

Capitalization sheet

Diversification of agricultural production



- Production of sunflower sprouts
- Cricket breeding
- Results

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Diversification of agricultural production

The diversification of agricultural production targets niche sectors activities that can generate additional sources of revenue.

The launch of sprouted seed production, which responds to the demand expressed by some hotel-restaurants in Siem Reap, is of particular interest insofar as, it allows the production of products with high added value, for which, the local demand is not yet satisfied.

As regarding crickets breeding, it is perceived as an interesting complementary activity since it requires only a moderate workload, and allows the obtention of high protein products consumed locally and in border countries, as well as a by-product valued as a fertilizer for agriculture.



Sunflower seeds



FRW of coconut



Biochar



Production place

Description method / tools

Production of sunflower sprouts

The raw materials required for the production of 3kg of sprouts are as follows:

Table of raw material ratios

Raw material	Quantity	Source
Non-treated sunflower seeds	0,9kg	Thailand
FRW of coconut	5kg dry weight	Producer
Biochar	4kg dry weight	Producer
Water	-	Well

The production is carried out in an outdoor ventilated space, also benefiting from the daylight, to allow the growth of the sprouted seeds.

The area is besides, covered and protected by fine mesh fences to prevent, respectively prolonged exposure to the sun and the intrusion of pests such as birds and rats.

For hygienic reasons too, the baskets are always placed on a table, which limits contamination by soil germs and insects.

Only one person is required for the production and approx. 2h30 to 3h workload is required over the full cycle.



Analysis elements

> If the coconut raw material is manufactured by the producers, the coconut fibers should be boiled for 1 hour from the boiling point to sterilize the medium.

> To prevent the risk of contamination from birds and rats, it is important to keep the production place closed at all times.



Step 3



Step 4



Step 5



Step 6

The production cycle lasts 7 to 8 days and includes the following steps:

Step	Method/Material	Time
⇒ Step 1: Biochar activation	The biochar has to be soaked for activation for 3 days before it can be used in step 4. Bucket, measuring cup or balance	3 days
⇒ Step 2: Soaking of seeds	Seeds are soaked between 10 to 12h Container	10 to 12h
⇒ Step 3: Germination	The seeds are removed from water and then placed on a damp tissue inside a container which is covered with a lid or opaque fabric to protect the seeds from light. The lid must, however, allow air to pass. Container, fabric and lid	12h
⇒ Step 4: Growth medium preparation	The biochar is mixed with the coconut fiber chunks in the proportions indicated in the table of raw materials. Bucket or other container, spatula and measuring cup.	15min
⇒ Step 5: Crops baskets preparation	The growing medium previously prepared is poured into the baskets to a thickness of 5 cm. The sprouted seeds are then spread evenly over the medium and covered with a little of this potting soil (just enough to cover the seeds) 9 trays 25 * 35cm for the production of 3 kg, spatula or shovel.	20min
⇒ Step 6: Watering	The medium is watered so as to saturate it and then covered with a cover or opaque fabric that lets the air pass to allow the plants to breathe. The medium must be able to remain wet for 2 days without requiring additional watering. Watering can, fabrics or lids.	2 days of germination



Step 7



Step 8

⇒ Step 7:
Maintenance

After two days, the lid is removed and the plants are watered at least twice a day to keep the soil moist enough. The baskets are also put in such a way they can receive sunlight. water sprayer

4 to 5
days

⇒ Step 8: Harvest

After these 4 to 5 days of growth, the sprouts are ready to be harvested. Young shoots should be cut with scissors or a sharp knife so as not to damage the plants and thus to keep them longer. In this way, the shoots can be stored for up to 7 days in the refrigerator.

30min

Sharp knife or scissors, baskets



Analysis elements

> The shoots are delicate and special attention must be paid when handling during the harvesting phase to avoid damaging them.

> Sprouts are packaged without previous cleaning, otherwise their shelf life will be reduced.

> The place of production and the equipment must be cleaned before each new cycle.



To remember...

Production is for a small number of producers because of niche markets (small size) and the strong production capacity on small space.

Quantity of water for watering has to be adapted according to the season (hygrometry) and temperature, in particular to avoid the development of molds.

Production area is outside but closed (to avoid the intrusion of pests) and kept clean throughout the production cycle (for hygiene).



Crickets



Cage model



Net



Palm leaves



Coconut shell



Eggs' cardboard

Cricket breeding

Rearing in itself, requires on the production cycle, on average, only 30 minutes of work per day. Though, it is also necessary to consider the time required for fitting the cage out, before the production activity. In the following description, the conception and production phases will be separated.

Conception phase

Cage building :

The wooden, iron or concrete materials can be used indifferently according to the preference and possibility of the producer, as long as they make it possible to ensure the robustness of the cage over the whole cycle. The dimensions of the cage taken as model in this document are: $H = 1\text{m} * I = 1.2\text{m} * L = 4.8\text{m}$ and, can host up to 100 eggs' pots (of approx. 10cm diameter), ie 20kg of adult crickets at the end of the cycle.

The tools and materials needed for the construction of an iron / concrete cage are:

Tools	Materials
hacksaw, welding machine, drill/ screw machine, concrete saw, meter, wood saw, hammer, level	iron or bamboo bars, cement boards, screws, nails, silicone sealant (for joints)

During construction, care should be taken to orient the rough part of the concrete towards the inside of the cage, so as to allow the insects to climb on it.

Cage layout:

The required materials are :

Materials
a net, bamboo slats, double-sided tape, plastic bottles, palm leaves/ coconut shell / honeycomb egg cartons, straw, mosquito net, pots (for eggs).

It is recommended to follow the 7 steps below:

- ⇒ Step 1: Insulating the cage from the ground
- ⇒ Step 2: Installing the bamboo support
- ⇒ Step 3: Creating the shelter
- ⇒ Step 4: Installing the straw bed
- ⇒ Step 5: Installing the net
- ⇒ Step 6: Delineating the cage borders
- ⇒ Step 7: Setting up the mosquito net



Step 1



Analysis elements

> Some predators (mostly ants) feed on eggs. It is therefore important to isolate the cage from the ground.



Step 2: Bamboo structure



Step 3: eggs' cardboards layout

Steps	Method/Material
⇒ Step 1: Insulating the cage from the ground	Protect the feet of the cage from the ground by immersing them in containers (plastic bottles) filled with water or old motor oil, in order to prevent predators from entering the cage (ants, mice, lizards)
⇒ Step 2: Installing the bamboo support	Install the bamboo support (see photo) in the bottom of the cage. It should be standing 7 cm from the bottom so as to create an airlock between the shelter and excrements and isolate the shelter from the heat of the ground. In addition, 30cm above the "bamboo bedstead" (serving as a support for the shelter), must be attached other strips of bamboo. These latter aim to support the drinking troughs and food that lay on the net
⇒ Step 3: Creating the shelter	the coconut shells, palm leaves and honeycomb eggs' cardboards are used to build the shelter. The materials can be combined to create the structure. If using eggs' cardboards: Arrange each tray straight and leave space between them (cf picture) to allow crickets to move in and out. (about 600 trays) If using coconut shells: Make a few holes on the shells of the size of an adult cricket and place each of them face concave towards the inside of the cage and shifted on two layers. (about 500 shells) If using palm leaves: Arrange each leaf with an angle of 30 to 40 degrees to allow the crickets to climb easily and leave space between them using a support such as an egg tray. (about 50 leaves)
⇒ Step 4: Installing the straw bed	Cover the shelter previously created with a thin layer of straws.



Step 5

⇒ Step 5: Installing the net

Place the net over the straw and then place a bamboo bar over it to hold the net in place.

⇒ Step 6: Delineating the cage borders

Install a double-sided tape on the top of the inner side of the concrete walls to prevent crickets from escaping.

⇒ Step 7: Setting up the mosquito net

Cover the cage with the mosquito net to prevent the intrusion of predators.



Step 6

Production phase

Cricket rearing :

It takes between 50 and 60 days to fulfill a cycle: from the hatching of juveniles to the collection of adult crickets through the reproduction phase. Crickets are initially imported from Thailand, then handed from producers to producers through sale/purchase activities

The production cycle consists of the following 4 major steps:

⇒ Step 1: Juvenile growth and reproduction

⇒ Step 2: Eggs laying

⇒ Step 3: Eggs hatching

⇒ Step 4: Collection of adult crickets



Step 7



Analysis elements

> Knowing that Cambodians prefer to eat wild and fresh crickets in the rainy season, it is necessary to carry out off-season breeding to benefit from attractive market prices and potential customers

Step 1: Juvenile growth and reproduction

Water and feed are placed in the center of the cage, while eggs' pots are placed along the inner walls. However, the feed evolving with the age of the crickets, we distinguish two age groups: the first between 1 and 15 days and the second with 15 days and +. The ratios below are given for 100 initial eggs' pots.

Crickets aged 1 to 15 days:

Food: 2kg of chick feed split into a total of 2 rations over the 15 days period. The low frequency of feed renewal over these 15 days, is due to the fact that the juveniles are fragile and small sizes, and a regular provision of feed could bury them involuntarily under it and thus cause their death.

Water: It is renewed every day by impregnation of a sponge / fabric on which young crickets can climb and suck the water. Indeed, at this stage of growth, they risk drowning if they do not have a support on which they can climb for drinking.



Water for the crickets aged under 15 days



Food and water for crickets aged above 15 days



Step 2



Step 3



Analysis elements

- > The biochar contained in the egg pots can not be reused after spawning because of the smell left, which repels the crickets
- > Crickets may do more than one spawning cycle, but as it affects the taste of adults we do not recommend to keep the adult for another cycle



Step 4

Crickets aged 15 days and more

Food: 6kg of chick feed mixed with 30kg of rice bran, divided into 2 to 3 rations over 40 days. Moreover, the mixture is supplemented with plants such as fruit and leaves of sponge squash, pumpkin, papaya, ripe palm fruit, etc., depending on what is available around and not consumed by the producers themselves. However, plants that are viscous or have a strong smell such as *Leucaena leucocephala*, and *sesbania* should not be used.

Water: The water is renewed daily in the trough, which consists of a shallow receptacle with stones and gravel inside, on which crickets can climb for drinking, without risk of drowning.

Step 2 : Eggs laying

After 45 days, adult crickets are able to reproduce and lay eggs. When its song is heard, the producer knows they are ready to lay eggs. In order to collect the eggs, the pots must be placed along the internal walls of the cage. It takes on average about 100 pots containing moist charcoal made from rice straw or husks.

The pots are covered with a few straws and held in place for an average of 2 days, the time of laying. It is important not to leave pots longer than necessary for spawning, otherwise eggs will be eaten by adults. It takes on average 2 days for 100 pots and 1 day for 50 pots.

Step 3 : Eggs hatching

The eggs are then moved to another cage for hatching. The pots should be moistened 2 to 3 times a day until hatching after 7 days.

The pots can be kept for the next production cycle or sold.

Step 4 : Collection of adults crickets

Between 50 and 60 days after the beginning of the cycle, adults can be collected for sale.

For this, it is advisable to undo one by one the different layers inside the cage and to collect the adults at the end in a bucket. At first we remove the feed, water and net; thereafter the shelter and bamboo support, before gathering the crickets in a corner of the cage for their collection with a shovel. The excrements at the bottom of the cage are used as fertilizer.



To remember...

A 2 months production cycle that, in its entirety, requires only a few hours of work (30h over two months).

A breeding period that mustn't overlook the seasons of capture of wild crickets so as to be competitive.

A pest-sensitive breeding that need to be protected (from ground and flying insects).

Critical points to watch for when feeding and watering juveniles, laying eggs and removing eggs' pots after spawning.

Results

	Sunflower sprouts	Cricket breeding
Key elements of demand		
Quantity sold	minimum of 1kg	-
Price	7 usd/kg	2,5 usd/kg of fresh crickets 2,5 usd/eggs' pot
Quality requirements	Non-treated seeds	-
Technical results		
Yield	28% (if including growth medium) and 333% (if just seeds)	100 eggs'pots give around 20kg of adult crickets
Duration of the cycle	7 to 8 days	50 to 60 days
Economic results		
Cost of production	3,09 usd/kg	297,83 usd/cycle
	Production costs vary according to input prices. The cost of production is calculated without taking into account the costs of investment in machinery and premises, nor cost of labor	The cost of production accounts for depreciation of the cage and material, the cost of the raw material and labor
Profit	3,91 usd/kg (without labor cost)	2,18 usd/cycle (10 first cycles)
Volume sold/period	3 kg/week	20kg of adult crickets and 100 eggs' pots in potential

Input prices for the production of sunflower sprouts:

Sunflower seeds = 4,5 usd/kg ; coconut fiber (FRW) = 0,84 usd/kg ; Biochar = 0,047 usd/kg ; Water= 0,25 usd/m³ if connected to the water network ; Labor = 0,62 usd/h

Premises = 100 usd for 3m*4,5m ; Cropping baskets = 1 usd/basket

Input prices for crickets breeding:

Eggs' pots = 2,5 usd/pot (same price for buying or selling) ; Chick feed = 0,625 usd/kg ; Rice bran = 0,2 usd/kg ; Eggs' cardboards = 15 usd/cycle (600 trays, 10% renewal/cycle) ; Material = 0,63 usd/set (depreciation over 10 cycles) ; Cage = 2,075 usd/cycle (depreciation over 60 cycles) ; Labor = 18,75 usd/cycle (30h workload)

NB: Cricket breeding charges can be reduced if the producer uses coconut shell or palm leaves instead of eggs' cardboards.

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