Greenhouses in Ghana

Recommendations

Introduction

The GhanaVeg programme has requested Wageningen UR Greenhouse Horticulture, in collaboration with the Wageningen UR Centre for Development and Innovation and the Forest and Horticultural Crops Research Centre, Kade, to conduct a quick scan on greenhouse horticulture in Ghana, also investigating business opportunities. These recommendations are extracted from the mission report.

Advantages of a greenhouse

A greenhouse offers a crop protection against adverse weather conditions such as hard winds and rains, and against pests. Combined with good management, this results in improved production and product quality, and better resource use efficiency.

The physical environment

The physical environment in Ghana is hot and humid, nevertheless, shows some geographical differences. Night temperatures are relatively high at Accra, and relatively low at Kumasi and Wenchi. Relative air humidity is relatively low at Kumasi, Wenchi and Tamale. Rainfall is relatively low right along the coast (Accra) and intermediate at Tamale.

Location	Temp night (^{o}C)	Temp day (^{o}C)	RH night (%)	RH day (%)	Rainfall (mm y^{-1})
Accra	24.5	31.3	89	66	891
Kade	23.7	33.1	92	66	1461
Kpandu (Volta)	22.6	32.6	92	64	1275
Kumasi	21.0	30.2	83	58	1484
Wenchi	20.9	29.8	80	55	1288
Tamale	22.5	33.3	47	44	1090

The enabling environment

The Ghanaian entrepreneurial environment is good: both domestic and foreign greenhouse construction and supplies companies can operate relatively easy. However, supplies are not easily available at all locations in the country, and maintenance of existing greenhouses is a matter of great concern. The knowledge level on protected cultivation in Ghana is low, resulting in mis-management of the greenhouse and the crop inside.

Greenhouse designs

The limited differences in temperature and relative air humidity among locations should not lead to great difference in greenhouse design. Location-specific dimensions of ventilation openings may vary , depending on winds speed, wind direction and temperature. Neither do the various crops require very different greenhouse designs.

Crop sanitation requires a double-door sluice that prevents pests from freely entering the greenhouse, and certain mesh sizes of the nets (that should at all times be closed!).

Net house. A net house with soil cultivation and drip irrigation by gravity is the simplest and cheapest. The greenhouse requires a construction that supports the net, a water tank that is filled for instance once per day, and some tubes and valves to supply water to the plants. Even cheaper would be a greenhouse in which the plants are watered by hand. Disadvantages of a net house are permeability for rains, and the low light transmission and therefore reduced crop growth. Cultivation in the soil introduces the considerable risk for soil borne diseases. A simple net house would be suitable if investments funds are scarce but if growers want to make a first step in protected cultivation nevertheless.

Wageningen UR Greenhouse Horticulture
PO Box 644, 6700 AP Wageningen,
The Netherlands
T: + 31 317 48 60 01
F:: +31 317 41 80 94
glastuinbouw@wur.nl
www.glastuinbouw.wur.nl

WAGENINGEN UR
For quality of life

Greenhouses in Ghana

Recommendations

Plastic house, no electricity. A plastic house with fixed window openings offers better protection against rains and makes more light available to the crop. Yields are potentially higher. However, good ventilation is necessary. A plastic house with not-automated fertigation is suitable for regions where electricity is not (always) available. Because of the tank that must be filled periodically, amounts of water and therefore the acreage should be relatively small.

Plastic house, with electricity, automated drip irrigation and mechanic ventilation, possibly with screens. Automated drip irrigation on the basis of radiation, temperature and/or soil moisture content requires electricity, and provides optimal amounts of water and nutrients to the crop. Mechanical ventilation moves around the indoor air. Screens, provided they are retractable, can reduce light intensity when needed (e.g., cucumber, young plants, many flowers if they would be cultivated). Flexible window openings are optional: they are useful if the need for ventilation varies. However, as ventilation requirements in Ghana are fairly high, windows are likely to be open all the time. Automated fertigation enables better application of water and nutrients, on the basis of the needs of the crop. A plastic house with automated fertigation is suitable for regions where electricity is guaranteed, where acreages are larger, and where knowledge is guaranteed.

Ventilation. As temperatures in Ghana are high, good ventilation is a must. This may be achieved through:

- Sufficient side ventilation that allows the entrance of fresh air. A compromise has to be made between a small mesh size that blocks the entrance of insects, and a larger mesh size that allows good ventilation.
- A tilted side that realizes a greater ventilation surface.
- One-sided top ventilation if winds come predominantly from one direction. Two-sided top ventilation if winds come from various directions.
- A good transpiring crop that reduces air temperature. This is only possible if water supply is continuous and sufficient.

Soil or substrate. If continuous water supply is guaranteed, either manually or mechanically, then it is recommended to grow on substrate, as this greatly reduces the risk of soil-borne diseases such as bacterial wilt. The frequent power cuts in Ghana play a role in this decision. Possible substrates are: disinfected soil, cocopeat, perlite, carbonated rice husk, biochar and compost. If continuous water supply is not guaranteed, then the grower must grow in the soil. Soil has much higher buffering capacities for especially water, but also nutrients. However, then the soil must be disinfected.

Greenhouse realized in Malaysia, suitable for a tropical climate. The greenhouse has a 2-sided top opening, tilted sides, nets along the sides that allow air entrance. With a mature, fully transpiring crop, an indoor temperature below the outdoor temperature is realized (Elings et al., 2012).

Greenhouse size. The size of a greenhouse with natural ventilation in a hot and humid climate is limited. If the greenhouse becomes too wide, then the air entering from the sides does not reach the centre of the greenhouse. Only in relatively cool areas (e.g. the highlands of East Africa), greenhouses can be larger. Active cooling on the basis of fossil energy would be very expensive. A crop can be grown in a larger greenhouse if the season is restricted to the wet season with lower levels of radiation that heat the greenhouse.

WAGENINGEN UR
For quality of life

Greenhouses in Ghana

Recommendations

Opportunities

Opportunities are grouped in two manners, viz. opportunities for the greenhouse sector versus opportunities for the broader horticultural & agricultural sector, and business versus general opportunities. Business opportunities are most interesting for the private sector, while general opportunities are more the domain of the public sector (although collabo-

	Greenhouse	**General horticulture & agriculture**
Business	A greenhouse design specific for Ghanaian local conditions that has sufficient natural ventilation capacity and that enables indoor production during (part of) the dry season. A local industry that produces greenhouse equipment and materials. Implementation of solar energy. Sensors that help growers to measure climate parameters. Variety trials. Hybrid varieties with good yield potential, pest and disease resistance and tolerance to high temperatures. Integrated Pest Management.	Country-wide availability of a wider selection of varieties. Supply of fertilizers and other agro-inputs. A laboratory for quickly analysis of soil samples. Cold stores to reduce post-harvest losses and decline of quality. Cleaning, sorting and packing practices to reduce product loss and increase value of produce.
General	An improved sanitary system in greenhouses. Strategies for soil / substrate sterilization. Establishment of direct linkages between potential buyers and producers. Cost-benefit analyses for a wide variety of production systems to make opportunities for commercial investments more transparent.	A good water infrastructure. Collaboration between private breeding companies and the Ghanaian research sector. A comprehensive greenhouse training programme for growers and students. Improved management practices. Experienced growers in an advisory role.

WAGENINGEN UR
For quality of life

Greenhouses in Ghana

Recommendations

Costs and benefits

Potential investors need a consistent basis for assessing the economic viability of greenhouses in Ghana. A cost and benefit analysis of an Amiran-type greenhouse dedicated to tomato production shows that if the farm price is 4.5 GHc kg^{-1} and fresh yields are 40 kg m^{-2} then investment will start yielding benefits after the 3rd year (solar panel and pumps factored in; if not then potential gains occur from the 2nd year). By contrast, if prices are close to those of open markets (2.5GHc kg^{-1}) then potential investments are financially less attractive.

#	Tomato price (GHc kg^{-1})	Tomato price* (€ kg^{-1})	Solar panel with pump	Financing term (year)	Cum. gross profits (€)	Cum. net profits (€)
1	2.5	0.625	no	3	26 261	10 406
2	4.5	1.125	no	3	47 270	31 415
3	2.5	0.625	yes	5	26 261	6 658
4	4.5	1.125	yes	4	47 270	28 315

Dr. Anne Elings
Wageningen UR Greenhouse Horticulture
PO Box 644, 6700 AP Wageningen, The Netherlands
T: + 31 317 48 32 50
F: +31 317 41 80 94
anne.elings@wur.nl
www.glastuinbouw.wur.nl

Yeray Saavedra Gonzalez, MSc
Wageningen UR, Centre for Development and Innovation (CDI)
P.O. Box 88, 6700 AB Wageningen, The Netherlands
T: +31 317 48 24 21
F: +31 317 48 68 01
yeray.saavedragonzalez@wur.nl

Prof. George Oduro Nkansah
Forest and Horticultural Crops Research Centre, Accra
PO Box LG44, Legon, Accra, Ghana
T: + 233 24 3831261
gonkansah2013@gmail.com

Summary

The climate in Ghana is hot and humid, and therefore, a greenhouse needs to have high ventilation capacities. This is best achieved through, amongst others, a one or two-sided top opening and netted sides. A double-door sluice is required for crop protection against insects.

It is strongly recommended to grow on substrate as otherwise soil borne diseases, e.g., bacterial wilt, will pose a serious threat to the crop. If electricity is not (always) available, then gravity-based fertigation can be used to frequently supply the crop with water and meet its demands for transpiration. If electricity is available, and if investment funds allow, then an automated fertigation system can be installed. Interrupted power supply can be avoided by a back-up generator or by solar energy, whereas soil-borne diseases are difficult to avoid. Financial benefits depend on various factors, however, greenhouse production can be profitable.