobile Field maintenance of machinery according to the needs of the farm.
- e) Produce spare parts according to the capabilities at its scarcity in the market and sale for optimal prices.
- f) Production processes and the right technology in the manufacture and renovation of components.
- g) Lectures on agricultural machines, machines that users can apply to their proper destination and thereby increasing the operational reliability of machines.

Taking into account the Ghanaian agriculture, we can say that agricultural technology is not evenly dispersed in different areas of Ghana. Building agricultural technology depends both on the intensity, the production of a given area and the distance from the control and industrial centers in Ghana.

Quality in maintenance and repairs carried out in most nursing services are at low level. The main causes include improper handling, lack of skilled labour on the implementation of maintenance and repairs, lack of spare parts. About 70 percent of servicemen do not have basic education or basic special course in the field of mechanization. Another reason is the large number of brands and models of tractors and other agricultural machinery. This complicates the import of spare parts, personnel training and acquiring experience of drivers and servicemen.

We can also critically evaluate primary records of conducted maintenance and repairs. Evidence either does not exist or is very incomplete. Therefore, total cost of maintenance workshops provides an incomplete picture. This implies that the costs attributable to

different types of automated equipment, facilities, machinery, and equipment cannot be classified and numerically processed.

4.5.1 Technical equipment, tools, and maintenance departments related Problems

Generally, piece of technological equipment is not a uniform system. It's either random or procured from different manufacturers. These causes can result from:

- a) Wide range of kinds, types, and brands of machines and production equipment (*see table 2 and 3*).
- b) In the case of small artisans frequent obsolescence of machinery.
- c) Lack of control usually technical, technological equipment, deficiencies in the calibration of equipment, machinery and equipment.
- d) A contingency of purchases sometimes expensive and complicated equipment workshop, to which it often lacks qualified personnel; fit exactly into the whole system (in which some articles are missing), so the effect of these investments often a loss and practically with no utility.

To avoid these errors, technical documentation must be organized to detect and improve the conditions of operation, service, and maintenance of machines. A major source of raising the level and cost of operational maintenance of machines is the availability of a suitable manner to Ghanaian condition on the basic rules and conditions to evaluate machine condition and management of renewal process.

The principle is based on the essence of renewal theory, according to which the optimum time recovery or optimum time to perform the nursing intervention is determined by the value of a diagnostic signal, which is the ratio of the sum of the costs of rehabilitation and operation of the sum of all periods of operation is minimal.

In mathematical terms:

$$u(s) = \frac{No(s) + N(s)}{t(s)}$$

Where

$u(s)$ = mean unit cost of renewal and operation

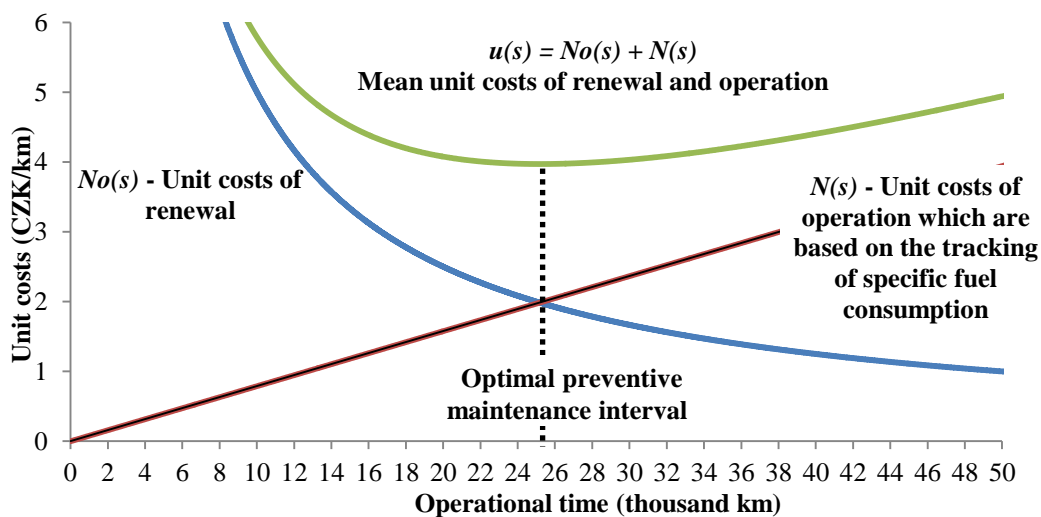
$No(s)$ = cost of renewal

$N(s)$ = cost of operation

$t(s)$ = mean time of operation

Descriptions about the equation

This general theory of renewal can be applied to problem solving of technical documentation and operating conditions of the operator. The relationship graph is shown in *graph 1*.



Graph 1 shows the relationship between the cost of renewal and the unit cost of operation. With these two graphs, we can determine the optimal preventive maintenance interval.

Source: TAE 2013. Pavlů, J., Aleš.Z., Jurča.V.

A graph constituting a sum function $u(s)$ - the basic elements of general purpose functions for recovery.

$N(s)$ - graph of the average unit cost recovery;

$No(s)$ - graph of the average unit cost of operation.

Equipment acquired under international assistance or imported by the Government is produced in different countries with different internal conditions. Manufacturer of machines, who determine the rules and guidelines for renewal, i.e. performing of maintenance, diagnosis, and repair obey these instructions internal conditions of their country - such as the different prices of various raw materials, labour, fuel, lubricant, etc. When producers are exporting machinery abroad, most manufacturers have their instructions either or do not permute or only to a negligible extent.

Compared to industrialized nations, Ghana has the following fundamental differences:

- a) Does not have its own source of fuel and lubricants and their prices are therefore very high,
- b) Imported machines and spare parts are very expensive - compared to prices in producer countries and several times more expensive,
- c) A qualified human labour in the conditions of Ghana's is very expensive,
- d) The climate in Ghana is characterized by stability, so that agro deadlines are not as limited as in Europe, implying that lower values are reached as well as the cost of downtime.

4.5.2 General requirements concerning the organization, conditions, and regulations for renewal

Due to the high cost of spare parts, is important to determine the time of repair. For example, when the renewal functional areas included in the cumulative effect of the defect:

- a) The economy of machines, which means that it increases fuel consumption and reduces the efficiency of the machine without a significant deterioration in the quality of work or production,
- b) The risk of an accident, in which case it is important to the extent incurred related disorders - disorders that do not depend if it is preferred to use fully Physical life, i.e. to keep the elements in the activities prior to the accident, if related disorders are extensive, it is necessary to fix the machine.

When performing technical maintenance, it is necessary to follow the instructions for adjusting fuel and lubrication systems, instructions for lubricating oil change intervals and maintenance; oil, fuel and air cleaners for machinery imported from Europe and other states like North America, Japan, etc. and in any case edit:

- Optimize replacement interval of lubricating oils,
- Having regard to excessive dust pollution, shorten maintenance intervals and replacement of all types of cleaning,
- Expensive components of fuel systems as long as possible to keep through adjustment in operation and prolong their life even at the expense efficiency of the machine as a whole,
- Having regard to average lower qualification operating personnel to implement adjustments in the organizational sphere - to provide expert supervision and assistance for quality performance of daily treatment and all other degrees of preventive care.

4.5.3 General indicators of the level of maintenance and servicing departments

- The performance of tasks
- Its own expense for maintenance activities
- Profits from maintenance activities
- The labour productivity

These indicators are not all but they are essential and necessary. They continuously increase with increasing levels of maintenance departments in accordance with the development of scientific and technological knowledge in practice.

4.5.4 A network of maintenance and Servicing enterprises in Ghana

Care undertakings in Ghana are still scarce. In Ghana, the main caring Enterprise is currently Agricultural Engineering Services, which is part of the Technical Directorate, under the Ministry of Agriculture and livelihood. This enterprise tackling the problem repairing divided into repairs to planned and unplanned (*Chart 4*).

The greatest difficulties arise when management decisions on the sequence of the various stages of repair. One of the most important points in solving this problem is the allocation of machines according to their importance, because the concept is based on the fact that all

machines are not equally important. The priorities will depend on the objective situation, but in any case it cannot be universally defined.

In repair and maintenance systems in developing countries it is recommend grading, by sorting 1 to 5 in ascending order;

1st level: If the problem affects or stops production

2nd level: when failure does not affect production, but it is expected that it will happen soon

3rd and 4th level: as in second level, but at a higher level of importance

5th level: when failure does not affect the production and jeopardize the safety of workers and nearby.

4.5.5 Maintenance resort as a subsystem

In terms of the technical system, maintenance has seven main elements:

Objective, Participants, Input, methods, outputs, tools and means and Surroundings.

Objective:

The objective of maintenance management is to ensure that machinery and equipment are accessible for production, their performance and reliability is okay, that the above target, ensuring the lowest possible cost.

Participants:

These are the people who are directly involved in repair - Head, technical, economic staff and foremen to superiors places, but also the mechanics, electricians and other tradesmen to subordinate positions.

I present below some examples of organizations of different maintenance groups:

i) Machinery maintenance groups of less than 20 people.

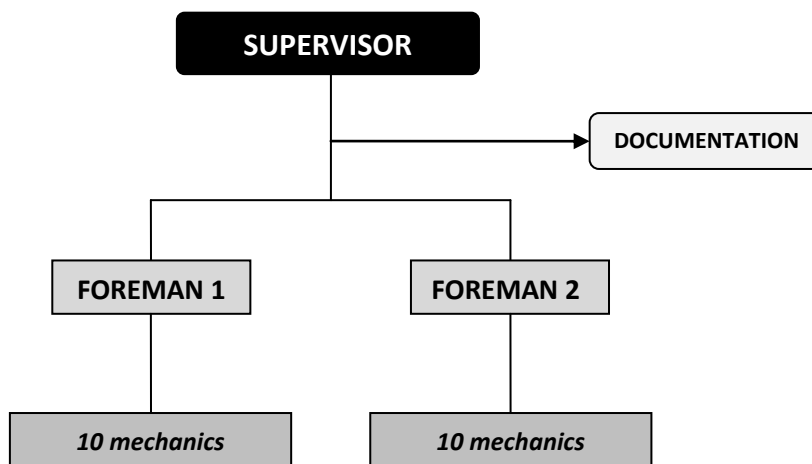
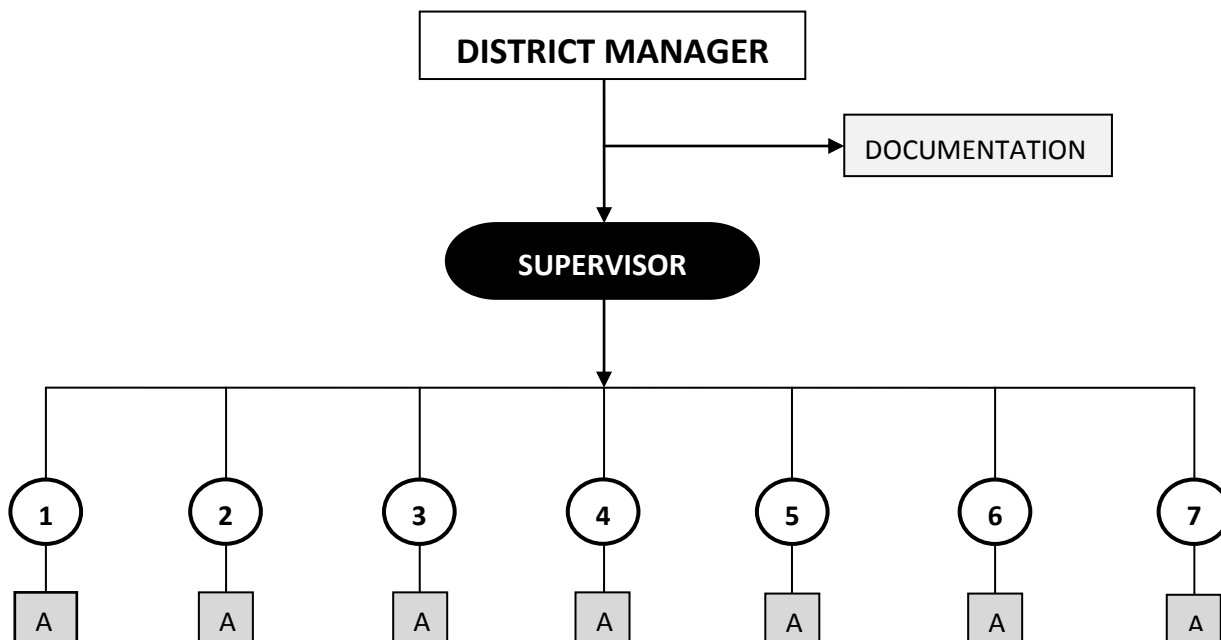


Chart 5: 20 mechanics under the supervision of 2 foremen.

Source: Author

Planning a maintenance program is determined by the supervisor. Referent only processes implemented and prepare work procedure.

ii) Machinery maintenance groups for 35 people



Where A represent 7 mechanics.

Chart 6: Maintenance group of 35 mechanics under the supervision of 7 supervisors.

Source: Author

iii) Machinery maintenance groups for 100 people

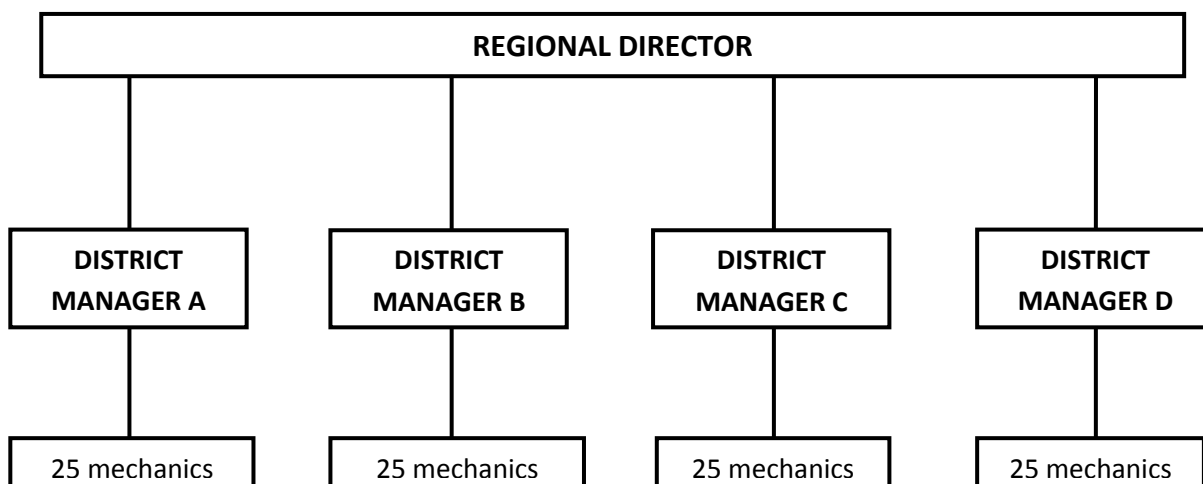


Chart 7 shows the maintenance group for 100 people under the supervision of 4 district managers.

Source: Author

Input

All primary attribute and analysis as well as history are the main input for maintenance to be performed. Physical inputs are spare parts and lubricants, other inputs are information about the condition of machines and time when the machines are needed in production.

Methods

When the board decides to accept scheduled maintenance system, it must go through two phases:

- **Pre-preparation phase** – This phase involves several procedures such as identifying inventory, schedule factories, assigning identification numbers, identification numbers marking machines, selection of appropriate equipment, manual and technical details, the file records of performance, employment hinterlands, etc.
- **Preparatory phase** – also includes several procedures such as repair list, repair instruction, preparation maintenance program, the preparation of lubricants.

Output

The main output of maintenance department is machinery and equipment in good condition, if possible, like new, in order to prolong its operational reliability.

Tools and means

For the repair group needs a variety of devices and equipment such as washing aggregate, oil tank, grease gun, pit installing, electrical measuring instruments, diagnostic equipment, etc. Janitorial resort also produces new spare parts and repair old ones. It means that the workshop must have the basic unit and the welding unit is required in each case.

Surroundings

An urgently needed for maintenance at surrounding resort is a factory or the undertaking to which it is part. Janitorial resort to fulfill its function well, other sectors must carry out its functions. But the most important thing for the success of the venture is collaboration between people.

Types of services or repairs required for the machine can be divided into two main groups:

1. ***Periodic service*** – type of service or repairs that may be planning or programming can also be found in the period that the machines would not work or during bad weather. The goal is always to minimize the loss of time.
2. ***Random (accidental) repair*** – cannot be planned, are important for the elimination of random negligence, or fault resulting from improper handling, poor handling of the machine or material defects. These defects that arise during irregularly, regular use of the machine, requiring immediate repair to the machine can continue its work without unnecessary loss of time. Servicing is effective when the ratio of lost time to time work is minimized.

In section 4, I tried to show the organization of the various maintenance groups that are part of a single nursing company in Ghana. Now, I present the main activities of one of its branch, based in Tamale.

This branch deals mainly overhauls components. Each component must be renovated by appropriate technology, this means:

- Repair parts on a qualitative level appropriate to their industry-standard
- Reduce the cost of repair of all components, whole, and parts.

Common technology used in the repair of components:

Entrance Income → External washing → Installation and Removal → Internal wash → Inspection and monitoring → Repair → Installation → Compact mounting → Testing and Inspection → Adjustment → Issuing **Output**

Individual sections for overhaul:

1. Section for engine repairs
2. Section for transmission repair
3. Section for front and rear axles
4. Section for the fuel system
5. Section for hydraulic system
6. Section for electrical system
7. Section for cooling and compressor system

Secondary but very important sections:

1. **Mechanical section** – work on the lathe machine, drilling, boring, grinding, milling, and shaping.
2. **Blacksmith and joiner section** – forge welding, arc welding, oxy-acetylene and automatic shifting Body work, carpenter.

5.0 Draft concept for specialized level of farm equipment's protection in Ghana

Ghana needs to transform its economy from agrarian to industrial so that it will be able to boost the life standard of the population to middle class income. Improving the condition of the food supply is at the forefront of the interests of broad sections of the population. Its members must apply progressive methods of work and expect the application of scientific and technical knowledge. Achieving self-sufficiency in food production is far from an easy task, especially when you overlook the continuing problems in the local agriculture - for lack of funds, the fragmentation of agricultural land, the low level of use of technology, lack of professional staff.

In Ghana, the problem is also territorial factor. The villages are made up of only a few houses on the small size of cultivated land often up to two hectares. The place where the rural population is concentrated, does not penetrate the prerequisites for the creation of large-scale farming, for whose development it is necessary to have agricultural machinery. Therefore, proposals, at least one workshop by the capacity of the farm, for example types of workshops, which is used in the Czech Republic for the first specialized level of care for the machine. The aim of this workshop is to educate future servicemen, mechanics - fitters, etc. from the local population.

These services are primarily demonstration workshops, which are the basic specialization article and should have three main activities:

- Performing technical maintenance events (both daily and periodic)
- Execution of technical diagnostics
- Performing a variety of extensive operative repair activities.

Based on the information and findings suggest that first department's specialized degree in Ghana have this basic job description:

- a) the possibility to perform all technical levels of maintenance of mobile equipment (tractors, trucks, self-propelled)
- b) the possibility of carrying out all stages of technical maintenances stable at the exit of machinery and equipment (mobile) in the form
- c) services in the field of care for batteries and tyres

- d) the first level of technical diagnostics (generally in the plane of sorting machines to a group of disorders with a group in mint condition)
- e) repair activity in the field of small tasks arising from the performance of maintenance , removal of random failures arising during operation, post-season repairs (if in a given body type repair purposeful)
- f) storing the basic means of material-technical supply to the care of the machine. The best solution for Ghana, it is likely to hold basic conditions to provide comprehensive services such as:
 - Department for external washing machines;
 - United workplaces for lubrication, external examination, inspection and adjustment, or performed minor repairs, etc.
 - Space for tyre repair, room for charging and care accumulators;
 - Filling station – workplace must be separated from their own workshops , with an adjacent storage tank and keep records of fuel consumption on individual machines;
 - Assembly hall for the removal of random failures of machines during the season and having fittings - welding shop, a small mechanical workshop, carpenter, a stock of spare parts and repair needs;
 - Storage facilities for short periods of storage, for long-term shutdown - a garage, covered storage buildings (sheds, shelters) and open storage position.
 - In terms of Ghana, the skilled operator fails to comply with the required level of service. For such cases, consider several plot options;
 - A small circuit - parking area, cleaning, lubrication, inspection and adjustment refueling, garaged bid tractors and machines separately or separately all sets;
 - Big circle - parking area cleaning, lubrication control, adjustment, assembly hall and workshops repair shops, refueling, garage;
 - At the apparent failure will be useful, for example, the machine came right out of the workplace outer cleaned in the assembly hall;

Advantages majority:

- 1.The relative autonomy of each workplace,
- 2.Easy to use different plot options,
- 3.Generally requires less floor space.

After studying all typical project maintenance centers in the Czech Republic I recommend solutions maintenance and repair work, which is shown in *diagram 3* at least for a regional level.

This center provides therefore the central workshop of the regional enterprises like Tamale. If necessary, it is effective to produce smaller devices for capital construction. In the framework of a comprehensive solution I propose to these work complementary diagnostic centers.

My upwards concept of first level specialized care of machine based upon issues that are currently relevant not only in Ghana, but across the developing countries. I tried to point out, as it should in future look modern workshop. Its tasks are to divide the two groups:

1. Provide repair and maintenance of agricultural machinery, spindles diagnosis in regions.
2. Educate future repairman in the area of care of the machines; take care of the ideological education of the public especially when they relate to properly use of equipment and materials.

Considering that this solution will be effective and promising for the development of care for farm equipment and agricultural mass production, which is now the key to solving national economy issues.

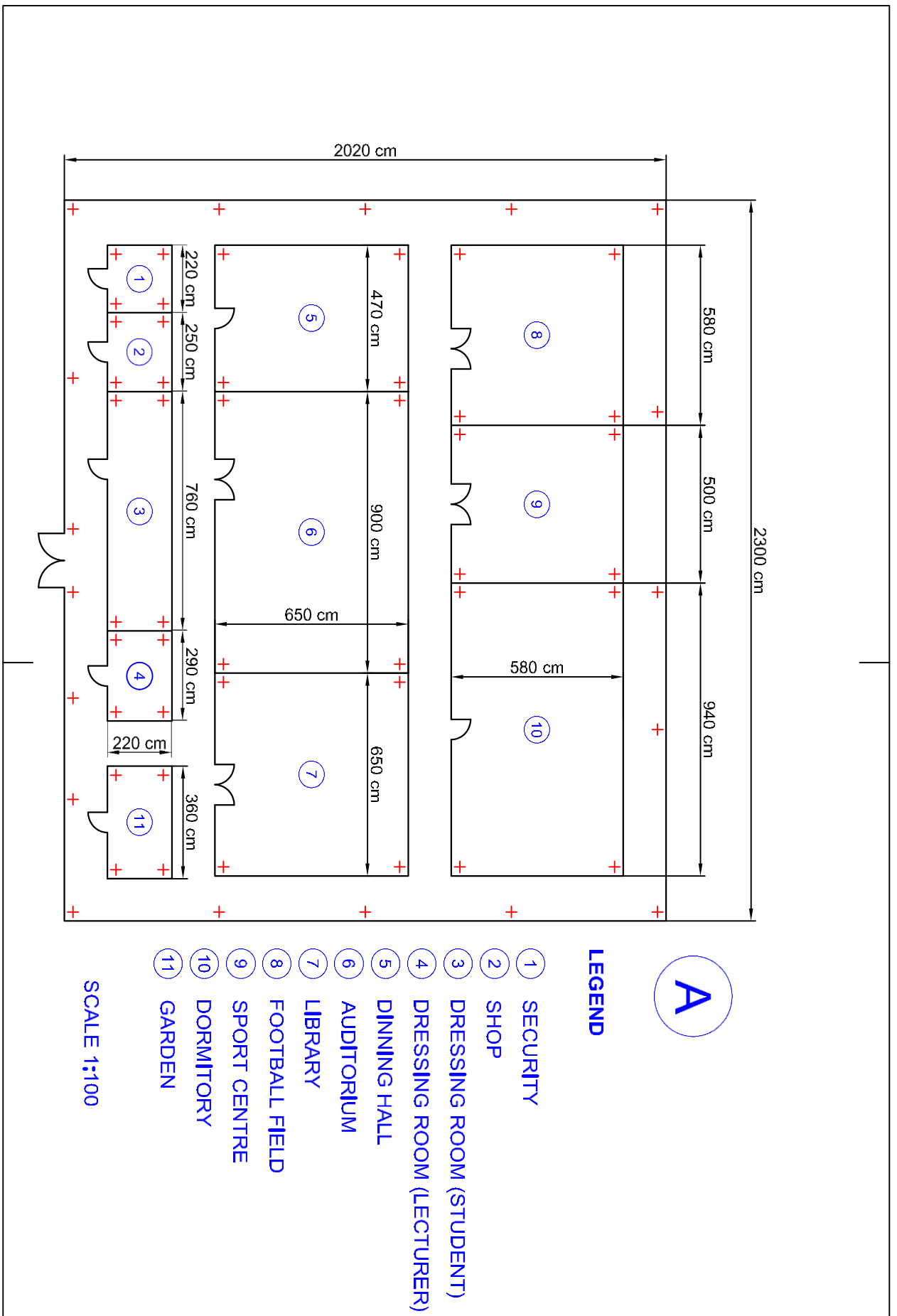
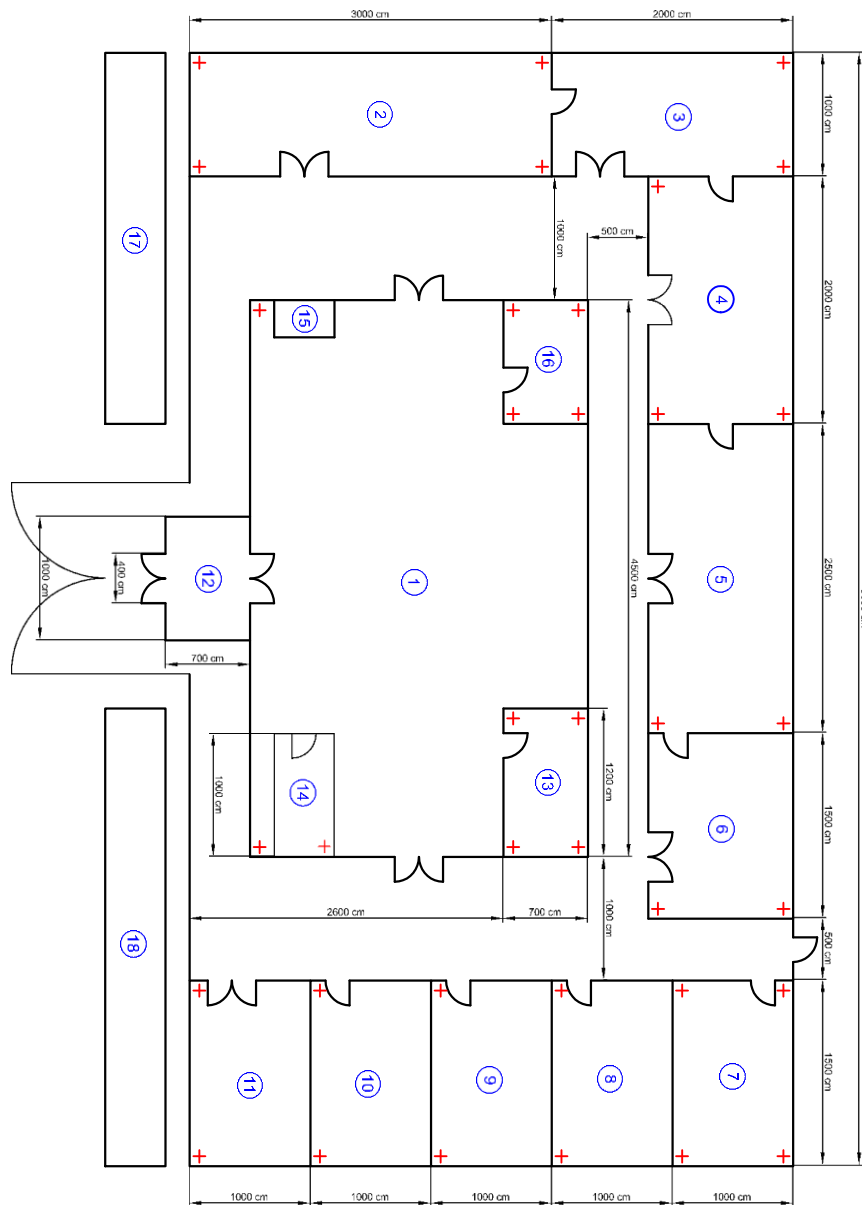


DIAGRAM 1: Proposed School facilities and dormitories for Vocational Education in Ghana

Source: Author



B

LEGEND

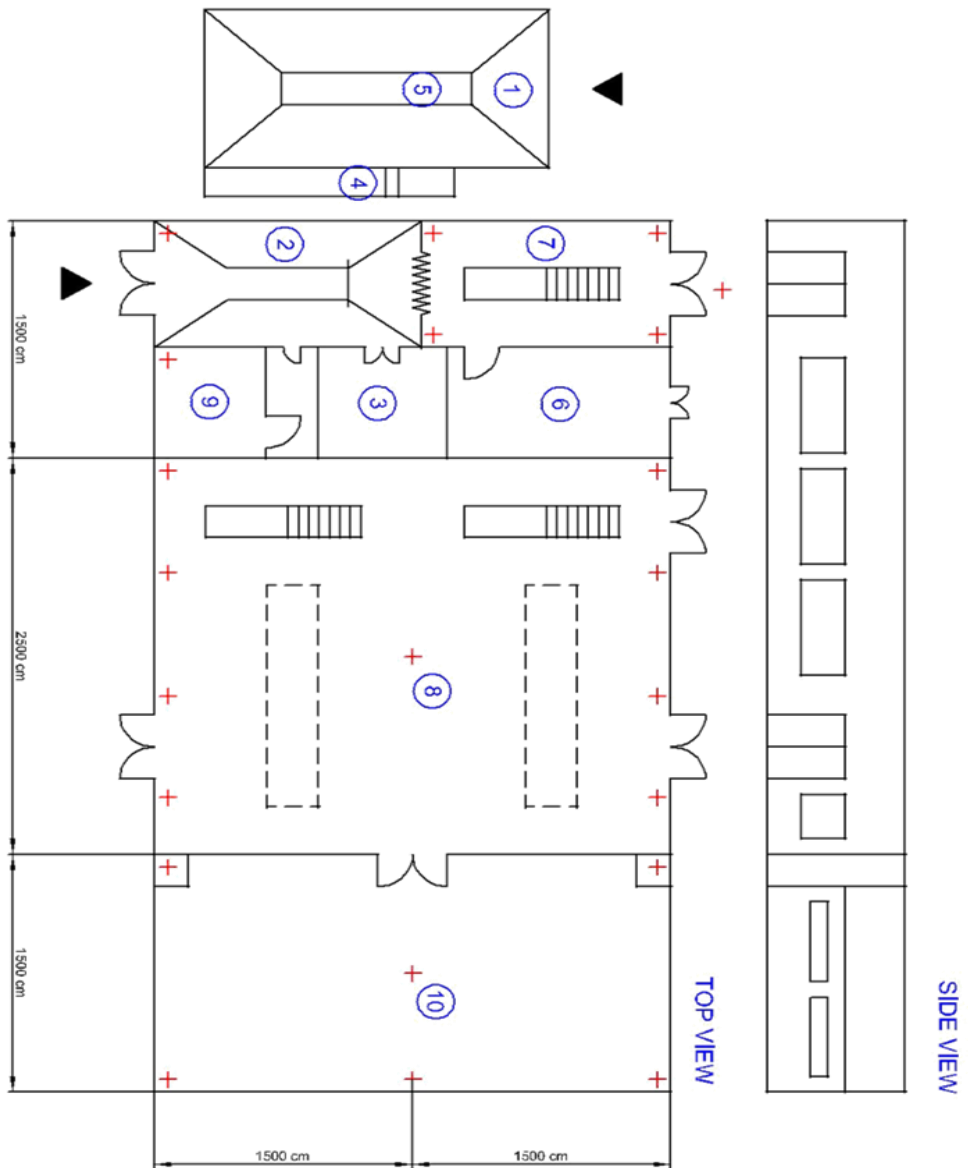
- ① MAINTENANCE HALL
- ② WELDING MECHANICAL SHOP
- ③ TRIVIAL MECHANICAL
- ④ OXY-ACETYLENE
- ⑤ LATHE MACHINE
- ⑥ ELECTRICAL SHOP
- ⑦ CLASSROOM A
- ⑧ CLASSROOM B
- ⑨ CLASSROOM C
- ⑩ CLASSROOM D
- ⑪ ADMINISTRATION BLOCK
- ⑫ CAR WASH
- ⑬ DIAGNOSTIC CENTRE
- ⑭ VULCANIZING CENTRE
- ⑮ OIL DRAWN CENTRE
- ⑯ DRESSING ROOM/ W/C/ TOOL BOX ROOM
- ⑰ & ⑱ PARKING AREA

SCALE 1:100

DIAGRAM 2: Layout of the proposed Vocational school
Source: Author

DIAGRAM 3: Proposed regional maintenance centre for Tamale

Source: Author



(C)

LEGEND

- ① SHED AND GARAGE FOR STORING
- ② WASHING AREA
- ③ MAINTENANCE & DIAGNOSTIC
- ④ CENTRAL WORKSHOP & OFFICE OF THE FOREMAN
- ⑤ FILLING STATION
- ⑥ SPARE PARTS WAREHOUSE
- ⑦ SMALL SCALE MAINTENANCE
- ⑧ CENTRAL MAINTENANCE
- ⑨ OFFICE
- ⑩ PARKING AREA AFTER REPAIR

SCALE 1:100

Diagram 1 describes the proposed school facilities and dormitories for vocational Education. It has the following features,

Security room: The securities men protect the school property, students and ensure that student abide by the rules and regulation of the school.

Shop: Open to both students and personnel to purchase basic items like stationary and foodstuff in the School.

Dressing room: Students and teachers have separate dressing room for changing after going for practical training.

Dining room: Students visit the place three times in a day to have breakfast, lunch and dinner respectively.

Auditorium: Is an assembly ground where conferences and special event are held.

Library: Open for students to make research using books, computer and borrowed useful books for studies. Students have the opportunity to use the library for further studies before and after classes.

Football field and Sport centre: Students performs various exercises to have a better health and heighten the sharpness of their mind.

Dormitory: Students sleep in the dormitory and has opportunity to help each other in terms of studies.

Diagram 2 shows the proposed vocational School. The centre includes the following;

Maintenance hall: Practical training of maintenance and servicing of farm machinery by students. The hall comprise of oil drain centre, diagnostic centre, vulcanizing centre and dressing room together with tool box room.

Welding mechanical shop: Students practice the basic of welding as well as mechanical works during training.

Trival mechanical shop: Train students on all kinds of mechanical servicing regarding farm machineries and equipment.

Oxy-acetylene shop: Students are trained on the basics of welding and cutting using oxy-acetylene.

Lathe machine workshop: Students are trained on the use of lathe machine for cutting, turning, facing, deformation, knurling etc. during maintenance of farm machinery.

Electric shop: Students learn about the electrical system of farm machinery so that troubleshooting can be done easily when an electrical fault occurs during operation.

Classrooms: Theory works are done in the various classrooms by instructors or teachers.

Diagram 3 is a proposed regional maintenance and servicing centre for Tamale. The centre comprise of the following;

1. *Spare parts store*: Spare parts store for fast moving items.
2. *Washing area*: For external washing before servicing.
3. *Maintenance and diagnostic*: Battery controlling, oil diagnostic and used oil collecting area
4. *Central workshop and office of the foremen*: Office for the foremen and the supervisors.
5. *Filling Station*: It is separated from the workshop and opens for farm machinery owners to top up fuel after servicing.
6. *Spare parts warehouse*: All various spare parts needed for farm machinery and equipment are store in this warehouse.
7. *Small Scale maintenance*: Open for small scale farmers to perform maintenance of farm machinery and equipment by servicemen.
8. *Central maintenance*: A big area where major maintenance of farm machinery and equipment are done such as splitting the engine to work on clutch, removing the engine block. etc.
9. *Closing and rest room*: Room for all necessary facilities.
10. *Parking area after repair*: Farm machinery short time parking area before dispatching.

5.1 Educational background of operators and service men in Ghana

Education of operators and servicemen are important in order to prolong the life span of farm machinery. It is necessary for both operators and servicemen to study the operational manual and understand the instructions. During my research, Tamale which its main occupation is agriculture has about 70 percent of operators with low educational background. Majority of the operators had Makaranta education. Makaranta comes from a word in Hausa and this word means “*Madrassa*” (school) in Arabic. Religion problem which can be found in the Northern part of Ghana promote a form of education whereby graduate learn Arithmetic only in Arabic language and do not study English. So in this case the operators learn how to operate the farm machinery from other operators without any formal machinery training. This means that those who train the operators train them with their limited experience on the field. Maintenance and servicing of farm machinery is affected since these operators cannot read manual of tractors and employ their own skills. In addition, maintenance is done by the tractor’s owner experience on the field, way- side mechanics or friends. The educational system differs from region to region. The Ministry of Education in Ghana must restructure the education for operators and servicemen so that the same curriculum can be used irrespective of the region. I strongly propose the educational reform English as a basic formal education.

5.2 Proposal concept of first level curriculum for servicemen

During my research, I visited a Secondary Vocational School in “*Nové Strašecí*” to have a general view of the educational system in Czech Republic in terms of vocational and technical training. After comparing the vocational and technical training of both Czech Republic and Ghana, I propose a first level curriculum for servicemen in Ghana which can be read in *table 5*. Since Ghana is a developing country, skills workers in a specific profession are necessary to reduce the level of unemployment in Ghana. This will not only improve the socio-economic development of Ghana but alleviate poverty in the country and prevent migration to urban area at a certain percentage.

SUBJECTS	AIM
1. (Ga/Twi) local language	Better communication at workplace using local language.
2. Technical drawing	Read drawings and use them for troubleshooting
3. Physical education	To keep fit all the time physically and mentally.
4. English language	Better command over the English language since is a medium of communication in class and understanding manuals.
5. Physics	To provide fundamental of physics to achieve the necessary skills in a wide range of practical application.
6. Mathematics	To have basic knowledge to solve algebraic equations, trigonometry, structure to solve specific problems.
7. Civic studies	To learn the ways of life, develop ideas and culture of a society.
8. Farm Practice	Visiting farm enable student to acknowledge practical training.
9. Agricultural machineries	Introduction of special types of farm machinery and the important task it performs on the farm.
10. Chemistry-Fuel and lubricant	Learn the basic chemical composition of fuel and lubricant of farm machinery and tribology.
11. Electro techniques	Have knowledge in electrical, automation and understand the basic function of sensors.
12. Materials and manufacturing	Learn the types of metals and their properties.
13. Basic Agriculture and ecology	Learn about agricultural practices and how plants interact with the environment.
14. Driving motor vehicle	Student must learn how to drive all kinds of farm machinery.
15. Maintenance Technology	To have basic knowledge on the types of maintenance and safety practices in the workshop.
16. Transport theory	To learn the efficient way of transporting farm equipment to the farm.
17. Information Technology	To have knowledge about computer and how to use it to solve diagnostic problems.
18. Industrial Engineering	Student learns how to reduce cost, increase efficiency of farm machinery during maintenance.
19. Reliability of machines	Have in-depth knowledge on ways to improve the performance of machines at a least expected cost.
20. Motor Vehicle	To learn the various parts of motor vehicle and its uses.
21. Economics and management	Learn how to plan and manage your finances in term of maintenance of farm machinery.

Table 5 shows the first level curriculum for service men in Ghana

Source: Author

Draft timetable for mechanic-repairmen

I propose a time table for mechanics-repairmen for 2 years.

	Subject	Number of weekly lessons in a year (hrs.)	
		I	II
1	(Ga or Twi) Local Language	1	-
2	English Language	1	-
3	Civic Studies	1	1
4	Mathematics	1	1
5	Physics	1	1
6	Chemistry-Fuel& lubricant	2	-
7	Physical Education	1	1
8	Economics and management	-	2
9	Technical Drawing	2	-
10	Material and manufacturing	3	3
11	Electro techniques	2	1
12	Agricultural machines	3	2
13	Motor Vehicles	-	3
14	Driving motor vehicle	2	-
15	Basic Agriculture and Ecology	1	1
16	Maintenance Technology	3	4
17	Industrial engineering Basic	2	2
18	Farm Practice	9	12
19	Reliability of machines	-	2
20	Transport theory	1	1
21	Information Technology	2	2
Total		38	38

Table 6: Draft time- table for mechanic-repair men.

Source: Author

To the curriculum I propose to include mainly vocational courses and training. I suggest including also the basic teaching of the English language, as English is the language of instruction. Basic professional courses such as engineering, technical drawing, electrical serve to acquire the necessary professional knowledge and skills that are necessary to create a basic theoretical training and hardware components of the productive forces of production. Special vocational subjects such as technology, engineering technology, machinery and equipment, provide knowledge about the work processes within a specific technology. The knowledge gained in these articles is the theoretical basis for the acquisition of practical skills.

The content of individual subjects is proposed to include the following basic information:

Physics - Information about physical quantities, construction of measuring instruments and methods of measurement of sound practice in connection with technical diagnostics.

Chemistry - Information about the issues of most commonly used materials in agriculture such as fertilizers, plant protection products and the main fuel and lubricants for machinery.

Electro techniques - Electrostatics, direct current, magnetism , alternating current , basic electronics , electrical machinery and apparatus , rectifiers , production and distribution of electric energy , electric light and lighting , electric heat and cooling and the basics of automation.

Engineering – Understand the concept of science and engineering materials, a manual machining and material processing, machining fundamentals, fundamentals of bonding including welding and metal forming, basic mechanics, and theory of machine parts.

Motor Vehicles – Have basic knowledge of machine parts, transmissions, engines, including fuel systems, and electric equipment, brake systems, chassis, equipment and accessories used in the design.

Basic Agriculture - Findings from the biological nature of agricultural production.

Crop production: construction of the plant body, metabolism and energy, plant growth and development, reproduction, seeds and seedlings, soil, climate, nutrients and fertilization, pest plants etc.

Livestock: anatomy and physiology of livestock nutrition and feeding characteristics of animals, breeding work, and their like.

Machines in Agriculture – Study about Agricultural transport, tillage, spreading of solid materials, working with liquids, seeding and planting, harvesting forage, grain, and root crops. Some content on this subject, I propose to use as a subject exercises where trainees are familiarized with the construction, adjustment and maintenance, lubrication and maintenance.

Machine reliability - Basic level: the quality of machinery knowledge, production and operational impact on quality; defects on machinery - wear, corrosion, fractures, cracks and deformations, their causes, mechanism and prevention. Problems of limit state machines and their components, endurance tests, initial processing results. Optimize Recovery: methods of determining the optimal time for performing maintenance intervention, repair machine element, replacement of the entire machine.

Technology of maintenance and repairs - It introduces basic technological processes used in machinery and equipment, maintenance and repair of machines and equipment type. The technology of maintenance: garaging and storage, exterior cleaning, lubrication equipment, lifting equipment and assembly pits. Technology Services: breakdown repair procedures, parts cleaning, disassembly, technical inspection, installation, start-up, testing, surface treatment. Renovation included: plastic deformation, welding, chemical and electrochemical methods, straightening deformed parts, repair parts with fractures and cracks. Renovation of typical components: shafts, bearings, gears, frames and structures, renovation of agricultural machinery tools. Repair type machines and their groups.

Professional training - it provides the necessary knowledge and skills necessary for the practical management of the activities set out qualifying characteristics.

Taking into account the fact that Ghana has extensive agriculture structure, we can determine the required number of apprenticeship or by arable farmland. This number depends on the level of national income of the country and the number of agricultural machinery. Therefore, I suggest that in the initial phase of about 100 Mechanics- servicemen on the whole territory of a year, that number will gradually be corrected. The only organization in Ghana that can take on this responsibility is the Council for Technical and Vocational Education and Training (COVET) which provides national policies on skill development. Vocational training is one of the most important parts of education. The training extends throughout the educational process. It takes place in workshops and at the working position. Given that it is an adult learner, graduates will have special training with certain specific characteristics.

In addition to normal training, which is included in the curriculum (in the first year nine and in the second year of twelve hours) proposes to expand vocational training for four hours on Saturday in addition to the normal working days, even when trainees do not learn in school. During the holidays, trainees must be directly involved in the production of work practice. The framework curriculum is presented in *table 5*. I came out with a plan which is similar to that of SOÚ Nové Strašecí, the Czech Republic, taking into account the current situation in Ghana.

In conclusion we can say for Ghana , given the current overall state of care of the machine that are not yet required very specialized workshops, which have a total intake area and of course the long haul , low level workshops user machines (basically the first level of specialization) then forces user machines and where would suffice small craft action , seek the assistance of large remote repaired, which often place small intervention renovating character perform extensive repair by single technological process . On the other hand, Ghana, like many other developing countries, registered the emergence of certain problems in cases when there is more massive educated person of university education for a particular sector if the sector does not have enough skilled workers and high school students, qualification of engineers is not in such a case, entirely graduates themselves may not have enough practical experience or workmanship; usually then seek employment outside the manufacturing sector.

5.3 Experience from Strom Praha sole agent of John Deere

During my research, I visited Strom Praha, which is a regional representative of Czech Republic based in Prague in “*Lohenická*” Street which sell, distribute, and service John Deere farm machinery in Czech Republic. The mother company based in Germany assists the service centre with technical support, training and special tools. This company has 40 centres in Czech Republic which does all maintenance and servicing of John Deere farm machinery. After farm machinery has been purchased, farm machinery owners have a year warranty from the manufacturer and three years from the service centre. All periodic maintenance is done by the technicians. Establishment of good relationship with the customers is necessary so that the company can continue to perform the service of farm machinery after the contract expires. The company also organizes in service training periodically for tractors owner so that they can do their daily maintenance on tractors each time. I propose that such agency should be established in Ghana to boost the agricultural sector which is very essential to encourage private ownership.

5.3.1 System of ordering spare parts

System of ordering spare parts in maintenance and servicing of farm machinery is vital to reduce the down time of the machinery when there is a breakdown. In Czech Republic, the problem of scarcity of spare has been solved due to good policies made by the maintenance centres like John Deere and the good relation it has with the mother company. Fast moving spare parts like gasket, filters, sealing/O ring, bearing, tyres, etc. are available at their main service centre and distributed to other centres. Comparing Czech Republic and Ghana, I propose that this system of ordering spare parts can be used to help improve on the availability of spare part at various maintenance centres. Distribution of spare parts to centres like Tamale can be done by post service (Private distribution centres association role). The maintenance centres should have a contract with the post service so that the spare parts can be delivered to them on time.

5.3.2 Introducing tribology in Ghana

Comparing to Ghana, tribology is well known in Czech Republic. Tribology is one of the important parts in maintenance and serving of farm machinery as one of the principal diagnostic signal. Tribology gives us an insight on the various losses and analyses those losses in machine parts. Minimize losses by introducing a layer of lubrication. Tribology help control the wear on surfaces by reducing the friction between the surfaces. It can be done by introducing lubricant which can be solid, liquid, or gas on the surfaces. Operators and service men should be educated frequently to know the important of tribology so as to improve the performance of moving parts of a machine, with fewer breakdowns.

5.3.3 Mobile service system

Strom Praha performs mobile service of farm machinery throughout Czech Republic for John Deere machinery when the need arises. The company has vans with tools and equipment at the various service centre which perform quick service when there is a breakdown to reduce down time of the machinery. The mobile service can only perform maintenance at the farming area which is serviceable. On-site service is more effective than transporting the farm machinery because the customer spends more money during the round trip to and from the dealer. I suggest that the government policy should be revised to encourage the private sector to establish a good relationship with producers of the farm machinery to be representative in the country.

5.3.4 Disposal of waste after maintenance of farm machinery

After maintenance and servicing of farm machinery, the waste should to be taken care in the right way to protect the environment. Below are the wastes after maintenance:

- Used oil
- Used Spare parts and rags

Used oil

Majority of servicemen and operators in developing countries are naive on the dangers used oil can bring to the environment if not properly dispose after maintenance. One basic property of oil is that it does not wear but can be contaminated. Experiences and research results shows that one litre of used oil can contaminate one million litres of drinking water. Disposing of used oil in a wrong way will pollute the environment. From my personal experience I have notice the improper ways in which oil is dispose in Ghana. They are as follows;

- a. Burial of used oil in the ground.
- b. Use to control pest and painting of timber for preservation.
- c. Dumping of used oil in drainage system, sewers.
- d. Used oil for burning in an open place.

During my research, I visited maintenance and servicing centre of John Deere at Strom Praha. The company has a contract with the supplier of oil. So, the operators and servicemen put all used oil in a special container for recycling by the supplier.

I propose that training should be organize for servicemen and operators at various maintenance centres in Ghana so that such practice of recycling used oil in Ghana can be achieved .The environmental agency in Ghana should frequently visit these maintenance centres without any notice and check whether used oil are properly dispose.

Used Rag and spare parts

Maintenance centres should make contract with company so that used rags and spare parts can be taken care of without causing any harm to the environment.The environmental protection Agency in Ghana should be strengthen to educate the public on the burning issue of disposal of waste after maintenance and servicing of farm machinery so that the population will be aware. This shows that the work of the environmental protection is at the very beginning stage and proposes as a must all maintenance and servicing centre must collect used oil and deliver to the central executive office for liquidation. And those centres which are not complying with the law should be heavily fined to avoid such practices. After studying the Czech Republic representative of John Deere maintenance centre, I recommend that strong or functional agent should be invited to certain maintenance and service centres in my country to control and give free hand to servicemen as well as operators.

6.0 Conclusion

I have defined the priorities in addressing some fundamental questions about the machine treatment. As a result of these considerations, I propose the field personnel training as a priority and the training preparation of the working class, by analogy to the construction sites of care facilities as priority building for maintenance-repair centers that are similar in the Czech Republic. Construction of universal or specialized large workshops can obviously run in parallel or with only a small delay - unbearable is when we consider only a reversal of that is preferred by creating specialized service and neglected first specialized degree. Proposed concept is substantially supported by the development of mechanization and automation of production in general, the introduction of high technology generations. Powerful new technology introduced into agriculture has certain specific characteristics, which are often significantly will shape and form the basic care.

Development of agricultural production, the raising and improvement is currently one of the key factors in the development of the national economy. Development of agriculture as a whole is inextricably linked to the introduction of new technologies, new techniques, and other elements of development. In the development of agriculture is not just about increasing the volume of production, but a simultaneous application of high efficiency. The basic conceptual approach to the care of the machine significantly affects the consumption of the labour, materials and energy.

Problems whose solution I dealt with in my thesis, relating to Ghana, as did the other developing countries are:

- a) Continuous improvement of training and education of personnel.
- b) Conceptual design of a basic network of care departments.

1. In addressing the first issue of raising the level of education and personnel training in the area of care machines, I came to the conclusion that in the preparation of blue-collar workers for the industry is lagging Ghana and the situation will soon improve, because the solution depends on the implementation of the reform all levels of education (colleges and universities). Therefore, my proposed solution is essentially temporary, and its validity is limited to the period before such reform. The solution I proposed training center for vocational school, majoring in mechanic - repairman.

That's why I suggested a two-year extension for graduates of grammar schools in the field of mechanic - repairman. For this field, I developed the basic concept of the curriculum, while I consulted the curricula of similar curricula in the vocational school in Nové Strašecí, Czech Republic.

2. In addressing the underlying network care units and in the assessment of machinery have been identified serious deficiencies in the content management technology imports, the mechanical acceptance of the technical conditions for the operation of the machines, the low level of knowledge of the quality characteristics of local circumstances. The situation is especially complicated by the large number of production brands of imported machinery. This, of course, there is the problem of shortage of spare parts, which can at present and in the present state difficult to remove.

To simplify the situation by greatly contributed to establish business relations with more than one or two manufacturers of agricultural equipment and at the same time with the import of new machinery to arrange a complete and systematic import of spare parts, like for example a company Strom Praha, John Deere representative for the Czech Republic. This would prolong machine life, ease the nursing units and, last but not least, there would be a saving of foreign exchange.

The question of building a basic network of care departments linked to the level of individual farms. For practical implementation, I suggested maintenance - repair center for the local conditions of the area Tamale in Northern Ghana. In the area of construction is promoted priority care facilities closely related to the user equipment. Although the thesis is intended for conditions of Ghana, designed solutions can be applied in other developing countries.

It would please me if my thesis contributed to solving the existential problems of the national economy of my country at least a small part.

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APPENDIX

- [1] **TABLE 1 :** Daily and annual maintenance performed on various farm machineries in Strom Praha. A typical example of invoice by Strom Praha
- [2] **PICTURE 1:** Typical workshop for maintenance and servicing of farm machinery in Ghana
- [3] **PICTURE 2:** Traditional way of modifying power tiller in Ghana.
- [4] **PICTURE 3:** Classroom block in SOÚ for theory class at Nové Strašice, Czech Republic.
- [5] **PICTURE 4:** Student in SOÚ performing a practical class(welding work),Nové Strašice, Czech Republic.
- [6] **PICTURE 5:** Lathe machine shop in SOÚ for practical work,Nové Strašice, Czech Republic.
- [7] **PICTURE 6:** Mechanical class room in SOÚ for practical work, Nové Strašice, Czech Republic.
- [8] **PICTURE 7:** Maintenance and servicing performed by service men in Strom Praha, Czech Republic.
- [9] **PICTURE 8:** Mobile maintenance and servicing of farm machinery van for Strom Praha, Czech Republic
- [10] **PICTURE 9:** Modern maintenance and servicing centre for farm machineries at Strom Praha in Czech Republic.
- [11] **PICTURE 10:** Author and Director of SOÚ, Ing. Jan Nechutný Nové Strašeci

John Deere 7430, 7530 Premium Tractors

Service (Daily / Every 10, Every 250, Every 500, Every 750 Hours)

Service	Daily or Every 10 Hours	Every 250 Hours	Every 500 Hours	Every 750 Hours
Check engine oil level.	•			
Check fuel filter.	•			
Air brake system - check compressed air tank for condensed water. If condensed water drains out, replace air-drier cartridge, otherwise do this every 1500 hours or every 2 years at the latest (see Service - Every 1500 Hours or 2 Years).	•			
Check lights.	•			
Lubricate front axle and front-wheel drive shaft. *	•			
Lubricate rear axle. *	•			
Lubricate three-point hitch. *	•			
Lubricate pick-up hitch. *	•			
Check oil level of transmission/hydraulic system. **	•			
Drain residue from fuel tank.		•		
Check oil level of transmission/hydraulic system.		•		
Check electrolyte level of battery.		•		
Lubricate the front axle, u.j. shafts and drive shaft.		•		
Check oil level in axle housing and final drives.		•		
Check the brakes.		•		
Lubricate front PTO drive shaft.		•		
Lubricate three-point hitch.		•		
Lubricate pivoting fenders.		•		
Lubricate cab suspension system.		•		
Lubricate trailer hitch and check that it functions properly.		•		
Lubricate pick-up hitch, tighten screws and check that it functions properly.		•		
Check neutral start circuit.		•		
Tighten wheel retaining bolts/nuts.		•		
Tighten screws on the front loader bracket.		•		
Check for wear at components of drawbar, tow hitch (piton-fix/ball-type) and pick-up hitches.		•		
Drain engine crankcase and refill with fresh oil. ***		•	•	
Replace engine oil filter element. ***		•	•	
Replace fuel filters.			•	
Lubricate rear axle.			•	
Lubricate the draft link bearings.			•	
Check the air intake hoses.			•	
Check ground connections (engine and cab).			•	

Service	Daily or Every 10 Hours	Every 250 Hours	Every 500 Hours	Every 750 Hours
Check engine drive belt for wear.			•	
Replace cab air filters. ****			•	
Replace transmission/hydraulic oil filters.				•
Replace front PTO filter.				•
Drain final drives, and refill with fresh oil (axle with brake).				•
* only necessary when operating in extremely wet and muddy conditions				
** only necessary if the tractor is driving external hydraulic equipment				
*** Engine oil must be changed at least once a year. Service intervals vary depending on the type of engine oil used and the sulfur content of the fuel. See "Diesel Engine Oil and Filter Service Intervals" in the "Fuel, Lubricants, Hydraulic Oil and Coolant" section.				
**** Ultra-Guard activated carbon filters only. Replace the filters with new ones at least once every year.				

Service (Annually, Every 1000, Every 1500 Hours)

Service	annually	1000 hours	1500 hours
Inspect seat belt.	•		
Drain engine crankcase and refill with fresh oil (see Service / Every 500 Hours).	•		
Check engine drive belt for wear (see Service / Every 500 Hours).	•		
Lubricate front PTO drive shaft (see Service / Every 250 Hours).	•		
Tighten screws on front loader bracket (see Service / Every 250 Hours).	•		
Replace cab air filters. *	•		
Use coolant test strip to test coolant (only if COOL-GARD II is used).	•		
Inspect hydraulic hoses.	•		
Have accumulator of cab suspension checked by your John Deere dealer.		•	
Have viscous fan drive checked by your John Deere dealer.		•	
Drain the axle housing and final drives, and refill with fresh oil.			•
Change oil in transmission/hydraulic system.			•
Replace air cleaner element and cab air filters.			•
Change front PTO oil and filter.			•
Have accumulator of TLS front axle checked by your John Deere dealer.			•
Air brake system - Change the air-drier cartridge (an earlier change may be necessary if condensed water drains out when checking compressed air tank, or every 2 years).			•
* Ultra-Guard activated carbon filters only.			



ZAKÁZKOVÝ LIST SZSSSV133356

Majitel stroje: Zemědělské družstvo Mečeříž	VIN: RW8210P012664	K opravě převzal:	Objednatel:
Mečeříž 41 294 77 Mečeříž	Stav pohonných hmot: MTH/balíky:20502 MTH 1/1 <input type="checkbox"/> 1/2 <input type="checkbox"/> 1/4 <input checked="" type="checkbox"/> 3/4 <input type="checkbox"/>	František Péč	Milan Novotný
IČO: 00105619 DIČ: CZ00105619	Místo provedení opravy: Servisní středisko	Datum započeti opravy: 06.12.2013	Datum ukončení opravy: 06.12.2013
Expozitura	Datum poruchy: 6.12.2013 00:00:00	Práce mimo pracovní dobu:	
Typ: JOHN DEERE 8210	Servisní technik: František Péč	Práce So,Ne, svátky:	
Číslo motoru:RG6081H130162	Počet ujetých km :	Datum předání nového stroje: 06.08.2001	
SPZ: MB 7049	Druh opravy: Fakturovaná služba	Díl co způsobil závadu:	
	Odhad ceny bez DPH:	Reklamační protokol	

Objednané služby

Údržba 1500 Mth.
Výměna hřídele spodního závěsu TBZ.

Popis činnosti

Demontáž poškozené spodní hřídele TBZ a montáž nové hřídele.
Výměna motorového oleje a filtru - použit Torqgard.Výměna oleje v předních koncových převodech.Výměna hydraulického a převodového oleje - použit Hygard.
Výměna oleje v přední nápravě.Výměna filtru paliva.Výměna vzduchových filtrů kabiny a sání vzduchu do motoru.Promazání stroje.

Podpis objednatele:

Položka		Počet MJ
R108290	HŘÍDEL	1,00 ks
R108305	ČEP 122X30 MM, VNITŘNÍ M8	1,00 ks
R107657	POLYURETAN PRACH. TĚSNĚNÍ	2,00 ks
R108306	TĚSNĚNÍ	1,00 ks
R107316	NÁDRŽKA	2,00 ks
R133691	ZÁTKA	1,00 ks
RE51629	VZDUCHOVÝ FILTR HRUBÝ JD8000	1,00 ks
RE51630	VZDUCH FILTR JEMNÝ JD8000	1,00 ks
RE57394	S/ MOTOROVÝ FILTR ***	1,00 ks
AR86745	FILTR PALIVOVÝ*	1,00 ks
RE508633	FILTR	1,00 ks
R119168	VZDUCHOVÝ FILTR JD8010	1,00 ks
RE174130	HYDRAULICKÝ FILTR 8010	1,00 ks
RE187966	VZDUCH. FILTR	1,00 ks
EXTREME GARD 8	OLEJ PŘEVODOVÝ 85W-140 20 L	7,00 l
HY GARD 209	HYDRAULICKÝ OLEJ, BAL. 209 L	150,00 l
TORQ GARD 209	OLEJ MOTOROVÝ, BAL.209 L	24,00 l
SM	Spotřební materiál-dílenská chemie,čistidlo	1,00
Práce	TBZ - demontáž,montáž hřídele	
Práce	Údržba 1500 Mth	

Po opravě stroj převzal: p. Šumichrást	Po opravě stroj předal: František Péč
Razítko a podpis:	Dne: 06.12.2013
	Razítko a podpis:

Na originální náhradní díly je poskytována záruka dle platných podmínek. Tento vztah se řídí ustanoveními obchodního zákoníku.

Zakázkový list uschovte až do vydání stroje. Ceny jsou platné dle aktuálního ceníku.

„Pozn.: Veškeré provozní kapaliny a součástky demontované při servisním zásahu nebo při údržbě jsou majetkem zákazníka.“

TABLE 1 : Daily and annual maintenance performed on various farm machineries in Strom Praha. A typical example of invoice by Strom Praha.
 Source: Head of Service Department of maintenance in Strom Praha



PICTURE 1: Typical workshop for maintenance and servicing of farm machinery in Ghana

Source: http://mofa.gov.gh/site/?page_id=156



PICTURE 2:Traditional way of modifying power tiller in Ghana

Source: http://mofa.gov.gh/site/?page_id=156



PICTURE 3:Classroom block in SOÚ for theory class at Nové Strašice, Czech Republic
Source: Author



PICTURE 4: Student in SOÚ performing a practical class(welding work),Nové Strašice, Czech Republic

Source: Author



PICTURE 5: Lathe machine shop in SOÚ for practical work,Nové Strašice, Czech Republic
Source: Author



PICTURE 6: Mechanical class room in SOÚ for practical work, Nové Strašice, Czech Republic
Source: Author



PICTURE 7: Maintenance and servicing performed by service men in Strom Praha,
Czech Republic
Source: Author



PICTURE 8: Mobile maintenance and servicing of farm machinery van for Strom
Praha, Czech Republic
Source: Author



PICTURE 9: Modern maintenance and servicing centre for farm machineries at Strom Praha in Czech Republic
Source: Author



PICTURE 10: Author and Director of SOÚ, Ing. Jan Nechutný Nové Strašeci

Source: Author