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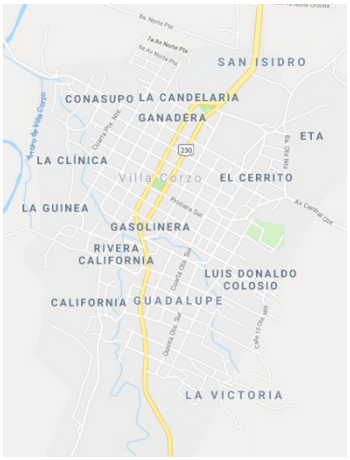
Factor: Animal Agriculture
Mexico

“Management of Genetic Resources for Aquaponics”

The chosen developing country for my research is Mexico.

The location where the research is going to be built on is: Chiapas, Villa Corzo town specificly.

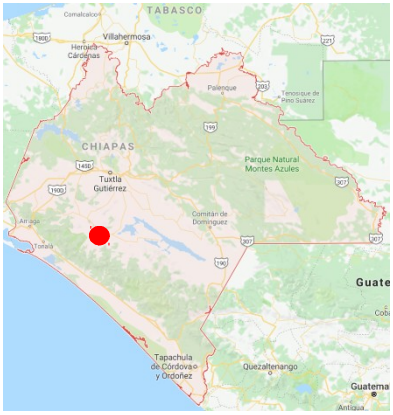
I chose Chiapas because is one of the poorest states in México and Villa Corzo because the conditions and resources prevailing in that region pair up with the purpose of my research.



Family Size.

According to INEGI´s (Instituto Nacional de Estadística y Geografía) 2016 census; in average, in Chiapas, a family consists of 3.4 individuals. The total amount of population in Chiapas is of approximately 5.3 million people, from which 1.5 million live in extreme poverty and 2.6 million are classified as poor. This results in a total of 4.1 million of inhabitants living in poverty; representing approximately 77.36% of the total population of the state of Chiapas.

Social deficiencies



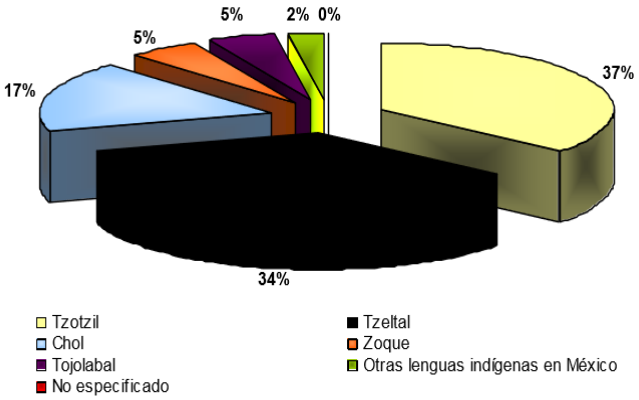
To generate an indicator close to the multidimensional poverty estimate proposed by the Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL), the ENSANUT (Encuesta Nacional de Salud y Nutrición) in 2012 included most of the issues considered by this indicator. This allowed for an estimate close to the same when constructing indicators of household deprivation, as well as an approximation to welfare

indicators by income. In Chiapas, the estimate indicates that 73.9% of the individuals lived in poverty conditions according to the multidimensional indicator, a figure higher than the 49.0% estimated for the country. Of the indicators of social deprivation, the estimated approximation of the lack of access to social security was the most prevalent deficiency in the population of Chiapas, which reaches 83.6%. With regard to the lack of access to health services, ENSANUT 2012, identified 21.5% of the population of the entity in this condition.[1]

Education

1ensanut.insp.mx. (2012). Encuesta Nacional de Salud y Nutrición Resultados por Entidad Federativa Chiapas 2012. July 5, 2018, de ensanut.insp.mx Sitio web: https://ensanut.insp.mx/informes/Chiapas-OCT.pdf p. 21

With regard to educational indicators, the information collected for each member of the household allowed to provide details about school attendance and the maximum level of studies reached. For Chiapas, the ENSANUT 2012 identified that 95.1% of children aged 6 to 14 years attended school, while among individuals aged 15 to 24 this percentage dropped to 39.8%. In both cases, these values were similar to the national average. The average of complete years of schooling in individuals of 15 years or more in Chiapas was 7.0 years, 16.7% lower than 8.4 years of the national average. In that sense, while the illiterate population of 15 years or more had a proportion of 7.0% in the country, in Chiapas that percentage was 2.1 times higher, since it reached 14.8%. In Chiapas, 26.9% of the population of five years or more spoke an indigenous language (4.5% times more than the national average); of which 27.3% were monolingual and the remaining 72.7% spoke also Spanish.[2] The indigenous languages that predominate in the State are Tzotzil 36%, Tzetzal 34.4% and Chol 17.4%.



Fuente: II Conteo de Población y Vivienda 2005.

According to the population aged 5 and over by indigenous and Spanish-speaking condition, in Chiapas 61.2% speak Spanish, while 36.5% speak only their mother language.[3]

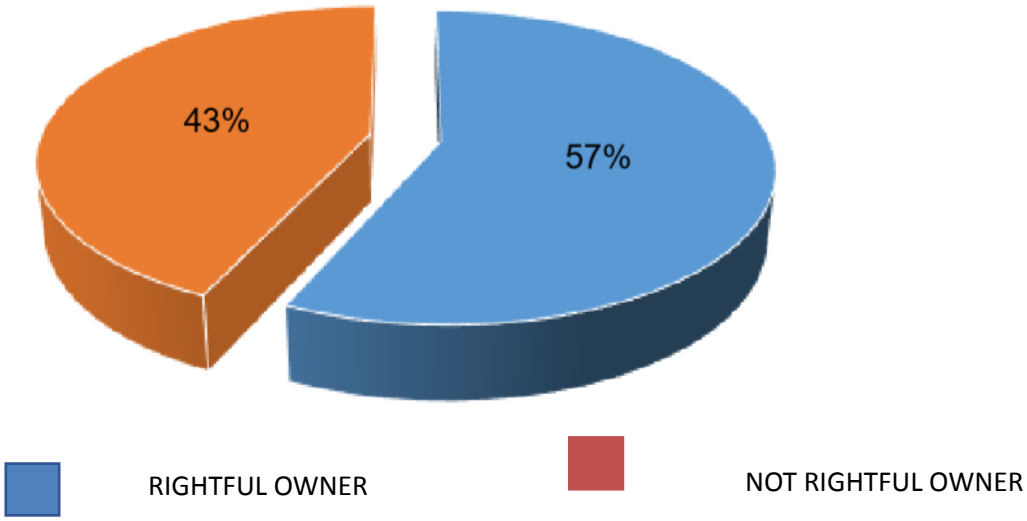
In Villa Corzo, there are 20 schools.

Total population with access to health care[4]

2ensanut.insp.mx. (2012). Encuesta Nacional de Salud y Nutrición Resultados por Entidad Federativa Chiapas 2012. July 5, 2018, de ensanut.insp.mx Sitio web: https://ensanut.insp.mx/informes/Chiapas-OCT.pdf p. 18

3catedraunescodh unam. (Unknown). CHIAPAS. September 8, 2017, de catedraunescodh.unam.mx Web Site: http://catedraunescodh.unam.mx/catedra/ocpi/pj/ie/docs/chiap_ie.pdf

4Comité Estatal de Información Estadística y Geográfica de Chiapas. Prontuario



In the area of health protection, the right to health or affiliation to some type of insurance or prepayment in health was considered, that is, a definition of financial protection that is expected to be reflected in the state of health by facilitating access to services. To the traditional right by occupational condition was added since 2004 the one provided by the SPSS, promoted by the federal government, and operated as Seguro Popular (SP) and Medical Insurance for a New Generation. The estimated figure for the ENSANUT 2012 adjusted the direct report of households to consider universal coverage for children born after December 1, 2006, which offers protection to children without social security coverage through Medical Insurance for a New Generation, as well as the beneficiaries to the IMSS (Instituto Mexicano del Seguro Social) and ISSSTE (Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado) by kinship according to the specific norms.[5] In Villa Corzo there are 2 health centers (Instituto de Salud and Hospital Regional Bicentenario)

Estadístico. (2015). Población con acceso a servicios de Salud en Chiapas .July 5, 2018, de Fomento Económico de Chiapas A. C. Sitio web: http://fec-chiapas.com.mx/sistema/noticias_files/poblacion_con_acceso_a_servicios_de_salud_en_chiapas.pdf

5ensanut.insp.mx. (2012). Encuesta Nacional de Salud y Nutrición Resultados por Entidad Federativa Chiapas 2012. July 5, 2018, de ensanut.insp.mx Sitio web: https://ensanut.insp.mx/informes/Chiapas-OCT.pdf p. 18

Chiapas´s basic diet consists of corn, beans, rice, pork, vegetables, and some fruits like bananas.

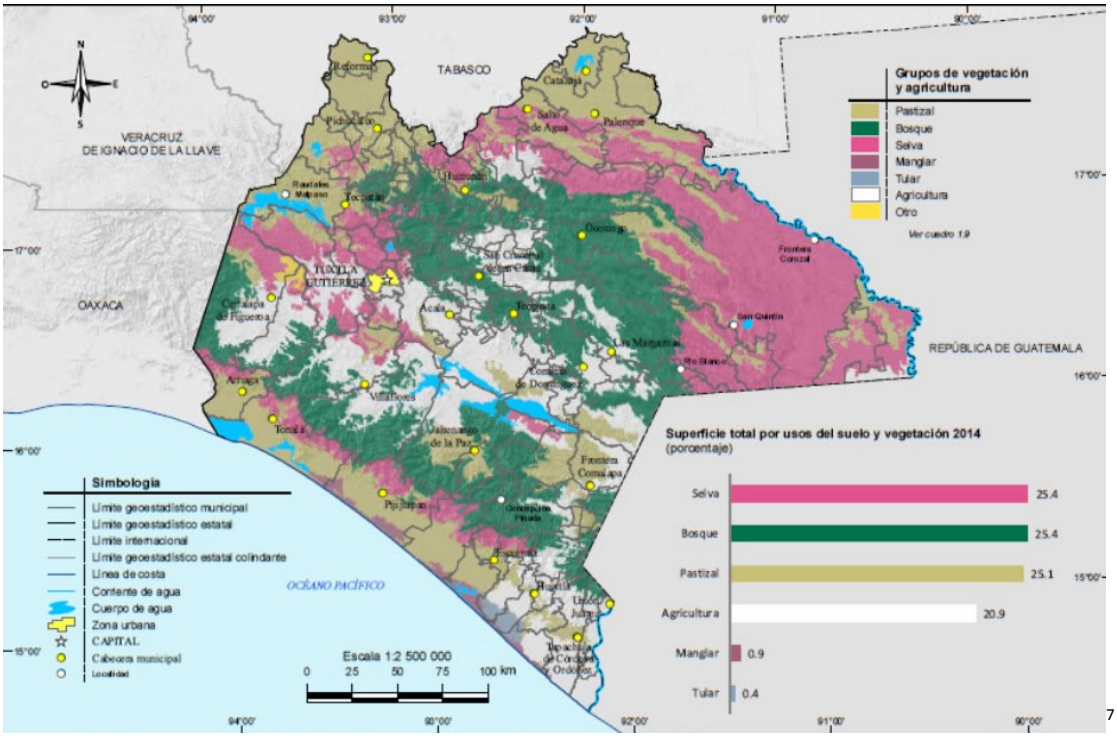
The main agricultural production is: Corn, beans, peanuts and coffee, as well as the race car company in the center of it.

The main livestock production is: Livestock Vaccine, swine and poultry.

.[6]

a. Farm size, crops grown, and agricultural practices

In the state of Chiapas a typical substance in farm family occupies a small area in rural areas most of them lack irrigation systems and production is for self consumption, and if there´s any surplus in productions, it´s usually sold in local markets.



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[6]Wikipedia editors. (Unknown). Chiapas. July 5, 2018, de Wikipedia Sitio web: https://es.wikipedia.org/wiki/Chiapas#Economía
Wikipedia editors. (Unknown). Villa Corzo. July 5, 2018, de Wikipedia Web Site: https://es.wikipedia.org/wiki/Villa_Corzo#ACTIVIDAD_ECONÓMICA

[7]Andrés G. Martínez. (2015). Vegetación del Estado de Chiapas. July 5, 2018, de paratodomexico Sitio web: https://www.paratodomexico.com/estados-de-mexico/estado-chiapas/vegetacion-chiapas.html

b. Major barriers to improving agricultural productivity, employment and earning a living wage, and gaining access to food markets and adequate nutrition.

Chiapas´s crisis is reflected in the fall of production and it´s value, which is seen in the contribution made by the agricultural sector in the generation of wealth in the whole of the economy of Chiapas: in 2009 Chiapas´s economy did not reach 10% of the GDP, an indicator that contrasts sharply with a predominantly rural population. We can also see it in the amount of population that works in the field, which in recent years has been decreasing; now there are more workers in commerce and services than in agriculture. 38% work in the field and 46% work in the tertiary sector.

A large number of peasants have emigrated to work in the United States. In the VIII agricultural, livestock and forestry census 2007 and in the IX ejidal census 2007 (INEGI, 2008) a very interesting fact is registered: the majority of the young people in five hundred ejidos and communities of Chiapas - little more than 20% of the total- has left the family: in 141, they have migrated to urban areas of the country; and in 282, towards the United States. In the rest -77-, they migrated to other rural areas of the country. This phenomenon confirms the impact of the crisis in the Chiapas countryside, which is reflected in a process of "de-ruralization" and in the emergence of a "new rurality".[8]

The hunger of most Chiapanecans is of such magnitude, especially in indigenous and peasant communities, that the National Crusade Against Hunger has included 55 of the 118 municipalities that make up the state. Of the 55 municipalities included in the Crusade, 25 present a situation of extreme vulnerability, and from these twenty-five municipalities, seven contribute the greatest number of inhabitants with hunger, whose sum reaches the figure of 180 431.[9] Likewise,

8Daniel Villafuerte-Solís. (2014). Crisis rural, pobreza y hambre en Chiapas. September 8, 2018, de www.scielo.org.mx Web Site: http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1665-80272015000100002

9Daniel Villafuerte-Solís. (2014). Crisis rural, pobreza y hambre en Chiapas. September 6, 2018, de www.scielo.org.mx Web Site:

Chiapas is one of the states with the most indigenous population in the country, which greatly influences the magnitude of the data presented, since they have very different customs and uses than the rest of the Chiapas population.[10]

In Chiapas, the indigenous population is equivalent to 957,255, which represents 26% of the total population.

In Villa Corzo the total of indigenous people is 60, 854.

And, 40.2% of the indigenous population does not receive any income, and 42% receive less than a minimum wage.[11]

Deforestation and degradation of forests has become a serious problem for Chiapas since in the period 1990-2009, 769, 300 hectares were lost. Villa Corzo was the most affected municipality with the largest deforested area, with more than 82, 000 hectares transformed from Forest to No Forest.[12]

Almost half of Chiapas´s population lacks food security (46%)

For children under five, nutritional status was assessed using anthropometric indexes constructed from measurements of weight, height and age.7 Anthropometric indices were transformed to Z scores using the reference standard of the World Health Organization (WHO) of 2006. The children whose Z score was less than -2 in weight for age, length or height for age and weight for length or height, respectively, were classified as, underweight and wasting, respectively. They were included as valid data the folowing ranges of values for each anthropometric indicator: between -6.0 and +5.0 Z points of weight for age; between -6.0 and +6.0 Z-points of height for age and between -5.0 and +5.0 Z-points of weight for height, with respect to the average of the aforementioned

http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1665-80272015000100002

10Daniel Villafuerte-Solís. (2014). Crisis rural, pobreza y hambre en Chiapas. September 7, 2018, de www.scielo.org.mx Web Site: http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1665-80272015000100002

11catedraunescodh unam. (Unknown). CHIAPAS. September 8, 2017, de catedraunescodh.unam.mx Web Site: http://catedraunescodh.unam.mx/catedra/ocpi/pj/ie/docs/chiap_ie.pdf

12www.gob.mx. (2016). INICIATIVA DE REDUCCIÓN DE EMISIONES (IRE) PROGRAMA DE INVERSIÓN . September 6, 2018, de www.gob.mx Sitio web: https://www.gob.mx/cms/uploads/attachment/file/83742/IRE_Programa_de_Inversion_Fraylesca.pdf p.27

reference population. When the Z score of any of the indicators was outside the range of acceptable values, the series of Z scores of all the indicators for that individual was eliminated. [13]

9.9% of adults between 20 and 59 years, men and women, presented anemia in Chiapas. In adults aged 60 years and older, the 21.7% had anemia. In adolescents between 12 to 19 years, 8.7% had anemia, and finally in children from 5 to 11 years old 13.3% have suffered anemia[14]

During the month of May of 2012, the unemployment rate in Chiapas ranked sixth, with a percentage of 2.9%, as was announced by the Employment and Employment Opportunity Indicators recently published by the National Institute of Statistics and Geography (INEGI).[15]

The key factor chosen as the focus of my research is: Animal Agriculture

Description of the proposal and the investigation.

This research will consist in the production of a species of fish, as well as finding suitable native plants of nutritional and/or commercial value to be grown-up in aquaponic systems. In this specific experimentation the aquaponic production combination is going to be tilapia (*Oreochromis niloticus*) and beans.

Aquaculture is the fastest way of fish production in the world, providing almost half

13ensanut.insp.mx. (2012). Encuesta Nacional de Salud y Nutrición Resultados por Entidad Federativa Chiapas 2012. July 5, 2018, de ensanut.insp.mx Sitio web: https://ensanut.insp.mx/informes/Chiapas-OCT.pdf p. 66

14ensanut.insp.mx. (2012). Encuesta Nacional de Salud y Nutrición Resultados por Entidad Federativa Chiapas 2012. July 5, 2018, de ensanut.insp.mx Sitio web: https://ensanut.insp.mx/informes/Chiapas-OCT.pdfp. 86

15http://www.sie7edechiapas.com/#!Incrementa-tasa-de-desempleo-enChiapas/cjds/558e35fd0cf2f97c80ece575. (Unknown). Incrementa tasa de desempleo en Chiapas. July 5, 2018, de fec-chiapas.com.mx Sitio web: http://fec-chiapas.com.mx/sistema/noticias_files/incrementa_tasa_de_desempleo_en_chiapas.pdf

of the global fish supply. By 2030, it is estimated that aquaculture production will grow by 40% to satisfy global fish demand. Tilapia, now the second most farmed fish in the world, has played an important role in the growth of aquaculture and will continue to in the future.[16]

Implementation of similar breeding programs for poor tropical countries was the main aim of the GIFT program, a program founded by FAO (Food and Agriculture Organization of the United Nations) and the World Fish to provide genetically improved Tilapia for poor countries to fight against hungry. To implement a governmentally founded breeding program for Tilapia in order to create a strain that performs better in aquaponic system will help small farmers to gain access to high quality protein and at the same time.[17]

16WorldFish. (2016). The gift that keeps giving. July 5, 2018, de worldfishcenter.org Sitio web:https://www.worldfishcenter.org/pages/gift/
17WorldFish. (2016). The gift that keeps giving. July 5, 2018, de worldfishcenter.org Sitio web: https://www.worldfishcenter.org/pages/gift/

18Emily Donaldson. (22nd Apr 2016). How aquaponics are revolutionizing food and farming. July 5, 2018, de 1millionwomen Sitio web: https://www.1millionwomen.com.au/blog/how-aquaponics-are-revolutionising-food-and-farming/

Aquaponics:

- Aquaponics is the integration of aquaculture with hydroponics in order to form a single food production system.
- Hydroponics is a specific method of producing plants using the elements needed for the growth of these (dissolved), instead of growing them in agricultural land.
- Aquaculture is defined as the set of procedures that allowed the breeding and production of different aquatic organisms.

Aquaponic systems

Aquaponic systems require very little water and land for the intensive production of tilapia, hydroponic vegetables such as beans. The fish provide adequate quantities of most of the nutrients required for plant growth. The nutrients are excreted directly by the fish or generated through the mineralization of organic waste. The plants utilize these nutrients to produce a valuable bioproduct and improve the system's profit potential. The hydroponic component also serves as a biofilter, removing ammonia through direct uptake by plants and through oxidation of ammonia and nitrite by nitrifying bacteria that grow on the tank surface area. A very stable balance is reached between nutrient generation and water treatment, which eliminates the need for the intensive water quality monitoring required by non-integrated systems. By removing nutrients, hydroponic plants extend water use and reduce discharge to the environment.[19]

[20]Animals improved for better production in aquaponic systems will increase yield and thus will give access to larger amounts of high quality protein to the farmers and their families without the need to increase the amount of resources used for

19James E. Rakocy*, Donald S. Bailey, John M. Martin and R. Charlie Shultz. (Unknown). TILAPIA PRODUCTION SYSTEMS FOR THE LESSER ANTILLES AND OTHER RESOURCE-LIMITED TROPICAL AREAS1. July 5, 2018, de University of the Virgin Islands Agricultural Experiment Station Sitio web: http://www.fao.org/tempref/docrep/fao/006/y4921e/y4921e03.pdfp. 94

20Emily Donaldson. (22nd Apr 2016). How aquaponics are revolutionizing food and farming. July 5, 2018, de 1millionwomen Sitio web: https://www.1millionwomen.com.au/blog/how-aquaponics-are-revolutionising-food-and-farming/

production making it more sustainable for the environment either for self-consumption or its sale.

As said before Chiapas is one of the poorest states in México, so by producing self-consumption food, that severe dilemma will start to decrease.

The quality of food will increase because every factor is maintained controlled and balanced, without being exposed to plagues, herbicides, bacteria, climatic changes, floods, pollution and other consequences of the environment.

It would help the economy in a way that since the product is grown locally, it would reduce the consumption of products that increase their costs for transportation and the maintenance that is needed for it, it is also cheaper and helps small towns by being a product more accessible for them.

Present status of this factor

Nowadays the genetic engineering industry is very important for all types of agriculture since it can increase the productivity of the crops and animals,

because it allows them to grow in environments of many kinds and therefore allows them to be produced in parts where they are needed and could not be previously cultivated, their physical and chemical properties are also strengthened, and thanks to their resistance to different climates and surroundings, their conservation and transfer is easier.[21]

The situation in cattle breeding or animal agriculture is getting worse because of the methane emissions in ruminant production, also because of the competition of protein for production of food for animal and human consumption. In addition, the needs of increase the amounts of land for farming had also increase the illegal use of protected areas and the loss of ecosystems and fragmentation of the forests. Moreover, many of the lands occupied for farming are not suitable for this purpose which leads to desertification of land deteriorating the environment and speeding up the loss of ecosystems.[22]

In Chiapas there´s no governmental registered aquaponics project.

What makes aquaponics stand out from other forms of production is that the main factors/issues that affect the production of food such as climate volatility, population growth, water scarcity, urbanization, energy demand, pollution, etc, don´t really cause a major impact in aquaponics because as said before, this system allows crops to endure and tolerate adverse environments, by changing the way they are produced and transported. In areas with challenging climates, limited water resources and/or land shortages, aquaponics can facilitate local food production, and replace the existing “failing” systems.

Budget

Materials needed

21ERP Agrícola. (20 octubre, 2016). Ingeniería genética en la agricultura: Riesgos y Oportunidades. July 5, 2018, de ERP Agrícola Sitio web: http://sistemaagricola.com.mx/blog/ingenieria-genetica-en-la-agricultura/

22P.Crossona, L. Shalloo, D.O’Brien, G.J.Lanigan, P.A.Foley, T.M.Boland, D.A.Kenny. (2011). A review of whole farm systems models of greenhouse gas emissions from beef and dairy cattle production systems. July 5, 2018, de ScienceDirect Sitio web: https://www.sciencedirect.com/science/article/pii/S0377840111001209

Hydroponics tubs (15 – 30 dollars)
Large commercial plastic tank of aquaculture fish tanks for farm (5 - 20 dollars)
Aquaponic tables and trays hydroponic system (20-50 dollars)
Active aqua air pump with 4 outlets, 15L per minute (28 dollars)
30% Food fo fish, Price per kilo 2.9 dollars approx. 17.4 dollars
Beans seeds (1.03 – 1.29 dollars per kilo) approx. 6.18 dollars
PVC Pipes: 50mm and 32mm diameter pipes were used. (2.7 dollars 4 meters)
Cost 0.06 dollars per individual (approx.10 dollars)
Water temperature requirements between 27 and 30 degrees Celsius.
Dissolved Oxygen 5 to 7 mg / kg
The general price for one single aquaponic system can be 149.2 dollars
The prices can be reduced depending on the quantity that is bought, since if it is bought wholesale for several aquaponic systems it is cheaper.

Based on my research, my recommendations on how to effectively address aquaponics to improve the food security of Chiapas are the following.

To provide genetically improved Tilapia, adapted to aquaponic systems, would be necessary a breeding program founded by the governments with a genetic nucleus where grow out test under aquaponic conditions are performed to a large number of animals to be selected as breeders, selected fish then will breed to produce a large number of fish (multipliers) which will be provide to the farmers so they can mate in their farms and produce their own fry to use in their aquaponic systems. In this way, multipliers provided to farmers will allow them to produce their own fry to be use in their systems, these multipliers will be provided yearly basis to farmers in order to give them access to the genetic gain achieved by the breeding program allowing farmers to increase their production without the need of scale their aquaponic.
It is also necessary to provide technical assistance to farmers so they learn to mate and produce fish, as well to provide them with the knowledge on how to create and maintain an aquaponic system for self-consumption.

To promote aquaponics with the use of genetically improved fish specifically adapted to these production systems will help to achieve the 1st, 7th and 8th items in the list of Millennium Development Goals: eradicate extreme poverty and hunger; ensure environmental sustainability and; global partnership for development.

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