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GEOMATIC ENGINEERING DEPARTMENT

A THESIS REPORT ENTITLED

IMPACT OF DRAINAGE ON YIELD OF MUSA SAPIENTUM

BY

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN GEOMATIC ENGINEERING

THESIS SUPERVISOR

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MARCH 2019

DECLARATION

I declare that, this thesis is my own work. It is being submitted for the degree of Master of Science in Geomatic Engineering in the University of Mines and Technology (UMaT), Tarkwa. It has not been submitted for any degree or examination in any University.

…………………………………………..

(Signature of candidate)

1st day of March, 2019

ABSTRACT

This report sought to confirm that drainage has impact on the number of flowers counted on Musa Sapietum Plantation in GEL. Beginning with the advantageous location of the plantation for three major reasons, of relative closeness to the Sea port, abundance of water for irrigation and weather condition not favourable for bleeding harmful insects. The objectives of this thesis are to find out if drain depth has influence on yield and Secondly to what extent should drain depth be essential for banana cultivation. Water for Irrigation was supplied to the plants as it is required but due to high permeability of the soil or rainfall, drainage were constructed to aid in removing excess water from around the roots in the soil. Sector 1 through to Sector 4 of Golden Exotics Ltd (GEL) plantation was used as a case study. The methods used were taking field drain measurements to determine the average drain depth per plot in each Sector. And collection of production data for Year 2017 which was used to calculate the average number of bunches harvested per plot. Microsoft Excel 2013 from GEL was then used to analyse the data to establish the findings of this project which concludes that the average number of bunches increased from depth range of 0.0 m - 0.3 m to 0.31 m – 0.6 m but there was no significant increase from drain depth from 0.9 m and above. ANOVA a statistical F test tool was used to test the significance of each depth range and average number of bunches harvested at 5% Significance.

DEDICATION

This thesis is dedicated to my dear wife,

Grace Baidoo-Antwi

For her patience and dedication to every course of my life.

ACKNOWLEDGEMENT

I thank the Almighty God for His love, protection and His timely interventions. I will also thank my Project Supervisor Dr. E.E. Duncan for his encouragement, advice and academic help even under acute moments in the presentation of my projects. Much thanks go to Dr. S. Mantey, Dr. Mrs Naa Mantey for sacrificing their private time in helping me on remote sensing practical, and other Lecturers who came my way and offered advice and practical help like Prof. B. Kumi-Boateng, Dr. Mrs. C.Boye, Dr, I.Yakubo, Dr. P. E. Baffoe and all I could not mention their name, I am very grateful and think I have made you also proud.

I will not forget to give great thanks to the Management of Golden Exotics Limited for giving me the opportunity to upgrade my knowledge, it is amazing the value of transformation this opportunity has given to me. It is like a sudden intense sunlight appearing in an opaque space, though looks like very thin ray it magnifies, conquers and brings hope.

Remembering both external and nucleus family for their tremendous support to me. I say God richly bless them and everyone who in diverse way spent their energies to make this project work a successful one.

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NOMENCLATURE

Content	TITLE
DN	Diameter Nominal
GEL	Golden Exotics Limited
TMH	Total Manometric Head
Km	Kilometer
m	Meter
m^3/h	Meter Cube per hour
PE	Polythene
PVC	Polymerizing Vinyl Chloride
VREL	Volta River Estate Limited

CHAPTER 1

INTRODUCTION

1.1 Problem statement

The primary aim of all commercial agricultural enterprises is to maximise profit. For a banana plantation, the aim is to maximize the yield per hectare (in tons), which could only be realised through maximizing the number of flowers which are commercially viable. Those poorly drained areas that are unable to produce the required number of flowers subsequently harvest underweight bunches. Many of such underweight bunches are required before the production targets of the farm, in tonnage terms, are realised. The harvestable number of bunches per year cannot exceed two times the number of plants planted per unit area, underweight bunches due to poor drainage may cause the plantation not to realise its production targets. The essence of drains in a banana plantation can therefore not be subsumed under any factor of production.

1.2 Research Objectives

The broader goal of this study is to evaluate the impact of drainage on bunch yield on the number of bunches harvested on Kasunya Plantation of Golden Exotics Limited. The Specific objectives are to,

- Ascertain whether or not construction of drains in the farm have an impact on number of flowers counted in a plot per annum.
- Ascertain the impact of the depth of drains on the number of flowers counted in a plot per annum
- Confirm that drains depth has influence on number of flowers count for the Sectors

1.3 Methods Used

The procedures adopted in writing this report requires the use of these methods;

- Field data collection using GPS
- Secondary data acquisition from Golden Exotics Ltd
- Data analysis by means of drain depth,, Average number of bunches and graph interpretation and
- ANOVA of Two Factor with Replication of drain depth range and average number of bunches.

1.4 Facilities used

The following materials were used in the data collection process before and during the time of the study;

- 10 m Tape measure from GEL
- Garmin 64sc Hand held GPS Receiver for GEL with 1 m least count and 3 m accuarcy
- Microsoft Excel 13 from GEL
- 2.16 Qgis software from GEL
- ANOVA Statistical Program in Excel 2013 from GEL

1.5 Thesis Organisation

This project started with the introduction of problem of statement that every agricultural enterprise aims at maximizing it profit, so the objective was to find out whether poor drainage in banana plantation affect yield.

Information about the location of the project also show its closeness to both the Volta River and the Tema harbor which has a great advantage on the investment. The Crop environment spells out the agronomic practices at Golden Exotics Ltd and considered herein that they were all respected to it fullness for the purpose of this project.

The methods used are collection of drain data with Handheld GPS and production data on flower count from Golden Exotics Ltd Production department. The QGIS software was used to plot the field drain points to see how spatial they represent in a Sector to ensure that the array of data points were correct before arithmetic average of the drain depth per plot was calculated. The depth of drains was grouped into drain depth ranges of 0.0 m – 0.3 m, 0.31 m – 0.6 m, 0.61 m – 0.9 m and greater than 0.91 m

The production data was sorted into Sectors, plots and the average flowers count calculated for each plot of a Sector and the average number of bunches for each drain depth range established.

A graph of each Sector for drain depth range and average number of bunches counted was plotted, and the behaviour was interpreted and analysis.

A two way ANOVA was performed for each Sector to confirm that drain depth range and their corresponding average number of bunches were intractable at 5% Confidence interval.

The conclusion was that yield increases with drain depth range from 0.0 m - 0.3 m and 0.6 m and begins to show a slight decline from 0.6 m – greater than 0.9 m.

Recommendation is that since all the beds have some drain depth and this project did not experiment on non drain land research should be on areas with drain to confirm the objectives of this project, CHAPTER 2

RELEVANT INFORMATION ABOUT THE STUDY AREA

2.1 Location of the Site

Golden Exotics Limited (GEL) is located in Kasunya (near Asutsuare in the Shai-Osudoku District) of Greater Accra region. The geographical location of GEL is on Latitude 6° 03′ 00″ N and Longitude 0° 13′ 48″ E. Fig. 2.1 shows the of the location of Kasunya (GEL) relative to Tema Sea port.

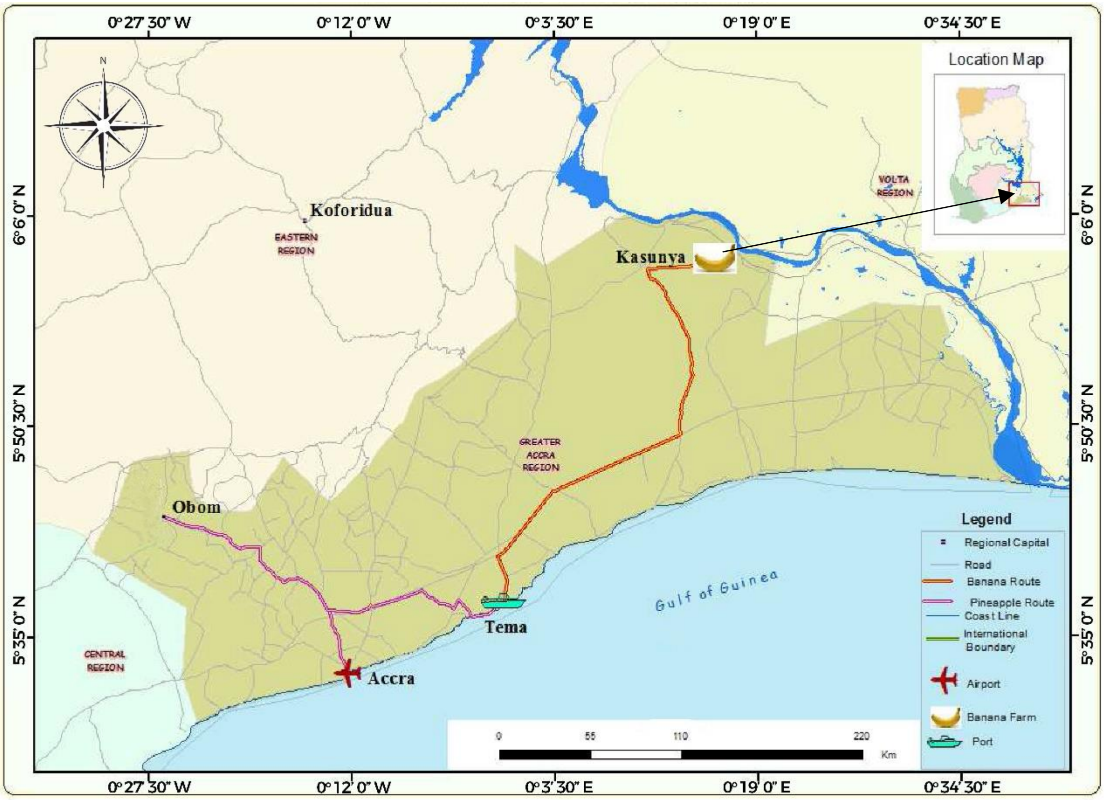

Fig. 2.1 Map of location of Golden Exotics Limited

GEL is located in an area which offers very favorable conditions for the production of bananas. Moreover, the proximity of the farm to the Tema port (60 Km), where the final fruits are sent for export, is a contributory factor to the success of the Company (Anon, 2012).

Created in the year 2003, GEL has become the leading banana producing plantation in Ghana. Producing about 57 000 tons per year and 60 ton/Ha. The presence of water in abundance from the River Volta shown in Fig. 2.4 and the dry climate (promoting lease disease environment) enables the company to produce bananas of high quality in Ghana with the use of chemical products that is among the lowest in the world (for pests control) and compost manufactured from residual of farm products (Anon, 2019).

2.2 Division of the Plantation into Sectors

The GEL plantation is divided into eleven Sectors as shown in Figure 2.2 with Sector 1 to Sector 7 being conventional and Sector 21 to Sector 24 Organic farm.

Sector 1 to Sector 5 were surveyed to fit into existing drainage infrastructure, whiles the rest were planned and engineered.

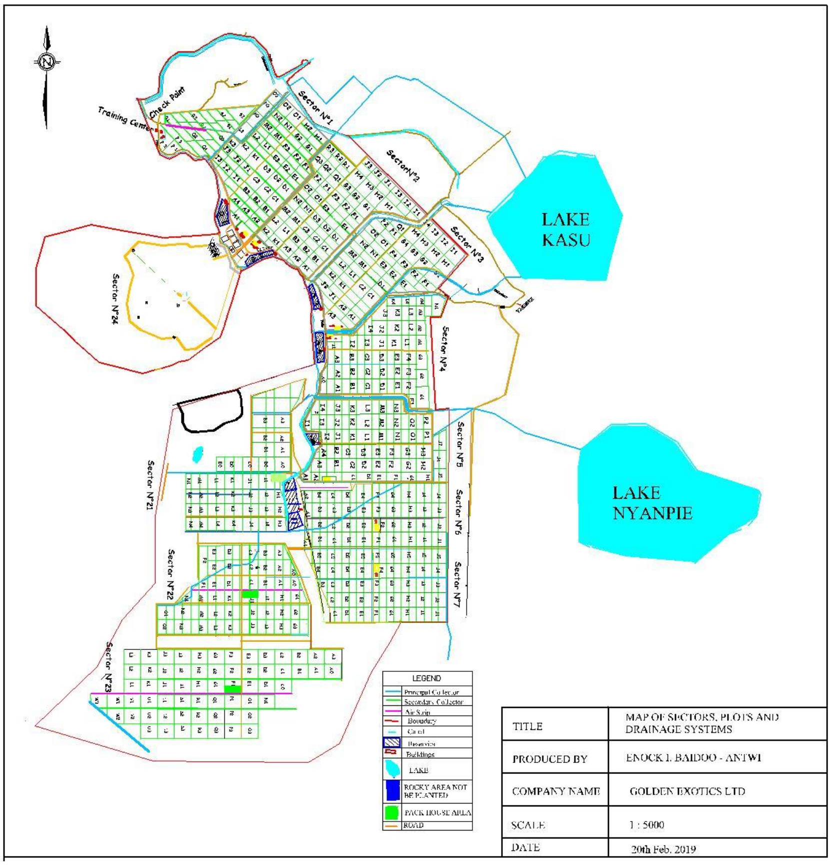

Fig. 2.2 GEL Plantation Divided into Sectors.

This report was written considering only Sector 1 to Sector 4 as in Fig.2.3 because it has the Sector with the highest (Sector 3) and lowest (Sector 1) production yield in the year 2015.

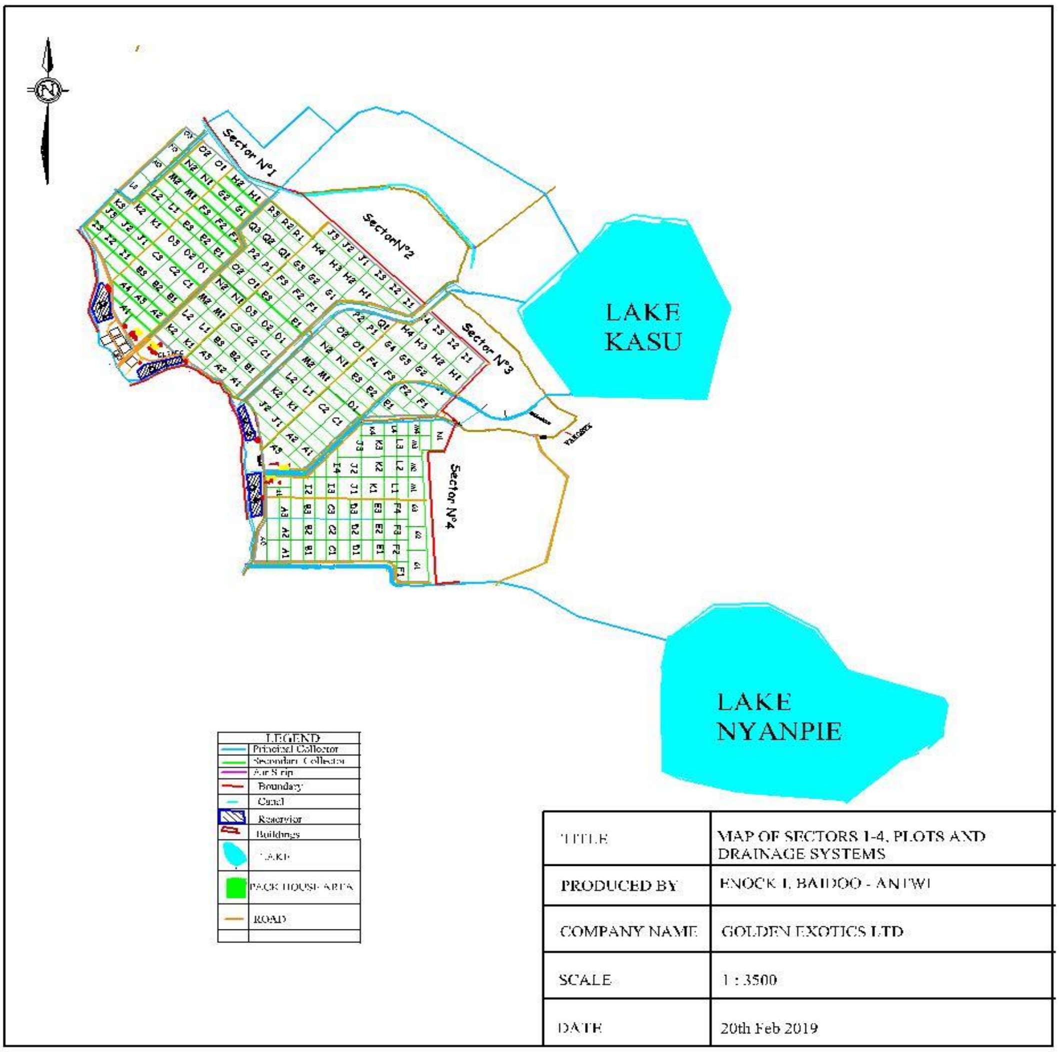

Fig. 2.3 Map of Sector 1 to Sector 4.

2.3 Information on Production

GEL remains the largest banana producer in Ghana, accounting for over 90% of the national production (57 000 tons in 2017 as against 49 488 tons in 2015). The total surface area of the farm is 1 500 Ha, 360 Ha is used for organic and 1 140 Ha is used for conventional farm. Crop yield is a measure of the amount of crops that is harvested per unit of land area (Chen, 2017). GEL has bit by bit thrived to produce an average yield of little above 60 tons/ha in

2017. For a banana farm to be economically viable it should attain a yield of 40 ton/ha whereas 60 ton/ha is classified a well to do farm (Anon., 2018a).

2.4 Crop Environment

Crop environment comprises of principally agronomic factors like; growing cycle and growing period; radiation; Climate; temperature; rooting; aeration; water quantity; nutrients (NPK); water quality; salinity; solidity, boron and chloride toxicities; pH, micronutrients and other toxicities; pests, diseases and weeds; flood, storm and wind.

Some of the agronomic practices GEL are:

- Ensuring balance Nutrition for the crops
- Adequate quality irrigation water for all year round
- Collect data on all Climatic elements, like Rainfall, Humidity,Temperature, Evaporation, Wind speed throughout the year, around the plantation.
- Ensuring Plant density ratio of 1700 trees/Ha
- Ensure favorable Soil pH.
- Pruning to ensure only the successor of the banana tree is left around the parent tree.
- Weeds Control
- Leave Cutting
- Land preparation
- Adequate removal of excess water from around the plant
- Diseases control, etc.

2.4.1 Nutrient

Banana requires high amount of nutrients, which are often supplied only in part by the soil and therefore needs to be supplemented by inorganic fertilizer.

The nutrient requirements in GEL per annum are Nitrogen is 400 Kg/Ha, Phosphorus 300 Kg/Ha and Potassium is 600 Kg/Ha.

During warm weather, apply a balanced fertilizer once a month an 8:10:8 NPK fertilizer appears to be adequate. A mature plant may require as much as 1-1/2 to 2 pounds of the above fertilizer each month. Young plants need a quarter to a third as much. Spread the fertilizer evenly around the plant in a circle extending 4 - 8 feet from the trunk. The fertilizer must not be allow to come in contact with the trunk.

Low soil fertility is one of the major constraints to optimum crop growth and yield. Soils fertility can be managed by fertilization, (Idupulapati *et al.*, 2016)
Due to the soil cycle of nutrient other micro-nutrient serves as additives, for examples Calcium influences yield through its interaction with N, P and K. In acidic soils, use of dolomite (Mg_2CO_3) and limestone ($CaCO_3$) as soil amendments is common (Brent, 2017).

2.4.2 Climate

Banana is a tropical plant requiring a warm and humid climate, grows well in a temperature range of 15ºC – 35ºC with relative humidity of 75-85%. It prefers tropical humid lowlands and is grown from the sea level to an elevation of 2 000 m. above mean sea level.

Bananas grow best in areas with 2 500 mm or more of well-distributed rainfall per year. Irrigation is needed if rainfall is inadequate or irregular. Banana plants do best in protected areas, because they are susceptible to wind damage. Average temperature of 27ºC (81ºF) and full sun are also beneficial for optimum plant development and yields. Because the morphological development of fruit takes 12 weeks to harvest the fruit on a fairly sunny day, however on a brighter sunny period the 12 weeks could be lessen to 9 to 10 weeks (Anon., 2017a).

2.4.3 Soil of Kasunya

The farm falls within a researched soil type known as Akuse series. In Ghana black soil known locally as Akuse clays, are mostly of little prominence agriculturally.
The Akuse clays fill a broad zone across the coastal savanna plains; although heavy and intractable, they respond well to cropping under irrigation and mechanical cultivation (Donna *et al.*, 2019).

2.4.4 Pruning

In pruning only one primary stem of each rhizome should be allowed to fruit. All excess shoots should be removed as soon as they are noticed. This helps channel all of the plant's energy into fruit production. Once the main stalk is 6 - 8 months old, permit one sucker to develop as a replacement stalk for the following season. When the fruit is harvested, cut the fruiting stalk back to 30 inches above the ground. Remove the stub several weeks later. The stalk can be cut into small pieces and used as mulch (Anon., 1987).

Determined pruning makes the plantation to be laid out in rows, so that if the suckers are in the same line, the plantation rows are unchanged. Properly pruned and trimmed trees provide a strong network of healthy growth for fruit bearing branches. Pruning helps train the size of the tree, and direct the growth where you want it to begin for early fruit production and optimum fruit quality conditions. Fruit trees benefit from early pruning starting at planting time in order to help balance out new root formation. Proper pruning techniques allow for good light penetration into the tree, resulting in an increase in fruit bud production in subsequent years, and improves fruit quality of the current year's crop (Anon., 2017b).

The pruning is orientated toward establishing good form and setting up the tree for future growth. The pruning of smaller trees makes for smaller pruning cuts which minimizes the threat of decay to enter the tree. Smaller trees take less time to prune and can be directly reflected into the price of the work (Anon., 2012).

2.4.5 Plant Density

Banana plants are usually not planted closer than 2 - 3 m apart. Planting density depends on the banana varieties planted and the management practices, the plant density in GEL is 1700 per hectare.

Addressing declining and often inherently low soil fertility could result in improved banana yields when couple with appropriate crop management, Plant density and banana residue management can affect soil fertility constraints and crop yields. Farmers believe that among the yield improving factors, plant density management offers some prospects. Choosing the correct plant density is vitally important for maximizing the yield potential of the plantation (Ndabamenye, 2013).

2.4.6 Weeds Control

One of the critical points in the banana production process is weed interference. They compete with the crop for water, light, nutrients and carbon dioxide. They can also release allelopathic substances that can influence crop development, as well as host pests and diseases. Therefore, an adequate management of weeds is of critical importance to obtain productivity in banana crops.

The first five months after banana planting are the most limiting for the crop. At this stage, weed control must be adequately carried out so that banana trees growth is not affected. After this period, the crop shades the area and becomes less sensitive to competition with weeds (Lanza *et al*., 2016). This shading leads to changes in the microclimate, disfavoring some weeds, especially those of type C4 metabolism, which require a high index of luminosity.

2.4.7 Insect Pests

The insect pests mostly observed are:

- root stock/rhizome weevil (*Cosmopolites sordidus*),
- stem borer (*Odioporus longicollis*),
- thrips,
- banana beetle (*Nodostoma subcostatum*),
- banana aphid (*Pentalonia nigronervosa*) and
- nematodes.

A selection of healthy planting material and suitable intercultural operations or cutting of affected leaf to decrease the spread of the insect and alternatively application of 0.04% endosulfan, 0.1% carbaryl or 0.05% monocrotophos depending upon the type of pest infestation have been found to be effective in controlling the pests.

Pseudo stem borer (Odoiporus longicollis Olivier)

For exsample the banana Psedostem weevil attacks the plant during flowering and bunch formation stage and cause severe yield loss by preventing the bunch development. The early symptoms are the jelly exudation on the banana stem which indicate the weevil and grub activity inside the stem. Due to feeding of stem by grubs the Pseudo stem becomes hallow and break at the apical region due to gush of win (Anon., 2011).

2.4.8 Diseases

The main diseases reported are panama wilt (*Fusarium oxysporum*), anthracnose (*Gleosporium musarum*), leaf spot (Sigatoka) [*Mycosphaarella musicola* & *Cercospora musae*], shoot rot (*Ceratostomella paradoxa*) and viral diseases. Disease free planting material should be used and the infected plant parts destroyed. Spraying with 1% Bordeaux, copper oxychloride or carbendazim in case of fungal infections has been found to give positive result

For exsample, Sigatoka Leaf Spot Disease (Mycospharellaspecies viz.fijiensis, M. musicola &M.eumusae) Among diseases caused by fungi, the leaf spot (Sigatoka) caused by Mycosphaerella fijiensis (Black Sigatoka), and M.musicola (Yellow Sigatoka),and M.eumusae (Septoria leaf spot), are considered to be the most serious.

Recently Septoria leaf spot has also been recorded to cause significant loss.

Damage such as:

- Severely affected areas is unsuitable for export because of the shortened shelf life.
- The quality of banana is drastically reduced.
- Small fingers, premature ripening and feel splitting are associated with the disease.
- Bunches are harvested from affected orchards ripens during transit symptoms:

The earliest visible symptoms of Sigatoka are light green, narrow speck of about 1 mm in length on the upper surface of the older leaf. The infected tissue then turns brown and dies. The extensive defoliation results in delayed flowering, reduction in number of hands and fingers.

In severe conditions, the whole leaf dries form the tip. Normally 15-18 functional leaves are necessary but due to Sigatoka leaf spot it is difficult to maintain even 10 leaves. The disease inflicts serious yield losses in almost all the commercial cultivars. Fingers do not fill out properly and often immature remain even after attaining the time of full maturity. Peel spitting and premature ripening are also associated with the disease (Anon., 2011).

2.4.9 Water for Irrigation

As the saying goes, “water is life”, the source of Kprong Hydro dam has been the source of life for the plantation all year round. Fig 2.4 shows the Kpong Hydro Electric Dam and Canal to the plantation.

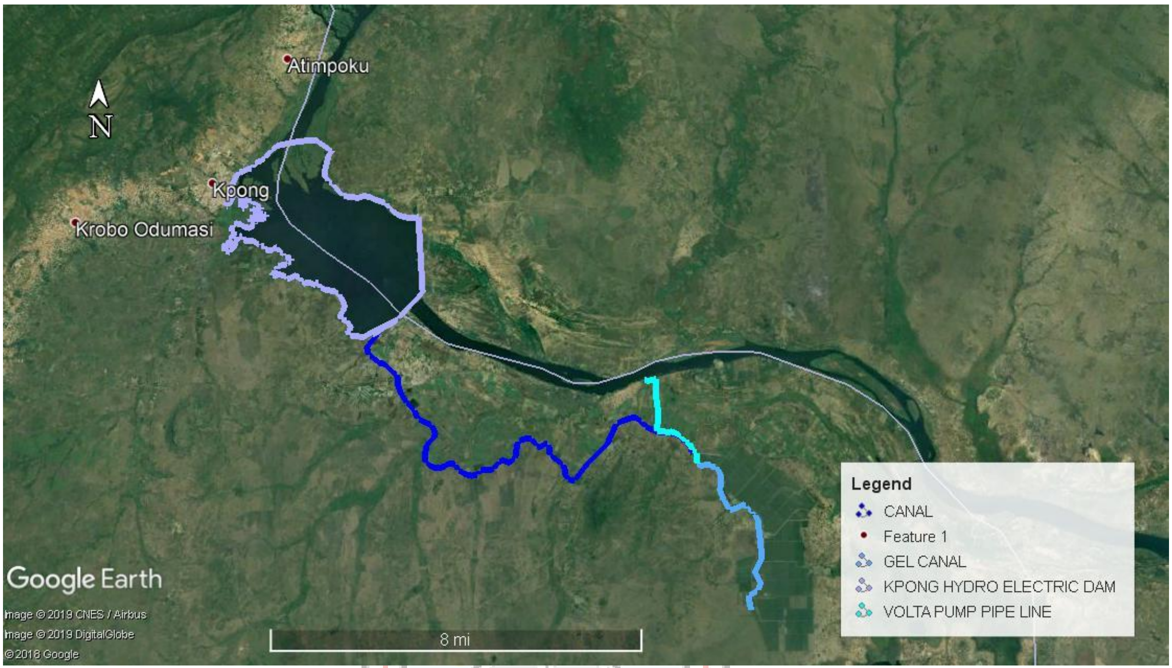

Fig. 2.4 Image of Volta River and how it supply water for farm irrigation

GEL is greatly gifted with abundant water from the river Volta. The water takes it sources from an intake at Kpong Hydro electrical dam reservoir and flows by gravity through a distance of 18km across Akuse to Asutsuare. This water is then lifted by the use of 3 gigantic electric pumps (3 060 m^3/h & 17 m TMH) at the entrance of the farm into GEL canal.

In the year 2016 an additional 4.5 Km irrigation pipe line was commissioned to increase water availability to GEL also to allow for more expansion. This newly irrigation pipe line lifts its water directly from the Volta River with the help of six powerful electric water pumps (620 m^3/h) into the GEL canal.

The water in the GEL canal travels by gravity along the entire farm and serves 8 reservoirs of various capacity ranging from 71 440 to 188 138 m^3. On top of each reservoir is installed two electric pumps (350 m^3/h). The layout of the piping system is made up of PVC pipes (DN 280 mm – 630 mm) and also PE pipes (DN 32 mm – 630 mm). GEL uses different water distribution system to supply water to the crops. These are: Mini sprinkler, Micro sprinkler and Drip lines); however, the most used system is the drip. Irrigation water is supplied following the monitoring of the evapotranspiration and the rainfall. There is a meteorological station in the farm which takes records of the daily evapotranspiration. Evaporation records is used to determine the rate of water loss to the atmosphere, plus the amount of water required per plant the total volume of irrigation water required per hectare is calculated.

2.4.10 Drainage System

Drainage is a means of removing excess water available in the soil for the root of the banana (Vézina, 2016a). In GEL the drainage work is managed by water balance department. This department also manages irrigation to ensure adequate water requirement of the banana plant. GEL uses the surface drainage systems by gravity. There are three types of open drains namely Principal, Secondary Collector and Tertiary drains. The tertiary drain removes excess water from the banana plant, passes it onto the Secondary collector and then sent to Principal collector which then is carried away from the farm. Fig 2.5 shows a tertiary drain with depth less than 0.3 m whiles Fig 2.6. shows a tertiary drain with depth greater than 0.9 m.

Fig. 2.5 Drain depth less than 0.3 m on GEL farm

Fig. 2.6 Drain depth greater than 0.9 m on GEL farm

2.5 Mechanized Harvesting

With the help of Cable way system and Aero-tractor, the banana fruit can be transported from any part of the farm to the processing house with less human involvement.

This investment has greatly helped in the quality and productivity because bunches do not suffer much bruises during of transportation to the processing house and the conveying time from the farm to the processing house is also reduced.

Fig. 2.7 Aero Tractor use to pull banana from a Sector on GEL Plantation

Fig. 2.8 Train of Banana arriving at the Processing House

CHAPTER 3
LITERATURE REVIEW

3.1 Origin and Brief History of Musa Sapietum

Musa sapietum, an edible banana, originated in the Indo-Malaysian region reaching to northern Australia (Ayala-Silva *et al.,* 2009). They are rapid-growing herbaceous perennials arising from underground rhizomes. The fleshy stalks or pseudo stems made by upright concentric layers of leaf sheaths establish the functional stem. The true stem begins as an underground corm which grows upwards, forcing its way out through the centre of the stalk 10-15 months after planting, at the end producing the terminal inflorescence which will later bear the fruit. Each stalk produces one huge flower cluster and then dies (Anon., 1999).

Their large elliptic leaf blades are extensions of the sheaths of the pseudo stem and are joined to them by fleshy, deeply grooved, short petioles. The leaves unfurl, as the plant grows, at the rate of one per week in warm weather, and extend upward and outward, becoming as much as 9 feet long and 2 feet wide. The leaf veins run from the mid-rib straight to the outer edge of the leaf (Anon., 1997).

The inflorescence shooting out from the heart in the tip of the stem, is at first a large, long-oval, tapering, purple-clad bud. As it unwraps, the slim, nectar-rich, tubular, toothed, white flowers appear. They are gathered in whorled double rows along the floral stalk, each cluster covered by a thick, waxy, hood like bract, purple outside and deep red within. The flowers occupying the first 5 - 15 rows are female. As the rachis of the inflorescence continues to elongate, sterile flowers with abortive male and female parts appear, followed by normal staminate ones with abortive ovaries. The ovaries contained in the first (female) flowers grow rapidly, developing parthenocarpically (without pollination) into clusters of fruits, called hands. The number of hands varies with the species and variety. The fruit (technically a berry) turns from deep green to yellow or red Bananas and plantains which are today grown in every humid tropical region and constitutes the 4th largest fruit crop of the world. The plant needs 10 - 15 months of frost-free conditions to produce a flower stalk. All but the robust varieties stop growing when the temperature drops below 14 °C. Growth of the plant stops totally when the temperature reaches 53 °C (Anon., 1997). High temperatures and bright sunlight will also scorch leaves and fruit, though bananas grow best in full sun. Freezing temperatures will kill the foliage. In most areas bananas require wind protection for best appearance and maximum yield. They are also susceptible to being blown over. Bananas, especially dwarf varieties, make good container specimens if given careful attention.

In 2016, the production of bananas in the world hit 148 million tonnes, with India and China having a combined total production of 28% of global production. Other major producers are the Philippines, Ecuador, Indonesia, and Brazil, together accounting for 20% of the world total production (Anon., 2018b). Banana constitutes a major staple food crop for millions of people in developing countries, with most producers being small-scale farmers either for home consumption or local markets. Because bananas produce fruit year-round, they offer a valuable food source during the hunger season (when the food from one annual/semi-annual harvest has been consumed, and the next is still to come) (Anon., 2008). Bananas therefore are important for global food security. Production in Africa is mainly concentrated at the West African Sub Region and has grown rapidly over the past 15 years, with Côte d'Ivoire for example exporting about 3.1% of the global trade. Production in Ghana started in the year 1988 by the Volta River Estates Limited (Arku-Mensah, 2019), and joined by Golden Exotics Limited in the year 2005. With the advent of Golden Exotics Limited, production and export of bananas to the European markets have risen steadily from 55 000 tons to 85 000 tons currently.

Bananas are a heavy feeder of all the conditions it require for optimum growth. (Morton, 1987). The soil must not be too acidic so a pH between 5.5 and 6.5 should be maintained (Hamilton, 2019). The banana is not tolerant of salty conditions, therefore salty soils and practices that make the soil salty must be avoided. The rapid growth rate of bananas make them heavy feeders of their nutrition and fertilizer requirements. A balanced application of fertilizers, especially NPK fertilizers must be done as required (Memon *et al.*, 2010). The banana require a great deal of water. Regular deep watering is an absolute necessity during warm weather. The importance of irrigation can therefore not be downplayed. Adequate irrigation to counter the effect of evapotranspiration is needed. Whereas the plant must not be allowed to dry out, excess watering must also be avoided and all standing waters and excess irrigation must be sent away from the field and from the root zone of the plant. This makes drainage so much important in irrigation water balance. Banana field that became poorly drained, even after establishment have had their leaves turned yellow, shown shorter leaf internodes (stunted growth), and have had significant reduction in yield. Drainage therefore amongst all the conditions for optimum growth, all things being equal, stands out to be the most important.

3.2 Production Areas of Banana in Ghana

Banana grows naturally in the forest and the transitional zones of Brong – Ahafo, Western, Ashanti, Eastern, Central and Volta Regions. A few farmers also interplant it on plantain farms around these areas. Volta River Estate Limited (VREL) is the second largest producer and exporter of banana in Ghana. VREL farms are located along the Volta Lake in the Asuogyaman District of the Eastern Region.

According to Nartey, (2011) among the freshly eaten horticultural crops export in Ghana, banana is second to pineapple as a foreign exchange earner. He explained further that, Ghana exported 2 972 tons of banana to the European market in 2007 which was an increment of 41% on what was exported in the year 2000. The fruit is also produced by many small scale farmers in the Kwahu area in the Eastern Region and the Ashanti Akim and Mampong areas in the Ashanti Region for the big domestic markets in Kumasi, Accra and Tema.

3.3 Water management

Water management in a banana plantation aims at finding a balance between the soil's water content and the requirements of the plant. The two main components are drainage, to eliminate excess water, and irrigation to make up for water deficits due to deficiency of rain or high evapotranspiration contents (Vézina, 2016b).

Information on crop water requirements is the main reference for efficient irrigation. It is also fundamental to other applications, e.g., to crop zoning and to drainage and hydrological studies (Silva *et al.*, 2015). Crop water requirements are represented by a combination of two separate processes, soil surface evaporation and crop transpiration, which together represent evapotranspiration (ET) (Doorenbos and Pruitt, 1975).

Spatial and temporal variability of soil water extraction from the root zone affect soil water balance determination (Silva *et al.*, 2015).

3.4 Soil Condition for Banana

Banana being classified as a heavy feeder crop requires a fertility of soil. The soil should be rich, well drained, fertile, free working, soils with plenty of organic matter are best suited for it cultivation (Anon., 2016).

Deep rich loamy soil with PH (5.5–6.5) is most preferred for banana farming. Soil for banana should have good drainage, adequate fertility and moisture. Saline solid, Calcareous soils are not suitable for banana cultivation. A soil which is neither too acidic nor too alkaline, rich in organic material with high nitrogen content, adequate phosphorus level and plenty of potash is good for banana (Anon., 2002).

The ideal soil should be well drained but have good water retention capacity (Anon., 2017) Bananas are shallow rooted, with the bulk of the root system in the top 30-40 cm. The crop performs best in well drained soils which are maintained at or near field capacity, that is, after free drainage has stopped, when the soil holds its maximum amount of water. Sandy loams and sandy clay loams are ideal soils for banana production. Sands should be avoided. (Diczbalis *et al.*, 1993)

3.5 Drainage

Drainage is the natural or assisted elimination of excess water that could reduce the development of banana plants. Indeed, since too much water deprives roots of oxygen, even temporary asphyxiation can cause irreversible damage. Drainage is used to ensure that the soil's oxygen levels and biological activity are optimal. The agricultural practice required some form of control of the water table (Vézina, 2016).

There are two types of drainage systems: open and underground. The choice will depend on the type of soil (porosity, permeability, texture and structure), rainfall, topography, hydrological profile and available resources. For example, open drains should be well maintained to ensure their good functioning. An underground system requires a higher initial investment, but less maintenance. To verify whether a plot is well drained, monitoring wells can be dug. If the time required for the water table to go back to its normal level after a period of saturation is long, the drainage should be improved (Vézina, 2016).

3.6 Analysis of Variance (ANOVA)

ANOVA is one of many statistical software packages and texts present multiple which comparison methods for treatment of group means only in the context of one way ANOVA. Stats Direct extends this to two way ANOVA by using the treatment group mean square from two way ANOVA for multiple comparisons. Treatment effects must be fixed for this use of multiple comparisons to be valid (Hsu, 1996).

CHAPTER 4

MATERIALS AND METHODS

4.1 Determination of average depth of drains

4.1.1 Field measurements

The field data was taken with Garmin Hand held GPS and 10 m measuring tape.

A plot was divided into three and the characteristics of the dimensions are taken.

That is;

- Bottom width
- Top width, and
- Height

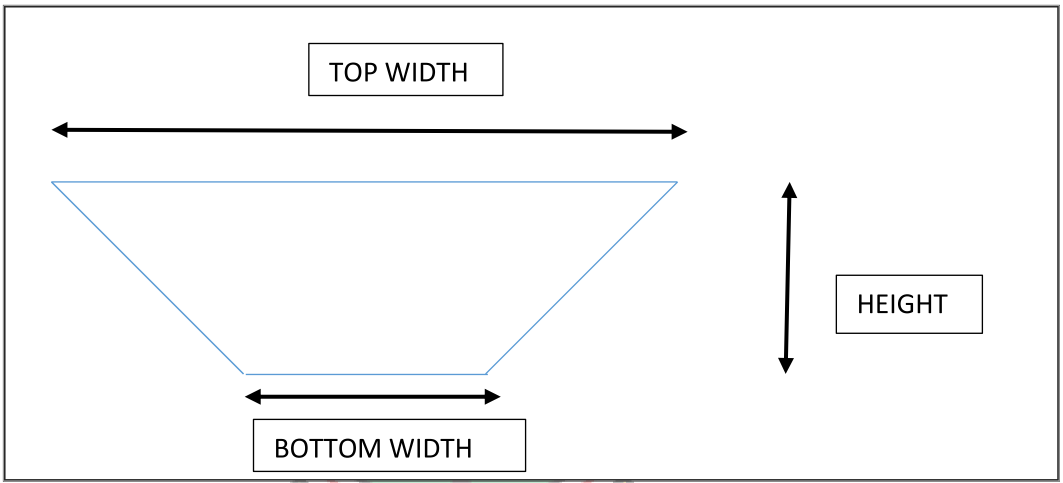

Fig. 4.1 Elements of drain dimension

The characteristics of the elements of drain under consideration is shown in Fig 4.1.

The bottom width and the top width depended on the height, because of the stability of the side slopes. In clay soils the best angle of repose is in a scale 1:2, though erosion at the bottom or the base renders the side slope unstable and therefore breaking over. The broken materials may block the flow of water thereby creating stagnant water situations.

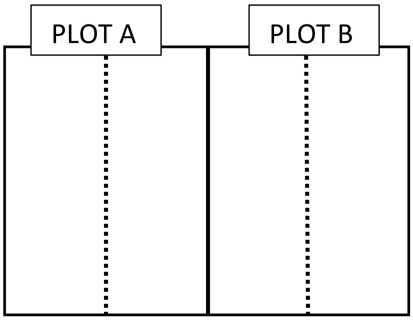

Fig. 4.2 Two plots merged for field data collection

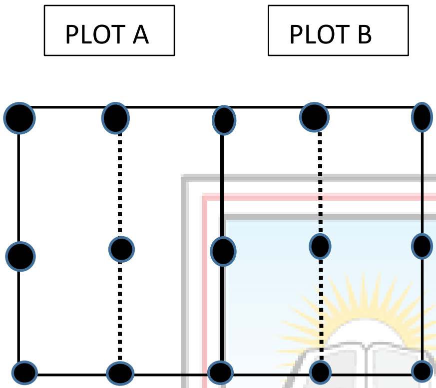

Fig. 4.3. Field observation location on a plot

Fig. 4.2 shows how a plot is divided into three plans and Fig. 4.3 shows how the field data points were predetermined for data collection. The average drain depth height for a plot is calculated by averaging the individual drain depth in a plot and it therefore represent the depth of the plot as shown in Appendix A, Appendix B,. Appendix C, Appendix D, Appendix E, Appendix F, Appendix G and Appendix H.

The following Maps (Fig.4.4, Fig.4.5, Fig.4.6, and Fig.4.7.) show the location of individual drain depth for each plot in Sector1, Sector 2, Sector 3 and Sector 4 respectively.

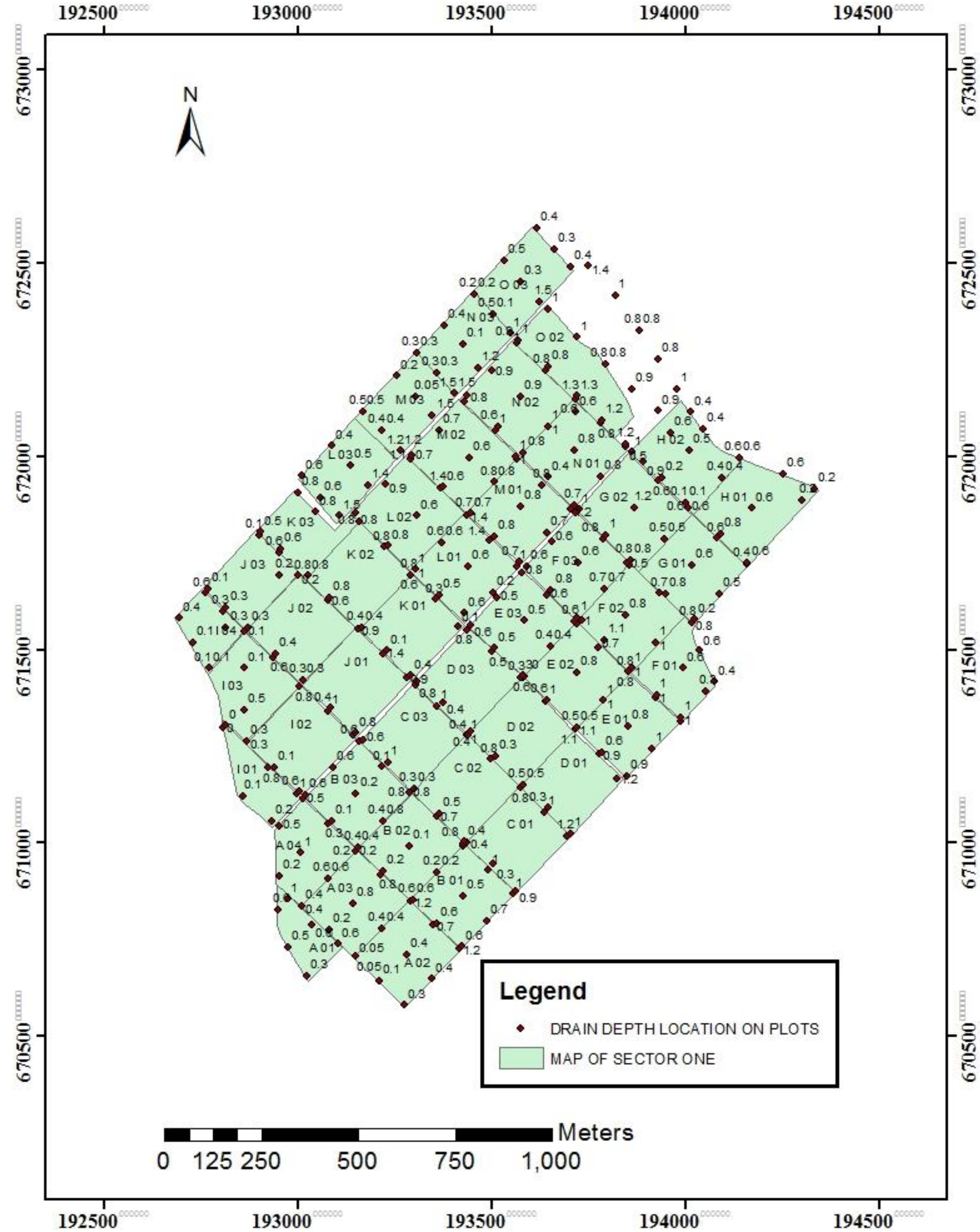

Fig.4.4 MAP OF LOCATION OF DRAIN DEPTH ON PLOTS IN SECTOR ONE

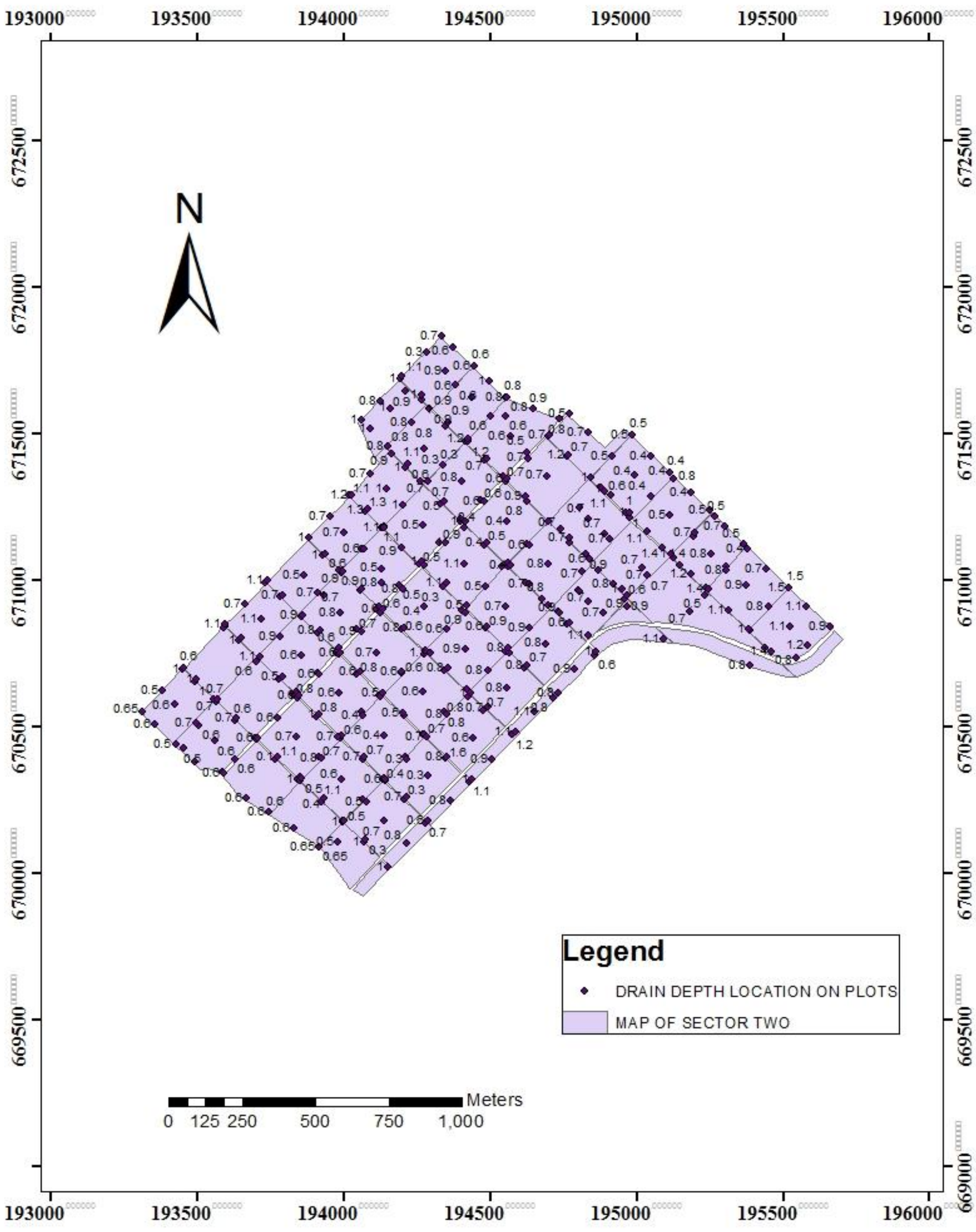

Fig. 4.5 MAP OF LOCATION OF DRAIN DEPTH ON PLOTS IN SECTOR TWO

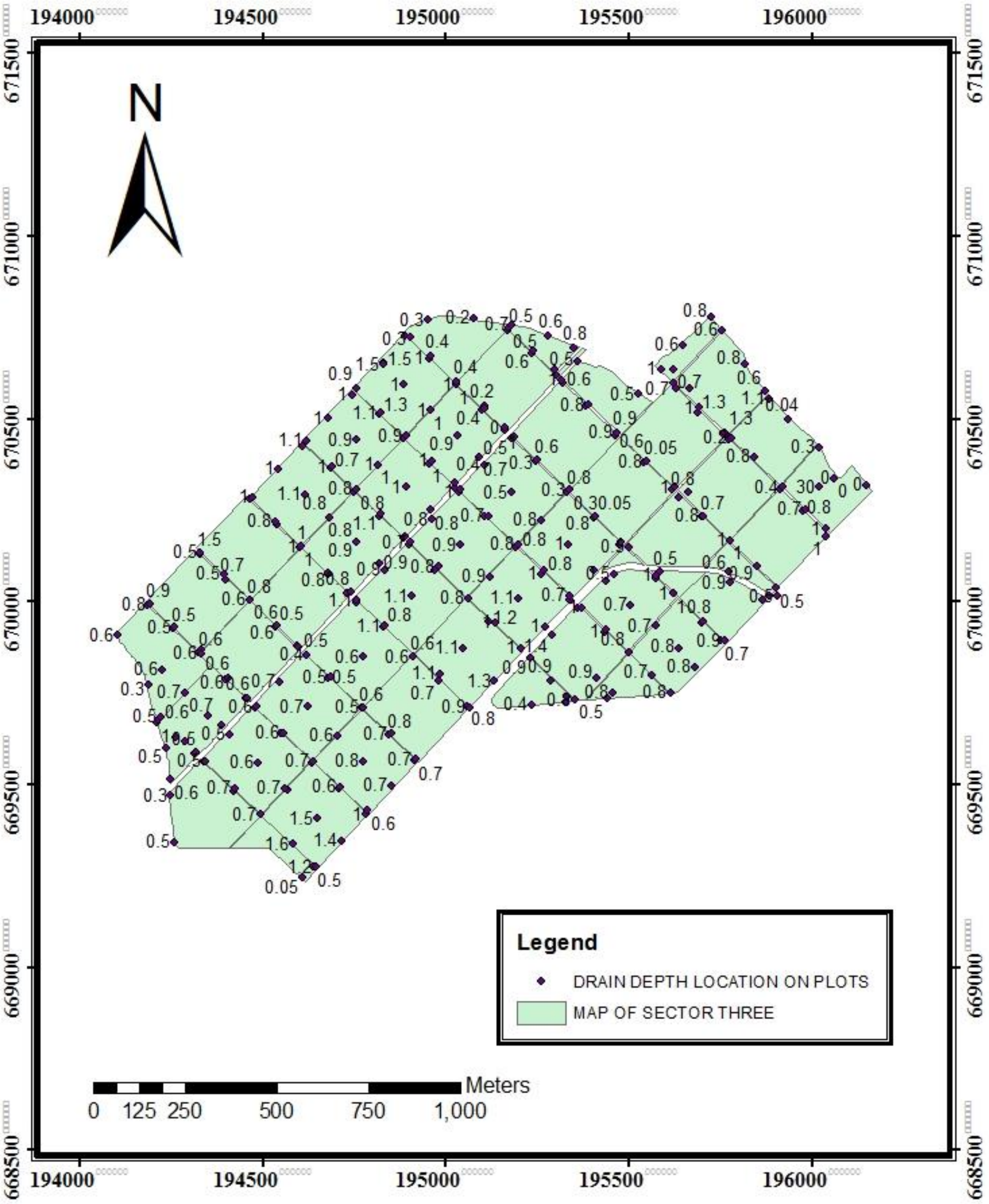

Fig. 4.6 MAP OF LOCATION OF DRAIN DEPTH ON PLOTS IN SECTOR THREE

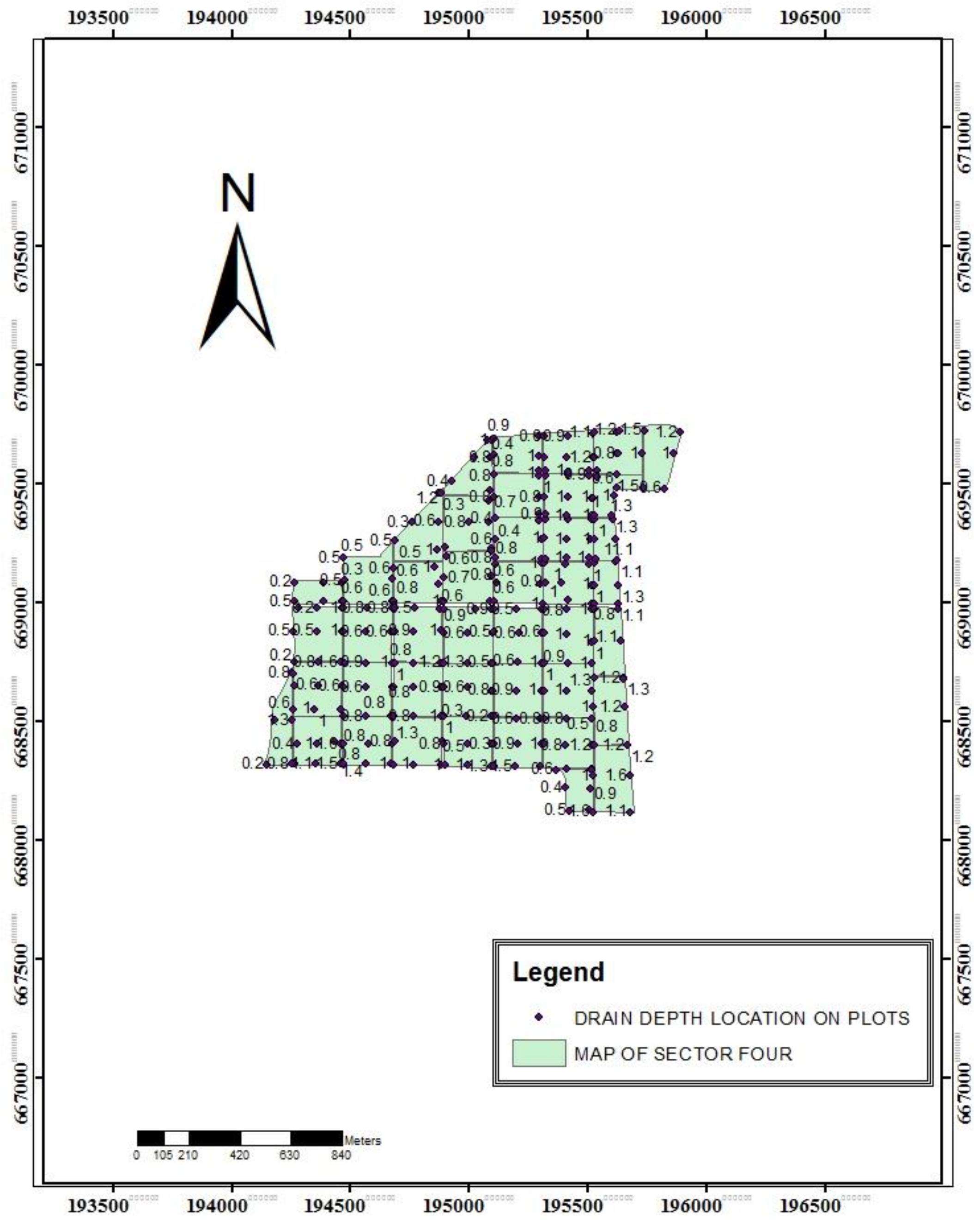

Fig.4.7 MAP OF LOCATION OF DRAIN DEPTH ON PLOTS IN SECTOR FOUR

4.2 Collection of production data

The production data for the year 2016/2017 on the number of bunches harvested per plot for the Sectors 1, 2, 3 and 4 was obtained from the production database of the banana plantation of Golden Exotics Limited. The data was sorted with the help of excel software by first grouping it into Sector 1, Sectors 2, Sector 3 and Sector 4.

Under each Sector all other data not associated with the Sector was edited and removed. Sorting was done to regroup the number of bunches harvested into plots of the Sector. At this point the total number of bunches harvested in the year for each plot in the Sector is regrouped and estimated.

4.3 Regrouping of Drain Ranges for Corresponding Average Bunches Harvested

In each Sector, drain depths were classified into ranges of 0 m – 0.30 m, 0.31 m – 0.6 m, 0.61 m - 0.9 m and greater than 0.9 m. With these four groupings the average number of bunches for each drain depth range was calculated as shown in Appendix I, Appendix J, Appendix K and Appendix L.

The Tables titled "Summary of average number of bunches harvested at different drain depth range for various Sectors" were extracted to match the various drain depth range with their corresponding average number of bunches harvested, they are in Table 5.1, Table 5.2, Table 5.3 and Table 5.4.

These Tables of Summary of average number of bunches harvest at different drain depth range for various Sectors was used to generate the graphs in Fig 5.1, Fig 5.2, Fig 5.3 and Fig 5.4 for Sector 1, Sector 2, Sector 3 and Sector 4 respectively.

Table 4.1 Summary of Average Number of Bunches Harvested at Different Drain Depth Range for Sector1

Sector	Drain depth range(meters)	Average number of bunches for depth
1	0-0.3	7981
1	0.31-0.6	10206.00
1	0.61-0.9	10369.00
1	>0.9	10749.00

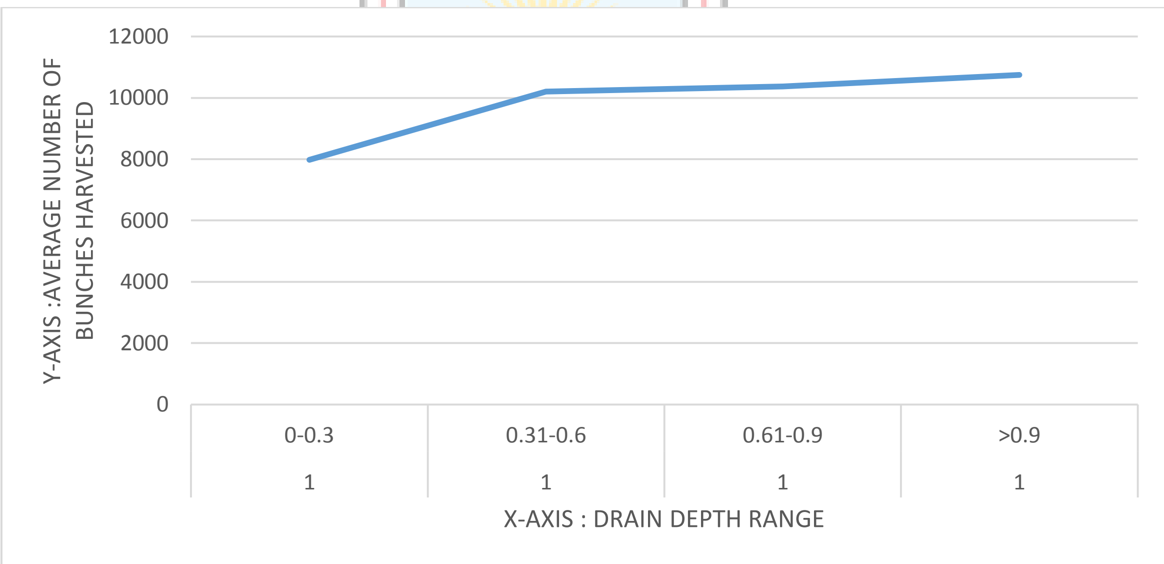

Fig. 4.8 Curve of average number of bunches harvested per drain depth range for Sector 1

Table 4.2 Summary of average number of bunches harvested at different drain depth range for Sector 2

Sector	Drain depth range(meters)	Average number of bunches for depth
2	0-0.3	0
2	0.31-0.6	10858.00
2	0.61-0.9	11394.00
2	>0.9	10647.00

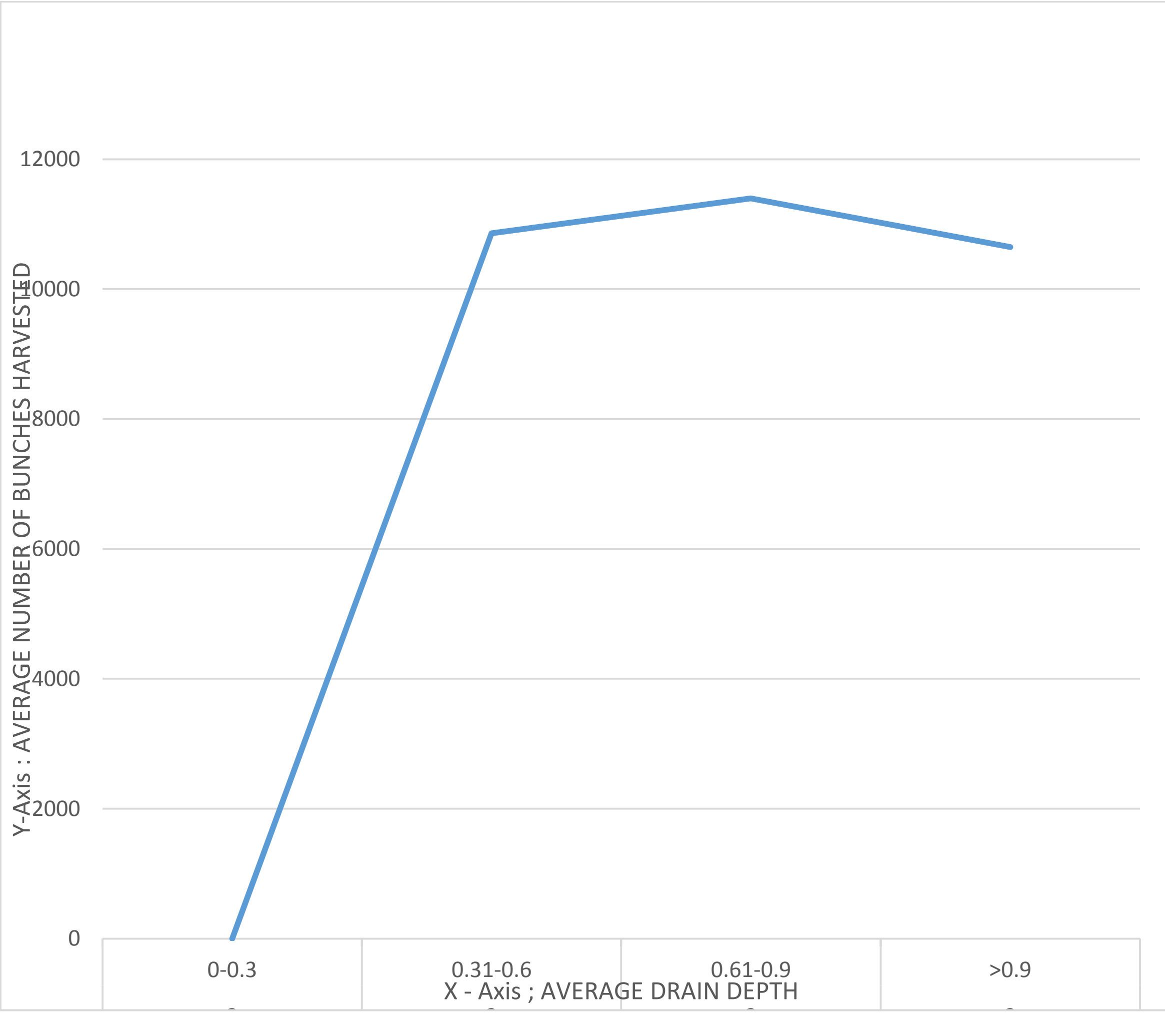

Fig. 4.9 Curve of average number of bunches harvested per drain depth range for Sector 2

Table 4.3 Summary of average number of bunches harvested at different drain depth range for Sector 3

Sector	Drain depth range(meters)	Average number of bunches for depth
3	0-0.3	10997
3	0.31-0.6	12351.00
3	0.61-0.9	11708.00
3	>0.9	11641.00

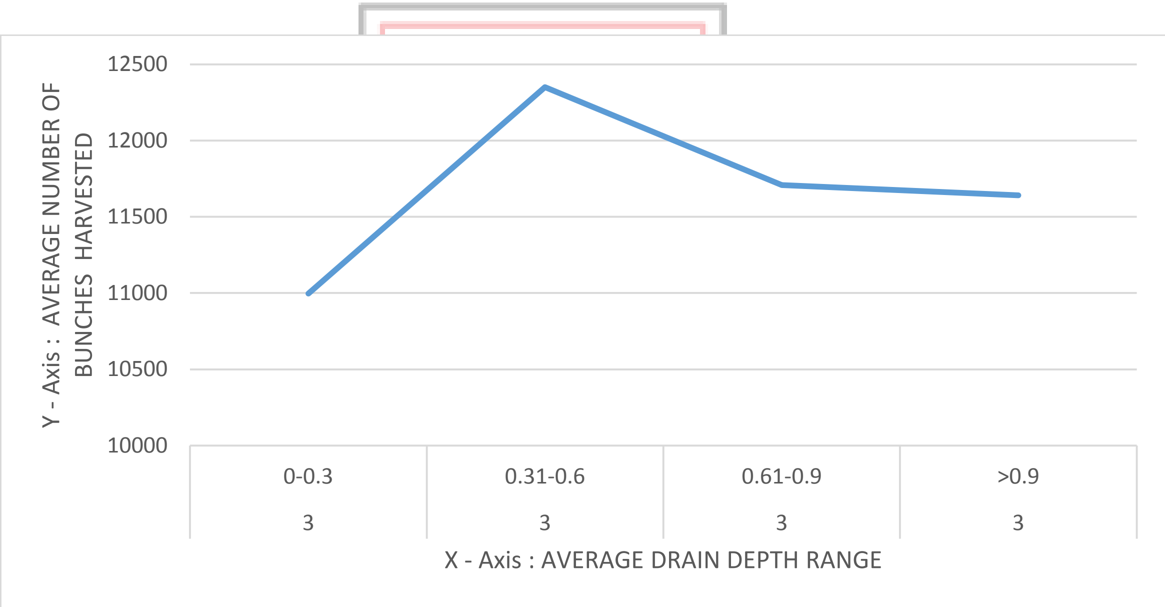

Fig. 4.10 Curve of average number of bunches harvested per drain depth range for Sector 3

Table 4.4 Summary of average number of bunches harvested at different drain depth range for Sector 4

Sector	Drain depth range(meters)	Average number of bunches for depth
4	0-0.3	0
4	0.31-0.6	8439.00
4	0.61-0.9	11905.00
4	>0.9	10233.00

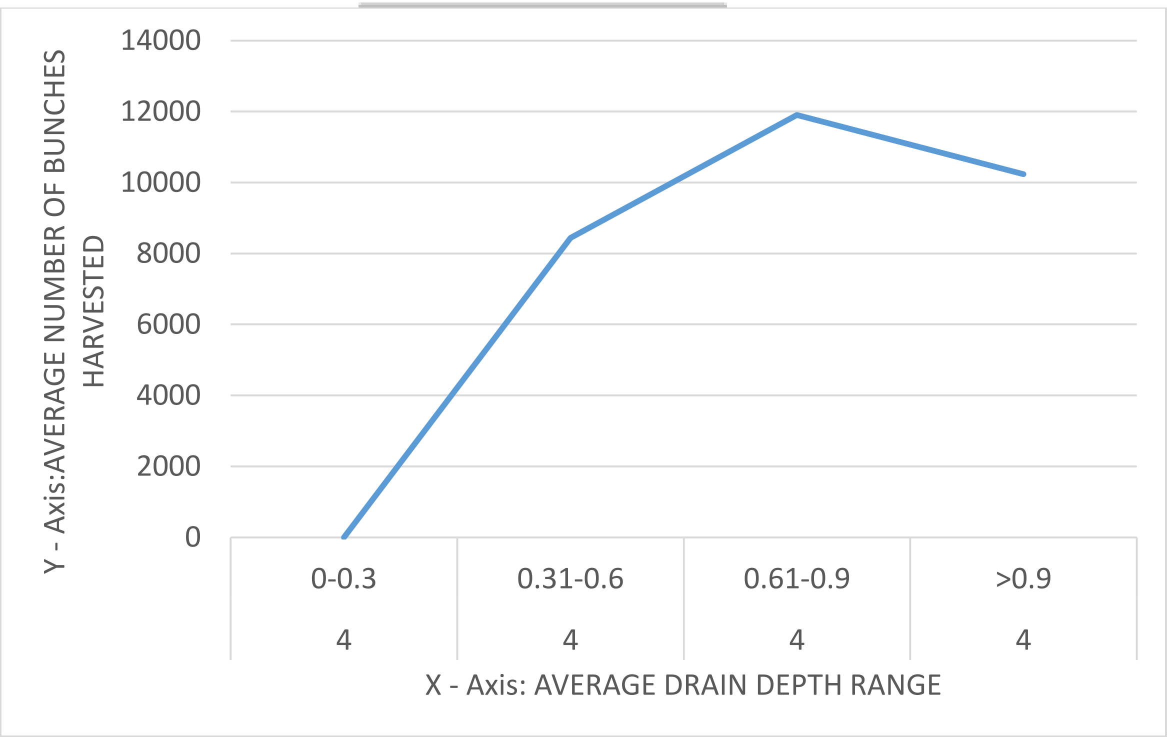

Fig. 4.11 Curve of average number of bunches harvested per drain depth range for Sector 4

Table 4.5 Summary of average number of bunches harvested at different drain depth range for Plantation

Sector	Drain depth range(meters)	Average number of bunches for depth
Plantation	0-0.3	4744.5
Plantation	0.31-0.6	10463.50
Plantation	0.61-0.9	11344.00
Plantation	>0.9	10817.50

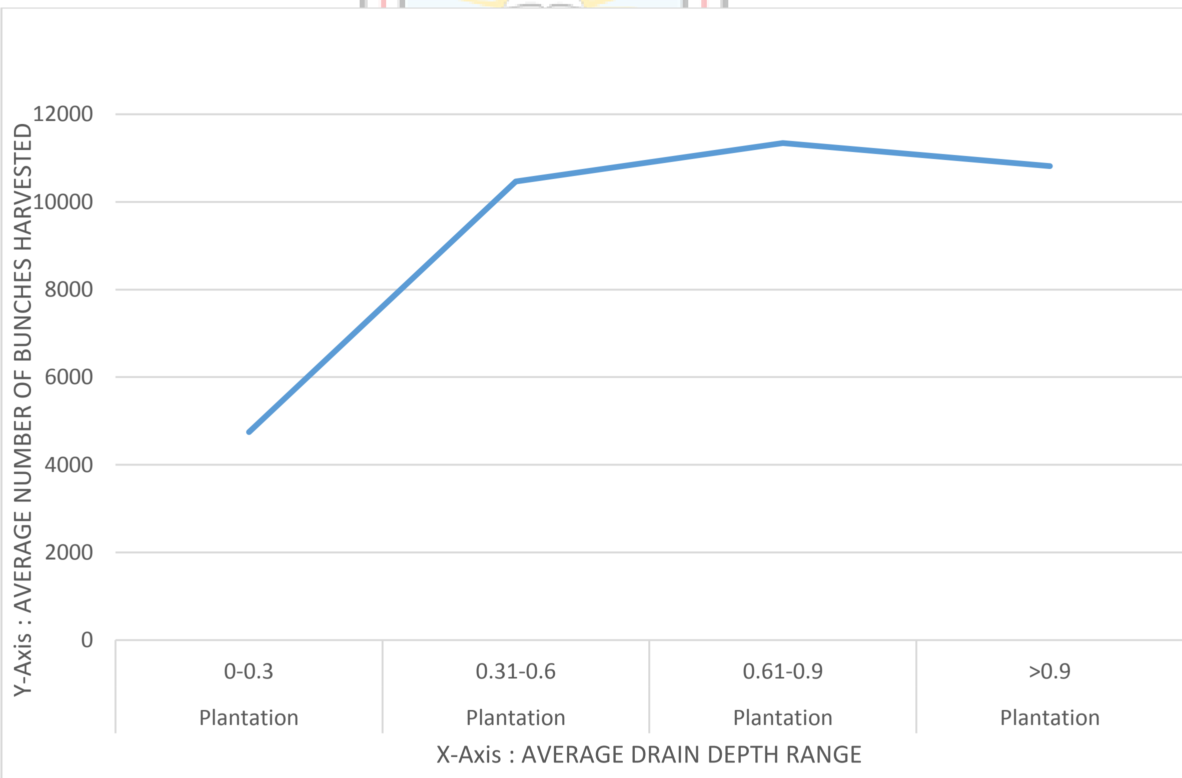

Fig. 4.12 Curve of average number of bunches harvested per drain depth range for Plantation

4.4 Drain Depth Distribution of the Area

The drain depth range was represented on a Map as in Fig. 4.13 and Fig. 4.14.
Fig. 4.13 shows a 1.0 m contour over the drain depth range distribution over the total land surface area of the project. The total surface area of the project is 738.06 Ha

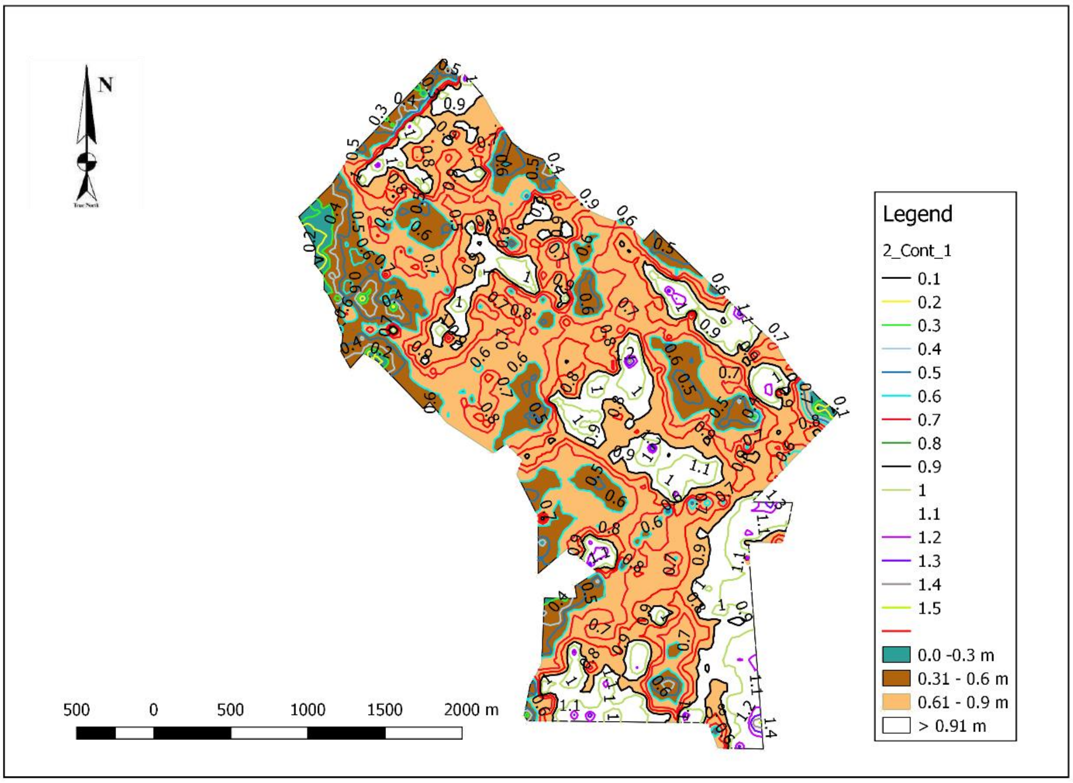

Fig. 4.13 0.1 m Contour Over Drain Depth Range Distribution.

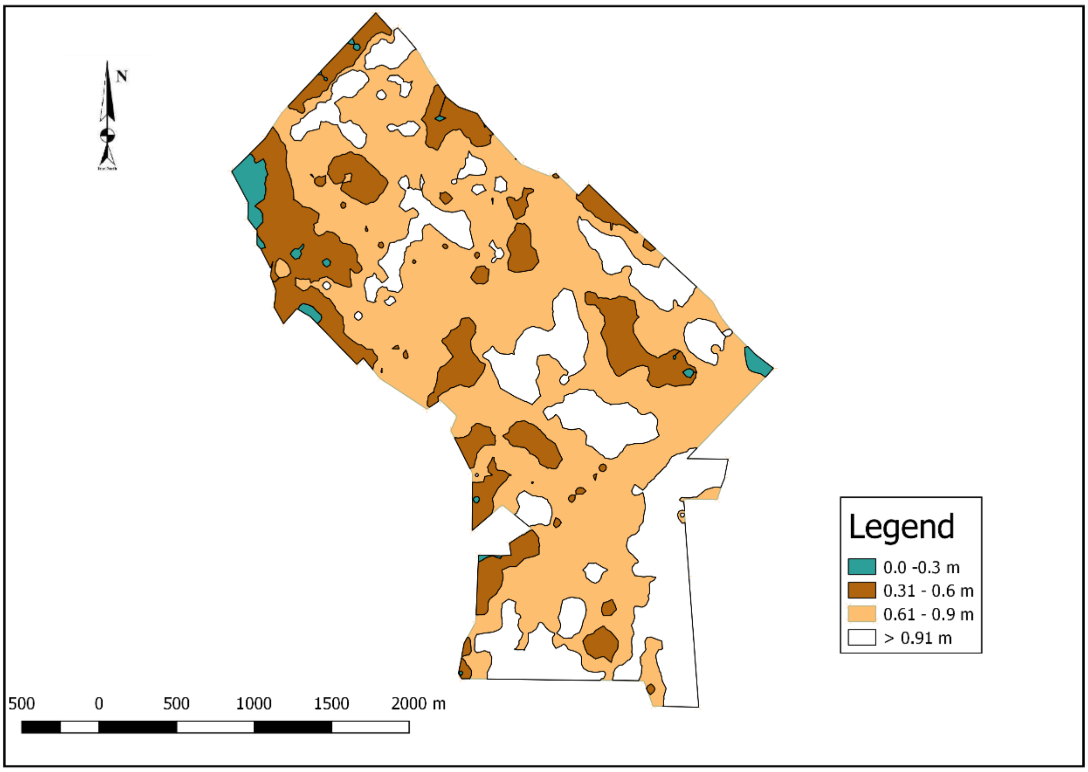

Fig. 4.14 Drain Depth Range Distribution

Table 4.6 Percentage of Land Surface for different drain depth range

Drain Depth Range (m)	Surface Area (Ha)	Percentage of the Surface Area (%)
0.0 - 0.3	10.48	1.42
0.31 - 0.6	134.15	18.18
0.61 - 0.9	415.8	56.34
> 0.9	177.63	24.06

Table 4.6 shows the different sizes of land surface for the different drain depth ranges and their percentages. The drain depth range of 0.61 – 0.9 m has the highest land cover and it represents 56.34 % of the project area.

It therefore suggests that the drain depth range of 0.61 – 0.9 m must be the maximum depth range ideal for the cultivation of banana.

4.5 Analysis of variance of the means

Analysis of variance of the means (ANOVA), a Microsoft application software which help to eliminate the laborious mathematical calculation of the sum of squares, the variance of two factors is used to derive the F, F critical and the P-values of each depth range of each Sector. The F's were compared with the F critical under normal distribution and the null hypothesis is either rejected or accepted. The P-value was similarly compared with the 10% alpha under normal distribution to confirm the results of the F-test of either reject or accept the null hypothesis.

In order to achieve the aim of this study, it is hypothesized that:

Null hypothesis

Ho: Drains have impact on the number of flowers counted per plot per annum

Ho: Depth of drains have impact on the number of flowers counted per plot per annum.

Alternative hypothesis

H_1: Drains have no impact on the number of flowers counted per plot per annum

H_1: Depth of drains have no impact on the number of flowers counted per plot per annum.

Table 4.7 Summary of Means of Drain Depths and corresponding Number of Bunches at different Drain Depth Range in Sector 1

	Range(m) 0.31-0.6	Range(m) 0.61-0.9	Range(m) >0.91
Drain Depth(m)	0.4	0.66	0.95
	0.46	0.71	1.01
	0.52	0.76	0.85
	0.55	0.82	1.01
Number of Bunches Harvested	11533	11212	10833
	10657	8100	10666
	10748	11365	10833
	11437	12123	10666

Table 4.8 ANOVA of Two Factor with Replication for Sector 1

Anova: Two-Factor With Replication						
SUMMARY	0.31-0.6	0.61-0.9	>0.91	Total		
Drain Depth						
Count	4	4	4	12		
Sum	1.93	2.95	3.82	8.7		
Average	0.4825	0.7375	0.955	0.725		
Variance	0.004425	0.004691667	0.0057	0.044718182		
Number of Bunches Harvested						
Count	4	4	4	12		
Sum	44375	42800	42998	130173		
Average	11093.75	10700	10749.5	10847.75		
Variance	207018.25	3163099.333	9296.333333	955112.5682		
Total						
Count	8	8	8			
Sum	44376.93	42802.95	43001.82			
Average	5547.11625	5350.36875	5375.2275			
Variance	35248888.92	34062533.44	33012904.04			
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	705947708.1	1	705947708.1	1253.378939	4.3E-18	4.41387
Columns	183662.0762	2	91831.03811	0.163041947	0.8508	3.55456
Interaction	184334.8712	2	92167.43561	0.163639206	0.8503	3.55456
Within	10138241.79	18	563235.6552			
Total	716453946.8	23				

Table 4.9 Summary of Means of Drain Depths and corresponding Number of Bunches at different Drain Depth Range in Sector 2

	Range(m) 0.31-0.6	Range(m) 0.61-0.9	Range(m) >0.91
Drain Depth(m)	0.53	0.61	0.91
	0.56	0.65	0.95
	0.57	0.75	0.98
	0.57	0.83	1.24
Number of Bunches Harvested	11705	10560	8792
	12106	12940	10233
	10808	10717	13365
	11132	13077	10001

Table 4.10 ANOVA of Two Factor with Replication for Sector 2

Anova: Two-Factor With Replication						
SUMMARY	0.31-0.6	0.61-0.9	>0.91	Total		
Drain Depth						
Count	4	4	4	12		
Sum	2.23	2.84	4.08	9.15		
Average	0.5575	0.71	1.02	0.7625		
Variance	0.00035833	0.009866667	0.0223333	0.04927		
Number of Bunches Harvested						
Count	4	4	4	12		
Sum	45751	47294	42391	135436		
Average	11437.75	11823.5	10597.75	11286.3		
Variance	336016.25	1879536.333	3802519.6	1926973		
Total						
Count	8	8	8			
Sum	45753.23	47296.84	42395.08			
Average	5719.15375	5912.105	5299.385			
Variance	37518113.3	40742190.83	33712705			
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	764184654	1	764184654	761.89	3.5E-16	4.41387
Columns	1570298.1	2	785149.05	0.78279	0.47208	3.55456
Interaction	1572190.51	2	786095.26	0.78373	0.47167	3.55456
Within	18054216.6	18	1003012			
Total	785381359	23				

Table 4.11 Summary of Means of Drain Depths and Corresponding Number of Bunches at Different Drain Depth Range in Sector 3

`	Range(m) 0.31-0.6	Range(m) 0.61-0.9	Range(m) >0.91
Drain Depth(m)	0.35	0.61	0.95
	0.48	0.66	1.01
	0.53	0.74	1.17
	0.6	0.81	1.24
Number of Bunches Harvested	9294	13138	10216
	13775	12638	9915
	9734	11458	13302
	9908	12421	12306

Table 4.12 ANOVA of Two Factor with Replication for Sector 3

Anova: Two-Factor With Replication						
SUMMARY	0.31-0.6	0.61-0.9	>0.91	Total		
Drain Depth						
Count	4	4	4	12		
Sum	1.96	2.82	4.37	9.15		
Average	0.49	0.705	1.0925	0.7625		
Variance	0.011133333	0.007766667	0.018291667	0.07795		
Number of Bunches Harvested						
Count	4	4	4	12		
Sum	42711	49655	45739	138105		
Average	10677.75	12413.75	11434.75	11508.8		
Variance	4330300.25	496112.25	2680230.25	2598198		
Total						
Count	8	8	8			
Sum	42712.96	49657.82	45743.37			
Average	5339.12	6207.2275	5717.92125			
Variance	34428380.43	44236529.87	38499676.92			
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	794602657.8	1	794602657.8	635.12	1.7E-15	4.41387
Columns	3030724.333	2	1515362.166	1.21122	0.32099	3.55456
Interaction	3029524.413	2	1514762.206	1.21074	0.32112	3.55456
Within	22519928.36	18	1251107.131			
Total	823182834.9	23				

Table 4.13 Summary of Means of Drain Depths and Corresponding Number of Bunches at Different Drain Depth Range in Sector 4

	Range(m) 0.31-0.6	Range(m) 0.61-0.9	Range(m) >0.91
Drain Depth(m)	0.4	0.62	0.95
	0.58	0.71	0.98
	0.4	0.78	1.18
	0.58	0.86	1.28
Number of Bunches Harvested	5601	10513	11050
	11278	10601	11732
	5601	11787	11621
	11278	11907	11658

Table 4.14 ANOVA of Two Factor with Replication for Sector 4

Anova: Two-Factor With Replication						
SUMMARY	0.31-0.6	0.61-0.9	>0.91	Total		
Drain Depth						
Count	4	4	4	12		
Sum	1.96	2.97	4.39	9.32		
Average	0.49	0.7425	1.0975	0.77667		
Variance	0.0108	0.010425	0.025225	0.08041		
Number of Bunches Harvested						
Count	4	4	4	12		
Sum	33758	44808	46061	124627		
Average	8439.5	11202	11515.25	10385.6		
Variance	10742776.33	558390.6667	98332.91667	5192563		
Total						
Count	8	8	8			
Sum	33759.96	44810.97	46065.39			
Average	4219.995	5601.37125	5758.17375			
Variance	24951729.8	36087358.74	37920916.34			
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	647065257	1	647065257	340.576	3.8E-13	4.41387
Columns	11463416.63	2	5731708.313	3.01682	0.07414	3.55456
Interaction	11456277.29	2	5728138.643	3.01494	0.07425	3.55456
Within	34198499.89	18	1899916.661			
Total	704183450.8	23				

CHAPTER 5
RESULTS AND DISCUSSION

5.1 Analysis of influence of drain depth on Yield

Table 4.1, the average number of bunches per plot at the different drain depth range for sector one. It show a general trend of increasing number of bunches with increasing depth range until a depth of greater than 0.9 m that show a slight increase in the bunch numbers but are not so much different from the different drain depth range that are from the previous depth range of 0.61- 0.9 m.

Table 4.2, the average number of bunches per plot at the different drain depth range for sector two. Unlike that of sector one, it shows a continuous increase in the number of bunches as depth of drains increase until it got to drain depth of greater than 0.9 m where it reduced in the average number of bunches.

Table 4.3, the average number of bunches per plot at the different drain depth range for sector three. It also shows an increasing trend of number of bunches with increasing drain depth till the drainage depth of 0.31 m to 0.6 m where it reduced slightly at 0.61 m to 0.9 and further decrease at drain depth greater than 0.91 m.

Table 4.4, the average number of bunches per plot at the different drainage depths for sector four. The results showed an increasing trend from 0 m to 0.31, to 0.61 m to 0.9 m and reduced significantly to drain depth range greater than 0.9 m.

The summary Tables; 4.1, 4.2, 4.3, and 4.4 for sectors 1, 2, 3, and 4 respectively showed average number of bunches per each drain depth range, showed the same trend consistent with that of the averages for the respective plots in the different sectors. The corresponding graphs on Fig; 4.8, 4.9, 4.10, and 4.11 shows the average number of bunches for sectors; 1, 2, 3, and 4 respectively. The graph showed curves consistent with that of the figures in the respective summary tables for the sectors.

Fig 4.8 showed that the average number of bunches for the depth range of 0 m -0.3 m is significantly different from that of the average for 0.31 m - 0.6 m. The average number of bunches for the drain depth range of 0.31 m - 0.6 m is significantly different from that of

0.61-0.9 m. The average number of bunches for the drain depth range of 0.61-0.9 m is however showed an increase but not significantly different from that of 0.91 m and above.

Fig 4.9. It showed that in the Sector all the drain depth were above 0.3 m and therefore could not register any number of bunches at depth range of 0 m - 0.3 m. However, there was significant number of bunches at 0.31 m - 0.6 m. The average number of bunches for the drain depth range of 0.31 m - 0.6 m is significantly different from that of 0.61 m - 0.9 m. The average number of bunches declined slightly for the drain depth range of 0.61 m - 0.9 m which is however not significantly different from that of 0.91 m and above.

Fig 4.10 It showed that the average number of bunches for the depth range of 0 m - 0.3 m is significantly different from that of the average for 0.31 m - 0.6 m. The average number of bunches for the drain depth range of 0.31 m - 0.6 m is significantly different from that of 0.61 m - 0.9 m. The average number of bunches for the drain depth range of 0.61 m - 0.9 m is however not significantly different from that of 0.91 m and above.

Fig 4.11 shows that the average number of bunches for the depth range of 0 m - 0.3 m is significantly different from that of the average for 0.31 m - 0.6 m. The average number of bunches for the drain depth range of 0.31 m - 0.6 m is significantly different from that of 0.61 m - 0.9 m. The average number of bunches for the drain depth range of 0.61 m- 0.9 m is however not significantly different from that of 0.91 meters and above.

Fig 4.12 shows the generals prediction that the average number of bunches for the depth range of 0.31 m - 0.6 m increased significantly from that of the average for 0.0 m - 0.3 m. The average number of bunches for the drain depth range of 0.61 m - 0.9 m increased significantly different from that of 0.31 m - 0.61 m. The average number of bunches for the drain depth range of 0.61 m - 0.9 m is however not significantly different from that of 0.91 m and above.

5.2 Discussions On Drain Depth Range with Average Number of Bunches Harvested

The banana is a heavy feeder of all is requirements for optimum growth (Anon., 2017). The excess of these requirements have proven to be detrimental to the growth of the banana plant. Excess water around the root zone of the banana for a long time could prevent nutrient uptake and initiate negative growth in the banana plant. A well-drained soil or a poorly drained soil with a good drainage systems within a banana plantation becomes a prerequisite for optimum growth and realization of yield projections, especially on a commercial estate. The results obtained across all the 4 sectors of study on the Kasunya Plantations, and the treatments across all the drain depth ranges showed the same trend. It, however, must be noted from the outset that, the results have shown that drainage is basic to banana cultivation and that even the plots that were given the minimum depth range of 0 m - 0.3 m showed a yield of good number of bunches across all the plots in the sectors studied. This confirms the first hypothesis which states that drains in a banana plantation have an effect on the number of bunches yielded in a banana plantation.

The further increase in the depth of the drains, from 0.3 1 m - 0.6 m, as shown in the results came with a corresponding increase in the number of bunches harvested in those areas with such depth, that were significantly different from the previous lower depth range of 0 mm-0.3 m areas. This could have meant a drain depth range of 0.31 m - 0.6 m would have been the optimum depth to which drains on a banana plantation should be sunk, until the number of bunches harvested in the plots with depth range of 0.61 m - 0.9 m showed a significantly higher numbers than the previously seemingly optimum depth range.

A further deepening of drain depths to 0.91 m and above, however, showed number of bunches harvested, that are not significantly different from the previous lower depth range of 0.61 m - 0.9 m. This results could only mean a show of diminishing yields even as the drains deepen beyond 0.9 m and may not be necessary to waste scarce resources. And if these depth levels become inevitable, significant increase in yields due to increasing depth should not be expected.

5.3 Discussions On ANOVA

The hypothesis established is to find out whether drains have impact on number of bunches (yield). Therefore the null hypothesis and alternative hypothesis will be:

Null hypothesis

Ho: Drains have impact on the number of flowers counted per plot per annum

against

H_1: Drains have no impact on the number of flowers counted per plot per annum

And

Alternative hypothesis

Ho: Depth of drains have impact on the number of flowers counted per plot per annum.

against

H_1: Depth of drains have no impact on the number of flowers counted per plot per annum.

Table 5.1 Summary of F and F-Critical for Significance Analysis

Sector	F	F critical
1	0.6696	3.008
2	0.6121	3.554
3	1.871	3.008
4	0.1037	3.554

The F and F-critical in Table 5.14 were extracted from the Tables; 4.8, 4.10, 4.12 and 4.14, Since F< $F_{critical}$ at 5% significance. He rejected nce this could mean the null hypothesis should be accepted and the alternative hypothesis rejected following the expression "Accept H_o: if F < $F_{critical}$ otherwise.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

It can be concluded from Fig 4.12, for the whole study area it shows that yield increases with drain depth and start to reduce at drain depth greater than 0.9 m.

It is concluded that effect of depth of drain could only be felt up to a depth of 0.9 m. Anything above that does not bring any significant additions to the yield and must be avoided if it is evitable.

It is also concluded that from the ANOVA statistics that drain and yield are intractable that it shows some sign of interdependence.

6.2 Recommendation

It is recommended that since the study was done in an area where all the beds have some drain depth, further research could be done on non drain land, to consolidate the findings of this research,

Studies should also be conducted on how long it takes a poorly drained plot to react to treatment once drained.

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APPENDIX A

DETERMINATION OF AVERAGE DRAIN DEPTH PER PLOT FOR SECTOR 1

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
A0	194270	668720	1.6	0.8	0.6	0.65	START
	194275	668716	1.7	0.8	0.8		
	194199	668525	1	0.5	0.2		MIDDLE
	194270	668522	2	0.5	1.3		
	194170	668341	0.8	0.4	0.2		END
	194270	668344	1.8	0.5	0.8		
A1	194280	668570	1.6	0.5	0.6	1.05	START
	194366	668570	1.7	0.5	1		
	194475	668570	2.3	0.5	1.5		
	194295	668427	1.3	0.5	0.4		MIDDLE
	194378	668424	1.7	0.8	1		
	194475	668424	2.8	0.8	1.6		
	194284	668344	1.9	0.5	0.8		END
	194368	668344	2.2	0.5	1.1		
	194475	668344	2.4	0.5	1.5		
A2	194282	668764	1.2	0.8	0.2	1	START
	194379	668764	1.6	0.8	0.8		
	194475	668764	2.4	0.5	1.6		
	194282	668664	1.4	0.7	0.6		MIDDLE
	194380	668664	1.25	0.8	0.6		
	194478	668664	2.5	0.5	1.6		
	194280	668570	1.7	0.5	1.1		END
	194366	668570	1.7	0.5	1		
	194475	668570	2.3	0.5	1.5		
A3	194299	668985	0.8	0.4	0.2	0.66	START
	194374	668985	1.6	0.6	0.2		
	194477	668985	1.6	0.6	1		
	194279	668889	1.4	0.8	0.5		MIDDLE
	194378	668889	1.2	0.5	0.5		
	194479	668889	1.8	0.8	1		
	194282	668764	1.2	0.8	0.2		END
	194379	668764	1.6	0.8	0.8		
	194475	668764	2.4	0.5	1.6		
B1	194485	668540	1.4	0.6	0.6	0.98	START
	194577	668540	1.9	0.8	0.8		
	194680	668540	2.4	0.5	1.6		
	194485	668424	1.6	0.5	0.6		MIDDLE
	194585	668424	1.5	0.5	0.8		
	194683	668424	2.1	0.5	1.3		
	194486	668344	1.4	0.5	0.8		END
	194575	668344	2.7	0.5	1.4		
	194680	668344	1.8	0.58	1		
B2	194489	668760	1.4	0.5	0.5	0.86	START
	194577	668760	1.5	0.5	0.9		
	194685	668760	1.8	0.5	1		
	194485	668662	1.6	0.6	0.6		MIDDLE
	194577	668660	1.6	0.8	0.6		
	194686	668660	2.1	0.5	1.2		
	194485	668540	1.4	0.6	0.6		END
	194577	668540	1.9	0.8	0.8		
	194680	668540	2.4	0.5	1.6		
B3	194483	668983	1.2	0.5	0.6	0.7	START
	194583	668983	1.9	0.8	0.8		
	194683	668983	1.5	0.5	0.8		
	194485	668886	1.5	0.6	0.5		MIDDLE
	194577	668886	1.4	0.5	0.6		
	194681	668886	1.4	0.5	0.6		
	194489	668760	1.4	0.5	0.5		END
	194577	668760	1.5	0.5	0.9		
	194685	668760	1.8	0.56	1		
C1	194692	668540	1.7	0.8	0.8	0.95	START
	194770	668540	1.7	0.6	0.8		
	194885	668540	2.1	0.8	1		
	194693	668435	1.9	0.8	0.8		MIDDLE
	194448	668435	1.9	0.8	0.8		
	194890	668435	2.6	0.5	1.4		
	194690	668342	1.8	0.5	0.8		END
	194770	668341	1.8	0.5	1		
	194888	668341	2.4	0.6	1.2		
C2	194695	668760	2.4	0.5	0.6	0.88	START
	194770	668760	1.4	0.5	0.8		
	194886	668760	2	0.5	1.2		
	194689	668660	1.3	0.6	0.6		MIDDLE
	194770	668660	1.6	0.6	0.8		
	194886	668660	2.2	0.5	1.4		
	194692	668540	1.7	0.8	0.8		END
	194770	668540	1.7	0.6	0.8		
	194885	668540	2.1	0.8	1		
C3	194693	668986	1.4	0.7	0.7	0.76	START
	194778	668984	1.4	0.5	0.5		
	194888	668983	1.6	0.5	0.9		
	194695	668889	1.2	0.8	0.6		MIDDLE
	194773	668889	1.5	0.5	0.9		
	194886	668892	2	0.5	1		
	194695	668760	1.4	0.5	0.6		END
	194770	668760	1.4	0.5	0.5		
	194886	668760	2	0.5	1.2		

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
D1	194894	668538	1.4	0.5	0.56	0.71	START
	194990	668538	1.2	0.5	0.3		
	195090	668538	1.1	0.5	0.2		
	194896	668424	1.8	0.5	0.8		MIDDLE
	194993	668424	1.8	0.5	0.5		
	195090	668424	2.1	0.5	0.8		
	194899	668340	2	0.5	1		END
	194993	668338	2.2	0.5	1		
	195090	668335	2.5	0.6	1.3		
D2	194994	668760	1.3	0.5	0.5	0.66	START
	194996	668760	2.5	0.8	1.3		
	195094	668760	2.2	0.9	1.2		
	194894	668660	1.9	0.8	0.9		MIDDLE
	194992	668660	1.6	0.5	0.6		
	195092	668645	1.3	0.5	0.5		
	194894	668538	1.4	0.5	0.5		END
	194990	668538	1.2	0.5	0.3		
	195090	668538	1.1	0.5	0.2		
D3	194894	668980	1.5	0.6	0.6	0.86	START
	195028	668980	2.2	0.8	1.3		
	195094	668980	1.6	0.8	0.9		
	194894	668880	1.3	0.5	0.6		MIDDLE
	194994	668880	1.3	0.5	0.6		
	195095	668885	1.5	0.5	0.8		
	194894	668760	2.2	0.9	1.2		END
	194996	668760	2.5	0.8	1.3		
	195094	668760	1.3	0.5	0.5		
E1	195104	668538	1	0.5	0.4	0.82	START
	195194	668530	1.5	0.5	0.6		
	195294	668530	2.3	0.8	1.2		
	195105	668424	1.1	0.5	0.3		MIDDLE
	195199	668424	1.8	0.5	0.9		
	195299	668424	1.9	0.5	1		
	195102	668335	0.8	0.5	0.3		END
	195190	668335	3.2	0.5	1.5		
	195290	668335	2.1	0.5	1.2		
E2	195099	668760	1.1	0.5	0.5	0.77	START
	195201	668765	1.4	0.5	0.6		
	195299	668760	1.8	0.5	1		
	195099	668645	1.4	0.5	0.8		MIDDLE
	195194	668645	1.8	0.5	0.9		
	195295	668645	2	0.5	1		
	195104	668538	1	0.5	0.4		END
	195194	668530	1.5	0.5	0.6		
	195294	668530	2.3	0.8	1.2		
E3	195099	668980	1.3	0.5	0.5	0.65	START
	195194	668980	1.4	0.6	0.5		
	195297	668982	1.8	0.6	0.9		
	195104	668887	1.1	0.5	0.5		MIDDLE
	195204	668880	1.3	0.5	0.6		
	195299	668880	1.6	0.5	0.8		
	195099	668760	1.1	0.5	0.5		END
	195201	668765	1.4	0.5	0.6		
	195299	668760	1.8	0.5	1		
F1	195356	668320	1.2	0.5	0.6	0.75	START
	195502	668320	2.2	0.5	1.2		
	195393	668245	1.4	0.5	0.4		MIDDLE
	195499	668240	2	0.8	0.9		
	195413	668151	1.3	0.5	0.5		END
	195494	668156	2	0.8	0.9		
F2	195306	668530	1.7	0.8	0.8	0.78	START
	195399	668530	2	0.5	0.8		
	195504	668530	1.6	0.5	0.5		
	195308	668424	1.8	0.6	0.8		MIDDLE
	195396	668420	2.3	0.8	0.8		
	195502	668422	2.4	0.8	1.2		
	195356	668320	1.2	0.5	0.6		END
	195402	668324	1.9	0.8	0.8		
	195502	668324	1.8	0.5	0.8		
F3	195306	668760	1.9	0.8	0.9	0.87	START
	195406	668758	1.9	0.5	0.9		
	195504	668758	2.1	0.5	1		
	195306	668645	1.9	0.8	0.8		MIDDLE
	195402	668645	2	0.5	1		
	195502	668645	1.8	0.5	0.9		
	195306	668530	1.7	0.8	0.8		END
	195399	668530	2	0.5	0.8		
	195504	668530	1.6	0.5	0.8		
F4	195306	668980	1.6	0.5	0.8	0.9	START
	195399	668978	1.8	0.5	0.8		
	195506	668980	1.9	0.5	1		
	195306	668885	1.5	0.6	0.6		MIDDLE
	195402	668878	2	0.5	1		
	195506	668845	2.3	0.5	1		
	195306	668760	1.9	0.8	0.9		END
	195406	668758	1.9	0.5	0.9		
	195504	668758	2.1	0.5	1.1		

APPENDIX B

CONT'D : DETERMINATION OF AVERAGE DRAIN DEPTH PER PLOT FOR SECTOR 1

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
G1	195513	668421	2.4	0.8	1.2	1.28	START
	195650	668421	2	0.8	1.2		
	195508	668295	1.7	0.5	1		MIDDLE
	195663	668294	1.7	0.8	1.6		
	195510	668146	3.2	0.8	1.6		END
	195662	668146	1.7	0.5	1.1		
G2	195513	668698	3.2	1.2	1.3	1.18	START
	195634	668695	2.4	0.9	1.2		
	195512	668578	2.1	0.5	1		MIDDLE
	195640	668578	2	0.5	1.2		
	195513	668421	2.4	0.8	1.2		END
	195650	668421	2	0.8	1.2		
G3	195513	668980	1.9	0.5	0.5	1	START
	195613	668980	1.7	0.8	0.8		
	195513	668848	2.4	0.8	1		MIDDLE
	195624	668848	2.3	0.87	1.1		
	195513	668698	3	1.2	1.3		END
	195634	668696	2.4	1.2	1.3		
I1	194281	669011	1	0.5	0.5	0.4	START
	194403	669015	1.3	0.5	0.6		
	194480	669015	1.4	0.5	0.7		
	194281	669090	1.3	0.8	0.2		END
	194400	669090	1.3	0.8	0.1		
	194480	669090	1.5	0.8	0.3		
I2	194486	669015	1.5	0.8	0.6	0.58	START
	194687	669015	1.6	0.6	0.8		
	194487	669098	1.4	0.5	0.5		MIDDLE
	194687	669103	1.4	0.5	0.6		
	194486	669190	1	0.5	0.5		END
	194486	669190	1.4	0.5	0.5		
I3	194690	669013	1.3	0.6	0.6	0.73	START
	194890	669013	1.6	0.5	0.9		
	194689	669146	1.2	0.5	0.6		MIDDLE
	194896	669113	1.5	0.5	0.8		
	194694	669261	1.2	0.5	0.5		END
	194892	669244	1.6	0.5	1		
I4	194694	669261	1.2	0.5	0.5	0.65	START
	194892	669244	1.6	0.5	1		
	194765	669337	1.3	0.5	0.3		MIDDLE
	194892	669337	1.4	0.5	0.6		
	194878	669460	1.2	0.3	0.3		END
	194894	669458	2	0.5	1.2		
J1	194896	669013	1.3	0.6	1	0.9	START
	195099	669008	2.2	0.8	1.4		
	194896	669108	1.5	0.6	0.7		MIDDLE
	195092	669113	2	0.8	0.9		
	194898	669225	1.8	0.8	0.6		END
	195092	669220	1.6	0.8	0.8		
J2	194898	669225	1.8	0.8	0.6	0.68	START
	195092	669220	1.6	0.8	0.8		
	194999	669337	1.6	0.8	0.8		MIDDLE
	195096	669336	1.6	0.6	0.9		
	194927	669505	1.2	0.5	0.4		END
	195100	669502	1.4	0.5	0.6		
J3	194927	669505	1.2	0.5	0.4	0.62	START
	195100	669502	1.6	0.6	0.7		
	195020	669605	1.3	0.8	0.5		MIDDLE
	195097	669605	1.6	0.5	0.7		
	195076	669673	1	0.5	0.4		END
	195099	669673	1.8	0.6	1		
K1	195101	669004	1.7	0.5	0.6	0.8	START
	195302	669001	1.6	0.5	1		
	195100	669088	1.8	0.8	0.6		MIDDLE
	195302	669082	1.6	0.5	0.8		
	195100	669168	1.5	0.6	0.8		END
	195303	669173	1.8	0.5	1		
K2	195102	669183	1.8	0.8	0.8	0.7	START
	195299	669183	1.4	0.5	0.8		
	195102	669266	1.1	0.5	0.6		MIDDLE
	195296	669266	1.4	0.5	0.8		
	195107	669352	0.8	0.5	0.4		END
	195299	669352	1.5	0.5	0.8		
K3	195107	669352	0.8	0.5	0.4	0.78	START
	195299	669352	1.5	0.6	0.8		
	195104	669440	1.6	0.5	0.8		MIDDLE
	195304	669444	1.6	0.5	0.9		
	195102	669534	1.5	0.5	0.8		END
	195302	669534	1.9	0.5	1		
K4	195102	669534	1.5	0.5	0.8	0.9	START
	195302	669545	1.9	0.5	1		
	195102	669613	1.8	0.8	0.8		MIDDLE
	195302	669601	1.9	0.6	1		
	195105	669681	1.9	0.6	0.9		END
	195302	669691	2	0.6	0.9		

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
L1	195304	669004	1.7	0.5	1.1	1.03	START
	195408	669018	2	0.5	1.2		
	195505	669004	1.5	0.5	0.9		
	195313	669090	1.7	0.6	0.9		MIDDLE
	195380	669090	1.9	0.5	1		
	195505	669080	1.5	0.5	1		
	195308	669180	2	0.8	1.2		END
	195400	669206	2	0.6	1		
	195504	669177	1.8	0.5	1		
L2	195308	669180	2	0.8	1.2	0.98	START
	195400	669206	2	0.6	1		
	195504	669177	1.8	0.5	1		
	195308	669271	1.8	0.6	1		MIDDLE
	195400	669266	1.6	0.6	1		
	195508	669266	1.8	0.5	0.9		
	195316	669361	2	0.5	0.9		END
	195404	669359	1.7	0.5	0.9		
	195504	669355	1.7	0.5	1		
L3	195304	669359	1.9	0.8	0.9	0.93	START
	195404	669359	1.7	0.5	1		
	195504	669355	1.7	0.5	1		
	195308	669441	1.8	0.8	0.8		MIDDLE
	195404	669441	1.8	0.5	1		
	195504	669438	1.6	0.5	1.1		
	195308	669534	1.6	0.5	0.8		END
	195404	669533	1.6	0.5	0.9		
	195508	669534	1.7	0.5	0.9		
L4	195308	669534	1.6	0.5	0.8	0.82	START
	195405	669533	1.6	0.5	1		
	195508	669534	1.7	0.5	0.9		
	195311	669604	1.9	0.8	0.6		MIDDLE
	195403	669604	1.7	0.5	0.9		
	195508	669604	1.6	0.5	0.9		
	195308	669691	1.4	0.5	0.6		END
	195406	669691	1.7	0.5	0.9		
	195507	669704	1.4	0.5	0.8		
M1	195513	669003	2.3	0.8	1.2	1.13	START
	195613	669004	1.9	0.6	1.1		
	195513	669080	1.9	0.8	1		MIDDLE
	195611	669080	1.9	0.6	1.3		
	195513	669177	2	0.8	1.1		END
	195606	667175	1.9	0.5	1.1		
M2	195513	669177	2	0.8	1.1	1.08	START
	195604	669175	1.9	0.5	1.1		
	195515	669273	1.8	0.8	1		MIDDLE
	195599	669266	1.8	0.5	1		
	195513	669355	1.8	0.5	1		END
	195594	669355	1.8	0.5	1.3		
M3	195513	669355	1.8	0.5	1	1.16	START
	195594	669355	1.8	0.5	1.3		
	195508	669438	1.5	0.6	1		MIDDLE
	195594	669444	1.6	0.6	1		
	195513	669532	2.3	0.6	1.2		END
	195608	669532	1.9	0.5	1.5		
M4	195513	669532	2.3	0.6	1.2	1.31	START
	195608	669532	1.9	0.5	1.5		
	195513	669605	2.1	0.8	1.2		MIDDLE
	195605	669620	2.1	0.6	1.4		
	195513	669706	1.9	0.8	1.1		END
	195608	669706	2.1	0.8	1.5		
N1	195606	669478	1.4	0.8	0.6	0.96	START
	195716	669481	1.6	0.8	0.8		
	195802	669476	1.7	0.9	0.6		
	195611	669621	1.7	0.6	0.8		MIDDLE
	195708	669620	1.7	0.9	1		
	195840	669620	1.9	0.5	1		
	195620	669715	2.4	0.8	1.2		END
	195720	669715	2	0.8	1.5		
	195865	669708	1.7	0.8	1.2		

APPENDIX C

DETERMINATION OF AVERAGE DRAIN DEPTH PER PLOT FOR SECTOR 2

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
A1	193914	670088	1.1	0.5	0.65	0.74	START
	193996	670172	1.5	0.5	0.7		
	193980	670105	1	0.5	0.5		MIDDLE
	194068	670105	1.6	0.5	1		
	194067	679936	1	0.5	0.6		END
	194148	670018	1.5	0.5	1		
A2	193743	670205	1.2	0.6	0.6	0.84	START
	193849	670312	1.6	0.5	1.1		
	193830	670150	1.2	0.6	0.6		MIDDLE
	193922	670243	1.8	0.5	1.1		
	193914	670088	1.1	0.5	0.65		END
	193996	670172	1.5	0.5	1		
A3	193590	670338	1	0.5	0.6	0.75	START
	193702	670454	0.9	0.5	0.6		
	193668	670255	1	0.5	0.6		MIDDLE
	193767	670387	1.6	0.5	1.1		
	193743	670205	1.2	0.6	0.6		END
	193842	670318	1.6	0.5	1		
B1	191452	670033	1.5	0.6	0.6	0.53	START
	194212	670101	1.5	0.8	0.8		
	194279	670169	1.5	0.5	0.7		
	194073	670111	0.9	0.5	0.3		MIDDLE
	194137	670175	1.6	0.8	0.7		
	194207	670249	1.2	0.7	0.3		
	193999	670177	1.4	0.5	0.5		END
	194078	670242	1.5	0.5	0.5		
	194143	670315	1.4	0.7	0.4		
B2	193998	670177	1.4	0.5	0.6	0.56	START
	194066	670250	1.4	0.8	0.5		
	194132	670318	1.4	0.7	0.4		
	193930	670255	1.2	0.7	0.4		MIDDLE
	193993	670318	1.6	0.8	0.6		
	194064	670387	1.3	0.5	0.7		
	193856	670322	1.3	0.8	0.5		END
	193923	670389	1.6	0.9	0.8		
	193988	670458	1.5	0.6	0.6		
B3	193705	670458	0.9	0.5	0.6	0.57	START
	193775	670527	0.9	0.5	0.6		
	193842	670598	0.8	0.4	0.5		
	193775	670395	0.9	0.6	0.1		MIDDLE
	193837	670463	1.6	0.8	0.7		
	193905	670533	1.7	0.8	0.8		
	193850	670327	1.9	1	0.6		END
	193915	670394	1.6	0.7	0.7		
C1	194287	670177	1.3	0.5	0.6	0.76	START
	194364	670245	1.4	0.5	0.8		
	194427	670310	2.3	0.5	1.1		
	194212	670256	1.7	0.8	0.7		MIDDLE
	194286	670329	1	0.5	0.3		
	194345	670391	1.2	0.8	1.6		
	194141	670318	1.7	0.6	0.6		END
	194214	670388	1	0.6	0.3		
	194269	670471	1.6	0.5	0.9		
C2	193978	670463	1.6	0.6	0.7	0.57	START
	194065	670536	1.1	0.5	0.4		
	194124	670600	1.4	0.5	0.5		
	194067	670393	1.5	0.8	0.7		MIDDLE
	194139	670468	1.4	0.7	0.4		
	194204	670537	1.4	0.7	0.4		
	194138	670322	1.6	0.5	0.6		END
	194209	670394	1	0.6	0.58		
	194269	670471	1.6	0.5	0.9		
C3	193845	670604	0.9	0.5	0.6	0.71	START
	193916	670678	0.9	0.5	0.6		
	193983	670744	0.9	0.5	0.6		
	193914	670542	2.1	1	1		MIDDLE
	193983	670611	1.6	0.8	0.6		
	194042	670679	1.8	1	0.8		
	193991	670468	1.3	0.5	0.6		END
	194058	670548	1.6	0.6	0.7		
	194122	670604	1.6	1	0.9		
D1	194438	670317	1.9	0.8	1	0.83	START
	194505	670388	2.2	0.8	0.9		
	194575	670470	2.2	0.6	1.2		
	194351	670396	1.9	0.8	0.8		MIDDLE
	194440	670458	1.9	1	0.6		
	194483	670563	2	0.9	0.7		
	194283	670464	1.4	0.6	0.7		END
	194352	670540	1.8	1.1	0.8		
	194422	670618	1.8	0.8	0.8		
D2	194274	670473	1.4	0.7	0.7	0.65	START
	194343	670547	1.8	0.8	0.8		
	194203	670543	1.3	0.5	0.5		MIDDLE
	194270	670616	2	1.1	0.6		
	194342	670691	1.6	0.8	0.8		
	194132	670614	1.5	0.9	0.5		END
	194198	670687	2	1.2	0.6		
	194272	670754	2.1	1.2	0.7		
D3	193988	670750	0.9	0.5	0.6	0.66	START
	194058	670823	1.1	0.5	0.9		
	194130	670989	0.9	0.5	0.8		
	194055	670685	1.3	0.8	0.6		MIDDLE
	194110	670750	2	1.1	0.7		
	194197	670830	1.6	1	0.6		
	194132	670614	1.5	0.8	0.5		END
	194198	670682	2	1.2	0.6		
	194273	670754	2.1	1.2	0.7		

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
E1	194428	670623	2.4	0.5	1.1	0.83	START
	194490	670690	2.1	0.6	0.8		
	194562	670763	1.9	0.8	0.8		
	194490	670567	2.4	1.2	0.7		MIDDLE
	194556	670630	2	0.7	0.8		
	194622	670705	1.6	0.7	0.7		
	194582	670475	1.8	0.5	1		END
	194649	670549	1.8	0.5	1.1		
	194718	670614	1.5	0.8	0.5		
E2	194273	670760	2	0.9	0.7	0.83	START
	194350	670833	2	1	0.6		
	194414	670900	1.8	0.7	0.9		
	194354	670698	1.5	0.8	0.8		MIDDLE
	194413	670763	1.9	0.8	0.9		
	194482	670835	2	0.9	0.9		
	194428	670623	2.4	0.6	1.1		END
	194490	670690	2.1	60	0.8		
	194562	670763	1.9	0.8	0.8		
E3	194133	670900	0.9	0.5	0.6	0.62	START
	194200	670969	1	0.5	0.8		
	194268	670045	1	0.5	0.8		
	194205	670836	2	0.8	0.8		MIDDLE
	194275	670909	1.8	1	0.4		
	194337	670975	1.7	1	0.3		
	194278	670760	2	0.9	0.7		END
	194350	670833	2	1	0.6		
	194414	670900	1.8	0.7	0.9		
F1	194566	670766	1.8	0.8	0.8	0.78	START
	194633	670835	2.2	1	0.9		
	194698	670911	2	1	0.6		
	194625	670709	1.8	0.7	0.8		MIDDLE
	194688	670782	2.1	0.8	0.8		
	194761	670850	2.1	1	0.7		
	194720	670620	1.6	0.7	0.6		END
	194788	670695	2	0.8	0.9		
	194860	670756	2.1	0.5	1		
F2	194421	670911	1.6	0.5	0.5	0.62	START
	194485	670978	1.6	0.5	0.5		
	194560	671043	1.5	1	0.4		
	194488	670840	1.6	0.5	0.6		MIDDLE
	194551	670908	1.8	0.7	0.7		
	194620	670990	1.8	1.1	0.4		
	194566	670756	1.8	0.8	0.8		END
	194633	670835	2.2	1	0.9		
	194678	670936	1.6	0.8	0.8		
F3	194274	671050	0.8	0.5	0.4	0.7	START
	194348	671127	1.4	0.5	1		
	194412	671193	1.1	0.5	0.85		
	194351	670991	2.2	0.7	1.1		MIDDLE
	194412	671054	2	0.5	1.1		
	194485	671122	1.5	0.8	0.5		
	194421	670911	1.6	0.9	0.5		END
	194485	670978	1.6	0.5	0.5		
	194553	671048	1.5	1	0.4		
G1	194736	670887	2	0.9	0.9	0.75	START
	194805	670961	1.4	0.8	0.6		
	194814	671030	1.6	0.6	0.7		
	194771	670852	1.8	1	0.6		MIDDLE
	194836	670924	1.5	0.7	0.7		
	194920	670984	1.6	0.8	0.8		
	194836	670811	1.8	0.5	1.1		END
	194886	670885	1.4	1.8	0.7		
	194936	670949	2.1	0.9	0.7		
G2	194569	671051	2.2	1.5	0.4	0.65	START
	194635	671118	2	1.1	0.6		
	194704	671191	2.3	1.4	0.6		
	194633	670984	1.9	0.9	0.7		MIDDLE
	194698	671054	1.5	0.5	0.8		
	194772	671128	1.6	0.5	0.7		
	194731	670890	2	1	0.8		END
	194802	670963	1.4	0.8	0.6		
	194868	671033	1.8	0.9	0.7		
G3	194415	671197	0.9	0.5	0.5	0.56	START
	194481	671267	1	0.5	0.6		
	194550	671336	1	0.5	0.6		
	194488	671126	1.8	1.3	0.4		MIDDLE
	194558	671198	1.8	1.3	0.4		
	194623	671267	2	1.1	0.8		
	194562	671058	2	1.2	0.4		END
	194625	671123	1.7	1	0.7		
	194698	671198	2.2	1.1	0.7		
H1	195386	670707	2.1	0.9	0.8	0.86	START
	195439	670765	1.6	0.8	0.8		
	195090	670795	2.2	0.8	1.1		MIDDLE
	195181	670889	2.4	1.1	0.7		
	195231	670946	2	1.2	0.5		
	194968	670946	1.6	1	0.9		END
	195036	671014	1.6	0.7	0.7		
	195147	671050	1.6	0.6	1.4		
H2	194840	671072	1.8	0.6	0.6	0.94	START
	194906	671140	2	0.6	0.7		
	194976	671212	1.8	0.7	1.1		
	194948	670966	1.8	0.7	1		MIDDLE
	195019	671039	1.6	0.6	0.7		
	195086	671110	2	0.5	1.4		
	194968	670946	1.6	1	0.9		END
	195036	671014	1.6	0.7	0.7		
	195147	671050	1.6	0.6	1.4		

APPENDIX D

CONT'D : DETERMINATION OF AVERAGE DRAIN DEPTH PER PLOT FOR SECTOR 2

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
	194738	671172	2.4	1.1	0.7		START
	194806	671245	1.7	0.9	0.7		
	194875	671315	2.2	1	0.8		
	194769	671142	2	1	0.7		MIDDLE
H3	194833	671206	1.8	0.5	0.7	0.75	
	194889	671303	1.7	0.6	0.6		
	194825	671086	2.1	0.6	0.9		END
	194889	671156	2	0.7	0.7		
	194962	671231	1.8	0.8	1		
	194557	671343	0.7	0.5	0.6		START
	194630	671415	1	0.5	0.7		
	194697	671488	1	0.5	0.6		
	194622	671283	2.3	1.4	0.9		MIDDLE
H4	194695	671355	1.8	1.1	0.7	0.71	
	194760	671423	1.6	1	0.7		
	194738	671172	2.4	1.1	0.7		END
	194806	671245	1.7	0.9	0.7		
	194875	671315	2	1	0.8		
	195386	670827	2.7	0.8	1.4		START
	195448	670910	1.8	0.8	1.8		
	195519	670973	1.5	0.6	1.5		
	195460	670754	2.7	0.8	1.4		MIDDLE
I1	195522	670838	1.9	0.8	1.1	1.24	
	195580	670909	2.4	0.6	1.1		
	195544	670734	2	1	0.8		END
	195583	670777	2.1	1	1.2		
	195660	670839	2.1	1	0.9		
	195243	670967	2.7	0.9	1.4		START
	195306	671034	2.1	1	0.8		
	195378	671105	2	1.1	0.4		
	195314	670895	1.8	1.1	1.1		MIDDLE
I2	195373	670980	2.3	1.1	0.9	0.95	
	195441	671038	1.5	0.8	0.7		
	195382	670830	2	1.1	1		END
	195448	670910	1.8	0.8	0.8		
	195519	670973	1.5	0.6	1.5		
	195125	671077	2.7	0.7	1.4		START
	195192	671148	2.1	0.5	1.1		
	195266	671215	2.1	0.8	0.5		
	195186	671019	1.3	0.9	1.2		MIDDLE
I3	195254	671088	1.8	0.8	0.8	0.93	
	195301	671183	2.3	1	0.7		
	195237	670973	2.4	0.8	1.4		END
	195303	671044	2.2	1.2	0.8		
	195366	671120	2.5	1.3	0.5		
	194974	671228	2.6	1.2	1		START
	195046	671284	1.3	0.6	0.4		
	195112	671368	1.8	1.2	0.4		
	195036	671164	2.6	1.3	1.1		MIDDLE
J1	195112	671219	1.3	0.5	0.5	0.66	
	195185	671299	1.8	1.1	0.4		
	195116	671089	2.2	0.8	1		END
	195197	671162	1.3	0.5	0.7		
	195250	671238	2.2	1.2	0.5		
	194844	671348	2.2	1.2	1		START
	194917	671423	1.2	0.5	0.5		
	194983	671494	1.9	0.9	0.5		
	194910	671290	2.5	1.2	1.1		MIDDLE
J2	194992	671358	1.3	0.5	0.4	0.63	
	195050	671422	1.3	0.5	0.4		
	194974	671228	2.6	1.2	1		END
	195046	671284	1.3	0.6	0.4		
	195112	671368	1.8	1.2	0.4		
	194701	671493	1.1	0.5	0.7		START
	194771	671565	0.9	0.5	0.5		
	194765	671426	1.6	1.1	1.2		MIDDLE
J3	194835	671504	2.2	1.2	0.7	0.72	
	194844	671348	2.2	1.2	1		END
	194917	671423	1.8	0.5	0.5		
	194983	671494	1.9	0.9	0.5		
	193585	670343	1.1	0.5	0.6		START
	193627	670388	1	0.5	0.6		
	193696	670459	1.1	0.5	0.6		
	193492	670378	0.9	0.5	0.5		MIDDLE
K1	193559	670450	1.1	0.6	0.6	0.61	
	193626	670521	1.2	0.5	0.6		
	193452	670425	0.9	0.5	0.5		END
	193504	670504	1.4	0.5	0.6		
	193566	670584	1.4	0.5	0.9		
	193425	670439	0.8	0.5	0.5		START
	193496	670512	1.4	0.8	0.7		
	193557	670592	1.4	0.8	0.6		
	193491	670652	1.7	0.6	1		MIDDLE
K2	193421	670575	1.5	0.6	0.6	0.68	
	193354	670506	1	0.6	0.6		
	193450	670694	1.6	0.5	1		END
	193380	670622	1	0.5	0.5		
	193311	670548	1.5	0.5	0.65		
	193569	670591	1.5	0.8	0.7		START
	193707	670729	1.5	0.8	0.8		
L1	193776	670659	1.3	0.5	0.8	0.7	MIDDLE
	193633	670527	1.2	0.6	0.7		
	193835	670603	1.4	0.6	0.6		END
	193705	670469	1.2	0.7	0.6		
	193452	670698	1.2	0.6	0.6		START
	193595	670839	1.8	0.8	1.2		
L2	193497	670659	1.6	0.7	1	0.88	MIDDLE
	193643	670793	1.4	0.6	1		
	193569	670591	1.5	0.8	0.7		END
	193707	670729	1.5	0.8	0.8		
	193712	670738	2.3	1.2	1.1		START
	193784	670805	1.4	0.7	0.9		
	193854	670873	1.2	0.5	0.8		
	193909	670817	1.1	0.5	0.7		MIDDLE
M1	193856	670740	0.9	0.4	0.6	0.72	
	193791	670670	1.1	0.6	0.5		
	193973	670752	1.4	0.7	0.7		END
	193910	670682	1.1	0.5	0.6		
	193839	670618	1.2	0.6	0.65		
	193595	670847	1.5	0.5	1.1		START
	193663	670918	1.2	0.5	0.7		
	193732	670988	1.5	0.5	1.1		
	193651	670801	0.9	0.5	0.5		MIDDLE
M2	193719	670865	1.6	0.8	1.1	0.91	
	193783	670941	1.4	0.8	0.9		
	193712	670738	2.3	1.2	1.1		END
	193784	670805	1.4	0.7	0.9		
	193854	670873	1.2	0.5	0.8		

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
	193982	670765	1.2	0.6	0.6		START
	194042	670832	0.9	0.5	0.5		
	194110	670900	1.6	0.5	0.9		
	193917	670825	1.6	0.6	0.8		MIDDLE
N1	193988	670886	1.1	0.6	0.8	0.77	
	194057	670963	1.7	0.6	0.85		
	193857	670880	1.2	1	0.9		END
	193912	670955	0.9	0.5	0.7		
	193984	671031	1.7	0.5	0.9		
	193739	670998	1.1	0.5	1.1		START
	193932	670948	1.3	0.5	0.5		
	193990	671024	1.9	0.8	0.9		
	193791	670948	1.2	0.6	0.7		MIDDLE
N2	193862	671014	1.1	0.5	0.5	0.8	
	193928	671084	1.6	0.5	1		
	193857	670880	1.2	1	0.9		END
	193912	670955	0.9	0.5	0.7		
	193984	671031	1.7	0.5	0.9		
	194120	670907	1.3	0.8	0.6		START
	194190	670982	1.4	0.8	0.5		
	194257	671053	1.8	0.8	0.5		
	194061	670967	2	0.8	0.85		MIDDLE
O1	194127	671038	1.5	0.5	0.5	0.71	
	194195	671108	2	0.5	0.9		
	193998	671028	2.2	0.8	0.85		END
	194067	671105	1.4	0.8	0.6		
	194132	671177	2.3	0.8	1.1		
	193996	671029	2	0.6	0.9		START
	194060	671107	1.4	0.6	0.5		
	194129	671178	2.3	0.8	1.1		
	193935	671090	1.8	0.9	0.6		MIDDLE
O2	194000	671161	1.6	0.8	0.7	0.87	
	194074	671233	1.8	0.6	1.3		
	193879	671143	1.2	0.5	1		END
	193952	671217	1	0.5	0.7		
	194017	671287	1	0.5	1.1		
	194264	671062	1.9	0.8	1		START
	194326	671128	1.5	0.8	0.9		
	194399	671201	1.5	0.8	1		
	194203	671117	2	0.8	1.2		MIDDLE
P1	194268	671188	1.3	0.6	0.5	0.9	
	194330	671257	1.9	1	0.9		
	194138	671177	2.3	0.8	1.1		END
	194204	671247	1.5	0.6	0.8		
	194261	671335	1.6	0.9	0.7		
	194135	671182	2.3	0.8	1.1		START
	194201	671255	1.8	0.9	1		
	194261	671335	1.6	0.9	0.7		
	194081	671241	2.1	1	1.3		MIDDLE
P2	194146	671312	2	1	1	0.98	
	194210	671381	2	1	1		
	194026	671290	1.8	0.5	1.2		END
	194091	671363	1	0.5	0.7		
	194164	671432	2	1	0.9		
	194398	671207	1.2	0.6	1.1		START
	194467	671270	1.2	0.7	0.6		
	194544	671348	0.8	0.7	0.3		
	194341	671268	1.2	0.7	0.5		MIDDLE
Q1	194404	671336	1.3	0.8	0.8	0.61	
	194480	671408	1.2	0.7	0.4		
	194285	671336	1.5	0.9	0.7		END
	194340	671390	1.6	1.2	0.3		
	194415	671472	1.2	0.8	0.8		
	194285	671336	1.5	0.9	0.7		START
	194340	671390	1.6	1.2	0.3		
	194415	671472	1.2	0.8	0.8		
	194219	671396	1.5	0.8	0.6		MIDDLE
Q2	194274	671448	1.9	0.8	1.1	0.75	
	194346	671525	1.4	0.8	0.8		
	194151	671455	1.7	0.8	0.8		END
	194233	671536	1.8	0.8	0.8		
	194293	671586	1.6	0.8	0.9		
	194151	671455	1.7	0.8	0.8		START
	194233	671536	1.8	0.8	0.8		
	194265	671616	2.1	1	1		
	194090	671515	2.2	0.8	1		MIDDLE
Q3	194158	671586	1.9	0.9	1	0.92	
	194211	671642	1.8	0.9	0.9		
	194058	671545	2.2	0.7	1		END
	194123	671609	1.4	0.6	0.8		
	194191	671686	1.9	0.6	1		
	194542	671355	1.2	0.8	0.7		START
	194626	671434	1	0.5	0.5		
	194736	671549	1.5	0.8	0.8		
	194488	671411	1.4	0.6	0.7		MIDDLE
R1	194567	671490	1.5	0.8	0.6	0.75	
	194644	671583	1.7	0.8	0.9		
	194422	671473	1.8	0.9	1.2		END
	194551	671559	1.2	0.8	0.6		
	194551	671623	1.4	0.6	0.8		
	194557	671623	1.4	0.6	0.8		START
	194501	671559	1.2	0.8	0.6		
	194557	671623	1.4	0.6	0.8		
	194357	671539	1.8	0.8	0.9		MIDDLE
R2	194436	671622	1.4	0.6	0.9	0.82	
	194496	671679	1.6	0.6	1		
	194422	671481	1.8	0.9	1.2		END
	194381	671664	1.5	0.6	0.6		
	194444	671730	1.3	0.9	0.6		
	194293	671582	1.6	0.8	0.9		START
	194381	671664	1.5	0.6	0.6		
	194444	671730	1.3	0.9	0.6		
	194264	671630	2.2	1	1		MIDDLE
R3	194348	671711	1.5	0.8	0.9	0.74	
	194372	671795	1.6	0.6	0.6		
	194197	671694	1.9	0.6	1.1		END
	194281	671776	1.2	0.6	0.3		
	194333	671831	1.6	0.8	0.7		

APPENDIX E

DETERMINATION OF AVERAGE DRAIN DEPTH PER PLOT FOR SECTOR 3

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
	194567	669483	1.7	0.6	1.5		START
	194567	669483	1.7	0.6	1.5		
	194634	669557	1.4	0.6	0.4		
	194583	669335	2.1	0.6	1.6		MIDDLE
A1	194649	669405	2.1	0.6	1.5	1.24	
	194707	669488	1.7	0.5	1.1		
	194646	669273	1.6	0.6	1.2		END
	194715	669345	2	0.5	1.4		
	194783	669417	1.6	0.5	1		
	194343	669562	1.4	0.8	0.5		START
	194410	669636	1.4	0.7	0.5		
	194478	669709	1.9	0.8	0.7		
	194424	669488	1.5	0.8	0.7		MIDDLE
A2	194487	669558	1.5	0.8	0.6	0.6	
	194550	669637	1.6	0.8	0.6		
	194494	669416	1.7	0.6	0.7		END
	194561	669489	1.1	0.5	0.7		
	194634	669557	1.4	0.6	0.4		
	194249	669468	1	0.8	0.3		START
	194338	669560	1.2	0.7	0.5		
A3	194257	669341	1	0.5	0.5	0.42	MIDDLE
	194420	669480	1.6	0.8	0.7		
	194610	669243	1.5	0.8	0.05		END
	194638	669273	1.7	0.6	0.5		
	194638	669563	1.6	0.5	0.7		START
	194704	669633	1.6	0.7	0.6		
	194769	669708	1.4	0.5	0.6		
	194710	669492	1.2	0.5	0.6		MIDDLE
B1	194775	669563	1.8	0.9	0.8	0.67	
	194843	669634	1.9	0.5	0.8		
	194786	669428	1.2	0.5	0.6		END
	194850	669496	1.6	0.5	0.7		
	194915	669564	1.7	0.5	0.7		
	194483	669711	1.6	0.7	0.6		START
	194547	669780	1.6	0.8	0.7		
	194618	669852	1.2	0.5	0.5		
	194558	669640	1.6	0.8	0.6		MIDDLE
B2	194623	669712	1.8	0.8	0.7	0.61	
	194680	669789	1.4	0.8	0.5		
	194638	669563	1.6	0.5	0.7		END
	194704	669633	1.6	0.7	0.6		
	194769	669708	1.4	0.5	0.6		
	194773	669709	1.6	0.5	0.5		START
	194911	669848	1.5	0.5	0.6		
C1	194850	669638	1.6	0.8	0.7	0.66	MIDDLE
	194979	669781	1.5	0.5	0.7		
	194917	669568	1.1	0.5	0.7		END
	195058	669713	1.2	0.5	0.8		
	194621	669854	1.2	0.5	0.4		START
	194757	669997	1.6	0.5	0.7		
C2	194686	669792	1.4	0.8	0.5	0.6	MIDDLE
	194830	669930	1.5	0.5	0.8		
	194773	669848	1.5	0.5	0.6		END
	194911	669848	1.5	0.5	0.6		
	195066	669709	1.5	0.5	0.9		START
	195133	669781	1.7	0.5	1.3		
D1	195234	669716	1	0.8	0.4	0.78	MIDDLE
	195287	669782	2	0.7	0.9		
	195325	669725	1.2	0.8	0.4		END
	195332	669740	1.9	1	0.8		
	194757	670003	2.1	0.5	1.1		START
	194833	670085	2.1	0.7	0.9		
	194901	670156	1.6	0.5	1.5		
	194833	669933	2.1	0.5	1.1		MIDDLE
D2	194905	670014	2.2	0.6	1.1	1.17	
	194971	670085	1.8	0.5	1.5		
	194983	669801	2.3	0.8	1.1		END
	195048	669872	1.6	0.5	1.1		
	195117	669945	1.8	0.5	1.2		

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
	195231	669845	2	0.7	0.9		START
	195291	669907	2	0.6	1.4		
	195360	669982	1.8	0.6	1.4		
E1	195351	669730	1.6	0.5	0.8	0.96	MIDDLE
	195410	669788	1.7	0.5	0.9		
	195432	669915	1.9	0.5	1		
	195442	669733	1.1	0.5	0.5		END
	195456	669751	1.6	0.5	0.8		
	195060	670008	2	0.8	0.8		START
	195192	670147	1.9	0.6	0.8		
	195135	669941	1.9	0.6	1		MIDDLE
E2	195196	670008	1.8	0.6	1.1	0.95	
	195260	670075	1.9	0.6	1		
	195204	669871	1.6	0.6	1		END
	195270	669931	1.6	0.6	1		
	195339	670005	1.6	0.6	0.9		
	194902	670161	1.4	0.5	0.7		START
	194962	670223	1.4	0.5	0.8		
	195035	670298	1.6	0.5	1		
	194980	670095	1.7	0.6	0.8		MIDDLE
E3	195038	670153	1.2	0.5	0.9	0.81	
	195107	670230	1.5	0.8	0.6		
	195060	670008	2	0.8	0.8		END
	195119	670066	1.7	0.5	0.9		
	195192	670147	1.9	0.6	0.8		
	195498	669858	1.8	0.8	0.8		START
	195574	669932	1.6	0.6	0.7		
	195620	670020	1.8	0.5	1		
	195563	669796	1.6	0.8	0.7		MIDDLE
F1	195635	669870	1.8	0.7	0.8	0.8	
	195698	669941	2.1	0.8	0.9		
	195613	669751	1.4	0.5	0.8		END
	195679	669820	2	0.8	0.8		
	195750	669893	1.6	0.6	0.7		
	195372	669982	2.1	0.7	1		START
	195438	670055	2	0.6	0.8		
	195459	670075	1.1	0.5	0.5		
	195436	669921	1.9	0.8	0.8		MIDDLE
F2	195505	669990	2.3	0.9	0.7	0.84	
	195572	670064	1.5	0.5	1.3		
	195498	669858	1.8	0.8	0.8		END
	195574	669932	1.6	0.6	0.7		
	195620	670020	1.8	0.5	1		
	195199	670155	1.9	0.8	0.8		START
	195261	670221	1.8	1	0.8		
	195331	670298	1.8	1	0.8		
	195268	670084	2	0.6	0.8		MIDDLE
F3	195334	670155	2.3	1	1	0.81	
	195404	670229	2	0.8	0.8		
	195338	670015	1.6	0.6	0.7		END
	195405	670085	1.3	0.5	0.8		
	195475	670155	1.8	0.8	0.8		
	195040	670304	1.4	0.5	0.5		START
	195106	670372	1.4	0.5	0.4		
	195178	670447	1.7	1	0.5		
	195118	670232	1.5	0.6	0.7		MIDDLE
F4	195178	670297	1.7	1.1	0.5	0.63	
	195244	670383	1.9	0.5	0.6		
	195199	670155	1.9	0.8	0.8		END
	195261	670221	2.2	1	0.9		
	195332	670298	1.8	1	0.8		

APPENDIX F

CONT'D : DETERMINATION OF AVERAGE DRAIN DEPTH PER PLOT FOR SECTOR 3

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
G1	195575	670070	2	0.5	1	0.76	START
	195585	670080	0.9	0.5	0.5		
	195703	669946	1.6	0.6	0.8		MIDDLE
	195775	670050	1.9	0.5	0.9		
	195761	669892	1.8	0.8	0.9		END
	195866	670005	1.5	0.5	0.5		
G2	195501	670148	2	0.9	0.5	0.48	START
	195635	670282	1.3	0.4	0.1		
	195697	670230	1.7	0.8	0.7		MIDDLE
	195774	670080	1.7	0.8	0.6		
	195884	670016	2.3	1.2	0.5		END
	195900	670035	1.9	1	0.5		
G3	195338	670304	1.8	1.2	0.3	0.29	START
	195462	670453	1.6	0.5	0.6		
	195409	670231	1.6	0.4	0.05		MIDDLE
	195542	670380	1.3	0.3	0.05		
	195479	670163	1.6	0.8	0.7		END
	195616	670305	1.8	0.3	0.05		
G4	195186	670449	1.6	0.8	0.4	0.46	START
	195320	670595	1.6	0.7	0.6		
	195250	670388	2	1.2	0.3		MIDDLE
	195383	670533	1.8	0.8	0.6		
	195338	670304	1.8	1.2	0.3		END
	195462	670453	1.6	0.5	0.6		
H1	195776	670167	1.8	0.6	1	0.9	START
	195911	670306	2.1	0.6	1.2		
	195848	670095	1.9	0.8	0.9		MIDDLE
	195976	670246	2.1	0.8	0.8		
	195905	670014	1.9	1.2	0.5		END
	196039	670178	1.7	0.5	1		
H2	195663	670297	1.6	0.5	0.8	0.88	START
	195772	670442	2.4	1	1.5		
	195703	670232	1.8	0.7	0.8		MIDDLE
	196060	670336	1.9	1.2	0		
	195776	670167	1.5	0.6	1		END
	195911	670306	2.1	0.6	1.2		
H3	195466	670460	1.3	0.6	0.9	1.1	START
	195666	670582	1.4	0.5	1.1		
	195547	670381	1.1	0.5	0.8		MIDDLE
	195688	670517	1.7	0.5	1.3		
	195624	670311	1.3	0.6	1		END
	195757	670457	2.2	0.6	1.5		
H4	195316	670604	1.3	0.5	1	0.8	START
	195361	670657	1.5	0.8	0.5		
	195390	670536	1.2	0.5	0.8		MIDDLE
	195526	670566	0.8	0.5	0.5		
	195466	670460	1.3	0.6	0.9		END
	195628	670582	1.4	0.5	1.1		
I1	195920	670312	2.1	1.2	0.4	0.4	START
	196018	670420	1.8	1.1	0.3		
	195982	670252	1.5	0.5	0.7		MIDDLE
	196060	670336	1.9	1.2	0		
	196036	670198	1.6	0.5	1		END
	196148	670317	1.6	1.2	0		
I2	195781	670447	1.9	1.2	0.2	0.53	START
	195881	670553	1.8	1.1	1.1		
	195841	670394	2	0.5	0.8		MIDDLE
	195936	670497	1.7	1.1	0.4		
	195920	670312	2.1	1.2	0.4		END
	196018	670312	1.8	1.1	0.3		
I3	195620	670634	0.9	0.4	0.7	0.95	START
	195766	670458	1.5	0.6	1.3		
	195690	670529	1.5	0.6	1		MIDDLE
	195817	670649	1.2	0.6	0.8		
	195763	670461	1.6	0.5	1.3		END
	195870	670574	1.2	0.8	0.6		
I4	195587	670634	1.5	0.5	1	0.74	START
	195647	670700	1.3	0.5	0.6		
	195723	670777	1.4	0.5	0.8		
	195620	670598	0.9	0.4	0.7		MIDDLE
	195755	670740	1.6	0.8	0.6		
J1	194246	669512	2	1.2	0.6	0.65	START
	194314	669583	1.4	0.5	0.6		
	194237	669600	1.5	0.5	0.5		MIDDLE
	194261	669629	1.9	0.6	1		
	194212	669667	0.9	0.5	0.7		END
	194215	669676	1.2	0.6	0.5		
J1	194318	669586	1.2	0.5	0.5	0.61	START
	194388	669660	2.1	0.8	0.8		
	194453	669734	1.8	0.9	0.6		
	194288	669618	1.5	0.7	0.6		MIDDLE
	194351	669688	1.4	0.7	0.5		
	194398	669786	1.4	0.6	0.6		
	194220	669683	1.4	0.5	0.6		END
	194289	669751	1.7	0.8	0.7		
	194323	669858	1.6	0.8	0.6		
J2	194220	669683	1.4	0.6	0.5	0.58	START
	194289	669751	1.7	0.8	0.7		
	194323	669858	1.6	0.8	0.6		
	194187	669772	0.7	0.4	0.3		MIDDLE
	194224	669813	1.2	0.6	0.6		
	194254	669925	1.7	0.5	0.5		
	194104	669906	1.3	0.6	0.6		END
	194184	669990	1.8	0.6	0.9		

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
K1	194457	669736	2.4	1.5	0.6	0.6	START
	194595	669878	1	0.6	0.5		
	194407	669788	1.1	0.5	0.6		MIDDLE
	194536	669928	1	0.7	0.5		
	194332	669867	1.1	0.6	0.6		END
	194463	670002	1.4	0.5	0.8		
K2	194332	669857	1.1	0.6	0.6	0.81	START
	194463	670002	1.4	0.8	0.8		
	194260	669928	0.9	0.5	0.5		MIDDLE
	194398	670060	1.5	0.8	0.7		
	194191	669992	1.7	0.8	0.8		END
	194328	670130	1.7	0.5	1.5		
L1	194596	669876	0.8	0.6	0.5	0.76	START
	194731	670022	1.6	0.8	1.1		
	194540	669935	1.2	0.8	0.6		MIDDLE
	194679	670075	1.4	0.7	0.8		
	194466	670004	1.3	0.6	0.6		END
	194602	670148	1.9	0.6	1		
L2	194466	670004	1.3	0.6	0.6	0.83	START
	194602	670148	1.9	0.8	1		
	194393	670074	0.9	0.5	0.5		MIDDLE
	194538	670208	2.3	0.6	1.2		
	194330	670134	1	0.5	0.5		END
	194465	670278	2.2	0.6	1.2		
M1	194742	670024	1.6	0.5	0.8	0.8	START
	194817	670101	1.7	0.5	0.9		
	194885	670173	1.6	0.5	0.8		
	194680	670078	1.9	0.9	0.8		MIDDLE
	194754	670161	2.1	0.7	0.9		
	194819	670233	1.7	0.6	0.6		
	194606	670150	2	0.8	0.9		END
	194682	670229	1.9	0.8	0.8		
	194750	670298	1.4	0.4	0.7		
M2	194606	670150	2	0.8	1	0.87	START
	194682	670229	1.9	0.8	0.8		
	194750	670298	1.4	0.4	0.7		
	194536	670218	2	0.8	0.8		MIDDLE
	194617	670292	2.1	0.8	1.1		
	194685	670364	1.7	0.5	0.7		
	194472	670284	2	0.8	1		END
	194543	670362	2.4	0.6	1		
	194608	670425	1.7	0.6	0.8		
N1	194888	670176	1.8	0.8	0.6	0.95	START
	194957	670249	1.8	0.6	0.8		
	195023	670310	2	0.8	1.1		
	194822	670240	1.9	0.5	1.1		MIDDLE
	194754	670440	1.9	0.8	0.9		
	194818	670511	2.2	0.3	1.3		
	194755	670304	2.3	0.6	0.8		END
	194891	670311	1.9	0.8	1		
	194953	670377	1.7	0.6	1		
N2	194755	670307	2.3	0.6	0.8	1.01	START
	194815	670373	1.7	0.5	1		
	194885	670446	1.9	0.8	1.1		
	194688	670367	2.4	0.8	1		MIDDLE
	194815	670372	1.7	0.5	1		
	194885	670446	1.9	0.8	1.1		
	194618	670439	2.6	0.8	1.1		END
	194677	670500	2.4	0.8	1		
	194743	670565	2.6	0.8	1		
O1	195024	670322	1.6	1	0.9	0.9	START
	195091	670395	1.3	0.6	0.7		
	195160	670469	1.8	0.8	1		
	194962	670384	1.8	0.8	0.8		MIDDLE
	195033	670451	1.8	0.6	0.9		
	195098	670524	1.7	0.8	0.9		
	194891	670451	1.8	0.5	0.9		END
	194958	670522	1.5	0.6	1		
	195028	670592	1.6	0.8	1		
O2	194891	670451	1.8	0.5	0.9	1.13	START
	194958	670522	1.5	0.6	1		
	195028	670592	1.6	0.8	1		
	194823	670514	2.2	0.8	1.1		MIDDLE
	194885	670591	1.4	0.8	1		
	194953	670663	1.8	0.8	1		
	194756	670583	1.8	0.5	0.9		END
	194828	670652	2	0.8	1.5		
	194890	670724	2.6	0.8	1.8		
P1	195160	670474	1.8	0.4	0	0.28	START
	195299	670618	1.4	0.4	0.4		
	195104	670535	1.4	0.4	0.2		MIDDLE
	195234	670678	1.2	0.5	0.3		
	194960	670670	1.8	1.2	0.4		END
	195030	670600	0.8	0.4	0.4		
P2	195030	670600	0.8	0.4	0.4	0.35	START
	195167	670740	2	0.8	0.5		
	195075	670774	1.4	0.9	0.2		MIDDLE
	195105	670525	1.1	0.5	0.4		
	194904	670720	1.2	0.4	0.3		END
	194950	670769	1.4	0.6	0.3		
Q1	195297	670633	1.3	0.6	0.6	0.63	START
	195350	670693	1.6	0.5	0.8		
	195238	670685	1.1	0.7	0.6		MIDDLE
	195278	670725	1.7	0.8	0.6		
	195173	670747	1.3	0.7	0.5		END
	195181	670756	1.3	0.7	0.7		
Q2	194891	670451	1.8	0.5	0.9	1.13	START
	194828	670647	2	0.8	1.5		
	194962	670384	1.8	0.8	1		

APPENDIX G

DETERMINATION OF AVERAGE DRAIN DEPTH PER PLOT FOR SECTOR 4

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
A0	194270	668720	1.6	0.8	0.6	0.65	START
	194275	668716	1.7	0.8	0.8		
	194199	668525	1	0.5	0.2		MIDDLE
	194270	668522	2	0.5	1.3		
	194170	668341	0.8	0.4	0.2		END
	194270	668344	1.8	0.5	0.8		
A1	194280	668570	1.6	0.5	0.6	1.05	START
	194366	668570	1.7	0.5	1		
	194475	668570	2.3	0.5	1.5		
	194295	668427	1.3	0.5	0.4		MIDDLE
	194378	668424	1.7	0.8	1		
	194475	668424	2.8	0.8	1.6		
	194284	668344	1.9	0.5	0.8		END
	194368	668344	2.2	0.5	1.1		
	194475	668344	2.4	0.5	1.5		
A2	194282	668764	1.2	0.8	0.2	1	START
	194379	668764	1.6	0.8	0.8		
	194475	668764	2.4	0.5	1.6		
	194282	668664	1.4	0.7	0.6		MIDDLE
	194380	668664	1.25	0.8	0.6		
	194478	668664	2.5	0.5	1.6		
	194280	668570	1.7	0.5	1.1		END
	194366	668570	1.7	0.5	1		
	194475	668570	2.3	0.5	1.5		
A3	194299	668985	0.8	0.4	0.2	0.66	START
	194374	668985	1.6	0.6	0.2		
	194477	668985	1.6	0.6	1		
	194279	668889	1.4	0.8	0.5		MIDDLE
	194378	668889	1.2	0.5	0.5		
	194479	668889	1.8	0.8	1		
	194282	668764	1.2	0.8	0.2		END
	194379	668764	1.6	0.8	0.8		
	194475	668764	2.4	0.5	1.6		
B1	194485	668540	1.4	0.6	0.6	0.98	START
	194577	668540	1.9	0.8	0.8		
	194680	668540	2.4	0.5	1.6		
	194485	668424	1.6	0.5	0.6		MIDDLE
	194585	668424	1.5	0.5	0.8		
	194683	668424	2.1	0.5	1.3		
	194486	668344	1.4	0.5	0.8		END
	194575	668344	2.7	0.5	1.4		
	194680	668344	1.8	0.58	1		
B2	194489	668760	1.4	0.5	0.5	0.86	START
	194577	668760	1.5	0.5	0.9		
	194685	668760	1.8	0.5	1		
	194485	668662	1.6	0.6	0.6		MIDDLE
	194577	668660	1.6	0.8	0.6		
	194686	668660	2.1	0.5	1.2		
	194485	668540	1.4	0.6	0.6		END
	194577	668540	1.9	0.8	0.8		
	194680	668540	2.4	0.5	1.6		
B3	194483	668983	1.2	0.5	0.6	0.7	START
	194583	668983	1.9	0.8	0.8		
	194683	668983	1.5	0.5	0.8		
	194485	668886	1.5	0.6	0.5		MIDDLE
	194577	668886	1.4	0.5	0.6		
	194681	668886	1.4	0.5	0.6		
	194489	668760	1.4	0.5	0.5		END
	194577	668760	1.5	0.5	0.9		
	194685	668760	1.8	0.56	1		
C1	194692	668540	1.7	0.8	0.8	0.95	START
	194770	668540	1.7	0.6	0.8		
	194885	668540	2.1	0.8	1		
	194693	668435	1.9	0.8	0.8		MIDDLE
	194448	668435	1.9	0.8	0.8		
	194890	668435	2.6	0.5	1.4		
	194690	668342	1.8	0.5	0.8		END
	194770	668341	1.8	0.5	1		
	194888	668341	2.4	0.6	1.2		
C2	194695	668760	2.4	0.5	0.6	0.88	START
	194770	668760	1.4	0.5	0.8		
	194886	668760	2	0.5	1.2		
	194689	668660	1.3	0.6	0.6		MIDDLE
	194770	668660	1.6	0.6	0.8		
	194886	668660	2.2	0.5	1.4		
	194692	668540	1.7	0.8	0.8		END
	194770	668540	1.7	0.6	0.8		
	194885	668540	2.1	0.8	1		
C3	194693	668986	1.4	0.7	0.7	0.76	START
	194778	668984	1.4	0.5	0.5		
	194888	668983	1.6	0.5	0.9		
	194695	668889	1.2	0.8	0.6		MIDDLE
	194773	668889	1.5	0.5	0.9		
	194886	668892	2	0.5	1		
	194695	668760	1.4	0.5	0.6		END
	194770	668760	1.4	0.5	0.5		
	194886	668760	2	0.5	1.2		

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
D1	194894	668538	1.4	0.5	0.56	0.71	START
	194990	668538	1.2	0.5	0.3		
	195090	668538	1.1	0.5	0.2		
	194896	668424	1.8	0.5	0.8		MIDDLE
	194993	668424	1.8	0.5	0.5		
	195090	668424	2.1	0.5	0.8		
	194899	668340	2	0.5	1		END
	194993	668338	2.2	0.5	1		
	195090	668335	2.5	0.6	1.3		
D2	194994	668760	1.3	0.5	0.5	0.66	START
	194996	668760	2.5	0.8	1.3		
	195094	668760	2.2	0.9	1.2		
	194894	668660	1.9	0.8	0.9		MIDDLE
	194992	668660	1.6	0.5	0.6		
	195092	668645	1.3	0.5	0.5		
	194894	668538	1.4	0.5	0.5		END
	194990	668538	1.2	0.5	0.3		
	195090	668538	1.1	0.5	0.2		
D3	194894	668980	1.5	0.6	0.6	0.86	START
	195028	668980	2.2	0.8	1.3		
	195094	668980	1.6	0.8	0.9		
	194894	668880	1.3	0.5	0.6		MIDDLE
	194994	668880	1.3	0.5	0.6		
	195095	668885	1.5	0.5	0.8		
	194894	668760	2.2	0.9	1.2		END
	194996	668760	2.5	0.8	1.3		
	195094	668760	1.3	0.5	0.5		
E1	195104	668538	1	0.5	0.4	0.82	START
	195194	668530	1.5	0.5	0.6		
	195294	668530	2.3	0.8	1.2		
	195105	668424	1.1	0.5	0.3		MIDDLE
	195199	668424	1.8	0.5	0.9		
	195299	668424	1.9	0.5	1		
	195102	668335	0.8	0.5	0.3		END
	195190	668335	3.2	0.5	1.5		
	195290	668335	2.1	0.5	1.2		
E2	195099	668760	1.1	0.5	0.5	0.77	START
	195201	668765	1.4	0.5	0.6		
	195299	668760	1.8	0.5	1		
	195099	668645	1.4	0.5	0.8		MIDDLE
	195194	668645	1.8	0.5	0.9		
	195295	668645	2	0.5	1		
	195104	668538	1	0.5	0.4		END
	195194	668530	1.5	0.5	0.6		
	195294	668530	2.3	0.8	1.2		
E3	195099	668980	1.3	0.5	0.5	0.65	START
	195194	668980	1.4	0.6	0.5		
	195297	668982	1.8	0.6	0.9		
	195104	668887	1.1	0.5	0.5		MIDDLE
	195204	668880	1.3	0.5	0.6		
	195299	668880	1.6	0.5	0.8		
	195099	668760	1.1	0.5	0.5		END
	195201	668765	1.4	0.5	0.6		
	195299	668760	1.8	0.5	1		
F1	195356	668320	1.2	0.5	0.6	0.75	START
	195502	668320	2.2	0.5	1.2		
	195393	668245	1.4	0.5	0.4		MIDDLE
	195499	668240	2	0.8	0.9		
	195413	668151	1.3	0.5	0.5		END
	195494	668156	2	0.8	0.9		
F2	195306	668530	1.7	0.8	0.8	0.78	START
	195399	668530	2	0.5	0.8		
	195504	668530	1.6	0.5	0.5		
	195308	668424	1.8	0.6	0.8		MIDDLE
	195396	668420	2.3	0.8	0.8		
	195502	668422	2.4	0.8	1.2		
	195356	668320	1.2	0.5	0.6		END
	195402	668324	1.9	0.8	0.8		
	195502	668324	1.8	0.5	0.8		
F3	195306	668760	1.9	0.8	0.9	0.87	START
	195406	668758	1.9	0.5	0.9		
	195504	668758	2.1	0.5	1		
	195306	668645	1.9	0.8	0.8		MIDDLE
	195402	668645	2	0.5	1		
	195502	668645	1.8	0.5	0.9		
	195306	668530	1.7	0.8	0.8		END
	195399	668530	2	0.5	0.8		
	195504	668530	1.6	0.5	0.8		
F4	195306	668980	1.6	0.5	0.8	0.9	START
	195399	668978	1.8	0.5	0.8		
	195506	668980	1.9	0.5	1		
	195306	668885	1.5	0.6	0.6		MIDDLE
	195402	668878	2	0.5	1		
	195506	668845	2.3	0.5	1		
	195306	668760	1.9	0.8	0.9		END
	195406	668758	1.9	0.5	0.9		
	195504	668758	2.1	0.5	1.1		

APPENDIX H

CONT'D : DETERMINATION OF AVERAGE DRAIN DEPTH PER PLOT FOR SECTOR 4

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
G1	195513	668421	2.4	0.8	1.2	1.28	START
	195650	668421	2	0.8	1.2		
	195508	668295	1.7	0.5	1		MIDDLE
	195663	668294	1.7	0.8	1.6		
	195510	668146	3.2	0.8	1.6		END
	195662	668146	1.7	0.5	1.1		
G2	195513	668698	3.2	1.2	1.3	1.18	START
	195634	668695	2.4	0.9	1.2		
	195512	668578	2.1	0.5	1		MIDDLE
	195640	668578	2	0.5	1.2		
	195513	668421	2.4	0.8	1.2		END
	195650	668421	2	0.8	1.2		
G3	195513	668980	1.9	0.5	0.5	1	START
	195613	668980	1.7	0.8	0.8		
	195513	668848	2.4	0.8	1		MIDDLE
	195624	668848	2.3	0.87	1.1		
	195513	668698	3	1.2	1.3		END
	195634	668696	2.4	1.2	1.3		
I1	194281	669011	1	0.5	0.5	0.4	START
	194403	669015	1.3	0.5	0.6		
	194480	669015	1.4	0.5	0.7		
	194281	669090	1.3	0.8	0.2		END
	194400	669090	1.3	0.8	0.1		
	194480	669090	1.5	0.8	0.3		
I2	194486	669015	1.5	0.8	0.6	0.58	START
	194687	669015	1.6	0.6	0.8		
	194487	669098	1.4	0.5	0.5		MIDDLE
	194687	669103	1.4	0.5	0.6		
	194486	669190	1	0.5	0.5		END
	194486	669190	1.4	0.5	0.5		
I3	194690	669013	1.3	0.6	0.6	0.73	START
	194890	669013	1.6	0.5	0.9		
	194689	669146	1.2	0.5	0.6		MIDDLE
	194896	669113	1.5	0.5	0.8		
	194694	669261	1.2	0.5	0.5		END
	194892	669244	1.6	0.5	1		
I4	194694	669261	1.2	0.5	0.5	0.65	START
	194892	669244	1.6	0.5	1		
	194765	669337	1.3	0.5	0.3		MIDDLE
	194892	669337	1.4	0.5	0.6		
	194878	669460	1.2	0.5	0.3		END
	194894	669458	2	0.5	1.2		
J1	194896	669013	1.3	0.6	1	0.9	START
	195099	669008	2.2	0.8	1.4		
	194896	669108	1.5	0.6	0.7		MIDDLE
	195092	669113	2	0.8	0.9		
	194898	669225	1.8	0.8	0.6		END
	195092	669220	1.6	0.8	0.8		
J2	194898	669225	1.8	0.8	0.6	0.68	START
	195092	669220	1.6	0.8	0.8		
	194999	669337	1.6	0.8	0.8		MIDDLE
	195096	669336	1.6	0.6	0.9		
	194927	669505	1.2	0.5	0.4		END
	195100	669502	1.4	0.5	0.6		
J3	194927	669505	1.2	0.5	0.4	0.62	START
	195100	669502	1.6	0.6	0.7		
	195020	669605	1.3	0.8	0.5		MIDDLE
	195097	669605	1.6	0.5	0.7		
	195076	669673	1	0.5	0.4		END
	195099	669673	1.8	0.6	1		
K1	195101	669004	1.7	0.5	0.6	0.8	START
	195302	669001	1.6	0.5	1		
	195100	669088	1.8	0.8	0.6		MIDDLE
	195302	669082	1.6	0.5	0.8		
	195100	669168	1.5	0.6	0.8		END
	195303	669173	1.8	0.5	1		
K2	195102	669183	1.8	0.8	0.8	0.7	START
	195299	669183	1.4	0.5	0.8		
	195102	669266	1.1	0.5	0.6		MIDDLE
	195296	669266	1.4	0.5	0.8		
	195107	669352	0.8	0.5	0.4		END
	195299	669352	1.5	0.5	0.8		
K3	195107	669352	0.8	0.5	0.4	0.78	START
	195299	669352	1.5	0.6	0.8		
	195104	669440	1.6	0.5	0.8		MIDDLE
	195304	669444	1.6	0.5	0.9		
	195102	669534	1.5	0.5	0.8		END
	195302	669534	1.9	0.5	1		
K4	195102	669534	1.5	0.5	0.8	0.9	START
	195302	669545	1.9	0.5	1		
	195102	669613	1.8	0.8	0.8		MIDDLE
	195302	669601	1.9	0.6	1		
	195105	669681	1.9	0.6	0.9		END
	195302	669691	2	0.6	0.9		

PLOTS	X	Y	TW	BW	H	AVG. DEPTH	REMARK
L1	195304	669004	1.7	0.5	1.1	1.03	START
	195408	669018	2	0.5	1.2		
	195505	669004	1.5	0.5	0.9		
	195313	669090	1.7	0.6	0.9		MIDDLE
	195380	669090	1.9	0.5	1		
	195505	669080	1.5	0.5	1		
	195308	669180	2	0.8	1.2		END
	195400	669206	2	0.6	1		
	195504	669177	1.8	0.5	1		
L2	195308	669180	2	0.8	1.2	0.98	START
	195400	669206	2	0.6	1		
	195504	669177	1.8	0.5	1		
	195308	669271	1.8	0.6	1		MIDDLE
	195400	669266	1.6	0.6	1		
	195508	669266	1.8	0.5	0.9		
	195316	669361	2	0.5	0.9		END
	195404	669359	1.7	0.5	0.9		
	195504	669355	1.7	0.5	1		
L3	195304	669359	1.9	0.8	0.9	0.93	START
	195404	669359	1.7	0.5	1		
	195504	669355	1.7	0.5	1		
	195308	669441	1.8	0.8	0.8		MIDDLE
	195404	669441	1.8	0.5	1		
	195504	669438	1.6	0.5	1.1		
	195308	669534	1.6	0.5	0.8		END
	195404	669533	1.6	0.5	0.9		
	195508	669534	1.7	0.5	0.9		
L4	195308	669534	1.6	0.5	0.8	0.82	START
	195405	669533	1.6	0.5	1		
	195508	669534	1.7	0.5	0.9		
	195311	669604	1.9	0.8	0.6		MIDDLE
	195403	669604	1.7	0.5	0.9		
	195508	669604	1.6	0.5	0.9		
	195308	669691	1.4	0.5	0.6		END
	195406	669691	1.7	0.5	0.9		
	195507	669704	1.4	0.5	0.8		
M1	195513	669003	2.3	0.8	1.2	1.13	START
	195613	669004	1.9	0.6	1.1		
	195513	669080	1.9	0.8	1		MIDDLE
	195611	669080	1.9	0.6	1.3		
	195513	669177	2	0.8	1.1		END
	195606	667175	1.9	0.5	1.1		
M2	195513	669177	2	0.8	1.1	1.08	START
	195604	669175	1.9	0.5	1.1		
	195515	669273	1.8	0.8	1		MIDDLE
	195599	669266	1.8	0.5	1		
	195513	669355	1.8	0.5	1		END
	195594	669355	1.8	0.5	1.3		
M3	195513	669355	1.8	0.5	1	1.16	START
	195594	669355	1.8	0.5	1.3		
	195508	669438	1.5	0.6	1		MIDDLE
	195594	669444	1.6	0.6	1		
	195513	669532	2.3	0.6	1.2		END
	195608	669532	1.9	0.5	1.5		
M4	195513	669532	2.3	0.6	1.2	1.31	START
	195608	669532	1.9	0.5	1.5		
	195513	669605	2.1	0.8	1.2		MIDDLE
	195605	669620	2.1	0.6	1.4		
	195513	669706	1.9	0.8	1.1		END
	195608	669706	2.1	0.8	1.5		
N1	195606	669478	1.4	0.8	0.6	0.96	START
	195716	669481	1.6	0.8	0.8		
	195802	669476	1.7	0.9	0.6		
	195611	669621	1.7	0.6	0.8		MIDDLE
	195708	669620	1.7	0.9	1		
	195840	669620	1.9	0.5	1		
	195620	669715	2.4	0.8	1.2		END
	195720	669715	2	0.8	1.5		
	195865	669708	1.7	0.8	1.2		

APPENDIX I

Average number of bunches per plot at different depth range for Sector 1

Sector	Plot	Drain depth range(meters)	Drain Depth(meters)	Number of bunches	Average number of bunches for depth
1	J 03	0-0.3	0.26	10191	7981
1	I 04	0-0.3	0.26	5771	
1	I 03	0.31-0.6	0.4	11533	10206
1	I 02	0.31-0.6	0.47	12381	
1	B 03	0.31-0.6	0.46	10636	
1	K 01	0.31-0.6	0.4	10792	
1	B 02	0.31-0.6	0.46	10657	
1	A 01	0.31-0.6	0.6	3424	
1	H 01	0.31-0.6	0.45	11743	
1	A 04	0.31-0.6	0.46	10094	
1	D 03	0.31-0.6	0.52	10748	
1	G 01	0.31-0.6	0.55	10904	
1	H 02	0.31-0.6	0.45	8207	
1	E 03	0.31-0.6	0.53	11072	
1	I 01	0.31-0.6	0.52	6524	
1	O 03	0.31-0.6	0.52	8377	
1	E 02	0.31-0.6	0.53	11068	
1	J 02	0.31-0.6	0.45	12746	
1	A 03	0.31-0.6	0.52	10794	
1	G 02	0.31-0.6	0.55	11437	
1	A 02	0.31-0.6	0.52	10785	
1	B 01	0.61-0.9	0.66	11212	10369
1	N 03	0.61-0.9	0.61	8601	
1	D 02	0.61-0.9	0.65	10996	
1	K 03	0.61-0.9	0.72	8033	
1	C 02	0.61-0.9	0.63	10701	
1	N 01	0.61-0.9	0.71	10519	
1	F 01	0.61-0.9	0.74	8100	
1	F 03	0.61-0.9	0.71	10450	
1	M 03	0.61-0.9	0.66	8012	
1	C 01	0.61-0.9	0.76	11365	
1	J 01	0.61-0.9	0.65	12156	
1	M 02	0.61-0.9	0.82	12123	
1	C 03	0.61-0.9	0.78	10702	
1	K 02	0.61-0.9	0.73	11439	
1	M 01	0.61-0.9	0.83	10377	
1	N 02	0.61-0.9	0.81	11659	
1	D 01	0.61-0.9	0.83	9916	
1	L 03	0.61-0.9	0.78	9024	
1	E 01	0.61-0.9	0.84	10609	
1	F 02	0.61-0.9	0.84	10936	
1	L 01	0.61-0.9	0.78	10825	
1	L 02	>0.9	0.95	10833	10749
1	O 02	>0.9	1.01	10666	

APPENDIX J

Average number of bunches harvested per plot at different depth range for Sector 2

Sector	Plot	Drain depth range(meters)	Drain Depth(meters)	Number of bunches	Average number of bunches for depth
2		0-0.3		0	0
2	B 01	0.31-0.6	0.53	11705	10858
2	B 02	0.31-0.6	0.56	12106	
2	B 03	0.31-0.6	0.57	10808	
2	C 02	0.31-0.6	0.57	11132	
2	C 01	0.31-0.6	0.76	11386	
2	A 01	0.31-0.6	0.74	8247	
2	J 02	0.31-0.6	0.63	9893	
2	E 03	0.31-0.6	0.62	11235	
2	F 02	0.31-0.6	0.62	11210	
2	K 01	0.31-0.6	0.61	10860	
2	K 02	0.61-0.9	0.68	11784	11394
2	D 02	0.61-0.9	0.65	12940	
2	Q 01	0.61-0.9	0.61	11356	
2	C 03	0.61-0.9	0.71	12303	
2	A 03	0.61-0.9	0.75	10717	
2	D 03	0.61-0.9	0.66	12371	
2	F 03	0.61-0.9	0.7	12365	
2	D 01	0.61-0.9	0.83	13077	
2	M 01	0.61-0.9	0.72	10809	
2	L 01	0.61-0.9	0.7	10945	
2	J 03	0.61-0.9	0.72	6813	
2	O 01	0.61-0.9	0.61	10538	
2	R 02	0.61-0.9	0.82	9282	
2	G 01	0.61-0.9	0.75	13998	
2	F 01	0.61-0.9	0.78	12195	
2	N 01	0.61-0.9	0.77	10310	
2	G 02	0.61-0.9	0.65	11675	
2	Q 02	0.61-0.9	0.75	12458	
2	J 01	0.61-0.9	0.66	10414	
2	N 02	0.61-0.9	0.8	8812	
2	A 02	0.61-0.9	0.84	12001	
2	E 02	0.61-0.9	0.83	11765	
2	R 03	0.61-0.9	0.74	4376	
2	H 03	0.61-0.9	0.75	10419	
2	E 01	0.61-0.9	0.83	11197	
2	O 02	0.61-0.9	0.87	9631	
2	R 01	0.61-0.9	0.75	12029	
2	H 01	0.61-0.9	0.86	19254	
2	P 01	0.61-0.9	0.9	15689	
2	G 03	0.61-0.9	0.71	12266	
2	H 04	0.61-0.9	0.71	11102	
2	L 02	0.61-0.9	0.88	9729	
2	H 02	>0.9	0.92	10428	10647
2	Q 03	>0.9	0.92	10147	
2	M 02	>0.9	0.91	8792	
2	P 02	>0.9	0.98	13365	
2	I 02	>0.9	0.95	10233	
2	I 03	>0.9	0.93	11569	
2	I 01	>0.9	1.24	10001	

APPENDIX K

Average number of bunches harvested per plot at different depth range for Sector 3

Sector	Plot	Drain depth range(meters)	Drain Depth(meters)	Number of bunches	Average number of bunches for depth
3	G 03	0-0.3	0.29	9875	10997
3	P 01	0-0.3	0.28	12120	
3	P 02	0.31-0.6	0.35	9294	12351
3	G 04	0.31-0.6	0.46	13881	
3	A 03	0.31-0.6	0.42	15270	
3	I 02	0.31-0.6	0.53	9734	
3	G 02	0.31-0.6	0.48	13775	
3	A 02	0.31-0.6	0.6	13698	
3	C 02	0.31-0.6	0.6	14376	
3	J 02	0.31-0.6	0.58	11226	
3	K 01	0.31-0.6	0.6	9908	
3	I 01	0.61-0.9	0.4	6832	11708
3	F 04	0.61-0.9	0.63	13892	
3	B 02	0.61-0.9	0.61	13138	
3	L 02	0.61-0.9	0.83	11857	
3	Q 01	0.61-0.9	0.63	2990	
3	C 01	0.61-0.9	0.66	12638	
3	H 04	0.61-0.9	0.8	10485	
3	J 01	0.61-0.9	0.65	11622	
3	G 01	0.61-0.9	0.76	12035	
3	B 01	0.61-0.9	0.67	11868	
3	L 01	0.61-0.9	0.76	11855	
3	F 02	0.61-0.9	0.84	12721	
3	F 01	0.61-0.9	0.8	13001	
3	M 01	0.61-0.9	0.8	11125	
3	I 04	0.61-0.9	0.74	11458	
3	E 03	0.61-0.9	0.81	12554	
3	O 01	0.61-0.9	0.9	10713	
3	F 03	0.61-0.9	0.81	12421	
3	K 02	0.61-0.9	0.81	12838	
3	H 01	0.61-0.9	0.9	10031	
3	D 01	0.61-0.9	0.78	15845	
3	M 02	0.61-0.9	0.87	10694	
3	H 02	0.61-0.9	0.88	11796	
3	E 02	>0.9	0.95	10216	11641
3	E 01	>0.9	0.96	13911	
3	N 01	>0.9	0.95	9377	
3	N 02	>0.9	1.01	9915	
3	I 03	>0.9	0.95	11414	
3	H 03	>0.9	1.1	13706	
3	O 02	>0.9	1.13	10624	
3	D 02	>0.9	1.17	13302	
3	A 01	>0.9	1.24	12306	

APPENDIX L

Average number of bunches harvested per plot at different depth range for Sector 4

Sector	Plot	Drain depth range(meters)	Drain Depth(meters)	Number of bunches	Average number of bunches for depth
4		0-0.3		0	0
4	I 01	0.31-0.6	0.4	5601	8439
4	I 02	0.31-0.6	0.58	11278	
4	A 00	0.61-0.9	0.65	7893	11905
4	J 03	0.61-0.9	0.62	10513	
4	A 03	0.61-0.9	0.66	12891	
4	B 03	0.61-0.9	0.7	13468	
4	F 01	0.61-0.9	0.75	4986	
4	I 04	0.61-0.9	0.65	8544	
4	D 01	0.61-0.9	0.71	10601	
4	E 02	0.61-0.9	0.77	12915	
4	I 03	0.61-0.9	0.73	14940	
4	E 03	0.61-0.9	0.65	13716	
4	C 03	0.61-0.9	0.76	11951	
4	D 02	0.61-0.9	0.66	12687	
4	J 01	0.61-0.9	0.9	13919	
4	K 02	0.61-0.9	0.7	12334	
4	D 03	0.61-0.9	0.86	13480	
4	K 03	0.61-0.9	0.78	11787	
4	B 02	0.61-0.9	0.86	11907	
4	L 04	0.61-0.9	0.82	10690	
4	F 04	0.61-0.9	0.9	13268	
4	K 01	0.61-0.9	0.8	11146	
4	E 01	0.61-0.9	0.82	12088	
4	J 02	0.61-0.9	0.68	15359	
4	F 03	0.61-0.9	0.87	13010	
4	K 04	0.61-0.9	0.9	11243	
4	A 01	0.61-0.9	0.65	11705	
4	F 02	0.61-0.9	0.78	12633	
4	C 02	0.61-0.9	0.88	11766	
4	M 03	>0.9	1.16	6413	10233
4	G 03	>0.9	1	860	
4	C 01	>0.9	0.95	11050	
4	M 02	>0.9	1.08	11254	
4	A 02	>0.9	1	11973	
4	L 01	>0.9	1.03	11456	
4	L 02	>0.9	0.98	11136	
4	G 02	>0.9	1.18	11621	
4	N 01	>0.9	0.96	10474	
4	B 01	>0.9	0.98	11732	
4	M 01	>0.9	1.13	10165	
4	L 03	>0.9	0.93	11436	
4	G 01	>0.9	1.28	11658	
4	M 04	>0.9	1.31	12038	

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